

CSE 4309 - Fall 2017 - Syllabus

Introduction to Machine Learning

Course web page: http://vlm1.uta.edu/~athitsos/courses/cse4309_fall2018/

Lecture times: MWF 11:00am-11:50am

Classroom: ERB 131

Textbook: Pattern Recognition and Machine Learning, Christopher M. Bishop, 2006.

Instructor:

Vassilis Athitsos

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Office hours: MW 12:00pm-1:30pm

Teaching assistant:

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Office: ERB 309

Office hours: TuTh 9:00am-11:00am, Fri 10:00am-11:00am.

Course Description

Description of Course Content: This course offers an introduction to machine learning. Topics include naive Bayes classifiers, linear regression, linear classifiers, neural networks and backpropagation, kernel methods, decision trees, clustering, and reinforcement learning. A strong programming background is assumed, as well as familiarity with linear algebra (vector and matrix operations), and knowledge of basic probability theory and statistics.

Prerequisites: Admitted into an Engineering Professional Program. C or better in each of the following: CSE 2320 (Algorithms), IE 3301 (probabilities), and CSE 3380 or MATH 3330 (Linear Algebra).

Student Learning Outcomes: After successfully taking this course, a student should be familiar with standard approaches to machine learning, be able to discuss pros and cons of these approaches, be able to implement basic machine learning methods, and be able to apply basic machine learning methods to real world problems.

Assignments

Assignment Policies

There are several assignments in this course. Each assignment may include both programming and written components. No assignment scores will be dropped. The following class policies regarding assignments will be followed:

- Programming assignments have to run on Matlab 2017a, unless permission is obtained via e-mail from the instructor or the teaching assistant.
- All assignments must be submitted via Blackboard.
- No deadline extensions for the entire class will be provided. (See syllabus about policy on extensions for individuals, based on emergencies documented in writing).
- Little or no extra credit will be provided.
- If you make multiple submissions to Blackboard for the same assignment, only the latest submission will be graded.
- **After you submit your solutions, you should download them and make sure that you submitted the correct files.** Every semester, several students ask for leniency, claiming that they did the assignment, but accidentally submitted the wrong files. These claims are often legitimate, but, unfortunately, no grade leniency will be accorded to such claims. It is each student's responsibility to doublecheck their submissions.
- **If, for whatever reason, you cannot submit on Blackboard, e-mail your solution to the instructor and the teaching assistant, from your UTA account, BEFORE the submission deadline.** This will serve as proof that you did the work. You still have to offer a very convincing explanation as to why you were not able to submit on Blackboard.

Each student is expected to work on each assignment INDIVIDUALLY and submit his or her own work. Similarly, each student is supposed to work individually in answering exam questions. The instructor will report to the Office of Student Conduct all violations of this policy, and all cases that are suspicious of such violations.

Late submission policy:

- All assignments are graded out of 100 points. Assignments submitted late will be penalized, at a rate of 4 penalty points per hour. The submission time will be the time shown on Blackboard. Any assignment submitted more than 25 hours late will receive no credit.
- Exceptions to late submission penalties will only be made for emergencies documented in writing, in strict adherence to UTA policy. For all such exception requests, the student must demonstrate that he or she made all efforts to notify the instructor as early as possible.
- Computer crashes, network crashes, software or hardware failure, Blackboard failure, e-mail failure, will NOT be accepted as justification for late submissions. If you want to minimize chances of a late submission, aim to submit early. You can always revise your submission till the deadline.
- Sometimes students submit the wrong files on Blackboard. Unfortunately, no credit or waiver of late penalties can be provided in such cases.
- If you find yourself in an emergency situation and can not deliver a homework on time, immediately inform the instructor and teaching assistant. Even if you have a valid reason for delivering late an assignment, you must make a convincing case that you have notified the instructor and teaching assistant as early as possible.

If you want to minimize chances of a late submission, aim to submit early. You can always revise your submission till the deadline.

