

CSCI 1420: Machine Learning

Instructor: Stephen Bach

Spring 2020

Time: Tuesday and Thursday, 2:30-3:50p
Location: Metcalf Research Building Auditorium
Web: cs.brown.edu/courses/csci1420/

Course Description

How can artificial systems learn from examples and discover information buried in data? We explore the theory and practice of statistical machine learning, focusing on computational methods for supervised and unsupervised learning. Specific topics include empirical risk minimization, probably approximately correct learning, kernel methods, neural networks, maximum likelihood estimation, the expectation maximization algorithm, and principal component analysis. This course also aims to expose students to relevant ethical and societal considerations related to machine learning that may arise in practice.

Required Materials

Understanding Machine Learning by Shai Shalev-Shwartz and Shai Ben-David.
Print copies are available in the bookstore, and a free PDF is available online:
cs.huji.ac.il/shais/UnderstandingMachineLearning/copy.html

Prerequisites

Students should have completed an intro sequence and taken at least two semesters of calculus, basic calculus-based probability, and linear algebra to be prepared for this course. We recommend comfort with multivariable calculus (particularly partial derivatives and gradients). Formally, the requirements are (CSCI 0160, 0180 or 0190) and (MATH 0100, 0170, 0180, 0190, 0200, 0350, minimum score of 4 in 'AP Calculus BC' or minimum score of 5 in 'IB HL Mathematics') and (CSCI 1450, 0450, APMA 1650 or 1655) and (CSCI 0530, MATH 0520 or 0540).

Learning Objectives

This course will cover both historic and modern machine learning algorithms viewed through the lens of various models, loss functions, and optimizers. Throughout this course you will develop a toolbox of techniques used to address classic machine learning problems such as regression, classification, clustering and dimensionality reduction. For each algorithm you work with, you will become familiar with the theoretical underpinnings that justify both their functionality and performance, as well as their limitations. Additionally, you will learn to recognize or discover which techniques are best to address a given learning problem.

Estimated Time Commitment

In addition to 3 hours in class each week, each student will spend approximately 8 to 12 hours per week on reading, homework, or preparing for exams, for total estimated time commitment of 180+ hours.

Teaching Staff

Instructor: Stephen Bach <stephen_bach@brown.edu>
(CIT 335, office hours by appointment)

Head TAs:

Angie Kim <jkim162>
Jessica Dai <jdai6>

Dylan Sam <dsam>

TAs:

Andrew Canino <acanino>
Andrew Wei <awei6>
Fabrice Guyot-Sionnest <fguyotsi>
Jacob Migneault <jmignea1>
Kelvin Yang <kyang35>
Shibei Guo <sguo16>
Snigdha Sinha <ssinha5>
Tyler Jiang <tjiang12>
Zsozso Biegl <zbiegl>

Andrew Peterson <apeter10>
Daniel Ben-Isvy <dbenisvy>
Irene Rhee <irhee>
Ken Noh <knoh1>
Rudra Srivastava <rsrivas2>
Seneca Meeks <smeeks>
Siyao Wang <swang181>
Yiming Zhang <yzhan281>

Ethics TAs:

Karen Tu <ktu2>

Kelvin Yang <kyang35>

TA Office Hours

See cs.brown.edu/courses/csci1420/calendar.html for availability.

Piazza

Found at piazza.com/brown/spring2020/csci1420. For guidelines on Piazza, see our collaboration policy. Please note, Piazza is only monitored by teaching staff from 9:00 AM to midnight—please don't expect any responses from staff after midnight.

Assignments

12 Homeworks (5% each)
Midterm (15%)
Final Exam (20%)
TopHat Participation (5%)

Exam Dates

The in-class midterm is on **Thursday, March 19**. The final exam is on **Tuesday, May 8** at 2 PM.

Students must take these exams as scheduled. No one will be able to take an exam at another time without supporting documentation from health services, CAPS, SEAS, or other appropriate source.

Course Policies

Collaboration Policy

Students are required to familiarize themselves with this course's collaboration policy: cs.brown.edu/courses/csci1420/docs/cs1420collaborationpolicy.pdf.

Key elements include the requirement that all students complete their own homework assignments. Students may discuss the assignments with each other, but may not work directly on the deliverables (write ups, code, etc.) during those discussions. No student may look at another student's work in progress, nor permit another to look at theirs. The only exception is when asking for help on Piazza.

