The Hong Kong Polytechnic University 香港理工大學

Department of Computing 電子計算學系

Secondary Major

in

AI and Data Analytics

(人工智能及數據分析)

July 2023 (Updated in June 2025)

This Document is applicable to students admitted from 2022/23 to 2024/25

This document is subject to review and changes which the programme offering Faculty/Department can decide to make from time to time. Students will be informed of the changes as and when appropriate.

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Part 1: General Information

1.1 Introduction

1.1.1 Programme Title : Secondary Major in Artificial Intelligence and Data Analytics (AIDA)

1.1.2 Host Department : Department of Computing

1.1.3 Credit Requirements : 36

1.1.4 Medium of Instruction : English

1.1.5 Implementation Date : September 2022

1.2 Rationale, Aims and Objectives

1.2.1 Rationale for AIDA

Data has been characterised as the new oil; it is valuable only if it can be refined into a form that drives profitable and productive activity. Artificial intelligence and data analytics (AIDA) are undoubtedly the most prevailing technologies to carry out such a refinement process and are the most important driving forces in our data-driven society today. Through the rapid technological developments of the 21st Century, big data has become available, and with remarkable success in the past decade. AIDA is thus becoming a de-facto standard approach to enrich business, advance technology and achieve breakthroughs in virtually all fields. Therefore, it is essential for students to possess expertise in AIDA and other underpinning technologies.

PolyU is fully aware of the opportunities and challenges brought about by the new economy and the Fourth Industrial Revolution, and believes that it is indispensable for the next generation of workforce to possess expertise in AIDA and other underpinning technologies such as robotics, the Internet-of-Things (IoT), and blockchain, to name a few.

1.2.2 Aims and Objectives

The AIDA Secondary Major is designed in response to the rapidly developing fields of artificial intelligence and data analytics that are currently gaining unprecedented traction in industry as well as generating demand for qualified professionals in the job market. By integrating within the major discipline of the student, this secondary major aims to produce the next generation of graduates skilled with AI computational thinking and data analytics acumen in their chosen discipline to meet the needs of society, help improve efficiencies and augment human capabilities.

This secondary major comprises interdisciplinary and integrated programmes to equip students with a strong foundation in computer science, statistics and mathematics, so as to nurture them to make use of AIDA techniques to solve contemporary problems in a discipline of their choice.

Each academic programme offering the option of this secondary major will incorporate a block of AIDA subjects (such as programming, mathematics, statistics, big data, AI and machine learning) into the study of the academic programme focusing on a particular discipline or domain. Students will complete their study within the normal programme duration and graduate with their respective bachelor's degree, equipped with technical skills related to AIDA, coupled with the domain knowledge from a block of subjects either specially designed, or chosen from the corresponding academic programme, in addition to the GUR subjects. An Integrated Capstone Project (ICP) will be included, with the aim of developing the capabilities of a student in analysing and solving complex and potential real-life problems, as well as training them in skills related to systematic development and documentation of a significant piece of work.

1.3 Programme's Intended Learning Outcomes (PILOs)

On successful completion of this secondary major in AIDA, students will be able to:

1. Understand the fundamentals of AIDA, and have the ability to apply them.
2. Design AIDA systems, components and processes to meet given specifications and constraints.
3. Identify, formulate and solve problems relevant to AIDA.
4. Use modern IT tools appropriate to AIDA practice.
5. Know the contemporary issues, and understand the impact of AIDA solutions in a global and societal context.

1.4 Selection Mechanism

Studying a Secondary Major is a free choice by students and not mandatory. Only students with a Cumulative GPA of 2.70 or above may be considered for Secondary Major enrolment. Students must apply to and obtain approval from their programme offering Department, no later than the commencement of the second year of study, to be admitted to the Secondary Major.

Part 2: Programme Structure and Curriculum

2.1 Programme Structure

The programme structure of the Secondary Major in Artificial Intelligence and Data Analytics (AIDA) is as follows:

Artificial Intelligence and Data Analytics (AIDA)	**Credits**
Core	30-33
Mathematics I for AIDA	(3)
Mathematics II for AIDA	(3)
Programming I: Programming Fundamentals	(3)
Programming II: Data Structures and Algorithms	(3)
Fundamentals of Data Analytics	(3)
Machine Learning	(3)
Artificial Intelligence	(3)
DSR-AIDA Bridging Subject(s)	(3-6)
Integrated Capstone Project	(6)
Electives	3-6
Total	**36**

2.2 Proposed Study Pattern

Stage	Subjects	Credits
Year 2	Mathematics I for AIDA	3
	Mathematics II for AIDA	3
	Programming I: Programming Fundamentals	3
	Programming II: Data Structures and Algorithms/ Fundamentals of Data Analytics	3
Year 3	Fundamentals of Data Analytics/ Programming II: Data Structures and Algorithms	3
	Machine Learning	3
	Artificial Intelligence	3
	DSR-AIDA Bridging Subject 1	3
Year 4	Integrated Capstone Project	6
	DSR-AIDA Bridging Subject 2 / Elective 1	3
	Elective 2	3

Note that students could swap around:
1. their Fundamentals of Data Analytics/ Programming II: Data Structures and Algorithms
2. their DSR-AIDA Bridging Subjects / Elective

in the proposed study pattern based on their own plan.

2.3 List of Core and Elective Subjects

Below are the tables summarising the core and elective subjects. Note that some students such as BME may need to take slightly more credits (AMA2511/2512 for Mathematics II).

(a) Core (compulsory subjects)

Subject code	Subject title	Credits
Mathematics I for AIDA (3 credits)		
AMA1110	Basic Mathematics I – Calculus and Probability & Statistics *(for AP, FCE and FENG students only)*	3
AMA1501	Introduction to Statistics for Business *(for students from other Faculties/ Schools)*	3
AMA2634	Introduction to Statistics *(for AMA students only)* (Pre-requisite: AMA1006 / AMA2691) (Exclusion: AMA2601)	3
Mathematics II for AIDA (3 credits)		
AMA1751	Linear Algebra *(for students from other Faculties/ Schools)*	3
AMA2111	Mathematics I *(for AP, FENG students only)* (Pre-requisite: AMA1007 / AMA1101 / AMA1102 / AMA1120 / AMA1130 / AMA1500) (Exclusion: AMA2007 / AMA2308 / AMA2380 / AMA2511 / AMA2882 / AMA290)	3
AMA2131	Mathematics for Engineers *(for CEE students only)* (Pre-requisite: AMA1130 / AMA 1131) (Exclusion: AMA2007 & AMA2111 & AMA290)	3
AMA2511 and AMA2512	Applied Mathematics I *(for BME students only)* (Pre-requisite: AMA1101 / AMA1102 / AMA1120) (Exclusion: AMA2007 & AMA2111) Applied Mathematics II *(for BME students only)* (Pre-requisite: AMA2511) (Exclusion: AMA2007)	2 2
Programming I: Programming Fundamentals (3 credits)		
COMP1012	Programming Fundamentals and Applications *(for students from other Faculties/ Schools than FENG/FB)* (Exclusion: COMP1011 / ENG2002)	3
ENG2002	Computer Programming *(for FENG students only)*	3
LGT3109	Introduction to Coding for Business with Python *(for FB students only)*	3
Programming II: Data Structures and Algorithms (3 credits)		
COMP2013/ DSAI2201	Data Structures and Algorithms (Pre-requisite: COMP1011 / COMP1012 / ENG2002 / LGT3109 & AMA1110 / AMA1501 / AMA2634 & AMA1751 / AMA2111)	3
Fundamentals of Data Analytics (3 credits)		
AMA1611/ DSAI1102	Data Analytics Fundamentals	3
AMA2233	Data Analytics and Visualization *(for AMA students only)* (Pre-requisite: AMA2222)	3

Subject code	Subject title	Credits
COMP1433/ DSAI1201	Introduction to Data Analytics	3
EIE1003	Foundations of Data Science	3
LGT/MM3425	Business Analytics *(for FB students only)* (Exclusion: LGT/MM2425 & LGT3425)	3
Machine Learning (3 credits)		
AMA4680	Statistical Machine Learning (Pre-requisite: AMA2222 / AMA2222A & AMA2602 / AMA2631/ AMA2691 / AMA3602 & AMA2701 / AMA2701A / AMA3001/ AMA3701 / AMA3723)	3
COMP4432/ DSAI4203	Machine Learning *(for students from other Faculties/ Schools than EIE)*	3
EIE3124	Fundamentals of Machine Intelligence *(for EIE students only)*	3
Artificial Intelligence (3 credits)		
COMP4431	Artificial Intelligence (Pre-requisite: COMP1012 / COMP2011 / ENG2002)	3
DSR-AIDA Bridging Subject(s) (3-6 credits)		
AF3213	Business Analytics in Accounting and Finance (Pre-requisite: LGT2425 / MM2425 / LGT3425 / MM3425)	3
AMA4602	High Dimensional Data Analysis (Pre-requisite: AMA2631 / AMA2631A / AMA2602 / AMA2691)	3
AP30019	Data Analysis Techniques for Scientists (Pre-requisite: AP20018)	3
BME34145	AIDA for Health Care and Smart Ageing (Pre-requisite: ENG2002)	3
BRE472	Information Technology and Building Information Modelling for Construction Management	3
BSE3610	Computational Methods in Building Sciences and Engineering	3
BSE4510	Building Automation and Control [Pre-requisite: BSE2122 & BSE3225 (before 2022/23 cohort) / BSE2124 & BSE3227 (from 2022/23 cohort)]	3
CBS3947	Programming and Data Analysis for Language Studies	3
CSE30313	Machine Learning Practice in Smart Mobility (Pre-requisite: One basic mathematics subject and one basic computer programming subject Mathematics AMA2007 / AMA2111 / AMA2131 / AMA2308 / AMA2707 / AMA290 Computer Programming AMA2222 / AMA2222A / COMP1011 / COMP1012 / ENG2002)	3
EE4014A	Intelligent Systems Applications in Electrical Engineering	3
EIE3127	Artificial Intelligence of Things (Pre-requisite: EIE2112 & EIE2113)	3
ENGL4022	Quantitative Literacy for Language Professionals	3
ENGL4026	Language and Social Data Analytics	3
HTM3228	Smart Service Design in Tourism and Hospitality (Pre-requisite: HTM2305)	3
HTM4362	Artificial Intelligence in Tourism and Hospitality	3
ISE3018	Logistics Automation	3

Subject code	Subject title	Credits
SFT304AF	Fashion Design	3
SFT330FB	Fashion Digital Marketing	3
LGT3108	Introduction to Enterprise Resource Planning System	3
LSGI3803	Spatial Data Analytics and Mining	3
ME46002	Numerical Methods for Engineers (Pre-requisite: AMA2111)	3
MM3462	Artificial Intelligence and Big Data for Business (Pre-requisite: MM3425)	3
SD3781	Interface Design	3
SD4788	User Experience Design	3
SO4020X	Application of AI and Data Analytics to Manage Ocular Problems	3
Integrated Capstone Project (6 credits)		
AF/LGT/ MM4913	Integrated Capstone Project (Exclusion: Any other equivalent capstone project)	6
AMA4953	Integrated Capstone Project (Exclusion: AMA4951, AMA4952 or any other equivalent capstone project)	6
AP40020	Integrated Capstone Project	6
BSE4728	Integrated Capstone Project (Pre-requisite: BSE3716 & any 4 of the below subjects: BSE3124 / BSE3125 / BSE3227 / BSE3228 / BSE3313 / BSE3322) (Exclusion: Any other equivalent capstone project)	6
BRE4661	Integrated Capstone Project (Pre-requisite: BRE366) (Exclusion: Any other equivalent capstone project)	6
BME44146	Integrated Capstone Project (Pre-requisite/co-requisite: BME31147 & BME34145) (Exclusion: Any other equivalent capstone project)	6
CBS4705	Integrated Capstone Project (Exclusion: Any other equivalent capstone project)	6
CSE49407	Integrated Capstone Project (Pre-requisite: All CSE subjects in Level 3 and all core subjects in Level 1-3 of Secondary Major in AIDA) (Exclusion: Any other equivalent capstone project)	6
EE4023	Integrated Capstone Project (Pre-requisite: Students should complete most of the subjects required of the programme in previous years before taking this subject) (Co-requisite: EE4014A) (Exclusion: Any other equivalent capstone project)	6
EIE4128	Integrated Capstone Project	6
ENGL4027	Integrated Capstone Project (Pre-requisite: ENGL3002) (Exclusion: Any other equivalent capstone project)	6
HTM4365	Integrated Capstone Project (Pre-requisite: HTM3205) (Exclusion: Any other equivalent capstone project)	6
ISE4001	Integrated Capstone Project (Pre-requisite: ISE3018) (Exclusion: ISE4008 Individual Project and ISE445 Capstone Project)	6
SFT4217X	Integrated Capstone Project	6

Subject code	Subject title	Credits
	(Exclusion: SFT415CP, SFT416CP & any other equivalent capstone project)	
LSGI4503	Integrated Capstone Project (Pre-requisite: COMP1011 & LSGI3803) (Exclusion: Any other equivalent capstone project)	6
ME49006	Integrated Capstone Project (Pre-requisite: ME31001, ME31002, ME32001, ME33001, ME34002, ME34004, ENG2002 & ME46002) (Exclusion: ME49001)	6
SD4470	Integrated Capstone Project - Production Design (Pre-requisite: SD4466) (Exclusion: Any other equivalent capstone project)	6
SD4790	Integrated Capstone Project - Interaction Design (Pre-requisite: SD4791) (Exclusion: Any other equivalent capstone project)	6
SO4039X	Integrated Capstone Project (Pre-requisite: SO4020X) (Exclusion: Any other equivalent capstone project)	6

(b) Electives (3-6 credits)

Subject code	Subject title	Credits
AAE4009	Data Science and Data-driven Optimisation in Airline and Airport Operations	3
AAE4011	Artificial Intelligence in Unmanned Autonomous Systems	3
AMA3201	Computational Methods (Pre-requisite: AMA2007 / AMA2008 / AMA2111 / AMA2308 / AMA2380 / AMA2512 / AMA2882 / AMA290 / AMA3001)	3
AMA3602	Applied Linear Models for Finance Analytics (Exclusion: AMA2631 / AMA2631A)	3
AMA3640	Statistical Inference (Pre-requisite: AMA2007 / AMA2111 / AMA2308 / AMA2703 / AMA2703A / AMA273 / AMA2882 & AMA1501 / AMA1502 / AMA2104 / AMA2601 / AMA2601A / AMA2634 / AMA2634A / AMA2691)	3
AMA3820	Operations Research Methods (Pre-requisite: AMA1007 / AMA1008 / AMA1101 / AMA1102 / AMA1120 / AMA1130 / AMA2007 / AMA2111 / AMA2701 / AMA2701A / AMA2703 / AMA2703A / AMA2308 / AMA2380 / AMA2512 / AMA2882 / AMA290)	3
AMA4602	High Dimensional Data Analysis (Pre-requisite: AMA2602 / AMA2631 / AMA2631A / AMA 2691)	3
AMA4650	Forecasting and Applied Time Series Analysis (Pre-requisite: AMA2602 / AMA2631 / AMA2631A / AMA364 / AMA4001)	3
AMA4670	Modelling of Epidemic and Pandemic (Pre-requisite: AMA2691 / AMA2702)	3
AMA4688	Simulation (Pre-requisite: AMA1501 / AMA1502 / AMA2104 / AMA2601 / AMA2634 / AMA2634A / AMA2691)	3
AMA4840	Decision Analysis	3

Subject code	Subject title	Credits
	(Pre-requisite: AMA1501 / AMA1502 / AMA2104 / AMA2601 / AMA2634 / AMA2634A / AMA2691)	
AMA4850	Optimization Methods (Pre-requisite: AMA2007 / AMA2111 / AMA2112 / AMA2308 / AMA2380 / AMA2882 / AMA3001)	3
AP40012	Machine Learning in Physics (Pre-requisite: AP20005)	3
AP40013	Energy Conversion and Storage with Machine Learning (Pre-requisite: AP20002)	3
BME34145	AIDA for Health Care and Smart Ageing (Pre-requisite: ENG2002)	3
BME44144	AIDA for Biosignal Processing and Medical Imaging (Pre-requisite: BME31116)	3
BRE368	AI and Data Analytics for Smart Construction	3
BSE458	Building Performance Diagnosis and Management [Pre-requisite: BSE3514 (before 2022/23 cohort) / BSE3515 (from 2022/23 cohort)]	3
BSE4610	Building Informatics (Pre-requisite: BSE1610 & BSE2610 & BSE3227)	3
CBS3410	Python for Language Analytics (Pre-requisite: CBS3947)	3
CBS4702	Advanced Topics in Quantitative Language Studies (Pre-requisite: CBS3947)	3
CBS4703	Social Media and Social Network Analysis	3
CBS4704	Workshop on Language Analytics (Pre-requisite: CBS4958)	3
CBS4844	Machine Aided Translation	3
CBS4954	Statistics for Language Studies	3
CBS4958	Fundamentals of Computational Linguistics (Pre-requisite: CBS3947)	3
CBS4962	Corpus and Language Technology for Language Studies (Pre-requisite: CBS1902)	3
COMP4434/ DSAI4434	Big Data Analytics (Pre-requisite: AMA1104 / AMA1110 & COMP1011 / COMP1012 / ENG2002 & COMP2011 / COMP2013/ DSAI2201)	3
COMP4436	Artificial Intelligence of Things (Pre-requisite: COMP1011 / COMP1012 / ENG2002)	3
COMP4442	Service and Cloud Computing (Pre-requisite: COMP2421 & COMP2432)	3
CSE30313	Machine Learning Practice in Smart Mobility (Pre-requisite: One basic mathematics subject and one basic computer programming subject Mathematics AMA2007 / AMA2111 / AMA2131 / AMA2308 / AMA2707 / AMA290 Computer Programming AMA2222 / AMA2222A / COMP1011 / COMP1012 / ENG2002)	3
EE3013B	Transportation Data Analytics (Pre-requisite: EE2029B)	3
EE4014A	Intelligent Systems Applications in Electrical Engineering	3
EIE4121	Machine Learning in Cyber-security	3

Subject code	Subject title	Credits
EIE4122	Deep Learning and Deep Neural Networks (Pre-requisite: AMA2104/ EIE3124)	3
ENGL4022	Quantitative Literacy for Language Professionals	3
ENGL4026	Language and Social Data Analytics	3
HTI3990	Big Data Analytics for Bioinformatics and Genomic Medicine	3
HTI4990	AIDA in Clinical Diagnosis and Radiotherapy	3
HTM4350	Big Data Analytics in Hospitality, Tourism and Events (Pre-requisite: HTM3205)	3
HTM4364	Social Media and Digital Marketing Analytics (Pre-requisite: HTM2324)	3
ISE3011	Applied Quality and Reliability with AIDA	3
ISE3017	Applied AIDA in Operations Research and Management	3
SFT403FI	Smart Textiles for Wearable Applications	3
SFT412FB	Fashion Market Intelligence	3
SFT303AF	AI in Fashion Business	3
LSGI3220	Building Information Modelling & 3D GIS	3
LSGI3801	GeoAI	3
LSGI3802	Spatial Data Science	3
LSGI3803	Spatial Data Analytics and Mining (Pre-requisite: AMA1751 & COMP1011 / COMP1012)	3
LSGI3804	Urban Big Data Analytics	3
LSGI3805	Urban Sensing for Smart City	3
ME41006	Perceptual Robotics (Pre-requisite: ME31002)	3
ME42001	Artificial Intelligence in Products (Pre-requisite: ME31002 / ME41004)	3
ME42011	Fundamentals of Robotics (Pre-requisite: ME31002 / ME41004)	3
SD4772	Interactive Media and Marketing	3

2.4 Curriculum Map

The relationship between Subjects and Programme's Intended Learning Outcomes (PILOs) is given as follows:

Subject	**Programme's Intended Learning Outcomes (PILOs)**				
	1	**2**	**3**	**4**	**5**
Mathematics I for AIDA					
AMA1110 Basic Mathematics I – Calculus and Probability & Statistics (for FCE and FENG students only)	✓		✓		
AMA1501 Introduction to Statistics for Business (for students from other Faculties/ Schools)	✓		✓		
AMA2634 Introduction to Statistics (for AMA students only)	✓		✓		
Mathematics II for AIDA					
AMA1751 Linear Algebra (for students from other Faculties/ Schools)	✓		✓		
AMA2111 Mathematics I (for FENG students only)	✓		✓		
AMA2131 Mathematics for Engineers (for CEE students only)	✓		✓		
AMA2511 Applied Mathematics I & AMA2512 Applied Mathematics II (both for BME students only)	✓		✓		
Programming I: Programming Fundamentals					
COMP1012 Programming Fundamentals and Applications (for students from other Faculties/ Schools)	✓				
ENG2002 Computer Programming (for FENG students only)	✓	✓	✓	✓	
LGT3109 Introduction to Coding for Business with Python (for FB students only)	✓		✓		✓
Programming II: Data Structures and Algorithms					
COMP2013/DSAI2201 Data Structures and Algorithms	✓	✓	✓		
Fundamentals of Data Analytics					
AMA1611/DSAI1102 Data Analytics Fundamentals	✓	✓	✓	✓	
AMA2233 Data Analytics and Visualization (for AMA students only)	✓	✓	✓	✓	
COMP1433/DSAI1201 Introduction to Data Analytics	✓	✓	✓	✓	✓

Subject	**Programme's Intended Learning Outcomes (PILOs)**				
	1	**2**	**3**	**4**	**5**
EIE1003 Foundations of Data Science	✓				✓
LGT/MM3425 Business Analytics (for FB students only)			✓		
Machine Learning					
AMA4680 Statistical Machine Learning (for AMA students only)	✓	✓	✓	✓	✓
COMP4432/ DSAI4203 Machine Learning (for students from other Faculties/ Schools than EIE)	✓	✓	✓	✓	✓
EIE3124 Fundamentals of Machine Intelligence (for EIE students only)	✓		✓		
Artificial Intelligence					
COMP4431 Artificial Intelligence	✓	✓	✓	✓	✓
DSR-AIDA Bridging Subject					
AF3213 Business Analytics in Accounting and Finance	✓		✓	✓	✓
AMA4602 High Dimensional Data Analysis	✓		✓	✓	✓
AP30019 Data Analysis Techniques for Scientists	✓		✓		
BME34145 AIDA for Health Care and Smart Ageing	✓	✓	✓	✓	✓
BRE472 Information Technology and Building Information Modelling for Construction Management	✓		✓	✓	
BSE3610 Computational Methods in Building Sciences and Engineering	✓		✓	✓	
BSE4510 Building Automation and Control		✓	✓	✓	✓
CBS3947 Programming and Data Analysis for Language Studies	✓		✓	✓	
CSE30313 Machine Learning Practice in Smart Mobility	✓	✓	✓	✓	✓
EE4014A Intelligent Systems Applications in Electrical Engineering	✓	✓	✓	✓	
EIE3127 Artificial Intelligence of Things	✓			✓	✓
ENGL4022 Quantitative Literacy for Language Professionals	✓		✓	✓	✓
ENGL4026 Language and Social Data Analytics	✓		✓	✓	✓
HTM3228 Smart Service Design in Tourism and Hospitality	✓	✓	✓	✓	✓
HTM4362 Artificial Intelligence in Tourism and Hospitality	✓	✓	✓	✓	
ISE3018 Logistics Automation		✓			✓

Subject	**Programme's Intended Learning Outcomes (PILOs)**				
	1	**2**	**3**	**4**	**5**
SFT304AF Fashion Design		✓	✓	✓	
SFT330FB Fashion Digital Marketing	✓			✓	
LGT3108 Introduction to Enterprise Resource Planning System				✓	✓
LSGI3803 Spatial Data Analytics and Mining	✓	✓	✓	✓	✓
ME46002 Numerical Methods for Engineers				✓	
MM3462 Artificial Intelligence and Big Data for Business	✓		✓		
SD3781 Interface Design			✓		
SD4788 User Experience Design			✓		✓
SO4020X Application of AI and Data Analytics to Manage Ocular Problems			✓	✓	✓
Integrated Capstone Project					
AF/LGT/MM4913 Integrated Capstone Project	✓		✓		
AMA4953 Integrated Capstone Project	✓	✓	✓	✓	✓
AP40020 Integrated Capstone Project		✓	✓	✓	✓
BME44146 Integrated Capstone Project	✓	✓	✓	✓	✓
BRE4661 Integrated Capstone Project	✓		✓	✓	✓
BSE4728 Integrated Capstone Project	✓	✓		✓	✓
CBS4705 Integrated Capstone Project	✓	✓	✓	✓	✓
CSE49407 Integrated Capstone Project	✓	✓	✓	✓	✓
EE4023 Integrated Capstone Project	✓	✓	✓	✓	
EIE4128 Integrated Capstone Project		✓	✓	✓	
ENGL4027 Integrated Capstone Project	✓	✓	✓	✓	✓
HTM4365 Integrated Capstone Project	✓		✓		
ISE4001 Integrated Capstone Project	✓		✓	✓	✓
SFT4217X Integrated Capstone Project		✓	✓	✓	✓
LSGI4503 Integrated Capstone Project	✓	✓	✓	✓	✓
ME49006 Integrated Capstone Project	✓	✓	✓		✓
SD4470 Integrated Capstone Project - Production Design	✓		✓	✓	✓
SD4790 Integrated Capstone Project - Interaction Design	✓		✓	✓	✓
SO4039X Integrated Capstone Project		✓	✓	✓	✓
Elective					
AAE4009 Data Science and Data-driven Optimisation in Airline and Airport Operations				✓	✓
AAE4011 Artificial Intelligence in Unmanned Autonomous Systems			✓	✓	
AMA3201 Computational Methods		✓	✓	✓	

Subject	Programme's Intended Learning Outcomes (PILOs)				
	1	2	3	4	5
AMA3602 Applied Linear Models for Finance Analytics	✓		✓	✓	✓
AMA3640 Statistical Inference	✓	✓	✓		
AMA3820 Operations Research Methods	✓	✓	✓		
AMA4602 High Dimensional Data Analysis	✓		✓	✓	✓
AMA4650 Forecasting and Applied Time Series Analysis	✓		✓	✓	✓
AMA4670 Modelling of Epidemic and Pandemic		✓	✓	✓	✓
AMA4688 Simulation	✓	✓	✓	✓	✓
AMA4840 Decision Analysis	✓		✓		✓
AMA4850 Optimization Methods	✓	✓	✓		
AP40012 Machine Learning in Physics		✓	✓	✓	
AP40013 Energy Conversion and Storage with Machine Learning		✓	✓		✓
BME34145 AIDA for Health Care and Smart Ageing	✓	✓	✓	✓	✓
BME44144 AIDA for Biosignal Processing and Medical Imaging	✓	✓	✓	✓	
BRE368 AI and Data Analytics for Smart Construction	✓		✓	✓	
BSE458 Building Performance Diagnosis and Management			✓	✓	✓
BSE4610 Building Informatics	✓	✓	✓		✓
CBS3410 Python for Language Analytics	✓		✓	✓	
CBS4702 Advanced Topics in Quantitative Language Studies	✓	✓	✓	✓	✓
CBS4703 Social Media and Social Network Analysis	✓	✓	✓	✓	✓
CBS4704 Workshop on Language Analytics	✓	✓	✓	✓	✓
CBS4844 Machine Aided Translation	✓		✓	✓	✓
CBS4954 Statistics for Language Studies	✓		✓	✓	✓
CBS4958 Fundamentals of Computational Linguistics	✓		✓	✓	✓
CBS4962 Corpus and Language Technology for Language Studies	✓	✓	✓	✓	✓
COMP4434/ DSAI4434 Big Data Analytics	✓	✓	✓	✓	✓
COMP4436 Artificial Intelligence of Things	✓	✓	✓	✓	✓
COMP4442 Service and Cloud Computing		✓		✓	
CSE30313 Machine Learning Practice in Smart Mobility	✓	✓	✓	✓	✓
EE3013B Transportation Data Analytics	✓	✓	✓	✓	✓
EE4014A Intelligent Systems Applications in Electrical Engineering	✓	✓	✓	✓	

Subject	**Programme's Intended Learning Outcomes (PILOs)**				
	1	**2**	**3**	**4**	**5**
EIE4121 Machine Learning in Cyber-security	✓		✓		
EIE4122 Deep Learning and Deep Neural Networks	✓		✓	✓	
ENGL4022 Quantitative Literacy for Language Professionals	✓		✓	✓	✓
ENGL4026 Language and Social Data Analytics	✓		✓	✓	✓
HTI3990 Big Data Analytics for Bioinformatics and Genomic Medicine	✓		✓	✓	✓
HTI4990 AIDA in Clinical Diagnosis and Radiotherapy	✓	✓		✓	✓
HTM4350 Big Data Analytics in Hospitality, Tourism and Events	✓	✓	✓		
HTM4364 Social Media and Digital Marketing Analytics	✓	✓	✓	✓	✓
ISE3011 Applied Quality and Reliability with AIDA	✓				✓
ISE3017 Applied AIDA in Operations Research and Management	✓			✓	✓
SFT403FI Smart Textiles for Wearable Applications		✓	✓		✓
SFT412FB Fashion Market Intelligence	✓			✓	
SFT303AF AI in Fashion Business		✓	✓	✓	
LSGI3220 Building Information Modelling & 3D GIS	✓	✓	✓	✓	✓
LSGI3801 GeoAI	✓	✓	✓	✓	✓
LSGI3802 Spatial Data Science	✓	✓		✓	✓
LSGI3803 Spatial Data Analytics and Mining	✓	✓	✓	✓	✓
LSGI3804 Urban Big Data Analytics	✓	✓	✓	✓	✓
LSGI3805 Urban Sensing for Smart City	✓	✓		✓	
ME41006 Perceptual Robotics	✓	✓	✓	✓	✓
ME42001 Artificial Intelligence in Products	✓	✓	✓		
ME42011 Fundamentals of Robotics	✓	✓	✓	✓	✓
SD4772 Interactive Media and Marketing			✓		

Appendix: Planned offering semesters for core subjects

Subject code	Subject title	Sem 1	Sem 2
Mathematics I for AIDA (3 credits)			
AMA1110	Basic Mathematics I – Calculus and Probability & Statistics	√	√
AMA1501	Introduction to Statistics for Business	√	√
AMA2634	Introduction to Statistics	√	√
Mathematics II for AIDA (3 credits)			
AMA1751	Linear Algebra	√	-
AMA2111	Mathematics I	√	√
AMA2131	Mathematics for Engineers	√	√
AMA2511 and AMA2512	Applied Mathematics I Applied Mathematics II	√ -	- √
Programming I: Programming Fundamentals (3 credits)			
COMP1012	Programming Fundamentals and Applications	√	-
ENG2002	Computer Programming	√	√
LGT3109	Introduction to Coding for Business with Python	-	√
Programming II: Data Structures and Algorithms (3 credits)			
COMP2013/ DSAI2201	Data Structures and Algorithms	√	√
Fundamentals of Data Analytics (3 credits)			
AMA1611/ DSAI1102	Data Analytics Fundamentals	-	√
AMA2233	Data Analytics and Visualization	-	√
COMP1433/ DSAI1201	Introduction to Data Analytics	√	√
EIE1003	Foundations of Data Science	-	√
LGT/MM3425	Business Analytics	√	√
Machine Learning (3 credits)			
AMA4680	Statistical Machine Learning	√	-
COMP4432/ DSAI4203	Machine Learning	-	√
EIE3124	Fundamentals of Machine Intelligence	-	√

Subject code	Subject title	Sem 1	Sem 2
Artificial Intelligence (3 credits)			
COMP4431	Artificial Intelligence	√	√

Remarks: The subject offer arrangement will be reviewed and adjusted when needed.

Part 3: Subject Syllabi

The departments reserve the right to revise and update the syllabi whenever appropriate and deemed necessary.

The latest subject syllabus can be viewed at https://www38.polyu.edu.hk/ePublic/subject-search-details.jsf.

Form AR 140

The Hong Kong Polytechnic University

Subject Description Form

Subject Code	AAE4009
Subject Title	Data Science and Data-driven Optimisation in Airline and Airport Operations
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	This subject will provide students with 1. A conceptual and practical foundation in airport and airline operations for knowledge representation and reasoning of artificial intelligence, data mining, soft computing and optimisation methods as problem solving tools; 2. Research methodology, data interpretation and analytical skills in regard to real-life data and case scenarios of airport and airline operations; and 3. Experience of conducting proper research experiments and engineering reports for results dissemination.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Identify and formulate the data-driven engineering problems in airport and airline operations; b. Transfer the expert knowledge into knowledge-based system and algorithms via machine learning approaches; c. Plan, design and develop appropriate algorithms via soft computing methods and analysis the data and the solution quality with alternatives; and d. Review the performance and make judgements based on numerical results and provide off-the-shelf suggestions, profitable solutions and actionable managerial insights.
Subject Synopsis/ Indicative Syllabus	Lectures are used to deliver the fundamental knowledge in relation to various aspects of machine learning, data mining, data analytics, data-driven optimisation and artificial intelligence in airline and airport operations (outcomes a to d). Several laboratories will be made available to equip students with the basic knowledge of data mining, soft computing, optimisation and artificial intelligence in solving aviation engineering problems (outcomes a to c).

	Given the basic knowledge of data science, a group mini project will be used to help students deepen their knowledge of a specific topic through literature study, methodology study, analysis of data, dissemination of research findings and report writing (outcomes a to d). The subject covers the following topics. Machine learning, data mining and artificial intelligence The topics include the following elements: Supervise and unsupervised learning approach. Descriptive methods, including clustering, association. Predictive methods, including classification and regression. Supervised learning algorithms: Nearest neighbour algorithm, fuzzy logic, gaussian mixture, neural network, linear regression, logistic regression, decision trees, Naïve Bayes, genetic algorithms Unsupervised learning algorithms: associate rules, principal component analysis, gaussian mixture Data-driven optimisation The topics include the following elements: Basic mathematical formulation and modelling, convex optimisation, data-driven modelling, airline scheduling planning, crew rostering, runway scheduling, gate assignment problem, air logistics transportation problem Optimisation methods and soft computing The topics include the following elements: Branch and Bound algorithm, heuristics, meta-heuristics, swarm intelligence
Teaching/Learning Methodology	Teaching is conducted through class lectures, case studies, and laboratory exercises. The basic knowledge, research methodology and theoretical models will be introduced. The understanding of how to address and formulate problems by using mathematical programming, artificial intelligence algorithms, and soft computing techniques with modern programming language is emphasised. Research methodology, data analytics skills, algorithm design skills and programme methods are taught in class as well as the related real-life scenarios using data to enhance their research abilities. Laboratory exercises, mini reports, oral disseminations and test are used to make up the course work marks.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed			
		a	b	c	d
1. Laboratory	40%	✓	✓	✓	✓
2. Mini report	20%			✓	✓
3. Oral presentation	10%			✓	✓
4. Test	30%	✓	✓	✓	✓
Total	100 %				

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Overall assessment: 1.0 x continuous assessment

The continuous assessment (100%) is aimed at enhancing the students' comprehension and assimilation of various topics of the syllabus via several laboratory teaching and laboratory report, numerical analysis, reading assignment. In particular, mini projects are used to assess the students' capacities of self-study and problem-solving and effective communication skills in English so as to fulfil the requirements of working in the aviation industry. Test will be conducted to evaluate the students performance in mathematical problem formulation and algorithm design for a given airport and airline engineering problem with a limited examination time.

Student Study Effort Expected

Class contact:	
▪ Lecture/seminar	24 Hrs.
▪ Laboratory	15 Hrs.
Other student study effort:	
▪ Literature review / Scientific finding and analysis / final report writing preparation / presentation material preparation	36 Hrs.
▪ Self-study / preparation	36 Hrs.
Total student study effort	111 Hrs.

Reading List and References

1. Barber, D. (2012). Bayesian reasoning and machine learning. Cambridge University Press.

2. Boyd, S., Boyd, S. P., & Vandenberghe, L. (2004). Convex optimization: Cambridge university press.

3. Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. (2009).

	Introduction to algorithms: MIT press. 4. De Neufville, R., & Odoni, A. (2003). Airport systems. planning, design and management. New York: McGraw-Hill. 5. Guido, S., & Müller, A. (2016). Introduction to machine learning with python (Vol. 282). O'Reilly Media. 6. Marsland, S. (2015). Machine learning: an algorithmic perspective. CRC press. 7. Richert, W. (2013). Building machine learning systems with Python. Packt Publishing Ltd. 8. Wallwork, A. (2016). English for writing research papers: Springer. 9. Wells, A. T. (2007). Air transportation: A management perspective: Ashgate Publishing, Ltd. 10. Wu, C.-L. (2016). Airline operations and delay management: insights from airline economics, networks and strategic schedule planning: Routledge.

Form AR 140

The Hong Kong Polytechnic University

Subject Description Form

Subject Code	AAE4011
Subject Title	Artificial Intelligence in Unmanned Autonomous Systems
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	This subject will provide students with 1. The main concepts, ideas, and techniques of advanced artificial intelligence (AI) in unmanned autonomous systems, e.g. unmanned aerial vehicles (UAV), unmanned ground vehicles (UGV); 2. The major components of typical unmanned autonomous systems fulfilling a certain function, such as environment inspection using UAVs; and 3. Experience in conducting proper experiments on unmanned autonomous systems and preparing engineering reports.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Apply AI algorithms or adopt AI tools in solving engineering problems in unmanned autonomous systems; b. Understand the relationship between multiple functions of unmanned autonomous systems, including perception, path planning, decision making, and control; c. Design partial of the functions of typical unmanned autonomous systems, such as positioning, and path planning; and d. Improve the existing AI algorithms to certain unmanned autonomous systems applications.
Subject Synopsis/ Indicative Syllabus	Lectures are used to deliver advanced knowledge concerning various aspects of AI, data analysis, and its applications in unmanned autonomous systems (outcomes a to d). The subject covers the following topics **Introduction to Artificial Intelligence**: The topic mainly includes the basic knowledge of machine learning such as conventional classification and regression together with high-level AI, such as convolutional neural network (CNN) for image segmentation. **Introduction to Unmanned Autonomous Systems**: The topic mainly includes the major existing applications of unmanned autonomous systems, such as UAV and UGV. Meanwhile, the topic will include the basic knowledge of typical unmanned autonomous systems.

<u>**Optimization Algorithm to Unmanned Autonomous Systems**</u>: The topic mainly includes the optimization algorithms such as Gauss-Newton used to solve the engineering problems related to unmanned autonomous systems.

<u>**Sensors for Unmanned Autonomous Systems**</u>: The topic mainly introduces the typical sensors applicable to unmanned autonomous systems. The sensors include the LiDAR, inertial measurement unit, and camera. Basic algorithms for sensors-based positioning will be introduced.

<u>**Navigation for Unmanned Autonomous Systems**</u>: The topic mainly include positioning and navigation for the unmanned autonomous system using simultaneous localization and mapping (SLAM) using LiDAR sensors together with point cloud processing, registration,

<u>**AI-aided Navigation for Unmanned Autonomous Systems**</u>: The topic mainly includes the application of AI in LiDAR SLAM using object detection in unmanned autonomous systems.

<u>**Group Project**</u>: A design project will be carried out for students to learn the deployment of AI in unmanned autonomous systems through practice.

Teaching/Learning Methodology

Teaching is conducted through class lectures and case studies. The basic knowledge, research methodology, and theoretical models will be introduced. The understanding of how to address and formulate problems by using mathematical programming, artificial intelligence algorithms, and optimization techniques in unmanned autonomous systems.

Research methodology, data analytics skills, and algorithm design skills are taught in class as well as the related real-life scenarios using data to enhance their research abilities. Mini reports, oral dissemination, and test are used to make up the coursework marks.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed			
		a	b	c	d
1. Examination	40%	✓	✓	✓	✓
2. Assignment	20%	✓	✓	✓	✓
3. Group report	20%	✓	✓	✓	✓
4. Group Presentation	20%		✓	✓	✓
Total	100 %				

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Overall Assessment:

0.40 × End of Subject Examination + 0.60 × Continuous Assessment

Examination is adopted to assess students on the overall understanding and the ability of applying the concepts. It is supplemented by continuous assessment including assignments, closed-book tests and group project. The continuous

	assessment is aimed at enhancing the students' comprehension and assimilation of various topics of the syllabus. In particular, group mini-project is used to assess the students' capacities of self-learning and problem-solving and effective communication skill in English so as to fulfill the requirements of being aircraft design engineers.	
Student Study Effort Expected	Class contact:	
	▪ Lecture	33 Hrs.
	▪ Tutorial/Case Study	6 Hrs.
	Other student study effort:	
	▪ Literature review / case study / reading	36 Hrs.
	▪ Self-study / preparation	36 Hrs.
	Total student study effort	111 Hrs.
Reading List and References	1. Guido, S., & Müller, A. (2016). Introduction to machine learning with python (Vol. 282). O'Reilly Media. 2. Marsland, S. (2015). Machine learning: an algorithmic perspective. CRC press. 3. Zhang, Tao, Qing Li, Chang-shui Zhang, Hua-wei Liang, Ping Li, Tian-miao Wang, Shuo Li, Yun-long Zhu, and Cheng Wu. "Current trends in the development of intelligent unmanned autonomous systems." Frontiers of information technology & electronic engineering 18, no. 1 (2017): 68-85. 4. Barfoot, Timothy D. State estimation for robotics. Cambridge University Press, 2017. 5. Thrun, S. (2002). Probabilistic robotics. Communications of the ACM, 45(3), 52-57.	

Subject Description Form

Subject Code	AF/LGT/MM4913
Subject Title	Integrated Capstone Project
Credit Value	6
Level	4
Pre-requisite / Co-requisite/ Exclusion	**Exclusion**: Any other equivalent capstone project
Objectives	The objectives of this subject are to: • provide a student with the opportunity to apply and integrate the knowledge of artificial intelligence and data analytics (AIDA) to his/her discipline in the Departmental Scheme. • develop the capabilities of a student in analyzing and solving complex and possibly real-life problems using AIDA. • Train students with skills on systematic development and documentation of a significant piece of work.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: Professional/academic knowledge and skills (a) conduct literature surveys to locate materials and sources relevant to the selected problem area in a specific discipline in the Departmental Scheme; (b) understand the materials obtained and connect the materials with the problem to be solved using AIDA knowledge and skills; (c) define and specify the problem precisely; (d) assimilate and apply the learnt knowledge to generate good solutions to the problem; (e) think critically the formulation of alternative models and solutions to the problem, in the analysis of approaches to the solution and their implementation; and (f) evaluate the final outcome in an objective manner; Attributes for all-roundedness (g) improve presentation and communication skills via oral presentation; (h) enhance technical report writing skills with proper organization of materials; (i) develop the ability to learn independently and to find/integrate information from different sources required in solving real-life problems; (j) manage the project efficiently and effectively through the supervision of supervisor(s); and (k) work collaboratively with related parties (e.g. vendors, sponsor company, technical support staff, team-partners, research students, etc.).
Subject Synopsis/ Indicative Syllabus	**1. In-depth Study of a Topic Typically Proposed by the Supervisor** **2. Project Meeting and Planning** **3. Proposal Writing** **4. Regular Progress Checking and Reporting** **5. Project Documentation** **6. Presentation and Demonstration** Students are expected to identify a project topic with a supervisor in their chosen discipline, and a co-supervisor with artificial intelligence and data analytics expertise.

<table>
<tr><td></td><td>Students need to demonstrate their knowledge in both their chosen discipline and AIDA in the project, receiving advice from both supervisors. The project should represent requisite effort in analysing and interpreting the data/information obtained, using the principles and techniques learnt from various related subjects. Students are also expected to demonstrate significant analytical and, preferably, research ability in the chosen application domain.</td></tr>
<tr><td>**Teaching/Learning Methodology**</td><td>The Integrated Capstone Project spans across the academic year for two consecutive semesters. The teaching/learning activities include regular project meetings with the supervisor and the co-supervisor, guided study of project materials, independent project development work and other project management tasks.</td></tr>
<tr><td>**Assessment Methods in Alignment with Intended Learning Outcomes**</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="11">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td>g</td><td>h</td><td>i</td><td>j</td><td>k</td></tr>
<tr><td>Continuous Assessment</td><td>100</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Total</td><td>100</td><td colspan="11"></td></tr>
</table>

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The Integrated Capstone Project will be accessed by the supervisor/co-supervisor and other assessors. Attributes to be assessed include, but not limited to, Problem Identification, Problem Solving, Communication and Presentation, Project Management, and Self-Discipline.

Integrated Capstone Projects should be problem-oriented and there are no restrictions on the nature of the problem except that it should be relevant to the student’s chosen discipline and AIDA. The project could be practical, academic or a hybrid in which the student is encouraged but not constrained to have some original contributions. Each student has to submit a proposal, a mid-term checkpoint progress report and a final report. The proposal must be approved by the supervisor/co-supervisor before the student can proceed with the Integrated Capstone Project. An oral presentation and demonstration is essential at the end of the project. A mid-term presentation and demonstration may also be required for proper continuous assessment.
</td></tr>
<tr><td rowspan="5">**Student Study Effort Expected**</td><td colspan="2">Class contact:</td></tr>
<tr><td>• Lecture</td><td>0 Hrs.</td></tr>
<tr><td colspan="2">Other student study effort:</td></tr>
<tr><td>• Searching and reading materials, meeting with supervisor / co-supervisor / others, design and system development, testing, documentation, presentation, etc.</td><td>210 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>210 Hrs</td></tr>
</table>

Reading List and References	**Reference Books:** 1. Kumar, Ranjit, *Research Methodology: A Step-by-step Guide for Beginners*, 3rd Edition, SAGE Publications, 2011. 2. Burns, Robert B., *Introduction to Research Methods*, 4th Edition, SAGE Publications, 2000. 3. Roberts, Carol M., *The Dissertation Journey: A Practical and Comprehensive Guide to Planning, Writing, and Defending Your Dissertation*, 3rd Edition, Corwin Press, 2007. 4. Mauch, James E. and Park, Namgi, *Guide to the Successful Thesis and Dissertation: A Handbook for Students and Faculty*, 5th Edition, Marcel Dekker, 2003. 5. Rudestam, Kjell Erik and Newton, Rae R., *Surviving Your Dissertation: A Comprehensive Guide to Content and Process*, 2nd Edition, Sage Publications, 2001. 6. Garson, G. David, *Guide to Writing Empirical Papers, Theses and Dissertations*, Marcel Dekker, 2002. 7. Reinhart, Susan M., *Giving Academic Presentations*, 2nd Edition, University of Michigan Press, 2013. 8. Oshima, Alice and Hogue, Ann, *Writing Academic English*, 4th Edition, Pearson Longman, 2006. 9. American Psychological Association. *Publication Manual of the American Psychological Association*, 6th Edition, American Psychological Association, 2010. 10. Szuchman, Lenore T., *Writing with Style: APA Style Made Easy*, 5th Edition, Wadsworth/Cengage Learning, 2011. 11. Statistics, simulation, programming, and relevant books. 12. ACM and IEEE magazines, Transactions and Journals. 13. Other International Journals. 14. Relevant conference proceedings and magazines (including ACM and IEEE conferences). 15. Technical reports from universities and major companies.

The Hong Kong Polytechnic University

Subject Description Form

Subject Code	AF3213
Subject Title	Business Analytics in Accounting and Finance
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	Pre-requisite: Introduction to Business Analytics (LGT2425/MM2425) or Business Analytics (LGT3425/MM3425)
Objectives	This subject introduces students to the basic concepts, methods and approaches of data analytics in accounting and finance. The growing volume of both structured and unstructured data has pushed forward a more data- driven form of decision making. Future accountants need to be able to collect and work with data. This subject aims to first introduce various accounting and financial research datasets and to provide students various quantitative analysis techniques in developing analytical data models to support decision-making. With the information developed from data modeling, it is crucial to communicate practical implications of quantitative analyses to any kind of audience member. This subject aims to further provide an introduction as well as a hands-on experience in data visualization and visual analytics to help summarize large amount of data effectively. Students will learn to combine analytic and interactive visualization approaches and use them to demonstrate or provide insights into real-world problems and situations.
Subject Learning Outcomes	Upon completion of the subject, students will be able to: a) know how data analytics are used to drive decisions in accounting and finance contexts; b) have an understanding of summarizing accounting and financial data; c) conduct analysis and presentation of data sets using accounting and finance cases.
Subject Synopsis/ Indicative Syllabus	**Basic Concepts and Methods of Data Analytics** Data preparation and cleaning; Data analytics approaches; Data visualization and summarization. **Applications of Data Analytics in Accounting and Finance** Diagnostic, predictive and prescriptive analytics in managerial and financial accounting and consumer banking. **Introduction of XBRL** XBRL (extensible Business Reporting Language) for Internet communication among businesses. **Data Visualization** Communicate results effectively using clear language and visualizations.
Teaching/Learning Methodology	Key concepts and techniques will be introduced through seminars and in-class and after-class exercises. The subject places a lot of emphasis on project work. Students will be required to deliver a project which emphasizes on real-world accounting and finance issues. By completing the project, students should have hands-on experience in using the knowledge they have learnt in class to solve accounting and finance problems in practice. Students are encouraged to share their views and experiences actively with their lecturer and classmates.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b	c			
Continuous Assessment							
1. Assignment Quizzes	10%	✓	✓	✓			
2. Class Report and Presentation	30%	✓	✓	✓			
3. Mid-tem test	10%	✓	✓	✓			
Final Examination	50%	✓	✓	✓			
Total	100%						

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Assignment Quizzes - Students have to read assigned reading materials and watch online tutorials to complete online quizzes, which would assess their understanding of the key concepts and techniques, and their applications.

Class Report and Presentation - are used to test students' ability in understanding the materials and in achieving the intended learning outcomes through a more in-depth investigation of different topics.

Mid-term Test & Final Examination - Mid-term test and final examination are used to test students' overall ability in applying the knowledge learnt in the subject.

Student Study Effort Expected

Class contact:	
Seminars	39 Hrs.
Other student study effort:	
Reading materials / textbook questions	39 Hrs.
On average around 16 hours will be spent on the assignment quizzes and around 20 hours for the group project discussion, presentation and written report	36 Hrs.
Total student study effort	114 Hrs.

Reading List and References

Introduction to Data Analytics for Accounting, 2021, by Richardson, Teeter and Terrell, McGraw-Hill.

2018 SEC reporting taxonomy (https://www.fasb.org/jsnfFASB/Page/SectionPage&cid=l 176169700059)

Subject Description Form

Subject Code	AMA1110
Subject Title	Basic Mathematics I – Calculus and Probability & Statistics
Credit Value	3
Level	1
Pre-requisite	Nil
Objectives	This subject aims to introduce students to the basic concepts and applications of elementary calculus and statistics. Emphasis will be on the understanding of fundamental concepts and the use of mathematical techniques in handling practical problems in science and engineering.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) apply analytical reasoning to solve problems in science and engineering; (b) make use of the knowledge of mathematical/statistical techniques and adapt known solutions to various situations; (c) apply mathematical modeling in problem solving; (d) demonstrate abilities of logical and analytical thinking.
Subject Synopsis/ Indicative Syllabus	Elementary calculus: Limit and continuity, derivatives and their geometric meaning, rules of differentiation including chain rule, Leibniz's rule and L'Hopital's rule, exponential and logarithmic functions, trigonometric functions and their inverses, hyperbolic and inverse hyperbolic functions, applications of differential calculus. Elementary Probability and Statistics: Descriptive statistics, random variables, probability and probability distributions, binomial, Poisson and normal distributions, applications. Population and random samples. Sampling distributions related to sample mean, sample proportions, and sample variances. Concepts of a point estimator and a confidence interval. Point and interval estimates of a mean and the difference between two means.
Teaching/Learning Methodology	Basic concepts and elementary techniques of differential and integral calculus and elementary statistics will be taught in lectures. These will be further enhanced in tutorials through practical problem solving.
Assessment Methods in Alignment with Intended Learning Outcomes	

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)			
		a	b	c	d
1.Assignments and mid-term tests	40%	✓	✓	✓	✓
2. Examination	60%	✓	✓	✓	✓
Total	100 %				

	Continuous Assessment comprises of assignments, in-class quizzes, online quizzes and a mid-term test. An examination is held at the end of the semester. Questions used in assignments, quizzes, tests and examinations are used to assess students' level of understanding of the basic concepts and their ability to use mathematical techniques in solving problems in science and engineering. Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes: *The subject focuses on understanding of basic concepts and application of techniques in differential/integral calculus, elementary statistics. As such, an assessment method based mainly on examinations/tests/quizzes is considered appropriate. Furthermore, students are required to submit homework assignments regularly in order to allow subject lecturers to keep track of students' progress in the course.*	
Student Study Effort Expected	Class contact:	
	▪ Lecture	26 Hrs.
	▪ Tutorial	13 Hrs.
	Other student study effort:	
	▪ Homework and self-study	81 Hrs.
	Total student study effort	120 Hrs.
Reading List and References	Chung, K.C. *A Short Course in Calculus and Matrices*, McGraw Hill 2013 Hung, K.F., Kwan, Wilson, Pong, T.Y. *Foundation Mathematics & Statistics*, McGraw Hill 2013 Larson, R., Edwards, B. *Single Variable Calculus*, Brooks/Cole 2012 Walpole, R.E., Myers, R.H., Myers, S.L. Ye, K. *Probability and Statistics for Engineers and Scientists*, Prentice Hall, 2012	

Subject Description Form

Subject Code	AMA1501
Subject Title	Introduction to Statistics for Business
Credit Value	3
Level	1
Pre-requisite	Nil
Objectives	This subject aims to: (i) provide students with a variety of basic techniques in understanding, interpreting, and analyzing data; (ii) allow students to develop skills in analyzing scenarios and problems in commerce and industry by applying statistical methods. The emphasis will be on applications of elementary statistical methods to commerce and industry.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. use a variety of basic techniques in understanding and interpreting data; b. apply elementary statistical methods in analyzing business scenarios and problems; c. think critically and creatively about the uses and limitations of statistical methods in business; d. use statistical package/software and interpret the output, appreciate the applications of information technology for statistical analysis in business.
Subject Synopsis/ Indicative Syllabus	**Descriptive Statistics** Presentation of business data in tabular, diagrammatic and graphic forms; misleading presentations. Summary measures of location and spread. **Probability** Concepts of probability. Probability rules. Bayes' Theorem. Random variables and expected values; uses and limitations in decision making. Common probability distributions: Binomial, Poisson and Normal. **Estimation** Simple random samples. Sampling distributions: mean, proportion and differences. Confidence intervals: mean, proportion and differences.

Hypothesis Testing
Hypothesis testing: mean, proportion and differences. Chi-square Test Test of goodness of fit. Test of independence.

Relationships between Variables
Exploratory data analysis. Linear relationships: ordinary least squares. Correlation coefficients.

Multiple Regression
Multiple regression equation. Inferences about parameters. Variable selection and its implementation in computer software (such as SPSS or R).

Teaching/Learning Methodology

The lectures aim to provide the students with an integrated knowledge required for the understanding and application of statistical concepts and techniques. To develop students' ability for logical thinking and effective communication, tutorial and presentation sessions will be held.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)			
		a	b	c	d
1. Assignment and Presentation	20%	✓	✓	✓	✓
2. Mid-term Test	30%	✓	✓	✓	
3. Examination	50%	✓	✓	✓	✓
Total	100 %				

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:
The subject focuses on knowledge, skill and understanding of **Business Statistics**, thus, **Exam-based assessment** is the most appropriate assessment method, including 30% test and 50% examination. Moreover, 20% worth of assignments and presentations are included as a component of continuous assessment so as to keep the students in progress

<table>
<tr><td rowspan="7">Student Study Effort Expected</td><td>Class contact:</td><td></td></tr>
<tr><td>▪ Lecture</td><td>26 Hrs.</td></tr>
<tr><td>▪ Tutorial and Student Presentation</td><td>13 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Assignments</td><td>20 Hrs.</td></tr>
<tr><td>▪ Self-study</td><td>61 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>120 Hrs.</td></tr>
<tr><td>Reading List and References</td><td colspan="2"><u>Study Guide</u>:

Introduction to Statistics for Business, Department of Applied Mathematics, The Hong Kong Polytechnic University

<u>Reference Books</u>:

Aczel, A.D., <i>Complete Business Statistics</i>, 7th ed., McGraw-Hill, 2009.

Levin, Richard I. and Rubin, David S., <i>Statistics for Management</i>, 7th ed., Prentice-Hall, 1998.

David S. Moore, George P. McCabe, Bruce A. Craig, <i>Introduction to the practice of Statistics</i>, 9th ed., W. H. Freeman and Company, 2017.

McClave, J. T., Benson, P. George and Sincich, Terry., <i>A First Course in Business Statistics</i>, 8th ed., Prentice Hall, 2001.</td></tr>
</table>

Subject Description Form

Subject Code	AMA1611
Subject Title	Data Analytics Fundamentals
Credit Value	3
Level	1
Pre-requisite and/or Exclusion(s)	Nil
Objectives	This subject is to introduce to students the fundamental concepts of data analytics and some basic skills and tools used in the field.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) apply statistical reasoning to describe and analyze different types of data sets (b) extend their knowledge of statistical techniques and adapt analytical procedures to different situations (c) develop and extrapolate statistical concepts in synthesizing and solving problems (d) search for useful information and use data analytics software in solving problems (e) undertake the formulation of data analytics problems through continuous self-learning (f) demonstrate the abilities of logical and analytical thinking
Subject Synopsis/ Indicative Syllabus	General introduction to data science Data collection, types of data, data structures, selected case studies Data preparation and exploration Data cleaning/processing, data summary, frequency table, density plot, data visualization, computational tools of statistics and data analytics (e.g., R/Python) Basic probability Experiment, event and probability, random variable, distributions, measures of central tendency and dispersion, measures of association

Statistics
Estimation of mean and variance, confidence interval, hypothesis testing, regression, prediction, classification, basic times series

Teaching/Learning Methodology

The subject will be delivered mainly through lectures and tutorials. The lectures will be conducted to introduce the basic data analytics concepts of the topics in the syllabus which are then reinforced by learning activities involving demonstration and tutorial exercise.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		(a)	(b)	(c)	(d)	(e)	(f)
1. Assignments/Test	40%	✓	✓	✓	✓	✓	✓
2. Examination	60%	✓	✓	✓	✓	✓	✓
Total	100%						

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Continuous Assessment comprises of assignments and/or quizzes, and test(s). A written examination is held at the end of the semester.

Student Study Effort Expected

Class contact:	
▪ Lecture	26 Hrs.
▪ Tutorial	13 Hrs.
Other student study effort:	
▪ Self-study	66 Hrs.
Total student study effort	105 Hrs.

Reading List and Reference

Adhikari, A. and DeNero, J. (2019). Computational and Inferential Thinking: The Foundations of Data Science. GitBook.

Davy, C., Meysman, A. D. B., and Ali, M. (2016) Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools. Manning Publications.

	Utts, J.M. (2014). Seeing Through Statistics (4th edition). Cengage Learning. Utts, J. M. and Heckard, R. F. (2015). Mind on Statistics (5th edition). Cengage Learning.

Subject Description Form

Subject Code	AMA1751
Subject Title	Linear Algebra
Credit Value	3
Level	1
Pre-requisite	Nil
Objectives	This subject aims to introduce students to basic principles and knowledge of elementary linear algebra. Emphasis will be on the understanding of fundamental concepts as well as applications of mathematical techniques in solving practical problems.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) Understand the concept of linear algebra and perform basic operations; (b) make use of the knowledge and techniques in linear algebra and adapt known results to various situations; (c) demonstrate abilities of logical and analytical thinking.
Subject Synopsis/ Indicative Syllabus	<u>Matrix algebra</u> Linear equations and matrices, matrix operations, row-reduction, echelon form, determinants. <u>Vector spaces</u> Vector space axioms, subspace, spanning sets, linear dependence and independence, bases and dimension. <u>Linear transformations</u> Definition of linear transformation, kernel and range, the matrix of a linear transformation, eigenvalues and eigenvectors, complex eigenvalues. <u>Inner product spaces</u> Inner product, norm, orthogonality, orthogonal projections, Gram-Schmidt orthogonalization process, diagonalization of symmetric matrices, least square problems, singular value decomposition.
Teaching/Learning Methodology	The subject will mainly be delivered through lectures and tutorials. The lectures will be conducted to introduce the theoretical background, and practical problems / scenarios will be discussed in the tutorial sessions to illustrate how the theory developed can be applied in practice.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)		
		a	b	c
1. Assignments/Quizzes	20%	✓	✓	✓
2. Midterm Test	20%	✓	✓	✓
3. Examination	60%	✓		✓
Total	100%			

Continuous Assessment comprises of assignments and/or quizzes, and test(s). A written examination is held at the end of the semester.

Student Study Effort Required

Class contact:	
▪ Lecture	26 Hrs.
▪ Tutorial	13 Hrs.
Other student study effort:	
▪ Assignments/Quizzes	35 Hrs.
▪ Self-study	35 Hrs.
Total student study effort	109 Hrs.

Reading List and References

References:

Steven Leon	Linear Algebra with Applications 9th Edition	Pearson 2014
David Lay	Linear Algebra and its Applications 5th Edition	Pearson 2014
Gilbert Strang	Introduction to Linear Algebra 5th Edition	Wellesley-Cambridge Press 2016

Subject Description Form

Subject Code	AMA2111
Subject Title	Mathematics I
Credit Value	3
Level	2
Pre-requisite	Calculus and Linear Algebra (AMA1007) or Calculus I (AMA1101) or Calculus IA (AMA1102) or Basic Mathematics II – Calculus and Linear Algebra (AMA1120) or Calculus for Engineers (AMA1130) or Foundation Mathematics for Accounting and Finance (AMA1500)
Exclusion	Intermediate Calculus and Linear Algebra (AMA2007) Mathematics for Engineers (AMA2308) Engineering Mathematics (AMA2380) Applied Mathematics I (AMA2511) Mathematics for Scientists and Engineers (AMA2882) Engineering Mathematics (AMA290)
Objectives	This subject aims to introduce students to the basic principles and techniques of engineering mathematics. Emphasis will be on the understanding of fundamental concepts as well as applications of mathematical methods in solving practical problems in science and engineering.
Intended Learning Outcomes	**Upon completion of the subject, students will be able to:** 1. apply mathematical reasoning to analyze essential features of different problems in science and engineering; 2. extend their knowledge of mathematical and numerical techniques and adapt known solutions in various situations; 3. develop and extrapolate the mathematical concepts in synthesizing and solving new problems 4. demonstrate abilities of logical and analytical thinking; 5. search for useful information in the process of problem solving.
Subject Synopsis/ Indicative Syllabus	1. Algebra of complex numbers Complex numbers, geometric representation, complex exponential functions, n-th roots of a complex number. 2. Linear algebra Systems of linear equations, vector spaces, inner product and orthogonality, eigenvalues and eigenvectors, applications. 3. Ordinary differential equations ODE of first and second order, linear systems, Laplace transforms, Convolution theorem, applications to mechanical vibrations and simple circuits.

4. <u>Differential calculus of functions of several variables</u>

   Partial derivatives, total differential, chain rule, Taylor's expansion, maxima and minima, directional derivatives, Lagrange multipliers, implicit differentiation, applications.

Teaching/Learning Methodology

The subject will be delivered mainly through lectures and tutorials. The lectures aim to provide the students with an integrated knowledge required for the understanding and application of mathematical concepts and techniques. Tutorials will mainly be used to develop students' problem solving ability.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	**% weighting**	**Intended subject learning outcomes to be assessed (Please tick as appropriate)**				
		1	**2**	**3**	**4**	**5**
1.Homework, quizzes and mid-term test	40%	✓	✓	✓	✓	✓
2. Examination	60%	✓	✓	✓	✓	✓
Total	100%					

Continuous Assessment comprises of assignments, in-class quizzes, online quizzes and a mid-term test. An examination is held at the end of the semester.

Questions used in assignments, quizzes, tests and examinations are used to assess students' level of understanding of the basic concepts and their ability to use mathematical techniques in solving problems in science and engineering.

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The subject focuses on understanding of basic concepts and application of techniques in engineering mathematics. As such, an assessment method based mainly on examinations/tests/quizzes is considered appropriate. Furthermore, students are required to submit homework assignments regularly in order to allow subject lecturers to keep track of students' progress in the course.

Student Study Effort Expected

Class contact:	
• Lecture	26 Hours
• Tutorial	13 Hours
• Mid-term test and examination	
Other student study effort	
• Assignments and Self study	78 Hours
Total student study effort:	**117 Hours**

Reading List and References

1. C.K. Chan, C.W. Chan and K.F. Hung, *Basic Engineering Mathematics*, McGraw-Hill, 2015.
2. Anton, H. *Elementary Linear Algebra* (11th edition). Wiley, 2014.

	3. Kreyszig, E. (2011). *Advanced Engineering Mathematics*, 10th ed. Wiley. 4. James, G. (2015). *Modern Engineering Mathematics*, 5th ed. Pearson Education Limited 5. Thomas, G. B., Weir, M. D. & Hass, J. R. *Thomas' Calculus*, 14th ed. Pearson Education 2017

Subject Description Form

Subject Code	AMA2131
Subject Title	Mathematics for Engineers
Credit Value	3
Level	2
Pre-requisite/	AMA1130 Calculus for Engineers AMA1131 Calculus
Co-requisite/ Exclusion	**Exclusion:** Intermediate Calculus and Linear Algebra (AMA2007), Mathematics I (AMA2111), Engineering Mathematics (AMA290)
Objectives	To acquire knowledge of engineering mathematics and to apply these tools for their feasible solution of practical problems in civil engineering.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. apply mathematical reasoning to analyze essential features of different problems; b. apply the fundamentals of mathematics to formulate problems; c. apply such fundamentals to obtain solutions to problems formulated; d. critically analyze and interpret the models formulated and solutions obtained to support the synthesis of logical and cost-effective solutions; e. communicate solutions logically and lucidly through calculation, sketch, drawing and in writing.
Subject Synopsis/ Indicative Syllabus	1. Function of several variables, partial derivatives, chain rule for several independent variables, material derivatives, Taylor's formula and Taylor's series, stationary points, maxima, minima and saddle points. Applications to Optimization. 2. Multiple integration, double and triple integrals, change of variables and Jacobian, polar, cylindrical and spherical coordinates. Volume, Centroid and Moment of inertia of a solid. 3. Vector calculus (gradient, curl and divergence), scalar and vectors fields, line integrals, surface integrals, Stokes Theorem, Gauss Divergence Theorem, and Green's Theorem. Applications to fluid flows. 4. Matrix calculation, system of linear equations, eigenvalues and eigenvectors, positive definite matrices and their basic properties, diagonalization of real symmetric matrices.

