CS 189/289A
Introduction to Machine Learning

Jonathan Shewchuk
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(Please send email only when Piazza is not feasible.)

Spring 2016
Mondays and Wednesday, 6:30–8:00 pm
2050 Valley Life Sciences Building

Instructions for the CS 289A Project are now available. Please find project partners and submit your proposal by Monday, April 4.

This class introduces algorithms for learning, which constitute an important part of Artificial Intelligence.

Topics include (not a complete list!)

- classification,
- regression,
- density estimation,
- clustering, and
- dimensionality reduction.

Best Links

- See the schedule of class and discussion section times and rooms.
- Access the CS 189/289A Piazza discussion group.
- If you want an instructional account, you can get one online. No more paper forms. Go to the same link if you forget your password or account name.

Prerequisites

- Math 53 (or another vector calculus course),
- Math 54 (or another linear algebra course),
- CS 70 (or other courses covering discrete math and probability), and
- CS 188 (Artificial Intelligence).

You should take the first three prerequisites quite seriously: if you don't have them, I strongly recommend not taking CS 189. CS 188 is not quite as essential, but still a very good idea.
If you want to brush up on prerequisite material, Stanford's machine learning class provides nice reviews of linear algebra and probability theory. Other suggestions for review material appear in this Piazza post.

Textbooks

Both textbooks for this class are available free online. Hardcover and Kindle/eTextbook versions are also available.


Homework

You have a total of 5 slip days that you can apply to your semester's homework. We will simply not award points for any late homework you submit that would bring your total slip days over five.

**Homework 1** is due February 10.

**Homework 2** is due February 18.

**Homework 3** is due March 3.

**Homework 4** is due March 31.

**The CS 289A Project** has a proposal due **Monday, April 4**. The video and final report are due **Friday, May 6**.

Previous midterms (including this semester's) are available: [Spring 2013](http://www.cs.berkeley.edu/~jrs/189/), [Spring 2014](http://www.cs.berkeley.edu/~jrs/189/), [Spring 2015](http://www.cs.berkeley.edu/~jrs/189/), [Fall 2015](http://www.cs.berkeley.edu/~jrs/189/), [Spring 2016](http://www.cs.berkeley.edu/~jrs/189/).

Lectures

Lecture topics and readings will be added here as I figure them out.


Lecture 4 (February 1): The support vector classifier, aka soft-margin support vector machine (SVM). Features and nonlinear decision boundaries. Read ESL, Section 12.2 up to and including the first paragraph of 12.2.1. My lecture notes (text). The screencast.


Lecture 7 (February 10): Gaussian discriminant analysis, including quadratic discriminant analysis (QDA) and linear discriminant analysis (LDA). Maximum likelihood estimation (MLE) of the parameters of a statistical model. Read ISL, Section 4.4. Optional: Read (selectively) the Wikipedia page on maximum likelihood. My lecture notes (text). The screencast.

February 15 is Presidents' Day.


Lecture 10 (February 24): Regression: fitting curves to data. The 3-choice menu of regression function + loss function + cost function. Least-squares linear regression as quadratic minimization and as orthogonal projection onto the column space. The design matrix, the normal equations, the pseudoinverse, and the hat matrix (projection matrix). Logistic regression; how to compute it with gradient ascent. Read ISL, Sections 4-4.3. My lecture notes (text). The screencast.

Lecture 11 (February 29): My Mom's 18th birthday (not kidding). Newton's method and its application to logistic regression. LDA vs. logistic regression: advantages and disadvantages. ROC curves. Weighted least-squares regression. Least-squares polynomial regression. Read ISL, Sections 4.4.3, 7.1, 9.3.3; ESL, Section 4.4.1. My lecture notes (text). The screencast. Happy birthday, Mom!


Lecture 14 (March 9): Kernel perceptrons. Kernel logistic regression. The Gaussian kernel. Subset selection. Lasso: penalized least-squares regression for reduced overfitting and subset selection. Read ISL, Sections 6-6.1.2 and the last part of 6.1.3 on validation; and ESL, Sections 3.4-3.4.3. Optional: Read ISL, Section 9.3.2 if you're curious about kernel SVM. My lecture notes (text). The screencast.


The Midterm takes place in class on Wednesday, March 16. You are permitted one “cheat sheet” of letter-sized (8½" × 11") paper.

March 21–25 is Spring Recess.

The Final Exam takes place on Friday, May 13, 3–6 PM. (CS 189 is in exam group 19.)

Discussion Sections and Teaching Assistants

Sections begin to meet on January 28. Sections 102 and 103 are cancelled.

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<th>101</th>
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Friday, 9 am | 112 | Aldo | 81 Evans |
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<td>71 Evans</td>
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<td>Friday, 11 am</td>
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<td>Friday, 2 pm</td>
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<td>Shaun</td>
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Your teaching assistants:
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Grading

- **40%** for homeworks.
- **20%** for the Midterm (Wednesday, March 16, in class).
- **CS 189: 40%** for the Final Exam (Friday, May 13, 3–6 PM; CS 189 is in exam group 19.)
- **CS 289A: 20%** for the Final Exam.
- **CS 289A: 20%** for a project.

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