Machine Learning

CS 445/545
Winter Quarter 2016

Time : Tuesdays and Thursdays, 2:00-3:50pm
Location: Cramer Hall, Room 53

Instructor: Melanie Mitchell, FAB 120-24, (503) 725-2412, mm-AT-pdx.edu
Office hours: M,W 2-3pm, or by appointment.

Teaching Assistant: Jordan Witte, jwitte-AT-pdx.edu.
Office hours: T,Th 1pm-2pm, in CS Fishbowl (just outside FAB 120).

Course Mailing List: ML2016@cs.pdx.edu

Prerequisites: Undergraduate-level courses in calculus, linear algebra, and probability and statistics. Facility in at least one high-level programming language.

Main topics:: Perceptrons, neural networks, evaluating classifiers, support vector machines, ensemble learning, Bayesian learning, unsupervised learning, evolutionary learning, and reinforcement learning

Textbook: No textbook. Readings will be assigned from materials available on-line.

Relation to CS 441/541 (Artificial Intelligence): A couple of the same topics will be covered (e.g., neural networks), but these will be covered in more depth and at a more theoretical level in this course than in CS 441/541. Otherwise, the topics in this course differ from the topics covered in CS 441/541.

Homework: The class will have several homework assignments, involving writing code for and/or experimenting with various machine learning methods.

Late homework policy: Students must request and be granted an extension on any homework assigment *before* the assignment is due. Otherwise, 5% of the assignment grade will be subtracted for each day the homework is late.

Exams: The class will have an in-class final exam. There will also be weekly short in-class quizzes to test basic understanding of the material presented in class and in the readings. You are allowed to bring in one double-sided page of notes for each quiz, and four double-sided pages of notes for the final exam.

Grading: Homework 50%, Quizzes 20%, Final exam 30%.

Academic integrity: Students will be responsible for following the PSU Student Conduct Code.

Students with disabilities: If you are a student with a disability in need of academic accommodations, you should register with the Disability Resource Center and notify the instructor immediately to arrange for support services.

Syllabus (subject to change):

Date	Topics	Homework and Reading
Tuesday Jan. 5	Introduction to machine learning (pptx , pdf) Perceptrons (pptx, pdf)	**Optional reading:** Chapters 1-3 of Michael Nielsen's online book on neural networks covers the basics of perceptrons and multilayer neural networks.
Thursday Jan. 7	Perceptions, continued Multilayer neural networks (pptx, pdf)	Homework 1 (Perceptrons), due Tuesday Jan. 19. Data (go to "Data Folder" and download "letter-recognition.data") Here is the 1991 paper that describes the data.
Tuesday Jan. 12	Quiz 1 (30 min) Multilayer neural networks, continued	
Thursday Jan. 14	Support vector machines (pptx, pdf)	**Reading:** A. Ben-Hur and J. Weston, A User's Guide to Support Vector Machines
Tuesday Jan. 19	SVMs, continued (pptx, pdf)	Homework 2 (Multilayer Neural Networks), due Tuesday Feb. 2.
Thursday Jan. 21	Quiz 2 (30 min) Evaluating classifiers (pptx, pdf)	**Reading:**: T. Fawcett, An introduction to ROC analysis, Sections 1-4, 7
Tuesday Jan. 26	Feature Selection and Dimensionality Reduction (pptx, pdf)	**Reading:**: L. Smith, A tutorial on principal components analysis
Thursday Jan. 28	Quiz 3 (30 min) Ensemble learning (pptx, pdf)	**Reading:** R. Schapire, A brief introduction to boosting

Tuesday Feb. 2	Ensemble learning, continued (pptx, pdf)	Homework 3 (SVMs and Feature Selection), due Tuesday Feb. 16 Homework 3 Addendum
Thursday Feb. 4	Quiz 4 (30 min) Bayesian learning (pptx, pdf)	**Reading:** C. Haruechaiyasak, A tutorial on naive Bayes classification
Tuesday Feb. 9	Bayesian learning, continued	
Thursday Feb. 11	Quiz 5 (30 min) Bayesian learning, continued	
Tuesday Feb. 16	Bayesian networks (pptx, pdf)	**Reading** S. Wooldridge, Bayesian Belief Networks Homework 4 (Bayesian Learning), due Thursday Feb. 25
Thursday Feb. 18	Quiz 6 (30 min) Bayesian networks, continued	
Tuesday Feb. 23	Unsupervised learning, part 1 (pptx, pdf)	**Reading:** Chapter 8 from Introduction to Data Mining by Tan, Steinbach, and Kumar, pp. 487-515, 532-541, 546-552.
Thursday Feb. 25	Unsupervised learning, part 2 (pptx, pdf) Choosing the K in K-means (pptx, pdf)	Homework 5 (K-means clustering), due Tuesday Mar. 8 Optdigits data
Tuesday March 1	Quiz 7 (30 min) Evolutionary learning, part 1 (pptx, pdf) Evolutionary learning, part 2 (pptx, pdf)	Robby the Robot C code
Thursday March 3	Reinforcement learning (pptx, pdf)	**Reading:** M. E. Harmon and S. S. Harmon, Reinforcement learning: A tutorial
Tuesday March 8	**Guest Lecture**, Will	Optional (ungraded) homework

	Landecker (Data Scientist, Lyft): Machine Learning in the Trenches Reinforcement learning, continued	(written assignment to review for final)
Thursday March 10	Deep learning and deep reinforcement learning (pptx, pdf)	
Monday March 14	Final exam: 10:15am - 12:05pm	