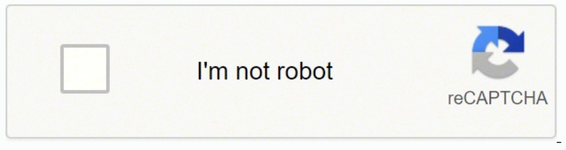

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Advanced introduction to machine learning cmu

You don't have any courses yet.You don't have any books yet.You don't have any Studylists yet.You haven't viewed any documents yet. Large datasets pose difficulties across the machine learning pipeline. They are difficult to visualize and introduce computational, storage, and communication bottlenecks during data preprocessing and model training. Moreover, high capacity models often used in conjunction with large datasets introduce additional computational and storage hurdles during model training and inference. This course is intended to provide a student with the mathematical, algorithmic, and practical knowledge of issues involving learning with large datasets. Among the topics considered are: data cleaning, visualization, and pre-processing at scale; principles of parallel and distributed computing for machine learning; techniques for scalable deep learning; analysis of programs in terms of memory, computation, and (for parallel methods) communication complexity; and methods for low-latency inference. Prerequisites Students are required to have taken a CMU introductory machine learning course (10-301, 10-315, 10-601, 10-701, or 10-715). A strong background in programming will also be necessary; suggested prerequisites include 15-210, 15-214, or equivalent. Students are expected to be familiar with Python or learn it during the course. Textbooks There will be no required textbooks, though we may suggest additional reading in the schedule below. The requirements of this course consist of participating in lectures, homework assignments, and two exams. The grading breakdown is the following: 25% Exam 1 25% Exam 2 45% Homework (6 Assignments all weighted equally) 5% Quizzes You are required to attend all exams. The exams will be given during class. Please plan your travel accordingly as we will not be able accommodate individual travel needs (e.g. by offering the exam early). If you have an unavoidable conflict with an exam (e.g. an exam in another course), notify us by filling out the exam conflict form which will be released on Piazza a few weeks before the exam. The homeworks will be divided into two components: programming and written. The programming assignments will ask you to implement ML algorithms from scratch; they emphasize understanding of real-world applications of ML, building end-to-end systems, and experimental design. The written assignments will focus on core concepts, “on-paper” implementations of classic learning algorithms, derivations, and understanding of theory. We will use Piazza for class discussions. Please go to this Piazza website to join the course forum (note: you must use a cmu.edu email account to join). We strongly encourage students to post on this forum rather than emailing the course staff directly (this will be more efficient for both students and staff). Students should use Piazza to: Ask clarifying questions about the course material. Share useful resources with classmates (so long as they do not contain homework solutions). Look for students to form study groups. Answer questions posed by other students to solidify your own understanding of the material. The course Academic Integrity Policy must be followed on the message boards at all times. Do not post or request homework solutions! Also, please be polite. Gradescope We use Gradescope to collect PDF submissions of open-ended questions on the homework (e.g. mathematical derivations, plots, short answers). The course staff will manually grade your submission, and you’ll receive personalized feedback explaining your final marks. You will also submit your code for programming questions on the homework to Gradescope. After uploading your code, our grading scripts will autograde your assignment by running your program on a VM. This provides you with immediate feedback on the performance of your submission. If you believe an error was made during manual grading, you’ll be able to submit a regrade request on Gradescope. For each homework, regrade requests will be open for only **1 week** after the grades have been published. This is to encourage you to check the feedback you’ve received early! Teaching Assistants Rahul Dharani OH: Tues 3:30pm-4:30pm Bhanu Prakash Guda OH: Fri 5pm-6pm Zhiyuan Guo OH: Wed 1:30pm-2:30pm Akshath Jain OH: Mon 4:30pm-5:30pm Vaibhav Jindal OH: Wed 5pm-6pm Maya Liu OH: Mon 1:30pm-2:30pm Shubhranshu Singh OH: Thurs 1pm-2pm Aramya Trivedi OH: Wed 10:30am-11:30am Qinxin Wang OH: Tues 10:30am-11:30am Xinrui Zheng OH: Mon 10am-11am Date Lecture Resources Announcements Data Pre-Processing and Visualization, Distributed Computing Jan 19 