City University of Hong Kong
Course Syllabus

offered by School of Data Science
with effect from Semester A 2021/22

Part I Course Overview

Course Title:	**Fundamentals of Machine Learning I**
Course Code:	**SDSC3006**
Course Duration:	**One Semester**
Credit Units:	**3**
Level:	**B3**
Proposed Area: *(for GE courses only)*	☐ Arts and Humanities ☐ Study of Societies, Social and Business Organisations ☐ Science and Technology
Medium of Instruction:	**English**
Medium of Assessment:	**English**
Prerequisites: *(Course Code and Title)*	**MA1503 Linear Algebra with Applications or MA2503 Linear Algebra and MA2506 Probability and Statistics**
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

(A 150-word description about the course)

This introduction course provides students with an extensive exposure to the fundamental elements of machine learning. This course will cover the classic statistical learning and the modern machine learning methods, with the focus on supervised learning. Topics cover the elementary concepts and general principles, classification, regularization, linear model, model selection, neural network models.

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.	Explain clearly fundamental principles and methods of machine learning	20%	√		
2.	Classify various learning tasks and select appropriate machine learning methods	20%	√	√	
3.	Apply machine learning techniques and algorithms to datasets and assess the performance by error analysis	30%	√	√	√
4.	Solve practical problems using machine learning methods	30%	√	√	√
		100%			

** If weighting is assigned to CILOs, they should add up to 100%.*

[#] Please specify the alignment of CILOs to the Gateway Education Programme Intended Learning outcomes (PILOs) in Section A of Annex.

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.)

TLA	Brief Description	CILO No.				Hours/week (if applicable)
		1	2	3	4	
Lecture	Formal lectures	√	√	√	√	2 hours/week
Laboratory work	Applying machine learning algorithms to datasets and understanding results		√	√		1 hour/week

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		
Continuous Assessment: 50%						
	√	√	√	√		
Homework assignments			√	√	30%	These are skills based assessment to enable students to demonstrate the basic concepts, methods and algorithms of machine learning, and applications of learning algorithms in some applications.
Project	√	√	√	√	20%	The assignment provides students chances to demonstrate their achievements on machine learning methods learned in this course.
Examination: 50% (duration: 2 hours)						
Examination	√	√	√	√	50%	
**The weightings should add up to 100%.*					100%	

For a student to pass the course, at least 30% of the maximum mark for the 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. Homework assignments	Ability to learn the basic concepts and apply methods and algorithms of machine learning.	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Project	Ability to apply methods and algorithms of machine learning to solve practical problems and present results.	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Examination	Ability to solve learning tasks using machine learning methods.	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.)

- Review of linear regression
- Fundamental concepts of machine learning: supervised/unsupervised learning; function approximation; bias-variance trade-off; training/testing errors; cross validation
- Classical classification: k-NN; LDA and QDA; Logistic regression; Naive Bayesian classifier
- Parametric and nonparametric regression: local polynomial regression, cubic spline, regression spline
- Regularization forms: ridge regression; Lasso regression
- Support vector machine: maximal margin; separating hyperplane; soft margin
- Trees and ensemble methods: CART; random forest; Bagging; Boosting
- Unsupervised learning: K-means; hierarchical clustering

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.	Lecture slides and other related material
2.	An Introduction to Statistical Learning, by James, Witten, Hastie, Tibshirani, Springer 2013

2.2. Additional Readings

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

1.	Pattern Recognition and Machine Learning, by *Christopher M. Bishop. Springer, 2006*
2.	The "Machine Learning" course of Andrew Ng at the website: https://www.coursera.org/learn/machine-learning
3.	Tom Mitchell. "Machine Learning". McGraw-Hill, 1997
4.	Learning Theory: An Approximation Theory Viewpoint, by Cucker and Zhou, Cambridge University Press, 2007.