Syllabus for Spring 2018

University of Wisconsin-Madison

Computer Science 760: Machine Learning

Credits: 3

Canvas Course URL: https://canvas.wisc.edu/courses/77597

Course Designations and Attributes: Graduate Level Course in CS within the area of Artificial Intelligence

Meeting Time and Location: 1:05-2:20 MWF, Psychology 113 (after the first three weeks, course will not meet on Friday unless students are notified at least a week in advance)

Instructional Mode: face-to-face lectures, homework assignments to be done alone, course project to be done in a team of 5 students (+/- 1 if needed)

Specify how Credit Hours are met by the Course:
This class meets for two 75-minute class periods each week (on average) over the spring semester and carries the expectation that students will work on course learning activities (reading, writing, problem sets, studying, etc.) for about 3 hours out of classroom for every class period. The syllabus includes more information about meeting times and expectations for student work. Note that for the first three weeks we will meet three times per week (MWF), and afterward just twice per week (MW unless otherwise specified), to accommodate needs later in the semester to defer up to three lectures for project work or other necessities.

INSTRUCTORS AND TEACHING ASSISTANTS

Instructor Title and Name: Prof. Mark Craven and Prof. David Page

Instructor Availability
Mark Craven will hold office hours 3-4:30pm on Wednesdays in room 4765 Medical Sciences Center, 1300 University Ave. (on the Charter Ave. side of the building). David Page will hold office hours 2:30-4pm on Fridays in the first floor of the Wisconsin Institute for Discovery (330 N. Orchard Street), room 1153/4 (across Randall St. from The Library and Subway).
Instructor Email/Preferred Contact: craven@biostat.wisc.edu, page@biostat.wisc.edu
Please put “CS 760” into the subject line of all correspondence, so we can better ensure we find your message even if it goes to the wrong folder (e.g., spam or clutter). We will strive for same-day replies. For questions about content, please email the professor who gave the lecture in question. For administrative questions, please address one email message to both of us.

Teaching Assistants: Daniel Griffin and Viswesh Periyasamy

TA Office Hours: 11am-Noon MW in CS 4384 (Daniel); 4:00-5:00pm TTh in Medical Sciences Center 4710 (Viswesh),

TA Email/Preferred Contact: dgriffin@cs.wisc.edu, viswesh@cs.wisc.edu

OFFICIAL COURSE DESCRIPTION

Course Description
Computational approaches to learning covering a variety of learning settings, algorithms, theory and applications.

Requisites
Students are strongly encouraged to have knowledge of introductory artificial intelligence (e.g., COMP SCI 540), introductory multivariate calculus, and basic concepts in probability.

LEARNING OUTCOMES
Students will understand what a learning system should do.

Students will distinguish among a variety of learning settings: supervised learning, unsupervised learning, reinforcement learning, active learning.

Students will employ a broad toolbox of machine-learning methods: decision trees, nearest neighbor, logistic and linear regression, neural nets, Bayesian networks, SVMs, ensemble methods.

Students will understand fundamental underlying theory: bias-variance tradeoff, PAC learning, mistake-bound theory.

Students will know how to characterize how well learning systems work, and they will employ sound experimental methodology for evaluating learning systems: cross validation, ROC and PR curves, hypothesis testing.

GRADING
Note that 14% of your grade depends on daily quizzes and hence on regular class attendance.
• Daily Quizzes: 14%
• Homework Assignments (4 anticipated): 36%
• Exam: 30%
• Project: 20%
• Final letter grades may be curved upward, but a minimum guarantee is made of an A for 93 or above, AB for 87 or above, B for 80 or above, BC for 75 or above, C for 70 or above, and D for 60 or above.

COURSE TOPICS
• Course Overview: (1 class period)
• Machine Learning Paradigms and Feature Vector Representation (1)
• Decision Trees and Overfitting (2)
• Instance-Based Learning, k-Nearest Neighbor (1)
• Machine Learning Methodology (2)
• Regression (Linear and Logistic, including Ridge, LASSO, and Elastic Nets) (1)
• Bayesian Network Learning including Naive Bayes and TAN (3)
• Neural Network Foundations (2)
• Learning Deep Neural Networks (1)
• Convolutional Neural Networks, Long Short-Term Memory (LSTMs), and Attention (1)
• Generative Adversarial Networks (1)
• Theory of ML (PAC, Mistake-Bound Model, Bias-Variance Tradeoff) (2)
• Support Vector Machines (2)
• Ensemble Methods (1)
• Reinforcement Learning (1)
• Reinforcement Learning for General Game Playing (Alpha Go, Alpha Zero) (1)
• Rule Learning and Relational Learning (1)
• Markov Networks (1)
• Statistical Relational Learning (1)
• Dimensionality-Reduction and Feature Selection (1)
• Fairness and Privacy (1)

RECOMMENDED TEXTBOOKS
• Understanding Machine Learning: From Theory to Algorithms. Shai Shalev-Shwartz, Shai Ben-David. Cambridge University Press, 2014. The online version of this book is available
EXAMS, QUIZZES, PAPERS & OTHER MAJOR GRADED WORK

• The exam will be in class in April (date TBD). A pen or pencil, a page of notes, and a calculator will be allowed. No other materials will be allowed.

HOMEWORK & OTHER ASSIGNMENTS

The programming assignments are to be done individually. You may communicate with other class members about the problem, but please do not seek or receive help from people not in the class, and please do not share answers or code. Your programs may be in C, C++, Java, Perl, Python, or R. You must submit both Linux executable and source code; your program should run on the CS Department computers. Please test them there; they will be graded based on how they run there, not elsewhere! Assignments are to be submitted at the course Canvas site.

Homework assignments are due at midnight on the assigned due date, and late homeworks will be penalized 10 points (out of 100) for each day that passes after the assigned due date. **Homeworks cannot be submitted more than one week late; the submission site will be locked at that time.** At the start of the course every student will be given 5 "free" days, each of which may be used to offset a 10-point late penalty. Only 2 free days can be used for any given written assignment, so that solutions can be posted at next class period. Free days are non-transferable, and no credit will be given for unused free days. Nevertheless, please use them sparingly because the late penalty is strictly enforced. Please do not ask for special consideration for travel, exams in other classes, and other extenuating circumstances; this is what the free days are for.

RULES, RIGHTS & RESPONSIBILITIES

See the Guide’s section on **Rules, Rights and Responsibilities.**

ACADEMIC INTEGRITY

By enrolling in this course, each student assumes the responsibilities of an active participant in UW-Madison’s community of scholars in which everyone’s academic work and behavior are held to the highest academic integrity standards. Academic misconduct compromises the integrity of the university. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these acts are examples of academic misconduct, which can result in disciplinary action. This includes but is not limited to failure on the assignment/course, disciplinary probation, or suspension. Substantial or repeated cases of misconduct will be forwarded to the Office of Student Conduct & Community Standards for additional review. For more information, refer to studentconduct.wiscweb.wisc.edu/academic-integrity/.

ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

McBurney Disability Resource Center syllabus statement: “The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison
policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform faculty [me] of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. Faculty [I], will work either directly with the student [you] or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA.” http://mcburney.wisc.edu/facstaffother/faculty/syllabus.php

DIVERSITY & INCLUSION

Institutional statement on diversity: “Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals.

The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world." https://diversity.wisc.edu/