

Machine Learning

Tentative Syllabus

CSCI 74020
Spring 2021

Instructor: Anita Raja, Ph.D., Professor of Computer Science

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Course Meeting Time: Thursdays 11:45am - 1:45pm

Meeting Format and Location: Fully Online Synchronous Class: Lectures will be held via blackboard collaborate during class time every week. Link will be posted on blackboard discussion board day before class. See Camera Use policy described below.

Office hours: TBA

zoom meetings during schedule times above or by appointment.

<https://huntercollege.zoom.us/j/95863175457?pwd=ZzdYYXlsTWpvcExGQk5HTEZCRVBMZz09>

Meeting ID: 958 6317 5457

Passcode: 138608

Prerequisites:

- Background in probability and statistics, vector algebra, linear algebra, calculus and optimization, algorithm design, and data structures is expected.
- Python programming skills, familiarity with Jupyter Notebook.
- Please be aware that the instructor in this course will require that the camera and audio be on during some class sessions especially during testing.

Course Credits: 3

This course requires 2 hours of classroom or direct faculty instruction and on average 2-6 hours of out-of-class student work each week for approximately 15 weeks. Out-of-class work may include but is not limited to: Required Reading, Coding assignments, Written assignments, and studying for quizzes and exams. Class participation will include occasional pop quizzes on the blackboard.

Course webpage: Blackboard; visit it regularly.

Textbook resources: There is no required text book for this class. Comprehensive lecture slides will be made available the day before class and videos of the lectures will be available via the blackboard. Students are encouraged to take notes during class. Other readings will be provided on the schedule page.

Though there is no required text for this course, my lectures will draw references substantially from Bishop and Geron below and also refer to other books in the list. Several of these books have free authorized versions online that you can find using a quick search.

- Pattern Recognition and Machine Learning (PRML) by Christopher M. Bishop (<https://www.microsoft.com/en-us/research/people/cmbishop/prml-book/>)
- Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems by Aurélien Géron
- The Elements of Statistical Learning: Data Mining, Inference, and Prediction by Trevor Hastie, Robert Tibshirani, Jerome Friedman (<http://web.stanford.edu/~hastie/ElemStatLearn/>)
- Data Mining: Practical Machine Learning Tools and Techniques, 2017, Witten, Frank, and Hall. Morgan Kaufmann, the fourth edition, ISBN 978-0-12-804291-5. <https://www.cs.waikato.ac.nz/ml/weka/book.html> Available through the Hunter bookstore: <http://hunter.textbookx.com/institutional/>. Errata for the text are posted at <http://www.cs.waikato.ac.nz/ml/weka/errata.html>
- Machine Learning: A Probabilistic Perspective by Kevin P. Murphy
- Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig (<http://aima.cs.berkeley.edu/>)

Advanced Topics:

- Reinforcement Learning: An Introduction by Richard S. Sutton and Andrew G. Barto (<http://www.incompleteideas.net/book/first/ebook/the-book.html>)
- Deep Learning by Ian Goodfellow, Yoshua Bengio, and Aaron Courville (<https://www.deeplearningbook.org/>)
- Boosting: Foundations and Algorithms by, Robert E. Schapire, and Yoav Freund

Catalog Description and Topics:

Machine Learning uses interdisciplinary techniques to automatically discover patterns in large volumes of data at high speed that help make predictions or decisions. It is now ubiquitous with applications spanning from medical decision making to financial informatics, weather tracking and homeland security. This course covers the theory, algorithms, and applications of machine learning. Students will study what is involved in learning models from data and how to evaluate these models.

Topics covered will include: (1) supervised learning: generative/discriminative learning, parametric/non-parametric learning, neural networks, and support vector machines; (2) unsupervised learning: clustering, dimensionality reduction, kernel methods; (3) learning theory: bias/variance tradeoffs; VC theory; (4) reinforcement learning and adaptive control and (5) fairness, bias and machine ethics.