Attendance Policy

At The University of Texas at Arlington, taking attendance is not required. Rather, each faculty member is free to develop his or her own methods of evaluating students' academic performance, which includes establishing course-specific policies on attendance. As the instructor of this section, I will follow the following attendance policy: Attendance is NOT mandatory for lectures. Attendance in lectures will NOT be used in calculating the semester grade. However, students are responsible for the material covered in the lectures. The instructor and teaching assistants will NOT honor requests to fill students in on what they missed in class.

While UT Arlington does not require instructors to take attendance in their courses, the U.S. Department of Education requires that the University have a mechanism in place to mark when Federal Student Aid recipients "begin attendance in a course." UT Arlington instructors will report when students begin attendance in a course as part of the final grading process. Specifically, when assigning a student a grade of F, faculty report the last date a student attended their class based on evidence such as a test, participation in a class project or presentation, or an engagement online via Blackboard. This date is reported to the Department of Education for federal financial aid recipients.

Class Participation

Class participation is optional, and will not be considered for the course grade. At the same time, students are highly encouraged to participate, by asking questions, as well as answering questions by the instructor. Class participation can be an important resource for students who have difficulty understanding any part of the course material.

Student Conduct

Students are expected to be professional and civil in their language and conduct:

- During lectures.
- During office hours.
- In any oral, written or electronic communication with the instructor and TAs.
- In assignment submissions.

For any student violating this policy, the instructor reserves the right to impose any grading penalties that the instructor considers appropriate, including a failing grade for the class, regardless of any other aspects of student performance. Examples of violations include language that is vulgar, insulting, disrespectful or threatening, making noise or talking with other students during lectures, disrupting lectures in any way, or making it difficult for other students to follow lectures in any way.

Grading

Programming Assignments	70%
First Midterm	10%
Second Midterm	10%
Final Exam	10%

The final semester score, calculated based on the percentages listed above, will be converted to letter grades based on the following scale:

- A: 90%
- B: 80%
- C: 70%
- D: 60%
- F: below 60%.

The instructor reserves the right to lower these thresholds, based on the distribution of scores and the degree of difficulty of the assignments and exams. The instructor also reserves the right to lower a student's grade as penalty for violating the requirements of professional and civil conduct, as described in the student conduct section of this syllabus.

Any request for re-grading must be made within 5 days of receipt of that grade. Re-grading can lead to a higher or lower grade, depending on grading errors that are discovered.

There will be little or no extra credit. If there are extra credit opportunities, they will be included as part of the assignments, and they will be available to all students. There will be no make-up opportunities, and there will be no way for individual students to do extra work and improve their grade at the end of the semester.

IMPORTANT: It should be clear to every student that course grades will depend **EXCLUSIVELY** on the above grading criteria. Students should not request nor expect any other factor to be considered in computing the course grade. For example, factors that will **NOT** be considered are: need of a better grade to keep financial aid, to stay in the program, to qualify for a job offer, or to graduate. Students are expected to carefully monitor their own performance throughout the semester and seek guidance from available sources (including the instructor) if they are concerned about their performance and the course grade that they will earn. However, **if the assignment scores are not good enough to warrant the desired grade at the end of the semester, there will be no other recourse for improving the grade.**

Withdrawals

The university withdrawal policy will be strictly adhered to. Up to the initial withdrawal date, all students will receive a W. After that date, the grade will be determined by the student's current average, and a WF or WP assigned as appropriate.

Expectations for Out-of-Class Study

Beyond the time required to attend each class meeting, students enrolled in this course should expect to spend an additional minimum of 10 hours per week of their own time in course-related activities, including reading required materials and completing assignments. Significantly more time may be needed for people having difficulties understanding the material, having a relatively weak mathematical or programming background, or having a relatively weak background in the prerequisite materials for this course.

