Homework 3

Instructions
This homework contains **6** concepts and **9** programming questions. In MS word or a similar text editor, write down the problem number and your answer for each problem. Combine all answers for concept questions in a single PDF file. Export/print the Jupyter notebook as a PDF file including the code you implemented and the outputs of the program. **Make sure all plots and outputs are visible in the PDF.**

Combine all answers into a single PDF named andrewID_hw3.pdf and submit it to Gradescope before the due date. Refer to the syllabus for late homework policy. Please assign each question a page by using the "Assign Questions and Pages" feature in Gradescope. Submissions to anywhere other than Gradescope will not be graded.

Here is a breakdown of the points for programming questions:

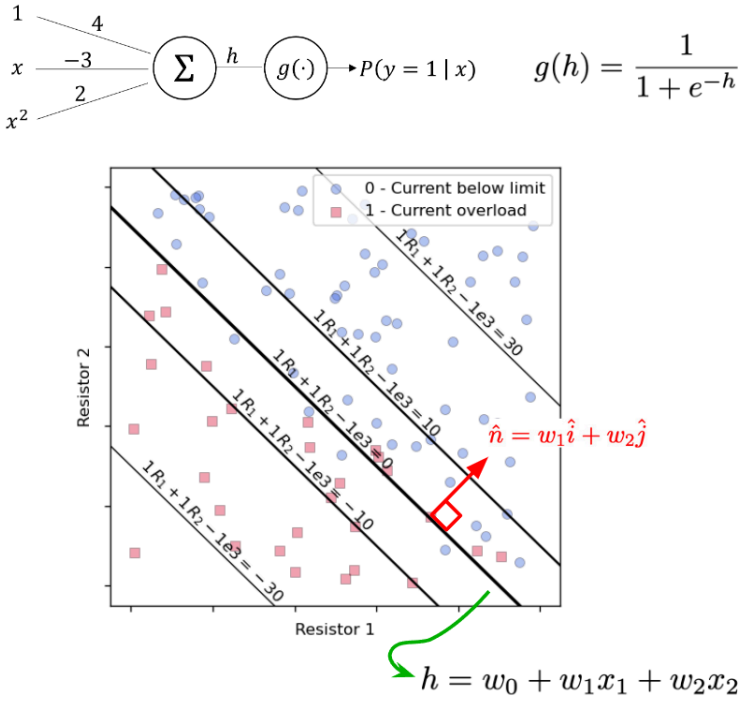
Name	Points
M3_HW1	20
M3_HW2	20
M3_HW3	20
M3_L1_P1	5
M3_L1_P2	5
M3_L1_P3	5
M3_L2_P1	5
M3_L2_P2	5
M3_L2_P3	5

Problem 1 (3 Points)

The sigmoid function is useful because

1. It restricts the output between -1 and 1 (T/F)
2. It has a probabilistic interpretation (T/F)
3. It is easily differentiable (T/F)

Problem 2 (2 Points)



Consider the level sets that correspond to different decision boundaries in the figure.
1) What are the bounds on the values of h?

2) What are the bounds on the values of *g(h)* where *g()* is the sigmoid function?

Problem 3 (1 Points)

More L2 regularization always leads to better fitting models. (T/F)

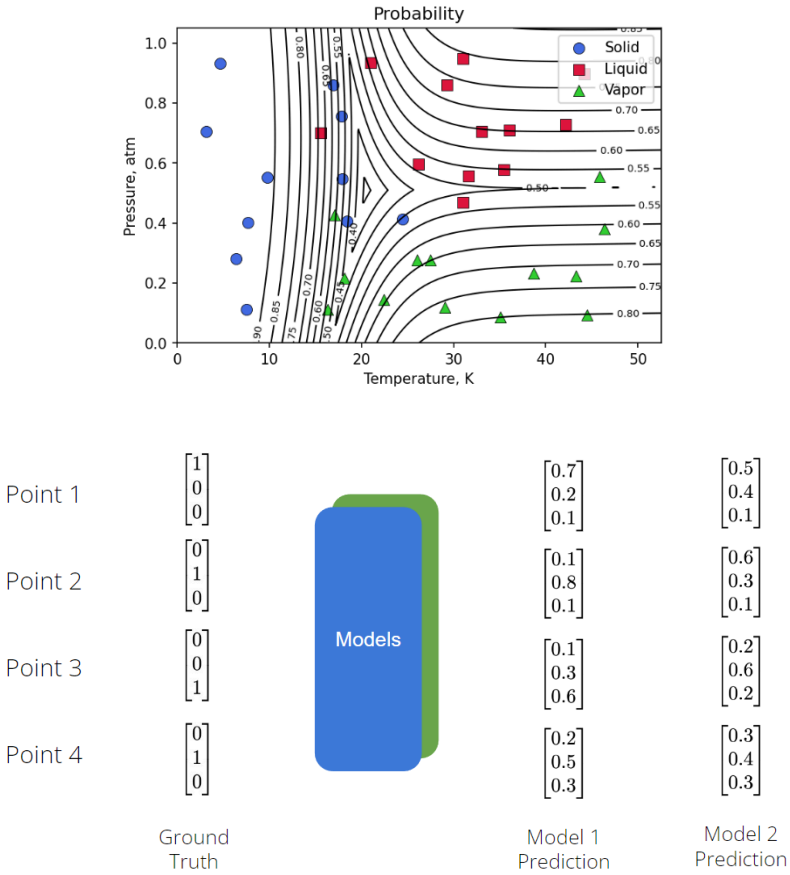
Problem 4 (1 Points)

Consider the following 4 class problem. A given test point $\boldsymbol{x}$ is evaluated by six binary classifiers with the following results:
A vs. B → class A
A vs. C → class C
A vs. D → class D
B vs. C → class C
B vs. D → class D
C vs. D → class D
What is the predicted class for the test point?

Problem 5 (1 Points)

For what number of classes is the number of classifiers required for one-versus-one and one-versus-rest classifiers equal?

Problem 6 (2 Points)



Consider the phase problem from the slides. There are three classes: solid, liquid, and vapor. We have four test points with ground truth labels shown below. We train two models that output the predictions below. By inspection, which model is best?