<table>
<tr><td>Teaching/Learning Methodology</td><td>Emphasis is placed on a pro-active learning approach. Fundamental knowledge will be introduced in the lectures, with interspersed questions, exercises and quizzes for class discussion and after class self study. Students will be expected to read up, do exercises and reflect critically on the material covered in class. A companion web site-cum-discussion forum will be available to facilitate questioning and discussion. Additional face-to-face discussion sessions can be arranged on request.</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="5">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td></tr>
<tr><td>1.Coursework</td><td>40</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>2. Final Examination</td><td>60</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>Total</td><td>100 %</td><td colspan="5"></td></tr>
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</td></tr>
<tr><td>Student Study Effort Expected</td><td>
<table>
<tr><td>Class contact:</td><td></td></tr>
<tr><td>▪ Lectures</td><td>26 Hrs.</td></tr>
<tr><td>▪ Tutorials</td><td>13 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Coursework and Self Study</td><td>78 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>117 Hrs.</td></tr>
</table>
</td></tr>
<tr><td>Reading List and References</td><td>Kreyszig, E. Advanced Engineering Mathematics, 10th ed., Wiley, 2011.

Zill, D.G. and Wright W.S. Advanced Engineering Mathematics, 5th ed., Sudbury, Mass. : Jones and Bartlett Publishers, 2014.

Marsden, J.E. Basic Multivariable Calculus, 3rd ed., Springer Verlag, 2002.

Chan, CK, Chan, CW, Hung KF Basic Engineering Mathematics, McGraw-Hill, 2015</td></tr>
</table>

Subject Description Form

Subject Code	AMA2233
Subject Title	Data Analytics and Visualization
Credit Value	3
Level	2
Pre-requisite	Principles of Programming (AMA2222) or equivalent
Objectives	This subject aims to provide students with knowledge and techniques in data visualization, which refers to the process of encoding data or information into visual form including statistical charts or other graphical objects. It aims to enrich students' knowledge in various disciplines such as visual communication, computer programming, logical reasoning, data science and statistics. These knowledges are essential for data analytics and reporting.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a) understand the principles of visual design and communication; b) acquire information from data using statistical methods and computer programming techniques c) familiarize with various types of diagrams suitable for representing datasets or statistical information under different situations; d) apply computer programming techniques to create computer graphics for data visualization; e) present data in visual form for effective communication and analytics; f) develop innovative ideas using big-data analytics and information technologies
Subject Synopsis/ Indicative Syllabus	**1. Visual communication** Principles of visual design, colour theory, perception. **2. Data analytics** Descriptive statistics, correlation and covariance, data processing, data analytics. **3. Foundations of data visualization** Basic charts and plots, statistical charts, scatter plots. **4. Visualization of time-oriented data** Time-oriented data, time series, real-time data, simulations. **5. Visualization of discrete structures** Networks, graphs, trees. **6. Visualization of scientific data** Spatial data, geospatial data, scalar and vector field. **7. Interactive data visualization** 3D-plots, animations, annotations, transformation, interactive controls.

Teaching/Learning Methodology

This subject emphasizes both the conceptual elements in visual communication and data analytics, and also practical techniques in using computer programming. The lectures will be taught in a workshop mode with hands-on exercises reinforcing taught concepts. Students are required to attend the laboratory sessions, which allows them to consolidate their concepts through laboratory tasks. These tasks involve practical work that help students to reinforce the programming skills learned for applications.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b	c	d	e	f
1. Continuous Assessment (assignments, quizzes, tests and laboratory exercises)	30%		✓	✓	✓	✓	
2. Examination	30%	✓	✓	✓	✓		
3. Project	40%	✓	✓	✓	✓	✓	✓
Total	100 %						

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The quizzes, tests and final examination will be designed to assess students' conceptual knowledge about the subject.

The assignments and laboratory exercises will be designed to assess students' practical techniques in using the data visualization tools.

The project will be designed to assess students' ability to apply their knowledge to analyze, visualize and report data in real-life situation.

Student Study Effort Required

Class contact:	
▪ Lecture	26 Hrs.
▪ Lab	13 Hrs.
Other student study effort:	
Assignments, quizzes, projects, exams	81 Hrs.
Total student study effort	120 Hrs.

Reading List and References

Matthew Ward, Georges Grinstein, Daniel Keim	Interactive Data Visualization, 2nd Edition	CRC Press, 2015
Tamara Munzner	Visualization Analysis and Design	CRC Press, 2014
Calus O. Wilke	Fundamentals of Data Visualization	O'Reilly, 2019
Ashwin Pajankar	Practical Python Data Visualization	Apress, 2021

	Kirthi Raman	Mastering Python Data Visualization	Packt Publishing, 2015
	Abha Belorkar, Sharath Chandra Guntuku, Shubhangi Hora, Anshu Kumar	Interactive Data Visualization with Python, 2nd Edition	Packt Publishing, 2020

Subject Description Form

Subject Code	AMA2511
Subject Title	Applied Mathematics I
Credit Value	2
Level	2
Pre-requisite	Calculus I (AMA1101) or Calculus IA (AMA1102) or Basic Mathematics II –Calculus and Linear algebra (AMA1120)
Co-requisite/ Exclusion	**Exclusion:** Intermediate Calculus and Linear Algebra (AMA2007), Mathematics I (AMA2111)
Objectives	This subject aims to introduce students to some fundamental knowledge of engineering mathematics. Emphasis will be on the understanding of fundamental concepts as well as applications of mathematical methods in solving practical problems in science and engineering.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) apply mathematical reasoning to analyze essential features of different problems in their discipline; (b) extend their knowledge of mathematical and numerical techniques and adapt known solutions in various situations; (c) develop and extrapolate the mathematical concepts in synthesizing and solving new problems (d) demonstrate abilities of logical and analytical thinking.
Subject Synopsis/ Indicative Syllabus	*Complex Numbers*: Algebra and geometry of complex numbers; polar form; DeMoivre's theorem; roots of a complex number. *Ordinary differential* equations: Simple ODE of first and second order; variation of parameters; applications. *Laplace Transform*: Laplace transform and inverse Laplace transform; properties of Laplace transformation with applications to solving initial value problems. *Series*: Infinite series; convergence tests; alternating series; power series; Taylor's and Maclaurin's expansion.
Teaching/Learning Methodology	The subject will be delivered mainly through lectures and tutorials. The lectures aim to deliver and to explain the concepts, theories and techniques. Tutorials will mainly be used to develop students' problem solving ability. Students are encouraged to enhance their understanding of the subject matters through self-study.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)			
		a	b	c	d
1.Homework, quizzes and mid-term test	40%	✓	✓	✓	✓
2. Examination	60%	✓	✓	✓	✓
Total	100 %				

Continuous Assessment comprises of assignments, in-class quizzes, online quizzes and a mid-term test. An examination is held at the end of the semester.

Questions used in assignments, quizzes, tests and examinations are used to assess students' level of understanding of the basic concepts and their ability to use mathematical techniques in solving problems in science and engineering.

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The subject focuses on understanding of basic concepts and application of techniques in engineering mathematics. As such, an assessment method based mainly on examinations/tests/quizzes is considered appropriate. Furthermore, students are required to submit homework assignments regularly in order to allow subject lecturers to keep track of students' progress in the course.

Student Study Effort Expected

Class contact:	
• Lecture	19 Hrs.
• Tutorial	7 Hrs.
• Mid-term test and examination	4 Hrs.
• Assignments and Self study	60 Hrs.
Total student study effort	90 Hrs.

Reading List and References

CHAN, C.K., CHAN, C.W., & HUNG, K.F.	Basic Engineering Mathematics	McGraw Hill 2015
Anton, H.	Elementary Linear Algebra, 11th edition	John Wiley & Sons 2014

	Kreyszig, E.	Advanced Engineering Mathematics, 10th edition	Wiley 2011
	JAMES, G.	Modern Engineering Mathematics	Pearson 2015
	Thomas, G.B., Weir, M.D., & Hass, J.R.	Thomas’ Calculus, 14th edition	Pearson Education 2017

Subject Description Form

Subject Code	AMA2512
Subject Title	Applied Mathematics II
Credit Value	2
Level	2
Pre-requisite	AMA2511
Co-requisite/ Exclusion	**Exclusion:** Intermediate Calculus and Linear Algebra (AMA2007)
Objectives	This subject aims to introduce students to some fundamental knowledge of engineering mathematics. Emphasis will be on the understanding of fundamental concepts as well as applications of mathematical methods in solving practical problems in science and engineering.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) apply mathematical reasoning to analyze essential features of different problems in their discipline; (b) extend their knowledge of mathematical and numerical techniques and adapt known solutions in various situations; (c) develop and extrapolate the mathematical concepts in synthesizing and solving new problems (d) demonstrate abilities of logical and analytical thinking.
Subject Synopsis/ Indicative Syllabus	*Linear Algebra*: General properties of matrices; elementary row operations; elementary matrices; systems of linear equations; inverse of a square matrix; determinant; eigenvalues and eigenvectors; orthogonality. *Fourier series*: Expansion of periodic functions by Fourier series; Parseval's Identity. *Calculus of several variables*: Revision of calculus of one variable; Partial derivatives, maxima & minima; directional derivatives, Lagrange multiplier.
Teaching/Learning Methodology	The subject will be delivered mainly through lectures and tutorials. The lectures aim to deliver and to explain the concepts, theories and techniques. Tutorials will mainly be used to develop students' problem solving ability. Students are encouraged to enhance their understanding of the subject matters through self-study.
Assessment Methods in Alignment with Intended Learning Outcomes	

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b	c	d		
1.Homework, quizzes and mid-term test	40%	✓	✓	✓	✓		
2. Examination	60%	✓	✓	✓	✓		

Total	100 %	

Continuous Assessment comprises of assignments, in-class quizzes, online quizzes and a mid-term test. An examination is held at the end of the semester.

Questions used in assignments, quizzes, tests and examinations are used to assess students' level of understanding of the basic concepts and their ability to use mathematical techniques in solving problems in science and engineering.

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The subject focuses on understanding of basic concepts and application of techniques in engineering mathematics. As such, an assessment method based mainly on examinations/tests/quizzes is considered appropriate. Furthermore, students are required to submit homework assignments regularly in order to allow subject lecturers to keep track of students' progress in the course.

Student Study Effort Expected

Class contact:	
• Lecture	19 Hrs.
• Tutorial	7 Hrs.
• Mid-term test and examination	4 Hrs.
• Assignments and Self study	60 Hrs.
Total student study effort	90 Hrs.

Reading List and References

CHAN, C.K., CHAN, C.W., & HUNG, K.F.	Basic Engineering Mathematics	McGraw Hill 2015
Anton, H.	Elementary Linear Algebra, 11th edition	John Wiley & Sons 2014
Kreyszig, E.	Advanced Engineering Mathematics, 10th edition	Wiley 2011
JAMES, G.	Modern Engineering Mathematics	Pearson 2015
Thomas, G.B., Weir, M.D., & Hass, J.R.	Thomas' Calculus, 14th edition	Addison Wesley 2017

Subject Description Form

Subject Code	AMA2634
Subject Title	Introduction to Statistics
Credit Value	3
Level	2
Pre-requisite	Basic Statistics I (AMA1006) or Probability & Distributions (AMA2691) or equivalent
Exclusion	Statistics for Finance Analytics (AMA2601)
Objectives	This subject is to introduce students to the compilation of statistical data, common probability distributions and elements of statistical inference.
Intended Learning Outcomes	Upon satisfactory completion of the subject, students should be able to: a. apply knowledge on descriptive statistics to organize and summarize data; b. find confidence intervals for the sample mean, sample variance and sample proportion; c. discuss the concepts of hypothesis testing, including the type I error, type II error, and one-sided and two sided tests; d. apply the concepts of hypothesis testing to simple statistical problems; e. use the Pearson's chi-square test for goodness of fit; f. carry out nonparametric tests for simple statistical problems; g. use statistical software, such as R, to visually present data and to perform simple statistical analyses for problems in different areas.
Subject Synopsis/ Indicative Syllabus	*Descriptive and Visual Statistics* Descriptive statistics: mean, mode, median, percentiles, variance, standard deviation, coefficient of variation. Frequency distributions and cumulative frequency distributions. Use statistical software to produce bar plots, boxplots, histograms, and ogives. *Estimation of Parameters* Point and interval estimators of mean, proportion, variance, and the difference between two means or two proportions. The normal distribution and the t-distribution. Sample size calculation for a pre-specified estimation accuracy. Applications. *Test of Hypotheses* Basic concepts in hypothesis testing: statistical hypotheses, type I and type II errors, one-sided and two-sided tests, significance levels, test statistics, and critical regions. Tests for population mean, population proportion, population variance, difference between two means, and difference between two proportions. The chi-square distribution and the Pearson's chi-square test for goodness of fit. Multiple-

testing correlation: Bonferroni correction. Applications.

Nonparametric Tests
The sign test, the signed rank test, the rank sum test, and the Kolmogrov-Smirnov test.

Teaching/Learning Methodology

The subject will be delivered mainly through lectures and tutorials. The lectures will be conducted to introduce the basic statistics concepts of the topics in the syllabus, which are then reinforced by learning activities including demonstration, tutorial exercise and assignments.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)						
		a	b	c	d	e	f	g
1. Assignments/Quizzes	15%	✓	✓	✓	✓	✓	✓	✓
2. Test	25%	✓	✓	✓	✓			
3. Examination	60%	✓	✓	✓	✓	✓	✓	
Total	100 %							

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:
The subject focuses on knowledge, skill and understanding of **Introduction to Statistics**, thus, **Exam-based assessment** is the most appropriate assessment method, including 25% test and 60% examination. Moreover, 15% worth of assignments and quizzes are included as a component of continuous assessment so as to keep the students in progress.
Continuous Assessment comprises of assignments and/or quizzes, and tests. A written examination is held at the end of the semester.

Student Study Effort Expected

Class contact:	
▪ Lecture	26 Hrs.
▪ Tutorial	13 Hrs.
Other student study effort:	
▪ Assignment/Quiz	26 Hrs.
▪ Self-study	40 Hrs.
Total student study effort	105 Hrs.

Reading List and References

Textbook:

Johnson, R., Miller, I. and Freund, J.E.	Miller & Freund’s Probability and Statistics for Engineers 8th edition	Prentice-Hall 2010

References:

Wackerly, D.D., Mendenhall, W., & Scheaffer, R.L.	Mathematical Statistics with Applications 7th edition	Duxbury Press 2007
Montgomery, D.C. and Runger, G.C.	Applied Statistics and Probability for Engineers 6th edition	Wiley 2013
Keller, G.	Statistics for Management and Economics 10th edition	Cengage Learning 2014
Anderson, D.R., Sweeney, D.J., Williams, T.A., Camm, J.D., & Cochran, J.J.	Statistics for Business and Economics 12th edition	Cengage Learning 2014

Subject Description Form

Subject Code	AMA3201
Subject Title	Computational Methods
Credit Value	3
Level	3
Pre-requisite	Intermediate Calculus and Linear Algebra (AMA2007) or Introduction to Differential Equations (AMA2008) or Mathematics I (AMA2111) or Mathematics for Engineers (AMA2308) or Engineering Mathematics (AMA2380) or Applied Mathematics II (AMA2512) or Mathematics for Scientists and Engineers (AMA2882) or Engineering Mathematics (AMA290) or Mathematical Methods for Data Science (AMA3001) or equivalent
Objectives	The subject introduces students to some fundamental knowledge of mathematical methods for finding numerical approximations to engineering problems. The emphasis will be on application of numerical methods to solving practical problems. Computer implementation of algorithms by students is emphasized. Computer software, such as Matlab, will be used to solve practical engineering problems.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: 1. apply mathematical reasoning to analyse essential features of different engineering problems; 2. extend their knowledge of mathematical and numerical techniques and adapt known solutions to different situations; 3. apply appropriate numerical techniques to model and solve problems in engineering; 4. develop and extrapolate mathematical concepts in synthesizing and solving new problem; 5. search for useful information in solving problems.
Subject Synopsis/ Indicative Syllabus	*Error propagation, solution of linear system and nonlinear equation:* Direct methods and iterative methods; Two-point methods and Fixed point iterations. *Finite difference, interpolation and numerical differentiation and integration:* Lagrange and Newton interpolating polynomials; Aitken's interpolating formula; Composite rules; Gauss quadrature. *Numerical solution of ordinary differential equation:* Predictor-corrector method; Runge-Kutta method.

Unconstrained nonlinear optimization:
One-dimensional and multi-dimensional search methods; Gradient methods.

Teaching/Learning Methodology

The subject will be delivered mainly through lectures and tutorials classes. The lectures will be conducted to introduce the concepts of various computational methods, which are reinforced by learning activities involving demonstration, example classes, assignments and exercises.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)				
		1	2	3	4	5
a. Continuous Assessment	40%	✓	✓	✓	✓	✓
b. Examination	60%	✓	✓	✓	✓	
Total	100%					

Continuous Assessment comprises of the mid-test and two assignments. A written examination is held at the end of the semester.

Student Study Effort Expected

Class contact:	
▪ Lecture	26 Hrs.
▪ Tutorial	13 Hrs.
Other student study effort:	
▪ assignments	20 Hrs.
▪ self study	58 Hrs.
Total student study effort	117 Hrs.

Reading List and References

<u>Textbook</u>:

Chen, X. & Yamamota, T.	Numerical Analysis	Coronasha 2008

<u>References</u>:

Chapra, S.C. & Canale, R.P.	Numerical Methods for Engineers: with Programming and Software Applications 5th edition	McGraw Hill 2006
Recktenwald, G.W.	Introduction to Numerical Methods and Matlab: Implementation and Applications	Prentice Hall 2000
Gerald, C.F. & Wheatley, P.O.	Applied Numerical Analysis 7th edition	Addison Wesley 2004

Subject Description Form

Subject Code	AMA3602
Subject Title	Applied Linear Models
Credit Value	3
Level	2
Pre-requisite	Nil [Students are expected to have some basic knowledge of linear algebra]
Exclusion	Applied Statistical Methods (AMA2631/AMA2631A)
Objectives	This subject is to provide students with an overview of linear models and their applications to finance analytics, to understand the principles and assumptions behind linear models, and enable students to perform linear regression analyses on real financial data using statistical software, such as R.
Intended Learning Outcomes	Upon satisfactory completion of the subject, students should be able to: a. gain a basic understanding of the Analysis of Variance (ANOVA) approach and its underlying assumptions; b. report and interpret results of ANOVA analyses; c. formulate and tackle simple/multiple linear regression problems so as to identify appropriate models for given problems, to perform variable selection, estimation and inference on regression parameters, and to perform model diagnosis; d. describe the fixed-effects model and random-effects model and explain their differences; e. develop the competence in the use of appropriate statistical software for the ANOVA and linear regression analyses for problems in finance; f. manage their own learning and make use of appropriate texts, learning materials and relevant websites; g. communicate effectively in a well-structured manner and build up an open-minded attitude; h. recognize the ethical and social responsibility of data analytics professionals.
Subject Synopsis/ Indicative Syllabus	*Analysis of variance* The ANOVA table; degrees of freedom; partitioning the sum of squares; the F-distribution; expectations of mean squares; the F-test for the global null hypothesis. Applications to finance analytics. *Simple linear regression* Model specification and assumptions; least squares estimation of parameters; inference on model parameters; coefficient of determination; confidence interval for the mean value of the response variable; prediction interval; test for lack of fit; examination of residuals. Applications to finance analytics.

Multiple linear regression
Model specification and assumptions; estimation and inference on the parameters; partial F-tests; polynomial regression; indicator variables for categorical independent variables. Applications to finance analytics, such as the Fama-French three-factor model.

Model selection
Information criteria: Akaike information criterion; Bayesian information criterion. Stepwise model selection.

Multicollinearity
The problem of multicollinearity; multicollinearity diagnostics; ridge regression and other solutions to multicollinearity.

Random effects model
Correlated observations; within groups and between groups sum of squares; maximum likelihood estimation;

Ethics in Statistics

Teaching/Learning Methodology

The subject will be delivered mainly through lectures and tutorials. The lectures will be conducted to introduce the elements of applied statistical methods in the syllabus, which are then reinforced by learning activities involving demonstration, tutorial exercise and computer assignments.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)							
		a	b	c	d	e	f	g	h
1. Computer Assignments	20%	✓	✓	✓	✓	✓	✓	✓	
2. Test	20%	✓	✓	✓	✓				
3. Examination	60%	✓	✓	✓	✓				✓
Total	100 %								

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:
The subject focuses on knowledge, skill and understanding of **Applied Statistical Methods**, thus, **Exam-based assessment** is the most appropriate assessment method, including 20% test and 60% examination. Moreover, 20% worth of computer assignments are included as a component of continuous assessment so as to keep the students in progress.
Continuous Assessment comprises of tests and computer assignments with real data. A written examination is held at the end of the semester.

Class contact:

<table>
<tr><td rowspan="6">Student Study Effort Expected</td><td>▪ Lecture</td><td>26 Hrs.</td></tr>
<tr><td>▪ Tutorial</td><td>13 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Assignment</td><td>33 Hrs.</td></tr>
<tr><td>▪ Self-study</td><td>33 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>105 Hrs.</td></tr>
<tr><td>Reading List and References</td><td colspan="2"><u>Textbook</u>:
Kutner, M.H., Nachtsheim, C.J., Neter, J, & Li, W. | Applied Linear Statistical Models 5th edition | McGraw Hill 2005
<u>References</u>:
Bowerman, B.L. & O'Connell, R.T. | Linear Statistical Models, an Applied Approach 2nd edition | Duxbury Press 2000
Montgomery, D.C., Peck, E.A.& Vining, G.G. | Introduction to Linear Regression Analysis 5rd edition | Wiley-Interscience 2012
Sclove, S. L. | A Course on Statistics for Finance 1st edition | CRC Press 2012</td></tr>
</table>

Subject Description Form

Subject Code	AMA3640
Subject Title	Statistical Inference
Credit Value	3
Level	3
Pre-requisite	Intermediate Calculus and Linear Algebra (AMA2007) or Mathematics I (AMA2111) or Mathematics for Engineers (AMA2308) or Mathematical Methods for Finance (AMA2703/AMA2703A) or Advanced Mathematical Methods for Economics and Finance (AMA273) or Mathematics for Scientists and Engineers (AMA2882) or equivalent **and** Introduction to Statistics for Business (AMA1501) or Introduction to Statistics (AMA1502) or Probability and Engineering Statistics (AMA2104) or Statistics for Finance Analytics (AMA2601/AMA2601A) or Introduction to Statistics (AMA2634/AMA2634A) or Probability and Distributions (AMA2691) or equivalent
Objectives	This subject is to enable students to understand the theory of statistical inference and apply it to data analysis.
Intended Learning Outcomes	Upon satisfactory completion of the subject, students should be able to: a. master the fundamental concepts of point estimation and interval estimation; b. apply methods of estimation, criteria of assessing a good estimator to determine the distribution and statistical properties of an estimator; c. perform tests of hypotheses relating population parameters and to judge the appropriateness and goodness of tests.
Subject Synopsis/ Indicative Syllabus	*Estimation: (17 hours)* Statistic, unbiased estimator, consistent estimator. Minimum variance unbiased estimator. Efficiency of an unbiased estimator. Sufficiency, Factorisation theorem. Information matrix. Cramér-Rao lower bound. Relative efficiency. Method of moments. Likelihood, maximum likelihood (ML) estimation. Properties of ML estimators. Iterative solutions of ML estimating equation. *Hypothesis testing: (11 hours)* Significance test. Types of error, power of test. Neyman-Pearson theorem. Uniformly most powerful test. Generalised likelihood ratio test. *Bayesian inference: (11 hours)* Bayes' formula, Prior and Posterior distributions. Uniform prior, Conjugate prior. Bayes' solution to decision problem. Loss function, Bayesian estimation. Credible

interval. Predictive inference.

Teaching/Learning Methodology

The subject will be delivered mainly through lectures and tutorials. The lectures will be conducted to introduce the statistical inference concepts in the syllabus, which are then reinforced by learning activities involving demonstration, tutorial exercise and assignments/quizzes.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)		
		a	b	c
1. Assignments	20%	✓	✓	
2. Quizzes	20%	✓	✓	
3. Examination	60%	✓	✓	✓
Total	100 %			

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The subject focuses on knowledge, skill and understanding of **Statistical Inference**, thus, **Exam-based assessment** is the most appropriate assessment method, including 60% examination. Moreover, 40% worth of assignments and quizzes are included as a component of continuous assessment so as to keep the students in progress.

Continuous Assessment comprises of assignments and/or quizzes. A written examination is held at the end of the semester.

Student Study Effort Expected

Class contact:	
• Lecture	26 Hrs.
• Tutorial	13 Hrs.
Other student study effort:	
• Assignment	30 Hrs.
• Self-study	36 Hrs.
Total student study effort	105 Hrs.

Reading List and References

Textbook:

Hogg, R.V., McKean, J.W. & Craig, A.T.	Introduction to Mathematical Statistics 7th edition	Prentice Hall 2012

References:

Bain, L.J. & Engelhardt, M.	Introduction to Probability and Mathematical Statistics 2nd edition	Duxbury Press 2000
Casella, G. & Berger,	Statistical Inference 2nd edition	Duxbury Press

	R.L.		2001
	Garthwaite, P., Jolliffe, I. & Byron, J.	Statistical Inference 2nd edition	Oxford Science Publication 2002
	Mood, A.M.	Introduction to the Theory of Statistics 3rd edition	McGraw-Hill 1974

Subject Description Form

Subject Code	AMA3820
Subject Title	Operations Research Methods
Credit Value	3
Level	3
Pre-requisite	Calculus (AMA1007) or Calculus and Linear Algebra (AMA1008) or Calculus I (AMA1101) or Calculus IA (AMA1102) or Basic Mathematics II – Calculus and Linear Algebra (AMA1120) or Calculus for Engineers (AMA1130) or Intermediate Calculus and Linear Algebra (AMA2007) or Mathematics I (AMA2111) or Advanced Calculus and Linear Algebra (AMA2701/AMA2701A) or Mathematical Methods for Finance (AMA2703/AMA2703A) or Mathematics for Engineers (AMA2308) or Engineering Mathematics (AMA2380) or Applied Mathematics II (AMA2512) or Mathematics for Scientists and Engineers (AMA2882) or Engineering Mathematics (AMA290) or equivalent
Objectives	This subject is to introduce students to the techniques for solving operations research problems and to enable them to choose the correct techniques to suit a particular problem with applications in resource management, network models, decision analysis, inventory management, queuing management, and project management.
Intended Learning Outcomes	Upon satisfactory completion of the subject, students should be able to: a) implement several basic deterministic and stochastic operations research models; b) synthesize the mathematical knowledge and techniques required in operations research model formulation; c) identify, define and formulate operations research problems in a systemic approach; d) execute and appraise the main algorithms for solving such operations research problems; e) interpret the results of these operations research algorithms; f) evaluate critically for improvement in solutions; g) communicate effectively in a well-structured manner and build up an open-minded attitude.
Subject Synopsis/ Indicative Syllabus	*Network flow models (8 hours)* Shortest path problem, critical path problem (PERT), minimal spanning tree

problem, maximal flow problem.

Integer programming models (8 hours)
Formulate operations research problems as integer programming, related decisions, exclusive decisions, contingent decisions, either-or constraints, fixed charge problems, total unimodularity, branch and bound method.

Inventory management (8 hours)
Deterministic inventory model, continuous review, shortage allowed, quantity discounts, periodic review, stochastic inventory model.

Queuing theory (6 hours)
Structure of queuing models, input source, queuing system, inter-arrival time, service time, exponential distribution, Poisson distribution, birth-death process, steady state, M/M/1 system.

Linear Programming (9 hours)
Modeling with linear programming; simplex method; sensitivity analysis.

Teaching/Learning Methodology

The subject will be delivered mainly through lectures and tutorials. The lectures will be conducted to introduce the basic operation research concepts and techniques of the topics in the syllabus, which are then reinforced by learning activities involving demonstration, tutorial exercise and assignments/quizzes.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)						
		a	b	c	d	e	f	g
1. Assignments/ Quizzes	15%		✓	✓	✓	✓	✓	✓
2. Tests	25%		✓	✓	✓	✓	✓	
3. Examination	60%	✓	✓	✓	✓	✓	✓	
Total	100 %							

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:
The subject focuses on knowledge, skill and understanding of **Operations Research Methods**, thus, **Exam-based assessment** is the most appropriate assessment method, including 25% test and 60% examination. Moreover, 15% worth of assignments / quizzes are included as a component of continuous assessment so as to keep the students in progress.
Continuous Assessment comprises of assignments and/or quizzes, and tests. A written examination is held at the end of the semester.

Student Study Effort Expected

Class contact:	
• Lecture	26 Hrs.

	• Tutorial	13 Hrs.
	Other student study effort:	
	• Assignment	15 Hrs.
	• Self-study	55 Hrs.
	Total student study effort:	109 Hrs.

Reading List and References	Textbook:		
	Taha, H.A.	Operations Research: An Introduction 10th edition	Pearson 2017
	Hiller, F.S. & Lieberman, G.J.	Introduction to Operations Research 10th edition	McGraw Hill 2015
	Johnson, R., Miller, I. & Freund, J.E.	Probability and Statistics for Engineers 9th edition	Pearson 2017
	Winston, W.L. & Goldberg J.B.	Operations Research: Applications and Algorithms 4th edition	Thomson/Brooks/Cole 2004
	Nahmias, Steven.	Production and Operations Analysis 6th edition	McGraw Hill 2009

Subject Description Form

Subject Code	AMA4602
Subject Title	High Dimensional Data Analysis
Credit Value	3
Level	4
Pre-requisite	Applied Statistical Methods (AMA2631/AMA2631A) or Applied Linear Models for Finance Analytics (AMA2602) or Applied Linear Models (AMA3602) or Statistics for Data Science (AMA3631) or equivalent
Objectives	This subject is to enable students to understand the theory of multivariate and high dimensional data analysis and apply it to real data analysis. The use of computer software such as R and MATLAB will be required in completing the assignments and mini-projects.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. master the basic techniques for high dimensional data analysis; b. produce presentable statistical analysis for high dimensional data; c. interpret analysis results and make recommendations for actions based on analysis results;
Subject Synopsis/ Indicative Syllabus	Multivariate distributions, marginal and conditional distributions, regression function, multiple and partial correlation coefficients. Principal component analysis, Canonical correlation analysis, Discrimination and classification, Clustering. High dimensional linear regression: regularized regression (ridge regression and LASSO); choice of tuning parameters. High dimensional logistic regression.
Teaching/Learning Methodology	The subject will be delivered mainly through lectures and tutorials. The lectures will be conducted to introduce the concepts of high dimensional data analysis methods in the syllabus, which are then reinforced by learning activities involving self-reading, demonstration, tutorial exercise, assignments and mini-project.
Assessment Methods in Alignment with Intended Learning Outcomes	

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)		
		a	b	c
1. Assignments/Projects	20%	✓	✓	✓

2. Quizzes/Mid-Term	20%		✓	✓
3. Examination	60%	✓		✓
Total	100 %			

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The subject focuses on knowledge, skills and understanding of **High Dimensional Data Analysis**, thus, **Exam-based assessment** is the most appropriate assessment method, including 60% examination. Continuous Assessment comprises of individual assignments/project (20%) and quizzes/mid-term (20%) are included so as to keep the students in progress. A written examination is held at the end of the semester.

Student Study Effort Expected

Class contact:	
• Lecture	26 Hrs.
• Tutorial	13 Hrs.
Other student study effort:	
• Assignment	20 Hrs.
• Project	20 Hrs.
• Self-study	30 Hrs.
Total student study effort:	109 Hrs.

Reading List and References

References:

Johnson, R.A. & Wichern, D.W.	Applied Multivariate Statistical Analysis, 6th edition	Prentice Hall 2007
Hastie, R., Tibshirani, R. & Friedman, J.	The Elements of Statistical Learning, 2nd edition	Springer Series in Statistics
Bühlmann, P., & Van De Geer, S.	Statistics for high-dimensional data: methods, theory and applications	Springer Sciences & Business Media 2011

Subject Description Form

Subject Code	AMA4650
Subject Title	Forecasting and Applied Time Series Analysis
Credit Value	3
Level	4
Pre-requisite	Applied Linear Models for Finance Analytics (AMA2602) or Applied Statistical Methods (AMA2631/AMA2631A) or Statistical Inference (AMA364) or Statistical Modeling for Discovery (AMA4001) or equivalent
Objectives	This subject is to introduce to students basic concepts and techniques of time series and forecasting. An applied approach will be emphasized.
Intended Learning Outcomes	Upon satisfactory completion of the subject, students should be able to: a. state the basic theory of time series analysis and forecasting approaches; b. synthesize the relevant statistical knowledge and techniques for forecasting; c. identify, define and formulate forecasting problem, and use procedures in popular statistical software for the analysis of time series and forecasting; d. interpret analysis results and make recommendations for the choice of forecasting methods; e. produce and evaluate forecasts for given time series; f. present analysis results of forecasting problems.
Subject Synopsis/ Indicative Syllabus	*Introduction to forecasting and smoothing models (5 hours)* Forecasting and time series, forecasting methods and errors, choosing a forecasting technique, simple exponential smoothing and double exponential smoothing. *Nonseasonal Box-Jenkins models and their identification (11 hours)* Stationary and nonstationary time series, sample autocorrelation and partial autocorrelation function, tentative identification of ARMA models. *Estimation, diagnostic checking, and forecasting for nonseasonal Box-Jenkins Models (14 hours)* Estimation, diagnostic checking, forecasting and case study. *Conditional heteroscedastic time series models (9 hours)* ARCH and GARCH models, estimation and testing.
Teaching/Learning Methodology	The subject will be delivered mainly through lectures and tutorials. The lectures will be conducted to introduce the concepts of forecasting and applied time series analysis in the syllabus, which are then reinforced by learning activities involving demonstration, tutorial exercise and assignments/mini-project.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b	c	d	e	f
1. Assignments/ Mini-project	20%	✓	✓	✓	✓	✓	✓
2. Tests	20%	✓	✓		✓	✓	
3. Examination	60%	✓	✓		✓	✓	✓
Total	100 %						

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:
The subject focuses on knowledge, skill and understanding of **Forecasting and Applied Time Series Analysis**, thus, **Exam-based assessment** is the most appropriate assessment method, including 20% test and 60% examination. Moreover, 20% worth of assignments /mini-project are included as a component of continuous assessment so as to keep the students in progress.
Continuous Assessment comprises of assignments and/or mini-project, and tests. A written examination is held at the end of the semester.

Student Study Effort Expected

Class contact:	
• Lecture	26 Hrs.
• Tutorial	13 Hrs.
Other student study effort:	
• Assignment/mini-project/laboratory	30 Hrs.
• Self-study	36 Hrs.
Total student study effort	105 Hrs.

Reading List and References

Textbook:

Chatfield, C. & Xing, H.	The Analysis of Time Series: An Introduction with R 7th edition	Chapman and Hall 2019

References:

Tsay, R.S.	Analysis of Financial Time Series 3rd edition	Wiley-Interscience 2010
Cryer, J.D. & Chan, K.S.	Time Series Analysis with Applications in R 2nd edition	Springer-Verlag 2008

Subject Description Form

Subject Code	AMA4670
Subject Title	Modelling of epidemic and pandemic
Credit Value	3
Level	4
Pre-requisite	Probability & Distributions (AMA2691) or equivalent and Multivariable Calculus (AMA2702) or equivalent
Objectives	Enables students to understand the history of epidemic and pandemic, theory and methods to model the spread of diseases in populations, including differential equations, demographic noise and measuremental noise, likelihood-based inference and iterated filtering. Enables students to familiarize themselves with disease modeling environments (the statistical software R)
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) Describe the basic principles of risk analysis in epidemiology; Describe the concepts used in the mathematical modeling of infectious diseases (b) Understand essential characteristics of differential equations type of models (c) Understand how models are used to guide control and prevention measures (d) Construct simple dynamic models and apply generic models to specific disease systems (e) Make predictions about controlling disease based on models (f) Using likelihood-based inference and iterated filtering to estimate unknown parameters.
Subject Synopsis/ Indicative Syllabus	Differential equations and characteristics of epidemic models; Simple compartmental (Susceptible-Infectious-Recovered) models; Dynamics of infectious diseases in populations; Basic reproductive number; Effective reproductive number; Herd immunity and Critical vaccination coverage; Likelihood-based inference and iterated filtering.
Teaching/Learning Methodology	A two-hour lecture will be conducted every week to motivate students with risk analysis and disease transmission examples to understand and learn the theory and techniques. A one-hour tutorial is designed to consolidate and develop students' knowledge through practical examples and discussions.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b	c	d	e	f
a. Assignments	25%	√	√	√	√	√	√
b. Project report	25%	√	√	√	√	√	√
c. Examinations	50%	√	√	√	√	√	√
Total	100 %						

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes. Students will be trained to write reports in project report component.

Student Study Effort Expected

Class contact:	
▪ Lecture	26 Hrs.
▪ Tutorial	13 Hrs.
Other student study effort:	
▪ Assignment and report	45 Hrs.
▪ Self-study	36 Hrs.
Total student study effort	120 Hrs.

Reading List and References

References:
Modeling Infectious Diseases in Humans and Animals, Matt J. Keeling & Pejman Rohani, Princeton University Press, ISBN: 9780691116174

Capasso V. Mathematical Structures of Epidemic Systems. Second Printing. Heidelberg, 2008: Springer.

Subject Description Form

Subject Code	AMA4680
Subject Title	Statistical Machine Learning
Credit Value	3
Level	3
Pre-requisite/	Applied Linear Models for Finance Analytics (AMA2602) or Applied Statistical Methods (AMA2631) or Probability & Distributions (AMA2691) or equivalent **and** Advanced Calculus and Linear Algebra (AMA2701/AMA2701A) or Further Mathematical Methods for Finance (AMA3723) or Mathematical Methods for Data Science (AMA3001) or equivalent **and** Principles of Programming (AMA2222/AMA2222A) or equivalent
Objectives	To provide a basic introduction to machine learning. To present fundamental concepts and algorithms for selected topics of machine learning, to provide the students with the necessary background for the application of machine learning to real problems, and to provide a starting point for students who are interested in pursuing research in machine learning or related fields.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a) Demonstrate mastery of the principles of machine learning b) Develop quantitative skills of machine learning and interpret the outcomes of machine learning algorithms. c) Identify, define, and formulate problems of machine learning in real applications and generate workable solutions to problems.
Subject Synopsis/ Indicative Syllabus	<u>Supervised Learning, Regression and Model Selection:</u> Generalized linear models; ridge regression, model selection, dimension reduction, principal component analysis, lasso; reproducing kernels, kernel ridge regression, regularization; stochastic gradient descent, online learning. <u>Supervised Learning, Classification:</u> Naive Bayes; decision trees; *k*-nearest-neighbor classifier; logistic regression; support vector machines, kernelized support vector machines; score-based classifiers, the receiver operating characteristic curve, AUC scores, imbalanced data. <u>Unsupervised Learning, Clustering:</u> *K*-means; agglomerative hierarchical clustering. <u>Other Selected Topics:</u>

<table>
<tr><td></td><td colspan="2">Cross validation; artificial neural networks, back-propagation, introduction to deep learning algorithms; introduction to software packages for machine learning; random forests.</td></tr>
<tr><td>Teaching/Learning Methodology</td><td colspan="2">The subject will mainly be delivered through lectures and tutorials in computer lab. The theoretical background and the real applications of learning algorithms are both emphasized.</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td colspan="2">
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="3">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td></tr>
<tr><td>1. Assignments/Projects</td><td>15%</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>2. Midterm Test</td><td>25%</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>3. Final Exam</td><td>60%</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Total</td><td>100%</td><td colspan="3"></td></tr>
</table>
<p>Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:
This subject focuses on the machine learning algorithms. Some of the algorithms concern important mathematical and statistical background. So it is important and appropriate to set the assignments and a midterm test for continuous assessment, and a final exam.
This subject emphasizes the practice of statistical machine learning. The projects are appropriate for assessing the related intended learning outcomes in the continuous assessment.</p>
</td></tr>
<tr><td rowspan="7">Student Study Effort Required</td><td>Class contact:</td><td></td></tr>
<tr><td>Lecture</td><td>26 Hrs.</td></tr>
<tr><td>Tutorial</td><td>13 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>Assignments/Projects</td><td>58 Hrs.</td></tr>
<tr><td>Self-study</td><td>30 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>127 Hrs.</td></tr>
<tr><td>Reading List and References</td><td colspan="2">
<p>Textbooks:</p>
<table>
<tr><td>Han, J., Kamber, M., and Pei, J.</td><td>Data Mining: Concepts and Techniques, 3rd Edition.</td><td>Morgan Kaufmann, 2011</td></tr>
<tr><td>James, G., Witten, D., Hastie, T., and Tibshirani, R.</td><td>An Introduction to Statistical Learning</td><td>Springer 2013</td></tr>
</table>
</td></tr>
</table>

References:

Tan, P.N., Steinbach, M., and Kummar, V.	Introduction to Data Mining	Pearson 2006
Hastie, T., Tibshirani, R, and Friedman, J.	The Elements of Statistical Learning	Springer 2009
Kelleher, J.D., Namee M.B., D'Arcy, A.	Fundamentals of Machine Learning for Predictive Data Analysis	The MIT Press 2015
Steinwart, I., Christmann A.	Support Vector Machines	Springer 2008
Goodfellow I., Bengio Y., Courville A.	Deep Learning	The MIT Press 2016

Subject Description Form

Subject Code	AMA4688
Subject Title	Simulation
Credit Value	3
Level	4
Pre-requisite	Introduction to Statistics for Business (AMA1501) or Introduction to Statistics (AMA1502) or Probability and Engineering Statistics (AMA2104) or Statistics for Finance Analytics (AMA2601) or Introduction to Statistics (AMA2634/AMA2634A) or Probability and Distributions (AMA2691) or equivalent
Objectives	This subject is to enable students to appreciate the principles and methods of system simulation. Emphasis is placed on the process of translating real-world problems into simulation models, and the model building techniques involved.
Intended Learning Outcomes	Upon satisfactory completion of the subject, students should be able to: a. identify the basic concepts of simulation and its utility in solving real-world problems; b. apply statistical knowledge and modelling techniques required to construct simulation models for real-world systems; c. apply statistical knowledge and techniques to verify and validate simulation models; d. analyze and interpret simulation outputs; e. present results of simulation analysis; f. communicate effectively in a well-structured manner and build up an open-minded attitude.
Subject Synopsis/ Indicative Syllabus	*Fundamental of Simulation Models* Principles of mathematical simulation, advantages and disadvantages of simulation, types of simulation models, steps in a simulation study. *Discrete-Event Simulation* General principles, components and organization of a discrete-event simulation model, simulation examples (e.g. production, queuing and inventory systems), event scheduling, gathering summary statistics. *Random Numbers* Generation of pseudo-random numbers, mid-square method, congruential methods, statistical tests of randomness. *Random Variates* Generation of random variates, inverse transformation method, acceptance-

rejection method, comparison of the methods, generation of random variates of discrete and continuous theoretical distributions, Monte Carlo method and its applications.

Tactical Planning in Simulation Models
Starting condition and equilibrium, problem of variability, estimation of population parameters, determination of sample size, variance reduction techniques.

Validity and Analysis
Verification and validation of simulation models, comparisons, appropriate statistical tests, sensitivity analysis, simulation run statistics, replication of runs, elimination of initial bias, batch means, and regenerative techniques.

Computer Language for Discrete-Event Simulation
Learn programming with the statistical computing software R.

Teaching/Learning Methodology

The subject will be delivered mainly through lectures and tutorials. The lectures will be conducted to introduce the simulation concepts of the topics in the syllabus, which are then reinforced by learning activities involving demonstration, tutorial exercise and project.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b	c	d	e	f
1. Project	25%	✓	✓	✓	✓	✓	✓
2. Assignments/Tests	25%	✓	✓	✓	✓		
3. Examination	50%	✓	✓	✓	✓		
Total	100 %						

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:
The subject focuses on knowledge, skill and understanding of **Simulation**, thus, **Exam-based assessment** is the most appropriate assessment method, including 25% test / quizzes and 50% examination. Moreover, 25% project is included as a component of continuous assessment so as to assess students' ability in constructing simulation models for real world problems and presenting results of simulation analyses.
Continuous Assessment comprises of a project, quizzes and/or tests. A written examination is held at the end of the semester.

Student Study Effort Expected

Class contact:	
▪ Lecture	26 Hrs.
▪ Tutorial	13 Hrs.

	Other student study effort:	
	▪ Project	56 Hrs.
	▪ Self-study	22 Hrs.
	Total student study effort	117 Hrs.
Reading List and References	<u>Textbook:</u> Ross, S.M. — Simulation 5th edition — Academic Press 2012 <u>Reference Book:</u> Law, A.M. & Kelton, W.D. — Simulation Modelling and Analysis 4th edition — McGraw Hall 2012	

Subject Description Form

Subject Code	AMA4840
Subject Title	Decision Analysis
Credit Value	3
Level	4
Pre-requisite	Introduction to Statistics for Business (AMA1501) or Introduction to Statistics (AMA1502) or Probability and Engineering Statistics (AMA2104) or Statistics for Finance Analytics (AMA2601) or Introduction to Statistics (AMA2634/AMA2634A) or Probability and Distributions (AMA2691) or equivalent
Objectives	This subject is to enable students to understand the theory and methods for decision analysis under uncertainty, to appreciate the use of expert judgment and value of information in decision making and risk management, and to apply them in industrial and financial areas.
Intended Learning Outcomes	Upon satisfactory completion of the subject, students should be able to: a. discuss the basic principles and assumptions for decision analysis; b. synthesize the decision making knowledge and techniques required in solving real-life problems; c. formulate mathematical models for practical decision problems, and assess critically the appropriateness of model used; d. solve decision problems and present decision analysis results; e. make recommendations for actions based on analysis results; f. define, formulate and solve problems in a systematic approach; g. communicate effectively in a well-structured manner and build up an open-minded attitude.
Subject Synopsis/ Indicative Syllabus	*Preliminary probability theory: (6 hours)* Review of probability theory, prior and posterior distributions, Bayes' theorem, choice of prior: bets, conjugate families of distributions, vague and improper priors. *Structure of decision analysis models: (8 hours)* Nature and classification of decision analysis problems, influence diagrams, decision trees, Bayesian intervals for parameters and predictions, decision analysis with sampling, expected value of information (perfect and imperfect), sensitivity analysis. *Decision analysis under uncertainty: (6 hours)* The maximin/maximax/Laplace criterion, criterion of realism, the minimax regret criterion, minimax decisions and Bayes' solutions including simple results,

game theory.

Decision analysis under risk: (6 hours)
Risk attitudes, measures of risk, risk premium, subjective measures and utility theory.

Decision analysis with multiattributes: (6 hours)
Conflicting objectives, analytic hierarchy process, goal programming, multi-attribute utility models, Pareto optimal, efficient frontier.

Applications: (7 hours)
Capital investment, inventory control, other industrial and financial applications.

Teaching/Learning Methodology

The subject will be delivered mainly through lectures and tutorials. The lectures will be conducted to introduce the concepts of decision analysis in the syllabus, which are then reinforced by learning activities involving demonstration, tutorial exercise and assignments.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)						
		a	b	c	d	e	f	g
1. Assignments	20%	✓		✓				✓
2. Tests	20%			✓	✓			
3. Examination	60%		✓	✓	✓	✓	✓	
Total	100 %							

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:
The subject focuses on knowledge, skill and understanding of **Decision Analysis**, thus, **Exam-based assessment** is the most appropriate assessment method, including 20% test and 60% examination. Moreover, 20% worth of assignments are included as a component of continuous assessment so as to keep the students in progress.
Continuous Assessment comprises of assignments and tests. A written examination is held at the end of the semester.

Student Study Effort Expected

Class contact:	
▪ Lecture	26 Hrs.
▪ Tutorial	13 Hrs.
Other student study effort:	
▪ Assignment	40 Hrs.
▪ Self-study	30 Hrs.

	Total student study effort	109 Hrs.
Reading List and References	Textbook: Winston, W.L. — Introduction to Probability Models: Operations Research, Volume II 4th edition — Brooks/Cole 2004 Pratt, J.W., Raiffa, H. & Schlaifer, R. — Introduction to Statistical Decision Theory — The MIT Press 2008 References: Goodwin, P. & Wright, G. — Decision Analysis for Management Judgment 4th edition — Wiley 2010 Clemen, R.T. & Reilly, T. — Making Hard Decisions with Decision Tools 1st edition — Duxbury Press 2003	

Subject Description Form

Subject Code	AMA4850
Subject Title	Optimization Methods
Credit Value	3
Level	4
Pre-requisite	Intermediate Calculus and Linear Algebra (AMA2007) or Mathematics I (AMA2111) or Mathematics II (AMA2112) or Mathematics for Engineers (AMA2308) or Engineering Mathematics (AMA2380) or Mathematics for Scientists and Engineers (AMA2882) or Mathematical Methods for Data Science (AMA3001) or equivalent
Objectives	To enable students to learn to use more advanced mathematical and computational techniques in optimization, applicable in solving real engineering and management problems.
Intended Learning Outcomes	Upon satisfactory completion of the subject, students should be able to: 1. Formulate problems in linear programming, convex programming, unconstrained nonlinear programming and constrained nonlinear programming; 2. master optimality conditions and duality theory for continuous optimization; 3. apply the main algorithms for solving linear programming, unconstrained nonlinear programming and constrained nonlinear programming problems.
Subject Synopsis/ Indicative Syllabus	*Linear programming:* Formulation and properties, duality, optimality conditions, simplex algorithms. *Convex programming:* Convex sets, convex functions, conjugate duality, optimality conditions, algorithms and convergence. *Unconstrained optimization:* One dimensional algorithms: Fibonacci and golden section search. Multidimensional method: steepest descent method; Newton's method; Line search method; conjugate gradient method and quasi-Newton method. *Constrained Optimization:* First and second optimality conditions; penalty and barrier functions. Unconstrained minimization method, sequential quadratical programming methods, reformulation methods, applications.
Teaching/Learning Methodology	The subject will be delivered mainly through lectures and tutorials. The lectures will be conducted to introduce the concepts of optimization methods in the

<table>
<tr><td></td><td>syllabus, which are then reinforced by learning activities involving demonstration, tutorial exercise and assignments.</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods</td><td rowspan="2">% weighting</td><td colspan="3">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>1</td><td>2</td><td>3</td></tr>
<tr><td>a. Computer Assignments</td><td>8%</td><td></td><td></td><td>✓</td></tr>
<tr><td>b. Tests</td><td>32%</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>c. Examination</td><td>60%</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Total</td><td>100 %</td><td colspan="3"></td></tr>
</table>
<p>Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:
The subject focuses on knowledge, skills and understanding of <u>Optimization Methods,</u> thus, <u>Exam-based assessment</u> is the most appropriate assessment method, including 60% examination. Continuous Assessment comprises of individual computer assignments (8%) and test (32%) are included so as to keep the students in progress. Quizzes and short tests will be used to assess (1) to (3). All will be assessed in the exam.</p>
</td></tr>
<tr><td>Student Study Effort Expected</td><td>
<table>
<tr><td>Class contact:</td><td></td></tr>
<tr><td>• Lecture</td><td>26 Hrs.</td></tr>
<tr><td>• Tutorial</td><td>13 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>• Assignment</td><td>15 Hrs.</td></tr>
<tr><td>• Self-study</td><td>55 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>109 Hrs.</td></tr>
</table>
</td></tr>
<tr><td>Reading List and References</td><td>
<p><u>Textbook</u>:</p>
<table>
<tr><td>Bazaraa, M.S., Sherali, H.D. and Shetty, C.M.</td><td>Nonlinear programming: theory and algorithms 3rd edition</td><td>New York: Wiley, 2006</td></tr>
</table>
<p>Reference:</p>
<table>
<tr><td>Fletcher, R.</td><td>Practical Method of Optimization 2nd edition</td><td>Wiley, 2000</td></tr>
<tr><td>Rockafellar, R.T.</td><td>Convex Analysis</td><td>Princeton Uni. Press 1996</td></tr>
<tr><td>Mangasarian, O.L.</td><td>Nonlinear programming</td><td>SIAM, 1994</td></tr>
<tr><td>Dennis, J.E. and Schnabel, R.B.</td><td>Numerical methods for unconstrained optimization and nonlinear equations</td><td>SIAM, 1996</td></tr>
</table>
</td></tr>
</table>

Subject Description Form

Subject Code	AMA4953
Subject Title	Integrated Capstone Project
Credit Value	6
Level	4
Exclusion	AMA4951, AMA4952, or any other equivalent capstone project subjects
Objectives	The objectives of this subject are to: • provide students with the opportunity to apply and integrate the knowledge of artificial intelligence and data analytics (AIDA) to investment science and finance analytics. • develop students' capabilities in analyzing and solving complex and substantial problems using AIDA. • Train students with skills on systematic development and documentation of a significant piece of work and in presenting the methodology, arguments and findings in a well-documented report.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: Professional/academic knowledge and skills (a) conduct literature surveys to locate materials and sources relevant to the selected problem area in a specific discipline; (b) understand the materials obtained and connect the materials with the problem to be solved using AIDA knowledge and skills; (c) define and specify the problem precisely; (d) assimilate and apply the knowledge and techniques in various disciplines in the analysis of real-life mathematical and statistical models to generate good solutions to the problem; (e) think critically the appropriateness of mathematical and statistical models and solutions to the problem, in the analysis of analytical methods and approaches to the solution and their implementation; and (f) interpret analysis results of the final outcome in an objective manner and make recommendations for actions based on analysis results; Attributes for all-roundedness (g) improve presentation and communication skills via oral presentation; (h) enhance technical report writing skills for organizing analysis results properly and present analysis results effectively; (i) develop the ability to learn independently and to find/integrate information from different sources required for problem-solving and solution-seeking; (j) manage the project efficiently and effectively through the supervision of supervisor(s); and

	(k) work both independently and collaboratively with related parties (e.g. vendors, sponsor company, technical support staff, team-partners, research students, etc.).
Subject Synopsis/ Indicative Syllabus	**1. In-depth Study of a Topic Typically Proposed by the Supervisor** **2. Project Meeting and Planning** **3. Proposal Writing** **4. Regular Progress Checking and Reporting** **5. Project Documentation** **6. Presentation and Demonstration** Students are expected to identify a project topic with a supervisor in their chosen discipline, and possibly a co-supervisor with artificial intelligence and data analytics expertise. They need to demonstrate their knowledge in both their chosen discipline and AIDA in the project, receiving advice from both supervisors. They are normally expected to contact local industry for real-life problems and together with the supervisor/co-supervisor to materialize them into project topics. The nature of the project should be applied through theoretical research with a practical prospect. The project should represent the requisite effort in analyzing and interpreting the data/information obtained, using the principles and techniques learnt from various related subjects. Students are also expected to demonstrate significant analytical and, preferably, research ability in the chosen application domain. A project proposal will be required that students identify the theme of the study, suggest the plan of collecting data/information and propose the methodology of analyzing the problem with justification. Oral presentation sessions will be arranged for students to report their work and findings. Class participation in the form of questions and discussions will be promoted. The final report is expected to include problem identification, relevant data, methodology of analysis, solutions, implementation, interpretations, conclusions, etc. Independent research, critical thinking, and creativity will be encouraged.
Teaching/Learning Methodology	The Integrated Capstone Project spans across the academic year for two consecutive semesters. The teaching/learning activities include regular project meetings with the supervisor/co-supervisor at least twice a month, guided study of project materials, independent project development work and other project management tasks. While the basic knowledge and techniques are learned via various subjects, students are required to learn some specific techniques by themselves independently with minimum guidance from the supervisor.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)										
		a	b	c	d	e	f	g	h	i	j	k
1. Interim report	10%	✓	✓	✓	✓	✓			✓	✓	✓	✓
2. Oral presentation	30%	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
3. Written report	60%	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Total	100 %											

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The Integrated Capstone Project will be accessed by the supervisor/co-supervisor and an independent assessor who is a staff member not formally involved in the work of the project.

The subject focuses on knowledge, skill and understanding of the **Integrated Capstone Project**. Thus, **Project-based assessment** is the most appropriate assessment method, including 60% written report. Moreover, 10% worth of interim report and 30% oral presentation are included as components of continuous assessment to assess students' ability in constructing case study models for real-world problems and presenting results of the analyses.

Attributes to be assessed include, but are not limited to, Problem Identification, Problem Solving, Communication and Presentation, Project Management, and Self-Discipline.

Student Study Effort Expected

Class contact:	
▪ Lecture	0 Hrs.
Other student study effort:	
▪ Meeting with supervisor / co-supervisor / others	70 Hrs
▪ Searching and reading materials, design and system development, testing, documentation, presentation, etc.	140 Hrs.
Total student study effort	210 Hrs.

Reading List and References

References:

Ross, S.M.	Simulation 5th edition	Academic Press 2012
Hull, J.C.	Options, futures and other derivatives 8th edition	Prentice Hall 2011
Greene, W.H.	Econometric Analysis 7th edition	Prentice Hall

			2011
	Kumar, Ranjit	*Research Methodology: A Step-by-step Guide for Beginners*, 3rd Edition	SAGE Publications 2011
	Roberts, Carol M.	*The Dissertation Journey: A Practical and Comprehensive Guide to Planning, Writing, and Defending Your Dissertation*, 3rd Edition	Corwin Press 2007
	Russell, Stuart and Norvig, Peter	*Artificial Intelligence: A Modern Approach, 4th Edition*	Pearson 2020
	Han, Jiawei and Kamber, Micheline	*Data Mining: Concepts and Techniques,* 3rd Edition	Morgan Kaufmann 2012
	James, G., Witten, D., Hastie, T., and Tibshirani, R.	*An Introduction to Statistical Learning*	Springer 2013
	Giuseppe C. Calafiore, Laurent El Ghaoui	*Optimization Models*	Cambridge University Press 2014

Subject Description Form

Subject Code	AP30019
Subject Title	Data Analysis Techniques for Scientists
Credit Value	3
Level	3
Pre-requisite / Co-requisite/ Exclusion	AP20018 Python Programming
Objectives	To introduce basic techniques in numerical computation, data analysis, data modeling, and their applications to practical problems in science and engineering.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) formulate problems in science and engineering in mathematical forms; (b) apply numerical methods for solving mathematical problems relevant to science and engineering; (c) demonstrate proficiency with statistical analysis of data; (d) formulate and apply appropriate models of data analysis to solve practical problems.
Subject Synopsis/ Indicative Syllabus	**Solution of nonlinear equations**: fixed-point iteration method, bisection method, Newton-Raphson method. **Approximation of data:** linear interpolation, Lagrange interpolation, Taylor series, approximation of derivatives using finite difference schemes. **Random numbers:** probability, probability density function, discrete and continuous random variables, uniform and non-uniform pseudo random numbers, exponential variables, Gaussian variables. **Statistical inference:** mean, standard deviation, variance and covariance, sum of random variables, law of large numbers, confidence level, hypothesis testing. **Regression**: linear regression, gradient descent, momentum, stochastic gradient descent, nonlinear regression, logistic regression.
Teaching/Learning Methodology	**Lecture**: To introduce basic techniques in numerical calculations, data analysis, and data modeling. Demonstrations on solution of practical problems will be conducted. Students are encouraged to raise questions when meeting difficulties. **Computer laboratory**: Students work on given problem sets either individually or through interaction among each other. They are encouraged to raise questions and discuss any issues with the instructor. These problem sets provide the opportunities to apply the knowledge gained from the lectures and to consolidate what have been learned.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)			
		a	b	c	d
(1) Continuous assessment	40	✓	✓	✓	✓
(2) Examination	60	✓	✓	✓	✓
Total	100				

The continuous assessment is based on computer laboratories, assignments and a mid-term test. The examination is a three-hour written final examination. Various kinds of questions will be set in both components to assess the intended learning outcomes.

Student Study Effort Expected

Class contact:	
• Lecture	26 h
• Laboratory	18 h
Other student study effort:	
• Self-study	76 h
Total student study effort	120 h

Reading List and References

Textbook:

L. Igual, S. Segu, "Introduction to Data Science. A Python Approach to Concepts, Techniques and Applications", Springer (2017).

References:

C. Shah, "A Hands-On Introduction to Data Science", Cambridge University Press (2020)

C.M. Bishop, "Pattern Recognition and Machine Learning", Springer (2006).

J Zelle, "Python Programming: an Introduction to Computer Science", 3rd Edition, Franklin, Beedle & Associates (2016).

A. Scopatz and K.D. Huff, "Effective Computation in Physics: Field Guide to Research with Python" O'Reilly Media (2015).

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Subject Description Form

Please read the notes at the end of the table carefully before completing the form.

Subject Code	AP40012
Subject Title	Machine Learning in Physics
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	AP20005/ subject in Programming I pool
Objectives	To introduce the fundamentals of machine learning as applied to problems in physical science.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: (a) extract, visualize and process data from online databases dedicated to materials scientists and physicists; (b) select machine learning models to solve specific problems; (c) implement various machine learning models in Python; and (d) evaluate and improve the performance of a model.
Subject Synopsis/ Indicative Syllabus *(Note 2)*	**Linear regression and classification**: databases, feature, representation, training set, error functions, gradient descent, univariate and multi-variate regression, logistic regression **Neural networks**: activation functions, back propagation, feed-forward networks, recurrent networks, deep learning **Theory of machine learning**: overfitting, validation, regularization, generalization, bias-variance **Application in physical science**: Materials Project database, bulk modulus, bandgap, energy, force, molecular dynamics
Teaching/Learning Methodology *(Note 3)*	The course will make use of public cloud computing to enhance the learning using nanoHUB.org as well as its features for collaboration and publishing. Students will learn how to program in Python with IPython notebooks and use external libraries such as Numpy, Scipy, Pandas and Tensorflow. **Lecture**: The concepts will be presented in class including some illustrative examples and algorithms related to solving problems in physics or engineering. **Computer laboratory**: During laboratory sessions, students will write small

programs individually or in groups to gain a deeper understanding of the topics discussed during the lectures. These sessions aim at developing the students' intuition and critical thinking upon discussion and exchange of ideas in order to engage in the proposed activities.

Assessment Methods in Alignment with Intended Learning Outcomes

(Note 4)

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)			
		a	b	c	d
(1) Continuous assessment	30	✓	✓	✓	✓
(2) Project	30	✓	✓	✓	✓
(3) Final exam	40		✓		✓
Total	100 %				

Continuous assessment includes participation in the computer laboratory sessions and turning on time the graded quizzes in order to check students' progress throughout the semester.

The project consists of a take-home exam and will be assigned during the second half of the semester. Students will use their knowledge gained in the class/lab to design a machine learning program in order to tackle a problem related to physical science. Reports will be graded.

The final examination is a 2-hour written final examination. Various questions will be set in both components to assess the intended learning outcomes.

Student Study Effort Expected

Class contact:	
• Lecture	26 Hrs.
• Computer Laboratory	13 Hrs.
Other student study effort:	
• Self-study	81 Hrs.
• Total student study effort	120 Hrs.

Reading List and References

Hands-on machine learning with Scikit-Learn and TensorFlow: concepts, tools, and techniques to build intelligent systems. Géron, Aurélien. O'Reilly Media, Inc., 2017.

A first course in machine learning. Rogers, Simon, and Mark Girolami. Chapman and Hall/CRC, 2016.

Machine Learning, MOOC from Stanford (CS229). Ng, Andrew.

Learning From Data, MOOC from Caltech. Yaser S. Abu-Mostafa.

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Subject Description Form

Subject Code	AP40013
Subject Title	Energy Conversion and Storage with Machine Learning
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	Material Science (AP20002)
Objectives	To introduce the concepts, principles and materials applied in the latest technologies for energy conversion and storage processes. To introduce basic concepts and techniques used in machine learning for the design of materials and management of device systems for energy conversion and storage.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a) understand the basic working principles and processes of energy conversion and storage in capacitors, batteries, solar cells, and heterogeneous catalysis; b) identify key materials used in capacitors, batteries, solar cells, and heterogeneous catalysis, and solve corresponding problems associated with those materials; and c) identify research problems that can be solved by machine learning based on judiciously selected datasets from materials or devices for energy conversion and storage.
Subject Synopsis/ Indicative Syllabus	**Materials for Energy Conversion and Storage:** Physical principles of and key materials for solar cells, batteries, capacitors and heterogeneous catalysis. **Machine Learning in Energy Storage Materials and Devices:** Machine learning examples in materials design for solar cells, batteries, capacitors and heterogeneous catalysis; Machine learning examples in lifetime prediction and management of devices.
Teaching/Learning Methodology	**Lecture**: The working principles of various kinds of energy conversion and storage processes will be explained, with particular emphasis on the key material issues for the latest development in solar cells, batteries, supercapacitors and heterogeneous catalysis. Examples will be used to illustrate how the basic concepts of machine learning can be applied to the design of materials and the management of device systems for better performance in energy conversion and storage processes. **Tutorial:** Students will work on a prescribed set of problems in tutorials.

They are encouraged to solve problems and to use their own knowledge to verify their solutions before seeking assistance. These problem sets provide them opportunities to apply their knowledge gained from the lecture. They also help the students to consolidate what they have learned. Furthermore, students can develop a deeper understanding of the subject in relation to daily life phenomena or experience.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)		
		a	b	c
1. Continuous assessment	40	✓	✓	✓
2. Examination	60	✓	✓	✓
Total	100			

Continuous assessment:
The continuous assessment includes assignments, oral presentation, and mid-term test which aim at checking the progress of student study throughout the course, assisting them in fulfilling the learning outcomes.
Assignments, in general, are used to reinforce and assess the concepts and skills acquired by the students; and to let them know the level of understanding that they are expected to reach.
One oral presentation is used to train the students with the ability to extract useful information from various sources and the ability to present in a clear, logic, and well-organized way.
One mid-term test will be administered during the course of the subject as a means of timely checking of learning progress by referring to the intended learning outcomes, and as a means of checking how effective the students digest and consolidate the materials taught in the class.