Emergency Exit Procedures

Should we experience an emergency event that requires us to vacate the building, students should exit the room and move toward the nearest exit:

- Safely and calmly exit the classroom through the front door.
- After exiting the door turn left, and walk to the end of the hallway, which is approximately 100 feet away from ERB 131. At the end of the hallway turn left again, to exit the building. An illuminated EXIT sign at the end of the hallway points towards the exit.

Faculty members and instructional staff will assist students in selecting the safest route for evacuation and will make arrangements to assist handicapped individuals.

The classroom is on the ground floor, so no stairs are needed to exit the building. At any rate, when exiting any building during an emergency, one should never take an elevator but should use the stairwells.

University Policies and Services

Grade Grievances:

Any appeal of a grade in this course must follow the procedures and deadlines for grade-related grievances as published in the current undergraduate and graduate catalogs.

Drop Policy:

The standard UTA drop policy applies to this course. Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student's responsibility to officially withdraw if they do not plan to attend after registering. Students will not be automatically dropped for non-attendance. Repayment of certain types of financial aid administered through the University may be required as the result of dropping classes or withdrawing. For more information, contact the Office of Financial Aid and Scholarships (<http://www.uta.edu/ses/fao>).

Disability Accommodations:

UT Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including The Americans with Disabilities Act (ADA), The Americans with Disabilities Amendments Act (ADAAA), and Section 504 of the Rehabilitation Act. All instructors at UT Arlington are required by law to provide "reasonable accommodations" to students with disabilities, so as not to discriminate on the basis of disability. Students are responsible for providing the instructor with official notification in the form of a letter certified by the Office for Students with Disabilities (OSD). Students experiencing a range of conditions (Physical, Learning, Chronic Health, Mental Health, and Sensory) that may cause diminished academic performance or other barriers to learning may seek services and/or accommodations by contacting:

- The Office for Students with Disabilities, (OSD) www.uta.edu/disability or calling 817-272-3364.
- Counseling and Psychological Services, (CAPS) www.uta.edu/caps/ or calling 817-272-3671 is also available to all students to help increase their understanding of personal issues, address mental and behavioral health problems and make positive changes in their lives.

Only those students who have officially documented a need for an accommodation will have their request honored. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at www.uta.edu/disability or by calling the Office for Students with Disabilities at (817) 272-3364.

Non-Discrimination Policy:

The University of Texas at Arlington does not discriminate on the basis of race, color, national origin, religion, age, gender, sexual orientation, disabilities, genetic information, and/or veteran status in its educational programs or activities it operates. For more information, visit uta.edu/eos.

Title IX Policy:

The University of Texas at Arlington ("University") is committed to maintaining a learning and working environment that is free from discrimination based on sex in accordance with Title IX of the Higher Education Amendments of 1972 (Title IX), which prohibits discrimination on the basis of sex in educational programs or activities; Title VII of the Civil Rights Act of 1964 (Title VII), which prohibits sex discrimination in employment; and the Campus Sexual Violence Elimination Act (SaVE Act). Sexual misconduct is a form of sex discrimination and will not be tolerated. For information regarding Title IX, visit www.uta.edu/titleIX or contact Ms. Jean Hood, Vice President and Title IX Coordinator at (817) 272-7091 or jmhood@uta.edu.

Academic Integrity:

All students enrolled in this course are expected to adhere to the UT Arlington Honor Code:

I pledge, on my honor, to uphold UT Arlington's tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence. I promise that I will submit only work that I personally create or contribute to group collaborations, and I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.

Instructors may employ the Honor Code as they see fit in their courses, including (but not limited to) having students acknowledge the honor code as part of an examination or requiring students to incorporate the honor code into any work submitted. Per UT System Regents' Rule 50101, paragraph 2.2, suspected violations of university's standards for academic integrity (including the Honor Code) will be referred to the Office of Student Conduct. Violators will be disciplined in accordance with University policy, which may result in the student's suspension or expulsion from the University.

