



Course CS 4375.501 Introduction to Machine Learning
Professor Vincent Ng
Term Fall 2016
Meetings MW 5:30-6:45 PM, SLC 2.302

Professor's Contact Information

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General Course Information

Pre-requisites, Co-requisites, & other restrictions CS3345 (Data Structures and Algorithms) and CS3341 (Probability and Statistics in Computer Science).

Machine learning is concerned with the question of how to construct programs that automatically improve their performance through experience. This course introduces the principles underlying the design of existing supervised and unsupervised machine learning algorithms. Topics to be covered include the following:

Course Description

1. **Supervised learning models and methods:** Decision trees, neural networks, nearest-neighbor algorithms, Bayesian learning, hidden Markov models, bagging, boosting
2. **Unsupervised learning:** Clustering
3. **Reinforcement learning:** Markov Decision Processes, online supervised learning, certainty equivalent learning, temporal difference learning, Q-learning
4. **General techniques:** Feature selection, cross-validation, maximum likelihood estimation, expectation-maximization, gradient descent

Learning Outcomes

Ability to understand and apply the following concepts in machine learning:

1. Decision trees
2. Neural networks
3. Bayesian learning
4. Instance-based Learning
5. Hidden Markov models
6. Clustering
7. Reinforcement learning

Required Texts & Materials

There is no required text.

Suggested Texts, Readings, & Materials

Machine Learning, Tom M. Mitchell, McGraw Hill, 1997.
Artificial Intelligence: A Modern Approach (second/third edition), Stuart Russell and Peter Norvig, Prentice Hall, 2003/2010.

Assignments & Academic Calendar

[Topics, Reading Assignments, Due Dates, Exam Dates]

8/22	Administrivia, course overview
8/24	Decision trees 1: basics of information theory, ID3
8/29	Decision trees 2: overfitting, pruning
8/31	Decision trees 3: inductive learning
9/7	Neural networks 1: linear regression and gradient descent
9/12	Neural networks 2: linear classification
9/14	Neural networks 3: backpropagation
9/19	Markov Decision Processes 1: delayed rewards, Markov systems
9/21	Markov Decision Processes 2: value iteration
9/26	Markov Decision Processes 3: policy iteration
9/28	Midterm 1
10/3	Reinforcement learning 1: model-based methods
10/5	Reinforcement learning 2: model-free methods
10/10	Midterm 1 Discussion
10/12	Bayesian learning 1: review of probability concepts
10/17	Bayesian learning 2: Bayesian and naïve Bayesian classification
10/19	Bayesian learning 3: Bayesian hypothesis selection
10/24	Inference with complete data: maximum likelihood estimation and EM
10/26	Instance-based learning, cross validation
10/31	Clustering: hierarchical and non-hierarchical clustering
11/2	Midterm 2
11/7	Hidden Markov models 1: Markov chains
11/9	Hidden Markov models 2: Viterbi decoding
11/14	Hidden Markov models 3: supervised training
11/16	Midterm 2 Discussion
11/28	Hidden Markov models 4: examples
11/30	Midterm 3
12/2	Hidden Markov models 5: unsupervised training
12/7	Midterm 3 Discussion

Course Policies

Grading (credit) Criteria	Homework assignments: 25% of the course grade Term project: 12% of the course grade Midterms: 36% of the course grade Final exam: 27% of the course grade
Make-up Exams	No makeup exams at a later/earlier date will be scheduled for any student unless a written medical note is provided.
Extra Credit	None
Late Work	Barring extenuating circumstances, all problem sets must be turned in on the date specified. Assignments turned in within 24 hours of the due date will receive 90% of its score. Assignments turned in within 48 hours of the due date will receive 70% of its score. Assignments more than 48 hours late will not be accepted.
Special Assignments	None
Class Attendance	Recommended but not required.
Classroom Citizenship	None
Field Trip Policies	None
Student Conduct and Discipline	The University of Texas System and The University of Texas at Dallas have rules and regulations for the orderly and efficient conduct of their business. It is the