Examination: This is a major assessment component of the subject. It is a closed-book examination. The emphasis of assessment is to test the understanding, analysis and problem solving ability of the students.

Student Study Effort Expected

Class contact:	
▪ Lecture & Tutorial	39 Hrs.
Other student study effort:	
▪ Self-study	81 Hrs.
Total student study effort	120 Hrs.

Reading List and References

Kathy Lu, **Materials in Energy Conversion, Harvesting and Storage**, John Wiley & Sons, 2014.

	C.D.Rahn and C.-Y.Wang, **Battery Systems Engineering**, John Wiley & Sons, 2013.

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Subject Description Form

Subject Code	AP40021
Subject Title	Capstone Project
Credit Value	6
Level	4
Pre-requisite / Co-requisite/ Exclusion	Nil.
Objectives	The objectives are to exert the student's ability in: • organizing a complete scientific, engineering and educational task that integrates the knowledge and skills in physics, materials science/technology, electrical or electronic engineering; • conducting systematic studies on physical mechanisms, theoretical analyses, numerical computations, device developments and/or system integrations using applied physics, materials, electrics and/or electronics; • critical thinking and problem-solving skills in physics, materials and engineering; • communication skills and team working spirits; • presenting the project results and writing project reports. • developing broad-based problem solving skills for various professions.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: <u>Professional/academic knowledge and skills</u> (a) plan and successfully complete a project relevant to the selected problem area in physics, materials and/or engineering; (b) conduct literature surveys to locate materials and sources, and understand the state of the art and connect the knowledge with the problem to be solved using physics mechanisms, material science and engineering experimental skills; (c) assimilate and apply the learnt knowledge to generate feasible solutions to the problem; (d) think critically the formulation of alternative models and solutions to the problem, in the analysis of approaches to the solution and their implementation; and (e) evaluate the final outcome in an objective manner. (f) recognize the limitations of the project and make suggestions for further work; (g) developing broad-based problem solving skills for various professions. <u>Attributes for all-roundedness</u> (h) improve presentation and communication skills via oral presentations; (i) enhance technical report writing skills with proper organization of materials; (j) develop the ability to learn independently and to find/integrate information from different sources required in solving real-life problems; (k) manage the project efficiently and effectively through the supervision of supervisor(s); and (l) work collaboratively with related parties (e.g. vendors, sponsor company, technical support staff, team-partners, research students, etc.).

(m)Subject Synopsis/ Indicative Syllabus

1. In-depth study of a topic typically proposed by the supervisor
2. Project meeting and planning
3. Proposal writing
4. Regular progress checking and reporting
5. Project documentation
6. Presentation and demonstration

Students are expected to identify a project topic with a supervisor in physics, materials and/or engineering. Students need to demonstrate their knowledge in their chosen discipline in the project, receiving advice from supervisors. The project should represent substantial efforts in analyzing and interpreting the data/information obtained, using the principles and techniques learnt from various related subjects. Students are also expected to demonstrate significant analytical and, preferably, research ability in physics, materials, engineering and applications.

Teaching/Learning Methodology

The Capstone Project spans across the academic year for two consecutive semesters. The teaching/learning activities include regular project meetings with the supervisor and the co-supervisor, guided study of project materials, independent project development work and other project management tasks.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)											
		a	b	c	d	e	f	g	h	i	j	k	l
Continuous assessment	40	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Project report	30	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Project presentation	30	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Total	100												

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The Capstone Project will be accessed by the supervisor and other assessors. Attributes to be assessed include, but not limited to, Problem Identification, Problem Solving, Scientific Merits and Engineering Significance of Project Results, Communication and Presentation, Project Management, and Attitude.

Capstone Projects should be problem-oriented and there are no restrictions on the nature of the problem except that it should be relevant to physics, materials and/or engineering. The project could be practical, academic or a hybrid in which the student is encouraged but not constrained to have some original contributions. Each student has to pass a project-starting interview, two progress interviews and a final presentation, and to submit a final project report. The proposal must be approved by the supervisor before the student can proceed with the Capstone Project. An oral presentation and demonstration is essential at the end of the project. Two progress interviews are required for proper continuous assessment.

Class contact:

Student Study Effort Expected	• Lecture	0 h
	Other student study effort:	
	• Searching and reading materials, meeting with supervisor / co-supervisor / others, design and system development, testing, documentation, presentation, etc.	210 h
	Total student study effort	210 h
Reading List and References	**References:** 1. Kumar, Ranjit, Research Methodology: A Step-by-step Guide for Beginners, 3rd Edition, SAGE Publications, 2011. 2. Burns, Robert B., Introduction to Research Methods, 4th Edition, SAGE Publications, 2000. 3. Roberts, Carol M., The Dissertation Journey: A Practical and Comprehensive Guide to Planning, Writing, and Defending Your Dissertation, 3rd Edition, Corwin Press, 2007. 4. Mauch, James E. and Park, Namgi, Guide to the Successful Thesis and Dissertation: A Handbook for Students and Faculty, 5th Edition, Marcel Dekker, 2003. 5. Rudestam, Kjell Erik and Newton, Rae R., Surviving Your Dissertation: A Comprehensive Guide to Content and Process, 2nd Edition, Sage Publications, 2001. 6. Garson, G. David, Guide to Writing Empirical Papers, Theses and Dissertations, Marcel Dekker, 2002. 7. Reinhart, Susan M., Giving Academic Presentations, 2nd Edition, University of Michigan Press, 2013. 8. Oshima, Alice and Hogue, Ann, Writing Academic English, 4th Edition, Pearson Longman, 2006. 9. American Psychological Association. Publication Manual of the American Psychological Association, 6th Edition, American Psychological Association, 2010. 10. Szuchman, Lenore T., Writing with Style: APA Style Made Easy, 5th Edition, Wadsworth/Cengage Learning, 2011. 11. Statistics, simulation, programming, and relevant books. 12. ACM and IEEE magazines, Transactions and Journals. 13. Other International Journals. 14. Relevant conference proceedings and magazines (including ACM and IEEE conferences). 15. Technical reports from universities and major companies.	

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Subject Description Form

Please read the notes at the end of the table carefully before completing the form.

Subject Code	BME34145
Subject Title	AIDA for Health Care and Smart Ageing
Credit Value	3
Level	3
Pre-requisite	ENG2002 Computer Programming
Objectives	The objectives of this subject are to: (1) Introduce the concept of precision medicine in the hospital and community healthcare service models in ageing society (2) Equip the students with the fundamental knowledge of artificial intelligence techniques and machine learning algorithms in clinical applications (3) Master the clinical problem formulation and typical data analytic skills (4) Understand the trend of technical development in medical artificial intelligence (5) Appreciate the ethical and legal issues related to medical artificial intelligence
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: (a) Understand ideological and theoretical underpinning of precision medicine (b) Describe the emerging and increasing healthcare demands in an ageing society (c) Articulate the major technological approaches of articular intelligence and machine learning to transform current healthcare service model in both hospital and community setting (d) Apply basic articular intelligence techniques and machine learning algorithm to tackle the given medical problem
Subject Synopsis/ Indicative Syllabus *(Note 2)*	• Introduction and overview • The unmet needs in healthcare with global ageing • Fundamental knowledge and scientific perspectives of ageing and age-related pathologies • The concept of precision medicine with 4 "P" principle: predictive, preventive, personalized and participatory

	• The trend of artificial intelligence and data technology to transform current healthcare system • Artificial intelligence and data technology to address the health problems in both hospital and community settings including but not limited to following aspects: **AI and data technologies to transform the healthcare service in the future of hospital** • Introduction to Hospital Authority Data Sharing Portal • AI-enabled patients triage system and surgical planning • Big data analytics-based diagnostics and prognostics • Brain-machine interface, neural decoding, neuralink • Patients data privacy and security **AI and data technologies to promote healthy ageing in the community** • Health and wellness monitoring using wearable sensors, the design of intelligent home for the older adults, such as fall prevention and motion detection • Smart devices for food safety and balanced diet, e.g. to monitor salt and sugar intake, and natural extracts • Mental health promotion via robotics-assisted speech, facial and emotion recognition **Laboratory sessions with hand-on experience on dealing various types of clinical tabular, imaging and bio-signal datasets** • Tabular data retrieval and analysis • Compute vision for medical imaging (histopathology) • Advanced electrophysiology: practical session
Teaching/Learning Methodology *(Note 3)*	It is an advanced course for the engineering students, aiming to facilitate students to gain the basic AI knowledge and data analytic skills to tackle healthcare problems. In the lectures, experts' experiences in AI and data technology development and applications will be shared. The guided reading and self-study will be further extended students' knowledge in the respective areas. In preparing the guided group discussion in tutorials, students will actively participate in the laboratory session and obtain the first-hand experiences on the cutting-edge AI and data technologies. Students will critically evaluate themselves during the group discussion. The group discussion and students' preparatory work will facilitate their writing of the laboratory reports. In the student group presentation, they will present the basic principles and findings from the lectures, self-study and laboratory sessions. What they learn from the lectures and tutorials will also be reflected in this group discussion and sharing, self-study, and student presentation.

Assessment Methods in Alignment with Intended Learning Outcomes

(Note 4)

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b	c	d		
1. Quiz	30%	✓	✓	✓			
2. Group presentation	30%	✓	✓	✓	✓		
3. Lab reports	30%			✓	✓		
4. In-class activities	10%	✓	✓	✓	✓		
Total	100 %						

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:
The basic knowledge and understanding of AIDA in healthcare will be examined in in-class MCQs, quiz, and also group presentation. The knowledge application will be tested in in-class discussion, group presentation and laboratory report.

Student Study Effort Expected

Class contact:	
▪ Lectures	30 Hrs.
▪ Laboratory	9 Hrs.
Other student study effort:	
▪ Reading assignments	39 Hrs.
▪ Open education resources	9 Hrs
▪ Group project	39 Hrs.
Total student study effort	126 Hrs.

Reading List and References

Textbooks:

- Artificial intelligence in medical imaging: opportunities, applications and risks; Erik R Ranschaert (editor), Sergey Morozov (editor), P. R. Algra (editor); Cham, Switzerland: Springer; 2019
- Medical imaging: artificial intelligence, image recognition, and machine learning techniques; K. C. Santosh (editor); Boca Raton, FL: CRC Press; 2020

Form AR 140

The Hong Kong Polytechnic University

Subject Description Form

Please read the notes at the end of the table carefully before completing the form.

Subject Code	BME44144
Subject Title	AIDA for Biosignal Processing and Medical Imaging
Credit Value	3
Level	4
Pre-requisite	BME31116 Biosignal Processing
Objectives	To equip students with basic knowledge and opportunities as well as risk of AIDA techniques for biosignal processing and medical imaging, and supply with examples in various application scenes. Thus, the students are capable of using AIDA as an essential tool in biosignal and medical imaging processing and analysis.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: (a) Understand the potentials and fundamentals of artificial intelligence and big data techniques in biosignal processing and medical imaging (b) Design AIDA systems, components and processes to meet given specifications and constraints in biosignal processing and medical imaging (c) Identify, formulate and solve problems relevant to AIDA in biosignal processing and medical imaging (d) Use modern IT tools appropriate to AIDA practice in biosignal processing and medical imaging (e) Understand the quality, regulatory, and ethical issues related to the use of AIDA in biosignal processing and medical imaging
Subject Synopsis/ Indicative Syllabus *(Note 2)*	• Landscape changes and opportunities: introduction of artificial intelligence and big data techniques for biomedical signal and imaging processing • Characterization of biomedical signals: feature engineering and extraction • Supervised and unsupervised learning • Neural networks: understanding and applications • Basic principles of deep learning and machine learning in imaging • Deep learning and machine learning applications with ECG and EEG signals • Data/image preparation for deep learning and machine learning; quality and curation of medical images and data; the value of structured reporting and enterprise imaging platform

- Imaging biomarkers, imaging biobanks, and radiomics
- Applications beyond image interpretation, such as for cardiovascular disease, breast cancer screening, and evaluation of neurological diseases, etc.
- Potentials, advantages, challenges, and risks of AIDA in biomedical signal and image processing

Teaching/Learning Methodology

(Note 3)

Students will learn the fundamentals and principles in lectures; Sufficient laboratory and tutorial hours will be provided; Practice projects/assignments will be adopted to assess the students' learning outcomes.

Assessment Methods in Alignment with Intended Learning Outcomes

(Note 4)

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b	c	d	e	
1. In-class quiz	10%	√					
2. Assignments (×2)	30%	√	√	√	√		
3. Labs (×2)	30%	√	√	√	√	√	
4. Final project (×1)	30%	√	√	√	√	√	
Total	100 %						

Note: To pass this subject, students must obtain grade D or above.

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

- The in-class quiz (multiple times in lectures and tutorials) is used to encourage the engagement of the students, and to assess the degree of the understanding the fundamentals of AIDA.
- Assignments and the final project are used to assess the degree that the students understand the knowledge and ability to apply the knowledge to solve problems and practice.
- The lab sessions are focused on testing the student on how much they gain practical experience and apply knowledge in practice.

Student Study Effort Expected

Class contact:	
▪ Lectures	10 Hrs.
▪ Tutorials	20 Hrs.
▪ Labs	9 Hrs.
Other student study effort:	
▪ Assignments, lab report, and final project	48 Hrs.
▪ Self-study	39 Hrs.

	Total student study effort	126 Hrs.
Reading List and References	- Walid Zgallai (editor), Biomedical Signal Processing and Artificial Intelligence in Healthcare, Academic Press (2020), https://doi.org/10.1016/C2018-0-04775-1 - Erik R. Ranschaert, Sergey Morozov, and Paul R. Algra, Artificial Intelligence in Medical Imaging： Opportunities, Applications and Risks, Springer (2019), https://doi.org/10.1007/978-3-319-94878-2	

Note 1: Intended Learning Outcomes
Intended learning outcomes should state what students should be able to do or attain upon subject completion. Subject outcomes are expected to contribute to the attainment of the overall programme outcomes.

Note 2: Subject Synopsis/Indicative Syllabus
The syllabus should adequately address the intended learning outcomes. At the same time, overcrowding of the syllabus should be avoided.

Note 3: Teaching/Learning Methodology
This section should include a brief description of the teaching and learning methods to be employed to facilitate learning, and a justification of how the methods are aligned with the intended learning outcomes of the subject.

Note 4: Assessment Method
This section should include the assessment method(s) to be used and its relative weighting, and indicate which of the subject intended learning outcomes that each method is intended to assess. It should also provide a brief explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes.

(Form AR 140) 8.2020

Subject Description Form

Subject Code	BME44146
Subject Title	Integrated Capstone Project
Credit Value	6
Level	4
Pre-requisite / Co-requisite/ Exclusion	**Exclusion**: Any other equivalent capstone project **Pre-requisite/Co-requisite:** BME31147 Biomedical Engineering Innovation for the Community BME34145 AIDA for Health Care and Smart Ageing
Objectives	The objectives of this subject are to: • Provide a student with the opportunity to apply and integrate subject matters to which he/she has been previously exposed in the programme as well as the knowledge of artificial intelligence and data analytics (AIDA) to carry out an independent project on a topic relevant to Biomedical Engineering (BME). • Develop the capabilities of a student in analyzing and solving complex and possibly real-life problems using BME-related technologies as well as AIDA. • Train students with skills on systematic development and documentation of a significant piece of work.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) Understand the importance and principles of research in BME disciplines as well as related ethical issues; (b) Perform literature search, critique, review, and write a detailed and critical account of current knowledge of a selected topic within BME disciplines; and correctly acknowledge sources of information and avoid plagiarism; (c) Connect the materials and information obtained to a problem/research question that can be solved using BME technologies and AIDA; and define and specify the problem/question precisely. (d) Integrate the subjects learned including AIDA to plan engineering design work including budget, resources, milestones, deliverables, and timeline; (e) Reflect the ability to apply the knowledge learned before including those related to AIDA to the independent study; (f) Understand the principles of statistics and perform appropriate statistical analysis of data gathered during the progress of the project; (g) Write a report to present and discuss the results to the team of project supervisors and to their own fellow students; (h) Deliver an oral presentation of the project and to provide appropriate answers to the questions.

Subject Synopsis/ Indicative Syllabus

The project can be a topic either on design or on research. Possible project areas include:

- Bioinstrumentation
- Biomaterials
- Biomechanics
- Prosthetics and Orthotics
- Rehabilitation Engineering / Assistive Technology
- Other BME relevant topics

Teaching/Learning Methodology

- **Lectures** – Principles in general research methodology, statistics and proposal writing will be taught.
- **Tutorial & Independent Project Study** – Student can work on a single project or team up with other students to form a group. Each student in the group will be working on a related project area but with different objective(s) / foci. Each student will be guided by a project supervisor who would meet with the student on a weekly basis. The project supervisor will monitor the progress of the student, point out relevant references and resources to the student, and if necessary, assist the student to focus and keep him/her on track. The methods that each student may employ to complete his/her project would of course vary from project to project. It could be empirical data collection, involving physical experiments or interviews with some forms of questionnaires. It could also be some form of theoretical analysis or design some clinical evaluation devices and even construction of prototypes.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)							
		a	b	c	d	e	f	g	h
Progress	10%	√	√	√	√	√	√		
Written proposal/report	45%	√	√	√	√	√	√	√	
Oral presentation	45%	√	√	√	√	√	√		√
Total	100%								

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The students will be assessed on their general understanding of the subject matter and the background literature, the clarity of their objectives, the appropriateness of the methodology, the validity of the data collected, and the relevance of the conclusions to their data; or for a design project, the innovativeness, practicality as well as the cost-effectiveness of the design. Assessments will also be made on the process of project execution (interim and final) in both the written reports and the oral presentations.

Student Study Effort Expected

Class contact:	
• Lecture	13 Hrs.

	• Tutorial	26 Hrs.
	• Data collection and data analysis	117 Hrs.
	Other student study effort:	
	• Literature review and report writing	78 Hrs.
	Total student study effort	234 Hrs.
Reading List and References	• King PH and Fries RC, *Design of Biomedical Devices and Systems*, CRC Press, 2009. • Dieter G, *Engineering Design: A Materials and Processing Approach*, 3rd ed., McGraw-Hill, 2000. • Otto K and Wood K, *Product Design*, Prentice Hall, 2001. • Fries RC, *Handbook of Medical Device Design*, Marcel Dekker, 2001. • Sanders MM and McCormick EJ, *Human Factors in Engineering and Design*, 7th ed., McGraw-Hill, 1993. • Salvendy G, *Handbook of Human Factors and Ergonomics*, 3rd ed., John Wiley & Sons, 2006. • Portney LG and Watkins MP, *Foundations of Clinical Research: Applications to Practice*, 3rd ed., Pearson/Prentice Hall, 2009. • Polgar S and Thomas SA, *Introduction to Research in the Health Sciences*, 5th ed., Elsevier, 2008. • Norman GR and Streiner DL, *Biostatistics: The Bare Essentials*, 3rd ed., B. C. Decker, 2008. • Beauchamp TL and Childress JF, *Principles of Biomedical Ethics*, 6th ed., Oxford University Press, 2009. • Day RA and Gastel B, *How to Write and Publish a Scientific Paper*, 6th ed., Greenwood Press, 2006. • Motulsky H, *Intuitive Biostatistics*, Oxford University Press, 1995. • Wong KL, *Methods in Research and Development of Biomedical Devices*, World Scientific, 2013. • Journal papers from the BME discipline.	

Subject Description Form

Subject Code	BRE 368
Subject Title	AI and Data Analytics for Smart Construction
Credit Value	3
Level	3
Pre-requisite /Co-requisite/ Exclusion	Nil
Objectives	This subject is intended to: 1. Equip students with the ability of using data analytics and machine learning in building engineering and management. 2. Enable the students appreciate the mathematical basis and the applications of the main models and methods used in the analysis of problems in the built environment. 3. Provide students an understanding of data-driven or AI-supportive building development and optimized operation of efficient building systems as a part of the integrated system of building fabric, building space, occupants, building services and controls. 4. Introduce applications of various digital construction technologies that can benefit from AI and DA, including robotic technologies, Modular Integrated Construction (MIC), and Building Information Modelling (BIM) in building design, construction, maintenances and operations.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Apply data analytics and AI tools to building and construction data. b. Apply mathematical modelling tools to analyse problems in the built environment. c. Understand the data-driven decision making process for practical construction engineering and management issues. d. Evaluate appropriateness of digital technologies in building construction, maintenance and operations.

Subject Synopsis/ Indicative Syllabus

This multi-faceted subject encompasses technologies in building construction, maintenance and operations. Combined with tools from big data analytics, AI, robotics and BIM, the subject enables better strategic decisions for designers, building managers and property owners to consider the building in the context of smartness and future needs.

1. Introduction to AI and DA applications in construction
    - Importance of big data in construction
    - Theoretical background of AI and DA
    - Concept of data-driven decision making and problem solving
    - Advanced technologies for field data collection and analysis
    - Examples of AI and DA applications in construction
    - Required knowledge and skill sets

2. Machine learning theory and tools
    - Introduction to machine learning
    - Supervised and unsupervised learning
    - Mathematical models for machine learning e.g., regression, classification, clustering etc.
    - Machine learning tools e.g., MATLAB machine learning tool box, Weka

3. AI and DA applications with construction data
    - Data mining and data analytics for construction management
    - Sensor data analysis for construction safety and health
        - Motion data analysis for unsafe behaviour identification
        - Physiological data analysis for physical and mental fatigue assessment
    - Video analytics
        - Construction activity recognition based on computer vision
        - Construction worker behaviour analysis based on computer vision
        - Construction component defects identification based on computer vision
    - 3D point cloud analysis
        - Object localization, detection, and identification based on 3D point clouds

4. Applications of digital construction technologies
    - Robotic technologies for various construction operations (e.g., plastering, rebar installation, curtain wall installation, cleaning and air quality control etc.)
    - Sensing technologies
    - Modular Integrated Construction (MIC)
    - Building Information Modelling (BIM)

Teaching/Learning Methodology

The concept, theory and applications of AI and DA in construction will be delivered through lectures. Tutorials will provide hands-on exercises on AI and DA tools to learn how to apply these tools with given data. Through a group project, students will explore the use of AI and DA tools for practical problem solving in construction. Students will be also required to study online learning materials.

Online learning materials:

- MATLAB Onramp (about 2hrs): https://www.mathworks.com/learn/tutorials/matlab-onramp.html
- WEKA Tutorials: https://www.tutorialspoint.com/weka/index.htm

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b	c	d		
1. Individual Assignments (Tutorials)	20	√	√	√	√		
2. Focus Study Report (Group project)	30	√	√	√	√		
3. Written Examination	50	√	√	√	√		
Total	100%						

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Coursework and examination will each constitute 50% of the overall assessment for the subject. The coursework mark will be based on the individual assignments and one group project (i.e., a focus study on AI and DA applications in construction practice).

The examination will be based on a 2 hours examination gearing towards the materials covered in the lecture periods and background readings. Coursework by assignment and group projects will be set to assess the students' abilities and skills required in this subject.

Student Study Effort Required

Class contact:	
• Lecture	26 Hrs.
• Tutorial	13 Hrs.
•	
Other student study effort:	
• Self-study, assignments, e-learning	40 Hrs.
• Group projects	40 Hrs.
Total student study effort	119 Hrs.

Reading List and References	Recommended: • Rafael Sacks, Chuck Eastman, Ghang Lee, Paul Teicholz (2018) BIM Handbook: A Guide to Building Information Modeling for Owners, Designers, Engineers, Contractors, and Facility Managers, 3rd Edition. Wiley. • Zacharias Voulgaris and Yunus Emrah Bulut (2018) AI for Data Science: Artificial Intelligence Frameworks and Functionality for Deep Learning, Optimization, and Beyond First Edition, Technics Publications • Bock, T., & Linner, T. (2016). Construction Robots Elementary Technologies and Single-Task Construction Robots. In Construction Robots: Elementary Technologies and Single-Task Construction Robots (p. I). Cambridge: Cambridge University Press. • Wang, D., Dai, F., & Ning, X. (2015). Risk Assessment of Work-Related Musculoskeletal Disorders in Construction: State-of-the-Art Review. *Journal of Construction Engineering and Management*, *141*(6), 04015008. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000979 • Hou, L., Wu, S., Zhang, G. (Kevin), Tan, Y., & Wang, X. (2020). Literature Review of Digital Twins Applications in Construction Workforce Safety. *Applied Sciences*, *11*(1), 339. https://doi.org/10.3390/app11010339 • Guo, B. H. W., Zou, Y., Fang, Y., Goh, Y. M., & Zou, P. X. W. (2021). Computer vision technologies for safety science and management in construction: A critical review and future research directions. *Safety Science*, *135*, 105130. https://doi.org/10.1016/j.ssci.2020.105130 • Wang, Q., & Kim, M.-K. (2019). Applications of 3D point cloud data in the construction industry: A fifteen-year review from 2004 to 2018. *Advanced Engineering Informatics*, *39*, 306–319. https://doi.org/10.1016/j.aei.2019.02.007 • Fan, H. and Li, H. (2012). "Retrieving similar cases for alternative dispute resolution in construction accidents using text mining techniques ". Automation in Construction, Elsevier, Vol. 34, pp.85-91 (2013). • Fan, H., Xue, F. and Li H. (2015). Project-based As-needed Information Retrieval from Unstructured AEC Documents, ASCE Journal of management in Engineering, January 2015, Vol. 31, No. 1. • Shen, L., Yan, H., Fan, H., Wu, Y., & Zhang, Y. (2017). An integrated system of text mining technique and case-based reasoning (TM-CBR) for supporting green building design. Building and Environment, 124, 388-401. • Yan, H., Yang, N., Peng, Y., & Ren, Y. (2020). Data mining in the construction industry: Present status, opportunities, and future trends. Automation in Construction, 119, 103331. • https://www.coursera.org/learn/machine-learning/home/welcome • https://www.mathworks.com/solutions.html?s_tid=gn_sol

Subject Description Form

Subject Code	BRE472
Subject Title	Information Technology and Building Information Modelling for Construction Management
Credit Value	3
Level	4
Pre-requisite / Co-requisite/ Exclusion	Nil
Objectives	This subject is intended to develop an understanding of the practical application of computer systems and packages in building life cycle process and the application of building information modelling (BIM) in construction.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. understand and demonstrate knowledge of building life cycle process. b. understand and demonstrate knowledge of the application of computer systems, BIM, Artificial Intelligence (AI), and Big Data analytics in various procurement stages of a building project. c. appraise commercially available and tailor-made computer packages and BIM application in building life cycle process.
Subject Synopsis/ Indicative Syllabus	The process of building life cycle. Identifying the benefits of construction IT/ BIM applications. Understanding core values of BIM, and its applicability in construction practice. The appraisal of IT/BIM systems in design, cost planning, procuring, project management and facility management. Understanding the fundamental theories behind AI and Big Data analytics, and existing tools. Exploring the use of AI and Big Data analytics in various construction applications. Exploring the extended use of BIM by combining it with AI and Big Data analytics.

Teaching/Learning Methodology

Lectures and tutorials will be run throughout the semester period. A lecture schedule outlining the topics to be covered will be distributed to students in the first lecture of the semester. During the tutorials, students will be required to assess and use various IT/BIM tools (e.g., Revit, Navisworks, AI/Big Data analytics packages) and to prepare group assignments.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b	c			
1. Individual Assignments (Tutorials)	20%	√	√	√			
2. Focus Study Report (Group project)	30%	√	√	√			
2. Examination	50%	√	√	√			
Total	100%						

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Coursework and examination will each constitute 50% of the overall assessment for the subject. The coursework mark will be based on the individual assignments and one group project (i.e., a focus study on potential applications of IT systems, BIM, AI, and Big Data analytics to solve existing practical problems during the life cycle of the building projects).

The examination will be based on a 2 hours examination gearing towards the materials covered in the lecture periods and background readings. Coursework by assignment and group projects will be set to assess the students’ abilities and skills required in this subject.

Student Study Effort Expected

Class contact:	
▪ Lectures	26 Hrs.
▪ Tutorials / Laboratory sessions	13 Hrs.
Other student study effort:	
▪ Self learning and recommended reading	90 Hrs.
Total student study effort	129 Hrs.

Reading List and References	ASCE Journal of Computing in Civil Engineering (http://*www.asce.org).* *Automation in Construction*. An International Research Journal. (http://*www.elsevier.com/locate/autocon).* Bryde, D., Broquetas, M. and Volm, J.M. (2013). *The Project Benefits of Building Information Modelling (BIM),* International Journal of Project Management, Volume 31, Number 7, pp. 971-980. Construction Industry Council (2014/15), Roadmap / Standard for Building Information Modelling in Hong Kong's Construction Industry. Eastman, C., Eastman, C.M., Teicholz, P., Sacks, R. and Liston, K. (2011). BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors, John Wiley & Sons. Electronic Journal of Information Technology in Construction (http://*www.itcon.org).* Azhar, S. (2011). Building information modeling (BIM): Trends, benefits, risks, and challenges for the AEC industry. Leadership and management in engineering, 11(3), 241-252. Gu, N., & London, K. (2010). Understanding and facilitating BIM adoption in the AEC industry. Automation in construction, 19(8), 988-999. Darko, A., Chan, A. P., Adabre, M. A., Edwards, D. J., Hosseini, M. R., & Ameyaw, E. E. (2020). Artificial intelligence in the AEC industry: Scientometric analysis and visualization of research activities. Automation in Construction, 112, 103081. Bilal, M., Oyedele, L. O., Qadir, J., Munir, K., Ajayi, S. O., Akinade, O. O., ... & Pasha, M. (2016). Big Data in the construction industry: A review of present status, opportunities, and future trends. Advanced engineering informatics, 30(3), 500-521.

Subject Description Form

Subject Code	BRE4661
Subject Title	Integrated Capstone Project
Credit Value	6
Level	4
Pre-requisite / Co-requisite / Exclusion	Pre-requisite: BRE366 (Analytical Skills and Methods) Exclusion: Any other equivalent capstone project, e.g. BRE466 (Capstone Project)
Objectives	The primary aim of the Integrated Capstone Project is to provide students with the opportunity of demonstrating research competence by providing them with a vehicle through which they can reveal a full understanding and evaluation of an issue or a topic that they choose to investigate. The Project is in the form of a final year Dissertation, and the issue or the topic should be based on the chosen programme major (i.e. Building Engineering and Management), together with the Artificial Intelligence and Data Analytics (AIDA) scheme as their Secondary Major, relevant to the construction industry with particular concerns to Hong Kong and its neighbouring environments. The specific objectives of this subject are to: • provide a student with the opportunity to apply and integrate the knowledge of artificial intelligence and data analytics (AIDA) to his/her chosen discipline of Building Engineering and Management; • develop the capabilities of a student in analyzing and solving complex and possibly real-life problems using AIDA knowledge and skills; and • Train students with skills on systematic development and documentation of a significant piece of work. The study might include an extensive literature review; the discovery, development or enhancement of a research model; the development of a measurement instrument, such as a questionnaire; or the comparison of statistical models for the evaluation of existing data. Where appropriate, students might join a departmental research group with AIDA expertise where they would be able to assist staff by working in a particular field of study.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: Generally a) display a culminating set of personal, academic and professional experiences/ learning; b) synthesize, integrate and/or apply previous knowledge instead of solely acquiring new knowledge/skills; c) apply general education principles; and d) engage in an interdisciplinary inquiry of at least two or more disciplines; Specifically through academic / professional knowledge and skills

	e) produce a research proposal related to a topic in the field of Building Engineering and Management with the identified problems to be solved using AIDA knowledge and skills; f) apply an appropriate research methodology to the chosen topic; g) conduct a critical and comprehensive literature review; h) identify specific problems, analyse data via AIDA knowledge and skills, evaluate findings and provide solutions via AIDA analytical results; i) communicate their ideas in a clear, concise and precise manner; and j) produce a study report that is based on their research and written in good English.
Subject Synopsis/ Indicative Syllabus	For those students choosing the Building Engineering and Management (BEM) programme as their Major and also opting for AIDA scheme as their Secondary Major, they are expected to identify a project topic in the field of Building Engineering and Management with the identified problems to be solved using AIDA knowledge and skills under the supervision of a supervisor with research expertise in artificial intelligence and data analytics. The topic should be engineering-oriented or engineering related area in construction. The Capstone Projects are grouped into a number of study areas within the research themes of the Department such as construction technology and science, production engineering, production and contract management, engineering economics, construction quality in engineering works, application of information or digital technology in the building industry, engineering materials, etc. Occasionally, if a student proposes a topic which is not within the context of engineering orientation, consideration and prior approval need to be sought from the BEM Programme Management Team. Students need to demonstrate their knowledge in both their chosen discipline (BEM) and AIDA in the project, receiving advice from the allocated supervisors. The project should represent requisite efforts in analysing and interpreting the data/information obtained, using the principles and techniques learned from various related subjects. Students are also expected to demonstrate significant analytical and, preferably, research ability in the chosen application domain of AIDA.
Teaching/Learning Methodology	Academic leadership is provided by the Departmental Capstone Project Committee comprising the BRE Undergraduate Scheme Chair and all the Programme Capstone Project Co-ordinators. The Committee is assisted by the supervisors who are BRE academic staff with research experience. The Integrated Capstone Project spans across the final year of study for two consecutive semesters (i.e. first semester and second semester). The teaching/learning activities include regular project meetings with the supervisors, guided study of project materials, independent project development work and other project management tasks. Each student will work under the guidance of a supervisor. The project supervision is timetabled for one hour per two weeks over the whole project study period, but students are expected to devote about a day per week of their own time to carry out study and research work. Students are encouraged to formulate a testable hypothesis with theoretical model or justifications; carry out an empirical test on the hypothesis; and draw inference(s) on research and practical implications from the findings.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (please tick as appropriate)									
		a	b	c	d	e	f	g	h	i	j
1. Final Proposal	15 %	✓	✓			✓	✓	✓			
2. Progress and Effort Report	15 %		✓				✓	✓	✓		
3. Final Report	70 %			✓	✓		✓	✓	✓	✓	✓
Total	100 %										

Explanation of the appropriateness of the assessment methods in assessing the intended subject learning outcomes:

Integrated Capstone Project should be problem-oriented and there are no restrictions on the nature of the problem except that it should be relevant to the student's chosen discipline (BEM) and AIDA. The project could be practical, academic or a hybrid in which the student is encouraged but not constrained to have some original contributions. Each student has to submit a Final Proposal, a Progress and Effort Report and a Final Report. The Final Proposal must be approved by the supervisor before the student can proceed with the Integrated Capstone Project. A mid-term progress and effort report may also be required for proper continuous assessment.

The assessment of each of the three tasks (Final Proposal, Progress and Effort Report, and Final Report) will be made based on the established "Assessment Rubrics" that will be adopted and approved by the Capstone Project Committee. The "Assessment Rubrics" will be made available for reference by both students and supervisors on the Dissertation Guide mounted up to the blackboard subject website. The main assessment criteria are underlined below for reference.

Final Proposal

The Final Proposal should include a problem statement, a preliminary literature review, the study's research aim and objectives, an outline of the research methodology, means of data analysis, a reference list, and an outline schedule of work.

(1) Problem Statement: A concise and precise explanation of the problem that the research intends to address and an outline of the scope of study. This in effect provides the purpose of the study.

(2) Literature Review: A summary of the relevant theories, research evidence, and descriptive materials bearing on the proposed research, including all information, published or otherwise, that aids in understanding and helps to explain the background to the research.

(3) Research Aim and Objectives: Linking of the problem statement and literature review should be made through a precise statement of a research aim and a number of specific objectives. If a testable question (hypothesis) is to be used then this should be clearly stated. This section is a critical part of the research proposal because the aim and objectives need to be consistent with the purpose of the study.

(4) Research Methodology: A statement describing the research design and data collection techniques must be provided. The description must be sufficiently detailed to permit an understanding of the proposed study without discussion with the student. If a questionnaire survey is to be conducted, a provisional questionnaire should be included. Sources of data and sampling technique should be identified along with any restrictions on confidentially and possible problems in data collection. The time required for phases of the study should be specified.

(5) Data Analysis: The way in which the data will be analyzed, including any statistical analysis, should be outlined. If a non-standard form of data analysis is to be used, justification should be given. If computer programs are to be used, they should be identified.

(6) Reference and Bibliographic List: All works cited in the text of the Proposal must be listed under a section entitled References at the end of the Proposal immediately before the appendices. References are necessary in order to provide the reader with adequate information for locating cited materials. Students are recommended to use the **Harvard referencing system**, details of which can be found on websites such as: "https://elc.polyu.edu.hk/Referencing/harvard.aspx". Alternatively, students can refer to the Student Handbook for other referencing systems, provided that consistency is adhered to.

(7) Outline Schedule of Work: Students should include an outline programme in the form of a bar chart showing how they intend to perform the major activities and various tasks in order to meet the key milestone date requirements from inception to completion of their dissertation research, taking into account such intervening disruptions as examinations, study tours and public holidays.

Progress and Effort Report

During the progress of the research, the student and Supervisor will meet for consultation. It is the responsibility of students to arrange meetings with their supervisors in order that they may report and discuss their progress. It is expected that students devote sufficient time to the capstone project bearing in mind the requirements outlined in the subject description form.

Discussions with Supervisors are essential to explore the challenges faced by the student as they learn about the research topic through the whole research process. Thus, students are required to produce evidence of their work at their meetings with their Supervisors, so that the problems encountered can be shared and solved together.

Assessment Proforma for "Final Proposal and Progress Report" (weighted 30% towards the overall grade)

Assessment Components	Assessment Criteria	Weightings
Final Proposal	Adequacy, structure, clarity, originality, length	15%
Progress Report	Consultations, diligence, enthusiasm, planning of work, progress management	15%
	Total	**30%**

Final Report

The Final Report should not normally exceed 10,000 words and is expected to include the following items: a declaration, an abstract, an introduction, research aim and objectives, literature review, research methodology, data collection, data analysis, and conclusions.

For the purpose of criterion-based assessment, the assessment of the completed Final Report is divided into six main elements, i.e. overall presentation, research aim and objectives, research methodology, literature review, data collection and analysis, conclusions and findings, with their corresponding weightings.

(1) Declaration: Each student shall print the statement identical to the one shown on Form BREDF4 (Completion Statement) on a fresh page, sign and incorporate in the submitted dissertation report as the first inside page.

(2) Abstract: A brief summary (200-400 words) of the research, normally including the main research objectives, the problems studied and the relevant theories, the methods of enquiry, and the most important results.

(3) Introduction: A description of the problems, along with detailed coverage of the theories and published research related to the research. This section often includes the reasons why the research merits study.

(4) Research Aim and Objectives: A re-statement of the research aim and objectives in the Final Dissertation Proposal (may be included in the Introduction).

(5) Literature Review: The literature search should be fully described showing the keywords and scientific databases used. A strong emphasis should be placed on refereed journal papers which can provide evidence of existing knowledge of the selected topic, obtained through scientific methods. The review should not only describe relevant theories, previous research, and descriptive material that have a bearing on the study, but also evaluate its worth. Evidence of independent analysis of the available literature should also be demonstrated. A basis for the chosen research topic should be established.

(6) Research Methodology: A clear statement of the planned research methods, as well as reporting of any ways in which the original methodology was modified as a result of constraints imposed in actually conducting the research. Some writers included this in the Introduction.

(7) Data Collection: This section should provide a clear and objective picture of the way in which the data was collected, including identification of any problems encountered and an explanation of the outcomes obtained. The data should be summarized and presented in an appropriate form, such as tables and diagrams, and not be evaluated or interpreted. Although some writers include analysis of the data in this section, others prefer to cover it separately.

(8) Data Analysis: This section should include the analysis and interpretation of the results of the research. The discussion should explain the degree to which the research objectives were achieved, the possible reasons for non-attainment of some research objectives, the ways in which the theories did or did not help to examine the problems, and an evaluation of the research results. In many reports, this section is the most important and often the longest in terms of words.

(9) Conclusions: The conclusions or outcomes of the study should be presented in this section. Included should be the major results that the study has achieved,

identification of unanswered questions and directions for further study, speculation about the importance of the findings to the body of knowledge in the construction and real estate fields and any other related items that the student wishes to emphasize.

(10) Reference and Bibliographic Lists: The Reference list should include full details of all publications cited in the Dissertation Report (see Item 4.6 for details), whereas the Bibliographic list (optional) contains details of all publications that have been used in the preparation.

(11) Appendices: The appendices should include copies of survey questionnaires, lengthy tables, graphs and lists not considered appropriate for inclusion within the main body of the Dissertation Report. Students should see the completed Dissertation Report as a holistic piece of scholarly work. The focus of the study topic should be clearly shown in the title, and throughout each chapter. The student should try to show the linkage between the various stages of the research process. Thus there should be 'signposting' throughout the written contents to explain how the chapters each contribute to the research objectives. For example, the literature review should link to the research objectives; the research objectives should link to the research methods; the research methods to the data analysis and explanation of the results; the results to the interpretation and discussion of implications; and finally to the conclusions.

Assessment Proforma for "Final Report" (weighted 70% towards the overall grade)

Assessment Items	Assessment Criteria	Weightings
Overall Presentation	Syntax, clarity, conciseness, preciseness, structure, aesthetics, graphics, length	10%
Research Aim and Objectives	Appropriateness and accomplishment of stated aim and objectives, accuracy of application	5%
Literature Review	Relevant parameters, adequate depth and breadth, accuracy, citations and references	15%
Research Methodology	Appropriateness, achievability, planning of research design, comprehensiveness, description	15%
Data Collection and Analysis	Relevancy, accuracy, adequacy, coherence of data analysis, logicality of interpretation	15%
Conclusions and Findings	Validity, logicality, substantiveness, originality, degree of critique, new ideas or models	10%
	Total	**70%**

Student Study Effort Required	Class contact:	
	▪ Guided study	10 Hrs.
	Other student study effort:	
	▪ Independent study	260 Hrs.
	Total student study effort	270 Hrs.
Reading List and References	**Essential:** Department of Building and Real Estate of PolyU. *Dissertation Guide.* (continuously updated). **Recommended (General Research Methods and Skills):** Bell, J. (1993). *Doing Your Research Project*, Open University Press. Blaikie, N. (2000). *Designing Social Research: The Logic of Anticipation*. Cambridge: Polity. Booth, W.C., Colomb, G.G. and Williams, J.M. (2003). *The Craft of Research*, 2nd ed. Chicago: The University of Chicago Press. Chau, K.W., Raftery, J. and Walker, A. (1998). The baby and the bathwater: Research methods in construction management. *Construction Management and Economics*, *16*(1), 99-104. Fellows, R.F. and Liu, A.M.M. (2015). *Research Methods for Construction*, 4th edition, Blackwell Science. Harris, R. and Cundell, I. (1995). Changing the property mindset by making research relevant. *Journal of Property Research*, *12*, 75-78. Holt, G. (1998). *A Guide to Successful Dissertation Study for Students of the Built Environment*, 2nd edition. The Built Environment Research Unit, University of Wolverhampton, England. Hussey, J. and Hussey, R. (2003). *Business Research: A Practical Guide for Undergraduate and Postgraduate Students*, 2nd edition, Basingstoke: Palgrave Macmillian, England. Kennedy, P. (2003). *A Guide to Econometrics*, 5th edition, USA: Blackwell Publishing. Knight, A. and Ruddock, L. (2008). *Advanced Research Methods in the Built Environment.* Chichester: Wiley-Blackwell. Kumar, R. (1996). *Research Methodology: A Step-by-Step Guide for Beginners*. Addison Wesley Longman. Levitt, R.E. (2007). CEM research for the next 50 years: Maximizing economic, environmental, and societal value of the built environment. *Journal of Construction Engineering and Management*, *133*(9), 619-28.	

Levin, R.I. and Rubin, D.S. (1998). *Statistics for Management*, 7th edition, PrenticeHall.

Lizieri, C. (1995). Comment: Relevant research and quality research: The researcher's role in the property market. *Journal of Property Research*, *12*, 163-166.

Lucey, T. (1992). *Quantitative Techniques, ELBS.*

Mason, J. (2002). *Qualitative Researching*. London: Sage.

Naoum, S.G. (1999). *Dissertation Research and Writing for Construction Students*, Butterworth-Heinemann.

Pindyck, R.S. and Rubinfeld, D.L. (1998). *Econometric Models and Economic Forecasts, 4th Edition*, Boston: McGraw-Hill International Editions.

Raftery, J., McGeorge, D. and Walters, M. (1997). Breaking up methodological monopolies: A multiparadigm approach to construction management research. *Construction Management and Economics*, *15*(3), 291-297.

Render, B. and Stair, R.M. Jr (2000). *Quantitative Analysis for Management, 7th Edition*. Prentice Hall, New Jersey.

Tan, W. (2002). *Practical Research Methods*. Pearson Education Asia Pte Ltd., Singapore.

Recommended (Artificial Intelligence and Data Analytics / AIDA):

Bock, T. and Linner, T. (2016). Construction Robots Elementary Technologies and Single-Task Construction Robots. In *Construction Robots: Elementary Technologies and Single-Task Construction Robots* (p. I). Cambridge: Cambridge University Press.

Darko, A., Chan, A.P.C., Adabre, M.A., Edwards, D.J., Hosseini, M.R. and Ameyaw, E.E. (2020). Artificial intelligence in the AEC industry: Scientometric analysis and visualization of research activities. *Automation in Construction*, *112*, 103081.

Fan, H. and Li, H. (2013). Retrieving similar cases for alternative dispute resolution in construction accidents using text mining techniques. *Automation in Construction*, *34*, 85-91.

Fan, H., Xue, F. and Li H. (2015). Project-based as-needed information retrieval from unstructured AEC documents. *Journal of Management in Engineering*, January, *31*(1).

Guo, B.H.W., Zou, Y., Fang, Y., Goh, Y.M. and Zou, P.X.W. (2021). Computer vision technologies for safety science and management in construction: A critical review and future research directions. *Safety Science*, *135*, 105130. https://doi.org/10.1016/j.ssci.2020.105130

Hou, L., Wu, S., Zhang, G. (Kevin), Tan, Y. and Wang, X. (2020). Literature review of digital twins applications in construction workforce safety. *Applied Sciences*, *11*(1), 339. https://doi.org/10.3390/app11010339

Rafael Sacks, Chuck Eastman, Ghang Lee and Paul Teicholz (2018). *BIM Handbook: A Guide to Building Information Modeling for Owners, Designers, Engineers, Contractors, and Facility Managers*, 3rd Edition. Wiley.

	Shen, L., Yan, H., Fan, H., Wu, Y. and Zhang, Y. (2017). An integrated system of text mining technique and case-based reasoning (TM-CBR) for supporting green building design. *Building and Environment*, *124*, 388-401. Wang, D., Dai, F. and Ning, X. (2015). Risk assessment of work-related musculoskeletal disorders in construction: State-of-the-art review. *Journal of Construction Engineering and Management*, *141*(6), 04015008. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000979 Wang, Q. and Kim, M.K. (2019). Applications of 3D point cloud data in the construction industry: A fifteen-year review from 2004 to 2018. *Advanced Engineering Informatics*, *39*, 306-319. https://doi.org/10.1016/j.aei.2019.02.007 Yan, H., Yang, N., Peng, Y. and Ren, Y. (2020). Data mining in the construction industry: Present status, opportunities, and future trends. *Automation in Construction*, *119*, 103331. Zacharias, Voulgaris and Yunus, Emrah Bulut (2018). AI for Data Science: Artificial Intelligence Frameworks and Functionality for Deep Learning, Optimization, and Beyond. First Edition, Technics Publications. Machine Learning: https://www.coursera.org/learn/machine-learning/home/welcome MathWorks: https://www.mathworks.com/solutions.html?s_tid=gn_sol

Subject Description Form

Subject Code	**BSE458**
Subject Title	**Building Performance Diagnosis and Management**
Credit Value	3
Level	4
Pre-requisite Co-requisite Exclusion	BSE3514 Engineering Management and Decision Making in Construction (Before 2022 cohort) or BSE3515 Construction Management for Building Sciences and Engineering (Effective from 2022/23) Nil Nil
Objectives	1. To appreciate that the design of buildings and building services systems need to take full account of user (occupant, operator) and operational requirements. 2. To examine how systems and equipment may not be compatible with the operating environment. 3. To learn from the operation and maintenance practices in existing buildings through reviews and surveys to understand why buildings and/or systems fail to deliver on performance. 4. To examine how design, installation, commissioning and performance diagnosis practices impact on building performance. 5. To identify good practices for use in the design of building services systems for new buildings, and retrofit and management of existing building services systems.
Intended Learning Outcomes	Upon completion of the subject, students will be: a) able to set design aims, objectives and criteria for the design of building services systems; b) able to foresee future operation and maintenance problems and prepare solutions for these problems; c) able to set aims, objectives and criteria for building services system operation, diagnosis, maintenance and management; and d) able to solicit support for system operation and performance management.
Subject Synopsis/ Indicative Syllabus	**Purpose of a building in use**: purpose of development, building as a long term investment, concept of continuous engineering of building services systems, concept of operational systems, ease of inspection and testing. **Design for operations and flexibility**: integration of building services systems with building fabric and structure, internal layout, space utilisation, access for maintenance, change of usage, strategic response to malfunctions and disasters. **Reliability of facilities**: safety systems, failure modes and effects, availability, reliability, maintainability, back up and standby strategy. **Operation and maintenance**: information and database for building services systems, computerized data recording and mining, vendor support, operation and maintenance contracts, inventory control, maintenance strategy, contingency and disasters management. **Commissioning and retrofit**: statutory requirements on facilities in use, energy/carbon audits, retro-commissioning, renovation, rehabilitation and modernization. **Performance assessment and benchmarking**: condition monitoring, performance assessment tools and methods, types and principles of benchmarking, systematic evaluations.
Teaching/Learning Methodology	Delivery of the subject entails a combination of lectures, seminars, tutorials and mini-projects: • Lectures cover introduction of the key subject elements and explanation of the relevant concepts, principles, cases and examples. • Seminars involve in-class discussions over questions which are purposely set based on the contents of some selected reading materials. • Tutorials allow students to raise any questions they may have in relation to any areas of the subject. • Mini-projects require students to demonstrate their ability of applying knowledge to accomplish tasks or tackle problems of the given projects.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b	c	d		
Project	20		✓	✓	✓		
Test	20	✓	✓	✓			
End-of-semester examination	60	✓	✓	✓	✓		
Total	100						

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Based on examination (60%), test (20%) and project work (20%).

Student Study Effort Expected

Class contact:	
▪ Lectures	27 Hrs.
▪ Seminars	6 Hrs.
▪ Tutorials	4 Hrs.
▪ In class assessment	2 Hrs.
Other student study effort:	
▪ Self study	81 Hrs.
Total student study effort	120 Hrs.

Reading List and References

Hensen, J.L.M. and Lamberts, R., Building performance simulation for design and operation, Abingdon: Spon Press.

Dhillon, B.S., Maintainability, maintenance and reliability for engineers. Taylor & Francis.

Duffuaa, S.O., Raouf, A. and Campbell, J.D., Planning and Control of Maintenance Systems: Modelling and Analysis, John Wiley & Sons.

Williams, B., An introduction to benchmarking facilities & justifying the investment in facilities, Building Economics Bureau Ltd.

Seaman, A., Condition Based Maintenance – An evaluation guide for building services, Application Guide AG 5/2001, BSRIA.

CIBSE Guide M: Maintenance Engineering and Management, The Chartered Institution of Building Services Engineers.

Preiser,W. and Vischer, J., Assessing Building Performance, Routledge.

The Hong Kong Polytechnic University

Subject Description Form

Please read the notes at the end of the table carefully before completing the form.

Subject Code	BSE3610
Subject Title	Computational Methods in Building Sciences and Engineering
Credit Value	3
Level	3
Pre-requisite **Co-requisite** **Exclusion**	Nil Nil Nil
Objectives	(1) Introduce students to the common mathematical idealisations used in building sciences and engineering, usually in the form of linear and non-linear ODEs, PDEs, Integral and Integro-differential equations; (2) Introduction to numerical solution methods based on discretisation of continua using finite difference and finite element methods (FDM/FEM); (3) Introduction to the solution of homogenous and non-homogenous linear systems arising from FDM/FEM discretisations. (4) Introduction to MATLAB for solving problems in building sciences and engineering using native MATLAB capabilities and by programming user functions and algorithms. This will provide students with the requisite computing knowledge to support their study in later stage, e.g., project work and elective subjects in the final year.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: a) apply mathematical reasoning to analyze essential features of different problems in building sciences and engineering; b) extend their knowledge of mathematical and numerical techniques and adapt known solutions to different situations in building sciences and engineering; c) analyze and model application problems using computational methods and fundamental knowledge in building sciences and engineering; d) write computational code using Matlab for solving problems in application and explain the computation results based on fundamental knowledge in building sciences and engineering.
Subject Synopsis/ Indicative Syllabus *(Note 2)*	The syllabus will be organised in four sections of equal weighting as follows: *Taxonomy of mathematical models in Building Sciences and Engineeering* Introduction to the idea of mathematical and computational modelling based on governing equations (ODEs/PDEs etc.); sub-models such as constitutive equations; and finally assumptions and constraints, such as initial and boundary conditions. Introduction to methods of solution including analytical methods and their limitations and how they can be overcome by numerical and computational approaches such the finite difference method and the finite element method.

Mathematical Equations of Building Sciences and Engineering

This subject introduces students to the fundamental theory of computational approaches used to as a general tool for numerically solving elliptic, parabolic and hyperbolic differential equations for a wide range of building sciences and engineering problems. Field problems described by the Laplace, Poisson equations are presented first and including analytical and computational approaches to solve them in the context of heat and mass transfer problems. Time dependent problems and time integraton schemes are presented in the context of transient heat transfer and solution of Fourier Equations. Wave equation is then introduced in the context of acoustics and electromagnetism. Incompressible flow problems are introduced through Euler and Navier-Stokes equations. BSE applications will include: acoustics and vibration; HVACR; indoor environment quality modelling and simulation including propagation of pollutants and pathogens; lighting and electrical sciences and ; and fire sciences and .

Finite Difference Method (FDM) and the Finite Element Method (FEM)

Theory and application of FDM and FEM based discretisation to selected mathematical representations of Building Sciences and Engineering problems introduced in the second section. Introduction to Strong and weak formulations of a problem and discretisation using FDM and variational and weighted residual approaches used in FEM. Methods for solving discretised linear systems; Solutions of non-linear equations; Newton-Raphson methods;

Matlab programming

Introduction to Matlab; Realization of computational methods introduced using Matlab; Visualization of computation results in Matlab; Computational code creation using Matlab; Applications.

Teaching/Learning Methodology

(Note 3)

Lectures –13sessions of 2-hour lecture are provided. Lectures are to introduce the basic concepts and associated theories.

Tutorials – 13 sessions of 1-hour tutorial help students solve difficult exercises in which the students cannot solve by themselves. Students are encouraged to prepare and complete the tutorial exercises at home. It helps enhance their learning outcomes.

Assignment – Provide opportunities to test students' understanding (formative & judgmental).

Assessment Methods in Alignment with Intended Learning Outcomes

(Note 4)

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b	c	d		
1. Class quizzes/tests	20%	✓	✓	✓	✓		
2. MATLAB Projects	30%	✓	✓	✓	✓		
3. Examination	50%	✓	✓	✓	✓		
Total	100 %						

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Quizzes and tests (week 4 to 7) – Facilitator can have a better understanding of

	individual student / students' weaknesses or strength so that remedial actions can be taken timely. MATLAB Projects (week 8 to 12) – Introductory and advanced programming projects with increasing level of difficulty based on taught and computing tutorial classes will be set to ensure students develop sufficient confidence in using MATLAB for computational work. Examination – Held at the end of the unit with questions aligned with the intended subject learning outcomes.	
Student Study Effort Expected	Class contact:	
	▪ Lectures	26 Hrs.
	▪ Tutorials and Computing Lab	13 Hrs.
	Other student study effort:	
	▪ Tutorial exercises and MATLAB Projects	28 Hrs.
	▪ Self-study and revision	50 Hrs.
	Total student study effort	117 Hrs.
Reading List and References	References: Kreyszig, E. — Advanced Engineering Mathematics — John Wiley 2011 Germund Dahlquist and Åke Björk — Numerical Methods in Scientific Computing, Volumes I and II — SIAM 2007 E. G. Thompson. — Introduction to the Finite Element Method - Theory, Programming and Applications — John Wiley and Sons, 2004 Palm, W.J. — Introduction to MATLAB for engineers, 3rd edition — McGraw Hill, 2011	

Subject Description Form

Subject Code	**BSE4510**
Subject Title	**Building Automation and Control**
Credit Value	3
Level	4
Pre-requisite Co-requisite Exclusion	(BSE2122 Electrical Technology and BSE3225 HVACR I (Before 2022 cohort)) or (BSE2124 Electrical Engineering Fundamentals and BSE3227 Heating, Ventilation, Air Conditioning and Refrigeration I (Effective from 2022/23)) Nil Nil
Objectives	The Building Automation (BA) system is an essential system of smart buildings. Dynamic performance and control of building services systems are important for the systems to meet the design objectives. This subject provides students with an opportunity to understand the principles and application of Building Automation system and building process control, so that they can explore the relevant knowledge and applications of the Building Automation system and the control of building services systems in smart buildings. Lecture and student-centred learning, such as seminar, laboratory tests, etc., are used allowing the student to be explored on the following issues: • The network of building automation (BA) and intelligent building (IB) systems, and the configuration of BA and IB systems. • Interfacing BA system with building services systems. • The dynamic performance of building processes/systems, control fundamentals and building process control. • Control strategies for better energy efficiency and building environmental performance.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a) undertake architectural design and specify the requirements for building automation systems and intelligent building technologies taking into account successful integration and flexibility to meet future demands; b) assess the impact of using different architectures, LAN protocols/standards in BA system design and selection; c) design and analyze the control of typical and non-typical building processes and manage the stability and tuning issues of process control; d) specify supervisory control and management strategies and assess their impact on indoor environmental quality, energy efficiency and reliability of systems and equipment; and e) integrate and apply in-depth understand of the integration/interface of building automation systems with building services systems and integration between different intelligent building systems.
Subject Synopsis/ Indicative Syllabus	Concepts and features of intelligent building: definitions and features of IB; building purpose; functions, flexibility and adaptability, building automation (BA), communication automation (CA) and office automation (OA). **Digital control stations**: binary data, microcomputer, data acquisition, input and output units, processor operation and software, sensor and actuator **LAN and BA network**: LAN and WAN, network architectures, LAN protocols, transceiver, medium interface, LAN interface, signal encoding and decoding, Lontalk, Ethernet, BA communication standards. **System dynamics and feedback control**: dynamic system, transfer function of linear systems, block diagram of dynamic system, open-loop and closed-lop controls, characteristics of feedback control systems, stability of feedback control systems, stability theory of linear feedback control systems.

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PID control: proportional control, integral control and derivative control, tuning of PID loops, open loop test method, closed loop test method, digital PID and direct digital control (DDC).

Local and supervisory control: tuning of local control loops and adaptive control; cascade and sequential control, compensation and sequencing control; on-line temperature and static pressure set-point reset, demand-controlled ventilation and economiser control, chilled water temperature reset, optimal control of heat rejection system, peak demand limiting and demand response control.

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<td>Teaching/Learning Methodology</td>
<td>Text books, published journal articles, physical and computer simulation test facilities, etc. are used to explore students to the planning, design, operation and problems of building automation systems, as well as the control and operational performance and problems of building services systems. Students will undertake small projects on relevant topics and practise the online operation and control of building services system in lab besides lectures and tutorials. They will also conduct case studies on real building automation and intelligent building systems and equipment to understand the configuration, architecture, operation and management, interfacing with building services systems, and to identify problem areas and possible solutions.</td>
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<tr>
<td>Assessment Methods in Alignment with Intended Learning Outcomes</td>
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<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="6">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td></td></tr>
<tr><td>Coursework</td><td>40</td><td></td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td>End-of-semester examination</td><td>60</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>Total</td><td>100</td><td colspan="6"></td></tr>
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Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The coursework consists of one in-class test, seminar presentation and report. Students are required to undertake small projects on relevant topics. They need to present their findings in the projects in a seminar and submit one report. The in-class test is usually held in the middle of the semester.

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<td>Student Study Effort Expected</td>
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<tr><td>Class contact:</td><td></td></tr>
<tr><td>▪ Lectures</td><td>20 Hrs.</td></tr>
<tr><td>▪ Seminar</td><td>4 Hrs.</td></tr>
<tr><td>▪ Tutorial</td><td>10 Hrs</td></tr>
<tr><td>▪ In-class test</td><td>2 Hrs</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Self study</td><td>40-55 Hrs.</td></tr>
<tr><td>▪ Preparation for seminar, laboratory report, etc.</td><td>44 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>120-135 Hrs.</td></tr>
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<tr>
<td>Reading List and References</td>
<td>

Wang S.W., Intelligent Buildings and Building Automation, Taylor & Francis (UK), 2009

ASHRAE, ASHRAE Handbook – HVAC Applications 2019.

Boed V., Networking and Integration of Facilities Automation Systems, CRC Press, 2000.

CIBSE Guide H – Building Control Systems, 2009.

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Form AR 140

The Hong Kong Polytechnic University

Subject Description Form

Subject Code	BSE4610
Subject Title	Building Informatics
Credit Value	3
Level	4
Pre-requisite/ **Co-requisite/** **Exclusion**	BSE1610, BSE2610, BSE3227 Nil Nil
Objectives	This subject aims to 1. introduce the transition of the building industry in the pervasive big data and AI era, with the focus on how big data and AI technologies fundamentally change building operations; 2. introduce typical techniques and technologies of building informatics; 3. equip students with basic data analytics skills for smart buildings; and 4. enable students to address energy, environment and safety issues in smart buildings by adopting the interdisciplinary approach
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: a. understand the technical foundations of building informatics; b. be familiar with typical applications of IoT and AI technologies in buildings; c. possess basic skills and experiences on using machine learning algorithms to analysing building data; d. apply the insights discovered from building data to improve building energy efficiency, built environment quality and building safety; and e. be able to communicate and work with IT and AI professionals to address the challenges facing buildings.
Subject Synopsis/ Indicative Syllabus *(Note 2)*	1. IoT for smart buildings: sensors, network, protocols 2. Application of IoT in building environment and safety monitoring; 3. Conventional data-driven methods: modelling, optimization, fault diagnosis 4. Big building data: data sources, format, characteristics, data pre-processing 5. Machine learning: clustering, regression and prediction 6. Application of machine learning in building data analytics 7. Smart building management: energy, environment and safety.
Teaching/Learning Methodology *(Note 3)*	Lectures teach students on the main concepts, methods and applications of building informatics, together with rich examples. Tutorials provide the opportunity for students to review and consolidate the lecture and reference materials through problem solving exercises.

Assessment Methods in Alignment with Intended Learning Outcomes

(Note 4)

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b	c	d	e	
1. Written assignment	15%	✓	✓			✓	
2. min-project	20%	✓		✓	✓	✓	
3. Seminar presentation	15%	✓	✓			✓	
4. final examination	50%	✓	✓	✓	✓	✓	
Total	100 %						

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Written assignment helps students to develop a good understanding of IoT technologies and their applications in smart buildings.
Mini-projects gives students the opportunity to gain hand-on experiences on using data analytics to solve practical problems.
Seminar presentation assesses students' oral communication ability with IT and data science professions regarding applications in smart buildings.

Student Study Effort Expected

Class contact:	
▪ Lecture	20 Hrs.
▪ Tutorials/Mimi-projects/presentations	19 Hrs.
Other student study effort:	
▪ Preparation of assignments, mini-project and presentation	41 Hrs.
▪ Self-study	40 Hrs.
Total student study effort	120 Hrs.

Reading List and References

1. Ron Bakker, Smart Buildings: Technology and the Design of the Built Environment, Routledge (Taylor & Francis Group), 2019.
2. James Sinopoli, Advanced Technology for Smart Buildings, Artech House, 2016.
3. Wang S.W., Intelligent Buildings and Building Automation, Spon Press (Taylor & Francis Group), London and New York, Nov. 2009
4. McGowan, John J., Energy and Analytics: Big Data & Building Technology Integration, The Fairmont Press, Inc., 2015.

	5. K. Hwang and M. Chen, Big Data Analytics for Cloud, IoT and Cognitive Computing, John Wiley Publisher, U. K., 2017. 6. Zhou, Zhi-hua. Machine Learning, Springer Singapore, 2021.

