Instructor: Ferda N. Alpaslan

Contact information: http://cow.ceng.metu.edu.tr

Lecture Schedule : Wednesday 9:40-12:30 A-101

Course Description

Machine Learning – CENG 562 - is a 3-credit, introductory graduate course on machine learning methods and applications offered by the Department of Computer Engineering at METU.

Topics covered include: Overview of learning, Concept learning, Version spaces, Inductive bias, PAC learning ,PAC learning, VC dimension, Mistake bounds, Decision trees, Neural networks, Estimation and confidence intervals, Bayesian learning: MAP and ML learners, MDL, Bayes Optimal Classifier, Naive Bayes Classifier, Bayes nets, EM Algorithm, Combining Learned Classifiers, Weighted Majority, Genetic algorithms, Genetic programming, Instance based learning, K-nearest neighbor, Locally weighted regression, Radial basis functions, Learning Rules, Inductive Logic Programming, Reinforcement learning.

Prerequisites

Students are expected to have the following background:

- Knowledge of basic computer science principles and skills, at a level sufficient to write a reasonably non-trivial computer program
- Knowledge of advanced data structures and algorithms
- Familiarity with the basic probability theory
- Familiarity with the basic linear algebra
- Preferably familiarity with artificial intelligence methods and algorithms

Work Load

Students are required to do a term project testing new ideas in machine learning. The term project may be done in teams of two persons (at most). Each group is expected to prepare a term paper, reporting his/her experiment(s) along with the interpretation of the results and pointers for further research. The paper should have the quality of, at least, an international symposium paper. The deadlines of the term project will be given later on.

Grading

Final	40%	
Project	60%	
	(1st progress report- literature survey	10%,
	2nd progress report-design and implementation	15%,
	Term paper (1st and 2nd progress report + exp.evaluation)	15%,
	Presentation and Demo	20%)

Course Overview

This course aims to provide an introduction to the basic principles, techniques, and applications of Machine Learning. Programming assignments and term projects are used to help clarify basic concepts. The emphasis of the course is on the *fundamentals*, and not on providing a mastery of specific commercially available software tools or programming environments.

In short, this is course is about the principles, design and implementation of *learning agents* --- programs that improve their performance on some set of tasks with experience. Upon successful completion of the course, you will have a broad understanding of machine learning algorithms and their use in data-driven knowledge discovery and program synthesis. You will be able to design and implement several machine learning algorithms. You will also be able to identify, formulate and solve machine learning problems that arise in practical applications. You will have a knowledge of the strengths and weaknesses of different machine learning algorithms (relative to the characteristics of the application domain) and be able to adapt or combine some of the key elements of existing machine learning algorithms to design new algorithms as needed. You will have an understanding of the current state of the art in machine learning and be able to begin to conduct original research in machine learning.

Weekly Schedule (Tentative)

WEEK	TOPICS
1	Overview of Machine Learning,
2	Concept Learning, Version Spaces,
3	Decision Tree Learning,
4	Artificial Neural Networks,
5	Evaluating Hypotheses,
6	Bayesian Learning, Naive Bayesian Learning
7	Computational Learning Theory,
8	MT-Exam
9	Instance-Based Learning,
10	Reinforcement Learning,
11	Genetic Algorithms, Learning Sets of Rules,
12	Analytical learning,
13	Presentations
14	Presentations

Course Material

The main text for this course is:

Tom Mitchell, Machine Learning. McGraw-Hill, 1997.

Course handouts and other materials can be downloaded from:
http://www.cs.cmu.edu/~tom/mlbook-chapter-slides.html

Recommended Journals:

- *Machine Learning*
- *Journal of Machine Learning Research*
- *Artificial Intelligence*, *Journal of Artificial Intelligence Research*
- *IEEE Transactions on Pattern Analysis and Machine Intelligence*
- *Knowledge-Based Systems*
- *Knowledge Discovery in Databases*
- *Data Mining and Knowledge Discovery*
- *Journal of AI Research*
- *AI Magazine*
- *IEEE Neural Networks Council*

Useful Links

- http://archive.ics.uci.edu/ml/
- The UC-Irvine ML Dataset Archive | The UC-Irvine KDD archive | more datasets
- The WEKA Machine Learning Project (code for many ML algorithms, as well as some datasets)
- Pointers to ML Courses
- Neural Network Resources
- Some SVM Stuff
- Machine Learning Benchmarking
- Aha's ML Links
- Stuart Russell's:AI on the Web (loads of links)
- Reinforcement Learning Repository

Project Timetable

Task	Date	Deliverable
Submission of the project proposals	March 9, 2011	Proposal report (hard copy)
Submission of the 1st progress report (literature survey)	March 23, 2011	Survey report (hard copy)
Submission of the 2nd progress report (design and implementation)	May 4, 2011	Design report (hard copy)
Submission of Term Papers	May 25, 2011	Term Paper (hard copy)
Presentations and demo	May 25, 2011 May 18, 2011	-
Final exam	?	

Refer to AAAI Guidelines (http://www.aaai.org/Publications/Author/author.php) for the format of all your papers.

Refer to the paper "How to Give a Good Research talk" at http://www.ceng.metu.edu.tr/~alpaslan/public/ProjectDocs/how_to_give_a_good_research_talk.pdf for a successful presentation of your own work.

Refer to the paper "How to Present a Paper in Theoretical Computer Science: A Speaker's Guide for Students" at http://www.ceng.metu.edu.tr/~alpaslan/public/ProjectDocs/how_to_present_paper.pdf for a successful presentation.