

CSE 493 G1/ 599 G1
Deep Learning
Winter 2024 Practice Quiz

Jan 12, 2023

Full Name: _____

UW Net ID: _____

Question	Score
True/False (4 pts)	
Multiple Choice (8 pts)	
Short Answer (8 pts)	
Total (20 pts)	

Welcome to the CSE 493 G1 Quiz Prep!

- The exam is 30 min and is **double-sided**.
- No electronic devices are allowed.

I understand and agree to uphold the University of Washington Honor Code during this exam.

Signature: _____

Date: _____

Good luck!

This page is left blank for scratch work only. DO NOT write your answers here.

1 True / False (4 points) - Recommended 4 Minutes

Fill in the circle next to True or False, or fill in neither. Fill it in completely like this: ●. No explanations are required.

Scoring: Correct answer is worth 1 points.

1.1 To avoid over-fitting on the train set, one should always tune hyperparameters on the test set.

- True
- False

SOLUTION:

False, you should hyperparam tune on the val set

1.2 When using $K=1$ for KNN, train accuracy is always greater than or equal to test accuracy.

- True
- False

SOLUTION:

True. Train Accuracy is 100% for $K=1$

1.3 Suppose we have trained a linear classifier (with weights W) that achieves 100% accuracy on our dataset. If we change the weights to $2W$, the classifier will maintain the same accuracy.

- True
- False

SOLUTION:

True.

1.4 KNN is more suitable for high-dimensional data.

- True
- False

SOLUTION:

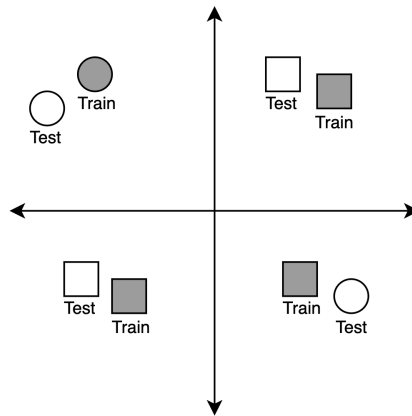
False. KNN's performance can deteriorate in high-dimensional spaces due to the "curse of dimensionality"

2 Multiple Choices (8 points) - Recommended 8 Minutes

Fill in the circle next to the letter(s) of your choice (like this: ●). No explanations are required. Choose ALL options that apply.

Each question is worth 2 points and the answer may contain one or more options. Selecting all of the correct options and none of the incorrect options will get full credits. For questions with multiple correct options, each incorrect or missing selection gets a 1-point deduction (up to 2 points).

2.1 Consider the dataset pictured below. The features of each datapoint are given by its position. So the datapoint (0,1) appears at position (0,1). The ground truth label of the datapoint is given by its shape, either circle or square. You have a test set of datapoints, shown with no fill, and a train set of data, shown with a grey fill. Which of the following statements are true about classifying this data?



- A: It is possible for a linear SVM to have 100% train accuracy
- B: It is possible for a linear SVM to have 100% test accuracy
- C: KNN with $K=1$ has higher test accuracy than with $K=4$
- D: KNN with $K=1$ has higher train accuracy than with $K=4$
- E: None of the above

SOLUTION:

A, C, D

A is True because we are using a linear SVM and it is possible to linearly separate the train data.

B is False because it is not possible to linearly separate the test data.

C is True because test accuracy is 75% when $K=1$, but 50% when $K=4$.

D is True because train accuracy is 100% when $K=1$, but 75% when $K=4$.

E is False

2.2 Why might you decide to train a neural network with softmax instead of using a KNN classifier on raw data?

- A: You believe your data is not linearly separable.
- B: Your train set is large, and you want a quick train time.
- C: Your train set is large, and you want a quick evaluation time.
- D: Your train set is large, and you want low memory costs at evaluation.
- E: You do not believe you have hand-constructed features that are useful for classification.

SOLUTION:

C, D, E

A is False because KNN is not a linear classifier, so you still might use a KNN even if you believe your data is not linearly separable.

B is False because neural networks generally need to train for a long time, while KNN do not.

C is True because neural networks have the same evaluation time regardless of train set size, but the evaluation time of KNNs scale with the train set size because you need to calculate the distance of a point to each train set and then sort them.

D is True because neural networks have the same memory cost regardless of train set size, but the memory cost time of KNNs scale with the train set size because you need to store the points to calculate the distances.

E is True because KNNs operate on some hand-constructed features, but neural networks are able to learn features from the data.

3 Short Answers (8 points) - Recommended 8 Minutes

Please make sure to write your answer only in the provided space.

3.1 Linear Classifier

You have a linear classifier with Weights W given below:

$$W = \begin{bmatrix} 3 & -1 & -2 \\ -3 & 1 & 4 \end{bmatrix}$$

This classifier has been trained to classify data points of the form $x = [a, b, c]$, where a represents how spiky a shape is, b represents how large a shape is and c represents how many dots the shape has.

The classifier will classify the shape as either a 'Wob' (class 1) or a 'Bob' (class 2). So the classifier works as follows:

$$Wx = \begin{bmatrix} \text{'Wob' Score} \\ \text{'Bob' Score} \end{bmatrix}$$

3.1.1 Classify a Point (4 points)

Consider the data point $x = [1, 3, -1]$. Is this classified as a 'Wob' or a 'Bob'?

SOLUTION:

$$Wx = \begin{bmatrix} 3 & -1 & -2 \\ -3 & 1 & 4 \end{bmatrix} \begin{bmatrix} 1 \\ 3 \\ -1 \end{bmatrix}$$

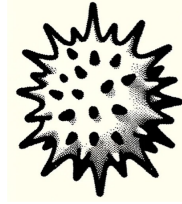
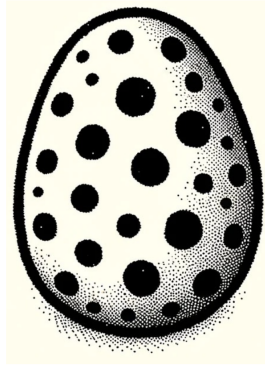
Let's compute this multiplication.
The product Wx results in:

$$Wx = \begin{bmatrix} 2 \\ -4 \end{bmatrix}$$

This means the score for 'Wob' is 2, and the score for 'Bob' is -4. Since the score for 'Wob' is higher, the data point $x = [1, 3, -1]$ is classified as 'Wob'.

3.1.2 Interpret the Classifier (4 points)

Examine the weights of W . Based on these weights, label which shape is 'Wob' and which shape is 'Bob'. (You may assume the the weights of the classifier correctly capture the features of the true objects.)



SOLUTION:

Looking at the weight vector, the first row is 3, -1, -2 which means that a Wob is spiky, but not large and doesn't have dots. The second row is -3, 1, 1 which means that a Bob is not spiky, but is large and has dots. So the shape on the left is a Bob and the shape on the right is a Wob.