Subject Description Form

Subject Code	BSE4728
Subject Title	Integrated Capstone Project
Credit Value	6
Level	4
Pre-requisite / Co-requisite/ Exclusion	**Pre-requisite:** BSE3716 Research Methods in Building Sciences and Engineering Any 4 of the below subjects BSE3124 Electricity and Buildings BSE3125 Optics and Lighting BSE3227 Heating, Ventilation, Air Conditioning and Refrigeration I BSE3228 Heating, Ventilation, Air Conditioning and Refrigeration II BSE3313 Hydraulic Systems BSE3322 Fire Safety Systems **Exclusion**: Any other equivalent capstone project
Objectives	Research project is undertaken by students with the aim of developing the skills and abilities to undertake, independently, a major piece of investigation in a specialist subject area in building sciences and engineering. The objectives are to: • provide a student with the opportunity to apply and integrate the previous and current academic studies of artificial intelligence and data analytics (AIDA) to the discipline of building sciences and engineering. • develop the capabilities of a student in analyzing and solving complex and possibly real-life problems using various building sciences and engineering approaches with AIDA. • Train students with skills on systematic development and documentation of a significant piece of work.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: <u>Professional/academic knowledge and skills</u> (a) conduct literature surveys to locate materials and sources relevant to the selected problem area in building sciences and engineering; (b) understand the materials obtained and connect the materials with the problem to be solved using various building sciences and engineering knowledge and skills of AIDA; (c) define and specify the problem precisely; (d) assimilate and apply the learnt knowledge to generate good solutions to the problem; (e) think critically the formulation of alternative models and solutions to the problem, in the analysis of approaches to the solution and their implementation; and (f) evaluate the final outcome in an objective manner; <u>Attributes for all-roundedness</u> (g) communicate and present clearly and concisely the progress and outcome of the study via oral presentation; (h) enhance technical report writing skills with proper organization of materials; (i) develop the ability to learn independently and to find/integrate information from different sources required in solving building sciences and engineering real-life problems;

	(j) manage the project efficiently and effectively through the supervision of supervisor(s); and (k) work collaboratively with related parties (e.g. vendors, sponsor company, technical support staff, team-partners, research students, etc.); (l) demonstrate good time management for the project.
Subject Synopsis/ Indicative Syllabus	The tasks to be accomplished by the students in this subject include, but are not limited to below, Project Planning Focus a) based on the developed methodology, acquire the necessary skills and abilities for the execution of the project; b) make necessary arrangements for the research work; and c) conduct preliminary investigations. Project Execution Focus d) conduct investigation and data collection in a critical and professional manner; e) demonstrate the ability to critically evaluate information and data; f) communicating clearly and concisely the progress and final outcome of the study; and g) demonstrate good management of time and resources available for the project. Students are required to confirm facts, reaffirm the results of previous work, solve new or existing problems, or develop new theories based on substantial literature review, concise methodology of experiments, survey, literature review, simulations, AIDA in the following building sciences and engineering areas. The research outcome will make practical applications. • Acoustic and noise control • Building automation • Built environment • Electrical engineering • Energy saving for buildings • Facilities engineering and management • Fire and safety • Indoor environmental quality • Refrigeration • Renewable energy • Ventilation and air-conditioning • Water supply and drainage Students are expected to identify a project topic with a supervisor in building sciences and engineering, artificial intelligence and data analytics expertise. Students need to demonstrate their knowledge in building sciences and engineering and AIDA in the project, receiving advice from supervisor(s). The project should represent requisite effort in analysing and interpreting the data/information obtained, using the principles and techniques learnt from various related subjects. Students are also expected to demonstrate significant analytical and, preferably, research ability in the chosen application domain.
Teaching/Learning Methodology	The Integrated Capstone Project spans across the academic year for two consecutive semesters. The teaching/learning activities include regular project meetings with the supervisor and the co-supervisor, guided study of project materials, independent project development work and other project management tasks.

Project Planning
The student shall take account of available resources, site access, time, etc., when refining aims and objectives when determining a project plan. Students are expected to acquire the required abilities and skills for the project work.

Project Plan Refining
The student shall have taken account of available resources, site access, time, etc., when refining aims, objectives and project plan, where deemed necessary in the execution of the work.

Record of Meetings and Activities
A record of all activities is to be maintained by the student. It shall record time spent at meetings, on self-study, on site investigations, etc. The supervisor shall check the record periodically. It should be brought to all meetings, updated regularly and submitted with the Project File.

Intermediate Presentation
At the end of 1st Semester, an intermediate presentation takes place before a group of academic staff. Each student is required to give a presentation on his or her works done and to answer questions in front of an assessment panel. Assessment by each member of the group is rationalised to a single score.

Project Execution
- Students must obtain the approval of their supervisor before embarking on any site surveys or physical measurements. Relevant approval shall be obtained from governing bodies (e.g. human ethic, animal ethic, laboratory safety) for sensitive data. The methodology must be clearly defined and resources identified.
- Students must gain proper permission to enter sites for conducting surveys or measurements. Where the department initiates a project, the department will help arrange access.
- Where equipment is to be transferred for use on site, an Equipment Loan Form must be completed.
- Students must gain approval from the Department for survey questionnaires before they are issued.

Project File
Each student maintains a file containing all relevant information and data for the project:
- Record of meetings and activities, feedback from supervising staff, correspondence etc.
- Interim review, project proposal, project paper and comments from assessors.
- Copies of major references used (except copyright material).
- Project notes, site and survey data, summary of equipment, software, etc.
- Any site/system/equipment drawings, catalogues, etc.
- Site/laboratory measurement data.
- Summary of hours spent in meetings with supervising staff and clients, self-study, practical work, etc.

Files on Disk
All text, graphics and data files relevant to the project are submitted with the Project File. This includes the Paper. These will be electronically submitted via Blackboard in the end of the 2nd Semester and/or format deemed appropriate.

Dissertation
At the end of the 2nd Semester, it is required to submit a dissertation. The dissertation should cover the complete research work and to be written in a style suitable for reading by research professionals. The content of the dissertation should include an abstract, an

introduction, a literature review, the methods (survey/experiment/simulation), results/analysis and discussion, conclusions and any others deemed appropriate.
The introduction part should give the backgrounds and justification of the proposed investigations, supported with a literature review, and the aims and objectives of the project; the methods part shall present the methods used, such as site survey, laboratory experiments or computer simulation, and list the scopes of the work to be undertaken. The result part shall include findings and data analysis, such as a comparison with relevant standards, verification, application or rejection of a theory, model or guidance, identification of the cause of a problem, etc. In this part, table/graphs shall preferably be used. At the end of the report, conclusions should be given.

The format of the paper shall be:

- The body of the paper is a maximum of 40-60 pages A4. Single column text. Font size12 pt. Double-line spacing.
- The pages of text and diagrams /graphs can be mixed.
- Only references, which are clearly mentioned in the text, shall be listed. Full citation to be given.
- Figures, charts and tables, including all labels, to be clearly legible. Minimum font size 8 pt, e.g., Helvetica.
- Acknowledgements are to be included
- The paper shall include a disclaimer signed by the author declaring the originality of the work.
- The paper shall go through similarity check, e.g. by Turnitin, given a similarity index must not be more than 30%. The checking report shall be submitted together with the paper.

Final Presentation

At the end of the 2nd Semester, a final presentation takes place before a group of academic staff, and may include outsiders. Each student is allocated a presentation period for their findings and then followed with a question and answer session. Assessment by each member of the group is rationalised to a single score.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)											
		a	b	c	d	e	f	g	h	i	j	k	l
Report	10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Presentations	30	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dissertation	40	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Continuous Assessment	20	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Total	100												

The Integrated Capstone Project will be accessed by the supervisor/co-supervisor and other assessors. Attributes to be assessed by regular meetings for project development & execution with project file, presentations and dissertation.

Assessment Key

1st Semester

Sem. Week	Assessment Element	Assessors	Assessment Elements	Weighting
13	Progress Report	Supervisor	Solving research problem, Quantitative literacy, Analyzing data, Drawing conclusion, Grammar, spelling and presentation.	10%
13	Intermediate Presentation	Group of staff	Supporting material, Organization, Delivery, Subject knowledge	15%
1-13	Project Development with Project File	Supervisor	Problem solving skills, Critical thinking, Initiative	10%

<u>2nd Semester</u>

Sem. Week	Assessment Element	Assessors	Elements	Weighting
13	Dissertation	Group of staff	Solving research problem, Quantitative literacy, Analyzing data, Drawing conclusion, Grammar, spelling and presentation	40%
13	Presentation	Group of staff	Supporting material, Organization, Delivery, Subject knowledge	15%
1-13	Project Execution with Project File	Supervisor	Problem solving skills, Critical thinking, Initiative	10%

The marking scheme used by the assessors for various assessment elements are given in the assessment rubrics. The grades may be subject to overall review and rationalisation of grades between groups by the Research Project subject examiner.

The aggregate percentage will be converted to the appropriate subject grade.

Student Study Effort Expected

Class contact:

• Group/Individual meeting • Experiment/Site survey/Simulation	52 Hrs 26 Hrs

Other student study effort:

• Searching and reading materials, meeting with supervisor / co-supervisor / others, design and system development, testing, documentation, presentation, etc.	- 162 Hrs
Total student study effort	240 Hrs

Reading List and References

1. JK Jesson, L Matheson, FM Lacey 2011. Doing your literature review: traditional and systematic techniques. LA, Calif.: SAGE.
2. K Williamson, G Johanson, 2017. Research Methods–2nd Ed. Information, Systems, and Contexts. Chandos Publishing: ELSEVIER.

	3. Roberts, Carol M., *The Dissertation Journey: A Practical and Comprehensive Guide to Planning, Writing, and Defending Your Dissertation*, 3rd Edition, Corwin Press, 2007.

Subject Description Form

Subject Code	CBS3410
Subject Title	Python for Language Analytics
Credit Value	3
Level	3
Pre-requisite / Co-requisite/ Exclusion	CBS3947 Programming and Data Analysis for Language Studies
Objectives	This subject introduces Python programming techniques for language analytics. Students will learn about the basics of language data analytics, major text processing tasks (e.g. tokenization and segmentation, syntactic and semantic preprocessing), and more advanced techniques of natural language processing (e.g. feature engineering, text classification, text summarization, sentiment analysis, etc.). Students will also be familiarized with the Python environment and resources for natural language processing tasks.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: **Category A:** Professional/academic knowledge and skills a. Demonstrate a deep understanding of the basics of natural language processing and the main issues of text processing; b. Set up a Python environment for text processing tasks; c. Comprehend, compose, and adapt Python codes for text processing; d. Get familiar with Python resources for natural language processing; e. Develop an understanding of advanced techniques of natural language processing; and f. Conduct an analytic study of corpus data on an advanced issue of natural language processing **Category B**: Attributes for all-roundedness g. Develop skills of critical thinking, logical analysis and real-life problem solving.
Subject Synopsis/ Indicative Syllabus	1. Basics of natural language processing 2. Setting up Python for natural language processing 3. Text preprocessing a) Segmentation and tokenization b) Semantic preprocessing c) Syntactic preprocessing 4. Feature engineering 5. Text classification 6. Text summarization 7. Sentiment analysis

Teaching/Learning Methodology

The subject will be taught through a combination of lecturing and laboratory exercises. Lectures will introduce concepts, theories and existing technologies. Laboratory exercises are designed to provide hands-on experience of using and developing computer programs and scripts for linguistic data analysis.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed						
		a	b	c	d	e	f	g
1. Programming Assignments	60%	✓	✓	✓	✓			✓
2. Analytics project	30%	✓	✓	✓	✓	✓	✓	✓
3. Classroom participation and exercises	10%	✓	✓	✓	✓	✓	✓	
Total	100%							

The subject is assessed continuously through a series of programming assignments, a corpus project, an R exercise report, and classroom participation. Students are expected to attend all classes and finish all in-class laboratory exercises.

Student Study Effort Expected

Class contact:	
▪ Lectures	26Hrs.
▪ Laboratory seminars	13Hrs.
Other student study effort:	
▪ Self-access lab activities	30Hrs.
▪ Other private study	40Hrs.
Total student study effort	109Hrs.

Reading List and References

Bird, S., Klein, E., & Loper, E. (2009). *Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit*. O'Reilly.

Sarkar, D. (2019). T*ext Analytics with Python: A Practitioner's Guide to Natural Language Processing*. Apress.

Natural Language Toolkit. https://www.nltk.org/.

The Python Tutorial. https://docs.python.org/3/tutorial/.

Subject Description Form

Subject Code	CBS3947
Subject Title	Programming and Data Analysis for Language Studies
Credit Value	3
Level	3
Pre-requisite / Co-requisite/ Exclusion	Nil
Objectives	This subject introduces the use of programming and data analysis techniques in language studies. Students will learn about the fundamentals of text processing with open-source packages in Python and the general ideas of major NLP (natural language processing) tasks. Students will also be familiarized with the conceptualization and compilation of linguistic corpora, as well as the use of corpora in computational linguistics. Furthermore, the course will also introduce R (and RStudio) as tools of data analysis and visualization, with a special focus on the analysis and reporting of language data.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: **Category A:** Professional/academic knowledge and skills a. Get familiar with basic programming skills and the programming environment in Python; b. Get familiar with programming skills for text processing and the NLTK package in Python; c. Understand the concept of linguistic corpora and use linguistic corpora for finding out information about language usage; d. Design and create a linguistic corpus, and create computer programs to query linguistic corpora; e. Get familiar with basic skills in language data processing with R and RStudio; and f. Perform basic functions of data visualization and data reporting in R **Category B**: Attributes for all-roundedness g. Demonstrate a good understanding of language processing on computers; and h. Develop skills of critical thinking, logical analysis and real-life problem solving.
Subject Synopsis/ Indicative Syllabus	1. Basics of programming with Python 2. Text processing in Python and NLTK a) Developing scripts for tokenization, lemmatization, POS processing, etc. b) Developing scripts for calculating word frequency, collocation,

    and predictability from a corpus

3. Linguistic corpora
    a) History and definition of linguistic corpora
    b) Varieties of corpora and their applications
    c) Linguistic annotation
    d) Using corpora: word frequency, concordances and other usage
4. Linguistic data analysis using R and RStudio
    a) Quantitative analysis with linguistic data
    b) Visualization and report compilation
5. Advanced language-related computer technologies
    a) Speech recognition
    b) Machine translation
    c) Computer-assisted translation
    d) Computer-assisted language teaching and learning
    e) Other applications

Teaching/Learning Methodology

The subject will be taught through a combination of lecturing and laboratory exercises. Lectures will introduce concepts, theories and existing technologies. Laboratory exercises are designed to provide hands-on experience of using and developing computer programs and scripts for linguistic data analysis.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed							
		a	b	c	d	e	f	g	h
1. Programming Assignments	40%	✓	✓					✓	✓
2. Corpus project	30%			✓	✓			✓	✓
3. R exercise report	25%					✓	✓	✓	✓
4. Classroom participation and exercises	5%	✓	✓	✓	✓	✓	✓		
Total	100%								

The subject is assessed continuously through a series of programming assignments, a corpus project, an R exercise report, and classroom participation. Students are expected to attend all classes and finish all in-class laboratory exercises.

Student Study Effort Expected

Class contact:	
▪ Lectures	24Hrs.
▪ Laboratory seminars	15Hrs.

	Other student study effort:	
	▪ Self-access lab activities	27Hrs.
	▪ Other private study	39Hrs.
	Total student study effort	105Hrs.
Reading List and References	Baayen, H. R. (2008). Analyzing linguistic data: a practical introduction to statistics using R. Cambridge University Press. Johnson, K. (2011). *Quantitative methods in linguistics*. John Wiley & Sons. Kennedy, G. (1998). *An Introduction to Corpus Linguistics.* London: Longman. McEnery, T., Xiao, R. and Tono, Y. (2006). *Corpus-Based Language Studies: An advanced resource book.* Oxford: Routledge. Natural Language Toolkit. https://www.nltk.org/. The Python Tutorial. https://docs.python.org/3/tutorial/.	

[Syllabus revised by Dr YAO Yao]

Subject Description Form

Subject Code	CBS4702
Subject Title	Advanced Topics in Quantitative Language Studies
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	**Pre-requisite:** CBS3947 Programming and Data Analysis for Language Studies
Objectives	This subject will focus on the introduction of advanced topics in computational linguistics (such as word embeddings and distributional semantics, Transformer models, or dialogue systems), both from a theoretical and from an applicative perspective. The main objective is to familiarize students with the current advanced trends of research in Natural Language Processing, and to give them the analytical and practical skills to work on their own corpus data.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: **Category A: Professional/academic knowledge and skills** a) Acquire skills to build computational models from corpus data; b) Think critically about how to adapt the models to predictive tasks on linguistic data and how to evaluate them; **Category B: Attributes for all-roundedness** c) Develop critical thinking and problem-solving skills.

Subject Synopsis/ Indicative Syllabus	• Theoretical introduction
	• Working with code
	    • Python libraries
	    • Text pre-processing
	    • Algorithm testing
	    • Evaluation of vector space models
	• Applications to concrete Natural Language Processing tasks
	• Current research trends

<table>
<tr>
<td>Teaching/Learning Methodology</td>
<td>• Lectures
• Hands-on class activities and discussion
• Out-of-class work: carrying out projects and assignments using the techniques practiced in class</td>
</tr>
<tr>
<td>Assessment Methods in Alignment with Intended Learning Outcomes</td>
<td>
<table>
<tr><th rowspan="2">Specific assessment methods/tasks</th><th rowspan="2">% weighting</th><th>a</th><th>b</th><th>c</th></tr>
<tr><th></th><th></th><th></th></tr>
<tr><td>1. In-class exercises</td><td>30%</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>2. Take-home tests</td><td>30%</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>3. Project</td><td>40%</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Total</td><td>100 %</td><td></td><td></td><td></td></tr>
</table>
Student will have to pass an in-class assignment and a take-home test. In addition, they will complete a small independent project in which they analyse a specific linguistic problem using the framework discussed in class.
</td>
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<tr>
<td>Student Study Effort Expected</td>
<td>
<table>
<tr><td>Class contact:</td><td></td></tr>
<tr><td>▪ Lectures</td><td>39 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Reading and other pre-class preparation (including worksheets)</td><td>46 Hrs.</td></tr>
<tr><td>▪ Projects</td><td>20 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>105 Hrs.</td></tr>
</table>
</td>
</tr>
<tr>
<td>Reading List and References</td>
<td>Books:

Bird, Steven and Klein, Ewan and Loper, Edward. 2009. Natural Language Processing with Python. O'Reilly.

Pilehvar, Mohammad Taher and Camacho-Collados, Jose, 2020. Embeddings in Natural Language Processing: Theory and Advances in Vector Representations of Meaning. In <i>Synthesis Lectures in Natural Language Processing Series,</i> Morgan & Claypool.</td>
</tr>
</table>

Subject Description Form

Subject Code	CBS4703
Subject Title	Social Media and Social Network Analysis
Credit Value	3
Level	4
Pre-requisite / Co-requisite/ Exclusion	Nil
Objectives	Social Network Analysis (SNA) is a field of data analytics that centers around relations between individuals, organizations, and society using networks and graph theory. Social media sites, such as Facebook and Instagram, use core elements of SNA to identify and recommend potential pages and profiles to follow. This subject aims to provide students with an overview of theoretical and methodological literature in the field of SNA with special reference to social media. Students will also gain hands-on experience with collecting network data from social media, and with constructing their own social network graphs using computer tools.
Intended Learning Outcomes	On successfully completing the subject, students will be able to: a. Demonstrate a good understanding of the theoretical and the methodological foundations of SNA b. Recognize different types of network data, and describe how they can be collected from social media c. Conduct basic analyses of social network data using different analytical tools d. Apply core concepts of SNA to theoretical and methodological research issues
Subject Synopsis/ Indicative Syllabus	1. Fundamentals of Social Network Analysis 2. Network Structure 3. Network Data Collection 4. Node Centrality 5. Community Detection 6. Network Visualization 7. Social Media Mining 8. Case Studies: Facebook and Instagram
Teaching/Learning Methodology	The mode of learning will consist of lectures, seminars, and lab activities. This will include discussions of readings from both textbooks and research papers related to specific aspects of SNA and social media.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed			
		a	b	c	d
1. Quiz	20%	✓	✓		
2. Assignment 1	20%	✓	✓	✓	
3. Assignment 2	20%	✓	✓	✓	
4. Project	40%	✓	✓	✓	✓
Total	100%				

There will be an in-class quiz, two take-home assignments, and a final project. The quiz is to assess students' understanding of the theoretical and methodological concepts. The two assignments will allow students to apply the concepts and techniques introduced in class to solve various problems. The final project will require students to construct their own social network graph including project design, data collection, implementation, and data analysis.

Student Study Effort Expected

Class contact:	
▪ Lectures	26 Hrs.
▪ Seminars/Laboratory Activities	13 Hrs.
Other student study effort:	
▪ Reading and studying	78 Hrs.
Total student study effort	117 Hrs.

Reading List and References

Recommended Reading

Scott, J. (2017). *Social Network Analysis*. Los Angeles: SAGE. 4th edition.

Newman, M.E.J. (2012). *Networks: An Introduction*. UK: Oxford University Press.

Aggarwal, Charu C. (Ed.) (2011). *Network Data Analytics*. Springer.

Wasserman, S., and K. Faust. (1994). *Social Network Analysis: Methods and Applications*. Cambridge University Press.

Bibliography

Bastian, M, S. Heymann, and M. Jacomy. (2009). Gephi: An Open Source Software for Exploring and Manipulating Networks. *ICWSM.*

Butts, C.T. (2008). Social Network Analysis: A Methodological Introduction. *Asian Journal of Social Psychology*, 11: 13–41.

Butts, C. T. (2009). Revisiting the foundations of network analysis. *Science*, 325(5939): 414.

Easley, D. and J. Kleinberg. (2010). *Networks, Crowds and Markets: Reasoning about a highly connected world*. Cambridge University Press.

	Faust, K. (2007). Very Local Structure in Social Networks. *Sociological Methodology*, 37:209–256. Kolaczyk, E. and G. Csardi. (2014). *Statistical Analysis of Network Data with R (UseR!)*. Springer. Moody, J. and D. R. White (2003). Structural Cohesion and Embeddedness: A Hierarchical Conception of Social Groups. *American Sociological Review*, 68:103– 127. Steen, M. van. (2010). *Graph Theory and Complex Networks. An Introduction*. Amsterdam. Tsvetovat, M. and A. Kouznetsov. (2011). *Social Network Analysis for Startups*. O'Reilly Media. Zafarani, R., M. A. Abbasi, H. Liu. (2014). *Social Media Mining: An Introduction*. Cambridge University Press.

Subject Description Form

Subject Code	CBS4704
Subject Title	Workshop on Language Analytics
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	**Pre-requisite:** CBS4958 Fundamental of Computational Linguistics
Objectives	This subject aims to achieve the following goals: • To allow the students to develop computational skills by investigating possible solutions to NLP problems and by practicing on real-world datasets • To introduce the students to a "shared task" setting, where they have to organize their work in a group, develop a NLP system and prepare a demo for the rest of the class
Intended Learning Outcomes	Upon completion of the subject, students will be able to: **Category A: Professional/academic knowledge and skills** (a) Familiarize with NLP literature and NLP resources to find possible solutions to a computational problem; (b) Working in a structured way on a project using NLP tools; **Category B: Attributes for all-roundedness** (c) Problem solving using systematic ways and group working.
Subject Synopsis/ Indicative Syllabus	• Introduction and overview of the tasks • Seminars for literature discussion • Project presentation
Teaching/Learning Methodology	The workshop will include three types of activities: • lectures/tutorials, in which the teacher will introduce the tasks to the students • research seminars prepared by the students • discussion of the projects, where the students prepare a demo of

the system that they developed and present it to the rest of the class

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed		
		a	b	c
1. Research Seminars	30%	✓		✓
2. Group Project	70%		✓	✓
Total	100 %			

All the above assessment methods are appropriate for evaluating students’ understanding of course materials, their programming and problem-solving skills. The group project will be used to assess the students’ capacity to work in a coordinated way within a team, which is an essential requirement for working on Natural Language Processing applications in the industry.

Student Study Effort Expected

Class contact:	
▪ Lecture	13 Hrs.
▪ Tutorial/Lab	26 Hrs.
Other student study effort:	
▪ Group work on the project	45 Hrs.
▪ Research Seminars	25 Hrs.
Total student study effort	109 Hrs.

Reading List and References

Text Book:

Steven Bird, Ewan Klein, Edward Loper, Natural Language Processing with Python, O’Reilly, 2009.

Subject Description Form

Subject Code	CBS4705
Subject Title	Integrated Capstone Project
Credit Value	6
Level	4
Pre-requisite / Co-requisite/ Exclusion	**Exclusion**: Any other equivalent capstone project
Objectives	The objectives of this subject are to: • provide a student with the opportunity to apply and integrate the knowledge of artificial intelligence and data analytics (AIDA) to language data analysis. • develop the capabilities of a student in analyzing and solving complex and possibly real-life problems using AIDA and language processing techniques. • Train students with skills on systematic development and documentation of a significant piece of work.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: Professional/academic knowledge and skills (a) conduct literature surveys to locate materials and sources relevant to the selected problem area in a specific discipline; (b) understand the materials obtained and connect the materials with the problem to be solved using AIDA knowledge and skills and language processing techniques; (c) define and specify the problem precisely; (d) assimilate and apply the learnt knowledge to generate good solutions to the problem; (e) think critically the formulation of alternative models and solutions to the problem, in the analysis of approaches to the solution and their implementation; and (f) evaluate the final outcome in an objective manner; Attributes for all-roundedness (g) improve presentation and communication skills via oral presentation; (h) enhance technical report writing skills with proper organization of materials; (i) develop the ability to learn independently and to find/integrate information from different sources required in solving real-life problems; (j) manage the project efficiently and effectively through the supervision of supervisor(s); and (k) work collaboratively with related parties (e.g. vendors, sponsor company, technical support staff, team-partners, research students, etc.).
Subject Synopsis/ Indicative Syllabus	**1. In-depth Study of a Topic Typically Proposed by the Supervisor** **2. Project Meeting and Planning** **3. Proposal Writing** **4. Regular Progress Checking and Reporting** **5. Project Documentation** **6. Presentation and Demonstration** Students are expected to identify a project topic with a supervisor in their chosen discipline, and a co-supervisor with artificial intelligence and data analytics expertise. Students need to demonstrate their knowledge in both language data analysis and AIDA

in the project, receiving advice from both supervisors. The project should represent requisite effort in analysing and interpreting the data/information obtained, using the principles and techniques learnt from various related subjects. Students are also expected to demonstrate significant analytical and, preferably, research ability in the chosen application domain.

Teaching/Learning Methodology

The Integrated Capstone Project spans across the academic year for two consecutive semesters. The teaching/learning activities include regular project meetings with the supervisor and the co-supervisor, guided study of project materials, independent project development work and other project management tasks.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)										
		a	b	c	d	e	f	g	h	i	j	k
Continuous Assessment	100	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Total	100											

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The Integrated Capstone Project will be accessed by the supervisor/co-supervisor and other assessors. Attributes to be assessed include, but not limited to, Problem Identification, Problem Solving, Communication and Presentation, Project Management, and Self-Discipline.

Integrated Capstone Projects should be problem-oriented and there are no restrictions on the nature of the problem except that it should be relevant to the student's chosen area in language data analysis and AIDA. The project could be practical, academic or a hybrid in which the student is encouraged but not constrained to have some original contributions. Each student has to submit a proposal, a mid-term checkpoint progress report and a final report. The proposal must be approved by the supervisor/co-supervisor before the student can proceed with the Integrated Capstone Project. An oral presentation and demonstration is essential at the end of the project. A mid-term presentation and demonstration may also be required for proper continuous assessment.

Student Study Effort Expected

Class contact:	
• Lecture	0 Hrs.
Other student study effort:	
• Searching and reading materials, meeting with supervisor / co-supervisor / others, design and system development, testing, documentation, presentation, etc.	210 Hrs.
Total student study effort	210 Hrs.

Reading List and References	**Reference Books:** 1. Kumar, Ranjit, *Research Methodology: A Step-by-step Guide for Beginners*, 3rd Edition, SAGE Publications, 2011. 2. Burns, Robert B., *Introduction to Research Methods*, 4th Edition, SAGE Publications, 2000. 3. Roberts, Carol M., *The Dissertation Journey: A Practical and Comprehensive Guide to Planning, Writing, and Defending Your Dissertation*, 3rd Edition, Corwin Press, 2007. 4. Mauch, James E. and Park, Namgi, *Guide to the Successful Thesis and Dissertation: A Handbook for Students and Faculty*, 5th Edition, Marcel Dekker, 2003. 5. Rudestam, Kjell Erik and Newton, Rae R., *Surviving Your Dissertation: A Comprehensive Guide to Content and Process*, 2nd Edition, Sage Publications, 2001. 6. Garson, G. David, *Guide to Writing Empirical Papers, Theses and Dissertations*, Marcel Dekker, 2002. 7. Reinhart, Susan M., *Giving Academic Presentations*, 2nd Edition, University of Michigan Press, 2013. 8. Oshima, Alice and Hogue, Ann, *Writing Academic English*, 4th Edition, Pearson Longman, 2006. 9. American Psychological Association. *Publication Manual of the American Psychological Association*, 6th Edition, American Psychological Association, 2010. 10. Szuchman, Lenore T., *Writing with Style: APA Style Made Easy*, 5th Edition, Wadsworth/Cengage Learning, 2011. 11. Statistics, simulation, programming, and relevant books. 12. ACM and IEEE magazines, Transactions and Journals. 13. Other International Journals. 14. Relevant conference proceedings and magazines (including ACM and IEEE conferences). 15. Technical reports from universities and major companies. 16. Guidelines for projects on language data analytics [available on Blackboard and departmental websites]. 17. Readings for individual projects suggested by the supervisor.

Subject Description Form

Subject Code	CBS4844
Subject Title	Machine Aided Translation
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	This subject aims to help students acquire fundamental knowledge and useful skills in the application of computer tools and resources for Chinese, English and multilingual translation. In addition to computer assisted human translation, students will also learn to take advantage of automatic computer translation by effective editing of source and target texts. More attention is given to advanced translation technology rather than elementary and general-purpose computer skills.
Intended Learning Outcomes	Upon completion of the subject, students will: a. understand the important concepts of computer-aided translation and automatic machine translation; b. be able to effectively use computer tools and resources to support human translation; c. be able to make good use of machine translation through pre-editing and post-editing; d. be able to create simple software tools or resources to support Chinese and English translation; e. have the basic ability to perform research in computer assisted translation.
Subject Synopsis/ Indicative Syllabus	1. Introduction to computer-aided translation 2. Automatic machine translation (i.e., computer translation) • The history of computer translation • Rule-based and corpus-based computer translation • Important computer translation systems on the Web • Evaluation and application of computer translation systems 3. Texts editing for computer translation • Pre-editing • Post-editing • Interactive editing • Semi-automatic editing 4. Terminology management • Terminology and terminology management • Using existing terminology resources • Building your own terminology resources 5. Translation memory • Translation units and translation memory • Using existing translation memories

  - Building your own translation memories
  - SDL Trados, Wordfast, Google Translate, etc.
6. Bilingual alignment of translation units
   - Sentences, words and translation units
   - Recognition of translation units
   - Alignment of translation units
7. Software localization and user interface translation
   - Products localization and globalization
   - Software localization and user interface translation
   - Computer assisted localization
8. Corpora as translation tools
   - Introduction to corpus linguistics
   - Using existing corpora
   - Building your own corpora
9. Databases as translation tools
   - Introduction to databases
   - Using existing databases
   - Building your own databases
10. Term projects (grouped or individual): to design and create a valuable software tool or resource (e.g. a corpus, an on-lined dictionary or a translation memory) to support language translation.

Teaching/Learning Methodology

The subject will be taught through lectures and laboratory seminars. Lectures enhanced with both online and offline demonstrations will introduce students to important concepts and valuable skills in Computer-Aided Translation. Laboratory seminars will provide students with hands-on training in computer tools application and software resources development for translation purposes. The language of instruction is English, aided by Chinese when needed.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed				
		a	b	c	d	e
1. Two assignments involving in-class activities.	60%	✓	✓	✓	✓	✓
2. One project	40%				✓	✓
Total	100%					

Assessment

The subject will be assessed by three assignments, including a project to find or select a problem in language translation and create an effective software tool/resource to help solve the problem. The other two assignments are designed to consolidate and improve students' understanding of and skills in the application of information technology to language translation.

Student Study Effort Expected	Class contact:	
	▪ Lectures	26 Hrs.
	▪ Laboratory seminars	13 Hrs.
	Other student study effort:	
	▪ Self-access lab activities	27 Hrs.
	▪ Other private study	39 Hrs.
	Total student study effort	105 Hrs.
Reading List and References	**References** Teacher’s lecture notes and practical work notes (to be delivered in class or on the Web). Austermuhl, F. (2001). *Electronic Tools for Translators.* Manchester: St. Jerome Publishing. Bhattacharyya, Pushpak (2015). *Machine translation*. Boca Raton : CRC Press Michał Kornacki (2018). Computer-assisted translation (CAT) tools in the translator training process. Berlin : Peter Lang McEnery, T., Xiao, R. and Tono, Y. (2006). *Corpus-Based Language Studies: An advanced resource book.* Oxford: Routledge. O'Hagan, Minako (2020). *Routledge Handbooks in Translation and Interpreting Studies.* Abingdon, Oxon : Routledge. Rodrigo, E. Y. (Ed.). (2008). *Topics in Language Resources for Translation and Localisation.* Amsterdam: John Benjamins. Samuelsson-Brown, G. (2010). *A Practical Guide for Translators*, 5th edition. Bristol: Multilingual Matters. Somers, H. (Ed.). (2003). *Computers and Translation: A translator's guide.* Amsterdam: John Benjamins. (Ch. 16: Post-editing) Thierry Poibeau (2017). *Machine Translation*. Boston: MIT Press. Wilks, Y. (2009). *Machine Translation: Its scope and limits.* New York: Springer. Zhang, X. (2016). Keeping the Meanings of the Source Text: An introduction to Yes Translate. In Sun, M. et al. (Eds.). *Chinese Computational Linguistics and Natural Language Processing Based on Naturally Annotated Big Data*: Lecture Notes in Artificial Intelligence, LNAI 10035, pp. 64–75. Switzerland: Springer. (EI indexed) Zhang, X. (2016). Computational Linguistics. In Chan S. (edited), *The Routledge Encyclopedia of the Chinese Language*, pp. 420–437.	

Oxford: Routledge. ISBN: 978-0-415-53970-8.

Zhang, X. and Li X. (2018). Achieving All-Correct Chinese Word Segmentation by Human-Computer Cooperation: A Study on Intersection Ambiguities. In Li, X., Sun, J. and Xu, J． eds. (李晓琪，孙建荣，徐娟主编), *Digital Teaching of Chinese Language 2018 (数字化汉语教学 2018)*. Beijing: Tsinghua University Press. (清华大学出版社), pp 165-176.

Zhang, X., Li, X. and Lun, C. (editors, 2015). The YES-CEDICT Chinese Dictionary (一二三漢英大詞典, Trial Edition, Version T: sorted by Traditional Chinese). *The Journal of Modernization of Chinese Language Education* (中文教学现代化学报), Vol.4, No.1 (Total No. 7), June, 2015. (http://xuebao.eblcu.com/)

馮志偉(2004). 機器翻譯研究. 北京： 中國對外翻譯出版公司.

海峽兩岸資訊科學技術名詞工作委員會 編 (2008). 海峽兩岸信息科學技術名詞. 北京: 科學出版社.

黃昌寧，李涓子 (2002). 語料庫語言學. 北京: 商務印書館.

王华树(2015). 计算机辅助翻译实践. 北京: 国防工业出版社

俞士文(2003, 主編). 計算語言學概論 . 北京: 商務印書館.

張小衡 (1999). 粵-普機器翻譯中的詞處理. 中文資訊學報, No. 3, Vol. 13, pp. 40 - 47.

張小衡 (2005). 上下文索引程式 ABCD 及其在語言翻譯中的應用. 載于李亞舒，趙文利，晏勤 (編). 科技翻譯資訊化. 北京: 科學出版社, pp. 241-245.

張小衡 (2011). 一個支持人工校對的中文簡繁體轉換工具. 發表於《全國第九屆計算語言學學術會議論文集》.

张小衡, 李笑通 (2013). 一二三笔顺检字手册 . 北京: 语文出版社.

张小衡, 李笑通 (2016).《一二三汉英大词典》的计算机辅助修订. In (李晓琪，金铉哲，徐娟主编), *数字化汉语教学 2016*. 北京：清华大学出版社, pp 147-152.

[Syllabus prepared by Dr ZHANG Xiaoheng]

Subject Description Form

Subject Code	CBS4954
Subject Title	Statistics for Language Studies
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	Statistical methods are used in the subfields of linguistics extensively, which helps linguists to discover language structures and patterns in processing languages. This is an introductory course to statistical analysis used in language studies. This course includes fundamental concepts in statistics, methods of descriptive and inferential statistics with application in analyzing quantitative linguistic data and solving linguistic problems. In particular, we focus on experimental designs, simple linear regression, hypothesis testing and statistical modeling of linguistic data. It offers hands-on experience with statistical analysis software, and provides students with theoretical background in statistics enough to understand the software output, and make a critical review of the results in a qualitative study. Students are also trained to report statistical results of linguistic data for their own projects.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: **Category A: Professional/academic knowledge and skills:** a) make intelligent and informed judgments concerning the statistical outputs of quantitative linguistic studies; b) identify linguistic problems and solve them using statistical methods; c) govern language structures from a statistical perspective; d) comprehend basic statistical terms, and perform simple analysis; e) report statistical results based on analysis of linguistic data. **Category B: Attributes for all-roundedness** f) improve learning skills involving collaboration with peer students g) foster critical thinking in solving linguistic problems

Subject Synopsis/ Indicative Syllabus	Statistical concepts: An Introduction What is statistics? Why do we need statistics in language studies? Frequency distribution Classification of linguistic data; Histograms; Shapes of distributions Introduction to statistical software Statistical software introduction Descriptive statistics Measures of central tendency and variability Normal distribution Characteristics of normal distribution; Data plotting Population estimation Sampling distribution of the mean; Confidence interval Hypothesis testing Design of investigation; The null hypothesis and the alternative hypothesis Parametric tests of significance Test statistic; Independent samples; Paired samples Chi-square test Basic characteristics of Chi-square test Correlation Nature of correlation; The Pearson product-moment correlation coefficient Simple linear regression Concepts of linear regression; Fitting data Multiple linear regression Concepts of multiple linear regression; Fitting more complex data ANOVA Introduction to one-way and two-way ANOVAs
Teaching/Learning Methodology	Besides face-to-face lectures, web-based study materials and in-class practice will be made. Assignments are closely related to the use of statistical software in analyzing linguistic data, and thus students are

strongly encouraged to apply the concepts and methodologies they learn to solve real-world linguistic problems.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed						
		a	b	c	d	e	f	g
1. Exercises & small assignments	30%	✓		✓	✓		✓	✓
2. Project/essay	70%	✓	✓	✓	✓	✓	✓	✓
Total	100%							

This subject intends to provide an overview of statistical methods in linguistic data analysis. Topics covered vary from basic statistical concepts, distributions, hypothesis testing, simple linear regression, multiple linear regression etc. It would be difficult to evaluate student's learning outcome with one or two single assignment(s) in term of term papers. Therefore, a number of exercises and small assignments, each with different focus and covering specific topics, will be given to students to help them grasp the basic concepts and to develop their abilities in handling statistical analysis.

Towards the end of the study period, students will be required to conduct a project on analyzing a linguistic problem using statistical techniques covered in this class. This final piece of work would require students to make use of the knowledge learnt in this subject and to demonstrate that they have achieved the intended learning outcomes.

Student Study Effort Expected

Class contact:	
▪ Lectures: 3 x 13	39 Hrs.
Other student study effort:	
▪ Assignments	40 Hrs.
▪ Reading	30 Hrs.
Total student study effort	109 Hrs.

Reading List and References

Essential Reading:

Gries, S. T. (2013). *Statistics for linguistics with R: a practical*

	introduction. Walter de Gruyter. **Selected Reference List:** Gómez, P. C. (2013). *Statistical methods in language and linguistic research*. Equinox. Lowie, W., & Seton, B. (2012). *Essential statistics for applied linguistics*. Palgrave Macmillan. Rasinger, S.M. (2008). *Quantitative Research in Linguistics*. New York, Continuum International Publishing Group

[Syllabus prepared by Dr CHEN Si]

Subject Description Form

Subject Code	CBS4958
Subject Title	Fundamentals of Computational Linguistics
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	**Pre-requisite:** CBS3947 Programming and Data Analysis for Language Studies
Objectives	This subject aims to achieve the following goals: • To introduce the field of computational linguistics and its history. • To introduce how linguistic structures can be automatically extracted and analyzed using computational methods. • To introduce the applications of computational linguistics and the basic technologies for such applications. • To provide hands-on experience of computational tools for text analysis.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: **Category A: Professional/academic knowledge and skills** (a) Understand and appreciate the development of the field of computational linguistics and its significance in modern applications; (b) Understand the complicated nature of human language and the challenges facing computational linguists; (c) Understand the scientific principles behind the various systems using natural language processing techniques; (d) Understand the principles of language resource annotation and information extraction; (e) Apply the above principles in analysis of data and acquire intended information through the use of tools; (f) Design simple programs for data extraction in different applications. **Category B: Attributes for all-roundedness** (g) Problem solving using systematic ways and learning independently.

Subject Synopsis/ Indicative Syllabus

- Introduction and overview
- Review on programming and regular expressions and state transition diagrams
- Annotation of language resources
- Morphological analysis and processing
- Segmentation and syntactic analysis
- Semantics representation and analysis
- Statistical models in natural language processing
- Applications using computational linguistics such as information retrieval, information extraction, machine translation and machine learning.

Teaching/Learning Methodology

This subject will be taught in a combination of lectures, tutorials and lab sessions. Lectures will cover concepts, algorithms and models with illustrative examples. Tutorials and lab sessions are designed to help students further their understanding of the materials covered in lectures and learn to apply the acquired knowledge to practical use.

In addition to the above, students are also expected to complete assignments and lab exercises, and attend quizzes and tests.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed						
		a	b	c	d	e	f	g
1. Assignments and lab exercises	40%	✓	✓	✓	✓	✓	✓	✓
2. Tests	60%	✓	✓	✓	✓	✓	✓	✓
Total	100 %							

All the above assessment methods are appropriate for evaluating students' understanding of course materials and their programming skills and problem solving skills. Individual assignments and lab exercises provide assessment on a regular basis, which also serve as a means of self-monitoring for students. Tests will assess students' overall understanding of the concepts and algorithms learnt in class and their mastery of basic programming skills.

Student Study Effort Expected	Class contact:	
	▪ Lecture	26 Hrs.
	▪ Tutorial/Lab	13 Hrs.
	Other student study effort:	
	▪ Study lecture/text book materials for understanding of concepts	35 Hrs.
	▪ Assignments, online QA, and preparation for the tests	40 Hrs.
	Total student study effort	114 Hrs.
Reading List and References	**Text Book**: Dan Jurafsky and James H. Martin, Speech and Language Processing, 2nd Edition, Prentice Hall, 2008 **References**: Christopher Manning and Hinrich Schuetze, Foundations of Statistical Natural Language Processing, MIT Press, 1999. Ruslan Mitkov, The Oxford Handbook of Computational Linguistics, Oxford University Press, 2005. Christopher Manning, Prabhakar Raghavan, and Hinrich Schuetze, Introduction to Information Retrieval, Cambridge University Press, 2008. Steven Bird, ewan Klein, and Edward Loper, Natural Language Processing with Python, O'Reilly Media, 2009 Sun, M., Liu, T., Wang, X., Liu, Z., Liu, Y. (Eds.) Chinese Computational Linguistics and Natural Language Processing Based on Naturally Annotated Big Data, Springer, 2018 Hopcroft, J.E. and Ullman, J.D., Introduction to Automata, Theory and Languages, Addison-Wesley, 1979. *International Journal of Computational Linguistics and Chinese Language Processing (IJCLCLP)*	

Subject Description Form

Subject Code	CBS4962
Subject Title	Corpus and Language Technology for Language Studies
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	**Pre-requisite:** CBS1902 Introduction to Linguistics
Objectives	This subject introduces corpus linguistics and other tools useful for linguistic analysis, with a focus on Chinese languages. The main objective is to familiarize students with the conceptual underpinning and recent developments in corpus linguistics, and give them experience in how to use corpora for various kinds of analysis, how to extract data from a corpus, and how to build a linguistic corpus.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: **Category A: Professional/academic knowledge and skills** a) Acquire skills to use corpora and perform in-depth linguistic analysis based on empirical data; b) Demonstrate knowledge of important issues in corpus linguistics in general and Chinese corpus linguistics in particular; c) Think critically about how to apply appropriate methodological techniques to cross-disciplinary studies of language; **Category B: Attributes for all-roundedness** d) Develop critical thinking and problem-solving skills.

Subject Synopsis/ Indicative Syllabus	• Introduction to corpus linguistics
	  • Overview of corpus linguistics
	  • Related research topics
	• Corpus use
	  • Types of corpora
	  • Factors to consider when choosing a corpus
	  • Lexical statistics
	  • Concordancers, n-grams
	  • Regular expressions
	  • Basic statistical methods
	• Corpus design
	  • How to make a corpus

    - Segmentation (especially in Chinese)
    - Annotations/tagging and metadata
    - Chinese-specific issues like encoding
- Applications (e.g. sentiment analysis)
- Theoretical issues and current trends/developments in corpus linguistics
- Other online tools/technology for language sciences (such as MRD/Lexicon, Grammar, WordNet/Ontology, TreeBank)

Teaching/Learning Methodology

- Lectures
- Hands-on class activities and discussion
- Out-of-class work: carrying out projects and assignments using the techniques practiced in class

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed			
		a	b	c	d
1. Out-of-class exercises	30%	✓		✓	✓
2. Take-home tests	30%	✓	✓	✓	✓
3. Corpus analysis project	30%	✓	✓	✓	✓
4. In-class participation	10%	✓		✓	
Total	100 %				

Most weeks' discussion will be paired with a worksheet or problem set to complete at home. In addition, students will complete one independent project in which analyze an aspect of language or examine a theoretical question about language by using corpus data.

Student Study Effort Expected

Class contact:	
▪ Lectures	39 Hrs.
Other student study effort:	
▪ Reading and other pre-class preparation (including worksheets)	46 Hrs.
▪ Projects	20 Hrs.
Total student study effort	105 Hrs.

Reading List and References

Including, but not limited to, selected excerpts from the following texts:

Books:

	McEnery, Tony, Richard Xiao & Yukio Tono. 2006. *Corpus-based Language Studies: An Advanced Resource Book*. London: Routledge. ISBN 0415286239. Wynne, M. 2005. *Developing Linguistic Corpora: A Guide to Good Practice*. Oxford: Oxbow Books. **Articles:** Chen, Keh-Jiann and Chu-Ren Huang. To Appear. Sinica Treebank. In Nancy Ide and James Pustejovsky (Eds.), *Handbook of Linguistic Annotation*. Springer. Chen, Keh-Jiann, and Chu-Ren Huang. 2015. Modern Chinese Balanced Corpus of Academia Sinica. In Rint Sybesma (Ed.), *Encyclopedia of Chinese Language and Linguistics*. Brill. Huang, Chu-Ren, Hong Jiafei, Weiyun Ma, and Petr Šimon. 2015. From Corpus to Grammar: Automatic Extraction of Grammatical Relations from Annotated Corpus. In Benjamin T'sou and Olivia Kwong (Eds.), *Linguistic Corpus and Corpus Linguistics in the Chinese Context*. Pp. 192-221. *Journal of Chinese Linguistics Monograph*. Hong Kong: Chinese University of Hong Kong Press. Huang, Chu-Ren, and Qi Su. 2015. Chinese Computational Linguistics: The State of the Art. In Rint Sybesma (Ed.), *Encyclopedia of Chinese Language and Linguistics*. Brill. Huang, Chu-Ren, Shu-Kai Hsieh, and Keh-Jiann Chen. 2017. *Mandarin Chinese Words and Parts of Speech: A Corpus-based Study*. London: Routledge. Huang, Chu-Ren, and Yao Yao. 2015. Corpus Linguistics. In James D. Wright (Ed.), *International Encyclopedia of the Social & Behavioral Sciences* (2nd edition), Volume 4 (pp. 949–953). Oxford: Elsevier.

Form AR 140

The Hong Kong Polytechnic University

Subject Description Form

Please read the notes at the end of the table carefully before completing the form.

Subject Code	COMP 1012
Subject Title	Programming Fundamentals and Applications
Credit Value	3
Level	1
Pre-requisite/ Co-requisite/ Exclusion	Exclusion: COMP 1011/ENG 2002
Objectives	The objectives of this subject are to: • provide students with knowledge on the fundamental elements in computer programming; and • introduce students to the application of computer programming in solving practical problems in different application domains.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: *Professional/academic knowledge and skills* (a) understand the programming elements for solving computing-related problems; (b) possess the ability to design and develop computer programs for solving problems in different application domains; (c) possess the ability to learn other high level programming languages independently; *Professional/academic knowledge and skills* (d) develop skills in general problem solving; (e) identify and develop problem solutions in a logical manner; and (f) solve problems in groups and develop group work.
Subject Synopsis/ Indicative Syllabus *(Note 2)*	**Topic** 1. Fundamentals of computing Basic concepts of computers and computing, elementary programming constructs, elementary data types. 2. I/O and flow control

<table>
<tr>
<td></td>
<td>Sending output to screen, getting input from keyboard, basic flow control: selection, repetition and function.
3. Data collection
Sequences, lists, tuples, sets, strings and dictionaries.
4. File operation
Creating and opening files, reading from file, writing to file.
5. Program design
Modular program design using functions, testing and debugging.
6. Applications
Sorting and searching: programming vs built-in Python functions, elementary data manipulation, NumPy arrays and matrices, problems in different application domains.
7. Other programming languages
Elementary data manipulation in R, interfacing to Python.</td>
</tr>
<tr>
<td>Teaching/Learning Methodology
<i>(Note 3)</i></td>
<td>This subject emphasizes both the conceptual elements in computer programming and practical experiences. Teaching includes both lectures and hands-on Lab exercises reinforcing taught concepts. Students should attend both lectures and laboratory sessions.

Continuous assessment helps to reinforce the programming concepts and skills learned in developing applications. Individual assignments provide additional practices to programming. Project(s) allow students to work in group to solve more practical problems. Quizzes mandate students to recap their knowledge and skill sets acquired through other assessment forms.

Final examination provides a summative assessment of overall student performance in applying programming skills in solving problems in various applications.</td>
</tr>
<tr>
<td>Assessment Methods in Alignment with Intended Learning Outcomes
<i>(Note 4)</i></td>
<td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="6">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td></tr>
<tr><td>Continuous Assessment</td><td>65%</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Assignments</td><td></td><td>√</td><td>√</td><td></td><td></td><td>√</td><td>√</td></tr>
<tr><td>Quizzes</td><td></td><td>√</td><td>√</td><td></td><td></td><td>√</td><td></td></tr>
<tr><td>Project(s)</td><td></td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>Final Examination</td><td>35%</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td></td></tr>
<tr><td>Total</td><td>100 %</td><td colspan="6"></td></tr>
</table>
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</tr>
</table>

	Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes: The continuous assessment and the final examination are designed to assess the specified learning outcomes. The formats may include written questions, programming exercises, projects and quizzes.	
Student Study Effort Expected	Class contact:	
	▪ Lecture	39 Hrs.
	▪ Lab	13 Hrs.
	Other student study effort:	
	▪ Assignments, Quizzes, Projects, Exam, Self-study	68 Hrs.
	Total student study effort	120 Hrs.
Reading List and References	1. David J. Pine. *Introduction to Python for Science and Engineering*, CRC Press, 2019. 2. Claus Führer, Jan Erik Solem and Olivier Verdier. *Computing with Python: An Introduction to Python for Science and Engineering*. Pearson, 2014. 3. William F. Punch and Richard Enbody. *The Practice of Computing Using Python*. 3rd Edition, Addison Wesley, 2017. 4. Jaynal Abedin and Kishor Kumar Das. *Data Manipulation with R*, 2nd Edition, Packt Publishing, 2015. 5. J.D. Long and Paul Teetor. *R Cookbook: Proven Recipes for Data Analysis, Statistics, and Graphics*. 2nd Edition, O'Reilly, 2019.	

Note 1: Intended Learning Outcomes
Intended learning outcomes should state what students should be able to do or attain upon subject completion. Subject outcomes are expected to contribute to the attainment of the overall programme outcomes.

Note 2: Subject Synopsis/Indicative Syllabus
The syllabus should adequately address the intended learning outcomes. At the same time, overcrowding of the syllabus should be avoided.

Note 3: Teaching/Learning Methodology
This section should include a brief description of the teaching and learning methods to be employed to facilitate learning, and a justification of how the methods are aligned with the intended learning outcomes of the subject.

Note 4: Assessment Method
This section should include the assessment method(s) to be used and its relative weighting, and indicate which of the subject intended learning outcomes that each method is intended to assess. It should also provide a brief explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes.

Subject Description Form

Subject Code	COMP1433
Subject Title	Introduction to Data Analytics
Credit Value	3
Level	1
Pre-requisite / Co-requisite / Exclusion	Nil
Objectives	The objectives of this subject are to: • understand data analytics concepts • apply data analytics tools • strengthen students' mathematics background for computing
Intended Learning Outcomes	Upon completion of the subject, students will be able to: *Professional/academic knowledge and skills* (a) understand basic data analytics concepts (b) manipulate, analyze and visualize data (c) understand and apply related mathematics operations
Subject Synopsis/ Indicative Syllabus	**Topic** **1. Data Analytics Basics** Defining data requirements, collecting data, processing data, cleaning data and analyzing data **2. Data Processing** Data manipulation, data analysis, data visualization **3. Statistical Analysis** Basic statistical functions, linear regression, time series analysis **4. Linear Algebra and Calculus** Vector basics, matrix basics, differentiation, integration, finding maxima and minima The aforementioned topics will be taught with the aid of a suitable programming language such as R.

<table>
<tr><td>Teaching/ Learning Methodology</td><td>Lectures on data analytics and mathematics concepts (e.g., using R) will be given through lectures. There will be in-class activities for active learning. Hands-on lab/exercises will be arranged for students to practice data analytics tools. Students will also be required to study e-learning materials.</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="5">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td></td><td></td></tr>
<tr><td>Continuous Assessment</td><td rowspan="2">55%</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>1. Assignments, Test, Quizzes</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td>Examination</td><td>45%</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td>Total</td><td>100%</td><td colspan="5"></td></tr>
</table>
The assignments/test/quizzes (individual assessment) are used to assess learning outcomes (a) – (c) (e.g., how to apply R). Finally, students are assessed by a formal examination, covering learning outcomes (a) – (c).</td></tr>
<tr><td>Student Study Effort Expected</td><td>
<table>
<tr><td colspan="2">Class contact:</td></tr>
<tr><td>▪ Class/ Learning Activities</td><td>39 Hrs.</td></tr>
<tr><td colspan="2">Other student study effort:</td></tr>
<tr><td>▪ Self-study, Assignments, e-Learning</td><td>66 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>105 Hrs.</td></tr>
</table></td></tr>
<tr><td>Reading List and References</td><td>Reference Books:
1. Beecher, K., <i>Computational Thinking</i>, BCS, 2017.
2. Teetor, P., <i>R Cookbook</i>, O’Reilly Media, 2011.
3. Wickham, H. and Grolemund, G., <i>R for Data Science</i>, O’Reilly Media, 2017.
4. Boyd, S. and Vandenberghe, L., <i>Introduction to Applied Linear Algebra</i>, Cambridge University Press, 2018.
5. Stewart, J., <i>Calculus: Early Transcendentals</i>, 8th Edition, Cengage Learning, 2015.</td></tr>
</table>

Form AR 140

The Hong Kong Polytechnic University

Subject Description Form

Please read the notes at the end of the table carefully before completing the form.

Subject Code	COMP2013
Subject Title	Data Structures and Algorithms
Credit Value	3
Level	2
Pre-requisite/ Co-requisite/ Exclusion	**Pre-requisite**:COMP1011 / COMP1012 / ENG2002 / LGT3109 and AMA1110 / AMA1501 / AMA2634 and AMA1751 / AMA2111
Objectives	To introduce students to data structures and algorithms, and how to use them to solve computational problems.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: (a) understand the properties of basic data structures, and their strengths and weaknesses; (b) understand how to analyze and compare the efficiency of algorithms; (c) possess the knowledge of common algorithms, and common techniques for designing algorithms; (d) understand the basic steps in designing and implementing efficient data structures and algorithms for solving computational problems efficiently in a high-level programming language; and (e) get familiar with critical thinking for computational efficiency.
Subject Synopsis/ Indicative Syllabus *(Note 2)*	1. **Analysis of algorithms** • Asymptotic notations. • Efficiency analysis. 2. **Data Structures** • Linear structures: linked-lists, stacks, queues. • Tree structures: binary trees, balanced trees, tree traversals. 3. **Searching and Sorting** • Greedy sorting algorithms: bubble sort, insertion sort, selection sort. • Sorting algorithms based on divide and conquer: quicksort and mergesort. • Heapsort and related data structures: priority queues, heaps. • Hashing: hash functions, collision resolution.

4. **Graphs**
    - Definition and representation.
    - Depth-first search and breadth-first search.
5. **Algorithmic Design Techniques**
    - Greedy and dynamic programming.
    - Divide-and-conquer.
    - Recursion.
6. **Applications**
    - Practical program development using combination of multiple data structures and algorithms.

Teaching/Learning Methodology

(Note 3)

The course material will be delivered as a combination of mass lectures and small group supervised tutorial and laboratory sessions.

Lectures will provide the required knowledge while tutorial and laboratory sessions allow students to acquire hands-on experience on programming with different algorithms.

Both written and programming assignments will be utilized in the course. Written assignments help students develop analysis and design skills, whereas programming assignments emphasize on implementation skills.

Assessment Methods in Alignment with Intended Learning Outcomes

(Note 4)

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)				
		a	b	c	d	e
Continuous Assessment	60%					
1. Exercises	20%	✓	✓	✓	✓	✓
2. Programming Project	20%	✓	✓	✓	✓	✓
3. Test	20%	✓	✓	✓		✓
Examination	40%	✓	✓	✓		✓
Total	100 %					

Student Study Effort Expected

Class contact:	
▪ Lecture	26 Hrs.
▪ Tutorial/Lab	13 Hrs.

	Other student study effort:	
	▪ Assignments, Quizzes, Projects, Self-study	101 Hrs.
	Total student study effort	140 Hrs.
Reading List and References	1. Goodrich, Michael T., Tamassia, Roberto, and Goldwasser, Michael H., *Data Structures and Algorithms in Java*, 6th Edition, Wiley, 2014. 2. Goodrich, Michael T., Tamassia, Roberto, and Goldwasser, Michael H., Data structures and algorithms in Python, Wiley, 2013. 3. Sedgewick, Robert and Wayne, Kevin, *Algorithms*, 4th Edition, Addison-Wesley, 2011. 4. Cormen, Thomas H., Leiserson, Charles E., Rivest, Ronald L. and Stein, Clifford, *Introduction to Algorithms*, 3rd Edition, MIT Press, 2009.	

Note 1: Intended Learning Outcomes
Intended learning outcomes should state what students should be able to do or attain upon subject completion. Subject outcomes are expected to contribute to the attainment of the overall programme outcomes.

Note 2: Subject Synopsis/Indicative Syllabus
The syllabus should adequately address the intended learning outcomes. At the same time, overcrowding of the syllabus should be avoided.

Note 3: Teaching/Learning Methodology
This section should include a brief description of the teaching and learning methods to be employed to facilitate learning, and a justification of how the methods are aligned with the intended learning outcomes of the subject.

Note 4: Assessment Method
This section should include the assessment method(s) to be used and its relative weighting, and indicate which of the subject intended learning outcomes that each method is intended to assess. It should also provide a brief explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes.

Subject Description Form

Subject Code	COMP4431
Subject Title	Artificial Intelligence
Credit Value	3
Level	4
Pre-requisite / Co-requisite / Exclusion	**Pre-requisite**: COMP1012 / COMP2011 / ENG2002
Objectives	The objectives of this subject are to: • introduce the fundamental concepts of artificial intelligence; • equip students with the knowledge and skills in programming of artificial intelligence techniques; • master the problem formulation and the typical intelligent algorithms • understand the technical development of artificial intelligence • aware the ethical issues related to artificial intelligence.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: *Professional/academic knowledge and skills* (a) understand the history, development, and technical trend of artificial intelligence; (b) understand the important concepts in artificial intelligence and the problem addressed by intelligent techniques; (c) familiarize with typical programming language and tool to implement artificial intelligence techniques; (d) master the characters of intelligent agent, knowledge based agent, problem solving agents, multiagent, and the typical examples. (e) learn the design rationale and the typical algorithms of problem-solving agents, in particular, search algorithms and their applications in real world; (f) master the skills and techniques in machine learning, such as decision tree induction, support vector machine, and artificial neural networks; (g) understand the ethical issues related to artificial intelligence. *Attributes for all-roundedness* (h) explore the nature of human intelligence and its role in problem solving;

<table>
<tr><td></td><td>(i) deepen thoughts and understanding of human abilities such as learning, reasoning and planning; and
(j) appreciate the rooted philosophical arguments in artificial intelligence and its impact on human thoughts.</td></tr>
<tr><td>Subject Synopsis/ Indicative Syllabus</td><td><table>
<tr><th>Topic</th></tr>
<tr><td>1. Introduction to Artificial Intelligence
Definition of artificial intelligence; basic concepts of human intelligence; scope of classical artificial intelligence problem; the birth, golden time, and the winter of artificial intelligence.</td></tr>
<tr><td>2. Agent and Knowledge Base
Definition of agents and rationality; design an intelligent agent; knowledge-based agents and knowledge representation language; inference using forward chain and backward chain; uncertainty and Bayesian networks.</td></tr>
<tr><td>3. Problem-solving Agents
Problem-solving agents; uninformed search strategies and typical algorithms; informed search strategies and typical algorithms; heuristic functions; hill-climbing search, simulated annealing search, genetic algorithms; constraint satisfaction problem and game problem.</td></tr>
<tr><td>4. Machine Learning
Supervised learning, unsupervised learning, and reinforcement learning; classification, clustering, and regression; decision tree; support vector machine, artificial neural networks.</td></tr>
<tr><td>5. Applications and Ethical Issues
Latest development of artificial intelligence; typical applications; ethical issues of artificial intelligence techniques and applications; benefits and risk to human society.</td></tr>
</table></td></tr>
<tr><td>Teaching/ Learning Methodology</td><td>During the lecture, students will come across the concepts, algorithms and applications in artificial intelligence, and will be supplemented by exercises, labs, and project.</td></tr>
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<tr>
<td>Assessment Methods in Alignment with Intended Learning Outcomes</td>
<td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="10">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td>g</td><td>h</td><td>i</td><td>j</td></tr>
<tr><td>1. Continuous Assessment</td><td>55%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>2. Final Examination</td><td>45%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td><td></td></tr>
<tr><td>Total</td><td>100 %</td><td colspan="10"></td></tr>
</table>
<p>Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:</p>
<p>Continuous assessments consist of a project, lab exercises, and quizzes, which are designed to facilitate students to achieve intended learning outcomes. Lab exercise is designed to encourage students to acquire good understanding of the relevant knowledge, practice in order to enrich their hands-on experience with various software tools. The project is designed to enhance students’ ability to acquire the understanding and using different knowledge, principles, techniques, tools to solve a real problem through team. Quizzes are to ensure the students understand the concepts.</p>
</td>
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<tr>
<td>Student Study Effort Expected</td>
<td>
<table>
<tr><td colspan="2">Class contact:</td></tr>
<tr><td>▪ Class activities including lecturers, tutorial, and labs</td><td>39 Hrs.</td></tr>
<tr><td colspan="2">Other student study effort:</td></tr>
<tr><td>▪ Coursework and Project</td><td>80 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>119 Hrs.</td></tr>
</table>
</td>
</tr>
<tr>
<td>Reading List and References</td>
<td>
<p>Textbooks:</p>
<p>1. Russell, Stuart and Norvig, Peter, <i>Artificial Intelligence: A Modern Approach</i>, 3rd Edition, Pearson, 2009.</p>
<p>Reference Books:</p>
<p>1. Pal, Sankar K. and Shiu, Simon C. K., <i>Foundations of Soft Case-Based Reasoning</i>, John Wiley, 2004.</p>
<p>2. Negnevitsky, Michael, <i>Artificial Intelligence: A Guide to Intelligent Systems</i>, 2nd Edition, Addison Wesley, 2005.</p>
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</table>

Subject Description Form

Subject Code	COMP4432
Subject Title	Machine Learning
Credit Value	3
Level	4
Pre-requisite / Co-requisite / Exclusion	Nil (but students are preferred to have some previous exposure to introductory Artificial Intelligence/Data Analytics concepts and be familiar with basic notions in linear algebra and probability)
Objectives	The objectives of this subject are to: • present the basic principles, concepts and models of modern machine learning; and • introduce recent advances of machine learning technology with impactful applications in pattern recognition, computer vision and other areas.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) understand the major concepts of machine learning models and algorithms; (b) develop basic intuitions into the effectiveness of machine learning techniques; (c) gain knowledge of applying machine learning techniques to various cutting-edge applications; and (d) design machine learning solutions to solve new challenging problems in practice.
Subject Synopsis/ Indicative Syllabus	**Topic** **1. Part I: Machine Learning Fundamentals** • Linear algebra and probability • Numerical computation and optimization • Learning tasks: Regression, classification, etc. • Performance issues: Cross-validation, Overfitting and curse of dimensionality, Bias-variance dilemma, etc.

2. Part II: Models and Techniques

- Supervised learning:
  - Parametric vs non-parametric methods
  - Decision tree based methods
  - Bayesian models
  - Neural networks and support vector machines
- Unsupervised learning:
  - k-means and hierarchical clustering
  - Spectral clustering and density-based clustering
  - Advanced models: autoencoder, embedding techniques, etc.
- Regression and boosting
- Feature selection and dimensionality reduction

3. Part III: Applications

- Handwriting recognition challenge, e.g. MNIST
- Object detection, recognition and tracking
  - Object feature descriptions: Engineering approach vs feature learning approach
  - Object detection examples, e.g. pixel clustering for face detection, etc.
  - Object recognition examples, e.g. face recognition via eigenface features
  - Object tracking examples, e.g. human motion tracking

Teaching/ Learning Methodology

39 hours of class activities including lectures on the main concepts and models, together with applicational case studies, tutorials and class/group discussions, laboratory works and student presentations. Additional reading of research papers will be assigned, whenever appropriate.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)				
		a	b	c	d	
Continuous Assessment	**55%**					
1. Assignments		✓	✓	✓		
2. Tests/Quizzes		✓	✓	✓		
3. Project				✓	✓	
Examination	**45%**	✓	✓	✓	✓	
Total	100%					

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Assignment: After-class assessment of the continuous understanding of the concepts, issues, models and applications of machine learning techniques by providing answers to given questions.

	Test/Quiz: In-class assessment of the understanding of the concept, issues, models and applications of machine learning techniques by providing answers to given questions. Project: Assessment of problem solving ability in dealing with practical application problems by written reports and oral presentations. End-of-term Assessment: Assessment of the overall performance by a written examination.	
Student Study Effort Expected	Class contact:	
	▪ Lecture/Tutorial/Lab	39 Hrs.
	Other student study effort:	
	▪ Self-study	83 Hrs.
	Total student study effort	122 Hrs.
Reading List and References	**Reference Books:** 1. Hastie, T., Tibshirani, R. and Friedman, J., T*he Elements of Statistical Learning*, 2^{nd} Edition, Springer, 2009. 2. Shalev-Shwartz, S. and Ben-David, S., *Understanding Machine Learning: From Theory to Algorithms*, 2014. 3. Bousquet, O., Boucheron, S. and Lugosi, G., I*ntroduction to Statistical Learning Theory,* Advanced Lectures on Machine Learning. 4. Mohri, M., Rostamizadeh, A. and Talwalkar, A., *Foundations of Machine Learning*. USA, Massachusetts: MIT Press, 2012. 5. Vapnik, V. N., *The Nature of Statistical Learning Theory*. Springer, 2000. 6. Bishop, Christopher, *Pattern Recognition and Machine Learning*, Springer, 2006. 7. To be amended and updated at the beginning of the semester.	

