CS 491/591 – Machine Learning – Spring 2014

MWF 11:00–11:50 a.m., Agriculture Bldg. 170

See the course web page for more information: www.cs.siu.edu/~cs491-1
The webpage is also accessible via D2L (online.siu.edu).

Professor: Dr. Norman Carver, Faner 3121, phone 453-6048, email: carver@cs.siu.edu.
Office hours: MWF 1:00pm – 3:00pm (or by appointment).

TA: Tianyang Wang, Faner 312?, phone 453-60??, email toseattle@siu.edu.
Office hours: TBA

Must purchase from Amazon. Cost is $28.

Workload 491: homeworks and labs (20%), midterm exam (40%), final exam (40%).
Workload 591: homeworks and labs (15%), midterm exam (30%), final exam (30%), project (25%).

Dates: vacations: 1/20, 3/10–3/14, last drop date: 3/30 (online);
final exam: Tues. 5/6, 12:50–2:50pm.

Course Structure:
The course will make significant use of CalTech’s material for the free online course “Learning From Data” by Professor Yaser Abu-Mostafa. Students will be expected to watch selected online videos, and purchase the accompanying textbook. The webpage for Learning From Data is: http://work.caltech.edu/telecourse.html

Because of the use of the online lectures, the course will not meet during all of its scheduled MWF times. Instead, students will be assigned particular video lectures to watch, with in-class meetings days scheduled to discuss the video lecture topics and ask questions. In-class meetings will also be used for lectures on material not covered in Learning From Data and for presentation of assignments that involve use of software.

The schedule of in-class meeting days will be available on the course website.

Course Overview:
Machine learning (ML) is the name given to the study of methods that allow computers to “automatically” improve their abilities to perform well on complex tasks, without the need for extensive (and time consuming) human engineering. Originally an artificial intelligence discipline, ML is now multidisciplinary, and being applied to an increasingly wide range of tasks in science, engineering, and economics. ML applications include: robot locomotion and navigation, autonomous vehicles, agents, game playing, data mining, engineering design, speech recognition, image recognition, and so forth.
LFD emphasizes that ML techniques typically involved the use of large amounts of data as the basis for developing solutions to problems. ML differs from other methods that utilize such data in being highly “empirical” rather than “analytic.” The aim of ML is not to use the data to develop a mathematical model of the problem. Rather the aim is simply to be able to predict the “output” for previously u

ML algorithms are typically classified based on what information is available to learn from and the goal of the learning process. Among the key learning classes that will be considered in the course are:

- inductive learning — identifying an appropriate function from data samples;
- concept learning — identifying concepts from features/attributes;
- supervised learning — training data has been labeled (by a “teacher”);
- unsupervised learning — only unlabeled examples are available (patterns/organization in data must be discovered);
- reinforcement learning — learn how to behave to maximize long term rewards, given only periodic feedback;
- Bayesian learning — develop probabilistic models for prediction;

Various specific learning algorithms will be studied, including:

- linear and logistic regression
- support vector machines and kernel methods
- decision trees
- temporal difference learning and Q-learning
- neural networks
- genetic algorithms and genetic programming
- Bayesian classifiers and learning Bayesian networks
- k-means clustering and nearest neighbor clustering

In addition to ML algorithms, the course will also cover theoretical aspects of ML, such as Computational Learning Theory, PAC Learning, inductive bias, etc.

There are many freely available ML software packages (and data sets), so students should be able to acquire practical experience with several different ML algorithms. This is one of the enjoyable aspects of ML: the ability to relatively easily try out many of the approaches.
Course Prerequisites:
*Undergraduates must have completed CS 330 with a C or better in order to take this course.*

Many elements of ML require a fairly high level mathematical background to fully understand. Because of this, complex mathematical aspects of certain algorithms and theories will not be examined in detail in this class. It will be assumed that students have a basic background in probability and algorithms. Students will not be assumed to have any AI background, though that can be helpful.

Course Grading:
All students will be graded based on attendance and participation, and homeworks/lab assignments, and two exams (midterm and final). Students registered for CS 591 will in addition be expected to carry out a project that involves experimentation with one (or more) ML techniques, and provide a writeup of their work.

*Note that while in-class lectures will be limited in number, students are expected to attend the scheduled meeting times and they are expected to be prepared to discuss the material. Absences and lack of participation will be noted and may significantly affect your final grade!*

Course Textbook:
Students will be required to have access to the textbook associated with *Learning From Data*. The *Learning From Data* website has a link to Amazon to purchase the text. Students that do not have the ability to order from Amazon should talk with the instructor. He can order books for students upon receipt of the purchase price of $28.

Other books that are available online will be used for particular topics and for additional suggested readings.