	<p>responsibility of each student and each student organization to be knowledgeable about the rules and regulations which govern student conduct and activities. General information on student conduct and discipline is contained in the UTD publication, <i>A to Z Guide</i>, which is provided to all registered students each academic year.</p> <p>The University of Texas at Dallas administers student discipline within the procedures of recognized and established due process. Procedures are defined and described in the <i>Rules and Regulations, Board of Regents, The University of Texas System, Part 1, Chapter VI, Section 3</i>, and in Title V, Rules on Student Services and Activities of the university's <i>Handbook of Operating Procedures</i>. Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations (SU 1.602, 972/883-6391).</p> <p>A student at the university neither loses the rights nor escapes the responsibilities of citizenship. He or she is expected to obey federal, state, and local laws as well as the Regents' Rules, university regulations, and administrative rules. Students are subject to discipline for violating the standards of conduct whether such conduct takes place on or off campus, or whether civil or criminal penalties are also imposed for such conduct.</p>
Academic Integrity	<p>The faculty expects from its students a high level of responsibility and academic honesty. Because the value of an academic degree depends upon the absolute integrity of the work done by the student for that degree, it is imperative that a student demonstrate a high standard of individual honor in his or her scholastic work.</p> <p>Scholastic dishonesty includes, but is not limited to, statements, acts or omissions related to applications for enrollment or the award of a degree, and/or the submission as one's own work or material that is not one's own. As a general rule, scholastic dishonesty involves one of the following acts: cheating, plagiarism, collusion and/or falsifying academic records. Students suspected of academic dishonesty are subject to disciplinary proceedings.</p> <p>Plagiarism, especially from the web, from portions of papers for other classes, and from any other source is unacceptable and will be dealt with under the university's policy on plagiarism (see general catalog for details). This course will use the resources of turnitin.com, which searches the web for possible plagiarism and is over 90% effective.</p>
Email Use	<p>The University of Texas at Dallas recognizes the value and efficiency of communication between faculty/staff and students through electronic mail. At the same time, email raises some issues concerning security and the identity of each individual in an email exchange. The university encourages all official student email correspondence be sent only to a student's U.T. Dallas email address and that faculty and staff consider email from students official only if it originates from a UTD student account. This allows the university to maintain a high degree of confidence in the identity of all individual corresponding and the security of the transmitted information. UTD furnishes each student with a free email account that is to be used in all communication with university personnel. The Department of Information Resources at U.T. Dallas provides a method for students to have their U.T. Dallas mail forwarded to other accounts.</p>
Withdrawal from Class	<p>The administration of this institution has set deadlines for withdrawal of any college-level courses. These dates and times are published in that semester's course catalog. Administration procedures must be followed. It is the student's responsibility to handle withdrawal requirements from any class. In other words, I cannot drop or</p>

