**Spring 2018**

# 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. B2

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

**Instructor:** Dr. M. R. Azimi, Professor
C201E Engineering Building
**Phone:** (970)-491-7956
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**Office Hours:** 3:30-4:30p.m. TR

**Grader:** Jack Hall

**Office Hours:** TBD

**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 adaptation 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. Adaptive filter theory, algorithms and structures
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, Deep Belief NN and Convolutional NN
15. Applications in pattern classification and recognition, signal/image processing
16. Final project presentation

**Grading Criteria:**

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| 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.