City University of Hong Kong
Course Syllabus

offered by Department of Computer Science
with effect from Semester A 2019/20

Part I Course Overview

Course Title:	Topics in Machine Learning
Course Code:	CS6487
Course Duration:	One semester
Credit Units:	3 credits
Level:	P6
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	CS5487 Machine Learning: Principles and Practice or CS5489 Machine Learning: Algorithms and Applications or CS5491 Artificial Intelligence
Precursors: *(Course Code and Title)*	Nil
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

This course examines advanced concepts and recent developments in machine learning. The course will consist of a mix of lectures, to introduce advanced concepts, and student-led seminars, for discussing recent developments. At the end of the course, students will have working knowledge of as well as practical experience in advanced machine learning. This is a topics course and the course syllabus will be adjusted to fit the interests of the students.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs	Weighting (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Understand advanced machine learning algorithms and how they are derived.			✓	
2.	Apply advanced machine learning algorithms to solve real-world problems.				✓
3.	Analyze and evaluate the effectiveness of advanced machine learning algorithms, and assess their relative merits.			✓	
4.	Develop new advanced machine learning algorithms to address algorithmic shortcomings and solve particular problems.				✓
5.	Document and report the derivation and evaluation of advanced machine learning through a written report and oral presentation.				✓
		100%			

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to self-life problems.

A3: *Accomplishments*
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

3. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

Teaching pattern:
Suggested lecture/tutorial/laboratory mix: 2 hrs. lecture/seminar; 1 hr. tutorial.

TLA	Brief Description	CILO No.					Hours/week (if applicable)
		1	2	3	4	5	
Lecture	In the first 10 weeks of the course, lectures will present selected advanced machine learning algorithms, and the intuition and theory behind them.	✓					2 hours
Seminar	In the last 3 weeks, students will present their topics of interest in the form of a seminar.	✓				✓	2 hours
Tutorial	Each week, students will work on problems during the tutorial sessions to gain better understanding of the lecture material.	✓					1 hour
Assignment	Students will derive/design a machine learning algorithm, implement, and test it.		✓	✓			2 assignments
Course Project	Students will design a system based on advanced machine learning. Students will report their results in a course report.		✓	✓	✓	✓	

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.					Weighting	Remarks
	1	2	3	4	5		
Continuous Assessment: 70%							
Student-led seminar	✓				✓	10%	
Assignment		✓	✓			30%	
Course Project^		✓	✓	✓	✓	30%	
Examination^: 30% (duration: 2 hours)							
						100%	

^For a student to pass the course, at least 30% of the maximum mark for course project and examination must be obtained.

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Student-led Seminar	1.1 ABILITY to APPLY machine learning to small problems and INTERPRET the results. 1.2 ABILITY to COMPARE the accuracy and efficiency of machine learning algorithms.	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Assignments	2.1 ABILITY to APPLY machine learning to real-world problems and INTERPRET the results. 2.2 ABILITY to EVALUATE, COMPARE, and CONTRAST different machine learning algorithms.	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Course Project and Presentation	3.1 ABILITY to APPLY machine learning to real-world problems and INTERPRET the results. 3.2 ABILITY to EVALUATE, COMPARE, and CONTRAST different machine learning algorithms. 3.3 ABILITY to REPORT about machine learning experiments.	High	Significant	Moderate	Basic	Not even reaching marginal levels
4. Examination	4.1 ABILITY to EXPLAIN machine learning algorithms, and INTERPRET results from machine learning algorithms. 4.2 ABILITY to EVALUATE, COMPARE, and CONTRAST different machine learning approaches. 4.3 ABILITY to DESIGN and DERIVE new machine learning algorithms.	High	Significant	Moderate	Basic	Not even reaching marginal levels

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

(An indication of the key topics of the course.)

Topics will be adjusted according to student interests. Possible topics will include:

- Probabilistic models
  - Time-series models, learning and inference.
  - Probabilistic graphical models, belief propagation.
  - Approximate inference methods, variational approximations, MCMC
  - Conditional random fields
  - Bayesian hierarchical modelling
  - Gaussian processes
- Deep learning
  - Neural networks, convolutional neural networks
  - Activation functions and sparsity
  - Backpropagation, stochastic gradient descent
  - Autoencoders and information bottleneck
  - Regularization and architecture design
  - Problems with deep learning
  - Variational auto-encoders
  - Generative adversarial networks
- Others
  - Non-linear manifold embedding
  - Random forests

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

1.	C.M. Bishop, *"Pattern Recognition and Machine Learning"*, Springer, 2006.

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

1.	T. Hastie, R. Tibshirani, and J. Friedman, *"The Elements of Statistical Learning: Data Mining, Inference, and Prediction (2nd Ed.)"*, Springer-Verlag, 2009.
2.	J. Pearl, *"Probabilistic Reasoning in Intelligent Systems: Networks of Plausible Inference (Representation and Reasoning)*", Morgan Kaufmann Pub, 1998.
3.	I. Goodfellow, Y. Bengio, and A. Courville, "*Deep Learning*", MIT Press, 2016.
4.	Murphy, "*Machine Learning: A Probabilistic Perspective*", The MIT Press, 2012
5.	Koller and Friedman, "*Probabilistic Graphical Models: Principles and Techniques*", The MIT Press, 2009