Lahore University of Management Sciences
CS 535/EE 514 Machine Learning
Fall 2023-24

Course description
Machine learning (ML) techniques allow computers to adapt to data and solve new problems related to previously encountered problems more efficiently. Such methods enable machines to perform practical exploratory and predictive tasks without being explicitly programmed. ML finds applications in speech recognition and synthesis, machine translation, object recognition, chatbots, question-answering, natural language understanding, anomaly detection, medical diagnosis and prognosis, autonomous vehicles and robots, time series forecasting, and much more. This introductory course covers the theoretical foundations and practical applications of ML and the design, implementation, and analysis of various ML algorithms. Students will learn to compare across and choose the most appropriate algorithms for multiple problem types and be able to design and implement their solutions. Students will be prepared for industry and academia and for pursuing advanced courses.

Course distribution	
Elective	This is an elective course.
Open for Student Category	Juniors, seniors, and graduates.
Close for Student Category	Please see the prerequisites below.

Course prerequisites

- Undergrads (Seniors/Juniors) must have passed:
  - An Ugrad/Grad course in Probability (MATH230 (Probability) OR DISC203 (Probability & Statistics) OR CS501 (Applied Probability)) OR ECON230 (Statistics and Data Analysis))
  - And a programming course (CS200/EE201 (Intro. to Programming)
  - And a course on Linear Algebra (MATH120 (LA with Diff. Equations))
- Grads are strongly advised to brush up their programming skills and take CS501 (Applied Probability), may be in parallel with ML
- All students must possess strong programming skills and proficiency in algorithm implementation in JAVA/C/Python/MATLAB

Course Offering Details				
Credit Hours	3 hours			
Lecture(s)	Nbr of lec(s) per week	2	Duration	75 minutes
Recitation/Lab (per week)	Nbr of lec(s) per week		Duration	
Tutorial (per week)	Nbr of lec(s) per week	1 (optional)	Duration	50 minutes

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TA Office Hours	TBA
Course URL (if any)	From last offering: https://www.c-salt.org/courses/machine-learning-f2021

Course Teaching Methodology (Please mention the following details in plain text)

- **Lectures:** In-person.
- **TA Sessions:** TAs will conduct asynchronous and synchronous sessions (in-person and online) to cover tutorials related to assignments.
- **Exams:** Exams will be conducted in person in pre scheduled sessions.
- **Quizzes:** Quizzes will be conducted during announced class timings.
- **Class discussions:** There will be a slack channel for all discussions (general, assignments, quizzes, etc.)

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)	
PEO-01	Demonstrate excellence in the profession through in-depth knowledge and skills in the field of Computing.
PEO-02	Engage in continuous professional development and exhibit a quest for learning.
PEO-03	Show professional integrity and commitment to societal responsibilities.

Course Objectives

The goal of this course is to get the students excited about Machine Learning and to enable them to:

- Develop a firm grip on the theory behind statistical learning
- Understand and rigorously go through the phases of the design, implementation, and evaluation of fundamental ML algorithms
- Choose the appropriate algorithm for each problem type and be able to compare the strengths and weaknesses of the algorithms
- Appreciate the end-to-end organic integration of ML in its application areas, from data sources, annotation pipelines, and choice of algorithms to societal biases, explainability of models, and potential to impact and even disrupt existing processes

COURSE LEARNING OUTCOMES (CLOs)	
	By the end of the course, students should be able to:
CLO1: CLO2: CLO3: CLO4:	• Develop an appreciation for what is involved in learning models from data, and integrating ML in existing real-world processes • Thoroughly understand the ML pipeline from design and data gathering to meaningful and relevant evaluation • Learn a wide variety of learning algorithms, and formulate and implement solutions to machine learning problems • Apply algorithms to real-world problems, optimize the trained models and report on the expected performance

CLO	CLO Statement	Bloom's Cognitive Level	PLOs/Graduate Attributes (Seoul Accord)
CLO1	Develop an appreciation for what is involved in learning models from data, and integrating ML in existing real-world processes	C2, C3	PLO2
CLO2	Thoroughly understand the ML pipeline from design and data gathering to meaningful and relevant evaluation	C3, C4, C5	PLO2, PLO3, PLO4
CLO3	Learn a wide variety of learning algorithms, and formulate and implement solutions to machine learning problems	C2, C5, C6	PLO4, PLO5
CLO4	Apply algorithms to real-world problems, optimize the trained models and report on the expected performance	C5, C6	PLO5

Grading Breakup and Policy

Assessment	Weight (%)	Related CLOs	ACM Recommended Disposition
Programming assignment(s)	25%	CLO2, CLO3, CLO4	D3, D4, D7, D9, D10
Quizzes	25%	CLO1, CLO2	D4, D7, D9, D10
Project	20%	CLO1 – CLO4	D1, D3, D4, D5, D6, D7, D8, D9, D11
Reading assignment(s)/homework(s)/Implementation of Research Paper(s)/viva	15%	CLO1 – CLO4	D3, D4, D7, D9, D10
Final examination + viva	15%	CLO1 – CLO4	D4, D7, D9, D10

Examination detail	
Midterm Exam	Yes/No: No Duration: Exam Specifications: