SDSC3006: FUNDAMENTALS OF MACHINE LEARNING I

Effective Term
Semester A 2024/25

Part I Course Overview

Course Title
Fundamentals of Machine Learning I

Subject Code
SDSC - School of Data Science
Course Number
3006

Academic Unit
School of Data Science (DS)

College/School
School of Data Science (DS)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
MA1503 Linear Algebra with Applications or MA2503 Linear Algebra and MA2506 Probability and Statistics or MA2510 Probability and Statistics

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

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.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Explain clearly fundamental principles and methods of machine learning	20	x		
2	Classify various learning tasks and select appropriate machine learning methods	20	x	x	
3	Apply machine learning techniques and algorithms to datasets and assess the performance by error analysis	30	x	x	x
4	Solve practical problems using machine learning methods	30	x	x	x

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 real-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.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	In lectures, students will learn theories and concepts on machine learning and various machine learning methods.	1, 2, 3, 4	3 hours/week
2	Laboratory	In labs, students will learn software of machine learning and apply appropriate algorithms to real-world datasets.	2, 3	1 hour/week

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Homework assignments	3, 4	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.
2	Project	1, 2, 3, 4	20	The assignment provides students chances to demonstrate their achievements on machine learning methods learned in this course.

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)

2

Additional Information for ATs

Note: To pass the course, apart from obtaining a minimum of 40% in the overall mark, a student must also obtain a minimum mark of 30% in both continuous assessment and examination components.

Assessment Rubrics (AR)

Assessment Task

Homework assignments

Criterion

Ability to learn the basic concepts and apply methods and algorithms of machine learning.

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Assessment Task
Project

Criterion
Ability to apply methods and algorithms of machine learning to solve practical problems and present results.

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
Examination

Criterion
Ability to solve learning tasks using machine learning methods.

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

- Review of probability and statistics
- 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
- Regularization methods: ridge regression, Lasso regression

- Support vector machine: maximal margin, separating hyperplane, soft margin
- Trees and ensemble methods: CART, random forest, bagging, boosting
- Unsupervised learning: PCA, K-means clustering, hierarchical clustering

Reading List

Compulsory Readings

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

Additional Readings

	Title
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.