Student Support Services:

UT Arlington provides a variety of resources and programs designed to help students develop academic skills, deal with personal situations, and better understand concepts and information related to their courses. Resources include tutoring, major-based learning centers, developmental education, advising and mentoring, personal counseling, and federally funded programs. For individualized referrals, students may visit the reception desk at University College (Ransom Hall), call the Maverick Resource Hotline at 817-272-6107, send a message to resources@uta.edu, or view the information at www.uta.edu/resources.

Electronic Communication:

UT Arlington has adopted MavMail as its official means to communicate with students about important deadlines and events, as well as to transact university-related business regarding financial aid, tuition, grades, graduation, etc. All students are assigned a MavMail account and are responsible for checking the inbox regularly. There is no additional charge to students for using this account, which remains active even after graduation. Information about activating and using MavMail is available at <http://www.uta.edu/oit/cs/email/mavmail.php>.

Campus Carry:

Effective August 1, 2016, the Campus Carry law (Senate Bill 11) allows those licensed individuals to carry a concealed handgun in buildings on public university campuses, except in locations the University establishes as prohibited. Under the new law, openly carrying handguns is not allowed on college campuses. For more information, visit <http://www.uta.edu/news/info/campus-carry/>

Student Feedback Survey:

At the end of each term, students enrolled in classes categorized as lecture, seminar, or laboratory shall be directed to complete a Student Feedback Survey (SFS). Instructions on how to access the SFS for this course will be sent directly to each student through MavMail approximately 10 days before the end of the term. Each student's feedback enters the SFS database anonymously and is aggregated with that of other students enrolled in the course. UT Arlington's effort to solicit, gather, tabulate, and publish student feedback is required by state law; students are strongly urged to participate. For more information, visit <http://www.uta.edu/sfs>.

Final Review Week:

A period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week unless specified in the class syllabus. **For this course (CSE 4309), we may postpone the deadline of the last assignment so that it falls within the Final Review week.** During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. During this week, classes are held as scheduled. In addition, instructors are not required to limit content to topics that have been previously covered; they may introduce new concepts as appropriate.

Active Threat Resources:

Please review the following link, providing critical safety information on effective options and actions to employ if faced with an active aggressor or other threat on campus: <https://police.uta.edu/crime-prevention/active-shooter-resources.php>.

Course Schedule

As the instructor for this course, I reserve the right to adjust this schedule in any way that serves the educational needs of the students enrolled in this course. The following schedule is tentative, and will be regularly updated.

Lectures Schedule

- Lecture 1: Wed 08/22 - Syllabus Overview, Introduction.
 - Slides: Overview of course syllabus. [PPT](#), [PDE](#).
 - Slides: Introduction. [PPT](#), [PDE](#).
 - Book reading: Chapter 1.
- Lecture 2: Fri 08/24 - Probability Distributions, Probability Densities, Gaussians.
 - Slides: Background on probabilities. [PPT](#), [PDE](#).
 - Book reading: Chapters 1, 2.
- Lecture 3: Mon 08/27 - Probability Distributions, Probability Densities, Gaussians.
 - Slides: Background on probabilities. [PPT](#), [PDE](#).
 - Book reading: Chapters 1, 2.
- Lecture 4: Wed 08/29 - Bayesian Estimation, Bayesian Classifiers, Naive Bayes.

