Course Project

The project for this class is completely open ended. You are encouraged to pick any topic you wish as long as there is a direct connection to the theory of machine learning algorithms, models, or applications. For example, you can study the theory behind the methods we study in class, or you can apply a theoretically guaranteed method to study an interesting problem in your own field of interest. You must work individually.

Feel free to talk to me to see if a project is suitable or not for this class.

This project is due at 11:59pm, December 8th, and a in-class presentation will be given in the last few weeks of the class. Extensions beyond this due date will only be given for genuine and unforeseen emergencies, such as serious illness or death in the family. To avoid last minute problems with laptops, hard drives, etc., be sure to keep your work regularly and frequently backed up as we do not generally consider such difficulties to be "emergencies".

1 Choose a topic

You should start by reading some papers on a topic, and then you might do some experiments, or try to simplify or improve some result. Alternatively, you may try to apply machine learning methods to a particular application, and see if the theoretical guarantees are satisfied. If not, discuss why.

Here are some examples of possible types of projects:

Example 1: Study a paper or two about an important methodology in machine learning, which is not covered in class. For example, you may study new clustering algorithms and their theoretical advances.

Example 2: Study ODE interpretation of gradient descent algorithms.

Example 3: Study an application of your own interest, like computer vision, sociology, psychology and biology. If you choose to do an application, I expect you to do some experiments on real datasets and get some interesting conclusions. It is also important that you run a method with theoretical guarantees, and discuss whether the assumptions are satisfied on the datasets.

2 Write a report

The end result of your project should be a written report that clearly and concisely describes what you did, what results you get and what the results mean. Try to limit your report to 8 pages. (You may write longer if you really think it's necessary but brevity will be much appreciated. If you exceed the page limit and I believe that is not necessary, a downgrade is possible.) The report should use 12pt font, 1-inch margins, and single spacing. The page length limits do not include figures, citations, tables or detailed proofs. (You may put figures, tables or detailed proofs or computations in Appendix.)

You should write your report as clearly as possible in a manner that would be understandable to a fellow classmate. You should not assume that the reader has background beyond the materials covered in class. Your report should begin by describing the problem you are studying including some background on what has been done before and the motivation for the problem, i.e., why it is worth studying. Previous work and outside sources should be cited throughout your report in a scholarly fashion following the style of academic papers in your area.

Next, you should clearly explain what you did, both from a high level, and then in more details. For an experimental paper, you should explain the experiments in enough detail that there is a reasonable possibility that a motivated reader would be able to replicate them. State your results clearly, and think about graphical tools you can use to make your presentation clearer (a table of numbers is usually less compelling than a graphical representation of the same data). Look through published papers for ideas. For a theoretical paper, the mathematical details should be explained well enough for the results to be stated with mathematical precision and clarity.

In every case, be sure to explain the meaning of your results.

3   Do a presentation

You will do a presentation for about 15 minutes in class during the last few weeks. Use a small number of slides to describe what you have done and what you get. Again, be clear and concise to make sure your classmates can understand why your study is interesting.

4   What you will be graded on

Projects will be graded along the following dimensions: (i) originality and creativity (10%); (ii) background material (10%); (iii) theoretical component or experimental design and execution (20%); (iv) discussion and interpretation of results (15%); (v) writing of the final report (clarity and conciseness) (20%); (vi) presentation (15%); (vii) overal effort (10%).