

SDSC4016: FUNDAMENTALS OF MACHINE LEARNING II

Effective Term

Semester B 2023/24

Part I Course Overview

Course Title

Fundamentals of Machine Learning II

Subject Code

SDSC - School of Data Science

Course Number

4016

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

SDSC3006 Fundamentals of Machine Learning I

Precursors

Nil

Equivalent Courses

Nil

Exclusive Courses

Nil

Part II Course Details

Abstract

This elective course provides students who have the basic foundations of machine learning with an intensive studies of advanced machine learning and deep learning techniques for data science. Topics include traditional machine learning models, deep learning techniques and other related methods.

Course Intended Learning Outcomes (CILOs)

CILOs		Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	State rigorously fundamental principles, ideas, theories, and methods of machine learning and deep learning	20	x		
2	Distinguish and compare various machine learning and deep learning models	20	x		
3	apply advanced machine learning algorithms and error analysis to typical datasets	40	x	x	x
4	Solve some practical problems by existing machine learning and deep learning methods and designing new algorithms	20	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.

Teaching and Learning Activities (TLAs)

TLAs	Brief Description	CILO No.	Hours/week (if applicable)	
1	Lecture	Learning through teaching is primarily based on lectures and demonstrations.	1, 2, 3, 4	39 hours in total
2	Mini-project	A typical machine learning problem will be given to students to solve. The students are expected to tackle the given problem, write a report and give a presentation. This learning activity will be mainly student-led but with instructor's structural guidance.	1, 2, 3, 4	After class

3	Take-home assignments	Learning through take-home assignments is primarily based on interactive problem solving and hand-on computer exercises allowing instant feedback.	2, 3, 4	after class
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Assessment Tasks / Activities (ATs)

ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1 Test Questions are designed to see how well the students have learned the fundamental theory of machine learning and deep learning, and applications of them to some datasets.	1, 2, 3, 4	30	
2 Mini-Project The project provides students chances to demonstrate how well they have achieved their intended learning outcomes.	1, 2, 3, 4	25	
3 Mini-Project Presentation The project provides students chances to demonstrate how well they have achieved their intended learning outcomes.	1, 2, 3, 4	25	

Continuous Assessment (%)

80

Examination (%)

20

Additional Information for ATs

(open-book taken-home programming exam)

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**

Test

Criterion

Ability to understand and apply the fundamental theory of machine learning and deep 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

Mini-Project Report

Criterion

Ability to demonstrate the understanding of the basic concepts, fundamental theory, deep learning methods, and their applications to some datasets.

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal level

Assessment Task

Mini-Project Presentation

Criterion

Ability to demonstrate how well the intended learning outcomes are achieved.

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal level

Assessment Task

Examination

Criterion

Ability to use Python to implement appropriate machine learning methods on given datasets and make accurate predictions.

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

Traditional machine learning, including Supervised Learning like SVM, regularizations, matrix factorization, tree; Unsupervised Learning like clustering, PCA, factor analysis; Semi-supervised Learning; Reinforcement learning.

Deep Learning, including feed-forward neural networks, convolutional neural networks, recurrent neural networks, autoencoders, generative adversarial networks, self-attention, transformer, deep RL, graph neural networks.

Reading List

Compulsory Readings

Title	
1	Lecture slides and other related material

Additional Readings

Title	
1	An Introduction to Statistical Learning, by James, Witten, Hastie, Tibshirani, Springer 2013
2	The Elements of Statistical Learning, by Hastie, Tibshirani, Friedman, Springer 2001
3	Mohri, M., Rostamizadeh, A., & Talwalkar, A. (2012). Foundations of machine learning (Adaptive computation and machine learning). Cambridge, MA: MIT Press.

4	Tom Mitchell. "Machine Learning" . McGraw-Hill, 1997.and http://www.cs.cmu.edu/~tom/NewChapters.html
5	Learning Theory: An Approximation Theory Viewpoint, by Cucker and Zhou, Cambridge University Press, 2007.