- Slides: Frequentist and Bayesian estimation. [PPT](#), [PDF](#).
- Slides: Bayes classifiers, naive Bayes. [PPT](#), [PDF](#).
- Book reading: Chapters 1, 2.
- Lecture 5: Fri 08/31 - Histograms
 - Slides: Histograms. [PPT](#), [PDF](#).
 - Book reading: Section 2.5.
- Lecture 6: Wed 09/05 - Histograms
 - Slides: Histograms. [PPT](#), [PDF](#).
 - Book reading: Section 2.5.
- **FRIDAY SEPTEMBER 07: CENSUS DATE.**
- Lecture 7: Fri 09/07 - Matlab Tips, Linear Regression.
 - Slides: Matlab Tips. [PPT](#), [PDF](#).
 - Slides: Linear Regression. [PPT](#), [PDF](#).
 - Book reading: Chapter 3.1.
- Lecture 8: Mon 09/10 - Linear Regression.
 - Slides: Linear Regression. [PPT](#), [PDF](#).
 - Book reading: Chapter 3.1.
- Lecture 9: Wed 09/12 - Linear Regression.
 - Slides: Linear Regression. [PPT](#), [PDF](#).
 - Book reading: Chapter 3.1.
- Lecture 10: Fri 09/14 - Linear Classification
 - Slides: Linear Classification. [PPT](#), [PDF](#).
 - Book reading: Chapter 4.
- Lecture 11: Mon 09/17 - Neural Networks.
 - Slides: Neural Networks. [PPT](#), [PDF](#).
 - Book reading: Chapter 5.
- Lecture 12: Wed 09/19 - Neural Networks.
 - Slides: Neural Networks. [PPT](#), [PDF](#).
 - Book reading: Chapter 5.
- Lecture 13: Fri 09/21 - Neural Networks.
 - Slides: Neural Networks. [PPT](#), [PDF](#).
 - Book reading: Chapter 5.

- Extra material: A high-level presentation on AI, machine learning, and deep learning. [PPT](#), [PDF](#).
- Lecture 14: Mon 09/24 - Decision Trees.
 - Slides: Decision Trees. [PPT](#), [PDF](#).
 - Book reading: Sections 14.4.
- Lecture 15: Wed 09/26 - Decision Trees.
 - Slides: More on Decision Trees (Practical Issues). [PPT](#), [PDF](#).
 - Book reading: Sections 14.4.
- Lecture 16: Fri 09/28 - Decision Trees.
 - Slides: More on Decision Trees (Practical Issues). [PPT](#), [PDF](#).
 - Book reading: Sections 14.4.
- Lecture 17: Mon 10/01 - Clustering, EM Algorithm.
 - Slides: Clustering. [PPT](#), [PDF](#).
- Lecture 18: Wed 10/03 - Clustering, EM Algorithm.
 - Slides: Clustering. [PPT](#), [PDF](#).
- Lecture 19: Fri 10/05 - Clustering.
 - Slides: Clustering. [PPT](#), [PDF](#).
- Lecture 20: Mon 10/08 - First Midterm Preparation: Questions and Answers.
- **Lecture 21: Wed 10/10 - FIRST MIDTERM**
- Lecture 22: Fri 10/12 - CANCELLED
- Lecture 23: Mon 10/15 - Markov Decision Processes.
 - Slides: Markov Decision Processes. [PPT](#), [PDF](#).
- Lecture 24: Wed 10/17 - Markov Decision Processes.
 - Slides: Markov Decision Processes. [PPT](#), [PDF](#).
- Lecture 25: Fri 10/19 - Reinforcement Learning.
 - Slides: Reinforcement Learning. [PPT](#), [PDF](#).
- Lecture 26: Mon 10/22 - Reinforcement Learning.
 - Slides: Reinforcement Learning. [PPT](#), [PDF](#).
- Lecture 27: Wed 10/24 - Reinforcement Learning.