We do not tolerate academic dishonesty. This includes cheating, lying about course matters, plagiarism, or helping others commit a violation. Keep in mind the obligations and expectations associated with the [Brown Academic and Student Conduct Codes](#).

Participation Policy

We use TopHat during class to facilitate active learning. Participation in these questions will count for 5% of your final grade, as described above. Participation is counted on a per-vote basis, with students receiving credit for answering a question, regardless of whether the answer is correct. Students can miss participating in up to 15 votes without penalty. After those 15, each missed vote will reduce a student's participation grade. Additional free votes will not be allowed for any reason.

Please also note that a single question might include multiple votes, e.g., before and after discussing with a partner. A class therefore may contain as many as four to eight votes. Voting without being physically present in class will be considered academic dishonesty.

Hours Policy

Our philosophy for TA hours is that they are for students to receive guidance on concepts and assignments, as opposed to receiving answers. Therefore, please do not go into hours expecting that a TA will give you the answer to a problem. This course will have two types of hours: individual hours and clinic hours. Clinic hours are TA-guided hours focused more on conceptual and written questions. Individual hours will make use of SignMeUp, and will follow department policy where each student has up to 15 minutes with a TA before they must sign up again.

Incomplete Policy

We expect everyone to be able to complete the course on time. However, we certainly understand that unexpected and uncontrollable situations may arise that prevent you from finishing the course on time, such as health problems and family crises. If you feel you cannot complete the course on time, please discuss with Prof. Bach the possibility of being given a grade of Incomplete for the course and setting a schedule for completing the course in the upcoming year.

Due Dates and Turning in Homework

All assignments are due at **12:00 pm noon**. Written homework is to be submitted through Gradescope. Programming homework is to be submitted via department machine handin scripts.

Late Policy

The late-day policy described below applies to all late days other than those due to illness, religious holidays, and other extensions granted by Prof. Bach in extreme circumstances. Thus days missed because of

job interviews are included in the late-day policy. Late days are applied to an entire homework, and not to individual components of the homework. In other words, choosing to use a late day for the electronic handin automatically constitutes the use of a late day on the written handin and vice versa.

Everyone is allowed a total of four late days on homework, and no more than three late days may be applied to any one homework assignment. Beyond that, you will be penalized 25 percentage points for each day an assignment is late. We will apply late days to assignments in an optimal fashion at the end of the semester.

If you are ill, you may get an extension without using late days if you get a note from either Health Services or a university dean, and contact Prof. Bach. If a religious holiday impacts your ability to meet an assignment deadline, you may also get an extension without using late days; please contact the instructor at the beginning of the semester.

Diversity and Inclusion

We strive to create and sustain a diverse and inclusive environment in which all students, faculty, and staff can thrive. It is everyone's responsibility to uphold this mission, and we ask students in the course to honor this. We take all complaints about discrimination, harassment, and other violations of [Brown's Discrimination and Harassment Policy](#) seriously. If anybody involved in the course has failed to make it an inclusive space for you, please contact either Prof. Bach or the department chair (Prof. Cetintemel). Laura Dobler and the department's [Diversity Advocates](#) are also available as a resource for members of historically underrepresented groups. [Additional resources](#) are listed on the department's website.

In addition, Brown welcomes students from all around the country and the world, and their unique perspectives enrich our learning community. To empower students whose first language is not English, an array of support is available on campus, including language and culture workshops and individual appointments. For more information, contact the English Language Learning Specialists at ellwriting@brown.edu.

Accommodations

Brown University is committed to full inclusion of all students. If you feel you have physical, psychological, or learning disabilities that could affect your performance in the course, we urge you to contact [SEAS](#). We will do whatever we can to support accommodations recommended by SEAS.

The departmental [Health and Wellness Advocates](#) are available as a resource for you to discuss any concerns, and to guide you through options and next steps for accommodations.

Mental Health

We understand that health encompasses your physical, mental, and emotional well-being. If for any reason you are struggling to balance your health with your coursework, we recommend that you take advantage of the resources available to you. We commit to working with you and any supporting offices at Brown to provide reasonable accommodations they recommend.

Academic deans are accessible every weekday in University Hall, and [Student Support Services](#) deans are available over the phone 24/7 and in person by appointment. Brown's [Counseling and Psychological Services](#) (CAPS) provides confidential in-house counseling, outside mental health resources, and notes for health accommodations. The department also has [Health and Wellness Advocates](#) who can assist you.