

Homework 4

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.

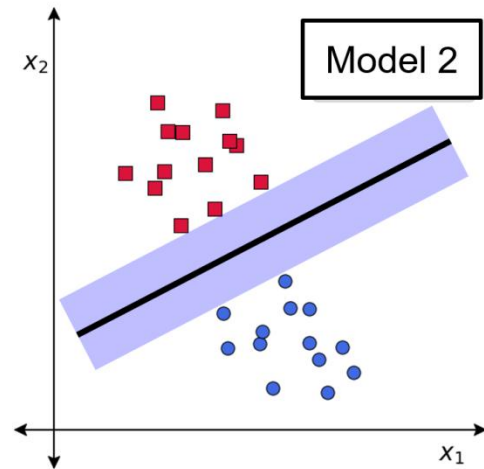
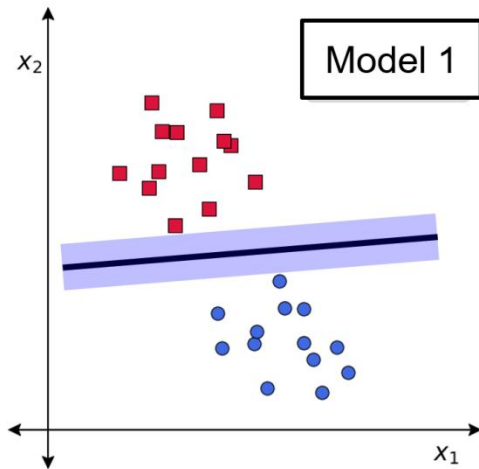
Combine all answers into a single PDF named `andrewID_hw4.pdf` and submit it to Gradescope before the due date. Refer to the syllabus for late homework policy. Please assign each question a page by using the “Assign Questions and Pages” feature in Gradescope.

Question	Points
Concept 1	2
Concept 2	2
Concept 3	2
Concept 4	2
Concept 5	2
Concept 6	2
M4-L1-P1	6
M4-L1-P2	6
M4-L1-P3	6
M4-L2-P1	6
M4-L2-P2	6
M4-L2-P3	6
M4-HW1	24
M4-HW2	24
M4-HW3	24
Total	120
Bonus	6

Problem 1

Which of the following two models represents a better discriminator?

Model 2 represents a better discriminator as it shows a larger decision boundary.



Problem 2
Multiple Choice (select one)

Consider an SVM classifier:

$$\begin{aligned} &\underset{\mathbf{w}, b}{\text{minimize}} \quad \frac{1}{2} \|\mathbf{w}\|^2 \\ &\text{subject to: } y_i (\mathbf{w}^T \mathbf{x}_i + b) \geq 1 \end{aligned}$$

We would like to solve the problem with a quadratic programming solver:

$$\begin{aligned} &\underset{x}{\text{minimize}} \quad (1/2)x^T P x + q^T x \\ &\text{subject to} \quad Gx \preceq h \\ &\quad \quad \quad Ax = b \end{aligned}$$

When inputting the inequality constraint for quadratic programming packages, how should G and h be formulated? Consider

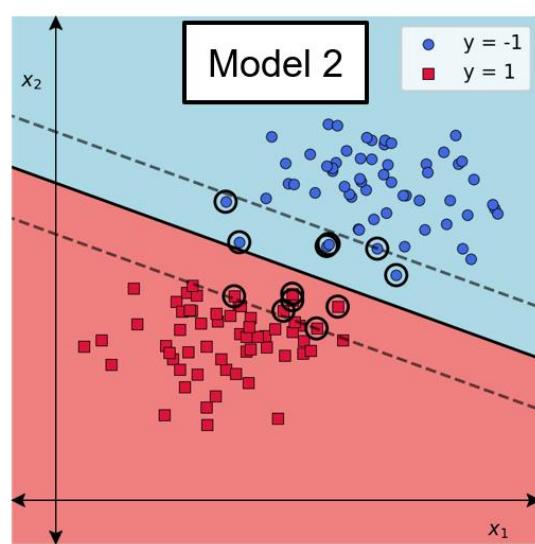
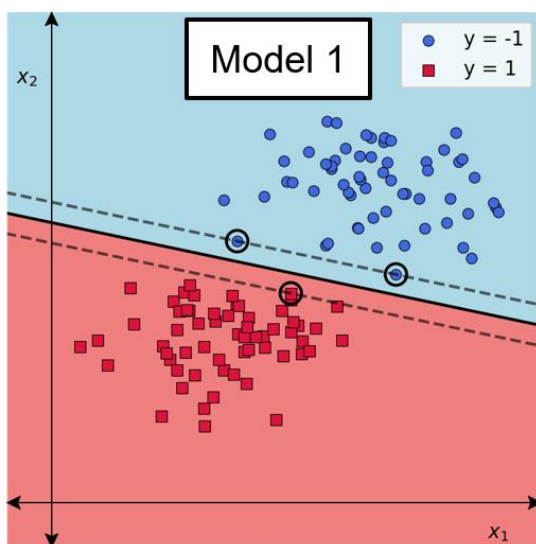
1. $G = y^*[x_1, x_2, 1]$, $h = 1$
2. $G = -y^*[x_1, x_2, 1]$, $h = 1$
3. $G = y^*[x_1, x_2, 1]$, $h = -1$
4. $G = -y^*[x_1, x_2, 1]$, $h = -1$
- 5.

4 is the correct formulation

Problem 3

Which of the following two trained models will be faster to evaluate a set of 1000 test points?

Model 1 will be faster as it has less supporting vectors.



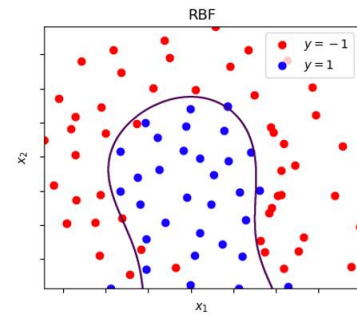
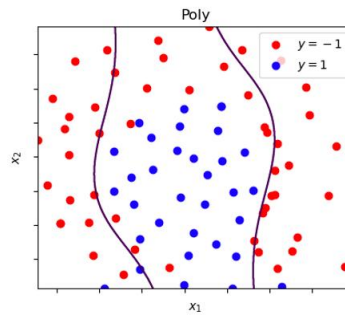
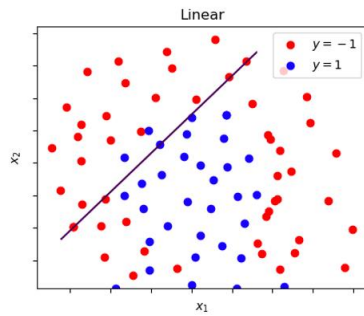
Problem 4

(Multiple Choice - select one)

Visually, which of the following SVM models classifies the data best?

1. Linear
2. Polynomial
3. RBF

RBF classifies data the best.



Problem 5

Consider a multiclass SVM which classifies between 3 different classes. Each class has the same number of data points. Which would be faster to train, a one-versus-one or one-versus-rest classifier?

One versus one would be faster to train as it deals with a smaller size of data.

Problem 6

The following SVR model is fit to the data with an RBF kernel. Assume the model uses epsilon insensitive loss, L_ϵ . How many data points contribute to the loss L_ϵ for the given model?

Only 4 points.

