

Homework 1

Math 198: Math for Machine Learning

Due Date: February 12

Name:

Student ID:

Instructions for Submission

Please include your name and student ID at the top of your homework submission. You may submit handwritten solutions or typed ones (L^AT_EX preferred). If you at any point write code to help you solve a problem, please include your code at the end of the homework assignment, and mark which code goes with which problem. Homework is due by start of lecture on the due date; it may be submitted in-person at lecture or by emailing a PDF to both facilitators.

1 Demographics

1. What year are you in and what is your major?
2. Which courses in the Math department have you taken prior to this course?
3. What courses in the CS or Data Science department have you taken prior to this course?
4. What courses in the Statistics department have you taken prior to this course?
5. What courses in the EE department have you taken prior to this course?
6. Have you taken any other courses which you believe are relevant to this one? If so, which?
7. Are you planning on taking CS 189 or another machine learning course?
8. What led you to enroll in this course, and what are you hoping to get out of it?

2 Perceptrons

1. Suppose we are working with two-dimensional data, and have the following datapoints:
Class A: $\mathbf{x}_1 = [1, 1]$, $\mathbf{x}_2 = [4, 4]$
Class B: $\mathbf{x}_3 = [1, -2]$, $\mathbf{x}_4 = [4, 1]$
 - (a) By observation, determine a decision boundary for this data.
 - (b) Using the file `hw1.py`, run the perceptron algorithm with learning rate $r = 0.1$ on this data, and report your final values for \mathbf{w} , b , and the decision boundary determined by the algorithm. (To run the file, run `python hw1.py` from your terminal.)
2. Can a perceptron be trained to learn the one-bit XOR operation, using the input values as features? Why or why not? (For those unfamiliar, $a \text{ XOR } b$ is true if and only if $a \neq b$.)
3. Prove that the perceptron algorithm will not converge if the data is not linearly separable.