Introduction (slides, video) HW1 Released Jan 21 Recitation 1: Introduction to Pyspark and Databricks (slides, video) Lab Notebook Jan 24 Distributed Computing, Spark (slides, video) Jan 26 Visualization, PCA (slides, video) Tutorial on PCAJL Theorem Jan 28 Recitation 2: Linear Algebra Review (slides, annotated, video) Lab Notebook Jan 31 Nonlinear Dimensionality Reduction (slides, video) t-SNE Basics of Large-Scale / Distributed Machine Learning Feb 2 Distributed Linear Regression, part I (slides, video) HW1 Due, HW2 Released Feb 4 Recitation 3: HW1 Written Solutions (video) Feb 7 Distributed Linear Regression, part II (slides, video) Feb 9 Kernel Approximation (slides, video) Feb 11 Recitation 4: Probability Recap (slides, annotated, video) Feb 14 Logistic Regression, Hashing (slides, video) Hash kernels, IHash kernels, II HW2 Due, HW3 Released Feb 16 Randomized Algorithms (slides, video) Count-min sketchLSH Feb 18 Recitation 5: Homework 2 Solutions (video) Feb 21 Distributed Trees (slides, video) Feb 23 Practice Exam HW3 Due Feb 25 Recitation 6: Homework 3 & Practice Exam 1 Solutions (video) Feb 28 Exam I Mar 2 Cloud Computing (slides, AWS slides, video) EMR Tutorial HW4 Released Mar 7 Spring Break (No Classes) Mar 9 Spring Break (No Classes) Scalable Deep Learning: Training, Tuning, and Inference Mar 14 Deep Learning, Autodiff (F21 slides, video) Mar 16 DL Frameworks, Hardware (slides, video) Mar 18 Recitation 7: Tensorflow Tutorial (notebook, video) Mar 21 Large-Scale Optimization (slides, video) HW4 Due, HW5 Released Mar 23 Optimization for DL (slides, video) Mar 25 Recitation 8: Optimization & Learning Rates (slides, notebook, video) Mar 28 Parallel/Distributed DL (slides, video) Mar 30 Hyperparameter Tuning (slides, video) Apr 1 Recitation 9: Homework 4 Solutions (video) Apr 4 Neural Architecture Search (slides, video) Apr 6 Inference, Model Compression (slides, , video) HW5 Due, HW6 Released (Tentative) Advanced Topics Apr 11 Federated Learning, part I Apr 13 Federated Learning, part II Apr 15 Recitation 10: Homework 5 Solutions Apr 18 Guest Lecture: Bilge Acun (FAIR) Apr 20 Guest Lecture: Josh Tobin (Gantry) HW6 Due THURSDAY 21ST Apr 22 Recitation 11: Homework 6 Solutions & Practice Exam 2 Solutions Apr 25 Course Summary Apr 27 Exam II You receive 4 total grace days for use on any homework assignment. We will automatically keep a tally of these grace days for you; they will be applied greedily. No assignment will be accepted more than 1 days after the deadline without written permission from Daniel, or Virginia. You may not use more than 1 grace day on any single assignment. All homework submissions are electronic. As such, lateness will be determined by the latest timestamp of any part of your submission. For example, suppose the homework requires submissions to both Gradescope Written and Programming– if you submit your Written on time but your Programming 1 minute late, your entire homework will be penalized for the full 24-hour period. In general, we do not grant extensions on assignments. There are several exceptions: Medical Emergencies: If you are sick and unable to complete an assignment or attend class, please go to University Health Services. For minor illnesses, we expect grace days to provide sufficient accommodation. For medical emergencies (e.g. prolonged hospitalization), students may request an extension afterwards by contacting their Student Liaison or Academic Advisor and having them reach out to the education associates Daniel Bird and Fatima Kizilkaya on their behalf. Family/Personal Emergencies: If you have a family emergency (e.g. death in the family) or a personal emergency (e.g. mental health crisis), please contact your academic adviser or Counseling and Psychological Services (CaPS). In addition to offering support, they will reach out to the instructors for all your courses on your behalf to request an extension. University-Approved Absences: If you are attending an out-of-town university approved event (e.g. multi-day athletic/academic trip organized by the university), you may request an extension for the duration of the trip. You must provide confirmation of your attendance, usually from a faculty or staff organizer of the event. For any of the above situations, you may request an extension by emailing Daniel Bird (dpbird@andrew.cmu.edu). The email should be sent as soon as you are aware of the conflict and at least 5 days prior to the deadline. In the case of an emergency, no notice is needed. Official auditing of the course (i.e. taking the course for an “Audit” grade) is not permitted this semester. Unofficial auditing of the course (i.e. watching the lectures online or attending them in person) is welcome and permitted without prior approval. Unofficial