Instructor: Dr. Vijayan K. Asari
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Phone: 937-229-4504
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Lectures:
Tuesday 4:30 pm – 5:45 pm
Thursday 4:30 pm – 5:45 pm

Location: KL 304

Course Objectives:
This course introduces the fundamental concepts and models of machine learning with a practical treatment of design, analysis, implementation and applications of algorithms which learn from examples. Topics include supervised and unsupervised learning, self organization, pattern association, feed-forward and recurrent architectures, manifold learning, dimensionality reduction, and model selection.

Prerequisites:
ECE 445 (Digital Signal Processing) or equivalent (Discrete Time Signals and Systems)

Reference Book:
There is no prescribed textbook for this course. Contents of several research articles published in international journals and conference proceedings will be used as basic resources to discuss various aspects of machine learning in an electrical and computer engineering perspective. The following book will be used as a reference textbook.

Pattern Classification (2nd edition)
R.O. Duda, P.E. Hart, and D.G. Stork
John Wiley & Sons, 2001

Class Attendance: Class attendance and taking class notes are extremely important in this course.

Course Outline:
1. Basic concepts of machine learning, machine perception, principles of learning and adaptation, supervised and unsupervised learning.
2. Linear discriminant functions and decision surfaces, generalized linear discriminant functions, minimization of perceptron criterion function, gradient descent algorithm.
5. Adaptive resonance theory, vigilance criteria, self organization, fuzzy ART and ARTMAP, ARTMAP as supervised learning network, Kohonen's self-organizing feature map.
6. Manifold learning, manifolds of perception, linear and nonlinear manifolds, local embedding, recurrent architectures for nonlinear manifolds.
7. Dimensionality reduction methods, component analysis and discriminants, principal component analysis, linear discriminant analysis, expectation minimization, hidden Markov models.
Projects
This is a project oriented course. There will be 8 projects including the final project. All the projects should be implemented in MATLAB or C/C++.

The methodology, program outline with flow chart and/or illustrations, implementation results with sample data sets, comments/discussions on the obtained results, and appropriate technical references should be submitted as hardcopy submissions (Format: single column, single space, 11-point Times New Roman font).

The program codes along with the dataset used for testing and validation should be send to the instructor for evaluation.

Late submissions will not be accepted.

Term Paper Format
Abstract, Introduction, Theoretical Description, Results and Discussion, Conclusion, and References (Minimum 4 references) Minimum 5 pages - including figures and illustrations.
Term Paper Presentation: 15 minutes for a paper.
Term Paper Submission Due Date: Thursday April 25, 2013.
Term Paper Grading: 10 points for paper and 5 points for presentation.

Typical Term Paper Topics
Machine learning in speech and language processing
Wavelet optimization for classification
Bayesian model selection criterion for HMM topology optimization
Support vector machines
Support vector clustering, Support vector learning
Multi-category generalizations
Multi-task learning
Multi-class classification
Multiclass boosting classification with active learning
Boosting trees for regression and classification
FloatBoost learning for classification
Learning Kernel classifiers
Classification via Kernel regression
Independent component analysis and multi-way factor analysis
Kernel Principal Component Analysis
Sparse Network of Winnows (SNoW) based object detection
Reinforcement learning
Markov decision processes
Learning mixtures of Gaussians
Learning nonlinear manifolds from time series

Grading Policy
Homework/Projects (7) 70 %
Final Project 15 %
Term Paper 15 %
Class Schedule *(Project Submission Due Dates and Term Paper Presentation Dates)*

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**Honor Code**

Students are expected to follow the University of Dayton Honor Code for all assignments and exams. Any violation will be dealt with strictly according to university policy. However, this is also a course which requires a lot of interaction. Sharing of ideas is encouraged, but all work that a student turns in with his/her name on it should reflect only his/her work. If at any time a student has a question about whether he/she is violating the Honor Code, please consult the instructor for clarification.

The academic Honor Code includes information for undergraduate and graduate students:
http://bulletin.udayton.edu/content.ud?v=26&p=2887&c=2915

Graduate students shall be governed by the current "Academic Dishonesty" section of the Graduate Bulletin:
https://bulletin.udayton.edu/content.ud?v=28&p=3143&c=3201

**The Honor Pledge**

"I understand that as a student of the University of Dayton, I am a member of our academic and social community. I recognize the importance of my education and the value of experiencing life in such an integrated community. I believe that the value of my education and degree is critically dependent upon the academic integrity of the university community, and so in order to maintain our academic integrity, I pledge to
- complete all assignments and examinations by the guidelines given to me by my instructors
- avoid plagiarism and any other form of misrepresenting someone else's work as my own
- adhere to the Standards of Conduct as outlined in the Academic Honor Code.
In doing this, I hold myself and my community to a higher standard of excellence and set an example for my peers to follow"