Spring 2024

ECE 656
Machine Learning and Adaptive Systems

Course Credits: 03

Prerequisites: ECE 512 or equivalent and ECE303 or knowledge of Random Variables

Class Hours: 5:00p.m-6:15p.m. Tuesdays and Thursdays

Place: Engr. D102

Textbook: S. Haykin, "Neural Networks and Learning Machines", Prentice-Hall, 3rd Ed, 2008.

Instructor: Dr. M. R. Azimi, Professor
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Office Hours: 2:00-4:00p.m. W

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Office Hours: ?

Objective:

The objective of this course is to introduce the students to adaptive system theory and machine learning techniques. Particular emphasis will be placed on different learning algorithms, learning discriminants, statistical pattern recognition, supervised and unsupervised learning, kernel machines for classification, regression and information retrieval, generative classifiers, manifold and deep learning, and applications in signal/image processing areas. Upon completion of this course students will be able to:

(a) Analyze adaptive system theory and methods for various learning models,
(b) Evaluate different machine learning and artificial neural network systems,
(c) Design and implement a machine learning system for a given problem,
(d) Analyze the performance of the designed systems using different performance metrics,
(e) Examine a wide range of application areas for machine learning algorithms covered in this course.

Course Outline:

1. Introduction to biological nervous systems
2. Fundamentals of artificial neural networks
3. Different learning algorithms, structures, and properties
4. Least mean squares (LMS) and recursive least squares (RLS) adaptive rules
5. Regularization theory and applications
6. Statistical pattern classification
7. Learning discriminants, Layered machines
8. Supervised and Unsupervised learning
9. Feedforward neural network and back-propagation learning
10. Self-organization and Associative memories

11. Structural risk minimization and kernel machines
12. Radial Basis Functions and Probabilistic neural networks
13. Manifold learning methods and application
14. Deep Learning, Convolutional NN, and Recurrent deep NN
15. Applications in pattern classification and recognition, signal/image processing
16. Final project presentation

Grading Criteria:

Assignments:	15%
Computer Projects	*50%
Final Project	35%

- There will be several computer projects using MATLAB toolboxes (or Python) dealing with the various machine learning paradigms and application areas.

- The topic of the final project must be approved by the instructor. A final report (75%) and an oral presentation (25%) must be delivered by the last week of the semester.

Important Notes:

1. Homework solutions and computer assignment reports that are based on collaborative efforts with other students will not be graded.
2. The use of online solution/tutor websites and content are **not permitted** for the reference or completion of any graded content in this course.