CSE 154 Deep Learning

Detailed Fall 2019 Syllabus

MWF 1:00-1:50, Mandeville B210

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Tutor: Yuda Song

**Course Description**

Neural networks have come back into fashion recently with the advent of deep networks, which are winning all of the most important computer vision contests, and have also been used in a number of other pattern-recognition and pattern transformation problems, and have become the method of choice in reinforcement learning. In this course, we begin with the fundamentals of neural networks: We introduce Perceptrons, linear and logistic regression, multilayer networks and back-propagation, convolutional neural networks, recurrent networks, and deep networks. The course will involve four programming assignments roughly every two weeks, a midterm, and a final.

**Learning Outcomes**

After taking this course, you should be able to understand about half of any particular NIPS paper, you should understand how back propagation works, know what a convolutional network is, know what a Long Short-Term Memory (LSTM) unit is, and have a working knowledge of PyTorch. You should be aware of some of the recent advances in deep learning. You should be able to construct your own deep learning model in PyTorch.

**Course Schedule**

Week 0-1: Overview of the course, Some machine learning basics, Linear regression, Gradient descent, Logistic Regression. (Sept. 27-Oct. 4)

Reading:

If your background in linear algebra is weak: Read Chapter 2 of the deep learning book.

If your background in probability and statistics is weak: Read Chapter 3 of the deep learning book, or Chapter 2 of Bishop. Bishop gives a great overview of pattern recognition in Chapter 1.

**This weekend: Programming Assignment 1 (PA1) handed out!**

Week 2: Back propagation learning, objective functions (October 7-11)

Optional Reading: Read Chapter 5.1-5.3 in the deep learning book, chapter 8 of the PDP book (will be posted on piazza) or Chapter 3 of Bishop

**October 11th: PA1 Due! PA2 (back propagation) handed out!**

Week 3: Objective functions and appropriate activation functions for each (Oct 14-18)

Optional Reading: DL book: Chapter 5.5, 5.7, 5.9, 5.10, 5.11. Bishop: Chapter 6.1, 6.7, 6.9; ch 8 PDP book

Week 4:  Regularization, batch normalization (Oct 21-25)

**October 23rd: PA 2 due! PA 3 handed out!**

**October 25th: Midterm!**

Week 5: Convolutional networks and deep learning (Oct 28-November 1)

Optional Reading: Chapter 7 of DL book, readings posted on Piazza

Week 6: (Nov. 4-8)

Optional Reading: Chapter 9 of DL book

**November 6th: PA3 Due! PA4 Handed out!**

Week 7: Recurrent networks (Nov. 11-15)

Optional Readings: Chapter 10 of DL book, last part of Ch. 8 of PDP book

Week 8: More Convolutional & Recurrent networks (Nov. 20)

Readings: TBA

**November 25th: PA 4 Due!**

Week 9: Reinforcement learning & Deep nets, recent papers (Nov. 25-29)

Readings: TBA

Week 10: Current directions, Ethics, and Summary (Dec 2-6)

Second Midterm**: Monday, December 2nd**

**Prerequisites:** Linear algebra, vector calculus, probability, and excellent programming skills. Python and NumPy experience will be very useful.

**Required work:** Clicker questions: 5% (participation only, I drop the two lowest), four programming assignments (60%), two midterms (15% each). Programs will be spread evenly through the term. Some programming assignments will include written homework. There will occasionally be extra credit on assignments. If this is the case, we will let you know what you have to do on the assignment itself.

**Clickers:** We will be using clickers, which are available at the UCSD bookstore. Why will we use clickers? Because I use the "peer instruction" method - this has been shown to increase learning (at least in terms of scores on tests), and it will keep you engaged in the material. Peer instruction involves having you discuss the answers to questions in class, and then all of us discussing the outcome. It *also* means that you must come to class *prepared* - hence there will be occasional simple quizzes at the beginning of class on the previous lectures and any assigned reading to encourage you to do that.

**Textbook:** There will be no textbook for this course, but I will make my slides available. There will be occasional readings posted, some of them original sources. Good reference books are:

Bishop (1995) *Neural Networks for Pattern Recognition*: Available online in pdf form – google it! We will be using Bishop’s notation in lectures.

Duda, Hart, & Stork (2001) *Pattern Classification*

Rumelhart, McClelland, and the PDP Group (1986) *Parallel Distributed Processing: Explorations in the microstructure of cognition.* Chapter 8 is the description of the derivation of back propagation. Available online from Jay McClelland’s web page. Good if you are interested in Cognitive Science.

Russell & Norvig (2010) *Artificial Intelligence: A Modern Approach*, 3rd Edition (Parts of Chapter 18).

