EE5434: MACHINE LEARNING FOR SIGNAL PROCESSING APPLICATIONS

Effective Term
Semester A 2026/27

Part I Course Overview

Course Title
Machine Learning for Signal Processing Applications

Subject Code
EE - Electrical Engineering
Course Number
5434

Academic Unit
Electrical Engineering (EE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
P5, P6 - Postgraduate Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Programming training equivalent to EE2331

Equivalent Courses
EE8403 Machine Learning for Signal Processing Applications

Exclusive Courses
Nil

Part II Course Details

Abstract

The students will gain a fundamental understanding of basic and emerging machine learning models and their applications in processing signals in various fields such as smart health, bioinformatics, adaptive control theory, medical image analysis etc.

The course is designed so that the students can obtain the basic ideas and intuition behind modern machine learning methods as well as some formal understanding of how and why they work. Correspondingly, one set of topics will focus on the general theme of statistical inference, which will allow the students to apply the basic techniques to different types of data, such as sensor data, discrete samples from wearables, and medical images. Another set of topics will focus more on existing machine learning models/algorithms such as supervised learning (neural networks, support vector machines); unsupervised learning (clustering, dimensionality reduction); adaptive control; transfer learning. The students will also engage in discussions of recent applications of machine learning such as medical image analysis, multi-sensor data analysis, spatial and temporal signal processing. This course requires students to have prior knowledge on basic programming skills, at a level sufficient to write a reasonable computer program, basic probability theory and linear algebra.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Identify the latest needs and issues in applying machine learning to infer patterns and knowledge from data obtained from modern technologies in signal processing;		x		
2	Identify key applications and research problems in signal processing that can benefit from machine learning algorithms and models		x	x	
3	Develop and implement key machine learning analysis techniques				x
4	Compare and justify using appropriate machine learning models and methods		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	Students will gain key concepts on statistical inference, machine learning models, algorithms, and implementation-related issues for applications in signal processing.	1, 2, 3, 4	3 hrs/wk(wk 1 - wk 8, wk 11 - wk 13)

2	Presentations by students	After the students obtained a good understanding of basic machine learning methods and models, they will need to identify some key applications or needs for using machine learning models/methods in signal processing by conducting critical reading of academic and industrial publications for delivering presentation(s).	1, 2, 3, 4	3 hrs/wk(wk 9 and 10)

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Tests (min.: 2)	1, 2, 3, 4	30	-	No
2	#Assignments (min.: 3)	1, 2, 3, 4	20	-	Yes

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)

2

Minimum Continuous Assessment Passing Requirement (%)

30

Minimum Examination Passing Requirement (%)

30

Additional Information for ATs

Remark: To pass the course, students are required to achieve at least 30% in course work and 30% in the examination.
may include homework, tutorial exercise, project/mini-project, presentation

Assessment Rubrics (AR)

Assessment Task

Examination (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Achievements in CILOs

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
Coursework (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
Achievements in CILOs

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 (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Achievements in CILOs

Excellent
(A+, A, A-) High

Good
(B+, B) Medium

Marginal
(B-, C+, C) Low

Failure
(F) Not even reaching marginal level

Assessment Task
Coursework (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

Achievements in CILOs

Excellent

(A+, A, A-) High

Good

(B+, B) Medium

Marginal

(B-, C+, C) Low

Failure

(F) Not even reaching marginal level

Additional Information for AR

Constructive Alignment with Programme Outcomes

PILO 1, 2 - Students will be able to describe current and anticipated trends in the selected areas, and be able to evaluate and analyze new technologies in the selected areas through literature survey.
PILO 6 - Students will be able to apply effective communication skills in their professions through report writing and presentation.

Part III Other Information

Keyword Syllabus

The course will give an overview of many concepts and techniques in machine learning, including both basic machine learning methods such as decision tree and also more powerful techniques such as deep learning. The course will also emphasize the applications of machine learning methods/models on different types of data. Some example topics can be found below:

1. Fundamental concepts in machine learning
- The problem formulation of learning
- Components of learning
- Different types of learning problems

2. Feasibility of learning
- Generalization errorX
- Effective hypothesis space
- Growth function of hypothesis
- VC (Vapnik-Cheronenkis) dimension and VC inequality

3. Fundamental learning models
- Linear learning models
- Generative models for discrete data
- Gaussian models
- Bayesian statistics
- Linear regression
- Logistic regression
- Perceptron model
- Neural network
- Expectation - Maximization algorithm
- Support Vector machines
- Non-linear transformation
- CNN (Convolutional Neural Network)X

Applicable for student admitted from Semester A 2024/2025 and thereafter

4. Application of machine learning in different fields such as multimedia processing and analysis, information technology

Applicable for student admitted from Semester A 2020/2021 to Semester B 2022/2023

5. Application of machine learning in different fields such as bioinformatics, smart health, medical image analysis

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Learning from data: Yaser S. Abu-Mostafa, Malik Magdon-Ismail, Hsuan-Tien Lin.
2	Pattern Recognition and Machine Learning Christopher M. Bishop, 2006
3	Machine Learning: a Probabilistic Perspective by Kevin Patrick Murphy