Subject Description Form

Subject Code	COMP4434
Subject Title	Big Data Analytics
Credit Value	3
Level	4
Pre-requisite / Co-requisite / Exclusion	**Pre-requisites**: AMA1104 / AMA1110 & COMP1011 / COMP1012 / ENG2002 & COMP2011 / COMP2013
Objectives	The objectives of this subject are to: • introduce students the concept and challenge of big data (3 V's: volume, velocity, and variety); and • teach students in applying skills and tools to manage and analyze the big data.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) understand the concept and challenge of big data and why existing technology is inadequate to analyze the big data; (b) collect, manage, store, query, and analyze various form of big data; (c) gain hands-on experience on large-scale analytics tools to solve some open big data problems; and (d) understand the impact of big data for business decisions and strategy.
Subject Synopsis/ Indicative Syllabus	

Topic
1. Introduction to Big Data The 3 V's, their challenges and application domains.
2. Collection of Big Data Eventual Consistency and NoSQL systems MongoDB, Google BigTable.
3. Large-Scale Data Analytics Systems Auto-Parallel Data Programming; MapReduce, Hive, and Parallel Databases
4. Basic Statistical Analysis Fruad and Benfords Law, Bayesian Introduction, Heteroskedasticity
5. Machine Learning Systems for Big Data
6. Graph Analytics Graph structures (diameter, connectivity, centrality), PageRank, Triangle counting

7. Sentiment Analysis

8. Data Visualization

Data types and dimensions; Visual encoding and perception

Teaching/ Learning Methodology

A mix of lectures and lab sessions is used to deliver the various topics in this subject. Lectures are conducted to initiate students with the concepts and techniques of big data. Students are given the opportunity to gain hands-on experience on both open-source and commercial big data analytics software during the laboratory sessions.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)			
		a	b	c	d
Continuous Assessment	**60%**				
1. Lab Exercises / Assignments		✓	✓	✓	✓
2. Project		✓	✓	✓	✓
3. Quiz		✓	✓		
Examination	**40%**	✓	✓		✓
Total	100 %				

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Continuous assessments consist of a project, assignments, lab exercises, and quizzes, which are designed to facilitate students to achieve intended learning outcomes. Lab exercise is designed to encourage students to acquire deep understanding of the relevant knowledge, practice in order to enrich their hands-on experience with various software tools. The project is designed to enhance students' ability to acquire the understanding and using different knowledge, principles, techniques, tools to solve a real problem through team. Quizzes are to ensure the students understand the concepts.

Examination will evaluate student's understanding and usage of big data technologies.

Student Study Effort Expected

Class contact:	
▪ Lectures	26 Hrs.
▪ Tutorials/Laboratory	13 Hrs.
Other student study effort:	
▪ Review the lecture	28 Hrs.
▪ Review the lab	14 Hrs.

	▪ Work on the project	15 Hrs.
	▪ Prepare the quizzes	9 Hrs.
	▪ Prepare the examination	11 Hrs.
	Total student study effort	116 Hrs.
Reading List and References	**Reference Books:** 1. Dolan, J.C.B., Dunlap, M., Hellerstein, J.M. and Welton, C., *MAD Skills: New Analysis Practices for Big Data*, 2009. 2. Rajaraman, Anand and Ullman, Jeffery David, *Mining of Massive Datasets*, Chapters 1-2, 2011. 3. Stonebraker, M., Abadi, D., DeWitt, David J., Madden, S., Paulson, E., Pavlo, A. and Rasin, A., “MapReduce and Parallel DBMS’s: Friends or Foes?”, *Communications of the ACM*, January 2010. 4. Dean, Jeffrey and Ghemawat, Sanjay, “MapReduce: A Flexible Data Processing Tool”, *Communications of the ACM*, January 2010. 5. Lin, Jimmy and Dyer, Chris, *Data-Intensive Text Processing with MapReduce*, Morgan and Claypool, 2010. 6. Cattell, Rick, “Scalable SQL and NoSQL Data Stores”, *ACM SIGMOD Record*, Volume 39, Issue 4, December 2010. 7. Elmagarmid, Ahmed K., Ipeirotis, Panagiotis G. and Verykios, Vassilios S., “Duplicate Record Detection: A Survey”, *IEEE Transactions on Knowledge and Data Engineering*, Volume 19, Issue 1, January 2007. 8. Koudas, N., Sarawagi, S. and Srivastava, D., “Record Linkage: Similarity Measures and Algorithms”, *Proceedings of the ACM SIGMOD International Conference on Management of Data*, June 2006. 9. Hothorn, Torsten and Everitt, Brian S., *A Handbook of Statistical Analyses Using R*, 3rd Edition, Chapter 3, CRC Press, 2014. 10. Gregory Park on overfitting to the leaderboard in a Kaggle Competition. 11. Wu, X.D., Kumar, V., Quinlan, J. Ross, Ghosh, J., Yang, Q. and et al., “Top 10 Algorithms in Data Mining, Knowledge and Information Systems”, *Journal of knowledge and Information Systems*, Volume 14, Issue 1, page 1-37, 2007. (Read C4.5) 12. Domingos, Pedro, “A Few Useful Things to Know about Machine Learning”, *Communications of the ACM*, Volume 55, Issue 10, 2012. 13. Alpaydin, Ethem, *Introduction to Machine Learning*, 3rd Edition, MIT Press, 2015. 14. Haykin, Simon, *Neural Networks and Learning Machines*, 3rd Edition, Pearson, 2016.	

	15. Hanaran, Pat, Tools for Data Enthusiasts. 16. Heer, J., Bostock, M. and Ogievetsky, V., “A Tour through the Visualization Zoo”, *Communications of the ACM*, Volume 53, Issue 6, June 2010.

The Hong Kong Polytechnic University

Subject Description Form

Subject Code	COMP4436
Subject Title	Artificial Intelligence of Things
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	COMP1011 / COMP1012 / ENG2002
Objectives	Students will learn the concepts and principles of AI empowered IoT. This subject teaches students the fundamentals and AIoT technology, covering concepts, methods, techniques, systems and applications. Students are expected to have preliminary background in computer programming, and AI. Students will be able to understand the fundamentals of AIoT, develop AIoT systems and apply AIoT to real-world applications.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: (a) Understand the fundamental concepts, technical challenges, and the state-of-the-art technology development and applications of AIoT; (b) Understand the protocols and platforms for sensing, networking and data analytics in IoT systems; (c) Learn and deploy the AI models, algorithms and techniques for IoT operation efficiency, cost reduction, event detection, and predictive maintenance in practice. (d) Discover potential AI-oriented usage scenarios in IoT and apply AIoT methods and techniques to solve various challenging IoT problems for practical applications with innovative solutions.
Subject Synopsis/ Indicative Syllabus *(Note 2)*	**Fundamentals** • **Introduction to IoT**: IoT applications, sensor systems, IoT sensing techniques, IoT networking, IoT Data analytics, IoT platforms and systems • **Introduction to AIoT**: AIoT concepts and issues, Technologies behind AIoT, AIoT application segments. **Advanced topics** • Technical architecture of AIoT • Smart sensors and devices; Wearables; Smart object and human sensing • Challenges of AI in networks for IoT • AI for IoT data analytics and automation

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- Distributed intelligence at the edge of IoT systems (edge computing; blockchain, etc.)
- Robotics for AIoT

<u>Applications</u>

- Intelligent manufacturing; Smart health; Smart infrastructure and construction.

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Teaching/Learning Methodology

(Note 3)

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The course is comprised of lectures, tutorials, and labs. During lectures, students are taught the important concepts, principles and technologies that drive the development of AIoT.

During tutorials and labs, students will be presented with both theoretical questions and practical scenarios of AIoT, and are required to study, analyze and propose solutions. Small group discussions will be encouraged and students will need to present their results and solutions in the form of reports and presentations.

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Assessment Methods in Alignment with Intended Learning Outcomes

(Note 4)

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<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="6">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td></td><td></td></tr>
<tr><td>1. Assignments</td><td>35%</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td><td></td></tr>
<tr><td>2. Project</td><td>25%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td>3. Exam</td><td>40%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td>Total</td><td>100 %</td><td colspan="6"></td></tr>
</table>

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Students will be assessed by their performance in three parts: assignments, project, and examination.

Assignments are written homework and/ or programming homework that assess students' abilities for comprehension of concepts and principles, algorithm design, and problem solving.

Projects involve a group of students to design and implement a solution for a practical AIoT application. Students collaboratively work together to apply what they have learned in the class to solve practical problems. The results are to be presented in the form of reports and / or presentations.

Exam is designed to assess students for their critical thinking skills and independent problem-solving ability.

</td>
</tr>
<tr>
<td rowspan="2">

Student Study Effort Expected

</td>
<td>
<table>
<tr><td>Class contact:</td><td></td></tr>
<tr><td>▪ Lecture</td><td>26 Hrs.</td></tr>
</table>
</td>
</tr>
</table>

	▪ Tutorial / Seminar / Lab	13 Hrs.
	Other student study effort:	
	▪ Self-study & reading, etc.	83 Hrs.
	Total student study effort	122 Hrs.
Reading List and References	**Reference Books:** 1. "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", by Francis DaCosta. Publisher: Apress. 2013. 2. "Internet of Things", by Vlasios Tsiatsis Stamatis Karnouskos Jan Holler David Boyle Catherine Mulligan. Publisher: Elsevier. 2nd edition. 2018. 3. "Big-Data Analytics for Cloud, IoT and Cognitive Computing", by Kai Hwang and Min Chen. Publisher: Wiley. 2017. 4. "Hands-On Artificial Intelligence for IoT: Expert machine learning and deep learning techniques for developing smarter IoT systems", by Amita Kapoor. Publisher: Packt Publishing Ltd. 2018. 5. "AIoT Innovation", ed. Fadi AI-Turjman. Publisher: Springer. 2020 6. "The Future of Artificial Intelligence, the Internet of Things, and Blockchain: From AI to AIoT to AIoTB". By Eugene Chang. Publisher: Amazon. 2019.	

Note 1: Intended Learning Outcomes
Intended learning outcomes should state what students should be able to do or attain upon subject completion. Subject outcomes are expected to contribute to the attainment of the overall programme outcomes.

Note 2: Subject Synopsis/Indicative Syllabus
The syllabus should adequately address the intended learning outcomes. At the same time, overcrowding of the syllabus should be avoided.

Note 3: Teaching/Learning Methodology
This section should include a brief description of the teaching and learning methods to be employed to facilitate learning, and a justification of how the methods are aligned with the intended learning outcomes of the subject.

Note 4: Assessment Method
This section should include the assessment method(s) to be used and its relative weighting, and indicate which of the subject intended learning outcomes that each method is intended to assess. It should also provide a brief explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes.

Subject Description Form

Subject Code	COMP4442
Subject Title	Service and Cloud Computing
Credit Value	3
Level	4
Pre-requisite / Co-requisite / Exclusion	**Pre-requisite**: 2421 Computer Organization & COMP 2432 Operating Systems, or equivalent subjects
Objectives	This is a fundamental course that provides students with the foundations of service and cloud computing, focusing on software development and applications. It covers the principles and concepts, the technical underpinnings and supporting technologies, and the best practices and applications. The objectives of this subject include: • To provide students with a broad view of the theoretical and technological aspects that has led to the evolution of service and cloud computing; • To teach students how service and cloud computing supports different forms of functionality that are essential to the modern IT industry, and the requirements of working with cloud computing environments and develop cloud-based services and applications; • To equip students with the underlying technologies of service and cloud computing including service-oriented architecture, cloud architecture and service models, virtualization, and cloud management; and • To equip students with the knowledge and skills for the planning, design and programming of cloud systems and software services for real-world applications.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: *Professional/academic knowledge and skills* (a) understand and appreciate the technological impact of service and cloud computing for future enterprises, and the technologies underpinning it; (b) apply systematic and principled practices to designing, implementing and deploying service and cloud-oriented computing; and (c) review and assess the risks, opportunities, costs and steps towards migrating existing systems to service and cloud computing. *Attributes for all-roundedness* (d) systematic and incremental approach to resolving practical enterprise computing problems and challenges; (e) learn to work effectively as a team member; and

<table>
<tr><td></td><td>(f) write technical reports and present solutions.</td></tr>
<tr><td>Subject Synopsis/ Indicative Syllabus</td><td>Topics:
1. Overview
The evolution of computing paradigms; Motivations and benefits of service and cloud computing; Definitions and principles of service and cloud computing; Applications of cloud computing.
2. Cloud Architecture and Service Models
Cloud architecture and major components; Physical infrastructure; Service models; Service provisioning;
3. Service and Cloud Computing Technology Foundation
Key technologies behind service and cloud computing; Resource sharing, scalability, multi-tenancy, and heterogeneity; Virtualization and Containerization; Cloud computing and service-orientation; Web Services, SOA, Web 2.0; Services co-ordination and composition, MSA, Devops, Agile; SDN.
4. Cloud Service Providers and Platforms
Services and functions provided by cloud service providers; Representative providers and platforms (Amazon, Microsoft, IBM, Google, Alibaba, etc); AWS (EC2, S3, CloudFront, composite services, etc);
5. Cloud-based Application Development
Concepts and principles: common cloud use cases; types of cloud services; support for cloud application development; principles of building cloud-based applications.
Methods and techniques: general procedure of cloud application development; paradigms of cloud applications (Web, Mobile, Content delivery, Event-driven, IoT, Big Data, Machine learning); Case study with AWS.
6. Cloud Management
Functionalities and requirements of cloud management; Core functions of cloud management; Platforms and tools for cloud management; Cloud security and data privacy.</td></tr>
<tr><td>Teaching/ Learning Methodology</td><td>The course is comprised of lectures, tutorials and laboratory exercises. During lectures, students are taught the important concepts and principles that drive the development of service computing, and how it connects to cloud. In the lecture, students are encouraged to actively participate in mini-discussions and questions that are designed to reinforce their understanding of concepts taught.
During tutorials, students will be presented with real and practical scenarios of enterprise case studies. In particular, they will be given the unique opportunities to study, analyze and propose solutions that leverage service and cloud computing</td></tr>
</table>

concepts. Small group discussions will be encouraged and students will need to present their results and solutions in the form of reports and presentations.

To reinforce practical aspects of their training, simple lab exercises will be conducted to expose students to the state-of-the-art tools and development environment that uses service and cloud computing as the underlying architecture to provide enterprise solutions.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b	c	d	e	f
1. Continuous Assessments	**55%**	✓	✓	✓	✓	✓	✓
2. Final Examination	**45%**	✓	✓	✓	✓		
Total	100%						

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Students taking the subject will be assessed by performance in two parts: continuous assessments and examination. Continuous assessment may include in-class discussions / quizzes, assignments, and tests.

The in-class discussions and quizzes engage students to actively participate in learning during lectures and tutorials. Students are to collaboratively work together to apply what they have learned in the class to solve practical problems. Assignment may include group projects that are designed to help students to work together in a small group to solve practical case studies and examples by applying concepts that are taught in the class. The results are to be presented in the form of reports and presentations. Tests and assignments are designed to help students reinforced their understanding of concepts and principles that are taught in the class. They are conducted to assess independent problem solving and critical thinking skills.

Student Study Effort Expected

Class contact:	
▪ Lectures, Tutorials / Labs	39 Hrs.
Other student study effort:	
▪ Assignments, Projects, Reading and Exam	66 Hrs.
Total student study effort	105 Hrs.

Reading List and References

Reference Books:

1. Chellammal Surianarayanan and Pethuru Raj Chelliah, *Essentials of Cloud Computing*, Springer, 2019.
2. Arshdeep Bahga and Vijay Madisetti, *Cloud Computing Solutions Architect: A Hands-On Approach*, Arshdeep Bahga & Vijay Madisetti, 2019.

	3. Articles from web, technical journals, and conference proceedings will be handed out or posted on L@PU Blackboard when needed.

Subject Description Form

Subject Code	CSE30313
Subject Title	Machine Learning Practice in Smart Mobility
Credit Value	3
Level	3
Pre-requisite	One basic mathematics subject* and one basic computer programming subject^ *AMA2007 Intermediate Calculus and Linear Algebra/ AMA2111 Mathematics I/ AMA2131 Mathematics for Engineers/ AMA2308 Mathematics for Engineers/ AMA2707 Intermediate Calculus and Linear Algebra/ AMA290 Engineering Mathematics ^AMA2222 Principles of Programming/ AMA2222A Principles of Programming / COMP1011 Programming Fundamentals/ COMP1012 Programming Fundamentals and Applications/ ENG2002 Computer Programming
Objectives	This subject aims to help students to learn the basic concepts in smart mobility, fundamentals in machine learning, and to obtain hands-on experience in developing smart mobility applications using emerging machine learning methods. Emphasis will be given to increase students' interest in smart mobility-related research on real-world scenarios.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) Understand the general concepts of smart mobility. (b) Apply emerging quantitative and machine learning technologies/ skills in smart mobility applications and develop solutions to smart mobility problems by applying the engineering research process. (c) Develop active learning, self-learning, and peer learning skills through project-based research inquiries. (d) Develop professional skills such as professional communication, teamwork, and time management.
Subject Synopsis/ Indicative Syllabus	This subject covers the following contents: 1. <u>Smart Mobility Concepts (1 week)</u> Overview of the concepts of smart mobility, emerging technologies in the era of big data analytics and urban informatics, and the state-of-the-art progress in smart mobility development in both Hong Kong and the rest of the world. This section mainly achieves the learning outcome (a). 2. <u>Review of Quantitative Methods (2 weeks)</u>

Review of the basic theory of optimization and statistical methods. This section mainly achieves the learning outcome (b).

3. Practical Implementation of Machine Learning Methods (4 weeks)

Understand and implement existing machine learning algorithms such as classification, regression, detection, and clustering with Jupyter Notebook; describe and analyze the performance of machine learning models; understand the practical implications in smart mobility. This section mainly achieves the learning outcome (b).

4. Hands-on Projects (6 weeks)

Project-based learning for hands-on projects that cover different perspectives in smart mobility, such as emerging mobility services and crowd-sensing. The hands-on projects particularly achieve the learning outcomes (b)(c)(d). Both projects are designed for students with and without machine learning backgrounds, and one example of the hands-on project is as follows:

- Autonomous driving with mAVs: this task challenges students to develop a framework that can automatically control mAVs to drive along the roads. The project requires the skills to write computer programs to control the mAVs, to formulate road lane detection algorithms as object detection and classification problems, and to collaborate with teammates in different backgrounds.

mAVs: mini-sized autonomous vehicles

Teaching/Learning Methodology

The subject is delivered using both lectures and projects. The lectures are used to explain basic concepts and theories in smart mobility and related machine learning applications. The projects are used to train students to integrate the previously learned subjects with hands-on experience, and to familiarize the students with state-of-the-art machine learning methods and research questions in smart mobility.

Students need to complete a set of assignments during the lectures, and the course project progress report, demonstration, as well as presentation are used to evaluate the project outcomes.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)			
		a	b	c	d
1. Assignments	20%	✓	✓		
2. Test	30%	✓	✓		
3. Course Project	50%	✓	✓	✓	✓
Total	100 %				

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

	Students will be assessed with continuous assessment. The continuous assessment consists of a set of assignments (20%), test (30%) and one course project (50%). Each assignment is designed to cover a particular aspect of quantitative skills and machine learning methods. The course project will be carried out in a group, but the performance of each student will be assessed individually. The performance assessment is based on progress updates, project demonstration, and oral presentation.	
Student Study Effort Expected	Class contact:	
	▪ Lecture	26 Hrs.
	▪ Tutorials / Project meeting	13 Hrs.
	Other student study effort:	
	▪ Reading and studying	20 Hrs.
	▪ Assignments	20 Hrs.
	▪ Course Project	40 Hrs.
	Total student study effort	119 Hrs.
Reading List and References	(1) Goldsmith, S., & Crawford, S. (2014). The responsive city: Engaging communities through data-smart governance. John Wiley & Sons (2) Bishop, B. (2006). Pattern Recognition and Machine Learning. Springer. (3) Hong Kong Smart City Blueprint: https://www.smartcity.gov.hk/ (4) Transport Department: https://www.td.gov.hk/en/home/index.html (5) Sidewalk Labs Toronto https://www.sidewalktoronto.ca/documents/	

Subject Description Form

Subject Code	CSE49407
Subject Title	Integrated Capstone Project
Credit Value	6
Level	4
Pre-requisite	All CSE subjects in level 3 and all core subjects in level 1-3 of AIDA (Secondary Major)
Exclusion	Any other equivalent capstone project
Objectives	The objectives of this subject are to: • provide a student with the opportunity to apply and integrate the knowledge of artificial intelligence and data analytics (AIDA) to his/her discipline. • develop the capabilities of a student in analyzing and solving complex and possibly real-life problems using AIDA. • Train students with skills on systematic development and documentation of a significant piece of work.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: Professional/academic knowledge and skills (a) conduct literature surveys to locate materials and sources relevant to the selected problem area in a specific discipline; (b) understand the materials obtained and connect the materials with the problem to be solved using AIDA knowledge and skills; (c) define and specify the problem precisely; (d) assimilate and apply the learnt knowledge to generate good solutions to the problem; (e) think critically the formulation of alternative models and solutions to the problem, in the analysis of approaches to the solution and their implementation; and (f) evaluate the final outcome in an objective manner; Attributes for all-roundedness (g) improve presentation and communication skills via oral presentation; (h) enhance technical report writing skills with proper organization of materials; (i) develop the ability to learn independently and to find/integrate information from different sources required in solving real-life problems; (j) manage the project efficiently and effectively through the supervision of supervisor(s); and (k) work collaboratively with related parties (e.g. vendors, sponsor company, technical support staff, team-partners, research students, etc.).
Subject Synopsis/ Indicative Syllabus	**1. In-depth Study of a Topic Typically Proposed by the Supervisor** **2. Project Meeting and Planning** **3. Proposal Writing** **4. Regular Progress Checking and Reporting** **5. Project Documentation** **6. Presentation and Demonstration** Students are expected to identify a project topic with a supervisor in their chosen discipline, and a co-supervisor with artificial intelligence and data analytics expertise. Students need to demonstrate their knowledge in both their chosen discipline and AIDA

<table>
<tr><td></td><td>in the project, receiving advice from both supervisors. The project should represent requisite effort in analysing and interpreting the data/information obtained, using the principles and techniques learnt from various related subjects. Students are also expected to demonstrate significant analytical and, preferably, research ability in the chosen application domain.</td></tr>
<tr><td>Teaching/Learning Methodology</td><td>The Integrated Capstone Project spans across the academic year for two consecutive semesters. The teaching/learning activities include regular project meetings with the supervisor and the co-supervisor, guided study of project materials, independent project development work and other project management tasks.</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="11">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td>g</td><td>h</td><td>i</td><td>j</td><td>k</td></tr>
<tr><td>Continuous Assessment</td><td>100</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Total</td><td>100</td><td colspan="11"></td></tr>
</table>

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The Integrated Capstone Project will be accessed by the supervisor/co-supervisor and other assessors. Attributes to be assessed include, but not limited to, Problem Identification, Problem Solving, Communication and Presentation, Project Management, and Self-Discipline.

Integrated Capstone Projects should be problem-oriented and there are no restrictions on the nature of the problem except that it should be relevant to the student’s chosen discipline and AIDA. The project could be practical, academic or a hybrid in which the student is encouraged but not constrained to have some original contributions. Each student has to submit a proposal, a mid-term checkpoint progress report and a final report. The proposal must be approved by the supervisor/co-supervisor before the student can proceed with the Integrated Capstone Project. An oral presentation and demonstration is essential at the end of the project. A mid-term presentation and demonstration may also be required for proper continuous assessment.
</td></tr>
<tr><td rowspan="5">Student Study Effort Expected</td><td colspan="2">Class contact:</td></tr>
<tr><td>• Lecture</td><td>0 Hrs.</td></tr>
<tr><td colspan="2">Other student study effort:</td></tr>
<tr><td>• Searching and reading materials, meeting with supervisor / co-supervisor / others, design and system development, testing, documentation, presentation, etc.</td><td>210 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>210 Hrs</td></tr>
</table>

Reading List and References	**Reference Books:** 1. Kumar, Ranjit, *Research Methodology: A Step-by-step Guide for Beginners*, 3rd Edition, SAGE Publications, 2011. 2. Burns, Robert B., *Introduction to Research Methods*, 4th Edition, SAGE Publications, 2000. 3. Roberts, Carol M., *The Dissertation Journey: A Practical and Comprehensive Guide to Planning, Writing, and Defending Your Dissertation*, 3rd Edition, Corwin Press, 2007. 4. Mauch, James E. and Park, Namgi, *Guide to the Successful Thesis and Dissertation: A Handbook for Students and Faculty*, 5th Edition, Marcel Dekker, 2003. 5. Rudestam, Kjell Erik and Newton, Rae R., *Surviving Your Dissertation: A Comprehensive Guide to Content and Process*, 2nd Edition, Sage Publications, 2001. 6. Garson, G. David, *Guide to Writing Empirical Papers, Theses and Dissertations*, Marcel Dekker, 2002. 7. Reinhart, Susan M., *Giving Academic Presentations*, 2nd Edition, University of Michigan Press, 2013. 8. Oshima, Alice and Hogue, Ann, *Writing Academic English*, 4th Edition, Pearson Longman, 2006. 9. American Psychological Association. *Publication Manual of the American Psychological Association*, 6th Edition, American Psychological Association, 2010. 10. Szuchman, Lenore T., *Writing with Style: APA Style Made Easy*, 5th Edition, Wadsworth/Cengage Learning, 2011. 11. Statistics, simulation, programming, and relevant books. 12. ACM and IEEE magazines, Transactions and Journals. 13. Other International Journals. 14. Relevant conference proceedings and magazines (including ACM and IEEE conferences). 15. Technical reports from universities and major companies.

The Hong Kong Polytechnic University

Subject Description Form

Subject Code	EE3013B
Subject Title	Transportation Data Analytics
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	Co-requisite: EE2029B
Objectives	1. To introduce various types of transportation data and ways to use the data to assess, analyze, and assist the modeling of transportation systems. 2. To equip the students with modeling and analysis techniques for transportation data. 3. To enable the students to understand problems and issues in real-world transportation data and methods to deal with them. 4. To prepare the students for tackling real-world transportation problems using data, with a combination of deep understanding of data issues and solid analytical skills.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Demonstrate theoretical knowledge of transportation data analytics b. Apply appropriate data analytics methods and tools to various types of transportation data and interpret the results c. Understand problems and issues in real-world data and ways to tackle those problems and issues
Subject Synopsis/ Indicative Syllabus	1. Diagnosis of roadway traffic using fixed-location sensor data and floating vehicle sensor data, bottleneck detection, and delay calculation 2. Estimation of vehicle queue length and delay at traffic signals 3. Modeling passenger and vehicle traffic using Bluetooth and Wi-Fi sensor data 4. Understanding transit passenger behavior using ridership data, travel time estimation 5. Modeling travel behavior using travel survey data, discrete choice model, regression

Teaching/Learning Methodology

Delivery of the subject is mainly through formal lectures and complemented by tutorials. Assignments and projects provide students hands-on experience in data modelling, estimation, and analysis of practical transportation problems, while report-writing enables students to practise writing skill.

Teaching/Learning Methodology	Outcomes		
	a	b	c
Lectures	✓	✓	✓
Tutorials	✓	✓	✓
Assignments and Projects	✓	✓	✓

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed		
		a	b	c
1. Individual assignments	60%	✓	✓	✓
2. Group projects	40%	✓	✓	✓
Total	100 %			

Individual assignments and group projects enable students to explore and apply analytical and tool-based data modelling techniques to evaluate transportation systems' characteristics and performance. Report-writing (for both individual assignments and group projects) enables students to interpret the data analysis results, link them to practical issues in transportation systems and find solutions.

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial	39 Hrs.
Other student study effort:	
▪ Individual assignments and Group Projects	35 Hrs.
▪ Self-study	33 Hrs.
Total student study effort	107 Hrs.

Reading List and References

1. Richard J. Larsen and Morris L. Marx, An Introduction to Mathematical Statistics and Its Applications, 5th Edition, Prentice Hall, 2012.
2. Robert S. Pindick and Daniel L. Rubinfeld, Econometric Models and Economic Forecasts, 4th Edition, Irwin/McGraw-Hill, 1998.
3. Jeremy Watt, Reza Borhani and Aggelos K. Katsaggelos, Machine Learning Refined: Foundations, Algorithms, and Applications, Cambridge University Press, 2016.
4. Marco Gori, Machine Learning: A Constraint-Based Approach, Morgan Kaufmann, 2017.

The Hong Kong Polytechnic University

Subject Description Form

Subject Code	EE4014A
Subject Title	Intelligent Systems Applications in Electrical Engineering
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	To introduce students to the fundamentals of intelligent systems and their applications in Electrical Engineering.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Have acquired a good understanding of the fundamental concepts and characteristics and methodologies of intelligent systems. b. Be able to appreciate the power and usefulness of intelligent systems. c. Be able to understand various intelligent system techniques such as expert systems, evolutionary computation, and neural network. d. Be able to integrate the intelligent system approaches in real-life problems. e. Have acquired skills in presentation and interpretation of mini-project results and communicate in written form.
Subject Synopsis/ Indicative Syllabus	1. ***Knowledge-based intelligent system*:** Concepts. Knowledge representation techniques. Structure of a rule-based expert system. Forward and backward chaining inference techniques. 2. ***Artificial neural network*:** Concepts. Perceptron. Multi-layer neural network. Training of neural networks. Recurrent and convolutional neural network. Supervised and unsupervised learning. 3. ***Evolutionary computation*:** Concepts. Genetic algorithm. Particle swarm optimization. 4. ***Applications of intelligent systems***. **Mini-project:** Apply the introduced intelligent system techniques to solve an engineering problem

Teaching/Learning Methodology

Lectures and tutorials are the primary means of conveying the basic concepts and theories. Experiences on system analysis, design and practical applications are given through mini-projects, in which the students are expected to solve the engineering problems using intelligent techniques with critical and analytical thinking. Mini-projects are designed to supplement the lecturing materials so that the students are encouraged to take extra readings and to look for relevant information.

Teaching/Learning Methodology	Outcomes				
	a	b	c	d	e
Lectures	✓	✓	✓	✓	
Tutorials	✓	✓	✓	✓	
Mini-projects	✓	✓	✓	✓	✓

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed				
		a	b	c	d	e
1. Examination	40%	✓	✓	✓	✓	
2. Class Test	25%	✓	✓	✓		
3. Mini-project Report and Presentation	25%	✓	✓	✓	✓	✓
4. Exercises	10%	✓	✓	✓		
Total	100%					

The outcomes on concepts, design and applications are assessed by the usual means of examination, test and exercises. Mini-projects and written report assess those on analytical skills, problem-solving techniques and practical considerations of intelligent system applications, as well as technical reporting, teamwork and presentation skills.

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial	33 Hrs.
▪ Mini-project presentation	6 Hrs.
Other student study effort:	
▪ Mini-project preparation/report	16 Hrs.
▪ Self-study	50 Hrs.
Total student study effort	105 Hrs.

Reading List and References

Reference books:

1. K.Y. Lee and M.A. El-Sharkawi, Modern Heuristic Optimization Techniques: Theory and Applications to Power Systems, Wiley-IEEE Press, 2008
2. M. Negnevitsky, Artificial Intelligence - A Guide to Intelligent Systems, Addison-Wesley, 2011
3. S. Samarasinghe, Neural Networks for Applied Sciences and Engineering: from Fundamentals to Complex Pattern Recognition. Auerbach Publications, 2016

Subject Description Form

Subject Code	EE4023
Subject Title	Integrated Capstone Project
Credit Value	6
Level	4
Pre-requisite / Co-requisite/ Exclusion	**Exclusion**: Any other equivalent capstone project **Pre-requisite:** The student should have completed most of the subjects required in previous years of the programme before taking this subject. **Co-requisite:** EE4014A
Objectives	The objectives of this subject are to: • provide a student with the opportunity to apply and integrate the knowledge of artificial intelligence and data analytics (AIDA) in electrical or transportation engineering. • develop the capabilities of a student in analyzing and solving complex and possibly real-life problems using AIDA. • Train students with skills on systematic development and documentation of a significant piece of work.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: <u>Professional/academic knowledge and skills</u> (a) conduct literature surveys to locate materials and sources relevant to the selected problem area in a specific discipline; (b) understand the materials obtained and connect the materials with the problem to be solved using AIDA knowledge and skills; (c) define and specify the problem precisely; (d) assimilate and apply the learnt knowledge to generate good solutions to the problem; (e) think critically the formulation of alternative models and solutions to the problem, in the analysis of approaches to the solution and their implementation; and (f) evaluate the final outcome in an objective manner; <u>Attributes for all-roundedness</u> (g) improve presentation and communication skills via oral presentation; (h) enhance technical report writing skills with proper organization of materials; (i) develop the ability to learn independently and to find/integrate information from different sources required in solving real-life problems; (j) manage the project efficiently and effectively through the supervision of supervisor(s); and (k) work collaboratively with related parties.
Subject Synopsis/ Indicative Syllabus	**1. In-depth Study of a Topic Typically Proposed by the Supervisor** **2. Project Meeting and Planning** **3. Proposal Writing** **4. Regular Progress Checking and Reporting** **5. Project Documentation** **6. Presentation and Demonstration** Students are expected to identify a project topic with a supervisor in their chosen discipline. Students need to demonstrate their knowledge in both their chosen discipline and AIDA in the project, receiving advice from the supervisor. The project should

represent requisite effort in analysing and interpreting the data/information obtained, using the principles and techniques learnt from various related subjects. Students are also expected to demonstrate significant analytical and, preferably, research ability in the chosen application domain.

Teaching/Learning Methodology

The Integrated Capstone Project spans across the academic year for two consecutive semesters. The teaching/learning activities include regular project meetings with the supervisor, guided study of project materials, independent project development work and other project management tasks.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)										
		a	b	c	d	e	f	g	h	i	j	k
Continuous Assessment	100	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Total	100											

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The Integrated Capstone Project will be accessed by the supervisor/co-supervisor and other assessors. Attributes to be assessed include, but not limited to, Problem Identification, Problem Solving, Communication and Presentation, Project Management, and Self-Discipline.

Integrated Capstone Projects should be problem-oriented and there are no restrictions on the nature of the problem except that it should be relevant to the student's chosen discipline and AIDA. The project could be practical, academic or a hybrid in which the student is encouraged but not constrained to have some original contributions. Each student has to submit a proposal, a mid-term progress report and a final report. The proposal must be approved by the supervisor/co-supervisor before the student can proceed with the Integrated Capstone Project. A mid-term oral presentation and demonstration is required for proper continuous assessment. An oral presentation and demonstration is essential at the end of the project.

Student Study Effort Expected

Class contact:	
• Briefing	2 Hrs.
Other student study effort:	
• Searching and reading materials, meeting with supervisor / co-supervisor / others, design and system development, testing, documentation, presentation, etc.	208 Hrs.
Total student study effort	210 Hrs

Reading List and References

Reference Books: To be advised by supervisor

Subject Description Form

Subject Code	EIE1003
Subject Title	Foundations of Data Science
Credit Value	3
Level	1
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	Being able to discover useful knowledge and information from a large amount of data is very critical to industry, business and government. This subject aims to provide students the fundamental concepts of data science and the basic technologies for data analytics. It provides hands-on experiences in data analytics and case studies in applications of data science in engineering, social science, healthcare, business and government. It also prepares students with the right mentality towards data and the ability to leverage data for decision-making.
Intended Subject Learning Outcomes	**Upon completion of the subject, students will be able to:** Category A: Professional/academic knowledge and skills 1. Understand the basic concepts and technologies of data science. 2. Acquire the basic technical know-how on data analytics. Category B: Attributes for all-roundedness 3. Understand the data-driven process for problem solving. 4. Demonstrate how to harness and process data for decision-making.
Subject Synopsis/ Indicative Syllabus	1. Introduction to Data Science • Data science vs. big data vs. data analytics • Benefits of data science • Skill sets required • Privacy, security and ethics • Example applications and case studies 2. Technologies for Data Science • Basic concepts in summary statistics • Graphs and plots for data analytics, e.g., box plots, scatter plots, histograms, run charts, etc. • Example case studies of exploratory data analytics for data science • Fundamental of machine learning for data science • Cloud technologies 3. Tools for Data Science • Data cleaning, e.g., OpenRefine • Machine learning tools, e.g., Microsoft ML Studio, Weka • Data visualization tools, e.g., Google Chart, Tableau 4. Applications with Case Studies • Recommendation systems • Spam filtering • Stock prediction • Social networks • Sentiment analysis
Teaching/Learning Methodology	**Lectures**: The subject matters will be delivered through lectures (both in-person and online ones). Students will be engaged in the lectures through Q&A, discussions and specially designed classroom activities. Practitioners and software vendors will be invited to give guest lectures. **Tutorials and Workshops**: Students will work on data analytics projects using

software tools. Students will start from small and easy projects in the first half of the subject. In the second half, students will work on a more realistic project that solves real-world problems, using the knowledge and know-hows that they have learnt from the small projects.

Assignment: Students will need to do a group-based mini-project on data science.

Assessment Methods in Alignment with Intended Subject Learning Outcomes

Specific Assessment Methods/Tasks	**% Weighting**	**Intended Subject Learning Outcomes to be Assessed (Please tick as appropriate)**			
		1	**2**	**3**	**4**
1. Continuous Assessment (total: 100%)					
• Mini-project (proposal, report and presentation)	30%	✓	✓	✓	✓
• Exercises	16%	✓	✓		
• Tests	24%	✓	✓		
• Laboratory activities	30%	✓	✓	✓	✓
Total	100%				

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Laboratory exercises and mini-project will require students to apply what they have learnt to solve problems. There will be open-ended questions that allow students to exercise their creativity in solution design.

Tests and Exercises assess students' achievement of the learning outcomes in a more formal manner.

Mini-project is group-based and weights 30% of the whole assessment. Among the 30% weight, 7% is for proposal, 13% is for final report, and 10% is for presentation (in the form of a 10-minutes video). Proposal and report (20% in total) are evaluated based on group, while presentation (10%) is evaluated individually. Each group member will present the part he/she is responsible for in the mini-project. The mini-project will make use of publicly available tools such as Microsoft Azure Machine Learning Studio so that requirements on programming knowledge is kept to a minimum, i.e., no programming background is assumed. Students will perform drag and drop of data sources, machine learning models, analytic methods, and evaluation methods from the tool to solve data science problems. Enthusiastic students could use the cloud-based API to perform more complex tasks.

Tests and Exercises weight 40% and they are individual assessments.

Laboratory activities weight 30% and they are individual assessments.

Overall, 80% of the assessment is individual assessment and 20% is group-based assessment.

Student Study Effort Expected

Class contact (time-tabled):	
• Lectures (In-person and online)	22 Hours
• Tutorial/Laboratory/Practice Classes	17 Hours
Other student study effort:	
• Lecture: preview/review of notes; homework/assignment; preparation for test/quizzes	30 Hours

	• Tutorial/Laboratory/Practice Classes: preview of materials, revision and/or reports writing	36 Hours
	Total student study effort:	**105 Hours**
Reading List and References	**Reference Materials:** 1. L. Cao, *Data Science Thinking: The Next Scientific, Technological and Economic Revolution*. Cham: Springer International Publishing, 2018. 2. L. Igual and S. Sequi, *Introduction to Data Science : a Python Approach to Concepts, Techniques and Applications*. Cham, Switzerland: Springer, 2017. 3. S. Alan and V. Torra, *Data Science in Practice*. Cham, Switzerland: Springer 2019. 4. G. Rebala, A. Ravi, and S. Churiwala, *An Introduction to Machine Learning*. Cham, Switzerland: Springer 2019. 5. P. Kromer and R. Jurney, *Big Data for Chimps*. O'Reilly, 2016. 6. T. Ojeda et al., *Practical Data Science Cookbook*. Packt Publishing Ltd, 2014. 7. A. Adhikari and J. DeNero, *Computational and Inferential Thinking: The Foundations of Data Science*. https://www.inferentialthinking.com/	

Subject Description Form

Subject Code	EIE3124
Subject Title	Fundamentals of Machine Intelligence
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To introduce basic knowledge about various algorithms that forms the foundation of machine intelligence. 2. To develop practical knowledge about machine intelligence.
Intended Subject Learning Outcomes	**Upon completion of the subject, students will be able to:** Category A: Professional/academic knowledge and skills 1. Understand the foundation knowledge about machine intelligence 2. Apply different techniques of machine intelligence to solve problems Category B: Attributes for all-roundedness 3. Presents ideas and findings effectively
Subject Synopsis/ Indicative Syllabus	**Syllabus:** 1. Introduction to machine intelligence Ideas of machine intelligence; Use of statistics in various phases of machine intelligence including data preparation, model selection, model evaluation, model presentation and prediction. 2. Use of statistics in machine intelligence Descriptive statistics; inferential statistics; Important findings in statistics for machine intelligence such as the Law of Large Numbers and Central Limit Theorem. 3. Parametric estimation Introduction to parametric estimation; classical parametric estimation such as Bayes Theorem, hypothesis testing and significance tests; Application examples of parametric estimation in machine intelligence including data pre-processing, parametric identification, model generation, validation and selection criteria. 4. Linear approaches Introduction to basic ideas of linear approaches for regression in machine intelligence; Introduction to techniques such as univariate linear model, least-squares estimation and maximum likelihood estimation. Application examples of linear regression techniques. 5. Nonlinear approaches Introduction to basic ideas of nonlinear approaches for regression in machine intelligence; Introduction to techniques such as artificial neural networks and radial basis functions. Application examples of nonlinear approaches for regression. Laboratory experiments: 1. Lab 1: Use of statistics in machine intelligence 2. Lab 2: Parametric estimation 3. Lab 3: Linear approaches for regression in machine intelligence

Teaching/ Learning Methodology

Teaching and Learning Method	**Intended Subject Learning Outcome**	**Remarks**
Lectures	1, 2	Fundamental principles and key concepts of the subject are delivered to students.
Tutorials	1, 2	Supplementary to lectures: Students will be able to clarify concepts and to have a deeper understanding of the lecture materials; Problems and applications are given and discussed.
Laboratory sessions	2, 3	Students will evaluate different methods of machine intelligence.

Assessment Methods in Alignment with Intended Subject Learning Outcomes

Specific Assessment Methods/ Task	**% Weighting**	**Intended Subject Learning Outcomes to be Assessed (Please tick as appropriate)**		
		1	**2**	**3**
1. Continuous Assessment (total 40%)				
• Tests	18%	√	√	
• Short quizzes	10%	√		
• Laboratory sessions	12%		√	√
2. Examination	60%	√	√	
Total	100%			

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Specific Assessment Methods/Tasks	**Remark**
Short quizzes and assignments	They can measure the students' understanding of the theories and concepts as well as their comprehension of subject materials.
Tests and examination	End-of-chapter-type problems are used to evaluate the students' ability in applying concepts and skills learned in the classroom; Students need to think critically and to learn independently in order to come up with an alternative solution to an existing problem. They need to present their solutions logically and systematically in the tests and the examination.
Laboratory sessions	Oral examination based on laboratory exercises will be conducted to evaluate student's technical knowledge and communication skills.

Student Study Effort Expected	**Class contact (time-tabled):**	
	• Lecture	24 Hours
	• Tutorial/Laboratory/Practice Classes	15 hours
	Other student study effort:	
	• Lecture: preview/review of notes; homework/assignment; preparation for test/quizzes/examination	36 Hours
	• Tutorial/Laboratory/Practice Classes: preview of materials, revision and/or reports writing	30 Hours
	Total student study effort:	**105 Hours**
Reading List and References	1. Jose Unpingco, Python for Probability, Statistics, and Machine Learning, second edition, Springer, 2019. 2. Steven W. Knox and Hoboken NJ, Machine learning: a concise introduction, Wiley 2018. 3. James D. Miller, Statistics for Data Science: leverage the power of statistics for data analysis, classification, regression, machine learning, and neural networks, Packt Publishing, 2017. 4. Pratap Dangeti, Statistics for machine learning: build supervised, unsupervised, and reinforcement learning models using both Python and R, Packt Publishing, 2017. 5. 5. Machine Learning: a Probabilistic Perspective by Kevin Murphy, MIT Press, 2012.	

Subject Description Form

Subject Code	EIE3127
Subject Title	Artificial Intelligence of Things
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	EIE2112 Foundation Techniques in Artificial Intelligence EIE2113 Introduction of IoT
Objectives	1. To introduce major application scenarios of artificial intelligence of things (AIoT) and their societal impacts. 2. To introduce AI techniques for AIoT applications. 3. To introduce communication, networking, and computing technologies for AIoT.
Intended Subject Learning Outcomes	**Upon completion of the subject, students will be able to:** Category A: Professional/academic knowledge and skills 1. Understand key features of AIoT systems and design principles. 2. Understand AI techniques, cloud/edge computing platforms, and wireless communication and networking techniques for AIoT. 3. Understand key application scenarios of AIoT and their social impacts. Category B: Attributes for all-roundedness 4. Think critically and creatively. 5. Assimilate new technological development in related field.
Subject Synopsis/ Indicative Syllabus	1. AIoT Basics: Key features of AIoT; Applications of AIoT; Market and ecosystem of AIoT. 2. Communication and Networking for AIoT: Wireless communications and networking for AIoT; Communication standards and protocols for AIoT. 3. Machine Learning for IoT: Introduction of basic machine learning techniques for AIoT. 4. AIoT Devices: Onboard processors; Onboard sensors; Communication modules; AI accelerators. 5. Cloud/edge Computing for AIoT: Cloud computing platforms; edge computing platforms. 6. Techniques for Resource-constrained AIoT Devices: Neural network compression; Edge computing-assisted inference. 7. AIoT application scenarios: Smart City; Industrial automation; Smart health; Internet of Vehicles.

Teaching/Learning Methodology

The basic features of AIoT will be described and explained in lectures. Supporting techniques, including wireless communication and networking, cloud/edge computing, as well as machine learning techniques, will be presented in lectures and tutorials. The application scenarios of AIoT will be introduced in lectures. Tutorial and lab sessions will be conducted to deliver hands-on skills on AIoT applications. The assignments and lab exercises will help students review the knowledge taught in class.

Teaching/Learning Methodology	Intended Subject Learning Outcomes				
	1	2	3	4	5
Lectures / Tutorials /Test	✓	✓	✓	✓	
Laboratory			✓	✓	✓

Assessment Methods in Alignment with Intended Subject Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)				
		1	2	3	4	5
1. Assignments	25%	✓	✓	✓	✓	
2. Test	15%	✓	✓	✓		
3. Laboratory	20%			✓	✓	✓
4. Examination	40%	✓	✓	✓		
Total	100%					

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Assignments, test, and examination let students review the taught materials, do further reading for deeper learning and apply the learnt materials to solving problems for AIoT systems.

Laboratory requires students to do further reading, search for information, and develop AIoT applications.

Student Study Effort Expected

Class contact (time-tabled):	
• Lectures	27 Hours
• Tutorial/Laboratory	12 Hours
Other student study effort:	
• Lecture: preview/review of notes; assignment; preparation for test/examination	36 Hours
• Tutorial/Laboratory: preview of materials, revision and/or reports writing	30 Hours
Total student study effort:	**105 Hours**

Reading List and References	**Textbook:** 1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos and David Boyle, *From Machine-To-Machine to the Internet of Things: Introduction to a New Age of Intelligence*, Academic Press, 2014. 2. Gurjit Kaur, Pradeep Tomar, and Marcus Tanque, *Artificial Intelligence to Solve Pervasive Internet of Things Issues*, Academic Press, 2020. 3. Yaser S. Abu-Mostafa, Malik Magdon-Ismail, and Hsuan-Tien Lin, *Learning from Data*, AMLBook, 2017. **Reference Materials:** 1. J. Gubbi, R. Buyya, S. Marusic, and M. Palaniswami, “Internet of Things (IoT): A vision, architectural elements, and future directions,” Future Gener. Comput. Syst., vol. 29, no. 7, pp. 1645–1660, Sep. 2013. 2. A. A. Fuqaha, M. Guizani, M. Mohammadi, M. Aledhari, and M. Ayyash, “Internet of Things: A survey on enabling technologies, protocols, and applications,” IEEE Commun. Surveys Tuts., vol. 17, no. 4, pp. 2347–2376, 4th Quart., 2015.
Last Updated	June 2021
Prepared by	ZHANG, Jun

Subject Description Form

Subject Code	EIE4121
Subject Title	Machine Learning in Cyber-security
Credit Value	3
Level	4
Pre-requisite	Nil
Co-requisite/ Exclusion	Nil
Objectives	1. To introduce concepts about machine learning techniques in cyber-security 2. To develop skills of using recent techniques for solving practical problems in cyber-security
Intended Learning Outcomes	**Upon completion of the subject, students will be able to:** Category A: Professional/academic knowledge and skills 1. Understand different machine learning techniques 2. Use different techniques for solving problems in cyber security Category B: Attributes for all-roundedness 3. Present ideas and findings effectively
Subject Synopsis/ Indicative Syllabus	**Syllabus:** 1. Machine learning techniques Introduction to machine learning; Basic concepts and classification; Supervised learning and unsupervised learning; classification; clustering; Neural Networks; Support vector machines; Dimensionality reduction; Deep learning 2. Machine learning development environments Software tools for implementing machine learning techniques; Generalization performance; Issues of over-fitting. 3. Malware Analysis Introduction to malware analysis; Types of malware analysis; static analysis, dynamic analysis; Behavioral vs code analysis; Use of machine learning techniques for malware detection such as K-Means, support vector machines, convolutional neural networks. 4. Phishing detection Introduction to phishing detection; Analysis of email/websites/message features for phishing characterization; Use of techniques such as logistic regression and decision tree for phishing detection. 5. Anomaly Detection Introduction to the anomaly definition; overview of anomaly detection techniques; static rules technique; use of machine learning techniques such as autoencoder for anomaly detection. **Laboratory Experiments:** Practical Works: 1. Evaluation of machine learning techniques in malware detection 2. Evaluation of machine learning techniques in phishing detection Forensic analysis of digital evidence.

Teaching/Learning Methodology

Teaching and Learning Method	Intended Subject Learning Outcome	Remarks
Lectures	1, 2	Fundamental principles and key concepts of the subject are delivered to students.
Tutorials	1, 2	Supplementary to lectures; Students will be able to clarify concepts and to have a deeper understanding of the lecture material; Problems and application examples are given and discussed.
Laboratory sessions	2, 3	Students will evaluate different kinds of machine learning techniques.
Mini-project	1, 2, 3	Students are required to study the use of machine learning techniques in cyber-security application. Students will need to submit a written report and make a presentation.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific Assessment Methods/Tasks	% Weighting	Intended Subject Learning Outcomes to be Assessed (Please tick as appropriate)		
		1	2	3
1. Continuous Assessment (total 50%)				
• Tests	17%	√	√	
• Short quizzes	10%	√	√	
• Laboratory sessions	5%		√	√
• Mini-project	18%		√	√
2. Examination	50%	√	√	
Total	100%			

The continuous assessment consists of tests, short quizzes, laboratory exercises and a mini-project.

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Specific Assessment Methods/Tasks	Remark
Short quizzes	These can measure students' understanding of the theories and concepts as well as their comprehension of subject materials.
Tests and examination	end-of chapter type problems used to evaluate students' ability in applying concepts and skills learnt in the classroom; students need to think critically in order to come with a solution for a problem.
Laboratory sessions, mini-project	oral examination will be conducted to evaluate student's technical knowledge and communication skills.

Student Study Effort Expected	**Class contact (time-tabled):**	
	• Lecture	24 Hours
	• Tutorial/Laboratory/Practice Classes	15 Hours
	Other student study effort:	
	• Lecture: preview/review of notes; homework/assignment; preparation for test/quizzes/examination	26 Hours
	• Tutorial/Laboratory/Practice Classes: preview of materials, revision and/or reports writing	40 Hours
	Total student study effort:	**105 Hours**
Reading List and References	1. Mark Stamp, Introduction to Machine Learning with Applications in Information Security, Chapman and Hall/CRC, 2017. 2. Chiheb Chebbi, Mastering Machine Learning for Penetration Testing, Packt Publishing Ltd, 2018. 3. Sumeet Dua and Xian Du, Data Mining and Machine Learning in Cybersecurity, Auerbach Publications, 2011. 4. Monnappa K A, Learning Malware Analysis, Packt Publishing Ltd, 2018. 5. Dipanjan Sarkar, Raghav Bali and Tushar Sharma, Practical Machine Learning with Python, Apress, 2018.	

Subject Description Form

Subject Code	EIE4122
Subject Title	Deep Learning and Deep Neural Networks
Credit Value	3
Level	4
Pre-requisite	EIE3124 Fundamentals of Machine Intelligence OR AMA2104 Probability and Engineering Statistics
Co-requisite/ Exclusion	Nil
Objectives	This course is for students who would like to equip themselves with cutting edge AI knowledge and knowhow that facilitate them to join the AI profession. Students will learn the foundations of deep learning and understand how to construct deep neural networks for real-world applications and AI systems. Students will also learn the major trends in deep learning and deep neural networks.
Intended Subject Learning Outcomes	**Upon completion of the subject, students will be able to:** Category A: Professional/academic knowledge and skills 1. Understand the benefits of deep learning and deep neural networks. 2. Understand the basic theories in deep learning and adversarial learning. 3. Understand how deep learning and deep neural networks are applied in real-world applications and AI systems. Category B: Attributes for all-roundedness 4. Understand the creative process when designing solutions to a problem.
Subject Synopsis/ Indicative Syllabus	1. A High-Level Perspective of Deep Learning and Deep Neural Networks 1.1 What are neural networks and deep neural networks? 1.2 Relationship among AI, machine learning, deep learning, and DNNs 1.3 Neural networks: From shallow to deep 1.4 How DNNs learn from data? 1.5 Examples of real-life applications 1.6 Pipeline and tools for building AI systems 2. Neural Networks and Deep Neural Networks 2.1 Vectors, matrices, tensors; vector space. 2.2 Perceptrons and multi-layer perceptrons 2.3 Geometric interpretation 2.4 Non-linear activation functions and their roles 2.5 Neural networks for classification and regression 2.6 Autoencoder 2.7 Attention mechanism 3. Deep Learning 3.1 Basic loss functions: MSE and cross-entropy (softmax) loss 3.2 Advanced loss functions: triplet, center, angular, and large-margin softmax loss 3.3 Gradient-based optimization: SGD, AdaGrad, RMSProp, Adam 3.4 Backpropagation 3.5 Weight initialization: pre-training and Xavier 3.6 Batch normalization 3.7 Regularization: Dropout, weight decay, L1 and L2, data augmentation, and early stopping 3.8 Internal representation 3.9 representation learning

4. Convolutional Neural Networks (CNNs)
    4.1 Structure of CNNs
    4.2 Why convolution
    4.3 Internal representation of CNNs
    4.4 Applications of CNNs: object recognition, speech recognition, ECG classification, etc.
    4.5 Interpretability and visualization of CNNs
    4.6 Time-delay neural networks

5. Recurrent Neural Networks (RNNs)
    5.1 Structure of RNNs
    5.2 Purpose of recurrent connections
    5.3 Long-short term memory (LSTM)
    5.4 Gated recurrent unit (GRU)
    5.5 Applications of RNNs: machine translation, sentiment analysis, etc.
    5.6 Attention in RNN

6. Applications of Deep Learning
    6.1 Healthcare
    6.2 Finance
    6.3 Computer vision
    6.4 Natural Language Processing
    6.5 Marketing and advertising
    6.6 Self-driving cars

7. Software and Hardware Tools
    7.1 Software stack: CUDA, cuDNN, Tensorflow, PyTorch, and Keras
    7.2 Cloud platforms: Amazon EC2 P3, Azure, Google Cloud, Nvidia GPU cloud, Alibaba Cloud, etc.
    7.3 Hardware: GPU, TPU, Nvidia Jetson

Teaching/Learning Methodology

Lectures: The subject matters will be delivered through lectures. Students will be engaged in the lectures through Q&A, discussions and specially designed classroom activities. The background theories on DL and DNNs will be accompanied by various real-applications.

Tutorials: During tutorials, students will work on/discuss some chosen topics. This will help strengthen the knowledge taught in lectures.

Laboratory and assignments: During laboratory exercises, students will perform hands-on tasks to practice what they have learned. They will evaluate performance of systems and design solutions to problems. The assignments will help students to review the knowledge taught in class.

While lectures and tutorials will help to achieve the professional outcomes, the open-ended questions in laboratory exercises and assignments will provide the chance for students to exercise their creatively in problem solving.

Assessment Methods in Alignment with Intended Subject Learning Outcomes

Specific Assessment Methods/Tasks	**% Weighting**	**Intended Subject Learning Outcomes to be Assessed (Please tick as appropriate)**			
		1	**2**	**3**	**4**
1. Continuous Assessment (total: 50%)					
• Homework and assignments	15%	✓	✓	✓	✓
• Tests and Quizzes	20%	✓	✓	✓	
• Laboratory exercises	15%			✓	✓
2. Examination	50%	✓	✓	✓	✓
Total	100%				

	Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes: Assignment, homework and laboratory exercises will require students to apply what they have learnt to solve problems. There will be open-ended questions that allow students to exercise their creativity in making design. Examination and tests: They assess students' achievement of the learning outcomes in a more formal manner.	
Student Study Effort Expected	**Class contact (time-tabled):**	
	• Lecture	24 Hours
	• Tutorial/Laboratory/Practice Classes	15 Hours
	Other student study effort:	
	• Lecture: preview/review of notes; homework/assignment; preparation for test/quizzes/examination	36 Hours
	• Tutorial/Laboratory/Practice Classes: preview of materials, revision and/or reports writing	30 Hours
	Total student study effort:	**105 Hours**
Reading List and References	**Reference Materials:** 1. I. Goodfellow, Y. Bengio and A. Courville, *Deep Learning*, MIT Press 2016 2. M.W. Mak and J.T. Chien, *Machine Learning for Speaker Recognition*, Cambridge University Press, 2020. 3. C.M. Bishop, *Pattern Recognition and Machine Learning*, Springer, 2006. 4. J. Langr and V. Bok, *GANs in Action*: *Deep Learning with Generative Adversarial Networks (GANs)*, Manning Publications, 2018. 5. F. Chollet, *Deep Learning with Python*, Manning Publications, 2018.	

Subject Description Form

Subject Code	EIE4128
Subject Title	Integrated Capstone Project
Credit Value	6
Level	4
Pre-requisite / Co-requisite/ Exclusion	Nil
Objectives	The objectives of this subject are to: • provide students with the opportunity to apply and integrate the knowledge of artificial intelligence and data analytics (AIDA) to their discipline. • develop the capabilities of students in analyzing and solving complex and possibly real-life problems using AIDA. • Train students with skills on systematic development and documentation of a significant piece of work.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: <u>Professional/academic knowledge and skills</u> (a) conduct literature surveys to locate materials and sources relevant to the selected problem area in a specific discipline; (b) understand the materials obtained and connect the materials with the problem to be solved using AIDA knowledge and skills; (c) define and specify the problem precisely; (d) assimilate and apply the learnt knowledge to generate good solutions to the problem; (e) think critically the formulation of alternative models and solutions to the problem, in the analysis of approaches to the solution and their implementation; and (f) evaluate the final outcome in an objective manner; <u>Attributes for all-roundedness</u> (g) improve presentation and communication skills via oral presentation; (h) enhance technical report writing skills with proper organization of materials; (i) develop the ability to learn independently and to find/integrate information from different sources required in solving real-life problems; (j) manage the project efficiently and effectively through the supervision of supervisor(s); and (k) work collaboratively with related parties (e.g. vendors, sponsor companies, technical support staff, team-partners, research students, etc.).
Subject Synopsis/ Indicative Syllabus	Students are expected to identify a project topic with a supervisor in their chosen discipline, and a co-supervisor with artificial intelligence and data analytics expertise. Students need to demonstrate their knowledge in both their chosen discipline and AIDA in the project, receiving advice from both supervisors. The project should represent requisite effort in analyzing and interpreting the data/information obtained, using the principles and techniques learnt from various related subjects. Students are also expected to demonstrate significant analytical and, preferably, research ability in the chosen application domain. The progression of the project will consist of the following stages. **<u>Project Specification</u>** In this stage, the student will work in conjunction with the project supervisor to draw up a concrete project plan specifying at least the following: 1. Background of the project; 2. Aims and objectives; 3. Deliverables;

4. Methodology to be adopted;
5. Schedule.

Project Execution

After the specification is done, the project will be pursued so that the objectives are to be met; the deliverables are to be produced in accordance with the schedule. The student and the project supervisor will meet constantly to discuss the progress. In particular the following should be demonstrated:

1. Adherence to the schedule;
2. Achievement of objectives by the student's work;
3. Initiatives of the students to work, design, and to solve problems;
4. Inquisitiveness of the student (e.g. to probe into different phenomena or to try different approaches);
5. Diligence of the students to spend sufficient effort on the project;
6. Systematic documentation of data, design, results, etc. during the process of working out the project.

Project Report

After the project is completed, it is important that the student is competent in disseminating the results for others to review. Through this dissemination process, project achievements can be communicated, experience can be shared, knowledge and skills learnt can be retained and transferred. The following elements will be important as evidence of students' achievement:

1. Project logbook (documenting the work done over the year);
2. Project report (hardcopy and softcopy);
3. Presentation;
4. Performance in a Question-and-Answer session;
5. Demonstration.

Teaching/Learning Methodology

The Integrated Capstone Project spans across the academic year for two consecutive semesters. The teaching/learning activities include regular project meetings with the supervisor and the co-supervisor, guided study of project materials, independent project development work and other project management tasks.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/ tasks	**% weighting**	**Intended subject learning outcomes to be assessed (Please tick as appropriate)**										
		a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
Continuous Assessment	100	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Total	100											

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The assessment of the project work is conducted continuously throughout the whole project period. The evidence of students' achievement will be documented in logbook and the reports submitted in various stages. The student will be required to give a presentation and demonstration so that he/she can communicate the project design, methodology, and achievement to other parties.

The Integrated Capstone Project will be assessed by the supervisor/co-supervisor and other assessors. Attributes to be assessed include, but not limited to, Problem Identification, Problem Solving, Communication and Presentation, Project Management, and Self-Discipline.

Integrated Capstone Projects should be problem-oriented and there are no restrictions on the nature of the problem except that it should be relevant to the student's chosen

	discipline and AIDA. The project could be practical, academic or a hybrid in which the student is encouraged but not constrained to have some original contributions. Each student has to submit a proposal, a mid-term checkpoint progress report and a final report. The proposal must be approved by the supervisor/co-supervisor before the student can proceed with the Integrated Capstone Project. An oral presentation and demonstration is essential at the end of the project. A mid-term presentation and demonstration may also be required for proper continuous assessment.	
Student Study Effort Expected	**Class contact:**	
	• Structured Study (regular meetings with supervisor)	78 Hours
	Other student study effort:	
	• Guided Study/Reading/Experiment • Reports • Presentation and Demonstration	132 Hours
	Total student study effort	**210 Hours**
Reading List and References	**Reference Books:** *To be specified by the project supervisor for each project.*	

Subject Description Form

Subject Code	ENG2002
Subject Title	Computer Programming
Credit Value	3
Level	2
Pre-requisite/Co-requisite/Exclusion	Nil
Objectives	(i) To introduce the fundamental concepts of computer programming (ii) To equip students with sound skills in C/C++ programming language (iii) To equip students with techniques for developing structured and object-oriented computer programs (iv) To demonstrate the techniques for implementing engineering applications using computer programs.
Intended Subject Learning Outcomes	**Upon completion of the subject, students will be able to:** 1. Familiarize themselves with at least one C/C++ programming environment. 2. Be proficient in using the basic constructs of C/C++ to develop a computer program. 3. Develop a structured and documented computer program. 4. Understand the fundamentals of object-oriented programming and be able to apply it in computer program development. 5. Apply computer programming techniques to solve practical engineering problems.
Subject Synopsis/ Indicative Syllabus	**Syllabus:** 1. Introduction to programming - Components of a computer; Programming environment; Process of application development. 2. Bolts and Nuts of C/C++ - Preprocessor; Program code; Functions; Comments; Variables and constants; Expressions and statements; Operators. 3. Program Flow Control - Branching and looping; Function parameters passing; Return values; Local and global variables; Scope of variables. 4. Program Design and Debugging - Structured program design; Debugging a program. Case study: Using the Visual C++ debugger. 5. Basic Object Oriented Programming - Objects and classes; Private versus public; Implementing class methods; Constructors and destructors. 6. Pointer and Array - Stack and Free store; Create and delete objects in the free store; Pointer arithmetic; Passing function arguments by pointer; Returning values by pointer; Array of objects; Array and pointer; Array of pointers; Pointer of array; Character array; Command-line processing. 7. Stream I/O - Input and output as streams; File I/O using streams.

