EEL 5840
FUNDAMENTALS OF MACHINE INTELLIGENCE (3)
Tuesday (1st period) and Thursdays (1st and 2nd periods)
New Eng Bdg NEB 201
Fall 2017

Department of Electrical and Computer Engineering, University of Florida

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Description: Overview of machine intelligence and the role of machine learning in variety of real-world problems in areas such as remote sensing and adaptive filtering. Probability and statistics to handle uncertain data. Learning models from data in both a supervised and unsupervised fashion. Linear models (e.g., linear discriminant analysis) and non-linear models (e.g., neural networks) for classification. Linear dimensionality reduction (e.g., principal components analysis) and non-linear dimensionality reduction (e.g., manifold learning techniques and self-organizing maps).

Pre reqs: Basic knowledge of probability, calculus, and linear algebra. Familiarity with at least one programming language will be crucial. Helpful, but not required, courses to have taken include: STA 3032 (Engineering Statistics), STA 4321 (Introduction to Probability), MAS 3114 (Computational Linear Algebra), MAS 4105 (Linear Algebra), and EEL 3834 (Programming for Electrical and Computer Engineers).

Objectives: Understand and utilize the concepts of machine learning for data science and electrical engineering. Focus on tools for multivariate data analysis and how to handle uncertain data with probability models. Both static and time varying data fitting and classification problems will be covered. Neural network implementations will also be used in the course.

Website:

Text Book: S. Theodoridis and K. Koutroumbas, Pattern Recognition. Academic Press: Cambridge, MA, 2009.

References: J. C. Principe, N. R. Euliano, and W. C. Lefebvre, Neural and Adaptive Systems: Fundamentals Through Simulation. Wiley: Hoboken, NJ, 2000.

R. O. Duda, P. E. Hart, and D. G. Stork, Pattern Classification. Wiley: Hoboken, NJ, 2000.

Pattern Recognition and Machine Learning, Springer 2006, by Christopher Bishop.

Schedule: This is an approximate schedule

Week 1: Introduction to machine learning problems and methodologies
Week 2: Review of linear algebra
Week 3: Linear projections to subspaces (PCA)
Week 4: Filtering and Least Squares
Week 5: Searching for the optimum- least means squares (LMS)
Week 6: Properties of LMS **Exam 1**
Week 7: Review of Probability theory and statistics
Week 8: Maximum likelihood, MAP, Regularization & Bayesian Prior Equivalence
Week 9: Bayesian hypothesis testing (classification)
Week 10: Quadratic Classifiers
Week 11: Neural Networks and delta rule **Exam 2**
Week 12: Backpropagation Algorithm
Week 13: Feature selection and mixture modeling
Week 14: Clustering with K-means
Week 15: Clustering
Week 16: Clustering Validation and Evaluation

Grading:

Assignment	Total Points	Percentage of Final Grade
Homework Sets (8)	10 (each)	35%
Exam Part1	30	10%
Exam Part2	30	10%
Project I	Letter grade	15%
Project 2	Letter grade	15%
Project 3	Letter grade	15%

Hw1: Linear algebra
Hw2: PCA
Hw3: Least square

Hw4: LMS
Hw5: Bayesian classifiers
Hw6: Neural Networks
Hw7: Feature Selection
Hw8: Clustering

Project 1: Noise cancellation
Project 2: Remote sensing
Project 3: MNIST digit recognition

Policy:

Percent	**Grade**	**Grade Points**
93.4 - 100	A	4.00
90.0 - 93.3	A-	3.67
86.7 - 89.9	B+	3.33
83.4 - 86.6	B	3.00
80.0 - 83.3	B-	2.67
76.7 - 79.9	C+	2.33
73.4 - 76.6	C	2.00
70.0 - 73.3	C-	1.67
66.7 - 69.9	D+	1.33
63.4 - 66.6	D	1.00
60.0 - 63.3	D-	0.67
0 - 59.9	E	0.00

Software: Homework and projects will be a mixture of programming and write-ups of your results and analyses. You are free to use any programming language for these assignments. You will need access to a fast personal computer to develop and run your code on real-world datasets that we provide.