Use of Python and Jupyter Notebook will be required for this course. Only scientific libraries such as SciPy, NumPy, Pandas, Matplotlib will be allowed to be used in the assignments and final project. Generally students are not allowed to use any machine learning library (scikit-learn, tensorflow, etc.) unless explicitly permitted.

Learning Goals:

The student must be able to demonstrate a working knowledge of the theoretical foundations and software of machine learning represented by the topics listed above.

Learning Outcomes:

By the end of the course, students should be able to

- Understand the process involved in equipping machines to learn models from data.
- Gain knowledge about a wide variety of learning algorithms and how to optimize them.
- Be skilled at evaluating models generated from data.
- Apply the algorithms to a real-world problem and report on the accuracy of the various models.
- Demonstrate an understanding of the ethical concerns typically arising in the context of computing

How to Succeed in this Course:

Plan on doing *all* of the following:

- Do the assigned readings *before* the lecture, *not after* it.
- Make a list of questions before the class.
- Give yourself enough time to complete assignments and the project. Each will need significant amount of effort.
- Submit all assignments on time.
- Solve a set of problems at the end of each chapter.
- Check the blackboard for updates.
- Study for exams.
- Adhere to assignment requirements and the College's Academic Integrity policy.

Syllabus and Readings:

The topics covered and tentative schedule are listed in the schedule document on the blackboard. You are responsible for everything in the listed chapters regardless of how much time we spend on them in class. As noted above, you should read ahead so that you can ask questions in class, email the instructor or use the blackboard discussion forum to clear up anything you find confusing. Responses to posting can be expected within 24 hours of the post during week days.

Course Grading Rubric

Your final course grade will be calculated as follows:

| | |
|--|--|
| Participation and Pop Quizzes | 10% |
| Assignments | 30% |
| Midterm Exam | 20% |
| Final Exam: Final Project + Possibly Short Oral Exam | 40% (25% final project; 15% oral exam) |

Logistics: Assignments, Projects and Participation

- We will use Blackboard collaborate for lectures. Recordings of the lectures will be posted on the blackboard page.
- We will use the waiting room feature via zoom for office hours and oral exams.
- Participation in class is encouraged. The Blackboard discussion board will be used for discussion for ML related questions. Students are encouraged to participate in these discussions in answering peer questions. The instructor will both respond when needed and supervise the discussion.
- Attendance will not be taken but pop quiz performance as well engagement in class discussion and blackboard discussion board will contribute towards participation grade.
- Students will need access to a camera since cameras must be turned on timed tests and exams.
- There will be one written midterm exam and the final exam will be composed of a final project deliverable and possibly an oral exam. The exams will cover class readings, notes and discussions.
- Assignments will be composed of both written and programming components. Each assignment will require several days of work.
- All submissions must be uploaded to the blackboard on time. Only electronic submissions will be accepted. Any handwritten and scanned components must be neat and legible.
- Assignments are individual submissions. You may discuss the assignments but the solution and code must be your own. Sharing and/or receiving solutions is not allowed. Please read academic integrity notes further below.
- It is imperative that all submitted program listings and executions be thoroughly documented. You are allowed to use the source code that is provided by the book. Acknowledge all code that you use from the textbook.
- All programs must compile and run. Zero credit will be given for programs that do not compile or do not run. Usually the homework assignments will only state the major objectives of the program to be written; it will be often up to you to make design decisions regarding I/O, efficiency, error handling, and so on. Make sure you test the code adequately to indicate the correctness and robustness of your approaches.
- All programming projects must be submitted **by the deadline**.
 - For each late day, 10% is deducted (i.e. ϵ to 24 hours late results in 10% penalty; 24-48 hours late means 20% penalty and so on). After three late days, the assignment **will not be accepted**.
- If you have questions about grading or believe that points were deducted unfairly, you must **email the instructor within a week after the grade for the assignment is posted**. No further consideration will be given to any assignment a week after the grade is posted.
- The final project will be a group project with 2-3 students with diverse backgrounds on each team. A set of topics and project specifications and criteria will be shared mid-semester. The final project will include a written component of at least 500 words.