Teaching/Learning Methodology

Teaching and Learning Method	**Intended Subject Learning Outcome**	**Remarks**
Lectures, supplemented with short quizzes	2,3,4	Students are introduced to the knowledge of computer programming through explanation and illustrative examples. Comprehension of the knowledge is strengthened with short quizzes. Students will be able to monitor the skills of using C/C++ and apply the techniques of developing structured object-oriented applications.
Laboratories/tutorials where problems are given to students for them to solve	1,2,3,4	Students apply what they have learnt in lectures and solve problems in exercises. The purpose is to ensure students have captured the important points. Tutors will aid the lecturer in helping the students finishing the exercises, and interactive Q&A will take place.
Assignment, tests and final examination	1,2,3,4,5	By doing assignment, students will develop a firm understanding and comprehension of the knowledge taught. They will analyse given C/C++ applications and apply knowledge to solve problems. They will have to design solutions by evaluating different alternatives. To enhance the students' problem solving skill in a given programming environment, open-book programming tests are arranged regularly. To assure students' understanding of fundamental concepts, a closed-book final examination is arranged.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific Assessment Methods/Tasks	**% Weighting**	**Intended subject learning outcomes to be assessed**				
		1	**2**	**3**	**4**	**5**
1. In-class exercises	10%	✓	✓	✓	✓	
2. Short-quizzes	10%		✓	✓	✓	
3. Programming tests	30%	✓	✓	✓	✓	✓
4. Assignment	20%	✓	✓	✓	✓	✓
5. Final examination	30%	✓	✓	✓	✓	✓
Total	100%					

<table>
<tr><td></td><td colspan="2">Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The short-quizzes are for assessing the understanding of fundamental concepts. The in-class exercises are conducted to help students familiarized with the programming language and skills. The programming tests are for assessing the ability of students on solving computer problems through programming within a specified period. Through doing assignment, students will be able to experience how to solve computer problems and design solutions by using a systematic approach. The final examination is for assessing the students' ability on using the programming language and analysing computer programs.</td></tr>
<tr><td rowspan="7">Student Study Effort Expected</td><td>Class contact:</td><td></td></tr>
<tr><td>• Lectures, Tests and Quizzes</td><td>26 Hours</td></tr>
<tr><td>• Laboratory/Tutorial</td><td>13 Hours</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>• Self-studying</td><td>57 Hours</td></tr>
<tr><td>• Homework</td><td>12 Hours</td></tr>
<tr><td>Total student study effort:</td><td>108 Hours</td></tr>
<tr><td>Reading List and References</td><td colspan="2">Reference Books:

1. S. Rao, <i>Sams Teach Yourself C++ in One Hour a Day</i>, 8th ed. Indianapolis, IN: Sams, 2017.
2. P. Deitel and H. Deitel, <i>C++ How to Program : Introducing the New C++14 Standard</i>, 10th ed. Boston, MA: Pearson, 2017.
3. R. Cadenhead and J Liberty, <i>Sams Teach Yourself C++ in 24 hours,</i> 6th ed. Indianapolis, IN: Sams, 2017.</td></tr>
</table>

The Hong Kong Polytechnic University

Subject Description Form

Please read the notes at the end of the table carefully before completing the form.

Subject Code	ENGL4022
Subject Title	Quantitative literacy for language professionals
Credit Value	3
Level	4
Pre-requisite / Co-requisite/ Exclusion	N.A.
Objectives	Quantitative literacy is the ability to solve real world problems with mathematical skills, and is valuable even in language-related professions such as language teaching, sales and marketing, and media and journalism. This subject equips future language professionals with practical quantitative skills for describing and analyzing language-relevant information, thereby adding value to their primary skillset. Students will learn how these skills complement verbal persuasion, analysis, and presentation in real life contexts where a strong emphasis is placed on quantifiable facts. No extensive mathematics background is required. The subject adopts a thematic and problem-based approach to meet the following objectives. 1. Introduce **general quantitative skills** to frame and solve problems which arise in the context of language professions 2. Equip students to address quantitative issues in **language teaching**, including student assessment and evaluation of teaching and learning processes 3. Equip students to address quantitative issues in **sales and marketing**, including the analysis of market surveys and sales trends 4. Equip students to address quantitative issues in **media and journalism**, including the critical understanding of opinion polls, metrics and rankings Students will benefit from an interactive pedagogical approach with balanced assessment tasks. Classroom and independent learning will be further supported by open-source statistical analysis software (JASP) and Microsoft Excel.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: (Professional/academic knowledge) a. Apply basic statistical knowledge to describe and make inferences with language-related information

	(Literacy skills) b. Recognize and produce quality work reflecting the complementary nature of verbal and numerical literacy in the workplace (Higher order thinking skills) c. Integrate verbal and numerical modes of reasoning to define and solve real world problems in different language-related contexts (Life-long learning skills) d. Develop critical and enduring awareness of the applicability of quantitative skillsets in language professions
Subject Synopsis/ Indicative Syllabus *(Note 2)*	**Introduction** **Week 1-4** • What quantitative literacy means to language professionals • Basic descriptive statistics (e.g. data presentation, variables, levels of measurement) • Basic inferential statistics (e.g. hypothesis testing for comparisons and correlations) **Theme 1: Quantitative literacy in language teaching** **Week 5-6** • Describing student characteristics • Monitoring student performance • Evaluating effectiveness of pedagogical practices **Theme 2: Quantitative literacy in sales and marketing** **Week 7-8** • Designing and analyzing verbal-numerical customer feedback surveys • Presenting quantitative information in sales reports • Combining rhetoric with statistics for persuasion **Theme 3: Quantitative literacy in the media** **Week 9-10** • Critically evaluating media information like opinion polls, metrics, and rankings **Summary and assessment** **Week 11-13** • Course summary • Individual presentations on applying quantitative skills to address a real-life problem in language professions
Teaching/Learning Methodology *(Note 3)*	The maximum class size of 30 allows for an interactive pedagogical approach. Each weekly session will last three hours, with a two-hour lecture immediately followed by a one-hour tutorial. In the lecture, the instructor will impart concepts supported by regular small group activities. This will be the main channel for transmitting **professional and academic knowledge** (intended learning outcome a.) In the tutorial, students will work on and present solutions to challenging discussion questions related to the lecture. While consolidating knowledge, they also reflect practical and realistic scenarios students are likely to face in the

future, thus encouraging the development of **higher order thinking skills** and **life-long learning** (intended learning outcomes c. and d.). Tutorial learning will be supported by open-source computer software (e.g. JASP) and Microsoft Excel.

Assessment also comprises an important part of the teaching and learning methodology. There will be one individual take-home assignment and one in-class quiz which encourages independent research and allows room for critical thought. There will also be an individual project and presentation where students apply quantitative analytical skills to frame and solve a hypothetical but realistic problem in a language profession. This supports development of teamwork and **literacy skills** (intended learning outcome c.)

Assessment methods and components may vary according to class size.

Assessment Methods in Alignment with Intended Learning Outcomes

(Note 4)

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)			
		a	b	c	d
1. Take-home assignment (short questions on first half of the subject)	35	/	/	/	/
2. In-class quiz (short questions on second half of the subject)	35	/	/	/	/
3. Individual project presentation	30	/		/	/
Total	100 %				

The take-home assignment and in-class quiz require students to demonstrate the attainment of all four intended learning outcomes (professional knowledge, literacy skills, higher order thinking skills, and life-long learning) with both verbal and numerical analysis and output. Accordingly, they are each weighted 35%.

While the individual project is a culmination of the whole semester's learning, it will be delivered as a verbal presentation with less emphasis on writing skills. It is accordingly weighted 30%.

Student Study Effort Expected	Class contact:	
	▪ Lecture + tutorial (3 hours x 13 weeks)	39 Hrs.
	Other student study effort:	
	▪ Independent reading (3 hours x 13 weeks)	39 Hrs.

	▪ Independent research (2 hours x 13 weeks)	26 Hrs.
	▪ Doing assignments (2 hour x 13 weeks)	26 Hrs.
	Total student study effort	130 Hrs.
Reading List and References	Background on QL These provide background information on QL and argue for its importance in general tertiary education. **Steen, L. A.** (2001). The case for quantitative literacy. In L. A. Steen (Ed.), Mathematics and democracy (pp.1–22). Princeton,NJ: Woodrow Wilson National Fellowship Foundation. Technical knowledge These are taken from textbooks and focus on statistical analysis/other concepts rather than their social applications. They will strengthen your understanding but are not strictly necessary if you can follow the lectures and use JASP. They can also be replaced with other statistics textbooks/guides on the same topics. **Boslaugh, S.** (2012). *Statistics in a Nutshell*. Sebastopol: O'Reilly. **Jones, S.** (2010). *Statistics in Psychology. Explanations without equations.* Basingstoke: Palgrave Macmillan**.** **Walker, I.** (2010). *Research Methods and Statistics*. Basingstoke: Palgrave Macmillan. **Longaker, M. G., & Walker, J.** (2010). *Rhetorical Analysis. A Brief Guide for Writers*. London: Longman. Reports These are real life reports and/or datasets on various social issues which will be discussed and used as examples in class. **The Economist Intelligence Unit.** (2018). *Making space: Surviving Sprawl.* **Sustainable Solutions Development Network**. (2018). *World Happiness Report.* Further readings These offer further information to enrich your understanding beyond the subject. They are optional but highly recommended if you continue to develop an interest for quantitative literacy. **Crauder, B., Evans, B., Johnson, J., & Noell, A.** (2015). *Quantitative Literacy: Thinking Beyond the Lines*. New York: W. H. Freeman.	

	Scholfield, P. (1995). *Quantifying Language. A Researcher's and Teacher's Guide to Gathering Language Data and Reducing it to Figures*. Bristol: Multilingual Matters.

Revised by Dennis Tay, March 2022

Note 1: Intended Learning Outcomes
Intended learning outcomes should state what students should be able to do or attain upon completion of the subject. Subject outcomes are expected to contribute to the attainment of the overall programme outcomes.

Note 2: Subject Synopsis/ Indicative Syllabus
The syllabus should adequately address the intended learning outcomes. At the same time over-crowding of the syllabus should be avoided.

Note 3: Teaching/Learning Methodology
This section should include a brief description of the teaching and learning methods to be employed to facilitate learning, and a justification of how the methods are aligned with the intended learning outcomes of the subject.

Note 4: Assessment Method
This section should include the assessment method(s) to be used and its relative weighting, and indicate which of the subject intended learning outcomes that each method purports to assess. It should also provide a brief explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes.

The Hong Kong Polytechnic University

Subject Description Form

Please read the notes at the end of the table carefully before completing the form.

Subject Code	ENGL4026
Subject Title	Language and social data analytics
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	N.A.
Objectives	Digital data like social media, news archives, and various kinds of sentiments, trends and demographics pervade our world. They often seem messy and unstructured but play an increasingly important role in the media, marketing, and education industries in today's digital economy. With appropriate analytical approaches, they can provide key insights into human behavior and optimize professional decision-making. Building upon their primary competencies like critical thinking and communication, this subject teaches future professionals in linguistic and social contexts how to derive and communicate insights from such data. Students will learn how to use the Python programming language to implement analytic techniques based on basic statistics and machine learning. Ethical issues arising from the rapid growth of the digital economy will also be critically discussed. No background in programming, data analytics, or statistics is assumed. The subject adopts a thematic and problem-based approach to meet the following objectives. 1.Introduce basic data analytic techniques and their implementation in Python 2.Train students to collect, analyze, interpret, and communicate data-driven insights for problem-solving and decision-making 3.Raise awareness of ethical challenges faced by today's digital economy An interactive pedagogical approach will be adopted with balanced assessment tasks. Classroom and independent learning will be supported by open-source software and other online resources.

Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: **Category A**: Professional/academic knowledge and skills a. Understand basic data analytic techniques b. Collect and analyze data in linguistic and social contexts with self-written programming code c. Communicate data analytic insights to the general public and professional audiences **Category B:** Attributes for all-roundedness d. Appreciate the growing importance and relevance of machine-assisted data analysis in linguistic and social contexts e. Weigh the benefits and potential pitfalls of data analytics along practical and ethical dimensions

Subject Synopsis/ Indicative Syllabus
(Note 2)
	Introduction
	• Contemporary data in linguistic and social contexts
	• The nature and scope of data analytics
	• Programming languages
	Data management, visualization, and communication
	• Data collection from online sources
	• Spreadsheets and dataframes
	• Visualizing patterns and relationships in data
	Data analytics #1: Working with numbers
	• The general(ized) linear model
	    o linear regression
	    o logistic regression
	• Prediction, classification, and clustering
	Data analytics #2: Working with words
	• Natural Language Processing and text analytics
	• Document classification
	• Sentiment analysis
	• Topic modelling
	Data ethics: a critical perspective
	• Privacy, discrimination, and social inequalities

Teaching/Learning Methodology *(Note 3)*	Each weekly session will combine lecture and seminar activities. During lecture activities, the instructor will impart concepts and facilitate class activities. This will be the main channel for transmitting professional and academic knowledge (ILO a, b, e). Seminar activities are student-led. Students will work in groups to analyze data and present solutions to practical problems. They prepare students for the workplace and develop higher order thinking skills and life-long learning (ILO c, d, e).

Teaching and learning is supported by the open-source programming language *Python* and online resources. Students will be expected to read the prescribed materials and revise previous lessons before each session.

There are two individual take-home assignments and an individualproject. The take-home assignments require conceptual understanding of data analytic techniques, writing basic programming code, and interpreting the analyses in context. The project requires students to apply these techniques and communicate insights and solutions in simulated professional settings.

Assessment Methods in Alignment with Intended Learning Outcomes

(Note 4)

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)				
		a	b	c	d	e
1. Take-home assignment 1	35	✓	✓	✓		✓
2. Take-home assignment 2	35	✓	✓		✓	✓
3. Individual project	30	✓	✓	✓	✓	✓
Total	100 %					

The take-home assignments (35% each) require individual students to demonstrate the intended learning outcomes by combining data analytic with critical thinking and writing skills. The group project (30%) requires students to work in groups to demonstrate the same skills, with an emphasis on verbal communication and presentation.

Student Study Effort Expected

Class contact:	
▪ Lecture (3 hours x 13 weeks)	39 Hrs.
Other student study effort:	
▪ Independent reading (3 hours x 13 weeks)	39 Hrs.
▪ Independent research (2 hours x 13 weeks)	26 Hrs.
▪ Assignments (2 hour x 13 weeks)	26 Hrs.
Total student study effort	130 Hrs.

Reading List and References

Beysolow II, T. (2018). *Applied Natural Language Processing with Python.* Berkeley: Apress.

Brookes, G., & McEnery, T. (2019). The utility of topic modelling for discourse studies: A critical evaluation. *Discourse Studies*, *21*(1), 3–21.

Bruce, P., Bruce, A., & Gedeck, P. (2020). *Practical Statistics for Data Scientists: 50+ Essential Concepts Using R and Python.* Sebastopol: O'Reilly.

Hai-Jew, S. (Ed.). (2017). *Data Analytics in Digital Humanities*. Cham: Springer.

Norton, P. et al. (2005). *Beginning Python.* Indianapolis: Wiley.

O'Neil, C. (2016). *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy*. New York: Crown Books.

Sarkar, D. (2016). *Text Analytics with Python*. Cham: Springer.

Tay, D. (2020). A computerized text and cluster analysis approach to psychotherapy talk. *Language & Psychoanalysis*, 9(1), 1–22.

Xu, W., & Zhang, C. (2018). Sentiment, richness, authority, and relevance model of information sharing during social Crises—The case of #MH370 tweets. *Computers in Human Behavior*, 89, 199–206.

Python libraries and user guides

- Pandas: https://pandas.pydata.org/
- Scikit-learn: https://scikit-learn.org/stable/
- Seaborn: https://seaborn.pydata.org/index.html
- Statsmodels: www.statsmodels.org/stable/user-guide.html
- Numpy: numpy.org/doc/stable/
- Scipy: https://www.scipy.org/docs.html

Other resources

- datacamp.com
- kaggle.com
- towardsdatascience.com

Revised by Dennis Tay, March 2022

Note 1: Intended Learning Outcomes
Intended learning outcomes should state what students should be able to do or attain upon subject completion. Subject outcomes are expected to contribute to the attainment of the overall programme outcomes.

Note 2: Subject Synopsis/Indicative Syllabus
The syllabus should adequately address the intended learning outcomes. At the same time, overcrowding of the syllabus should be avoided.

Note 3: Teaching/Learning Methodology
This section should include a brief description of the teaching and learning methods to be employed to facilitate learning, and a justification of how the methods are aligned with the intended learning outcomes of the subject.

Note 4: Assessment Method
This section should include the assessment method(s) to be used and its relative weighting, and indicate which of the subject intended learning outcomes that each method is intended to assess. It should also provide a brief explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes.

Subject Description Form

Subject Code	ENGL4027
Subject Title	Integrated Capstone Project
Credit Value	6
Level	4
Pre-requisite / Co-requisite/ Exclusion	**Pre-requisite**: ENGL3002 Research Methods for Language Studies **Exclusion**: Any other equivalent capstone project
Objectives	The objectives of this subject are to: • provide students with the opportunity to apply and integrate knowledge of artificial intelligence and data analytics (AIDA) to the study of English, communication, and applied linguistics. • develop the capabilities of students in analyzing and solving complex and possibly real-life problems using AIDA, preferably in professional contexts, including educational contexts. • train students with the skills necessary for the systematic development and documentation of a significant piece of work.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: Professional/academic knowledge and skills (a) demonstrate a high level of professional communicative competence in English, communication, and applied linguistics through a final project; (b) conduct literature surveys to locate materials and sources relevant to the selected problem in the area of English, applied linguistics, or communication to tackle topics selected for the project; (c) understand the materials obtained and connect the materials with the problem to be solved using knowledge and skills in AIDA, English, communication, or applied linguistics; (d) identify and analyse language-related issues systematically and logically; (e) assimilate and apply the learnt knowledge to generate good solutions to the problem; (f) critically consider the formulation of alternative models and solutions to the problem in the analysis of approaches to the solution and their implementation; and (g) evaluate and present the final outcome in a clear, objective, effective, and convincing manner with the knowledge and skills acquired; Attributes for all-roundedness (h) enhance technical reporting skills with proper organization of materials; (i) develop the ability to work critically, learn independently, and find/integrate information from different sources required in solving real-life problems; (j) exercise sound judgement and develop intellectual curiosity; (k) manage the project efficiently and effectively through the supervision of supervisor(s) and co-supervisor(s); and (l) apply problem-solving skills to careers, personal development, and life-long learning.
Subject Synopsis/ Indicative Syllabus	**1. In-Depth Study of a Topic Typically Proposed by the Supervisor** **2. Project Meeting and Planning** **3. Proposal Writing** **4. Regular Progress Checking and Reporting** **5. Project Documentation**

6. Presentation and/or Demonstration

Students are expected to identify a project topic with a supervisor from the Department of English and Communication, and a co-supervisor with expertise in artificial intelligence and data analytics. Through the project, students need to demonstrate their knowledge in both English and applied linguistics and AIDA while receiving advice from both the supervisor and co-supervisor. The project should represent requisite effort in analysing and interpreting the data/information obtained, using the principles and techniques learnt from various related subjects. Students are also expected to demonstrate significant analytical and, preferably, research ability in both AIDA and English, applied linguistics, or communication.

With advice from the Capstone Project Coordinator and project supervisors, students select, justify, and apply techniques learnt from Research Methods for Language Studies and other related subjects to design, conduct, and produce a Capstone Project for submission by the end of Semester 2, Year 4. Detailed guidelines for conducting the Capstone Project will be made available to students at the beginning of Semester 1, Year 4.

The project may consist of either a 6,000-word dissertation or an alternative medium/format project (e.g., poster with presentation, advertising campaign, video, programming code, and/or application) accompanied by a 500-1000-word written document.

In conceptualising and designing the project, students can consider one of the following directions:

1. Students can follow usual approaches to designing and conducting a research project, applying skills and knowledge learnt from the subject Research Methods for Language Studies and other subjects.
2. Students may wish to consider conducting the project in the context of professional workplaces. For example, they can design and conduct the project at the organization where they completed their Work-Integrated Education (WIE) placements or Service Learning course, with permission from their workplace supervisors. In this case, students are encouraged to consider designing a project for solving a practical problem related to the actual workplace/profession/industry/community.

Teaching/Learning Methodology

The Integrated Capstone Project spans across the academic year for two consecutive semesters. The teaching/learning activities include regular project meetings with the supervisor and the co-supervisor, guided study of project materials, independent project development work, and other project management tasks.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% Weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)											
		a	b	c	d	e	f	g	h	i	j	k	l
1. Capstone Project	90	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2. Proactiveness and time management	10									✓	✓	✓	
Total	100												

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

	The Integrated Capstone Project will be assessed by the supervisor and co-supervisor. Attributes to be assessed include, but are not limited to, Problem Identification, Problem Solving, Communication and Presentation, Project Management, and Self-Discipline. 10% of the supervisor's mark is based on the supervisor's holistic evaluation of the student's performance throughout the project. Integrated Capstone Projects should be problem-oriented, and there are no restrictions on the nature of the problem except that it should be relevant to both the BAEAL Programme and AIDA. The project could be practical, academic, or a hybrid in which the student is encouraged but not constrained to have some original contributions. This project work will not only contribute to the fulfilment of the subject's intended learning outcomes but also to the student's long-term development of their professional and academic knowledge and skills, as well as a variety of generic attributes, especially their ability to learn independently, think critically and analytically, and solve real-world problems with what they have learned from the programme. Each student has to submit a proposal, a mid-term checkpoint progress report and a final report. The proposal must be approved by the supervisor and co-supervisor before the student can proceed with the Integrated Capstone Project. A final project submission of some sort (e.g., in the form of an oral presentation, paper, or other demonstration) is essential at the end of the project. A mid-term presentation and demonstration may also be required by the supervisor and/or co-supervisor for progress assessment.	
Student Study Effort Expected	Class contact:	
	• Lecture	0 Hrs.
	Other student study effort:	
	• Searching and reading materials, meetings with supervisor/co-supervisor/others, design and system development, testing, documentation, presentation, etc.	210 Hrs.
	Total student study effort	210 Hrs
Reading List and References	**Reference Books:** 1. Burns, R. (2000). *Introduction to research methods* (4th ed.). SAGE Publications. 2. Creswell, J. W. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications. 3. Dörnyei, Z. (2007). *Research methods in applied linguistics.* Oxford University Press. 4. Garson, G. D. (2002). *Guide to writing empirical papers, theses, and dissertations*. Routledge. 5. Kumar, R. (2011). *Research methodology: A step-by-step guide for beginners* (3rd ed.). SAGE Publications. 6. Mauch, J. E., & Park, N. (2003). *Guide to the successful thesis and dissertation: A handbook for students and faculty* (5th ed.). Marcel Dekker. 7. Merrigan, G., & Huston, C. (2019). *Communication research methods* (4th ed.). Oxford University Press.	

	8. Reinhart, S. M. (2013). *Giving academic presentations* (2nd ed.). University of Michigan Press. 9. Roberts, C. M., & Hyatt, L. (2018). *The dissertation journey: A practical and comprehensive guide to planning, writing, and defending your dissertation* (3rd ed.). Corwin. 10. Rudestam, K. E. & Newton, R. R. (2014). *Surviving your dissertation: A comprehensive guide to content and process* (4th ed.). SAGEPublications. 11. Statistics, simulation, programming, and relevant books. 12. ACM and IEEE magazines, Transactions and Journals. 13. Other International Journals. 14. Relevant conference proceedings and magazines (including ACM and IEEE conferences). 15. Technical reports from universities and major companies. Additional papers and books relevant to the student’s specific project topic will be identified by the student or recommended by the supervisor and/or co-supervisor.

Form AR 140

The Hong Kong Polytechnic University

Subject Description Form

Please read the notes at the end of the table carefully before completing the form.

Subject Code	HTI3990
Subject Title	Big Data Analytics for Bioinformatics and Genomic Medicine
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	N/A
Objectives	This subject aims to: a. Instil in students the foundation knowledge of human genomics; b. Expose students to the data analytic algorithms in bioinformatics; c. Introduce students to the challenges and clinical applications of bioinformatics and genomic medicine; and d. Offer students hands-on experience in conducting bioinformatics analyses and data interpretation.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: a. Explain the concepts in human genomics; b. Understand various bioinformatics algorithms, identify their advantages and drawbacks, and offer possible solutions to problems; c. Discuss the challenges and applications of data analytics in bioinformatics and genomic medicine; and d. Apply the data analytic techniques to perform bioinformatics analyses, and interpret the data obtained.
Subject Synopsis/ Indicative Syllabus *(Note 2)*	Fundamentals of human genomics • DNA • RNA • Protein • Genes • Genetics of human diseases Commonly used bioinformatics tools, algorithms, and analyses • Biological databases • Sequence alignment • Phylogenetic analysis • Genome-wide association studies • Next-generation sequencing

- RNA-seq analyses
- Sequence-based predictive methods, such as prediction of motifs and domains, protein structure, protein function, etc.

Omics
- Genomics
- Transcriptomics
- Proteomics
- Other omics, such as metabolomics
- Challenges and applications in genomic medicine, such as pharmacogenomics, genetic testing, etc.

Teaching/Learning Methodology

(Note 3)

Lectures to introduce the fundamentals of human genomics, tools, algorithms and analyses commonly used in bioinformatics, and to explain their potential applications in genomic medicine.

Computer practical to guide the students to use the latest IT strategy to conduct bioinformatics analyses. The practical reports aim to enhance their skills in data interpretation and report writing.

Case studies to critically examine the bioinformatics techniques applied in different scenarios. Exchange of ideas among students are highly encouraged.

Assessment Methods in Alignment with Intended Learning Outcomes

(Note 4)

Specific assessment methods/tasks 60% continuous; 40% examination	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)			
		a	b	c	d
1. Continuous Assessment	**60%**				
Computer Practical	45%		√	√	√
Case Studies and Presentation	15%	√	√	√	
2. Examination	**40%**	√	√	√	√
Total	**100 %**				

Computer practical will assess students' understanding on various algorithms and their ability to conduct basic bioinformatics analysis with the appropriate tools and parameters. The practical reports will test their data interpretation skills.

	Case studies require the students to examine real-life scenarios, critically review if the appropriate bioinformatics techniques have been applied, and explain the rationale during the presentation. The case studies and presentation will assess students' knowledge, ability in critical thinking and data interpretation. Discussion and exchange of ideas during the Questions & Answers Section will be encouraged. Examination will comprise MCQs, short questions and essays to evaluate the students' ability in understanding the basic concepts in human genomics, the bioinformatics algorithms, various bioinformatics tools and analyses, challenges and the applications in genomic medicine. The examination will also assess their data interpretation skills.	
Student Study Effort Expected	Class contact:	
	▪ Lectures	27 Hrs.
	▪ Computer practicals	9 Hrs.
	▪ Presentation of case studies	3 Hrs.
	Other student study effort:	
	▪ Preparation of practical reports	15 Hrs.
	▪ Preparation of case studies	10 Hrs.
	▪ Self study	53 Hrs.
	Total student study effort	117 Hrs.
Reading List and References	Bexevanis, A.D., Bader, G.D. and Wishart, D.S. (2020) *Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins (4th Edition).* Wiley. ISBN: 9781119335955. Lesk, A. (2019) *Introduction to Bioinformatics (5th Edition).* Oxford University Press. ISBN: 9780198794141. Strachan, T., Goodship, J., Chinnery P.F. (2015) *Genetics and Genomics in Medicine.* Garland Science. ISBN: 9780815344803. Various online biological databases and bioinformatics tools.	

Note 1: Intended Learning Outcomes
Intended learning outcomes should state what students should be able to do or attain upon subject completion. Subject outcomes are expected to contribute to the attainment of the overall programme outcomes.

Note 2: Subject Synopsis/Indicative Syllabus
The syllabus should adequately address the intended learning outcomes. At the same time, overcrowding of the syllabus should be avoided.

Note 3: Teaching/Learning Methodology
This section should include a brief description of the teaching and learning methods to be employed to facilitate learning, and a justification of how the methods are aligned with the intended learning outcomes of the subject.

Note 4: Assessment Method
This section should include the assessment method(s) to be used and its relative weighting, and indicate which of the subject intended learning outcomes that each method is intended to assess. It should also provide a brief explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes.

(Form AR 140) 8.2020

Subject Description Form

Subject Code	HTI4990
Subject Title	AIDA in Clinical Diagnosis and Radiotherapy
Credit Value	3
Level	4
Pre-requisite / Co-requisite/ Exclusion	Nil
Objectives	Artificial intelligence and data analytics (AIDA) have been investigated extensively in various fields. This subject aims to teach the students the applications of AIDA in clinical diagnosis and radiotherapy. Emphasis is put in the most prevalent and advanced applications in various aspects in clinical diagnosis and radiotherapy.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. demonstrate understanding of basic principles of clinical diagnosis and radiotherapy b. explain the roles of AIDA in clinical diagnosis and radiotherapy c. demonstrate understanding of the applications of AIDA in clinical diagnosis and radiotherapy d. discuss the strengths and weaknesses of various AIDA methods in their applications in clinical diagnosis and radiotherapy
Subject Synopsis/ Indicative Syllabus	**AIDA in clinical diagnosis (18)** ■ Basic principles and processes of clinical diagnosis ■ Different algorithms and models ■ Applications in clinical diagnosis ■ Current trend in clinical diagnosis applications **AIDA in radiotherapy (18)** ■ Basic principles and processes of radiotherapy processes ■ Different algorithms and models ■ Applications in radiotherapy ■ Current trend in radiotherapy applications **Advanced topics (3)** ■ The state-of-art AIDA methods and potential applications in clinical diagnosis and radiotherapy
Teaching/Learning Methodology	This subject provides broad knowledge on the basic principles and applications of AIDA in clinical diagnosis and radiotherapy. Lectures aim to cover the theoretical concepts of various AIDA methods

and their applications in clinical diagnosis and radiotherapy. Tutorial sessions will be used to reinforce the theoretical learning in various AIDA methods and enhance the application of the knowledge in clinical environments. A practical session on AI will facilitate the students in understanding the basic AI principles and process. The students will discuss the strengths and weaknesses of the various AIDA methods.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks 100% continuous	% weighting	Intended subject learning outcomes to be assessed			
		a	b	c	d
1. Written assignment	20%	√	√	√	√
2. Group presentation	20%	√	√	√	√
3. Written test	60%	√	√	√	√
Total	100 %				

Written assignment: students are required to discuss the strengths and weaknesses of specific applications of AIDA in clinical diagnosis or radiotherapy. This assignment assesses students' understanding of basic concepts and their integration and analytical abilities of the relevant knowledge

Group presentation: students are required to present one specific application of AIDA in clinical diagnosis or radiotherapy in a group. This presentation assess the students' understanding of basic concepts and their presentation and communication skills

Written test: The written test assesses students' integration and application of the knowledge and concepts in various AIDA methods, and their applications in clinical diagnosis and radiotherapy.

Student Study Effort Expected

Class contact:	
■ Lecture	26 Hrs.
■ Practical	4 Hrs.
■ Tutorial	9 Hrs.
Other student study effort:	
■ Self Study	30 Hrs.
■ Practical Work & Report	40 Hrs.
■ Total student study effort	109 Hrs.

Reading List and References	Ranschaert E. Artificial Intelligence in Medical Imaging. Springer 2019 Fujita H. Trends in Artificial Intelligence Theory and Applications. Artificial Intelligence Practices. Springer 2020 Masmoudi M. Artificial Intelligence and Data Mining in Healthcare. Springer 2021 Chang D. Basic Radiotherapy Physics and Biology. Springer 2021 Bushberg J. The Essential Physics of Medical Imaging 4th Ed. LWW 2020 Russell S. Artificial Intelligence: A Modern Approach 4th Ed. Pearson 2020

The Hong Kong Polytechnic University

Subject Description Form

Subject Code	HTM3228
Subject Title	Smart Service Design in Tourism and Hospitality
Credit Value	3
Level	3
Pre-requisite / Co-requisite/ Exclusion	HTM2305 – Delivering Service Quality
Objectives	This subject is designed to introduce students to the principles of experience design and service management, concepts of design thinking and design science, functionalities of service diagnosis tools and smart technologies, as well as other subject-related knowledge. Upon completion of this subject, students will be able to thoroughly assess and identify areas for further improvement in the existing tourism or/and hospitality businesses' service systems. Students will also be able to provide recommendations for optimizing the service design and service experience.
Intended Learning Outcomes *(Note 1)*	Upon completion of this subject, students will be able to: **A. Competent Professional** • Understand the principles of experience design and service management • Understand and apply concepts of design thinking and design science to develop new service ideas / optimize existing service provision • Understand the functionalities of service diagnosis tools and smart technologies, and utilize those tools to improve service provision **B. Critical Thinkers** • Critically evaluate the soundness of existing tourism or/and hospitality businesses' service systems • Identify and define problems in the existing businesses' service systems in general and specific service encounters in particular **C. Innovative Problem Solvers** • Identify solutions and implementation plans to resolve problems in the existing tourism or/and hospitality businesses' service systems • Identify adequate technologies that can advance the quality of service design and service experience offered to consumers **D. Effective Communicators** • Effectively communicate the evaluation results and problems found in existing tourism or/and hospitality businesses' service systems

- Effectively communicate the solutions to resolve existing problems and introduce adequate technologies to clients / interested parties

E. **Lifelong learner** (not applicable)

F. **Ethical Leader** (not applicable)

G. **Socially Responsible Global Citizen**

  - Recognize the personal and corporate social responsibilities in designing and optimizing service systems for global citizens

Subject Synopsis/ Indicative Syllabus

(Note 2)

Key topics to be addressed in this subject include (but not limited to):

- Principles of experience design
- Service management
- Design thinking and design science
- Smartness and smart technologies
- Service diagnosis tools
- Primary data collection and analysis methods
- Secondary data collection and analysis methods

Teaching/Learning Methodology

(Note 3)

- **Interactive lectures:** Key concepts, principles, theories and other background knowledge relating to the subject will be explained and discussed with students in the interactive lectures.

- **Tutorials:** Useful tools and skills will be introduced to students in the tutorial sessions. Case studies, practical trainings, hands-on practices will also be provided to students in the tutorial sessions.

- **Group project:** Students will work in teams and comprehensively evaluate the service system of a selected tourism or/and hospitality business. Apart from evaluating and outlining problems via using the knowledge learnt from lessons, students will be asked to provide solutions and implementation plans for the management of their selected businesses' consideration.

Assessment Methods in Alignment with Intended Learning Outcomes

(Note 4)

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)				
		A	B	C	D	G
1. Class attendance and participation	10%	√	√	√		√
2. Group project	30%	√	√	√	√	√
3. Mid-term test	30%	√	√	√	√	√
4. Final exam	30%	√	√	√	√	√
Total	100 %					

Student Study Effort Expected	Class contact:	
	▪ Lectures (2 hours x 13 weeks)	26 Hrs.
	▪ Tutorials (1 hour x 13 weeks)	13 Hrs.
	Other student study effort:	
	▪ Self-study	52 Hrs.
	▪ Group project	30 Hrs.
	Total student study effort	121 Hrs.
Reading List and References	• Fesenmaier, D. R., & Xiang, Z. (2017). *Design Science in Tourism: Foundations of Destination Management*. Springer, Cham. • Barile, S., & Polese, F. (2010). Smart service systems and viable service systems: Applying systems theory to service science. *Service Science, 2*(1-2), 21-40. • Beverungen, D., Müller, O., Matzner, M., Mendling, J., & Vom Brocke, J. (2019). Conceptualizing smart service systems. *Electronic Markets, 29*(1), 7-18. • Buhalis, D., & Leung, R. (2018). Smart hospitality—Interconnectivity and interoperability towards an ecosystem. *International Journal of Hospitality Management, 71*, 41-50. • Chung, N., Lee, H., Ham, J., & Koo, C. (2021). Smart Tourism Cities' Competitiveness Index: A Conceptual Model. In *Information and Communication Technologies in Tourism 2021* (pp. 433-438). Springer, Cham. • Gretzel, U., Werthner, H., Koo, C., & Lamsfus, C. (2015). Conceptual foundations for understanding smart tourism ecosystems. *Computers in Human Behavior, 50*, 558-563. • Henkens, B., Verleye, K., & Larivière, B. (2021). The smarter, the better?! Customer well-being, engagement, and perceptions in smart service systems. *International Journal of Research in Marketing, 38*(2), 425-447. • Kabadayi, S., Ali, F., Choi, H., Joosten, H., & Lu, C. (2019). Smart service experience in hospitality and tourism services: A conceptualization and future research agenda. *Journal of Service Management,* 30(3), 326-348. • Li, Y., Hu, C., Huang, C., & Duan, L. (2017). The concept of smart tourism in the context of tourism information services. *Tourism Management, 58*, 293-300. • Neuhofer, B., Buhalis, D., & Ladkin, A. (2015). Smart technologies for personalized experiences: a case study in the hospitality domain. *Electronic Markets, 25*(3), 243-254. • Troisi, O., Grimaldi, M., & Monda, A. (2019). Managing smart service ecosystems through technology: how ICTs enable value cocreation. *Tourism Analysis, 24*(3), 377-393.	

	- Yang, H., Song, H., Cheung, C., & Guan, J. (2021). How to enhance hotel guests' acceptance and experience of smart hotel technology: An examination of visiting intentions. *International Journal of Hospitality Management, 97*, 103000.

The Hong Kong Polytechnic University

Subject Code	HTM4350
Subject Title	Big Data Analytics in Hospitality, Tourism and Events
Credit Value	3
Level	4
Pre-requisite / Co-requisite/ Exclusion	HTM3205 – Analysing and Interpreting Research (or other equivalent subjects)
Objectives	This subject is designed to provide students with the fundamental concepts and practical applications of big data analytics in tourism and hospitality industry. This course will emphasize how to understand, analyze and articulate data analytics as well as produce original insights from big data applications. Students will perform a variety of analytical practices using a big data programming to have hands-on experiences. Upon completion of the subject, students will be able to obtain comprehensive understandings of big data analytics for facilitating better business decision-making process.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: **A. Competent professional:** • possess and be able to apply the skills, knowledge and abilities relevant to managerial concepts in big data analytics • discuss the basic concepts and principles of big data analytics • possess and be able to apply the skills, knowledge and abilities relevant to managerial concepts in big data analytics • discuss the basic concepts and principles of big data analytics **B. Critical Thinkers** • execute efficient big data analytics to solve hospitality and tourism business problems • follow and acquire the procedures in implementing big data analytics • critically evaluate and review big data analytics that create values • understand and compare a variety of big data analytics **C. Innovative Problem Solvers** • apply business analytics to identify business insights and support better business decision-making **D. Effective Communicators (not applicable)** **E. Lifelong Learners (not applicable)**

F. Ethical Leaders

- understand global and ethical standards in general data protection regulation

G. Socially Responsible Global Citizen (not applicable)

Subject Synopsis/ Indicative Syllabus

1. Business analytics and big data in hospitality and tourism
2. Smart city and smart tourism
3. Data issues / management
4. Statistical inference
5. Descriptive analytics
6. Data visualization
7. Predictive Analytics 1: Linear / Multiple regression
8. Predictive Analytics 2: Logistic regression
9. Classification / clustering methods
10. Geospatial analytics
11. Spatial data visualization
12. Ethical issues related to big data

Teaching/Learning Methodology

This subject will use various teaching and learning methods including lectures, case studies and class discussion. Lectures and case studies will enable students to understand fundamental concepts of big data analytics in hospitality and tourism fields. Class discussion gives students opportunities to assess and evaluate contemporary big data analytics in hospitality and tourism. Furthermore, this subject will offer students learning environment involving hands-on experiences that uses a tool of big data analytics, such as Python.

Assessment Methods in Alignment with Intended Learning Outcomes

(Note 4)

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)						
		A	B	C	F			
1. Attendance and class participation	10%	✓	✓	✓	✓			
2. Mid-term exam	20%	✓	✓	✓				
3. Individual assignments	40%	✓	✓	✓				
4. Final exam	30%	✓	✓	✓	✓			
Total	100 %							

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

To pass this subject, students are required to obtain Grade D or above in the aggregated assessment components.

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

- Attendance and class participation assess students' levels of involvement and engagement in class and proactive attitude toward Q&A.
- Mid-term exam tests students' cognitive understandings of theories/concepts related to big data analytics and application of analytical tools/methods (i.e., Python).
- Individual assignments evaluate students' comprehension of class contents and analytical ability. The assignments will ask students to develop statistical/analytical methods applying corresponding knowledge covered during the class.

Final exam assesses students' comprehensive understandings of big data analytics and application of analytical skills to solve business problems in hospitality and tourism fields.

Student Study Effort Expected	Class contact:	
	▪ Lecturer	39 Hrs.
	Other student study effort:	
	▪ Preparation for lectures	31 Hrs.
	▪ Preparation of mid-term and final exams / individual assignment	60 Hrs.
	Total student study effort	130Hrs.

Reading List and References

McKinney, W. (2012). *Python for data analysis: Data wrangling with Pandas, NumPy, and IPython*. O'Reilly Media, Inc.

Sharda, R., Delen, D., & Turban, E. (2015). Business intelligence and analytics:
Systems for decision support (Tenth ed.). Boston: Pearson.

Sigala, M., Rahimi, R., & Thelwall, M. (Eds.). (2019). *Big Data and Innovation in Tourism, Travel, and Hospitality: Managerial Approaches, Techniques, and Applications*. Springer.

Journals:
Annals of Tourism Research
Tourism Management
Journal of Travel Research
International Journal of Hospitality Management

	International Journal of Contemporary Hospitality Management Information Technology and Tourism

Form AR 140

The Hong Kong Polytechnic University

Subject Description Form

Please read the notes at the end of the table carefully before completing the form.

Subject Code	HTM4362
Subject Title	Artificial Intelligence in Tourism and Hospitality
Credit Value	3
Level	4
Pre-requisite / Co-requisite/ Exclusion	Nil
Objectives	The objective of this subject is to learn the fundamental concepts and practical applications of artificial intelligence (AI) in the tourism and hospitality industry, understand the critical components of AI technologies and examine the key relevant issues. At the end of the subject, students will be able to build new insights of AI technologies in tourism and hospitality industry, identify and solve the challenges during their implementations, and anticipate future trends and prospects.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: **A. Competent Professionals** • Discuss the basic concepts, and describe critical components of AI technologies. **B. Critical Thinkers** • Examine, apply and evaluate the AI technologies and concepts within the context of management and operations of tourism and hospitality organizations. • Critically assess the advantages and disadvantages of applying AI technologies in a tourism and hospitality context. **C. Innovative Problem Solvers** • Identify, define, and solve problems relevant to AI in a tourism and hospitality management context. **D. Effective Communicators** • Working as a team to research, plan, organize, and present a project on AI technology for a service operation. **E. Lifelong Learners** (not applicable)

	F. Ethical Leader - Understand and apply ethical skills to make sound decisions in both principle and practice **G. Socially Responsible Global Citizen** (not applicable)
Subject Synopsis/ Indicative Syllabus *(Note 2)*	1. Introduction to AI 2. Basic terms and knowledge of AI 3. Key AI technologies and its applications in tourism and hospitality industry 4. Intelligent agent and problem solving in tourism and hospitality industry 5. Machine learning and its applications in tourism and hospitality industry 6. AI-Driven Hospitality and Tourism Business Strategy 7. AI in tourism and hospitality management – The future 8. AI ethical issues and concern
Teaching/Learning Methodology *(Note 3)*	1. **Interactive lectures** will be given with class discussions and illustrations of artificial intelligence concepts and methods. 2. **Tutorials** will be held to provoke active class participation in discussion. Problems will be raised for group discussions in the tutorials. 3. **Projects** will be used to invoke students in investigative activities that require them to employ knowledge of, and skills from, more than one discipline. For group project, team members will have to make a presentation on their chosen topic. A question-and-answer session will be held after the presentation in order to authenticate the students' understanding and critical thinking ability. 4. **Guest speaker** will be invited to give lectures/seminars on specific issues related to AI technologies in order to enhance students' understanding of the theories learnt and their applications. 5. **Case studies** will be used to give students the opportunities to place themselves in the position of the decision maker and apply their analytical and critical thinking skills to explore scenarios and solutions.
Assessment Methods in Alignment with Intended Learning Outcomes *(Note 4)*	

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)				
		A	B	C	D	F
i. Assignments and quizzes	25%	√	√	√		
ii. Group project and presentation	30%		√	√	√	√
iii. Class participation	10%	√	√	√	√	√

iv. Final exam	35%	√	√	√		
Total	100%					

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Assignments and quizzes intends to examine the extent students can critically assess and apply the AI technologies in tourism and hospitality management.

Group Project and presentation will enable students to work in teams and apply AI technologies in a real world setting. This component is essential as students will be able to illustrate the application of these technologies, and assess the influence of these technologies for tourism and hospitality management.

Class participation intends to examine whether students can use AI technologies and knowledge to explain and clarify ideas in addition to asking questions throughout the semester.

Final exam intends to measure to what extent student can understand, apply and critically assess AI technologies and knowledge they have learnt in the course of a semester.

Student Study Effort Required

Class contact:	
▪ Lecture	26 Hrs.
▪ Tutorial	13 Hrs.
Other student study effort:	
▪ Reading assigned readings	25 Hrs.
▪ Preparation for the tutorials and	14 Hrs.
▪ Preparation for the examinations	25 Hrs.
▪ Preparation for the group project	20 Hrs.
Total student study effort	123 Hrs.

Reading List and References

- Aluri, A., Price, B. S., & McIntyre, N. H. (2019). Using machine learning to cocreate value through dynamic customer engagement in a brand loyalty program. *Journal of Hospitality & Tourism Research*, *43*(1), 78-100.
- Barro, S., & Davenport, T. H. (2019). People and machines: Partners in innovation. *MIT Sloan Management Review*, *60*(4), 22-28.
- Bird, S., Klein, E., & Loper, E. (2009). Natural Language Processing with Python. *O'Reilly Media.*
- Bishop, C. M. (2006). Pattern recognition and machine learning. *Springer.*
- Brynjolfsson, E., & Mcafee, A. N. D. R. E. W. (2017). The business of artificial intelligence. *Harvard Business Review*, 1-20.
- Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. *The MIT Press.*
- Hagendorff, T. (2020). The ethics of AI ethics: An evaluation of

	guidelines. *Minds and Machines*, 1-22. • He, K., Zhang, X., Ren, S., & Sun, J. (2016). Deep residual learning for image recognition. In *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition* (pp. 770-778). • Ivanov, S., Gretzel, U., Berezina, K., Sigala, M., & Webster, C. (2019). Progress on robotics in hospitality and tourism: a review of the literature. *Journal of Hospitality and Tourism Technology*, *10*(4), 489-521. • Jobin, A., Ienca, M., & Vayena, E. (2019). The global landscape of AI ethics guidelines. *Nature Machine Intelligence*, *1*(9), 389-399. • Law, R., Li, G., Fong, D. K. C., & Han, X. (2019). Tourism demand forecasting: A deep learning approach. *Annals of Tourism Research*, *75*, 410-423. • Martinez-Torres, M. R., & Toral, S. L. (2019). A machine learning approach for the identification of the deceptive reviews in the hospitality sector using unique attributes and sentiment orientation. *Tourism Management*, *75*, 393-403. • Rességuier, A., & Rodrigues, R. (2020). AI ethics should not remain toothless! A call to bring back the teeth of ethics. *Big Data & Society*, *7*(2), 2053951720942541. • Trappl, R. (1986). Impacts of Artificial Intelligence: An Overview. *Impacts of Artificial Intelligence: Scientific, Technological, Military, Economic, Societal, and Political.* DBLP. • Tung, V. W. S., & Au, N. (2018). Exploring customer experiences with robotics in hospitality. *International Journal of Contemporary Hospitality Management*, *30*(7), 2680-2697. • Tung, V. W. S., & Law, R. (2017). The potential for tourism and hospitality experience research in human-robot interactions. *International Journal of Contemporary Hospitality Management*, *29*(10), 2498-2513.

Note 1: Intended Learning Outcomes
Intended learning outcomes should state what students should be able to do or attain upon subject completion. Subject outcomes are expected to contribute to the attainment of the overall program outcomes.

Note 2: Subject Synopsis/Indicative Syllabus
The syllabus should adequately address the intended learning outcomes. At the same time, overcrowding of the syllabus should be avoided.

Note 3: Teaching/Learning Methodology
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Note 4: Assessment Method
This section should include the assessment method(s) to be used and its relative weighting, and indicate which of the subject intended learning outcomes that each method is intended to assess. It should also provide a brief explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes.

The Hong Kong Polytechnic University

Subject Description Form

Please read the notes at the end of the table carefully before completing the form.

Subject Code	HTM4364
Subject Title	Social Media and Digital Marketing Analytics
Credit Value	3
Level	4
Pre-requisite / Co-requisite/ Exclusion	HTM 2324 Marketing in Hospitality, Tourism and Events in the Digital Age (or other equivalent subjects)
Objectives	This course provides students with professional knowledge in social media and digital marketing analytics about how to measure social media and digital marketing performance in the tourism, hospitality and events industries. It helps students to develop an understanding of social media and digital marketing analytics; the process through marketing analytics to craft experiences that profoundly reflect each customer's needs, expectations, and behaviors; measure real social media ROI: sales, leads, and customer satisfaction; and track the performance of all paid, earned, and owned social media channels. In addition, it helps the students understand how to integrate paid and earned social media data to drive more value for tourism, hospitality and events organizations through new marketing and social media investments.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: **A. Competent professional:** Students should be able to integrate and to apply social media and digital marketing analytics knowledge and skills that are fundamental to functioning effectively as an digital marketing analytics professional (professional competence); understand the global trends and opportunities related to social media and digital marketing analytics (global outlook); and demonstrate entrepreneurial spirit and skills in their social media and digital marketing analytics related work, including the discovery and use of opportunities, and experimentation with novel ideas (entrepreneurship). **B. Critical thinker:** Students should be able to examine and critique the validity of social media and digital marketing information, arguments, and different viewpoints, and to reach sound judgments on the basis of credible

	evidence and logical reasoning in social media and digital marketing analytics contexts. **C. Innovative problem solver:** Students should be able to identify and define social media and digital marketing analytics problems in both professional and day-to-day contexts, and produce innovative solutions to solve marketing problems. **D. Effective communicator:** Students should be able to comprehend and communicate effectively in English orally and in writing, in social media and digital marketing analytics contexts. **E. Lifelong learner:** Students should be able to recognise the social media and digital marketing analytics need for continual learning and self-improvement, and be able to plan, manage and evaluate their own learning in pursuit of self-determined goals in social media and digital marketing contexts. **F. Ethical leader:** Students should have an understanding of leadership and be prepared to serve as a digital marketing leader and a team player (leadership and teamwork); be capable of building and maintaining relationship and resolving conflicts in group work situations (interpersonal competence); and demonstrate ethical reasoning in social media and digital marketing contexts (ethical reasoning). **G. Socially responsible global citizen:** Students should have the capacity for understanding different cultures and social development needs in in social media and digital marketing contexts (interest in culture and social development); and accept their responsibilities as digital marketing professionals to society, their own nation and the world (social, national, and global responsibility).
Subject Synopsis/ Indicative Syllabus *(Note 2)*	1. Overview of social media, digital and content marketing analytics 2. Understanding the synergetic digital ecosystem in hospitality, tourism and events industries 3. Understanding social media listening and digital marketing analytics tools in hospitality, tourism and events industries 4. Understanding digital brand analysis and audience analysis 5. Digital ecosystem analysis and maps 6. Tracking return on investment approaches 7. Understanding digital influence and developing influence approach 8. Understanding the social media landscape analysis 9. The role of digital analytics on launching a new product 10. Forecasting the digital marketing analysis of the future

11. Using digital analytics to anticipate a crisis

Teaching/Learning Methodology

(Note 3)

I. Lectures with discussions in class and illustration of real tourism, event and hospitality cases will be used.

II. Tutorials will be conducted with hands-on examples, interactive activities and group discussions to support and reinforce the topics covered in lectures.

III. Group Project will involve asking students to form small teams for working on a case study that relates to social media and digital marketing analytics in the hospitality, tourism and events industries. The project requires students to evaluate the impact of the social media and digital marketing based on the case and provide recommendations accordingly.

IV. Guest speakers or speakers from the Hotel ICON and tourism and events organizations will be invited to give lectures/seminars on contemporary practices of social media and digital marketing analytics in hospitality, tourism and events organizations.

Assessment Methods in Alignment with Intended Learning Outcomes

(Note 4)

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)						
		A	B	C	D	E	F	G
i.Tutorial exercise and discussions	10%	√	√	√	√	√	√	√
ii.Individual written assignment	15%	√	√	√		√		√
iii. Group project	35%	√	√	√	√	√	√	√
iv. Final examination	40%	√	√	√				
Total	100 %							

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Tutorial exercises and discussions: Students will work on hands-on examples, exercises and discussions on problems related to the topic discussed in lecture to demonstrate their understanding of the conceptions and ability to apply the concepts in solving the digital marketing problem.

Individual written assignment: This is a written paper which students will be asked to conduct an analysis of a case study with simulated dataset. Students will be required to make recommendations based on the analysis result.

	Group Project: Group Project comprising of a group digital marketing analytic report and a group presentation. It involves an in-depth analysis of social media and digital marketing strategy of a hospitality, tourism and events organization. Both written and presentation skills will be assessed. **Examination**: Examination will be used to assess the students' understanding of the knowledge and application ability in answering applied social media and digital marketing analytics related problems in the hospitality and tourism industry.	
Student Study Effort Expected	Class contact:	
	▪ Lecture	26 Hrs.
	▪ Tutorial	13 Hrs.
	Other student study effort:	
	▪ Reading textbook and assigned reading	15 Hrs.
	▪ Preparation for continue assessments	65 Hrs.
	▪ Studying for examination	15 Hrs.
	Total student study effort	134 Hrs.
Reading List and References	***Required Readings:*** Hemann, C., & Burbary, K. (2018). *Digital marketing analytics: making sense of consumer data in a digital world* (Second edition). Pearson Education, Inc. ***Suggested Readings:*** McGuire, K. A. (2017). *The analytic hospitality executive : implementing data analytics in hotels and casinos* (1st edition.). Wiley. Park, Deukhee, Kim, Woo Gon, & Choi, Soojin. (2019). Application of social media analytics in tourism crisis communication. *Current Issues in Tourism*, 22(15), 1810–1824. Rana, Nripendra P, Slade, Emma L, Sahu, Ganesh P, Kizgin, Hatice, Singh, Nitish, Dey, Bidit, Gutierrez, Anabel, & Dwivedi, Yogesh K. (2019). *Digital and Social Media Marketing*. Springer International Publishing AG. Singh, Amandeep. (2021). *Big Data Analytics for Improved Accuracy, Efficiency, and Decision Making in Digital Marketing*. IGI Global. Sponder, M., & Khan, G. F. (2018). *Digital analytics for marketing*. Routledge.	

Note 1: Intended Learning Outcomes
Intended learning outcomes should state what students should be able to do or attain upon completion of the subject. Subject outcomes are expected to contribute to the attainment of the overall programme outcomes.

Note 2: Subject Synopsis/ Indicative Syllabus
The syllabus should adequately address the intended learning outcomes. At the same time over-crowding of the syllabus should be avoided.

Note 3: Teaching/Learning Methodology
This section should include a brief description of the teaching and learning methods to be employed to facilitate learning, and a justification of how the methods are aligned with the intended learning outcomes of the subject.

Note 4: Assessment Method
This section should include the assessment method(s) to be used and its relative weighting, and indicate which of the subject intended learning outcomes that each method purports to assess. It should also provide a brief explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes.

Subject Description Form

Subject Code	HTM4365
Subject Title	Integrated Capstone Project
Credit Value	6
Level	4
Pre-requisite / Co-requisite/ Exclusion	**Pre-requisite:** HTM3205 – Analyzing and Interpreting Research **Exclusion**: Any other equivalent capstone project
Objectives	The objectives of this subject are to: • provide students with the opportunity to apply and integrate the knowledge of artificial intelligence and data analytics (AIDA) to the hospitality and tourism industry. • develop the capabilities of students in analyzing and solving complex and possibly real-life problems using hotel and tourism management (HTM) and AIDA knowledge. • train students with the skills necessary for the systematic development and documentation of a significant piece of work.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: Professional/academic knowledge and skills (a) conduct literature surveys to locate materials and sources relevant to the selected problem area in hospitality and tourism; (b) understand the materials obtained and connect the materials with the problem to be solved using HTM and AIDA knowledge and skills; (c) define and specify the problem precisely; (d) assimilate and apply the learnt knowledge to generate good solutions to the problem; (e) think critically the formulation of alternative models and solutions to the problem, in the analysis of approaches to the solution and their implementation; and (f) evaluate the final outcome in an objective manner; Attributes for all-roundedness (g) improve presentation and communication skills via oral presentation; (h) enhance technical report writing skills with proper organization of materials; (i) develop the ability to learn independently and to find/integrate information from different sources required in solving real-life problems; (j) manage the project efficiently and effectively through the supervision of supervisor(s); and (k) work collaboratively with related parties (e.g. vendors, sponsor company, technical support staff, team-partners, research students, etc.).
Subject Synopsis/ Indicative Syllabus	**1. In-depth Study of a Topic Typically Proposed by the Supervisor** **2. Project Meeting and Planning** **3. Proposal Writing** **4. Regular Progress Checking and Reporting** **5. Project Documentation** **6. Presentation and Demonstration**

Students are expected to identify a project topic with a supervisor in School of Hotel and Tourism Management (SHTM) and a co-supervisor with expertise in artificial intelligence and data analytics. Students need to demonstrate their knowledge in both HTM and AIDA in the project relevant to the hospitality or tourism industry, receiving advice from both supervisors. The project should represent requisite effort in analysing and interpreting the data/information obtained, using the principles and techniques learnt from various related subjects. Students are also expected to demonstrate significant analytical and, preferably, research ability in the chosen application domain.

Teaching/Learning Methodology

The Integrated Capstone Project spans across the academic year for two consecutive semesters. The teaching/learning activities include regular project meetings with the supervisor and the co-supervisor, guided study of project materials, independent project development work and other project management tasks.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)										
		a	b	c	d	e	f	g	h	i	j	k
Continuous Assessment	100	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Total	100											

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The Integrated Capstone Project will be assessed by the supervisor and/or co-supervisor and other assessors. Attributes to be assessed include, but are not limited to, Problem Identification, Problem Solving, Communication and Presentation, Project Management, and Self-Discipline.

Integrated Capstone Projects should be problem-oriented and there are no restrictions on the nature of the problem except that it should be relevant to HTM and AIDA. The project could be practical, academic or a hybrid in which the student is encouraged but not constrained to have some original contributions. Each student has to submit a proposal, a mid-term checkpoint progress report and a final report. The proposal must be approved by the supervisor and/or co-supervisor before the student can proceed with the Integrated Capstone Project. An oral presentation/demonstration is essential at the end of the project. A mid-term presentation and demonstration may also be required for progress assessment.

Student Study Effort Expected

Class contact:	
• Lecture	0 Hrs.
Other student study effort:	
• Searching and reading materials, meeting with supervisor / co-supervisor / others, design and system development, testing, documentation, presentation, etc.	210 Hrs.
Total student study effort	210 Hrs

Reading List and References	**Reference Books:** 1. Kumar, Ranjit (2011). *Research Methodology: A Step-by-step Guide for Beginners* (3rd ed.). SAGE Publications. 2. Burns, Robert B. (2000). *Introduction to Research Methods* (4th ed.). SAGE Publications. 3. Finn, M., Elliott-White, M., & Walton, M. (2000). *Tourism and Leisure Research Methods – Data Collection, Analysis and Interpretation*. Pearson Education, UK. 4. Roberts, Carol M. (2007). *The Dissertation Journey: A Practical and Comprehensive Guide to Planning, Writing, and Defending Your Dissertation* (3rd ed.). Corwin Press. 5. Mauch, James E. and Park, Namgi (2003). *Guide to the Successful Thesis and Dissertation: A Handbook for Students and Faculty* (5th ed.). Marcel Dekker. 6. Rudestam, Kjell Erik and Newton, Rae R. (2001). *Surviving Your Dissertation: A Comprehensive Guide to Content and Process* (2nd ed.). Sage Publications. 7. Garson, G. David (2002). *Guide to Writing Empirical Papers, Theses and Dissertations*. Marcel Dekker. 8. Reinhart, Susan M. (2013). *Giving Academic Presentations* (2nd ed.). University of Michigan Press. 9. Oshima, Alice and Hogue, Ann (2006). *Writing Academic English* (4th ed.). Pearson Longman. 10. American Psychological Association (2010). *Publication Manual of the American Psychological Association* (6th ed.). American Psychological Association. 11. Szuchman, Lenore T. (2011). *Writing with Style: APA Style Made Easy* (5th ed.). Wadsworth/Cengage Learning. 12. Statistics, simulation, programming, and relevant books. 13. ACM and IEEE magazines, Transactions and Journals. 14. Other International Journals. 15. Relevant conference proceedings and magazines (including ACM and IEEE conferences). 16. Technical reports from universities and major companies.

Updated on 18 March 2022

[Draft] Subject Description Form

Subject Code	ISE3011
Subject Title	Applied Quality and Reliability with AIDA
Credit Value	3
Level	3
Pre-requisite/Co-requisite/Exclusion	
Objectives	The subject will provide students with 1. the understanding of quality and reliability systems; 2. the ability to develop quality and reliability systems by applying AIDA; 3. the ability to conduct quality and reliability control by applying AIDA.
Intended Learning Outcomes	Upon completion of the course, students will be able to a. integrate AIDA in quality and reliability systems; b. use appropriate AI tools for better process quality and reliability control; c. make decision by using quality and reliability principle and techniques.
Subject Synopsis/ Indicative Syllabus	1. Introduction to Quality and Reliability Basic concepts of quality and quality planning; Reliability fundamental; Quantification of reliability; Failure rate prediction and reliability estimation; Basic concepts of process variation and process capability study; Control charts and statistical tolerancing. 2. Quality Control by applying AIDA AIDA techniques for Monitoring (e.g., sensors, image recognition); Proactive Monitoring; Anomalies Prediction. Using AIDA for acceptance sampling plans; Case Studies for using AIDA for quality control. 3. System Reliability by applying AIDA Reliability block diagrams. Estimation of reliability functions by applying AIDA; Case Studies for using AI for Quality Control.

<table>
<tr><td>Teaching/Learning Methodology</td><td>The teaching pedagogy of this subject is a combination of classroom teaching and experiential learning. It consists of a series of lectures and well-organized laboratory activities. Emphasis is put on the acquisition of required skills and knowledge in artificial intelligence for quality and reliability. The lectures provide the basics and theories while the laboratory activities cover the skills following an interest-based approach.</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="6">Intended subject learning outcomes to be assessed</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td></td><td></td><td></td></tr>
<tr><td>Quizzes and Midterm Test</td><td>40%</td><td>✓</td><td>✓</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Laboratory Exercises</td><td>20%</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td><td></td></tr>
<tr><td>Final Examination</td><td>40%</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td><td></td></tr>
<tr><td>Total</td><td>100 %</td><td colspan="6"></td></tr>
</table>
Quizzes and midterm test are used to assess students’ understanding of the concepts of applying AIDA in quality control and system reliability. The laboratory exercises are used to assess their ability on using AIDA technology. At the end of the course, an examination is given to students to assess their knowledge on using AIDA for quality control, system reliability, proactive monitoring and predicting anomalies.</td></tr>
<tr><td>Student Study Effort Expected</td><td>
<table>
<tr><td>Class contact</td><td></td></tr>
<tr><td>▪ Lecture 2 hours/week for 13 weeks</td><td>26 Hrs.</td></tr>
<tr><td>▪ Tutorial/Case Study 1 hour/week x 13 weeks</td><td>13 Hrs.</td></tr>
<tr><td>Other student study efforts</td><td></td></tr>
<tr><td>▪ Self Study/Assignment</td><td>58 Hrs.</td></tr>
<tr><td>▪ Case Study</td><td>13 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>110 Hrs.</td></tr>
</table></td></tr>
<tr><td>Reading List and References</td><td>1. Sheila Anand, and L. Priya, <i>A Guide for Machine Vision in Quality Control</i>, New York, NY: CRC Press, 2020.
2. Diego Galar Pascual, <i>Artificial Intelligence Tools: Decision Support Systems in Condition Monitoring and Diagnosis</i>, Boca Raton, FL: CRC Press, 2015.
3. Pravinbhai Bhatt, Babji Srinivasan, Nirav Pravinbhai Bhatt, <i>Process</i></td></tr>
</table>

	Control Fundamentals: Analysis, Design, Assessment and Diagnosis, Boca Raton: CRC Press, 2020. 4. José A. Orosa García, *Quality Control: Developments, Methods and Applications*, New York: Nova Publishers, 2012. 5. Ruth P. Saunders, *Implementation Monitoring and Process Evaluation*, Thousand Oaks, CA: SAGE, 2016. 6.

[Draft] Subject Description Form

Subject Code	ISE3017
Subject Title	Applied AIDA in Operations Research and Management
Credit Value	3
Level	3
Pre-requisite/Co-requisite/Exclusion	
Objectives	The subject will provide students with 1. the understanding of the basics of operations research and management; 2. the ability to model/formulate real life operations research and management problems with the enrichment of AIDA technologies; 3. the ability to solve operations research and management problems.
Intended Learning Outcomes	Upon completion of the course, students will be able to a. apply AIDA techniques to enrich the modelling of operations management; b. apply the results of AIDA to produce operations research and management solutions; c. solve operations research and operations management problems.
Subject Synopsis/ Indicative Syllabus	1. Introduction to modelling with AIDA Data driven modelling approach; AIDA techniques for data driven modelling (e.g., machine learning, big data). 2. Operations Research Modelling by using AIDA Basic operations research concept; Optimization algorithms (e.g., linear programming, integer programming, dynamic programming); Mathematical modelling with AIDA; Case Studies for using AIDA for operations research. 3. Operations Management Modelling by using AIDA Basic concept of demand management, and managing capacity; Case Studies for using AIDA for operations management.

Teaching/Learning Methodology

The teaching pedagogy of this subject is a combination of classroom teaching and experiential learning. It consists of a series of lectures and well-organized laboratory activities. Emphasis is put on the acquisition of required skills and knowledge in artificial intelligence for enriching modelling of operations research and operations management. The lectures provide the basics and theories while the laboratory activities cover the skills following an interest-based approach.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed					
		a	b	c			
Quizzes and Midterm Test	40%	✓	✓				
Laboratory Exercises	20%	✓	✓	✓			
Final Examination	40%	✓	✓	✓			
Total	100 %						

Quizzes and midterm test are used to assess students’ understanding of the concepts of applying AIDA to enrich the modelling of operations research and operations management. The laboratory exercises are used to assess their ability on using AIDA technology. At the end of the course, an examination is given to students to assess their knowledge on using AIDA to enrich the modelling of operations research and operations management, and to solve the modelled problems.