- Slides: Reinforcement Learning. [PPT](#), [PDF](#).
- Lecture 28: Fri 10/26 - Reinforcement Learning.
 - Slides: Reinforcement Learning. [PPT](#), [PDF](#).
- Lecture 29: Mon 10/29 - Nearest Neighbors.
 - Slides: Nearest Neighbors. [PPT](#), [PDF](#).
- Lecture 30: Wed 10/31 - Nearest Neighbors.
 - Slides: Nearest Neighbors. [PPT](#), [PDF](#).
- **FRIDAY NOVEMBER 02: LAST DAY TO DROP CLASSES.**
- Lecture 31: Fri 11/02 - Sequential Data, Dynamic Time Warping.
 - Slides: Dynamic Time Warping. [PPT](#), [PDF](#).
 - Book reading: Chapter 13.
- Lecture 32: Mon 11/05 - Sequential Data, Dynamic Time Warping.
 - Slides: Dynamic Time Warping. [PPT](#), [PDF](#).
 - Book reading: Chapter 13.
- Lecture 33: Wed 11/07 - Second Midterm Preparation: Questions and Answers
- **Lecture 34: Fri 11/09 - SECOND MIDTERM**
- Lecture 35: Mon 11/12 - Sequential Data, Dynamic Time Warping.
 - Slides: Dynamic Time Warping. [PPT](#), [PDF](#).
 - Book reading: Chapter 13.
- Lecture 36: Wed 11/14 - Sequential Data, Dynamic Time Warping.
 - Slides: Dynamic Time Warping. [PPT](#), [PDF](#).
 - Book reading: Chapter 13.
- Lecture 37: Fri 11/16 - Hidden Markov Models.
 - Slides: Hidden Markov Models - Introduction. [PPT](#), [PDF](#).
 - Book reading: Chapter 13.
- Lecture 38: Mon 11/19 - Hidden Markov Models.
 - Slides: Hidden Markov Models - Algorithms. [PPT](#), [PDF](#).
 - Book reading: Chapter 13.
- Lecture 39: Mon 11/26 - Hidden Markov Models.

- Slides: Hidden Markov Models - Algorithms. [PPT](#), [PDF](#).
 - Book reading: Chapter 13.
 - Lecture 40: Wed 11/28 - Support Vector Machines.
 - Slides: Support Vector Machines. [PPT](#), [PDF](#).
 - Book reading: Chapter 7.
 - Lecture 41: Fri 11/30 - Support Vector Machines.
 - Slides: Support Vector Machines. [PPT](#), [PDF](#).
 - Book reading: Chapter 7.
 - Lecture 42: Mon 11/03 - Final Preparation: Questions and Answers
 - **FINAL EXAM: FRI 12/07, 11:00am-1:30pm.**
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Additional Material

This material is optional, and no part of the grade will depend on it.

If there is time, some of this material may be covered in lectures.

- Dimensionality Reduction, PCA.
 - Slides: PCA. [PPT](#), [PDF](#).
 - Book reading: Chapter 12.
 - SVD and Recommendation Systems.
 - Slides: SVD. [PPT](#), [PDF](#).
 - Convolutional Neural Networks.
 - Link: [A course from Stanford](#).
 - Link: [Slides from that course](#).
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Assignments Schedule

- Assignment 1. Due date: Fri 09/14, 5:00pm.
Topics: probabilities, naive bayes classifiers, Gaussians, histograms.

- Assignment 2. Due date: Fri 09/28, 5:00pm.
Topics: logistic regression, linear regression, gradients and optimization.
 - Assignment 3. Due date: Fri 10/19, 5:00pm.
Topics: neural networks and backpropagation.
 - Assignment 4. Due date: Fri 11/02, 5:00pm.
Topic: decision trees.
 - Assignment 5. Due date: Fri 11/16, 5:00pm.
Topic: clustering.
 - Assignment 6. Due date: Fri 11/30, 5:00pm.
Topic: reinforcement learning.
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Optional Assignments

Here is a list of optional assignments, that provide practice on additional topics. Doing these assignments will not provide extra credit, and will not influence the semester grade in any way. Please refer to the [lectures](#) page for slides and reading material on the topics covered in these assignments.

- [K-Nearest Neighbor Classifiers](#).
 - [Dynamic Time Warping](#).
 - [PCA](#).
 - [SVD](#).
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Emergency Phone Numbers: In case of an on-campus emergency, call the UT Arlington Police Department at 817-272-3003 (non-campus phone), 2-3003 (campus phone). You may also dial 911. The non-emergency number is 817-272-3381.