- Students are encouraged to ask questions in class. The class participation grade will be evaluated using the following criteria:
 - Relevance and intellectual depth of questions.
 - Accurate responses to questions posed in class.
 - Initiating and/or Engaging in discussions in class and via online board that help further understanding of course topics among students.
 - Innovative and neat solution approaches to problems posed in class.

Course Material and Communication

All course material (i.e. slides or other sources) will be uploaded on *blackboard*. Homework assignments will be uploaded on *blackboard*. We will also use *blackboard email and discussion board* for communication.

If you have a question about the class, topics covered, homework, etc. please first check the posts in the Q & A section. If you did not find an answer, please post your question there. That will make it easier for all students to see answers. You can also answer questions of fellow students. Do not post any code solutions. For questions involving personal matters you can email me. Talk to me if there are questions or concerns about the course. I also welcome feedback on the course progress through out the semester.

The standards and requirements set forth in this syllabus serve as the course policy. Notice of any modifications/changes to the syllabus will be by announcement in class or by changes to this syllabus posted on the course website along with the change date.

Camera Use and Recordings Policy

Students who participate in this class with their camera on or use a profile image are agreeing to have their video or image recorded solely for the purpose of creating a record for students enrolled in the class to refer to, including those enrolled students who are unable to attend live. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live.

Make-up Policy

All exams must be taken and submitted on time. Failure to take an exam counts as a zero grade on that exam. **There will be no make-up exams.** In case you must miss an exam or a homework for a unforeseen valid medical/family emergency, you have to inform me as soon as possible (no later than the day of the exam or earlier), provide appropriate

documentation and there will be a conversation on whether and how your exam grade composition will be adjusted.

Academic Integrity

Please read the CUNY policy here

<https://www.cuny.edu/about/administration/offices/legal-affairs/policies-procedures/academic-integrity-policy/>.

I take academic integrity very seriously to ensure fairness in grading to all students in the class and to ensure that the grade you get reflects the value of your degree and quality of the institution you will graduate from.

1. While you are encouraged to discuss project assignments with others, **all work submitted must be your own**. You MAY NOT show your solution to a classmate or ask another student to see their solution. You may not ask another student to debug your code.
2. You may not use code from the Internet (e.g. StackOverflow). You can use code from the textbook unless otherwise specified in the assignment. You should properly attribute the code (add a comment citing in detail the source of the code — NOTE: you must always do this whenever you find yourself using others' code).
3. You may not post your code or answers where it is accessible to others, and you may not seek help from online forums. Contract cheating is a form of academic dishonesty in which students get others to complete their coursework for them. Please read more information on Contract cheating from http://en.wikipedia.org/wiki/Contract_cheating
4. As a rule of thumb, **you must type and debug your code without directly copying someone else's code**. For the first incident of cheating or plagiarism your grade will be a 0 and it will not be dropped as the lowest. For the second incident, you will fail the class. We report all incidents to the Office of Student Affairs.
5. More details in the programming rules document on the blackboard.

ADA Compliance

In compliance with the American Disability Act of 1990 (ADA) and with Section 504 of the Rehabilitation Act of 1973, Hunter College is committed to ensuring educational parity and accommodations for all students with documented disabilities and / or medical conditions. It is recommended that all students with documented disabilities (Emotional, Medical, Physical and / or Learning) consult the Office of Accessibility located in Room E1124 to secure necessary academic accommodations. For further information and assistance please call (212-772-4857)/TTY (212-650-3230).