Student Study Effort Expected

Class contact	
▪ Lecture 2 hours/week for 13 weeks	26 Hrs.
▪ Tutorial/Case Study 1 hour/week x 13 weeks	13 Hrs.
Other student study efforts	
▪ Self Study/Assignment	58 Hrs.
▪ Case Study	13 Hrs.
Total student study effort	110 Hrs.

Reading List and References

1. Eberhard Hechler, Martin Oberhofer, Thomas Schaeck, Srinivas Thummalapalli, *Deploying AI in the Enterprise: IT Approaches for Design DevOps, Governance, Change Management, Blockchain, and Quantum Computing*, Apress, 2020.

2. David Forsyth, *Applied Machine Learning*, Cham: Switzerland, Springer, 2019.

	3. Gopinath Rebala, Ajay Ravi, Sanjay Churiwala, *An Introduction to Machine Learning*, Cham: Springer, 2019. 4. Henrik Brink, Joseph W. Richards, Mark Fetherolf, *Real-world machine learning*, Shelter Island, NY: Manning Publications Co., 2017. 5. Frederick S. Hillier, and Gerald J. Lieberman, *Introduction to Operations Research*, New York, NY: McGraw-Hill, 2015, Tenth edition. 6. William J. Stevenson, Operations Management, New York, NY: McGraw-Hill, 2021, Fourteenth edition.

Form AR 140

The Hong Kong Polytechnic University

Subject Description Form

Please read the notes at the end of the table carefully before completing the form.

Subject Code	ISE3018
Subject Title	Logistics Automation
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	This subject provides students with 1. the understanding of artificial intelligence and automation concept; 2. the understanding of artificial intelligence and automation applications in facilitating logistics operations; and 3. the ability to identify potential applications of artificial intelligence and automation in logistics operations in practice.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: a. evaluate and improve the performance of terminal operations based on logistics engineering approach; b. analyze and design a solution to enhance warehouse operation efficiency and accuracy by using robots and automation technology; and c. analyze and develop a solution to support last-mile delivery operations by using drones and unmanned guided vehicles.
Subject Synopsis/ Indicative Syllabus *(Note 2)*	1. <u>Artificial Intelligence and Automation</u> Introduction to artificial intelligence and automation. 2. <u>Container Terminal Automation</u> Introduction to container terminal industries and container terminal operations. Applications of automation technologies, (e.g., automated cranes, automated vehicles, information systems) in yard, quay, and gate operations. 3. <u>Warehouse Automation</u> Warehouse and distribution center operations. Applications of autonomous robots, e.g., order picking robots and

autonomous mobile robots, to enhance order picking, and goods storage and retrieval operations.

4. Last-mile Automation

   Last-mile delivery operations. Applications of drones and unmanned guided vehicles in last-mile delivery.

Teaching/Learning Methodology

(Note 3)

The teaching pedagogy of this subject is a combination of classroom teaching and experiential learning. It consists of a series of lectures and well-organized laboratory activities. Emphasizing is put on the acquisition of required skills and knowledge in artificial intelligence and automation applied in logistics industries. The lectures provide the basics and theories while the laboratory activities cover the skills following an interest-based approach.

Assessment Methods in Alignment with Intended Learning Outcomes

(Note 4)

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed		
		a	b	c
Quizzes and Midterm Test	40%	✓	✓	✓
Laboratory Exercises	20%		✓	
Final Examination	40%	✓	✓	✓
Total	100%			

Quizzes and midterm test are used to assess students' understanding on the concepts of applying logistics automations in logistics operations. The laboratories are used to assess their ability on using logistics automation technology. At the end of the subject, an examination is given to students to assess their learning outcomes.

Student Study Effort Expected

Class contact:	
▪ Lecture 3 hours/week for 7 weeks	21 Hrs.
▪ Tutorial/Laboratory 3 hours/week for 6 weeks	18 Hrs.
Other student study effort:	
▪ Laboratory Reports	39 Hrs.
▪ Preparation for Tests and Examination	39 Hrs.
Total student study effort	117 Hrs.

Reading List and References

1. Jerry Kaplan 2016, *Artificial Intelligence*, New York, NY: Oxford University Press.
2. Eric Su 2016, *Operational Risk Management in Container Terminals*, Abingdon, Oxon, New York, NY: Routledge.

	3. Ning Zhao, Yuan Liu, Weijian Mi 2020, *Digital Management of Container Terminal Operations*, Singapore: Springer. 4. Gwynne Richards 2018, *Warehouse Management: A Complete Guide to Improving Efficiency and Minimizing Costs in the Modern Warehouse*, London, United Kingdom: Kogan Page Limited. 5. Christian Wurst, Luca Graf 2021, *Disrupting Logistics: Startups, Technologies, and Investor Building Future Supply Chains*, Springer International Publishing. 6. Albert Causo 2020, *Advances on Robotic Item Picking: Applications in Warehousing & e-commerce Fulfillment*, Springer.

Note 1: Intended Learning Outcomes
Intended learning outcomes should state what students should be able to do or attain upon subject completion. Subject outcomes are expected to contribute to the attainment of the overall programme outcomes.

Note 2: Subject Synopsis/Indicative Syllabus
The syllabus should adequately address the intended learning outcomes. At the same time, overcrowding of the syllabus should be avoided.

Note 3: Teaching/Learning Methodology
This section should include a brief description of the teaching and learning methods to be employed to facilitate learning, and a justification of how the methods are aligned with the intended learning outcomes of the subject.

Note 4: Assessment Method
This section should include the assessment method(s) to be used and its relative weighting, and indicate which of the subject intended learning outcomes that each method is intended to assess. It should also provide a brief explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes.

(Form AR 140) 8.2020

The Hong Kong Polytechnic University

Subject Description Form

Please read the notes at the end of the table carefully before completing the form.

Subject Code	ISE4001
Subject Title	Integrated Capstone Project
Credit Value	6
Level	4
Pre-requisite/ Co-requisite/ Exclusion	Pre-requisite: ISE3018 Logistics Automation Exclusion: ISE4008 Individual Project and ISE445 Capstone Project
Objectives	While the specific objectives of integrated capstone projects may vary from one project to another, students are expected to develop the following generic skills through the learning experience of working on an individual project under the guidance of a supervisor: 1. Skills to obtain information needed to formulate a problem in logistics, and to devise and implement strategies that will produce a solution. 2. Skills to apply and integrate the knowledge of artificial intelligence and data analytics (AIDA) to logistics. 3. Skills to apply knowledge, procedures (principles, techniques and methods), and to understand their limitations in problem identification, data analysis and formulation of logical observations and or solutions. 4. Capabilities of analyzing and solving complex and possibly real-life problems using AIDA. 5. Skills to work effectively as an individual using one’s own initiative and within constraints. 6. Skills to prepare, present, and defend a project report effectively.

Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: a. understand the background, as well as define the objectives (time, cost and technical requirements) and deliverables of a project that address a significant issue relevant to the field of logistics; b. formulate strategies and methodologies to achieve the project objectives within the constraints of a given situation, and understand the materials obtained and connect the materials with the problem to be solved using AIDA knowledge and skills; c. select, apply, integrate and, ideally, extend available knowledge, procedures and tools to collect data in performing the needed investigational or design work, and to draw conclusions that address the project objectives; d. communicate effectively with stakeholders of the project outputs and work independently to produce, within applicable constraints, optimal solutions that address the project objectives; e. evaluate the final outcome in an objective manner, and prepare, present, and defend a clear, coherent and succinct report.
Subject Synopsis/ Indicative Syllabus *(Note 2)*	Each student is required carry out an individual project in an area relevant to the discipline of logistics engineering. Details of the work will depend on the subject of the project that the student works on.
Teaching/Learning Methodology *(Note 3)*	Throughout the duration of the project, the supervisor provides guidance and monitors the progress of the project. The progression of the project typically follows the following indicative stages: **Project Definition** – in this stage, the student will work in consultation with the project supervisor to draw up a project plan addressing issues such as: ● Background of the project ● Aims and objectives ● Deliverables ● Project scope and applicable constraints ● Coverage of literature review ● Methodologies to be considered ● Project schedule **Project Execution** – This is the major part of the project. After the project requirements are defined, the student will work independently under the guidance of the project supervisor towards the achievement of the project objectives and produce the project deliverables in a given situation. On his or her own initiative, the student will meet the project supervisor regularly

to review progress and discuss issues of the project. In this stage, the student should demonstrate:

- Adherence to the schedule
- Initiatives to acquire and synthesize knowledge, collect the needed data, and solve problems
- Tenacity, resourcefulness, critical thinking and creativity in achieving project objectives
- Systematic documentation of data, design and results throughout the process

The student is required to maintain a project workbook that records the meetings held and summarizes the work performed in this stage.

Project Report – On completion of the project, the student will disseminate the results to examiners to review. The major deliverables of this stage are:

- A written project report (softcopy and hardcopy)
- An oral presentation
- Taking questions and comments in a question-and-answer session

The proposed project defined by the student and/or the supervisor should be in an area relevant to the field of logistics. The project will be used as a vehicle for the student to integrate his/her knowledge gained in the programme. In order to achieve the subject learning outcomes, it is not appropriate to have projects mainly focused on literature review or pure computer programming. Depends on the nature of the project, the work covers by the students may include the background and scope of the project; literature review, field works; experiments; data collection; case studies; methodology; discussion; and conclusion.

Assessment Methods in Alignment with Intended Learning Outcomes

(Note 4)

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed				
		a	b	c	d	e
▪ Progress	15%	✓	✓	✓	✓	
▪ Workbook	10%	✓	✓	✓	✓	
▪ Final Report	50%	✓	✓	✓	✓	✓
▪ Oral Presentation	25%	✓	✓	✓	✓	✓
Total	100%					

The workbook is designed to assist the project student to organise and document, in summary form, his or her project work in a systematic manner. This workbook, to be submitted at the end of Semester 1, will be commented by the Project Supervisor and then assessed by a co-examiner of the project. The final report should be a clear, coherent and succinct document that disseminate the background, problem statement, objectives and expected deliverables, literature review, methodologies, project execution,

<table>
<tr><td></td><td colspan="2">analysis and, where appropriate, design, as well as discussion and conclusions. Thus, the written report and the oral presentation are assessed by the project supervisor and a co-examiner to determine the achievement of all the learning outcomes of the project work.
The project supervisor, who communicates regularly with the student, will assess the student’s progress during project execution.</td></tr>
<tr><td rowspan="8">Student Study Effort Expected</td><td>Class contact:</td><td></td></tr>
<tr><td>▪ Briefing on Final Year Project</td><td>2 Hrs.</td></tr>
<tr><td>▪ Information Literacy Seminar</td><td>2 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Meetings with Supervisor and/or project stakeholders 2 Hrs. × 13</td><td>26 Hrs.</td></tr>
<tr><td>▪ Literature review/field work/experiments</td><td>120 Hrs.</td></tr>
<tr><td>▪ Analysis/report writing</td><td>90 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>240 Hrs.</td></tr>
<tr><td>Reading List and References</td><td colspan="2">1. Blaxter, L., et al. 2001, <i>How to Research</i>, 2nd edn, Open University Press
2. Bryman, A. 1989, <i>Research Methods and Organization Studies</i>, Unwin Hyman
3. Campbell, W.G., et al. 1990, <i>Forms and Style: Thesis, Reports, Term Papers</i>, 8th edn, Boston, Houghton Mifflin
4. Murray, Rowena 2002, <i>How to Write a Thesis</i>, Open University Press</td></tr>
</table>

Note 1: Intended Learning Outcomes
Intended learning outcomes should state what students should be able to do or attain upon subject completion. Subject outcomes are expected to contribute to the attainment of the overall programme outcomes.

Note 2: Subject Synopsis/Indicative Syllabus
The syllabus should adequately address the intended learning outcomes. At the same time, overcrowding of the syllabus should be avoided.

Note 3: Teaching/Learning Methodology
This section should include a brief description of the teaching and learning methods to be employed to facilitate learning, and a justification of how the methods are aligned with the intended learning outcomes of the subject.

Note 4: Assessment Method
This section should include the assessment method(s) to be used and its relative weighting, and indicate which of the subject intended learning outcomes that each method is intended to assess. It should also provide a brief explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes.

Subject Description Form

Subject Code	LGT/MM3425
Subject Title	Business Analytics
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	**Exclusion**: Introduction to Business Analytics (LGT/MM2425) and Business Analytics (LGT3425)
Objectives	This subject aims to expose students to the cutting-edge practices and technologies (including artificial intelligence and cloud computing) which are used for transforming business data and big data into useful information. It focuses on the cultivation of a sense of viewing business problems from a data perspective and critical thinking in business analytics. Through equipping students with a solid understanding of the principles, methods and technologies for business analytics, students can apply business intelligence tools to effectively address various issues faced by organizations. Hands-on practices for relevant computer application software and computer programming (Python) will be emphasized in the whole subject.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: **a.** Understand the current concepts and applications of business analytics in both local and global business environments **(BBA Outcome 6b)** **b.** Analyze business situations and tackle business problems using various types of business analytics tools **(BBA Outcome 6b)**. **c.** Understand how current technologies such as artificial intelligence and cloud computing contribute to the success of data analytics implemented in companies **(BBA Outcome 5c)** **d.** Think critically and creatively on applying business analytics in different business contexts and daily contexts **(BBA Outcome 6b)** **e.** Identify and evaluate business opportunities using business analytics **(BBA Outcome 5c)** **f.** Identify the critical managerial and ethical issues in using business analytics **(BBA Outcome 6b)**
Subject Synopsis/ Indicative Syllabus	The subject presents an overview of strategic and managerial issues on business analytics in modern enterprises. Upon completion of the subject, students will be able to grasp fundamental issues of business analytics: **Business Analytics Overview**

	Introduction to business analytics, data-analytic thinking, data science solution for business problems **Predictive Modelling** Introduction to predictive modeling. Forecasting analytics. **Prescriptive Analytics** Introduction to optimization and simulation. **Decision Analytics** What is a good model? Visualizing model performance, introduction to data. mining and text analytics. Students will learn the relationships among artificial intelligence, cloud computing and big data, and understand how they can be integrated and applied in business analytics.
Teaching/Learning Methodology	The course will use a variety of methods as its pedagogy to help students achieve the above learning outcomes. 1. General announcement and an opportunity for students to ask questions to address any unfinished thoughts from the previous class; 2. Overview of the current class agenda and its relationships to past discussion; 3. Extended period of students- or instructor-led discussion of the key issues in the assigned case or readings. Collaborative learning strategies (learning via discussion in a small group) may be employed during part of this time; 4. Lab sessions during tutorials to provide students hands-on experiences of using business analytics tools.

Assessment Methods in Alignment with Intended Learning Outcomes

(Note 4)

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b	c	d	e	f
Continuous Assessment	**50%**						
1. Participation	5%	✓	✓	✓	✓	✓	✓
2. Individual Assignment(s)	15%	✓	✓	✓	✓		
3. Group Assignment(s)	30%	✓	✓	✓	✓	✓	✓
Examination	**50%**	✓	✓	✓	✓	✓	✓
Total	100%						

**Weighting of assessment methods/tasks in continuous assessment may be different, subject to each subject lecturer.*

To reflect the significant technology content in this subject, 10% (*or more*) of the overall weighting of this subject is based on individual assessment concerning technology-related knowledge.

To pass this subject, students are required to obtain Grade D or above in the overall subject grade.

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes: the various methods are designed to ensure that all students taking this subject to have a balanced learning experience.

Feedback is given to students immediately following the presentations and all students are invited to join this discussion.

Student Study Effort Expected

Class contact:	
▪ Lectures	26 Hrs.
▪ Tutorials	13 Hrs.
Other student study effort:	
▪ Preparation for lectures	28 Hrs.
▪ Preparation of assignment / group assignment and presentation / examination	56 Hrs.
Total student study effort	123Hrs.

Reading List and References	***Recommended Textbooks and References*** ***Recommended Textbooks*** Camm, J.D., Cochran, J.J., Fry, M.J., Ohlmann, J.W., Anderson, D.R., Sweeney, D.J. and Williams, T.A. (2019). *Business Analytics (3rd edition).* Cengage Learning. ***Reference Books*** Akerkar, R. (2019). *Artifical Intelligence for Business*. Springer. Albright, S. C. and Wayne L. Winston (2014), *Business Analytics: Data Analysis & Decision Making, 5th Edition*, Cengage Learning. Morrison, R. (2015). *Data-driven Organization Design: Sustaining the Competitive Edge through Organizational Analytics*, EBSCOhost ebook collection. Provost, F., & Fawcett, Tom. (2013). *Data Science for Business (1st ed.)*. Sebastopol, Calif: O'Reilly. Ragsdale, C. (2015). *Spreadsheet Modeling & Decision Analysis: A Practical Introduction to Business Analytics (7e, Seventh ed.).* Stamford, CT: Cengage Learning. ***Other References*** Rentschler, Christina Verena. (2017). *Data at the edge but what does it mean? MS&E 238 Blog: Leading Trends in Information Technology*. Stanford University. Fu, K. & Xu, W. (2018). Risks of trusting the physics of sensors: protecting the Internet of Things with embedded security. *Communications of the ACM*, 61 (2), 20 – 23.

The Hong Kong Polytechnic University

Subject Description Form

Subject Code	LGT3108
Subject Title	Introduction to Enterprise Resource Planning System
Credit Value	3
Level	3
Normal Duration	1-semester
Pre-requisite / Co-requisite/ Exclusion	Nil
Objectives	This course is to introduce the most important issues, technologies, usages, and concepts associated with ERP systems and their applications in business firms, where a commercial ERP system, such as SAP, will be used as a learning platform for students. The objective is to enable students to: 1. understand the basic concepts and up-to-date technologies (such as cloud computing and business intelligence) of ERP systems; 2. be familiar with the basic usage of ERP systems, such as SAP, for various business processes; 3. be able to analyze important issues in implementing an ERP system in a firm; 4. develop ability and confidence in exploiting benefits from ERP systems and/or other information technology for business **.**
Subject Learning Outcomes	Upon completion of the subject, students will be able to: a. To demonstrate a clear and relevant understanding of the definitions, importance, potential business values, and relevant technologies of ERP systems; b. To demonstrate the ability in learning the applications of ERP and using the up-to-date ERP systems (such as SAP) for business c. To demonstrate a clear understanding of the life-cycle model of the process that a firm goes through with ERP systems

Subject Synopsis/ Indicative Syllabus

Topics	Sub-topics	Remarks
Introduction to ERP	Introduction to the course Introduction to ERP and ERP Life Cycle	Lectures and Case Study
	ERP Technology, Market Awareness, and Future Trends Cloud-based ERP	
	Business Functions and Business Process Business Process Modeling	
Management with ERP systems	Data Management in ERP	Lectures and Lab Tutorials, with a commercial ERP system, such as SAP, as a learning platform for students' practice and for the lecturer's demonstration
	Sales and marketing management with ERP	
	Procurement management with ERP	
	Production Management with ERP	
	Accounting, finance, and human resource management with ERP	
Managing the Life Cycle of an ERP Project	ERP Initiatives & Selection	Lectures, Case Study, and Group Project
	ERP Design and Implementation	
	After ERP going live	
Selected advanced topics on ERP	Applications of Business Analytics and Intelligence with ERP	Lectures, Case Study, Demonstration, and Site visit/Invited speaker

Teaching/Learning Methodology

- During lectures, basic concepts of ERP and ERP systems will be introduced, and case studies will be discussed.
- During tutorials, students will be guided to practice applications and usages of ERP systems in a computer lab.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b	c			
Coursework	50 %	✓	✓				
Examination	50 %	✓		✓			
Total	100 %						

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The coursework includes a series of tutorial exercises of using ERP systems, and assignments and case studies. They are used to assess the subject outcomes 1 and 2 respectively. The final exam is based on questions relevant to basic concepts of ERP and a case study about the ERP life cycle, which are relevant to subject outcomes 1 and 3.

Student Study Effort Expected

Class contact:	
▪ Lectures	26 Hrs.
▪ Tutorials	13 Hrs.
Other student study effort:	
▪ Assignment and Self-Study	45 Hrs.
▪ Additional Exercises on ERP after class	42 Hrs.
Total student study effort	126 Hrs.

Reading List and References

<u>Recommended Textbook</u>

Monk, Ellen and Wagner, Bret J. (2014) *Concepts in Enterprise Resource Planning*, 4th Edition, Course Technology Cengage Learning

<u>Useful Reference Textbooks</u>

Bradford, Marianne. (2015) Modern ERP: Select, Implement & Use: Today's Advanced Business Systems, Third Edition, Lulu

O'Leary, Daniel E. (2000) Enterprise Resource Planning Systems: Systems, Life cycle, Electronic Commerce, and Risk, Cambridge University Press

The Hong Kong Polytechnic University

Subject Description Form

Subject Code	LGT3109
Subject Title	Introduction to Coding for Business with Python
Credit Value	3
Level	3
Normal Duration	1-semester
Pre-requisite / Co-requisite/ Exclusion	Nil
Objectives	Python is a popular coding (programming) language. It is easy to learn, and has been widely used by business professionals to facilitate their daily operational tasks and analytical jobs. This course introduces the fundamentals of Python language and its applications for task automation for business operations, and data management for business analytics. Students with or without programming experience are all welcome. The objective of this course is to enable students to: 1. grasp the fundamentals of Python language and the basics of coding; 2. be familiar with the basic usage of Python language in business applications; 3. be able to apply basic knowledge and skills of Python programming for basic business applications; 4. develop ability, interest, and confidence in exploiting benefits from coding for business.
Subject Learning Outcomes	Upon completion of the subject, students will be able to: a. read and analyse basic Python programs; b. develop, test and debug basic Python programs; c. understand business applications of Python programs; d. apply Python programming for basic business applications in task automation data management.

Subject Synopsis/ Indicative Syllabus

Topics	Sub-topics	Remarks
Python Fundamentals	Getting Started: What's the use of Python? How to type and execute Python programs?	Lectures and Lab Tutorials
	Variables, Simple Data Types, and Basic Flow Control	
	Functions	
	Strings, Lists, and Dictionaries	
	Testing and Debugging Python Programs	
	Object-Oriented Programming	
Business Applications of Python (1): Task Automation in Business Operations	Organizing, Reading, and Writing Working Files	Lectures, Case Study, and Lab Tutorials
	Working with CSV Files and Excel Spread Sheets	
Business Applications of Python (2): Data Management for Business Analytics	Data Cleaning	Lectures, Case Study, and Lab Tutorial
	Data Analysis	
	Data Visualization	

Teaching/Learning Methodology

- During lectures, basic knowledge of python language and its business application will be introduced and discussed.
- During tutorials, students will be guided to practice the basic usages and development of Python programs for business applications in a computer lab.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b	c	d		
Coursework	50 %	✓	✓	✓	✓		
Examination	50 %	✓	✓	✓	✓		
Total	100 %						

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The coursework includes a series of written assignments to assess the subject outcomes (a) and (c), as well as a series of tutorial exercises for practicing the development of Python programs to assess the subject outcomes (b) and (d). The final exam is based on questions relevant to basic concepts, knowledge, and skills about Python language and its business applications, to access subject outcomes (a) – (d).

To reflect the significant technology content in this subject, *10% (or more)* of the overall weighting of this subject is based on individual assessment concerning technology-related knowledge.

Student Study Effort Expected

Class contact:	
▪ Lectures	26 Hrs.
▪ Tutorials	13 Hrs.
Other student study effort:	
▪ Assignment and Self-Study	40 Hrs.
▪ Additional Exercises on Python Programming After Tutorials	47 Hrs.
Total student study effort	126 Hrs.

Reading List and References

Reference Textbook

Charles Russell Severance, Sue Blumenber, Elliott Hauser, and Aimee Andrion . (2016) *Python for Everybody: Exploring Data in Python 3*. CreateSpace Independent Publishing Platform.

Clinton W. Brownley. (2016) *Foundations for Analytics with Python: From Non-Programmer to Hacker*, O'Reilly Media.

Al Sweigart. (2019) *Automate the Boring Stuff with Python, 2nd Edition: Practical Programming for Total Beginners*. No Starch Press.

Subject Code	LSGI3220
Subject Title	**Building Information Modelling & 3D GIS**
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	The aims of this subject are: 1. To understand the industry needs and trend of BIM development; 2. To teach functions of BIM software; 3. To describe the theories and concepts of BIM; 4. To introduce the technologies of Building Information Modelling (BIM) and 3D Geographic Information Systems (GIS) and their integration;
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Grasp knowledge on BIM concepts, technologies and standards (L2); b. Utilize BIM and GIS software to build 3D models (L2); c. Operate BIM software for project process management, including engineering and construction components (L3); d. Demonstrate knowledge on 3D data interoperability between BIM, City GML and GIS (L3);
Subject Synopsis/ Indicative Syllabus	1. Basic concepts of BIM: standard, stages (design, tendering, construction, and maintenance), level of detail, multi-dimension, and the development and emergence; 2. Benefits of Building Information Modelling (BIM) technologies: 3D model project setup, creation, editing and modifying of building components in details, 3D visualization and analysis, clash detection; 3. Integration 3D GIS with BIM: models and data (GIS data, Lidar data, IFC, CityGML), and other exchange standard and platform); 4. Practical skills on BIM: Autodesk Revit with representative cases.
Teaching/Learning Methodology	Teaching and learning materials will be provided on-line for students to download easily. Contact hours will be used for formal lectures, in-class discussions and presentations, and practical work.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b	c	d		
1. Individual essay	20	√			√		
2. Test	30	√	√	√	√		
3. Project	50		√	√	√		
Total	100						

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:
Practical work / project will be used to assess students' ability to process and manage BIM data in a spatial context. The essay will assess students' independent understanding of basic concepts and students' ability of independent thinking, English writing skills.

Student Study Effort Expected

Class contact:	
Lecture	26 Hrs.
Practical	26 Hrs.
Other student study effort:	
Project preparation work	25 Hrs.
Self study	28 Hrs.
Total student study effort	105 Hrs.

Reading List and References

Subject Description Form

Subject Code	LSGI3801
Subject Title	**GeoAI** [GeoAI is the revised subject name in which previous submission named as Geospatial Intelligence and Geo-visualization]
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	The objectives of this subject are: 1. To frame any geospatial problem using a machine learning approach, 2. To enable students become proficient in the use of conventional and modern geovisualization techniques, 3. To enable students properly apply geovisualization principles and methods to practical problems 4. To enable students to know how to create and extract relevant and useful features of a given geospatial problem, 5. To introduce common machine learning approaches to perform classification and estimation, and 6. To enable students properly apply qualitative indices to assess the results and the model.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: 1. Define various types of visual representations (L1) 2. Explain the techniques for thematic mapping and visualization (L2) 3. Extract or create useful features from a geospatial dataset (L3), 4. Improve the geospatial data quality by data pre-processing (L3) , 5. Construct a machine learning workflow to extract information of a geospatial problem (L4), 6. Assess the results using different qualitative indicator (L3), and 7. Handle different geospatial data collected from different platforms and understand the pros and cons of each covered approach (L4).
Subject Synopsis/ Indicative Syllabus	**A. Problem Definition** Framing and understanding a geospatial problem (e.g., number of classes), desirable accuracy/outcomes, choice of geospatial data, data resolution, etc. **B. Principles and theories for symbol and map design.** Visual variables, colour scheme, visual information processing,

	perceptional theories, map perception, map evaluation. **C. Scale and generalization:** Theories and principles of map generalization in digital environment, algorithms for various operations in both vector and raster modes, automated systems. **D. Geo-Visualization:** Variables for visualization (dynamic variable, screen variables, exploration acts, web-specific variables), cartograms, pictorial maps, dynamic maps, rendering and animations, virtual reality, augmented reality **E. Data Preparation and Pre-processing** Outlier removal, data cleaning, data/coordinate transformation, etc. **F. Feature Selection and Extraction** Preparation of features based on location, time, attributes and/or semantic information, dimension reduction, principal component analysis, etc. **G. Machine Learning/Classification Model** Supervised and unsupervised learning, parametric and non-parametric models, clustering and segmentation, etc. **H. Model Validation and Accuracy Assessment** Confusion matrix, accuracy, F-measures, quantity disagreement and allocation disagreement, receiver operating characteristic (RoC) curve, etc. **I. Case Studies and Applications** LiDAR point clouds, spatial-temporal dataset, urban big data, etc.
Teaching/Learning Methodology	• Lectures will be used to introduce the subject materials. • Lab sessions will be broken down into different stages of machine learning process using Python. • A final group project will be introduced to enhance the team spirit, communication skills, problem solving skill, and presentation skill.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)						
		1	2	3	4	5	6	7
1. Lab assignments	30%	√	√	√	√	√		√
2. Mid-term test	30%	√	√	√	√		√	√
3. Project (Report and presentation)	40%	√	√	√	√	√	√	√
Total	100%							

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Continuous assessment consists of two components: lab assignments and a group project. Four lab assignments will be given to the students covering different stages of the machine learning process. The group project (upon discussion with the subject lecturer) will let students work on a specific geospatial problem (e.g. point cloud classification, urban big data analysis, information extraction from spatial-temporal images, etc.) with a submission of a group report and a final presentation.

Student Study Effort Expected

Class contact:	
▪ Lecture	26 Hrs.
▪ Practical	26 Hrs.
Other student study effort:	
▪ Reading of textbook and journal papers	23 Hrs.
▪ Project completion and writing	40 Hrs.
Total student study effort	115 Hrs.

Reading List and References

1. Yamagata, Y., & Seya, H. (Eds.). (2019). Spatial analysis using big data: Methods and urban applications. Academic Press. 302 pp.
2. Shan, J., & Toth, C. K. (Eds.). (2018). Topographic laser ranging and scanning: principles and processing. CRC Press. 637 pp.

	3. Pedregosa, F., et al., (2011). Scikit-learn: Machine learning in Python. *Journal of Machine Learning Research*, 12, 2825-2830. 4. VanderPlas, J. (2016). Python data science handbook: Essential tools for working with data. O'Reilly Media, Inc. 743 pp. 5. Dent, B. 1999. *Cartography: Thematic Map Design*. 5th edition, Wm C. Brown Publishers. 417pp. 6. Robinson, A. et al., (1995). *Elements of Cartography*. 6th edition, John Wiley & Sons Inc. 674pp. 7. Slocum, T., McMaster, R., Kessler, F. and Howard, H., 2004. *Thematic Cartography and Geographic Visualization*, Second Edition, Jul 2004, Pearson Education, 528 pages. 8. MacEachren, A. and D. Taylor (eds.) (1994). *Visualization in Modern Cartography*. Pergamon. 345pp. 9. Kraak, M.-J., and Brown, A. (eds.), Web Cartography. Taylor and Francis, 213pp. 10. Keates, J., (1989). *Cartographic Design and Production*. 2nd edition, Longman. 261pp.

Subject Description Form

Subject Code	LSGI3802
Subject Title	**Spatial Data Science** [Spatial Data Science is the revised subject name in which previous submission named as Spatial Data and Geo-Information Science]
Credit Value	3
Level	3
Pre-requisite/ **Co-requisite/ Exclusion**	Nil
Objectives	This subject aims at presenting the fundamental concepts and principles of geographic information Sciences (GISc), including spatial data, spatial modelling and analysis in GISc. It also provides an appreciation of the operation of Geographic Information Systems (GIS) to carry out what have been learnt theoretically. Students' English communication and critical thinking will also be addressed through written assessments. Student will also understand the concepts and sciences about the Open Data in Hong Kong and worldwide.
Intended Learning Outcomes	At the end of this subject students who gain a pass will be able to: 1. Grasp a general understanding of GISc concepts / theories 2. Grasp a understanding of the concepts and theories about the Open Data 3. Master the operation of at least one GIS software 4. Able to construct a small spatial database with relevant attribute data, perform a simple analysis of spatial pattern and present results graphically
Subject Synopsis/ Indicative Syllabus	A. **Overview** Evolution of GIS, its development and relationships with other disciplines; an overview of the basic functions of GIS and how GIS is different from CAD and database systems. B. **Fundamental Principles of GISc** Recognition, abstraction and modelling the real world; uncertainty of spatial data quality; scale and generalization; georeference; spatial analysis. C. **Hardware and Software Components** The user interface, the database, the software, the storage devices, the digitizer, the scanner and the display devices.

	D. Space model and Spatial Features Space and its tessellations; nature of spatial features, their entities and relationships; interpreting different classes of features from maps. **E. Management of attributes in database** Difference between spatial and non-spatial attributes; procedures of tagging attributes to features and linking up attributes from different databases; use of primary identifier. **F. Concepts and theories of Open Data** in Hong Kong and worldwide, how to retrieve and process the Open Data spatially and apply in real-life applications **G. Spatial Data Structures** The structures of simple data types such as point, line, text and image; vector and raster representation of spatial features – comparison and conversion; symbolisation of spatial features; graphic editing. **H. Topological Data Structures** The need for topology; elementary graph theory; simple topological data structures; essence of topology building. **I. Spatial Query and Analysis** Use of retrieval functions to find spatial features and to obtain their attribute values; distance and area measurement; operation and basic algorithms for simple topological analysis, buffer zone generation and overlay analysis. **J. Data Modelling and Representation for Buildings (BIM)** Modelling of building and building components; solid model vs surface model; attribution of building components. **K. Applications of GIS** Urban planning, transport, environmental study, land management, Hong Kong digital map data, e.g. the Computerized Land Information System (CLIS) and its BMS, GIRS, CIS.
Teaching/Learning Methodology	Teaching and learning will largely be conducted through weekly lectures. The subject materials, work examples, useful web sites and required readings will be uploaded to the on-line platform for students' easy reference. The contact hours will be used for lecturing the theory and concepts, individual and group discussions. In addition, a timetable for specific topics will be scheduled and a quiz will be used as formative assessment in order to help students to further identify their strengths and weaknesses. Students' knowledge and practical skills will be developed in the assigned practical sessions. A written report along with series of data has to be produced. Upon completing these exercises, students will be able to grasp a basic but solid understanding of GIS concepts for further advanced GIS

subjects in their later stages of studies.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		1	2	3	4		
1. In-class practicals	40	✓	✓	✓	✓		
2. Quiz	10	✓	✓				
3. Examination	50	✓	✓				
Total	100%						

Students’ knowledge and skills will be continuously assessed with the practical exercises assigned each week, a quiz and end of semester examination aims at testing the basic concepts.

Students need to pass both continuous assessment and examination in order to pass the whole subject.

Student Study Effort Expected

Class contact:	
▪ Lecture	26 Hrs.
▪ Practical	26 Hrs.
Other student study effort:	
▪ Self-study, reading and revision	53 Hrs.
Total student study effort	105 Hrs.

Reading List and References

1. Aranoff, S. (1990) *Geographic Information Systems: A Management Perspective*; WDL Publications.
2. Chang, K.T. (2002) *Introduction to Geographic Information Systems*, McGraw-Hill Higher Education.
3. Chen, Y.Q. & Lee, Y.C. (eds) (2001) *Geographical Data Acquisition,* Springer Wien New York.
4. Clarke, K.C. (1990) *Analytical and Computer Cartography*, Englewood Cliffs, N.J.: Prentice-Hall.
5. Laurini, R. & Thompson, D. (1992) *Fundamentals of Spatial Information Systems*, London: Academic Press.
6. Peuquet, M. (1990) *Introductory Readings in Geographic*

	Information Systems, Taylor & Francis. 7. Rhind, D. W. (1991) *Geographical Information System: Principles and Applications*, Harlow, Essex, England: Longman Scientific and Technical; New York: Wiley. 8. Robinson, A.H. & Sale, R. (1995) *Elements of Cartography*, 6th ed., New York: John Wiley & Sons, Inc. 9. Paul Longley, M. Goodchild, D. Rhind, and D. Maguire (1999) *Geographical Information System: Principles and Technical Issues*, New York: John Wiley & Sons, Inc.

Subject Description Form

Subject Code	LSGI3803
Subject Title	Spatial Data Analysis and Mining
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	AMA1751 Linear Algebra & COMP1011 Programming Fundamentals
Objectives	1. To develop students' understanding on what geospatial data analysis and mining are. 2. To enable students to learn the methods of spatial data analysis and mining including classification, clustering analysis, pattern analysis, network analysis. 3. To enable students to properly apply spatial data analysis and mining techniques to practical problems.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: a. Explain the purpose of spatial data analysis and mining (L3) b. Describe a range of data analysis and mining methods and their use in analyzing spatial data (L2) c. Identify and select the appropriate methods for various real-world problems (L3) d. Test models through validation and able to criticize their reliability (L4)
Subject Synopsis/ Indicative Syllabus *(Note 2)*	**<u>Subject Synopsis</u>** • Introduction of spatial data • Spatial data acquisition and preprocessing Data cleaning, calibration, and integration • Exploratory Spatial data analysis and visualization • Descriptive and regression analysis Descriptive statistics for spatial data Geographically weighted regression • Point data pattern analysis Quadrat estimation K functions • Network analysis Accessibility measurement Shortest path algorithm • Area data pattern analyses Global spatial dependence Local spatial dependence • Spatial interpolation and surface analysis Distance based interpolation Geostatistics methods • Spatial data mining Classification Clustering Change detection Machine learning methods Artificial intelligence methods

Teaching/Learning Methodology

(Note 3)

1. Lectures to explain theories and methodology;
2. Lab sessions and a small individual project to reinforce the theories and methodology introduced during the lectures, so as to enable students to gain deeper understanding of the principles and techniques, to acquire practical problem-solving skills, to become critical in thinking; and
3. A group project is designed to enhance the critical thinking, team spirit, problem solving skill, leadership and presentation skill.

Assessment Methods in Alignment with Intended Learning Outcomes

(Note 4)

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b	c	d		
1. Assignment	30%	✓	✓	✓			
2. Class project	30%		✓	✓	✓		
3. Written test	40%	✓	✓	✓	✓		
Total	100 %						

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

It consists of 100% continuous assessment through assignment (30%), class project (30%), and written test (40%). Assignment includes lab and tutorial. Through these activities, students will be assessed about the fundamental knowledge in spatial data mining and the practical capabilities of performing spatial data mining using actual data sets. Class project include student presentation and report. Problem based learning is carried out during the project work, and is reinforced by Q and A. Presentation contributes to the all-round development of students. Written test is designed to monitor student learning at knowledge level. Students are expected to achieve a minimum standard to be able to obtain a passing grade in line with criterion referenced assessment approach.

Student Study Effort Expected

Class contact:	
▪ Lectures	26 Hrs.
▪ Tutorials	13 Hrs.
Other student study effort:	
▪ Assignments/Self Study	31 Hrs.
▪ Preparation and class project	30 Hrs.
Total student study effort	120 Hrs.

Reading List and References	1. Statistical methods for spatial data analysis / Schabenberger & Gotway (2005) 2. Statistical analysis of spatial and spatio-temporal point patterns / Diggle (2013) 3. Applied spatial data analysis with R / Bivand, Pebesma, & Gómez-Rubio (2013) 4. Applied spatial analysis of public health data / Lance & Carol (2003) 5. Spatial statistics: geospatial information modeling and thematic mapping / Mohammed A. Kalkhan (2011) 6. Spatial data mining: theory and application / Li, Wang, & Li (2015)

Subject Description Form

Subject Code	LSGI3804
Subject Title	**Urban Big Data Analytics**
Credit Value	3
Level	3
Pre-requisite	Nil
Objectives	This course aims to provide in-depth knowledge and hands-on techniques on urban big data analytics. This course will introduce the concept of urban big data, and the methods for acquiring, processing, and analyzing these data sets. It will also introduce applications for urban planning, environmental analysis, transportation and mobility, housing, urban sustainability and resilience, business intelligence, and urban socio-economics.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Understand the definition and principles of urban big data (1) b. Obtain broad knowledge in fundamental concepts, algorithms and techniques for big data mining and their applications to large-scale data warehouses and big data analytics (2) c. Understand solutions and issues in big data mining and analytics (3)
Subject Synopsis/ Indicative Syllabus	A. Introduction of urban big data B. Big data acquisition C. Big data processing and management o Aggregation o Systematic, stochastic, and gross error cleaning o Database technologies and spatiotemporal indexing D. Method and techniques in big data analysis and mining o Urban big data mining and knowledge discovery o Distributed and parallel computing o Deep learning and artificial intelligence o Visualization of urban big data o Bias of urban big data E. Urban big data applications o Transportation o Traffic monitoring o Urban planning o Smart cities

- Urban logistics
- Urban infrastructure
- Business intelligence
- Internet of things

Teaching/Learning Methodology

1. Lectures to explain theories and methodology;
2. Assignments to reinforce the theories and methodology introduced during the lectures, so as to enable students to gain deeper understanding of the principles and techniques, to become critical in thinking; and
3. A group project is designed to enhance the critical thinking, team spirit, problem solving skill, leadership and presentation skill.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		1	2	3			
1. Lab assignments	30%	√	√	√			
2. Project (Report and presentation)	70%	√	√	√			
Total	100%						

Student Study Effort Expected

Class contact:	
▪ Lectures	26 Hrs.
▪ Lab Sessions	26 Hrs.
Other student study effort:	
▪ Project	60 Hrs.
Total student study effort	112 Hrs.

Reading List and References

Zheng Yu. Urban Computing. MIT Press, 2019.

Wang, S. and Goodchild, M. F. CyberGIS for Geospatial Innovation and Discovery. Springer, Dordrecht, Netherlands, 2018.

Townsend, Anthony M. Smart cities: Big data, civic hackers, and the quest for a new utopia. WW Norton & Company, 2013.

O'sullivan, David, and David Unwin. Geographic information analysis. John Wiley & Sons, 2014.

O'sullivan, Arthur. Urban economics. McGraw-Hill/Irwin, 2007.

Subject Description Form

Subject Code	LSGI3805
Subject Title	**Urban Sensing for Smart City**
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	• To give students a background to the current state of development of the remote sensing discipline including basic principles of imaging, image processing and data types and sources • To develop students' skills in image processing • To give students a basis to apply the skills and techniques already learned to practical problems of the urban environment To encourage students to examine ways of applying their knowledge and skills to actual urban problems and situations
Intended Learning Outcomes	Upon completion of the subject, students will be able to: 1. Be familiar with the 'state of the art' in earth resource monitoring from remote sensing platforms (L1) 2. Have the ability of knowledge on solving the urban problems and issues related to smart sensing (L2) 3. Understand the current 'state of the art' in the application of smart sensing of urban environment in Hong Kong (L3) 4. Solve problems arising from real-life examples (L4)
Subject Synopsis/ Indicative Syllabus	A. Introduction to remote sensing and physical principles of imaging B. Smart sensors and platforms: aircraft, satellites and scanning systems C. Internet of Things: Concepts, theories, applications, and recommendations D. Applications of remote sensing in the urban environment and in the natural environment
Teaching/Learning Methodology	Teaching and learning materials will be delivered on-line for students to download easily. Contact hours will be used for formal lectures, hybrid problem-solving and practical work. Group projects will form a part of the practical work and these will require students to use initiative and explore a wide range of solutions.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		1	2	3	4		
1.Written Examination	50	√	√	√			
2. Practical assignments	40			√	√		
3. Multiple Choice (phase) test	10	√	√				
Total	100 %						

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Continuous assessment consists of two components, phase test and practical work. The phase test will assess students' basic understanding of physical concepts and the state of the art of the discipline, independently. Practical work will be used to reinforce, and assess students' understanding of the image processing practice and skills gained during the course. A written examination will test students' independent skills of expression, knowledge of the discipline, and the ability to apply procedures and concepts to a defined problem of urban areas in Hong Kong.

Student Study Effort Expected

Class contact:	
▪ Lecture	26 Hrs.
▪ Practical	26 Hrs.
Other student study effort:	
▪ Reading of textbook and journal papers	23 Hrs.
▪ Assignment completion and writing	40 Hrs.
Total student study effort	115 Hrs.

Reading List and References

1. Lillesand, T. and Keifer 2008, Remote Sensing and Image Interpretation, 6th ed.Wiley.
2. Mather, P. 1999, Computer processing of remotely sensed images, 2nd Edition, Wiley.
3. Longley, P., M. Goodchild, D. Maguire and D. Rhind, 1999, Geographic Information Systems (2nd Edition), John Wiley & Sons, INC., USA

	4. Skidmore, A. 2002. Environmental modelling with GIS and Remote Sensing. Taylor and Francis Recommended: 5. Campbell, J.B. (1996). Introduction to remote sensing. Guilford Press, New York. 1996. 6. Robinson A. H. et al., (1996) Elements of Cartography. 6th Edition, Wiley & Sons, New York. Supplementary: 7. The International Journal of Remote Sensing, The Remote Sensing Society, UK. 8. ISPRS Journal of Photogrammetry and Remote Sensing. Elsevier, Amsterdam. 9. Photogrammetric Engineering and Remote Sensing. American Society of Photogrammetry, USA.

Form AR 140

The Hong Kong Polytechnic University

Subject Description Form

Please read the notes at the end of the table carefully before completing the form.

Subject Code	LSGI4503
Subject Title	Integrated Capstone Project
Credit Value	6
Level	4
Pre-requisite/ Co-requisite/ Exclusion	**Pre-requisite:** COMP1011 Programming Fundamentals, LSGI3803 Spatial Data Analytics and Mining **Exclusion:** Any other equivalent capstone project
Objectives	The objectives of this subject are to: • Promote students' knowledge of artificial intelligence and data analytics (AIDA) to prepare for the increasing presence of AI and Big Data in land surveying and geo-informatics; • Provide a student with the opportunity to apply and integrate AIDA into land surveying and geo-informatics; • Develop the capabilities of a student in analyzing and solving complex and possibly real-life problems using AIDA; • Train students with skills on integrate AIDA and land surveying and geo-informatics to achieve a higher order learning process and to apply this to solve professional problems.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: **<u>Professional/academic knowledge and skills</u>** (a) get familiar with the latest approaches of AIDA in land surveying and geo-informatics, including machine learning (ML) and deep learning (DL); (b) conduct literature surveys to locate and collect materials and sources relevant to the selected problem area in a land surveying and geo-informatics; (c) understand the materials obtained and connect the materials with the problem to be solved using AIDA knowledge and skills, including data pre-processing and visualization; (d) define and specify the problem precisely (e.g., model selection or creation); (e) assimilate and apply the learned knowledge to generate good solutions to the problem (e.g., model optimization);

	(f) think critically about the formulation of alternative models and solutions to the problem, in the analysis of approaches to the solution and their implementation; and (g) evaluate the final outcome in an objective manner; **<u>Attributes for all-roundedness</u>** (h) improve presentation and communication skills via oral presentation; (i) enhance technical report writing skills with proper organization of materials; (j) develop the ability to learn independently and to find/integrate information from different sources required in solving real-life problems; (k) manage the project efficiently and effectively through the supervision of supervisor(s); and (l) work collaboratively with related parties (e.g., vendors, sponsor company, technical support staff, team-partners, research students, etc.).
Subject Synopsis/ Indicative Syllabus *(Note 2)*	**1. In-depth Study of a Topic Typically Proposed by the Supervisor** Students are expected to identify a project topic with a supervisor in their chosen discipline, and a co-supervisor with artificial intelligence and data analytics expertise. Students need to demonstrate their knowledge in both their chosen discipline and AIDA in the project, receiving advice from both supervisors. For a specific topic, an in-depth study in the targeted domain is required. **2. Project Meeting and Planning** The project should represent the requisite effort in analysing and interpreting the data/information obtained, using the principles and techniques learned from various related subjects. Students are also expected to demonstrate significant analytical and, preferably, research ability in the chosen application domain. Regular meetings with supervisors are procced to make a plan for their topics. **3. Proposal Writing** A project proposal will be submitted in the first semester. This proposal will contain a comprehensive literature review, an outline of the problem, objectives, project design, proposed methodology (AIDA), and solution evaluation. The preliminary results are also provided as well as the next plan with a timetable for project completion. **4. Regular Progress Checking and Reporting** Regular progress will be reported to supervisors, and supervisors will provide timely comments and suggestions to students in project execution, including guidance in data pre-processing, model selection, and result evaluation. **5. Project Documentation** The materials including data sets, coding, output data, and technical documentation, should be documented and archived, and students must submit a bound copy of their dissertation along with relevant documents.

6. Presentation and Demonstration

In the second semester, students will present a summary of their dissertation topic and defend the results and conclusions during a Q & A session.

Teaching/Learning Methodology

(Note 3)

The Integrated Capstone Project spans across the academic year for two consecutive semesters. The teaching/learning activities include regular project meetings with the supervisor and the co-supervisor, guided study of project materials, independent project development work, and other project management tasks.

Assessment Methods in Alignment with Intended Learning Outcomes

(Note 4)

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)											
		a	b	c	d	e	f	g	h	i	j	k	l
Continuous Assessment	100	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Total	100 %												

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The Integrated Capstone Project will be accessed by the supervisor/co-supervisor and other assessors. Attributes to be assessed include, but not limited to, Problem Identification, Problem Solving, Communication and Presentation, Project Management, and Self-Discipline.

Integrated Capstone Projects should be problem-oriented and there are no restrictions on the nature of the problem except that it should be relevant to the student's chosen discipline and AIDA. The project could be practical, academic, or a hybrid in which the student is encouraged but not constrained to have some original contributions. Each student has to submit a proposal, a mid-term checkpoint progress report, and a final report. The proposal must be approved by the supervisor/co-supervisor before the student can proceed with the Integrated Capstone Project. An oral presentation and demonstration are essential at the end of the project. A mid-term presentation and demonstration may also be required for proper continuous assessment.

Student Study Effort Expected

Class contact:	
▪ Lecture	0 Hrs.
Other student study efforts:	
▪ Searching and reading materials, meeting with supervisor/co-supervisor/others, design and system development, testing, documentation, presentation, etc.	210 Hrs.
Total student study effort	210 Hrs.

Reading List and References	1. Kumar, Ranjit, *Research Methodology: A Step-by-step Guide for Beginners*, 3rd Edition, SAGE Publications, 2011. 2. Burns, Robert B., *Introduction to Research Methods*, 4th Edition, SAGE Publications, 2000. 3. Roberts, Carol M., *The Dissertation Journey: A Practical and Comprehensive Guide to Planning, Writing, and Defending Your Dissertation*, 3rd Edition, Corwin Press, 2007. 4. Mauch, James E. and Park, Namgi, *Guide to the Successful Thesis and Dissertation: A Handbook for Students and Faculty*, 5th Edition, Marcel Dekker, 2003. 5. Rudestam, Kjell Erik and Newton, Rae R., *Surviving Your Dissertation: A Comprehensive Guide to Content and Process*, 2nd Edition, Sage Publications, 2001. 6. Garson, G. David, *Guide to Writing Empirical Papers, Theses and Dissertations*, Marcel Dekker, 2002. 7. Reinhart, Susan M., *Giving Academic Presentations*, 2nd Edition, University of Michigan Press, 2013. 8. Oshima, Alice and Hogue, Ann, *Writing Academic English*, 4th Edition, Pearson Longman, 2006. 9. American Psychological Association. *Publication Manual of the American Psychological Association*, 6th Edition, American Psychological Association, 2010. 10. Szuchman, Lenore T., *Writing with Style: APA Style Made Easy*, 5th Edition, Wadsworth/Cengage Learning, 2011. 11. Statistics, simulation, programming, and relevant books. 12. ACM and IEEE magazines, Transactions and Journals. 13. Other International Journals. 14. Relevant conference proceedings and magazines (including ACM and IEEE conferences). 15. Technical reports from universities and major companies. 16. Ian Goodfellow, Yoshua Bengio, and A. Courville, *Deep Learning*. MIT Press, 2016. 17. F. Chollet, *Deep learning with python*. New York, NY: Manning Publications, 2017. 18. Fatimazahra Barramou, El Hassan El Brirchi, Khalifa Mansouri, Youness Dehbi, *Geospatial Intelligence*. Springer, Cham, 2021 19. Cresson R. *Deep Learning for Remote Sensing Images with Open Source Software*. CRC Press, 2022.

Note 1: Intended Learning Outcomes
Intended learning outcomes should state what students should be able to do or attain upon subject completion. Subject outcomes are expected to contribute to the attainment of the overall programme outcomes.

Note 2: Subject Synopsis/Indicative Syllabus
The syllabus should adequately address the intended learning outcomes. At the same time, overcrowding of the syllabus should be avoided.

Note 3: Teaching/Learning Methodology
This section should include a brief description of the teaching and learning methods to be employed to facilitate learning, and a justification of how the methods are aligned with the intended learning outcomes of the subject.

Note 4: Assessment Method
This section should include the assessment method(s) to be used and its relative weighting, and indicate which of the subject intended learning outcomes that each method is intended to assess. It should also provide a brief explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes.

Subject Description Form

Subject Code	ME41006
Subject Title	Perceptual Robotics
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	Pre-requisite: ME31002 Linear Systems and Control
Objectives	The subject aims to equip students with knowledge of: 1. Artificial robot perception 2. Perception-guided control 3. Adaptive robot behaviour 4. Perception-aided algorithms
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a) Able to mathematically model the different perceptual modalities used for robotic systems; b) Able to design perception-guided motion controls for mechanical robots c) Able to use perceptual feedback to implement adaptive robot behaviours d) Able to design perception-aided methods for learning properties about the environment e) Able to conduct experiments with perceptual and robotic systems
Subject Synopsis/ Indicative Syllabus	**Artificial robot perception.** Vision sensors (monocular perception and RGB-D sensors), thermal imaging (models and principles), touch (force and tactile imaging), proximity (different ranging methodologies), audio sensing. **Perception-guided control.** Sensor-motion coordination problem, derivation of sensorimotor models (analytical and computational), formulation of sensor servoing controls (vision-based, thermal-based, touch-based, proximity-based). **Adaptive robot behaviour.** Braitenberg machines, reactive motion paradigms (potential fields, subsumption architecture, etc.), hybrid paradigms, multi-agent systems, robot babbling, bug algorithms, sensor-based navigation. **Perception-aided algorithms.** Iterative closest point (ICP), simultaneous localisation and mapping (SLAM), sensor-based model learning, and image registration. **Practical work.** A robotic platform is assigned to a team of 2-3 students. Each chapter is delivered with a hands-on experimental session where students reinforce their knowledge in the subject.

Teaching/Learning Methodology

1. Lectures aim at providing students with fundamental knowledge required for understanding and analysing different perceptual robotic systems, including its mathematical models, controller design, and algorithms. (Outcomes a to d)
2. Tutorials aim at enhancing students' analytical and problem solving skills on robotics. Students will be able to solve real-world problems using the knowledge they acquired in the class. (Outcomes a to d)
3. The experiments/project aim to provide hands-on experience for developing perceptual robots, and reinforcing the acquired knowledge. (Outcomes a to e)

Teaching/Learning Methodology	Intended Subject Learning Outcomes to be assessed				
	a	b	c	d	e
1. Lecture	√	√	√	√	
2. Tutorial	√	√	√	√	
3. Experiments/Project	√	√	√	√	√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)				
		a	b	c	d	e
1. Class test	10%	√	√	√	√	√
2. Coursework: includes assignments, project, experiments, lab report	40%	√	√	√	√	√
3. Final Examination	50%	√	√	√	√	
Total	100 %					

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Overall Assessment:

0.50 x End of Subject Examination + 0.50 x Continuous Assessment.

1. The continuous assessment aims at evaluating the progress of the students' study, assisting them in self-monitoring the respective learning outcomes, and applying the knowledge learnt in practical situations.
2. The examination is used to assess the knowledge acquired by the students for understanding and analysing the problems critically and independently; as well as to determine the degree of achieving the subject learning outcomes.

Student Study Effort Expected

Class contact:	
▪ Lectures	33 Hrs.
▪ Tutorials / Laboratory	6 Hrs.
Other student study effort:	

	▪ Course work	40 Hrs.
	▪ Self-learning	36 Hrs.
	Total student study effort	115 Hrs.
Reading List and References	1. Lecture Notes, Articles, and Handouts 2. Computer Vision: A Modern Approach, David A. Forsyth and Jean Ponce, latest edition. 3. Introduction to AI Robotics, Robin Murphy, MIT Press Cambridge, MA, USA, latest edition. 4. Principles of Robot Motion: Theory, Algorithms, and Implementations, Howie Choset et al, MIT, latest edition. 5. Vehicles: Experiments in Synthetic Psychology, Valentino Braitenberg, MIT Press Ltd, latest edition. 6. Robotics Modelling, Planning and Control, Bruno Siciliano at al, latest edition.	

Developed in June 2019

Subject Description Form

Subject Code	ME42001
Subject Title	Artificial Intelligence in Products
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	Pre-requisite: ME31002 Linear Systems and Control ; or ME41004 Mechatronics and Control
Objectives	To provide students with basic knowledge on Artificial Intelligence (AI) for product design and development.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Apply knowledge of mathematics, expert systems, fuzzy systems and learning models to aid the design and development of intelligent products and systems. b. Understand applications of AI in different fields. c. Work effectively as a member to tackle a multi-disciplinary design project involving the application of AI. d. Appreciate the state-of-the-art applications of AI in products and present a design project via computer programming and written report.
Subject Synopsis/ Indicative Syllabus	*Expert Systems* - Principles of expert systems; Knowledge representations; Inference mechanisms; Graph search algorithms; Rule-based expert systems; Application of expert systems to product design and product data management using Prolog or available software packages. (Delete some topics) *Fuzzy Inference Systems* - Fuzzy sets and crisp sets; Membership functions; Properties of fuzzy sets; Operations on fuzzy sets; Operations on fuzzy relations; Fuzzy if-then statements; Inference rules; Developing fuzzy inference systems using Matlab or available software packages. *Learning Models* – Introduction to different learning algorithms and models; Regression; Classification; Supervised learning; Unsupervised learning; Reinforcement learning; Neural Network; Deep learning; Developing learning models using Python or available software packages

Teaching/Learning Methodology

1. The lectures are aimed at providing fundamental knowledge on artificial intelligence for product design and development. (Outcomes a and b)
2. The tutorials/computer labs are aimed at enhancing applicable skills of the students. Examples of machine intelligence and other forms of AI in commercial products will be involved. (Outcomes a and b)
3. The project is aimed at integrating the knowledge that will be applied through a team project on product design and development with intelligence systems. (Outcomes a - d)

Teaching/Learning Methodology	Outcomes			
	a	b	c	d
Lecture	√	√		
Tutorial	√	√		
Project	√	√	√	√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)			
		a	b	c	d
1. Class Test	10%	√	√		
2. Homework	10%	√	√		
3. Group Project	30%	√	√	√	√
4. Examination	50%	√	√		
Total	100%				

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Overall Assessment:
0.50 x End of Subject Examination + 0.50 x Continuous Assessment.

The weighting of 50% on continuous assessment is meant to allow students to consolidate their learning through continuous effort such as assignments and project work. The group project will be assigned to students at early stage of the subject study which enables students to link the knowledge they learnt with the project step by step. Report and the presentation will be major outcomes of the project work that will show how the students are able to design intelligent systems for products. The examination is used to assess the knowledge acquired by the students for understanding artificial intelligence of the products.

Student Study Effort Expected	Class contact:	
	▪ Lecture	30 Hrs.
	▪ Tutorial / Computer Labs	9 Hrs.
	Other student study effort:	
	▪ Reading and review	20 Hrs.
	▪ Homework assignment	10 Hrs.
	▪ Project Report	36 Hrs.
	Total student study effort	105 Hrs.
Reading List and References	1. Luger, G.F., and Stubblefield, W.A., Artificial Intelligence and the Design of Expert Systems, The Benjamin/Cummings Publishing Co., latest edition. 2. Clocksin, W. F., Programming in Prolog, Berlin; New York: Springer-Verlag, latest edition. 3. Ross, Timothy J., Fuzzy logic with engineering applications, Chichester; Hoboken, NJ: Wiley, latest edition. 4. Campesato, O., Artificial Intelligence, Machine Learning, and Deep Learning, Mercury Learning & Information, latest edition.	

Revised Jun 2020

Subject Description Form

Subject Code	ME42011
Subject Title	Fundamentals of Robotics
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	Pre-requisite: ME31002 Linear systems and control; or ME41004 Mechatronics and Control
Objectives	1. To provide students with the concepts and techniques for the design, modeling, analysis of robotic systems. 2. To provide students with the fundamental knowledge of machine vision for robot guidance and automation.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Identify different types of robots and their applications in the industry. b. Construct the kinematics and dynamics equations of robotic systems. c. Apply trajectory planning algorithms to generate the path for robotic systems. d. Apply different machine vision and image processing algorithms to automate robotic systems.
Subject Synopsis/ Indicative Syllabus	**Robot Modeling** - Degrees of freedom, coordinate frames and homogeneous transformations, Denavit-Hartenberg (DH) convention, forward and inverse kinematics, Jacobian matrix, singularity, motion models for mobile robots, Lagrange's equation kinetic and potential energy, trajectory planning and obstacle avoidance. **Computer Vision** - Image formation, acquisition, histogram, edge and line detections, image enhancement, filtering, object recognition, camera modeling and calibration. **Laboratory Work** There is at least 1 2-hour laboratory session or an equivalent project. Typical Experiments are: 1. Object manipulation through a robot manipulator. 2. Path planning of mobile robots for collision avoidance 3. Image processing with monocular cameras.

Teaching/Learning Methodology

Lectures aim at providing students with an integrated knowledge required for understanding and analyzing different robots, including system modeling, trajectory planning and image processing (Outcomes a to d)

Tutorials aim at enhancing students' analytical and problem solving skills on robotics. Students will be able to solve real-world problems using the knowledge they acquired in the class. (Outcomes a to d)

The project/experiments aims to have hand-on experience to automation of a robot system with vision or other functions. (Outcomes a to d)

Teaching/Learning Methodology	Outcomes			
	a	b	c	d
1. Lectures	√	√	√	√
2. Tutorials		√	√	√
3. Homework assignments		√	√	√
4. Project or experiments	√	√	√	√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed			
		a	b	c	d
1. Examination	50%	√	√	√	√
2. Class Test	20%	√	√	√	√
3. Coursework including Project/Experimental Work	30%	√	√	√	√
Total	100%				

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

1. The assessment is comprised of 50% continuous assessment and 50% examination.
2. The continuous assessment consists of three components: homework assignments, test, and experiments/projects. They are aimed at evaluating the progress of students' study, assisting them in self-monitoring of fulfilling the respective subject learning outcomes, and enhancing the integration of the knowledge learnt.
3. The examination is used to assess the knowledge acquired by the students for understanding and analyse the problems critically and independently; as well as to determine the degree of achieving the subject learning outcomes.

Student Study Effort Expected	Class contact:	
	▪ Lecture	33 Hrs.
	▪ Tutorial/Laboratory	6 Hrs.
	Other student study effort:	
	▪ Reading and review	36 Hrs.
	▪ Coursework (assignments, project)	40 Hrs.
	Total student study effort	115 Hrs.
Reading List and References	1. S. B. Niku, Introduction to robotics : analysis, control, applications, Wiley, latest edition. 2. M. W. Spong S. Hutchinson, and M. Vidyasagar, Robot Modeling and Control, Wiley, latest edition. 3. C. Bishop, Pattern Recognition and Machine Learning, Springer, latest edition. 4. R. C. Gonzalez and R. E. Woods, Digital Image Processing, Prentice Hall, latest edition.	

Revised June 2021

Subject Description Form

Subject Code	ME46002
Subject Title	Numerical Methods for Engineers
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	Pre-requisite: AMA2111 Mathematics I
Objectives	To teach students numerical methods of solving typical engineering problems.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Formulate simple engineering problems with knowledge in data analysis and engineering mathematics. b. Solve non-linear equations, simultaneous linear algebraic equations, eigenvalue problems, using numerical methods. c. Perform numerical differentiation and integration and analyze the errors. d. Know the contemporary issues, and understand the impact of artificial intelligence in a global and societal context. e. Use MATLAB or other data analysis tools to compute the solutions of engineering problems using the appropriate numerical methods.
Subject Synopsis/ Indicative Syllabus	***Introduction to Mathematical Modelling and Computational Methods* –** Importance of computational modelling in engineering. Data representation and errors. Applications of commercial software packages such as MATLAB. Functions and plotting using MATLAB. ***Computer Solution of Non-linear Equations*** - Bracketing Methods. Bisection Method. Open Methods. Newton-Raphson Method. Secant Method. Convergence of methods. Determination of multiple roots. Engineering applications. ***Simultaneous Linear Equations* -** Solving simultaneous linear equations by Matrix Inversion. Cramer's Rule. Gauss Elimination. Gauss-Jordan Elimination. LU decomposition method. Engineering applications and choice of methods. Eigenvalues Problems. ***Optimization* -** Unconstrained optimization. Multi-dimensional optimization. Unconstrained optimization. ***Curve Fitting and Data Analysis* -** Interpolation using splines. Linear Least-Squares Regression. Nonlinear Regression. Introduction to Machine Learning Algorithms. ***Numerical Differentiation and Integration* -** Taylor's series expansion. Finite differences for the first derivative and the second derivative. High-accuracy differentiation formulas. Trapezoidal rule. Simpson's rule. High-order Newton-Cotes formulas. Applications of numerical differentiation and integration in heat transfer, solid mechanics and fluid flow problems.

Teaching/Learning Methodology

Lectures are used to deliver the fundamental knowledge in relation to numerical methods. (Outcomes a - d)

Tutorials will be conducted in small groups to facilitate discussions. (Outcomes a - d)

Computational workshops provide hands-on experience in using software to solve numerical problems. (Outcomes b - e)

Teaching/Learning Methodology	Outcomes				
	a	b	c	d	e
Lecture	√	√	√	√	
Tutorial	√	√	√	√	
Computational workshop		√	√	√	√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)				
		a	b	c	d	e
1. Test	20%	√	√	√	√	
2. Assignment	30%	√	√	√	√	√
3. Examination	50%		√	√		
Total	100%					

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Overall Assessment:
0.50 × End of Subject Examination + 0.50 × Continuous Assessment

Tests will be conducted to assess students' learning on numerical methods.

Assignments will be used to assess students' learning on using numerical methods in solving engineering problems and using computational software in solving such problems.

Examination will be conducted to assess students' learning on numerical methods.

Student Study Effort Expected

Class contact:	
▪ Lecture	33 Hrs.
▪ Tutorial	4 Hrs.
▪ Computational Workshop	2 Hrs.
Other student study effort:	
▪ Performing assignment	40 Hrs.
▪ Applying computational software	12 Hrs.

