CS 281: Advanced Machine Learning
Syllabus

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1 Course Description

The course will be devided roughly in three modules.

In the first module, we will review some of the fundamental concepts of machine learning in more depth than an introduction to machine learning. For example, we will discuss gradient descent, which you are probably already familiar with, but go over an analysis of convergence. The goal of the first module is too deepen your understanding of machine learning.

In the second module, we will do a deep dive into neural networks and deep learning, including convolutional neural networks, recurrent neural networks, or attention mechanism. The goal of the second module is to get you up too speed on the latest work in deep learning.

In the third module, we will do a deep dive into Probabilistic machine learning, including mixture models, topic models, and inference methods such as MCMC or variational inference. The goal of the second module is to get you up too speed on the latest work in probabilistic machine learning.

To see the full anticipated schedule, please consult the website: `https://harvard-ml-courses.github.io/cs281-web/`.

2 Prerequisites

Familiarity with the basics of: calculus, linear algebra, and probability theory. Programming.

3 Lectures

Lectures are Monday/Wednesday, 12:30 to 14:15. Lectures will be given by either Jean-Baptiste (John) Tristan or Michael Wick.

4 Sections

There will be two types of sections. Some sections will focus on reviewing or introducing tools and techniques. For the other sections, we have selected papers that have won either test of time awards or best paper awards at NeurIPS and ICML. Students are required to read the papers and the section will be dedicated to discussing the papers.

5 Assignments

We will have 4 assignments, each of which will be worth 10% of the final grade. Assignments will contain both programming/data science exercises and theory problems.

6 Project

6.1 Objective

The objective of this final project is to explore new research in machine learning. The ideal outcome would be a paper that could be submitted a top machine learning conferences.

6.2 Collaboration

You should work in a group of 3 or 4 people. Groups of 2 will be considered with permission. Larger groups will not be permitted.

6.3 Deliverables

There are four deliverables. The proposal and status report may be submitted up to a week late with a 50% penalty. There will be no extensions given for the poster and final report.

Project Proposal Write a two-page document describing the plan for your project. This should clearly state what problem you are trying to solve. If you have developed a new model, explain what models this work will build on and how it resolves deficiencies. If it is a new algorithm for inference, explain the regimes for which you think it well be well-suited. If you are developing a new theoretical contribution, discuss the theorems you will prove. For problem-driven papers, discuss the data and the unique challenges that make this interesting. Identify relevant work and algorithms you intend to implement as baselines. This does not need to be a comprehensive document and I expect that it will be speculative. Your focus should be on identifying the questions you wish to answer about your data or your method and specifying clearly what success will mean.

Abstract and Status Repor Write a one-page document including a one paragraph draft of the abstract for the final paper. Use the remainder of the page to describe the status of your project. What have you proved? What baselines have you established? Have there been unexpected results, good or bad?

Poster Presentation We will have a class poster session, where you will present a conference-style poster. SEAS will pay for the poster printing (more details about this to come). You will also submit the poster as a PDF.

Final Report Using the NeurIPS conference paper format (available at http://nips.cc), write a paper of up to ten pages. This paper should have a typical conference style, with abstract, introduction, etc. You should clearly state what problem you are trying to solve, introduce and explain your approach, and review the relevant literature. It should explain in detail the experiments that were run, show their results and discuss conclusions that can be drawn.

7 Midterm

The midterm will be worth 20% of the final grade. It will contain a quiz and a few programming and theory problems.

8 Grading Summary

- Midterm: 15%
- Assignments: 40%

- Project proposal: 10%
- Project abstract and status report: 5%
- Project poster: 10%
- Project report: 20%