Course Outline for COMP 598
Mathematical Foundations of Machine Learningh
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Introduction

In this course I will teach theoretical aspects of machine learning. The course
will overlap with courses taught by Profs. Pineau and Precup but will have a
more theoretical and mathematical flavour; there will be no implementation
assignments. The point of the course is to understand the reason why certain
algorithms work. Thinking mathematically is a must: I will not diminish
the mathematical level to serve the needs of people who are underprepared.

Prerequisites

I expect a certain level of mathematical maturity. People in Honours math-
ematics or physics programs typically have this. The core material that you
need is linear algebra and probability. However, passing classes in these
two topics does not mean that you are prepared. You need to be willing to
engage with mathematical material and learn things that are different from
anything you may have seen before.

Grading

Grades will be based on a few (3 or 4) assignments **and** a term paper. There
may be an interview with the instructor on the contents of the term paper
if reading the term paper does not satisfy the instructor.

Topics

- Basic probability

- High-dimensional geometry

- PAC learning: VC dimension, Rademacher complexity

- Online learning

- Convex optimization and the SVM

- Neural networks and SGD

- Kernel methods

- Intro to measure theory

- MDPs and reinforcement learning

- Bisimulation

Academic Integrity

McGill University values academic integrity and treats it seriously. Please see the website

`http://www.mcgill.ca/integrity`

for more details. In the present class we expect that the work that you turn in is your own. You can discuss ideas and approaches with your friends but you cannot blindly copy their solutions. If we find that someone has handed in a correct solution that they cannot satisfactorily explain to me, we will treat it as a case of cheating and prosecute accordingly.