	▪ Private study	25 Hrs.
	Total student study effort	116 Hrs.
Reading List and References	1. S.C. Chapra and R.R. Canale, Numerical Methods for Engineers, McGraw-Hill, latest edition. 2. S.S. Rao, Applied Numerical Methods for Engineers and Scientists, Prentice-Hall, latest edition. 3. S.C. Chapra, Applied Numerical Methods with MATLAB for Engineers and Scientists, McGraw-Hill, latest edition. 4. D.M. Etter, Engineering Problem Solving with Matlab, Prentice-Hall, latest edition.	

Revised December 2021

Subject Description Form

Subject Code	ME49006
Subject Title	Integrated Capstone Project
Credit Value	6
Level	4
Pre-requisite / Co-requisite/ Exclusion	**Pre-requisite:** ME31001 Dynamics and Vibrations; ME31002 Linear Systems and Control; ME32001 Manufacturing Fundamentals; ME33001 Mechanics of Materials; ME34002 Engineering Thermodynamics; ME34004 Fluid Mechanics; ENG2002 Computer Programming; and ME46002 Numerical Methods for Engineers. **Exclusion**: ME49001 Final Year Capstone Project
Objectives	The objectives of this subject are to: (a) Provide students with an opportunity of integrating and applying knowledge from different disciplines of mechanical engineering (ME) with artificial intelligence and data analytics (AIDA) to conduct an engineering project that is open-ended and requires team collaboration for its completion; (b) Develop the capabilities of a student in analyzing and solving complex and possibly real-life problems using ME and AIDA knowledge; (c) Train students with skills on systematic development and documentation of a significant piece of work.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: <u>Professional/academic knowledge and skills</u> (a) Conduct literature search including patents, books, archived publications and product catalogues, and to perform the state-of-the-art and benchmark studies; (b) Formulate the problem precisely, and utilize knowledge and skills from ME and AIDA to generate good solutions to the open-ended real-world problems encountered in the project; (c) Think critically the formulation of alternative models and solutions to the problem, in the analysis of approaches to the solution and their implementation; (d) Design, plan and carry out scientific and engineering experiments (physical tests and/or computer numerical simulations) to prove the feasibility of their designed solutions; (e) Design the test apparatus, rigs, assemblies or systems as required by the project; (f) Apply appropriate engineering tool (analytical, experimental, and/or computational) for carrying out tasks in the development and implementation of a designed solution; (g) Select and employ the appropriate manufacturing methods in the production and fabrication of components and assemblies required by the project; <u>Attributes for all-roundedness</u> (h) Work in a professional manner and comply with all applicable standards and regulations in conducting the project; (i) Take into account of safety, legal, environmental protection considerations in an engineering project

(j) Participate and lead in a multi-functional team, and communicate their project work to sponsors (if any), supervisors, other peer teams, and even non-technical audience and articulate the results and findings with scientific and logical arguments;
(k) Evaluate the potential impact of their designed solution on performance, safety, cost and environment, and evaluate the final outcome in an objective manner;
(l) Improve presentation and communication skills via oral presentation, and enhance technical report writing skills with proper organization of materials.

Subject Synopsis/ Indicative Syllabus

1. **In-depth Study of a Topic Typically Proposed by the Supervisor**
2. **Project Meeting and Planning**
3. **Proposal Writing**
4. **Regular Progress Checking and Reporting**
5. **Project Documentation**
6. **Presentation and Demonstration**

Students are expected to identify a project topic with a supervisor with artificial intelligence and data analytics expertise in ME Department. Students need to demonstrate their knowledge in both ME and AIDA in the project, receiving advice from supervisor. The project should represent requisite effort in analysing and interpreting the data/information obtained, using the principles and techniques learnt from various related subjects. Students are also expected to demonstrate significant analytical and, preferably, research ability in the chosen application domain.

Teaching/Learning Methodology

The Integrated Capstone Project spans across the academic year for two consecutive semesters. The teaching/learning activities include regular project meetings with the supervisor, guided study of project materials, independent project development work and other project management tasks.

Teaching/Learning Methodology	Outcomes											
	a	b	c	d	e	f	g	h	i	j	k	l
Regular project meetings and guided study	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)											
		a	b	c	d	e	f	g	h	i	j	k	l
Continuous monitoring	15%	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Interim report	10%	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Final report	50%	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Oral examination	25%	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Total	100%												

The Integrated Capstone Project will be accessed by the supervisor and other assessors. Attributes to be assessed include, but not limited to, Problem Identification, Problem Solving, Communication and Presentation, Project Management, and Self-Discipline. Integrated Capstone Projects should be problem-oriented and there are no restrictions on the nature of the problem except that it should be relevant to ME and AIDA. The project could be practical, academic or a hybrid in which the student is encouraged but not constrained to have some original contributions.

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Overall Assessment: 1.0 × Continuous Assessment

(a) Performance of each student should be assessed individually together with the team's overall performance by the supervisor, an independent assessor, the peers and an examination panel consisting of at least three academic staff;

(b) The continuous monitoring of a project group as a whole and that of each group member on an individual basis are conducted by the supervisor. The interim report is assessed by the independent assessor. The final report is assessed by both the supervisor and the independent assessor. As part of the assessment process, each group member is required to specify his/her own contribution in completing the project when compared to his/her team mates (peer assessment). In case of an industrial-based project, comments will be invited from the industrial supervisor but he/she will not be required to perform the formal assessment;

(c) The supervisor monitors and assesses the overall and individual progresses through regular meetings. The interim report should be submitted to the independent assessor at around week 8 of the first semester. The final report submitted before the end-of-year examination is assessed by both the supervisor and the independent assessor. Due consideration of each student's individual contribution and performance will be taken into account;

(d) During the oral examination, every group member is required to present the project especially on his/her significant contribution to the whole project, and respond to the questions addressed to him/her by the examination panel. Marks for oral examination are awarded to individual student by taking into account the group's overall performance;

(e) The assessment system is summarized as shown in the following table:

Assessor	Assessment Component (% of the total)				
	Continuous Monitoring (15)	Interim Report (10)	Final Report (25)	Final Report (25)	Oral Examination (25)
Supervisor	✓		✓		
Independent Assessor		✓		✓	
Examination Panel					✓

Student Study Effort Expected	Class contact:	
	• Guided study	26 Hrs.
	Other student study effort:	
	• Conducting project	154 Hrs.
	• Literature search and private study	72 Hrs.
	Total student study effort	252 Hrs
Reading List and References	To be advised by supervisor.	

Developed in November 2021

Form AR 140

The Hong Kong Polytechnic University

Subject Description Form

Please read the notes at the end of the table carefully before completing the form.

Subject Code	MM3462
Subject Title	Artificial Intelligence and Big Data for Business
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	Pre-requisite: Business Analytics (MM3425) or equivalent
Objectives	Modern Artificial Intelligence (AI) and Big Data have fundamentally reshaped today's business and society, especially in the areas of business decision making, business processes, and enhancement of business models. This trend has created great demand for business graduates to have necessary knowledge and skills in AI and big data for continuous business innovation. This subject aims to develop student's understanding of the concepts and applications of AI and big data for business. Students will also have hands-on experience in using big data/AI-based big data tools to solve real world business problems.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: a. Understand the principles, methods, and technologies of AI and big data in business. **(BBA Outcome 6a)** b. Think reflectively and creatively on applying AI and big data technologies in business contexts. **(BBA Outcome 3c & 6a)** c. Grasp hands-on knowledge and skills of big data management, visualization, and analytics for business purposes. **(BBA Outcome 6b)** d. Identify and formulate existing business problems, design business plans by using AI and big data to solve these business problems, and evaluate the effectiveness of the proposed solutions. **(BBA Outcome 3c & 6a)**
Subject Synopsis/ Indicative Syllabus *(Note 2)*	This subject provides students with a solid understanding of the cutting-edge technologies like AI and Big Data, specifically, it covers the below topics: **Artificial Intelligence for business** • Machine Learning • Deep Learning • Artificial Neural Network • Natural Language Processing • Robotics technologies

- AI applications in various business contexts (e.g., recommendation engine, customer interaction, decision automation, etc.)

Big data concepts and applications

- Introduction of big data
  -4Vs, data source, type, infrastructure, life cycle, etc.
- Big data storage
  -Relational and non-relational databases, like RDBMS, NoSQL, and NewSQL databases
- Big data processing and technologies
  -Virtualization and cloud computing
  -Apache software, including Hadoop, Cassandra
- Big data analytics and visualization
  -Machine learning with Rapidminer
  -Visualization with Tableau

Relationship between AI and big data

Applications of AI and big data in innovative business solutions

Teaching/Learning Methodology

(Note 3)

The course will use a variety of methods as its pedagogy to help students achieve the above learning outcomes.
Basic principles and concepts of AI and Big Data will be introduced through lectures. In the tutorial sessions, students will have practical exposure to Tableau and Rapidminer – the big data visualization and AI-based big data tools. For other sessions of tutorial classes, students will form in small groups to discuss about cases related to the corresponding lectures. Through the above teaching and learning methods, students should be able to generalize the concepts to business situations via critical thinking skills, and able to integrate and synthesize course concepts with ideas in other domains.

Assessment Methods in Alignment with Intended Learning Outcomes

(Note 4)

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)			
		a.	b.	c.	d.
Continuous Assessment	**50%**				
1. Participation	10%	√	√	√	√
2. Individual assignment	15%	√	√	√	√
3. Group Assignments	25%	√	√		√
Final Exam/Assignment	**50%**	√	√		√
Total	100 %				

**Weighting of assessment methods/tasks in continuous assessment may be different, subject to each subject lecturer.*

To pass this subject, students are required to obtain Grade D in the overall grade.

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

<table>
<tr><td></td><td colspan="2">The group project in the continuous assessment is designed specifically to assess students’ ability to think reflectively and creatively in group work on applying AI and big data related knowledge in business contexts. The key concepts and analytical skills acquired by students can be reflected in their home/tutorial works (case studies, hands-on sessions, and individual paper), and their performance in the final assessment. The final exam/assignment may include essay questions and/or case analysis.</td></tr>
<tr><td>Student Study Effort Expected</td><td>Class contact:</td><td></td></tr>
<tr><td></td><td>▪ Lecture</td><td>26 Hrs.</td></tr>
<tr><td></td><td>▪ Tutorial</td><td>13 Hrs.</td></tr>
<tr><td></td><td>Other student study effort:</td><td></td></tr>
<tr><td></td><td>▪ Preparation for discussion and hands-on exercise</td><td>32 Hrs.</td></tr>
<tr><td></td><td>▪ Individual assignment and group assignments</td><td>46 Hrs.</td></tr>
<tr><td></td><td>Total student study effort</td><td>117 Hrs.</td></tr>
<tr><td>Reading List and References</td><td colspan="2"><i>Recommended Textbook and References</i>
<u>Textbooks:</u>
1. Doug R. (2020), <i>Artificial Intelligence for Business</i>, Pearson, 2nd edition.
2. Balamurugan B., Nandhini A. R., Seifedine K., Amir H. G. (2021), <i>Big Data: Concepts, Technology and Architecture</i>, John Wiley & Sons, Inc.
<u>Other Readings:</u>
1. Relevant cases and other business readings.</td></tr>
</table>

Note 1: Intended Learning Outcomes
Intended learning outcomes should state what students should be able to do or attain upon subject completion. Subject outcomes are expected to contribute to the attainment of the overall programme outcomes.

Note 2: Subject Synopsis/Indicative Syllabus
The syllabus should adequately address the intended learning outcomes. At the same time, overcrowding of the syllabus should be avoided.

Note 3: Teaching/Learning Methodology
This section should include a brief description of the teaching and learning methods to be employed to facilitate learning, and a justification of how the methods are aligned with the intended learning outcomes of the subject.

Note 4: Assessment Method
This section should include the assessment method(s) to be used and its relative weighting, and indicate which of the subject intended learning outcomes that each method is intended to assess. It should also provide a brief explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes.

Subject Description Form

Subject Code	SD3781
Subject Title	Interface Design
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	The digital interface is a core concrete component of artifacts which enables interactive dynamic experiences. It embodies the design concepts and supports the interaction between users and a system. The design and development of it is basically user-centric. This course facilitates students to internalise principles of interface design through identification, comparison, application of principles, and practising user-centred design processes. It also extends discussions to various digitally mediated environments and stimulates student critiques of user-centred approaches when compared with other alternatives in different context and scenarios.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: Professional skills a. Carry out basic interaction design process: task analysis, rapid prototyping, user testing, evaluation, and iteration. b. Identify application of interaction design principles and design patterns in existing interfaces. c. Compare different styles of interfaces in different contexts. d. Apply interaction design principles and carry out rapid prototyping and user testing to exercise interface design for a specific context. Transferable skills e. Communicate effectively and precisely using technical terms.
Subject Synopsis/ Indicative Syllabus	Students will be introduced to: Concepts and Principles • Conventions and developments of the graphical user interface • Principles of interaction design • User-centred design processes: prototyping and user testing • Case study: websites, video games, digital art, hand-held devices, etc. • Trends of user interface design direction: e.g., tactile, gestural, immersive, or adaptive interfaces Techniques and Experiments • Rapid prototyping techniques • Information visualization regarding advances in artificial intelligence or data analytics.

Teaching/Learning Methodology

Activity	Purpose
Lecture	Introduces students to domain knowledge in line with learning outcomes.
Workshop	Allows students to put principles into practice with short in-class exercises.
Case study	Assists students in identifying, relating, and distinguishing course contents.
Presentation and Critique	Provide students with opportunities to articulate, distinguish, and review knowledge independently and critically.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed										
		a	b	c	d	e						
1. Presentations and critiques	20%		✓	✓		✓						
2. Assignments	60%	✓		✓	✓							
3. In-class exercises	20%	✓	✓	✓	✓							
Total	**100%**											

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Presentations and critiques ensure students to internalize course contents by visualizing and presenting ideas, as well as addressing comments.

Exercises and assignments ensure students to elaborate on course contents by performing extended readings, contextual reviews, as well as demonstrating principles in making artifacts.

Student Study Effort Expected

Class contact:	
▪ Lectures, presentations	24 Hrs.
▪ Workshops and tutorials	15 Hrs.
Other student study effort:	
▪ Reading, presentation preparation	20 Hrs.
▪ Assignments	46 Hrs.
Total student study effort	**105 Hrs.**

Reading List and References

Books

- Bolter, J. D. & Gromala, D. (1997) *Windows and Mirrors: Interaction Design, Digital Art, and the Myth of Transparency*. The MIT Press.
- Chow, K., Chan V. & Ho A. (2009) *Multimedia Rules: Rethinking design principles*. The SD Press.
- Cooper, A. (2007) *About Face 3: The Essentials of Interaction Design*. Wiley.
- Krug, S. (2005) *Don't Make Me Think*. New Riders Press.
- Neil, T. (2012) *Mobile Design Pattern Gallery*. O'Reilly Media, Inc.

	- Saffer, D. (2008) *Designing Gestural Interfaces: Touchscreens and Interactive Devices*. New Riders Press. - Shneiderman, B. (2009) *Designing the User Interface: Strategies for Effective Human-Computer Interaction*. Addison Wesley.

The Hong Kong Polytechnic University

Subject Description Form

Subject Code	SD4470
Subject Title	Integrated Capstone Project – Product Design
Credit Value	6
Level	4
Pre-requisite / Co-requisite/ Exclusion	Pre-requisite: SD4466 Capstone Project I Exclusion: Any other equivalent capstone project
Objectives	It is generally assumed that over the course of design projects, more analytical knowledge-gathering and conceptualising activities (research) tend to occur before more synthesis-oriented production and refinement activities (implementation). the student will be provided with the opportunity to apply and integrate the knowledge of artificial intelligence and data analytics (AIDA). Based on this assumption, this subject offers students a context to engage in self-determined design development and production work following-up on their preceding Capstone Project 1.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: Professional skills a. Demonstrate the ability to carry out iterative design development process through incorporating different theories and technological innovations. b. Apply relevant design development, research methods and processes learned on the programme using AIDA knowledge and skills. c. Defend their work in a critique context to argue for the implementation of novel concepts with the consideration of making positive value change. d. Carry out design evaluations and refinement with sound time/project management. e. Produce detail descriptions and illustrations for presentation and production planning including drawings with dimensions and consideration of materials and production processes. Transferable skills f. Apply critical thinking and life-long learning skills. g. Produce a reflective report and substantiate relevant sustainability claims or positive social value change.
Subject Synopsis/ Indicative Syllabus	The subject requires students to apply a suitable selection of all knowledge-gathering and proposal formulation techniques taught on this programme and AIDA up to this point, including: 1. Produce information graphic to illustrate methods and findings and insights for effective communication 2. Record the concept development process through mock-up and functional prototype making

3. Record the experimentation of materials and production processes
4. Present the design concepts with strong evidence, creatively and explicitly
5. Identify relevant industry and show potentiality of career development
6. Record of all design processes and supporting materials with in-depth reflection and show life-long learning skills

Teaching/Learning Methodology

The teaching and learning methodology of subject is squarely centred on studio tutorial interaction between students and tutors as well as on tutor-critiqued milestone student presentations. Supporting lectures are offered if/as deemed necessary by tutors. Tutors are typically in charge of groups of 3 to 6 students. Tutorials occur in groups or individually as deemed appropriate by students and tutors.

Activity	**Purpose**
Lecture	Introduces theories and principals related to the topic.
Tutorial	Guides students through the development of projects, individually and in small groups.
Seminar	Discusses assigned readings related to the topic, expanding students' contextual knowledge.
Critique	Allows students to learn from the strengths and weaknesses of their peers and provides a framework for evaluating the effectiveness of students' projects from various perspectives.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)						
		a	b	c	d	e	f	g
1. Interim Presentation	30 %	✓	✓	✓	✓		✓	
2. Final Presentation	50 %	✓	✓	✓	✓	✓	✓	
3. Final Report	20 %	✓	✓		✓	✓	✓	✓
Total	100 %							

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Interim Presentation	Evaluates students' ability to identify an issue, needs, or design opportunities; the overall quality of the design brief; considerations of intended audience/users; evidence of divergent and convergent thinking; range of concept explorations and quality; visualisation skills; verbal and visual communication of ideas.
Final Presentation	Evaluates students' ability to make informed design decisions based on project criteria as set out in the design brief; the strength of the final chosen concept; relevance of the final solution to the brief; aesthetic value; technical competence; professionalism; personal insights into the design problem; the ability to communicate their

		final solution via visual and written means.
	Final report	Evaluates students' ability to critically reflect on the design and learning process; the organisation of a body of process material; the clarity of the report; the quality of the written communication.

Student Study Effort Expected	Class contact:	
	▪ Lectures, workshops and in-class exercises	9 Hrs.
	▪ Tutorials: group and individual	54Hrs.
	▪ Critiques	15 Hrs.
	Other student study effort:	
	▪ Self-study	40 Hrs.
	▪ Project work	152 Hrs.
	Total student study effort	**270 Hrs.**

Reading List and References

Books

Cagan J., & Vogel, C.M. (2002). *Creating breakthrough products: Innovation from product planning to program approval.* Prentice Hall.

Denning, Peter J. (2002). The invisible future: The seamless integration of technology into everyday life. McGraw-Hill.

Frisa, M. L., Lupano, M., Tonchi, S., Antonelli, P., Muschamp, H. & Pearlman C. (2002). *Total living*. Charta.

Miller, R. B., Heiman S. E, & Tuleja, T. (2011). *The new strategic selling.* (Rev. 3rd. ed..). Kogan Page.

Papanek V. J. (1995). *The green imperative: Ecology and ethics in design and architecture.* Thames & Hudson.

Papanek V. J. (1972). *Design for the real world: Human ecology and social change.* Pantheon Books.

Postrel V. (2003). *The substance of style: How the rise of aesthetic value is remaking commerce, culture and consciousness.* Harper Collins.

Wheeler, A. (2003). *Designing brand identity*. John Wiley & Sons.

Magazines/journals

View Point

Design Management Journal

Subject Description Form

Subject Code	SD4772 (previous subject code: SD3771)
Subject Title	Interactive Media and Marketing
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	Marketing drastically changes its shape in the digital age. With the advent of the new media, marketing takes place at different facets, including websites, electronic direct mails, social networks, location-based services, and others. It takes various forms, such as viral marketing, game-based marketing, or customer relationship management. Designers in the digital age have to develop the related mindset and skillset to make more effective and persuasive delivery of messages. This subject introduces students to the basic principles of marketing, with a view to opening up possibilities for more persuasive marketing campaigns with all accessible digital media tools. This subject also introduces the marketing and design implications of data made available by various digital platforms.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: Professional skills a. identify and compare different marketing elements on the digital platform b. contrive appropriate marketing strategies for the digital generation c. demonstrate new interactive experience and the added values generated from it Transferable skills d. reflect critically on their learning process e. communicate effectively and precisely using technical terms
Subject Synopsis/ Indicative Syllabus	Students will be introduced to: • Internet marketing and online advertising • Marketing strategies for the digital age • Web management • Search engine optimization • Viral elements in digital marketing • Social media and online consumer engagement • Online branding and reputation management • Location-based marketing • Game-based marketing • Data analytics and the implications

- Case study

Teaching/Learning Methodology

Activity	Purpose
Lecture	To provide students with a theoretical approach to the subject
Tutorial	To guide students on the development of projects, individually and in small groups
Workshop	To provide students with hands-on experience and to put principles into practice.
Assignment	To give students guided challenges in order to use what they have learned and to provide them with an opportunity to personalize those skill-sets with their individual insights.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed										
		a	b	c	d	e						
1. Assignment	90%	✓	✓	✓	✓	✓						
2. Participation	10%		✓	✓	✓	✓						
3.	%											
4.	%											
Total	**100%**											

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The assignments are designed to let the students demonstrate what they learn and reflect

Student Study Effort Expected

Class contact:	
▪ Lecture	19 Hrs.
▪ Tutorial and workshop	20 Hrs.
Other student study effort:	
▪ Reading, preparation for presentation	22 Hrs.
▪ Project work and Assignment	44 Hrs.
Total student study effort	**105 Hrs.**

Reading List and References

Books

Krug, S. (2006) *Don't make me think! : a common sense approach to Web usability.* New Riders.

Ryan, D. (2012) *Understanding digital marketing: marketing strategies for engaging the digital generation.* Philadelphia, Pa.: Kogan Page.

	Ryan, D & Jones, C. (2011) *The Best Digital Marketing Campaigns in the World.* Philadelphia, Pa.: Kogan Page. Weinschenk, S. (2009). *Neuro web design : what makes them click?* New Riders Zichermann, G. & Linder J. (2010) *Game-based Marketing: Inspire Customer Loyalty Through Rewards, Challenges, and Contents.* Wiley.

Subject Description Form

Subject Code	SD4788
Subject Title	User Experience Design
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	User experience (UX) design is a design approach that explores, creates, and evaluates design solutions with the goal of enriching the experiences of users and customers. Current literature recognizes that experience emerged from users interacting with products, services, and people among other tangible and intangible touchpoints. Also, experiences involve a sense-making process between an individual's inner world, the present moment, and future orientations. Digital technology also plays a role in mediating user experiences with these touchpoints. Therefore, UX design incorporates theories, knowledge, and practices from different academic fields, such as psychology, marketing, design, and technology. This subject introduces UX design to students through case studies of existing systems and practices of the digital product development process. Students will also be inspired to incorporate emergent interactive technologies to create products and services with interactive dynamic experiences.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: <u>Professional skills</u> a. Delineate user experience components and give examples from existing applications or digital products b. Perform user experience evaluation on existing applications or digital products c. Identify recent digital interaction development trends in society and explain their impact on everyday life d. Carry out digital product development process from user experience perspective <u>Transferable skills</u> e. Communicate design proposal effectively and precisely
Subject Synopsis/ Indicative Syllabus	Students will be introduced to: <u>Concepts and Principles</u> ● Experience design literacy ● Persuasion and technology ● Digital product development process in relation to user experience design: task analysis, persona, user scenario, service blueprint, etc. ● Advances in interactive technologies ● Case study: online branding, internet applications, mobile applications, etc. <u>Techniques and Experiments</u> ● Design methods for user experience: Persona, Scenario, Storytelling, service blueprint etc.

Teaching/Learning Methodology

Activity	Purpose
Lecture	To introduce students to domain knowledge in line with learning outcomes
Workshop	To put principles into practice with short in-class exercises
Case study	To assist students in identifying, relating, and distinguishing course contents
Presentation and Critique	To provide students with opportunities to articulate, distinguish, and review knowledge independently and critically

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed				
		a	b	c	d	e
1. Presentations and critiques	30%	✓		✓		✓
2. Assignments	70%	✓	✓	✓	✓	✓
Total	**100%**					

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Assignments ensure students to elaborate on course contents by performing extended readings, contextual reviews, as well as demonstrating principles by making artifacts.

Student Study Effort Expected

Class contact:	
▪ Lectures, presentations	19 Hrs.
▪ Workshops	20 Hrs.
Other student study effort:	
▪ Reading, presentation preparation	30 Hrs.
▪ Assignments	36 Hrs.
Total student study effort	**105 Hrs.**

Reading List and References

Books
Calvo, R.A. & Dorian, P. (2014) *Positive Computing Technology for Wellbeing and Human Potential*, MIT Press.

Fogg, B. J. (2002) *Persuasive Technology: Using Computers to Change What We Think and Do*. Morgan Kaufmann

Hassenzahl, M. (2010) *Experience Design: Technology for All the Right Reasons*. Morgan & Claypool Publishers.

Wendel, S. (2020). *Designing for behavior change: Applying psychology and behavioral economics* (2nd ed..). Sebastopol, CA: O'Reilly Media.

Articles
Desmet, P. M. A., & Pohlmeyer, A. E. (2013). Positive design: An Introduction to Design for Subjective Well-Being. *International Journal of Design*, 7(3), 5–19.

The Hong Kong Polytechnic University

Subject Description Form

Subject Code	SD4790
Subject Title	Integrated Capstone Project - Interaction Design
Credit Value	6
Level	4
Pre-requisite / Co-requisite/ Exclusion	Pre-requisite: SD4791 Capstone Project I Exclusion: Any other equivalent capstone project
Objectives	The objectives of this subject are to: • provide a student with the opportunity to apply and integrate the knowledge of artificial intelligence and data analytics (AIDA) to the design discipline. • develop the capabilities of a student in analyzing and solving complex and possibly real-life problems using AIDA. • Train students with skills on systematic development and documentation of a significant piece of work. • In this capstone project, students will formulate design problems, generate design concepts, undertake design and creation processes, and produce material outcomes, which demonstrate their creative and insightful applications of knowledge and skills they have acquired from the programme.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: Professional skills a. Formulate design problems of human needs for new experiences. b. Perform substantial research and analysis. c. Develop conceptual, technical, and cultural frameworks. d. Make critical judgment based on contextual review. e. Carry out iterative design processes. f. Apply principles and techniques acquired in other subjects to accomplish project goals; understand the materials obtained and connect the materials with the problem to be solved using AIDA knowledge and skills. Transferable skills g. Critically reflect results and documents development. h. Communicate effectively and precisely with professional vocabularies.
Subject Synopsis/ Indicative Syllabus	Students will undertake a complete design and creation process to apply a suitable selection of all knowledge-gathering and proposal formulation techniques taught on this programme and AIDA to accomplish their project aims. Teachers will serve as project supervisors or advisors to guide students from project specification to project completion. Faculty members may lead

different project teams according to their areas of expertise and research interests.

Teaching/Learning Methodology

Activity	Purpose
Tutorial	Advises students on their project development.
Production workshop	Allows students to execute their project plans and evaluate their concepts iteratively.
Presentation and Critique	Provide students with opportunities to articulate, distinguish, and review design concepts independently and assertively.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed							
		a	b	c	d	e	f	g	h
1. Presentations and critiques	20%								✓
2. Continuous assessment	60%	✓	✓	✓	✓	✓	✓		
3. Project report	20%							✓	
Total	**100%**								

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Presentations require students to reflect upon the course contents, define scope and focus, mark out relations and make comparison, assert and structure their arguments, etc.

Peer critiques further prompt students to compare, analyse, and make judgment independently and assertively.
Continuous assessment evaluates students' progress in different stages of project development.

Project report summarises students' final achievements in terms of project background, research processes and findings, project goals, design strategies and processes, final concepts and solution, and evaluation.

Student Study Effort

Expected

Class contact:	
▪ Tutorials and workshops	78 Hrs.
Other student study effort:	
▪ Project development	132 Hrs.
Total student study effort	**210 Hrs.**

Reading List and References

Books

Hekkert, P., & van Dijk, M. (2011). *Vision in design: A guidebook for innovators*. BIS.

Lupton, E. (2017). *Design is storytelling*. Cooper Hewitt, Smithsonian Design Museum.

Martin, B., & Hanington, B. (2012). *Universal methods of design 100 ways to research complex problems, develop innovative ideas, and design effective solutions* (1st ed..). Rockport.

Vijay Kumar. (2012). *101 Design Methods*. Wiley.

	Websites Interactions. https://interactions.acm.org/ Communications of the ACM. https://cacm.acm.org/ Wired. https://www.wired.com/ Ted. http://www.ted.com RSA. http://www.thersa.org/

Form AR 140

The Hong Kong Polytechnic University

Subject Description Form

Please read the notes at the end of the table carefully before completing the form.

Subject Code	SO4020X
Subject Title	Application of AI and Data Analytics to Manage Ocular Problems
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	NIL
Objectives	1. To equip students with knowledge of contemporary challenges in the ophthalmic field 2. To provide students insight of applying AIDA to tackle problems related to the eye and the visual system
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. describe epidemiology of refractive errors in the world and the public health perspective of refractive errors b. demonstrate the understanding on clinical management of refractive errors by different means c. demonstrate the understanding of contemporary challenges of ocular problems in the ophthalmic field d. demonstrate the ability to apply AIDA in the ophthalmic field e. design AIDA systems, components and processes to meet given specifications and constraints
Subject Synopsis/ Indicative Syllabus	Epidemiology of refractive errors in different regions andcountries: past, present and future Public health and refractive errors: the societal, economical and personal cost of refractive errors Clinical methods to manage refractive errors: an overviewof history and current clinical practice Complications from refractive errors Contemporary ophthalmic issues affecting the world Application of AIDA in the ophthalmic field
Teaching/Learning Methodology	**Lecture**: Didactic teaching will be used. Real examples will be covered to illustrate different ophthalmic challenges. **Problem based learning.** **Tutorial:** Student-centred tutorial so students, as a group, can share problems among themselves and try to solve them together. It also helps students to consolidate what they have learned from the lectures.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)				
		a	b	c	d	e
1. Coursework (tests)	50	✓	✓	✓		
2. Assignment	50	✓	✓	✓	✓	✓
Total	100 %					

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Several written tests will be arranged during the course to examine students' knowledge on the challenges in the ophthalmic field.

Assignment will be given to assess students the application of AIDA to tackle problems in the ophthalmic field. This can examine their problem-solving skills, critical thinking and analytical power.

Student Study Effort Expected

Class contact:	
▪ Lecture	30 Hrs.
▪ Tutorial	4 Hrs.
▪ Problem-based learning	5 Hrs.
Other student study effort:	
▪ Self-study	80 Hrs.
Total student study effort:	**119 Hrs.**

Reading List and References

Saw S, Matsumura S, & Hoang Q. (2019). Prevention and management of myopia and myopic pathology. Investigative Ophthalmology & Visual Science, 60(2), 488-99.

Cooper J. (2019). Etiology and Management of Myopia. Advances in Ophthalmology and Optometry, 4, 39-64.

Farooqui J, Acharya M, & Kekan M. (2019). Current trends in surgical management of myopia. Community Eye Health, 32(105), S5-S6.

Moore M, Loughman J, Butler JS, Ohlendorf A, Wahl S, et al. (2021). Application of big-data for epidemiological studies of refractive error. PLOS ONE, 16(4): e0250468.

	Avinash V. Varadarajan, Ryan Poplin, Katy Blumer, Christof Angermueller, Joe Ledsam, Reena Chopra, Pearse A. Keane, Greg S. Corrado, Lily Peng, Dale R. (2018). Webster; Deep learning for predicting refractive error from retinal fundus images. Investigative Ophthalmology & Visual Science, 59(7), 2861-8.

Note 1: Intended Learning Outcomes
Intended learning outcomes should state what students should be able to do or attain upon subject completion. Subject outcomes are expected to contribute to the attainment of the overall programme outcomes.

Note 2: Subject Synopsis/Indicative Syllabus
The syllabus should adequately address the intended learning outcomes. At the same time, overcrowding of the syllabus should be avoided.

Note 3: Teaching/Learning Methodology
This section should include a brief description of the teaching and learning methods to be employed to facilitate learning, and a justification of how the methods are aligned with the intended learning outcomes of the subject.

Note 4: Assessment Method
This section should include the assessment method(s) to be used and its relative weighting, and indicate which of the subject intended learning outcomes that each method is intended to assess. It should also provide a brief explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes.

Form AR 140

The Hong Kong Polytechnic University

Subject Description Form

Please read the notes at the end of the table carefully before completing the form.

Subject Code	SO4039X
Subject Title	Integrated Capstone Project
Credit Value	6
Level	4
Pre-requisite/ Co-requisite/ Exclusion	• Application of AI and Data Analytics to Manage Ocular Problems (SO4020X) • Any other equivalent capstone project should be excluded.
Objectives	The objectives of this subject are to: • provide a student with the opportunity to apply and integrate the knowledge of artificial intelligence and data analytics (AIDA) to optometry / vision science; • develop the capabilities of a student in analyzing and solving complex and possibly real-life problems using AIDA; • Train students with skills on systematic development and documentation of a significant piece of work.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: <u>Professional/academic knowledge and skills</u> (a) conduct literature review to locate materials and sources relevant to optometry / vision science; (b) understand the materials obtained and connect the materials with the problem to be solved using AIDA knowledge and skills; (c) define and specify the problem precisely; (d) assimilate and apply the learnt knowledge to generate good solutions to the problem; (e) think critically the formulation of alternative models and solutions to the problem, and their implementation; and (f) evaluate the final outcome in an objective manner; <u>Attributes for all-roundedness</u> (g) improve presentation and communication skills via oral presentation; (h) enhance technical report writing skills with proper organization of materials; (i) develop the ability to learn independently and to find/integrate information from different sources required in solving real-life problems; (j) manage the project efficiently and effectively through the supervision of supervisor(s); and (k) work collaboratively with related parties (e.g. vendors, sponsor company, technical support staff, team-partners, research students, etc.).
Subject Synopsis/ Indicative Syllabus	**1. In-depth Study of a Topic Proposed by the Supervisor** **2. Project Meeting and Planning** **3. Proposal Writing** **4. Regular Progress Checking and Reporting**

5. **Project Documentation**
6. **Presentation and Demonstration**

Students are expected to identify a project topic with a supervisor in optometry / vision science, and a co-supervisor with artificial intelligence and data analytics expertise. Students need to demonstrate their knowledge in both optometry / vision science and AIDA in the project, receiving advice from both supervisors. The project should represent requisite effort in analysing and interpreting the data/information obtained, using the principles and techniques learnt from various related subjects. Students are also expected to demonstrate significant analytical and, preferably, research ability in optometry / vision science.

Teaching/Learning Methodology

The Integrated Capstone Project spans across the academic year for two consecutive semesters. The teaching/learning activities include regular project meetings with the supervisor and the co-supervisor, guided study of project materials, independent project development work and other project management tasks.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)										
		a	b	c	d	e	f	g	h	i	j	k
Continuous Assessment	100	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Total	100											

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The Integrated Capstone Project will be accessed by the supervisor/co-supervisor and other assessors. Attributes to be assessed include, but not limited to, Problem Identification, Problem Solving, Communication and Presentation, Project Management, and Self-Discipline.

Integrated Capstone Projects should be problem-oriented and there are no restrictions on the nature of the problem except that it should be relevant to optometry / vision science and AIDA. The project could be practical, academic or a hybrid in which the student is encouraged but not constrained to have some original contributions. Each student has to submit a proposal, a mid-term checkpoint progress report and a final report. The proposal must be approved by the supervisor/co-supervisor before the student can proceed with the Integrated Capstone Project. An oral presentation and demonstration is essential at the end of the project. A mid-term presentation and demonstration may also be required for proper continuous assessment.

Student Study Effort Expected

Class contact:	
▪ Lecture	0 Hrs.
Other student study effort:	
▪ Searching and reading materials, meeting with supervisor / co-supervisor / others, design and system development, testing, documentation, presentation, etc.	210 Hrs.
▪ Total student study effort	210 Hrs

Reading List and References	**Reference Books:** 1. Kumar, Ranjit, *Research Methodology: A Step-by-step Guide for Beginners*, 3rd Edition, SAGE Publications, 2011. 2. Burns, Robert B., *Introduction to Research Methods*, 4th Edition, SAGE Publications, 2000. 3. Roberts, Carol M., *The Dissertation Journey: A Practical and Comprehensive Guide to Planning, Writing, and Defending Your Dissertation*, 3rd Edition, Corwin Press, 2007. 4. Mauch, James E. and Park, Namgi, *Guide to the Successful Thesis and Dissertation: A Handbook for Students and Faculty*, 5th Edition, Marcel Dekker, 2003. 5. Rudestam, Kjell Erik and Newton, Rae R., *Surviving Your Dissertation: A Comprehensive Guide to Content and Process*, 2nd Edition, Sage Publications, 2001. 6. Garson, G. David, *Guide to Writing Empirical Papers, Theses and Dissertations,* Marcel Dekker, 2002. 7. Reinhart, Susan M., *Giving Academic Presentations*, 2nd Edition, University of Michigan Press, 2013. 8. Oshima, Alice and Hogue, Ann, *Writing Academic English*, 4th Edition, Pearson Longman, 2006. 9. American Psychological Association. *Publication Manual of the American Psychological Association,* 6th Edition, American Psychological Association, 2010. 10. Szuchman, Lenore T., *Writing with Style: APA Style Made Easy,* 5th Edition, Wadsworth/Cengage Learning, 2011. 11. Statistics, simulation, programming, and relevant books. 12. ACM and IEEE magazines, Transactions and Journals. 13. Other International Journals. 14. Relevant conference proceedings and magazines (including ACM and IEEE conferences). 15. Technical reports from universities and major companies.

Note 1: Intended Learning Outcomes
Intended learning outcomes should state what students should be able to do or attain upon subject completion. Subject outcomes are expected to contribute to the attainment of the overall programme outcomes.

Note 2: Subject Synopsis/Indicative Syllabus
The syllabus should adequately address the intended learning outcomes. At the same time, overcrowding of the syllabus should be avoided.

Note 3: Teaching/Learning Methodology
This section should include a brief description of the teaching and learning methods to be employed to facilitate learning, and a justification of how the methods are aligned with the intended learning outcomes of the subject.

Note 4: Assessment Method
This section should include the assessment method(s) to be used and its relative weighting, and indicate which of the subject intended learning outcomes that each method is intended to assess. It should also provide a brief explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes.

Subject Description Form

Subject Code	**SFT303AF**
Subject Title	**AI in Fashion Business**
Credit Value	**3**
Level	**3**
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	Students will be exposed to various AI technologies being applied in the fashion industry. They will also learn the fundamental principles and mechanisms of sophisticated and commonly applied data-driven technologies, raw data analysis, and dataset structure for formulating new Artificial Intelligence (AI) applications to boost and reshape the fashion retail and marketing operations.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) understand how the AI technologies can be applied in real-life cases for enhancing fashion marketing and retailing operations and innovations; (b) be aware of basic data-driven technologies and methods to analyse data and create appropriate dataset for AI model training (c) label data for fashion related AI tasks such as image recognition, and segmentation, as well as conduct test script to be familiar with these technologies; and (d) initiate ideas or business models using AI technology for the cases/projects of fashion firms; and (e) plan, organise and deliver effective oral presentations on project work.
Subject Synopsis/ Indicative Syllabus	(a) Basic knowledge of AI for fashion business applications • Image classification: concept of image features, image classifications, attributes recognition based on the neural network. • Voice recognition: types of voice recognition technical, music style recognition and retrieval. • Video understanding: background and related knowledge about video understanding. • Text understanding. Demonstrate the tasks belong to text understanding.

	(b) Application of AI Technologies in Fashion Business • Fashion understanding • Fashion retail and marketing (c) Labelling Training Data and Testing Pre-trained Model • Labelling fashion attributes data for attributes recognition • Labelling fashion segmentation data for clothing parsing • Run test scripts to be familiar with the codes (d) Problem Formulation for Applying AI technologies in Fashion Business • Discussing the potential cases exist in current fashion industry • Problem formulation for into a technical problem with a clear solution • Searching technologies to solve the problem and verify its feasibility
Teaching/Learning Methodology	In this subject, students will gain an understanding of various types of AI technology for fashion business; how to evaluate the task and define data for model training; how to assess the availability of the data and collect them to construct the training set; and how to formulate a fashion business process into a technical task and assess the feasibility. The following tools may be used: 1. Visual Studio Code for running the testing script 2. Github: the largest source code host which provides access control and several collaboration features such as bug tracking, feature requests, task management, continuous integration, and wikis for every project. 3. LabelBee: it is an open-source annotation library to label data for general AI tasks. Lectures and tutorials will underpin students' understanding of the subject contents. Instrumental cases will be adopted to illustrate the usability of the principles in real-life fashion business. Coursework including assignments and group project will also be included.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b	c	d	e	
1. Assignments	25%	✓	✓	✓			
2. Project	25%	✓	✓	✓	✓	✓	
3. Examination	50%	✓	✓	✓			
Total	100%						

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Assignments are given to assess students' understanding on subject matters.

Project require the students to develop an AI-engaged application and potential technical proposal to benefit or improve the existing fashion industry. The project requires a project proposal and presentation as well.

A final 2-hour exam will be closed book examination.

Student Study Effort Expected

Class contact:	
• Lecture	26 Hrs.
• Tutorial	12 Hrs.
Other student study effort:	
• Self-study/Preparation	46 Hrs.
• Project/Assignments	24 Hrs.
Total student study effort	108 Hrs.

Reading List and References

<u>**Books:**</u>

Wong, W. K. (Ed.). (2018). *Artificial Intelligence on Fashion and Textiles: Proceedings of the Artificial Intelligence on Fashion and Textiles (AIFT) Conference 2018, Hong Kong, July 3–6, 2018* (Vol. 849). Springer.

Wong, W. K. (Ed.). (2017). *Applications of computer vision in fashion and textiles*. Woodhead Publishing.

	<u>Paper Articles:</u> Al-Rawi, M., & Beel, J. (2020). Towards an Interoperable Data Protocol Aimed at Linking the Fashion Industry with AI Companies. *arXiv preprint arXiv:2009.03005*. Cheng, W. H., Song, S., Chen, C. Y., Hidayati, S. C., & Liu, J. (2021). Fashion meets computer vision: A survey. *ACM Computing Surveys (CSUR)*, *54*(4), 1-41. Gong, W., & Khalid, L. (2021). Aesthetics, Personalization and Recommendation: A survey on Deep Learning in Fashion. *arXiv preprint arXiv:2101.08301*. Kashilani, D., Damahe, L. B., & Thakur, N. V. (2018, August). An overview of image recognition and retrieval of clothing items. In *2018 International Conference on Research in Intelligent and Computing in Engineering (RICE)* (pp. 1-6). IEEE. Liu, S., Liu, L., & Yan, S. (2014). Fashion analysis: Current techniques and future directions. *IEEE MultiMedia*, *21*(2), 72-79. Mohammadi, S. O., & Kalhor, A. (2021). Smart Fashion: A Review of AI Applications in the Fashion & Apparel Industry. *arXiv preprint arXiv:2111.00905*. Sha, T., Zhang, W., Shen, T., Li, Z., & Mei, T. (2021). Deep Person Generation: A Survey from the Perspective of Face, Pose and Cloth Synthesis. *arXiv preprint arXiv:2109.02081*. Song, S., & Mei, T. (2018). When multimedia meets fashion. *IEEE MultiMedia*, *25*(3), 102-108. Zou, X., & Wong, W. (2021). fAshIon after fashion: A Report of AI in Fashion. *arXiv preprint arXiv:2105.03050*.

Subject Description Form

Subject Code	**SFT304AF**
Subject Title	**AI in Fashion Design**
Credit Value	**3**
Level	**3**
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	The objective of this class is to prepare students to be forerunners in the digital fashion world that involves an Artificial Intelligence (AI) based assistant creation process and innovative ways to create and exhibit their design works. Students will learn the fundamentals of AI in fashion design and how to use and adopt AI technologies to help their creative process and exhibit their design works. Students will gain experience to finish the design process with the help of various AI technologies.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) be aware of the digital transformation and virtual fashion, and critically think what the future of digital fashion will be in metaverse; (b) demonstrate knowledge of various strategies for commonly and potentially adopted AI technologies in fashion arena; (c) understand how the engagement of AI technologies in fashion design process and create futuristic digital fashion collection by using an AI-based fashion design technology; and (d) plan, organise and deliver effective oral presentations on project work.
Subject Synopsis/ Indicative Syllabus	(a) Future of Fashion Design Digital fashion cases and collections launched; Pros and Cons of digital fashion; what metaverse-like worlds will be or should be (b) AI Technologies for Creating Virtual Fashion Introduce the backbone AI technologies for fashion design. (c) Introduction and Hands On Workshop of AI-based Interactive Design Assistant for Fashion (AiDA) system Being familiar with technical tools to generate sketches. (d) Creation of Fashion Collection Using an AI-based Interactive Design Assistant for Fashion (AiDA) system to propose the mood board and create a collection.

<table>
<tr>
<td>Teaching/Learning Methodology</td>
<td>In this subject, students will gain an understanding of the types of AI technology that can be applied in fashion design; how to create designs effectively and efficiently by adopting AI technology; how to make use of AI technology to analyze vast amounts of trend data and suggest design adjustments.

The following tool may be used:
AI-based Interactive Design Assistant for Fashion (AiDA) System

Lecture discussion and tutorials will underpin students' understanding of the subject contents. Instrumental cases will be adopted to illustrate the usability of the principles in fashion design process. Apart from lecturing, coursework including assignments and project will also be included.</td>
</tr>
<tr>
<td>Assessment Methods in Alignment with Intended Learning Outcomes</td>
<td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="4">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td></tr>
<tr><td>1. Assignments</td><td>25%</td><td>✓</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>2. Project</td><td>25%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>3. Examination</td><td>50%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Total</td><td>100%</td><td colspan="4"></td></tr>
</table>
Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Assignments are given to assess students' understanding on subject matters.

The subject has a project, which requires the students to develop a set of collection based on AiDA and demonstrate their thinking about how to improve the AI design system. The project requires a project proposal and presentation as well.

A final 2-hour exam will be closed book examination.
</td>
</tr>
</table>

Student Study Effort Expected	Class contact:	
	• Lecture	26 Hrs.
	• Tutorial	12 Hrs.
	Other student study effort:	
	• Self-study/Preparation	46 Hrs.
	• Project/Assignments	24 Hrs.
	Total student study effort	108 Hrs.
Reading List and References	**<u>Books:</u>** Wong, W. K. (Ed.). (2018). *Artificial Intelligence on Fashion and Textiles: Proceedings of the Artificial Intelligence on Fashion and Textiles (AIFT) Conference 2018, Hong Kong, July 3–6, 2018* (Vol. 849). Springer. Wong, W. K. (Ed.). (2017). *Applications of computer vision in fashion and textiles*. Woodhead Publishing. **<u>Paper Articles:</u>** Dubey, A., Bhardwaj, N., Abhinav, K., Kuriakose, S. M., Jain, S., & Arora, V. (2020). AI Assisted Apparel Design. *arXiv preprint arXiv:2007.04950.* Kato, N., Osone, H., Oomori, K., Ooi, C. W., & Ochiai, Y. (2019, March). Gans-based clothes design: Pattern maker is all you need to design clothing. *In Proceedings of the 10th Augmented Human International Conference 2019 (pp. 1-7).* Ravi, A., Patro, A., Garg, V., Rajagopal, A. K., Rajan, A., & Banerjee, R. H. (2019). Teaching DNNs to design fast fashion. *arXiv preprint arXiv:1906.12159.* Sbai, O., Elhoseiny, M., Bordes, A., LeCun, Y., & Couprie, C. (2018). Design: Design inspiration from generative networks. *In Proceedings of the European Conference on Computer Vision (ECCV) Workshops (pp. 0-0).* Yan, H., Zhang, H., Liu, L., Zhou, D., Xu, X., Zhang, Z., & Yan, S. (2022). Toward Intelligent Design: An AI-based Fashion Designer Using Generative Adversarial Networks Aided by Sketch and Rendering Generators. *IEEE Transactions on Multimedia.* Zou, X., & Wong, W. (2021). fAshIon after fashion: A Report of AI in Fashion. *arXiv preprint arXiv:2105.03050.*	

Subject Description Form

Subject Code	**SFT330FB**
Subject Title	**Fashion Digital Marketing**
Credit Value	**3**
Level	**3**
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	This subject shall provide both theoretical and practical knowledge of digital market to fashion students. Digital marketing covers website creation, planning, optimization. Search engine optimization (SEO), social media analytics and marketing, digital customer journey design, and business data analytics. The latest development of the digital technologies for marketing will also be introduced.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) Develop digital marketing strategy for fashion brands (b) Select the right digital marketing tools for specific marketing purpose (c) Develop right contents for web, mobile, and social media marketing (d) Design engaging customer digital journey (e) Apply new digital technologies for fashion marketing
Subject Synopsis/ Indicative Syllabus	(1) Introduction of fashion digital marketing (2) Search Engine Optimization (SEO) and Search Engine Marketing (SEM) (3) Understanding digital marketplaces (4) Personalized digital marketing with data analytics (5) Social media listening, storytelling and branding (6) Designing and executing digital marketing campaign (7) Digital customer journey management (8) Artificial Intelligence (AI) applications for customer insights and marketing automation (9) Digital inclusion and equity design and strategy (10) Emerging topics and technologies for digital marketing

<table>
<tr>
<td>Teaching/Learning Methodology</td>
<td>Lectures

- Introduction of digital marketing theoretical concepts, latest research findings, and fashion brands case studies
- Guest speakers from digital marketing sector

Tutorials
- Case discussion
- Hands-on experience of digital technologies

The fundamental concepts of digital marketing, and best practices in the industry will be delivered in lectures. Tutorials will be conducted in both the classroom, the computer lab, or online so that students may both experience, design and develop, mobile applications that are suitable for fashion and luxury goods retailers.

There will be guest speakers on specific topics and on the trend of digital marketing in the fashion industry.

A flipped classroom approach will be used in some lectures to improve learning experience and student engagement. The flipped classroom supplements the tutorials that have technical contents.

Group project submission shall report individual contributions of each team member.</td>
</tr>
<tr>
<td>Assessment Methods in Alignment with Intended Learning Outcomes</td>
<td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="6">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td></td></tr>
<tr><td>1. Group project</td><td>50%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>2. Exam</td><td>50%</td><td>✓</td><td>✓</td><td></td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>Total</td><td>100%</td><td colspan="6"></td></tr>
</table>

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:
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</table>

Student Study Effort Expected	Class contact:	
	• lecture	26 Hrs.
	• tutorial	12 Hrs.
	Other student study effort:	
	• Group project	50Hrs.
	• Reading	20Hrs.
	Total student study effort	108Hrs.
Reading List and References	**<u>Reference book</u>** Gilbert, R. M. (2019). *Inclusive design for a digital world: Designing with accessibility in mind*. Apress. Unger, R., & Chandler, C. (2012). *A Project Guide to UX Design: For user experience designers in the field or in the making*. New Riders. **<u>Reading List</u>** Berman, R., & Katona, Z. (2013). The role of search engine optimization in search marketing. *Marketing Science*, *32*(4), 644-651. Campbell, C., Sands, S., Ferraro, C., Tsao, H. Y. J., & Mavrommatis, A. (2020). From data to action: How marketers can leverage AI. *Business Horizons*, *63*(2), 227-243. Klein, J. F., Zhang, Y., Falk, T., Aspara, J., & Luo, X. (2020). Customer journey analyses in digital media: exploring the impact of cross-media exposure on customers' purchase decisions. *Journal of Service Management*, *31*(3), 489-508. Liu, S., Perry, P., & Gadzinski, G. (2019). The implications of digital marketing on WeChat for luxury fashion brands in China. *Journal of Brand Management*, *26*(4), 395-409. Tueanrat, Y., Papagiannidis, S., & Alamanos, E. (2021). Going on a journey: A review of the customer journey literature. *Journal of Business Research*, *125*, 336-353.	

Subject Description Form

Subject Code	**SFT403FI**
Subject Title	**Smart Textiles for Wearable Applications**
Credit Value	**3**
Level	**4**
Pre-requisite/ Co-requisite/ Exclusion	Exclusion ITC4202T Smart Textiles for Wearable Applications
Objectives	The subject provides the knowledge of the latest development, including materials, technologies and products, in smart textiles for wearable application.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) assess technologies involved in smart textile and wearable products and manufacturing processes, their advantages and disadvantages; (b) describe the development trends in technologies for smart textiles and wearable products and their potential in industrial applications. (c) cooperate efficiently in a team to achieve goals; (d) develop critical and creative thinking; (e) develop the ability to adapt new technologies and update their knowledge; (f) develop the ability for sourcing, selecting and integrating information.
Subject Synopsis/ Indicative Syllabus	**(I) Smart Fibres and Fibrous Assembles** Electric functions of textile polymers. Electrically conductive fibres, optical fibres. Photochromic fibres. Electrochromic fabrics. Active polymer fibres. **(II) Interactive Textile Devices** Fibre-based electronic circuit and systems. Flexible fabric strain sensors. Soft tactile sensors, textile electrodes for biopotentials. Textile energy harvesters. Textile energy storages. Photonic fabric displays. Textile circuit boards. **(III) Wearable Products and System Analysis** Thermal regulating garments. Health monitoring garments. shoes. Wearable phototherapy device. **(IV) Manufacturing Technologies** Smart yarn formations. Incorporation of smart functions by weaving, knitting, embroidery, printing, coating and lamination.

<table>
<tr>
<td>Teaching/Learning Methodology</td>
<td>
<p>Lectures will be used to introduce the principles, applications and decision implications of various technological developments to students.</p>
<p>Laboratory/studio involving case studies will be used to provide hands-on experience and supplement the lecture program.</p>
<p>Students will be encouraged to interact with the lecturer, and present their own findings based on investigation of the new developments and new products. Individual assignments, laboratory/studio work and group projects will be the major parts of continuous assessment components.</p>
</td>
</tr>
<tr>
<td>Assessment Methods in Alignment with Intended Learning Outcomes</td>
<td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="6">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td></tr>
<tr><td>Continuous Assessment</td><td>50%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td><i>1. Assignment/ laboratory work</i></td><td>25%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td><i>2. Group project</i></td><td>25%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Examination</td><td>50%</td><td>✓</td><td>✓</td><td></td><td>✓</td><td></td><td></td></tr>
<tr><td>Total</td><td>100%</td><td colspan="6"></td></tr>
</table>
<p>Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:</p>
<p>In the continuous assessment, by individual assignments, laboratory/studio work and group projects, all rounded education will be focused. In addition to professional knowledge, the importance of teamwork, critical and creative thinking, the ability to adapt new technologies, and the demonstration of initiative in sourcing, selecting and integrating information will be stressed. For example, interaction among group members will improve their communication skills, their teamwork spirit, leadership as well as entrepreneurship potential. In order to gain systematic technical knowledge/skills, students will also be asked to do assignments.</p>
</td>
</tr>
</table>

	In the examination, students' learning performance in terms of defining concepts, explaining principles and describing and analysing application examples as well as providing various forms of rationale for smart textile and wearable products and corresponding integration processes will be assessed.	
Student Study Effort Expected	Class contact:	
	• Lecture	26 Hrs.
	• Laboratory	12 Hrs.
	Other student study effort:	
	• Assignments	25 Hrs.
	• Self-study	42 Hrs.
	Total student study effort	105 Hrs.
Reading List and References	**Books** **Essentials** Tao, X. M. (2015), *Handbook of smart textiles*. Springer. (e-version available) Tao, X. M. (2005), *Wearable electronics and photonics*. Elsevier. Schneegass, S., & Amft, O. (2017). *Smart textiles: Fundamentals, design, and interaction (Human-computer interaction series).* Springer. **Supplementary** Tao, X. M. (2001), *Smart fibres, fabrics and clothing – fundamentals and applications*. Elsevier. Helal, A. (Sumi). (2008), Mokhtari, Mounir, Abdulrazak. *The Engineering Handbook of Smart Technology for Aging, disability, and Independence*, John Wiley & Sons, Inc., Bessam. (e-version available)	

	Periodicals Textile Research Journal Smart Materials Bulletin Smart Materials and Structures High Performance Textiles Textile Outlook International Medical Textiles

Subject Description Form

Subject Code	**SFT412FB**
Subject Title	**Fashion Market Intelligence**
Credit Value	**3**
Level	**4**
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	The subject gives an overview of collecting, transforming, and organizing data to draw conclusions, make predictions, and drive informed decision making for fashion businesses.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) advance the ability to develop deep knowledge of data sources required in fashion business (b) advance the ability to stay current on emerging technologies, data types and methods (c) learn how to turn data into a competitive advantage and make better management decisions for fashion organizations (d) upskill data management technical skills and grow into data analysts or consultants in fashion organizations (e) nurture professionalism, demonstrate critical/creative thinking skills, and build communication skills and teamwork spirit.
Subject Synopsis/ Indicative Syllabus	**(I) What is Fashion Market Intelligence?** − Business values of data for fashion business − Information gathering and decision making − Data warehouses **(II) Fashion data analytics with free and open-source software** (e.g., KNIME) − KNIME in a nutshell; Moving around in KNIME: Nodes; Hello world in KNIME: CSV reader, sorter, excel writer − Business programming in python **(III) Transforming fashion data** Applying data mining tools and analytics: modelling data, combining tables, joiner, aggregating values (e.g., GroupBy, pivoting)

(IV) What is machine learning?

- The machine learning way:
  (i) predicting fashion market prices, (ii) segmenting fashion customers, and (iii) finding the best fashion promotion strategy
- Three types of learning algorithms:
  (i) supervised learning, (ii) unsupervised learning, and (iii) reinforcement learning
- Evaluating fashion businesses' performance

(V) Market Intelligence for Fashion Business

- Analysis, design, and implementation of systems for fashion market intelligence
- Market intelligence – customer segmentation
- Social media, big data, and data mining
- Strategic approach to market intelligence

Teaching/Learning Methodology

Lectures will provide fundamental knowledge (i.e., the concepts, technologies, and methods) of data analytics.

Tutorials will be used to apply the learned knowledge and principles into students' own data analytics trials.

Group/individual projects will be given to develop students' ability to define problems; students will have an opportunity to try themselves how to transfer data into addressing the described problems and making better management decisions for fashion organizations

In-class participation will be very important in tutorials and group discussions.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)				
		a	b	c	d	e
Continuous Assessment	**50%**	✓	✓	✓	✓	✓
1. Group project	*30%*	✓	✓	✓	✓	✓
2. Individual assignment and participation	*20%*	✓	✓	✓	✓	
Examination	**50%**	✓	✓	✓	✓	
Total	100%					

	Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes: The assessment methods will be designed to assess diverse aspects of students’ the learning outcomes.	
Student Study Effort Expected	Class contact:	
	Lecture	26 Hrs.
	• Tutorial	12 Hrs.
	• Other student study effort:	
	Group project	67 Hrs.
	• Total student study effort	105 Hrs.
Reading List and References	**Books** De Mauro, A. (2021). *Data analytics made easy: Analyze and present data to make informed decisions without writing any code*. Packt. Sharda, R., Delen, D., & Turban, E. (2021). *Analytics, data science, & artificial intelligence: Systems for decision support*. Pearson Education Limited. **Recommended** Google Data Analytics Certificate: https://grow.google/certificates/data-analytics/#?modal_active=none	

Form AR 140

The Hong Kong Polytechnic University

Subject Description Form

Please read the notes at the end of the table carefully before completing the form.

Subject Code	SFT4217X
Subject Title	Integrated Capstone Project
Credit Value	6
Level	4
Pre-requisite/ Co-requisite/ Exclusion	**Exclusion**: ITC4056T Final Year Project by Thesis, ITC4215D Final Year Project by Collection and any other equivalent capstone project
Objectives	The objectives of this subject are to: • provide a student with the opportunity to apply and integrate the knowledge of artificial intelligence and data analytics (AIDA) to his/her discipline. • develop the capabilities of a student in analyzing and solving complex and possibly real-life problems using AIDA. • Train students with skills on systematic development and documentation of a significant piece of work.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: <u>Professional/academic knowledge and skills</u> (a) conduct literature surveys to locate materials and sources relevant to the selected problem area in a specific discipline; (b) understand the materials obtained and connect the materials with the problem to be solved using AIDA knowledge and skills; (c) define and specify the problem precisely; (d) assimilate and apply the learnt knowledge to generate good solutions to the problem; (e) think critically the formulation of alternative models and solutions to the problem, in the analysis of approaches to the solution and their implementation; and (f) evaluate the final outcome in an objective manner; <u>Attributes for all-roundedness</u> (g) improve presentation and communication skills via oral presentation; (h) enhance technical report writing skills with proper organization of materials; (i) develop the ability to learn independently and to find/integrate information from different sources required in solving real-life problems; (j) manage the project efficiently and effectively through the supervision of supervisor(s); and

<table>
<tr><td></td><td>(k) work collaboratively with related parties (e.g. vendors, sponsor company, technical support staff, team-partners, research students, etc.).</td></tr>
<tr><td>Subject Synopsis/ Indicative Syllabus
<i>(Note 2)</i></td><td>1. In-depth Study of a Topic Typically Proposed by the Supervisor
2. Project Meeting and Planning
3. Proposal Writing
4. Regular Progress Checking and Reporting
5. Project Documentation
6. Presentation and Demonstration

Students are expected to identify a project topic with a supervisor in Fashion and Textiles, and a co-supervisor with artificial intelligence and data analytics expertise. Students need to demonstrate their knowledge in both the fashion and textile discipline and AIDA in the project, receiving advice from both supervisors. The project should represent requisite effort in analysing and interpreting the data/information obtained, using the principles and techniques learnt from various related subjects. Students are also expected to demonstrate significant analytical and, preferably, research ability in the chosen application domain.</td></tr>
<tr><td>Teaching/Learning Methodology
<i>(Note 3)</i></td><td>The Integrated Capstone Project spans across the academic year for two consecutive semesters. The teaching/learning activities include regular project meetings with the supervisor and the co-supervisor, guided study of project materials, independent project development work and other project management tasks.</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes
<i>(Note 4)</i></td><td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="11">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td>g</td><td>h</td><td>i</td><td>j</td><td>k</td></tr>
<tr><td>1. Continuous Assessment</td><td>100%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Total</td><td>100%</td><td colspan="11"></td></tr>
</table>

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The Integrated Capstone Project will be accessed by the supervisor/co-supervisor and other assessors. Attributes to be assessed include, but not limited to, Problem Identification, Problem Solving, Communication and Presentation, Project Management, and Self-Discipline.

Integrated Capstone Projects should be problem-oriented and there are no restrictions on the nature of the problem except that it should be relevant to fashion and textiles discipline and AIDA. The project could be practical, academic or a hybrid in which the student is encouraged but not constrained to have some original contributions. Each student has to submit a proposal, a mid-term checkpoint progress report and a final report.</td></tr>
</table>

	The proposal must be approved by the supervisor/co-supervisor before the student can proceed with the Integrated Capstone Project. An oral presentation and demonstration is essential at the end of the project. A mid-term presentation and demonstration may also be required for proper continuous assessment.	
Student Study Effort Expected	Class contact:	
	▪ Lecture	0 Hrs.
	Other student study effort:	
	▪ Searching and reading materials, meeting with supervisor/co-supervisor/others, design and system development, testing, documentation, presentation, etc	210 Hrs.
	Total student study effort	210 Hrs.
Reading List and References	**Reference Books** 1. Kumar, Ranjit, *Research Methodology: A Step-by-step Guide for Beginners*, 3rd Edition, SAGE Publications, 2011. 2. Burns, Robert B., *Introduction to Research Methods*, 4th Edition, SAGE Publications, 2000. 3. Roberts, Carol M., *The Dissertation Journey: A Practical and Comprehensive Guide to Planning, Writing, and Defending Your Dissertation*, 3rd Edition, Corwin Press, 2007. 4. Mauch, James E. and Park, Namgi, *Guide to the Successful Thesis and Dissertation: A Handbook for Students and Faculty*, 5th Edition, Marcel Dekker, 2003. 5. Rudestam, Kjell Erik and Newton, Rae R., *Surviving Your Dissertation: A Comprehensive Guide to Content and Process*, 2nd Edition, Sage Publications, 2001. 6. Garson, G. David, *Guide to Writing Empirical Papers, Theses and Dissertations*, Marcel Dekker, 2002. 7. Reinhart, Susan M., *Giving Academic Presentations*, 2nd Edition, University of Michigan Press, 2013. 8. Oshima, Alice and Hogue, Ann, *Writing Academic English*, 4th Edition, Pearson Longman, 2006. 9. American Psychological Association. *Publication Manual of the American Psychological Association*, 6th Edition, American Psychological Association, 2010. 10. Szuchman, Lenore T., *Writing with Style: APA Style Made Easy*, 5th Edition, Wadsworth/Cengage Learning, 2011. 11. Statistics, simulation, programming, and relevant books. 12. ACM and IEEE magazines, Transactions and Journals. 13. Other International Journals. 14. Relevant conference proceedings and magazines (including ACM and IEEE conferences). 15. Technical reports from universities and major companies.	

Note 1: Intended Learning Outcomes
Intended learning outcomes should state what students should be able to do or attain upon subject completion. Subject outcomes are expected to contribute to the attainment of the overall programme outcomes.

Note 2: Subject Synopsis/Indicative Syllabus
The syllabus should adequately address the intended learning outcomes. At the same time, overcrowding of the syllabus should be avoided.

Note 3: Teaching/Learning Methodology
This section should include a brief description of the teaching and learning methods to be employed to facilitate learning, and a justification of how the methods are aligned with the intended learning outcomes of the subject.

Note 4: Assessment Method
This section should include the assessment method(s) to be used and its relative weighting, and indicate which of the subject intended learning outcomes that each method is intended to assess. It should also provide a brief explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes.

(Form AR 140) 8.2020