	<p>withdraw any student. You must do the proper paperwork to ensure that you will not receive a final grade of "F" in a course if you choose not to attend the class once you are enrolled.</p>
<p>Student Grievance Procedures</p>	<p>Procedures for student grievances are found in Title V, Rules on Student Services and Activities, of the university's <i>Handbook of Operating Procedures</i>.</p> <p>In attempting to resolve any student grievance regarding grades, evaluations, or other fulfillments of academic responsibility, it is the obligation of the student first to make a serious effort to resolve the matter with the instructor, supervisor, administrator, or committee with whom the grievance originates (hereafter called "the respondent"). Individual faculty members retain primary responsibility for assigning grades and evaluations. If the matter cannot be resolved at that level, the grievance must be submitted in writing to the respondent with a copy of the respondent's School Dean. If the matter is not resolved by the written response provided by the respondent, the student may submit a written appeal to the School Dean. If the grievance is not resolved by the School Dean's decision, the student may make a written appeal to the Dean of Graduate or Undergraduate Education, and the dean will appoint and convene an Academic Appeals Panel. The decision of the Academic Appeals Panel is final. The results of the academic appeals process will be distributed to all involved parties.</p> <p>Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations.</p>
<p>Incomplete Grades</p>	<p>As per university policy, incomplete grades will be granted only for work unavoidably missed at the semester's end and only if 70% of the course work has been completed. An incomplete grade must be resolved within eight (8) weeks from the first day of the subsequent long semester. If the required work to complete the course and to remove the incomplete grade is not submitted by the specified deadline, the incomplete grade is changed automatically to a grade of <u>F</u>.</p>
<p>Disability Services</p>	<p>The goal of Disability Services is to provide students with disabilities educational opportunities equal to those of their non-disabled peers. Disability Services is located in room 1.610 in the Student Union. Office hours are Monday and Thursday, 8:30 a.m. to 6:30 p.m.; Tuesday and Wednesday, 8:30 a.m. to 7:30 p.m.; and Friday, 8:30 a.m. to 5:30 p.m.</p> <p>The contact information for the Office of Disability Services is: The University of Texas at Dallas, SU 22 PO Box 830688 Richardson, Texas 75083-0688 (972) 883-2098 (voice or TTY)</p> <p>Essentially, the law requires that colleges and universities make those reasonable adjustments necessary to eliminate discrimination on the basis of disability. For example, it may be necessary to remove classroom prohibitions against tape recorders or animals (in the case of dog guides) for students who are blind. Occasionally an assignment requirement may be substituted (for example, a research paper versus an oral presentation for a student who is hearing impaired). Classes enrolled students with mobility impairments may have to be rescheduled in accessible facilities. The college or university may need to provide special services such as registration, note-taking, or mobility assistance.</p> <p>It is the student's responsibility to notify his or her professors of the need for such an accommodation. Disability Services provides students with letters to present to</p>

	<p>faculty members to verify that the student has a disability and needs accommodations. Individuals requiring special accommodation should contact the professor after class or during office hours.</p>
Religious Holy Days	<p>The University of Texas at Dallas will excuse a student from class or other required activities for the travel to and observance of a religious holy day for a religion whose places of worship are exempt from property tax under Section 11.20, Tax Code, Texas Code Annotated.</p> <p>The student is encouraged to notify the instructor or activity sponsor as soon as possible regarding the absence, preferably in advance of the assignment. The student, so excused, will be allowed to take the exam or complete the assignment within a reasonable time after the absence: a period equal to the length of the absence, up to a maximum of one week. A student who notifies the instructor and completes any missed exam or assignment may not be penalized for the absence. A student who fails to complete the exam or assignment within the prescribed period may receive a failing grade for that exam or assignment.</p> <p>If a student or an instructor disagrees about the nature of the absence [i.e., for the purpose of observing a religious holy day] or if there is similar disagreement about whether the student has been given a reasonable time to complete any missed assignments or examinations, either the student or the instructor may request a ruling from the chief executive officer of the institution, or his or her designee. The chief executive officer or designee must take into account the legislative intent of TEC 51.911(b), and the student and instructor will abide by the decision of the chief executive officer or designee.</p>
Off-Campus Instruction and Course Activities	<p>Off-campus, out-of-state, and foreign instruction and activities are subject to state law and University policies and procedures regarding travel and risk-related activities. Information regarding these rules and regulations may be found at http://www.utdallas.edu/BusinessAffairs/Travel_Risk_Activities.htm. Additional information is available from the office of the school dean.</p>
Comet Creed	<p><i>This creed was voted on by the UT Dallas student body in 2014. It is a standard that Comets choose to live by and encourage others to do the same:</i></p> <p><i>“As a Comet, I pledge honesty, integrity, and service in all that I do.”</i></p>
UT Dallas Syllabus Policies and Procedures	<p><i>The information contained in the following link constitutes the University’s policies and procedures segment of the course syllabus.</i></p> <p><i>Please go to http://go.utdallas.edu/syllabus-policies for these policies.</i></p>

These descriptions and timelines are subject to change at the discretion of the Professor.