Hunter College Policy on Sexual Misconduct

In compliance with the CUNY Policy on Sexual Misconduct, Hunter College reaffirms the prohibition of any sexual misconduct, which includes sexual violence, sexual harassment, and gender-based harassment retaliation against students, employees, or visitors, as well as certain intimate relationships. Students who have experienced any form of sexual violence

on or off campus (including CUNY-sponsored trips and events) are entitled to the rights outlined in the Bill of Rights for Hunter College.

a. Sexual Violence: Students are strongly encouraged to immediately report the incident by calling 911, contacting NYPD Special Victims Division Hotline (646-610-7272) or their local police precinct, or contacting the College's Public Safety Office (212-772-4444).

b. All Other Forms of Sexual Misconduct: Students are also encouraged to contact the College's Title IX Campus Coordinator, Dean John Rose (jtrose@hunter.cuny.edu or 212-650-3262) or Colleen Barry (colleen.barry@hunter.cuny.edu or 212-772-4534) and seek complimentary services through the Counseling and Wellness Services Office, Hunter East 1123. CUNY Policy on Sexual Misconduct Link:

<http://www.cuny.edu/about/administration/offices/la/Policy-on-Sexual-Misconduct-12-1-14-with-links.pdf>

Thank you for abiding by these policies. Doing so will ensure the learning experience is most productive and fair to everyone taking this class and/or the future offerings of this course.

CUNY Policies: As indicated above, online courses are subject to the same CUNY policies as are in-person courses regarding academic integrity, the acceptable use of computer resources, equal opportunity and non-discrimination, sexual misconduct, workplace violence, domestic violence, and reasonable accommodations for persons with disabilities. The associated links are listed below:

- CUNY Academic Integrity Policy: <https://www.cuny.edu/about/administration/offices/legal-affairs/policies-procedures/academic-integrity-policy/>
- CUNY Policy on Acceptable Use of Computer Resources: <https://www.cuny.edu/wp-content/uploads/sites/4/page-assets/about/administration/offices/cis/it-policies/ComputerUsePolicy1.pdf>
- CUNY Policy on Acceptable Use of University Data in the Cloud: <https://www.cuny.edu/wp-content/uploads/sites/4/page-assets/about/administration/offices/cis/information-security/security-policies-procedures/Acceptable-Use-of-University-Data-in-the-Cloud-2019-8-19a.pdf> (and related Data Classification Standard: <https://www.cuny.edu/wp-content/uploads/sites/4/page-assets/about/administration/offices/cis/information-security/security-policies-procedures/Data-Classification-Standard-CUNY-2019-8-19a.pdf>)
- CUNY Intellectual Property Policy: <https://www.cuny.edu/wp-content/uploads/sites/4/page-assets/about/administration/offices/legal-affairs/policies-procedures/Intellectual-Property-Policy.pdf>
- CUNY information on copyright: <https://www.cuny.edu/about/administration/offices/legal-affairs/intellectual-property/copyright-materials/>
- CUNY Equal Opportunity and Non-Discrimination Policy: <https://www.cuny.edu/about/administration/offices/legal-affairs/policies-procedures/equal-opportunity-and-non-discrimination-policy/>
- CUNY Policy on Sexual Misconduct: <http://www.cuny.edu/wp-content/uploads/sites/4/page-assets/about/administration/offices/legal-affairs/policies-procedures/Sexual-Misconduct.pdf>

- CUNY Campus and Workplace Violence Prevention Policy: <https://www.cuny.edu/wp-content/uploads/sites/4/page-assets/about/administration/offices/legal-affairs/CUNY-Campus-and-Workplace-Violence-Prevention-Policy-2.28.11-and-amended-9.26.2011.pdf>
- CUNY Domestic Violence and the Workplace Policy: http://policy.cuny.edu/general-policy/article-v/#policy_5.061
- CUNY Procedures for Implementing Reasonable Accommodations and Academic Adjustments: <https://www.cuny.edu/about/administration/offices/legal-affairs/policies-procedures/reasonable-accommodations-and-academic-adjustments/>

Acknowledgements:

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