auditors will not be given access to course materials such as homework assignments and exams. Pass/Fail is allowed in this class, no permission is required from the course staff. The grade for the Pass cutoff will depend on your program. Be sure to check with your program / department as to whether you can count a Pass/Fail course towards your degree requirements. If you have a disability and have an accommodations letter from the Disability Resources office, I encourage you to discuss your accommodations and needs with Daniel Bird and Fatima Jeffrey as early in the semester as possible. I will work with you to ensure that accommodations are provided as appropriate. If you suspect that you may have a disability and would benefit from accommodations but are not yet registered with the Office of Disability Resources, I encourage you to contact them at access@andrew.cmu.edu. Read this Carefully The purpose of student collaboration is to facilitate learning, not to circumvent it. Studying the material in groups is strongly encouraged. It is also allowed to seek help from other students in understanding the material needed to solve a particular homework problem, provided no written notes (including code) are shared, or are taken at that time, and provided learning is facilitated, not circumvented. The actual solution must be done by each student alone. The presence or absence of any form of help or collaboration, whether given or received, must be explicitly stated and disclosed in full by all involved. Specifically, each assignment solution must include the corresponding collaboration section. If you gave help after turning in your own assignment and/or after answering the collaboration section, you must update your answers before the assignment’s deadline, if necessary by emailing the course staff or a Piazza post. Collaboration without full disclosure will be handled severely, in compliance with CMU’s Policy on Academic Integrity. Some of the homework assignments used in this class may have been used in prior versions of this class, or in classes at other institutions, or elsewhere. Solutions to them may be, or may have been, available online, or from other people or sources. It is explicitly forbidden to use any such sources, or to consult people who have solved these problems before. It is explicitly forbidden to search for these problems or their solutions on the internet. You must solve the homework assignments completely on your own. We will be actively monitoring your compliance. Collaboration with other students who are currently taking the class is allowed, but only under the conditions stated above. You are encouraged to read books and other instructional materials, both online and offline, to help you understand the concepts and algorithms taught in class. These materials may contain example code or pseudo code, which may help you better understand an algorithm or an implementation detail. However, when you implement your own solution to an assignment, you must put all materials aside, and write your code completely on your own, starting “from scratch”. Specifically, you may not use any code you found or came across. If you find or come across code that implements any part of your assignment, you must disclose this fact in your collaboration statement. Students are responsible for proactively protecting their work from copying and misuse by other students. If a student’s work is copied by another student, the original author is also considered to be at fault and in gross violation of the course policies. It does not matter whether the author allowed the work to be copied or was merely negligent in preventing it from being copied. When overlapping work is submitted by different students, both students will be punished. To protect future students, do not post your solutions publicly, neither during the course nor afterwards. All violations (even first one) of course policies will always be reported to the university authorities (your Department Head, Associate Dean, Dean of Student Affairs, etc.) as an official Academic Integrity Violation and will carry severe penalties. The penalty for the first violation is a one-and-a-half letter grade reduction. For example, if your final letter grade for the course was to be an A-, it would become a C+. The penalty for the second violation is failure in the course, and can even lead to dismissal from the university. This course is based in part on material developed by Heather Miller, Ameet Talwalkar, William Cohen, Anthony Joseph, and Barnabas Poczos. Previous courses: 10-605/10-805, Fall 2021; 10-405/10-605, Spring 2021; 10-605/10-805, Fall 2020; 10-405/10-605, Spring 2020.

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