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	COMP6710
Subject Title	Advanced Machine Learning
Credit Value	3
Level	6
Pre-requisite/ ~~Co-requisite/~~ ~~Exclusion~~	Nil (but knowledge in introductory machine learning concepts and basic notions in linear algebra and optimization are preferable)
Objectives	The goals of this course include: ➢ To present the fundamentals and theoretical foundations of traditional and modern machine learning. ➢ To introduce recent advances of machine learning techniques and their high-impact applications in artificial intelligence.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: a. Acquire in-depth knowledge of the principles and theories of machine learning models and algorithms. b. Critically review issues and challenges in modern machine learning. c. Develop new insights into cutting-edge machine learning techniques. d. Develop creative and original solutions to practical machine learning problems.
Subject Synopsis/ Indicative Syllabus *(Note 2)*	**Fundamentals** • Overview of various machine learning paradigms including supervised learning, unsupervised learning, semi-supervised learning, and reinforcement learning. • Introduction to traditional machine learning and deep learning. **Advanced Topics** • Learning theory • Transfer learning, meta learning, few/zero-shot learning • Self-supervised learning, contrastive learning • Generative models • Graph-based learning, geometric deep learning **Applications** • Machine learning/deep learning applications in computer vision, natural language processing, web search and recommendation, knowledge discovery and miming, and healthcare.

<table>
<tr><td>Teaching/Learning Methodology

(Note 3)</td><td>39 hours of class activities including lectures on the main concepts, models, and theory, together with case studies, and class questions/answers/discussions. Additional reading of research papers will be assigned, whenever appropriate.</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes

(Note 4)</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></td><td></td></tr>
<tr><td>1. Quiz</td><td>20 %</td><td>✓</td><td></td><td>✓</td><td></td><td></td><td></td></tr>
<tr><td>2. Assignment</td><td>20 %</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td>3. Project</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>
</table>
Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Quiz: assessment of the ability for comprehension of fundamental concepts, principles, algorithms, and theories by providing answers to given questions.

Assignment: assessment of the ability for identifying important issues in current research and exploring solutions through surveys and case studies.

Project: assessment of the ability for solving practical research problems with implementation of algorithms or systems for demonstration. The results will be presented in written reports and oral presentations.
</td></tr>
<tr><td>Student Study Effort Expected</td><td>
<table>
<tr><td>Class contact:</td><td></td></tr>
<tr><td>▪ Lecture/Tutorial</td><td>39 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Self-study</td><td>83 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>122 Hrs.</td></tr>
</table>
</td></tr>
<tr><td>Reading List and References</td><td>

1. T. Hastie, R. Tibshirani and J. Friedman. The Elements of Statistical Learning, 2nd Ed., Springer, 2009.
2. S. Shalev-Shwartz and S. Ben-David. Understanding Machine Learning: From Theory to Algorithms. 2014.
3. O. Bousquet, S. Boucheron and G. Lugosi. Introduction to Statistical Learning Theory. Advanced Lectures on Machine Learning.
4. Mohri, Mehryar; Rostamizadeh, Afshin; Talwalkar, Ameet (2012). Foundations of Machine Learning. USA, Massachusetts: MIT Press.
5. Tomaso Poggio, Lorenzo Rosasco, et al. Statistical Learning Theory and Applications, 2016 Fall, MIT 9.520
6. V. N. Vapnik. The Nature of Statistical Learning Theory. 2000.
7. Christopher Bishop, Pattern Recognition and Machine Learning. Springer, 2006.
8. Goodfellow Ian, Yoshua Bengio, and Aaron Courville. Deep learning. MIT Press, 2016.
9. T. Poggio and F. Anselmi. Visual Cortex and Deep Networks: Learning Invariant Representations, Computational Neuroscience Series, MIT Press, 2016.

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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.