Goodfellow, Bengio, and Courville: *Deep Learning*, available online, here: <http://www.deeplearningbook.org/>

**Programming considerations**

***Do not post your code on github!!! You will be held responsible if someone else uses your code.***

We will do some programming assignments individually, and others in teams of two or three. I will give 4 programming assignments. If you don’t know anyone in the class, piazza has a “search for teammates” feature. We are not matchmakers: You must do this yourselves! Part of the learning experience is learning to divide tasks into parts and figure out the interface between the parts. Also, learning to work with someone else. When you are out in the work world, you *will* be thrown together with people you don’t know and forced to work together. *Get used to it!*

***Assignments 1 & 2 should be done in Python, with numPy. Assignments 3 & 4 will be done in PyTorch. NumPy*** has lots of features that make working with matrices and vectors easy, and many built-in useful functions. If we give you starter code for the assignment, it will be in Python. Python is available on the machines in the basement.

**Grading policy**

Written homework and programming assignments will be submitted using gradescope. Programming assignments are due at midnight on the date due (that is, 11:59PM). After midnight, and until midnight of the next day, programming assignments can be turned in for 90% credit. After midnight, and until midnight of the next day, programming assignments can be turned in for 50% credit. After that, you’re hosed. The only exceptions will be if you have broken all of your arms or something equally disastrous. ("I stayed late at the Belly Up and overslept" is *not* acceptable).

**Cheating:** Don’t. Working in pairs or trios on the machine problems is sometimes required, but working together on homework must follow the (spirit of the) Gilligan’s Island rule (Dymond, 1986): No notes can be made during a discussion, and you must watch one hour of Gilligan’s Island or equally insipid television show before writing anything down. Obviously, sharing during exams is explicitly prohibited. Suspected cheating will be reported to the Dean. In this course we expect students to adhere to the [UC San Diego Integrity of Scholarship Policy](http://senate.ucsd.edu/Operating-Procedures/Senate-Manual/Appendices/2). This means that you will complete your work honestly, and with integrity.

**Missed exams:** Exams may be made up within a reasonable time frame (e.g., with a day or so). Please advise the instructor if you know you will be out of town for an exam. We may give you an exam prior to your leaving town.

**Resources**

We will endeavor to answer your questions on Piazza in a timely manner. We will hold office hours almost every day of the week. There are many online deep learning courses that have good lectures available. If you are not getting answers to your questions on Piazza within 24 hours, please text the professor at 619-823-3033 and I will give the TAs holy hell.

The IDEA Engineering Student Center, located just off the lobby of Jacobs Hall, offers a variety of programs, listed in the IDEA Center Facebook page at <http://www.facebook.com/ucsdidea/> and the Center web site at <http://idea.ucsd.edu/>. The IDEA Center programs support both undergraduate students and graduate students and offers tutoring, if I am not mistaken.

**Diversity and Inclusion**

We are committed to fostering a learning environment for this course that supports a diversity of thoughts, perspectives and experiences, and respects your identities (including race, ethnicity, heritage, gender, sex, class, sexuality, religion, ability, age, educational background, etc.). Our goal is to create a diverse and inclusive learning environment where all students feel comfortable and can thrive.

Our instructional staff will make a concerted effort to be welcoming and inclusive to the wide diversity of students in this course. If there is a way we can make you feel more included please let one of the course staff know, either in person, via email/discussion board, or even in a note under the door. Our learning about diverse perspectives and identities is an ongoing process, and we welcome your perspectives and input.

We also expect that you, as a student in this course, will honor and respect your classmates, abiding by the UCSD Principles of Community (<https://ucsd.edu/about/principles.html>). Please understand that others’ backgrounds, perspectives and experiences may be different than your own, and help us to build an environment where everyone is respected and feels comfortable. In particular, be respectful in responding to other students on the Piazza page.

If you experience any sort of harassment or discrimination, please contact the instructor as soon as possible. If you prefer to speak with someone outside of the course, please contact the Office of Prevention of Harassment and Discrimination:<https://ophd.ucsd.edu/>.

**Students with Disabilities**

We aim to create an environment in which all students can succeed in this course. If you have a disability, please contact the Office for Students with Disability (OSD), which is located in University Center 202 behind Center Hall, to discuss appropriate accommodations right away. We will work to provide you with the accommodations you need, but you must first provide a current Authorization for Accommodation (AFA) letter issued by the OSD. You are required to present their AFA letters to Faculty (please make arrangements to contact me privately) and to the OSD Liaison in the department in advance so that accommodations may be arranged.

**Basic Needs/Food Insecurities**

If you are experiencing any basic needs insecurities (food, housing, financial resources), there are resources available on campus to help, including The Hub and the Triton Food Pantry. Please visit <http://thehub.ucsd.edu/> for more information.