EEL 5840
ELEMENTS OF MACHINE INTELLIGENCE (3)
Tuesday (1st period) and Thursdays (1st & 2nd periods)
New Eng Bdg NEB 202
Fall 2016

Department of Electrical and Computer Engineering, University of Florida

Instructors: Damon Woodard, Associate Professor
Office: Materials Engineering Bldg. (ME) 226E, Phone: 352-273-2130
Email: dwoodard@ufl.edu, Website: http://dwoodard.ece.ufl.edu/
Office hours: Wed and Thu 14:00-15:00

Jose C. Principe, Distinguished Professor of Engineering
Office: New Engineering Bldg. (NEB) 451, Phone: 352-392-2622
Email; principe@ufl.edu, Website: http://cnel.ufl.edu/
Office hours: Wed 9:00-11:00

TAs: Isaac J. Sledge, Office: NEB 454, Email: isledge@ufl.edu
Office hours: Tu 10:00-12:00
Catia S. Silva, Office: NEB 454, Email: catiaspsilva@ufl.edu
Office hours: Thu 10:00-12:00

Description: Overview of machine intelligence and the role of machine learning in variety of real-world problems in areas such as biometrics 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 and support vector machines) 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 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: Pattern Recognition and Machine Learning, Springer 2006, by Christopher Bishop.

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.

S. Theodoridis and K. Koutroumbas, Pattern Recognition. Academic Press: Cambridge, MA, 2008.

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: Recursive Least Squares (RLS) **Exam 1**
Week 7: Review of Probability theory and statistics
Week 8: Maximum likelihood and Regression
Week 9: Bayesian hypothesis testing (classification)
Week 10: Neural Networks and backpropagation
Week 11: Support Vector Machines (SVMs) **Exam 2**
Week 12: Feature selection and mixture modeling
Week 13: Deep Learning
Week 14: Clustering with K-means and fuzzy
Week 15: Self Organizing Map (SOM) and Clustering validation
Week 16: Nonlinear data projections **Exam 3**

Grading:

Assignment	**Total Points**	**Percentage of Final Grade**
Homework Sets (8)	10 (each)	25%
Exam Part1	30	10%
Exam Part2	30	10%
Exam Part3	40	10%
Project I	Letter grade	15%
Project 2	Letter grade	15%
Project 3	Letter grade	15%

Hw1: Linear algebra
Hw2: Least square
Hw3: LMS and RLS
Hw4: Probablility
Hw5: Bayesian classifiers
Hw6: Neural Networks
Hw7: SVMs
Hw8: K-means and SOM

Project 1: Noise cancellation
Project 2: MNIST digit recognition
Project 3: Biometric

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.