

Subject Description Form

Subject Code	COMP5564
Subject Title	Machine Learning and Applications in Finance
Credit Value	3
Level	5
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, calculus and probability)
Objectives	The objectives of this subject are to enable students to: 1. understand the basic principles, concepts and models of modern machine learning techniques; and 2. apply modern machine learning techniques to solve practical problems in the financial industry such as portfolio optimization, optimal trading, and option pricing and risk management
Intended Learning Outcomes <i>(Note 1)</i>	Upon completion of the subject, students will be able to: a) understand the major concepts of machine learning models and algorithms with a focus on financial applications; b) adopt particular machine learning approach(es) to solve classical problems of Finance such as portfolio optimization, optimal trading, and option pricing and risk management; c) successfully design and implement a machine learning enabled solution, and assess its performance; d) critically evaluate the effectiveness of machine learning techniques and gain knowledge and abilities to apply machine learning techniques to various cutting-edge applications
Subject Synopsis/ Indicative Syllabus <i>(Note 2)</i>	I. Supervised Learning Fundamental concepts like training and testing data, the dimensionality of input space, generalization, supervised learning steps, choice of algorithms, bias-variance dilemma, and overfitting. Models like kNN, naïve Bayes, decision trees, neural networks and multi-layer perceptron, deep learning models. II. Reinforcement Learning Definitions, Markov decision processes, the algorithm for control learning, the criterion of optimality, value function, directed policy search, reinforcement learning methods like policy-based learning, Q-

	Learning, deep reinforcement learning, inverse reinforcement learning, etc. III. Applications of Machine Learning in Finance Supervised learning in Finance, dimensionality reduction & financial data visualization, Markov decision processes and reinforcement learning for option pricing, reinforcement learning for optimal trading and market modelling, reinforcement learning and inverse reinforcement learning for portfolio stock trading. IV. Case Studies Different classical and emerging cases will be chosen for in-depth study and analysis.																																						
Teaching/Learning Methodology (Note 3)	Lectures teach students the main concepts of the course, together with comprehensive examples, and class questions and answers for easy understanding. Tutorials and lab sessions help students to review the learned concepts, and master the practical techniques and necessary tools for effective system/application development. Group project offers the opportunity for students to develop analytical and problem-solving skills through system implementation and interpersonal communication.																																						
Assessment Methods in Alignment with Intended Learning Outcomes (Note 4)	<table><tr><th rowspan="2">Specific assessment methods/tasks</th><th rowspan="2">% weighting</th><th colspan="4">Intended subject learning outcomes to be assessed (Please tick as appropriate)</th></tr><tr><th>a</th><th>b</th><th>c</th><th>d</th></tr><tr><td>1. Assignments</td><td rowspan="3">55</td><td></td><td></td><td></td><td></td></tr><tr><td>2. Project</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr><tr><td>3. Quiz(zes)/Test(s)</td><td></td><td></td><td></td><td></td></tr><tr><td>4. Examination</td><td>45</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: Continuous assessment consists of assignments, projects, and quiz(zes)/test(s) to facilitate students to achieve the intended learning outcomes. Assignments and Quiz(zes)/Test(s) are to measure students’ understanding of the relevant subject matters including the principles, concepts, methodologies, and techniques by proving answers to the questions. Project is to assess students’ ability of solving real problems by designing and implementing learned techniques and developing practical solutions.	Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)				a	b	c	d	1. Assignments	55					2. Project	✓	✓	✓	✓	3. Quiz(zes)/Test(s)					4. Examination	45	✓	✓		✓	Total	100 %				
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4. Examination	45	✓	✓		✓																																		
Total	100 %																																						

	The examination will assess and evaluate the student's overall understanding of the subject.	
Student Study Effort Expected	Class contact:	
	▪ Class activities	39 Hrs.
	▪	Hrs.
	Other student study effort:	
	▪ Assignments, Project, Quiz(zes)/Test(s), Examination	66 Hrs.
	▪	Hrs.
	Total student study effort	105 Hrs.
Reading List and References	1. Matthew F. Dixon, Igor Halperin and Paul Bilokon. <i>Machine Learning in Finance</i>. Springer, 2020. 2. Ashwin Rao, Tikhon Jelvis, <i>Foundations of Reinforcement Learning with Applications in Finance</i>. https://stanford.edu/~ashlearn/RLForFinanceBook/book.pdf 3. Eryk Lewinson, <i>Python for Finance Cookbook: Over 50 recipes for applying modern Python libraries to financial data analysis</i>. Packt Publishing, 2020. 4. Ian Goodfellow, <i>Deep Learning</i>, MIT, 2016. 5. Jared Dean, <i>Big Data, Data Mining, and Machine Learning: Value Creation for Business Leaders and Practitioners</i>. Wiley, 2014. 6. Leskovec, Rajaraman, Ullman, <i>Mining of Massive Datasets</i>, 2nd Ed., Cambridge University Press, 2014.	