

# Final

⚠ This is a preview of the published version of the quiz

Started: Jan 20 at 5:38pm

## Quiz Instructions

This is the final exam for the course 422/622. You have 3 hours to complete the final.

### Question 1

5 pts

Is there a situation where you would want to use a decision tree over a neural network? If so, give an example (be concrete). If not, explain why not.

Edit View Insert Format Tools Table

12pt ▾ Paragraph ▾ | **B** *I* U A ▾  ▾  $\tau^2$  ▾ | ⋮

p



0 words



### Question 2

5 pts

Name two advantages of a perceptron over an SVM. That is, why might you use a perceptron instead of an SVM?

Edit View Insert Format Tools Table

12pt ▾ Paragraph ▾ | **B** *I* U A ▾  ▾  $T^2$  ▾ | :

p



0 words



### Question 3

5 pts

Learning to read is an example of reinforcement learning, imitation learning, or both? Explain.

Edit View Insert Format Tools Table

12pt ▾ Paragraph ▾ | **B** *I* U A ▾  ▾  $T^2$  ▾ | :

p



0 words



#### Question 4

5 pts

A false positive pregnancy test is an example of bad precision or recall. Briefly explain.

Edit View Insert Format Tools Table

12pt ▾

Paragraph ▾

**B**

*I*

U

A ▾



$\tau^2$  ▾



p



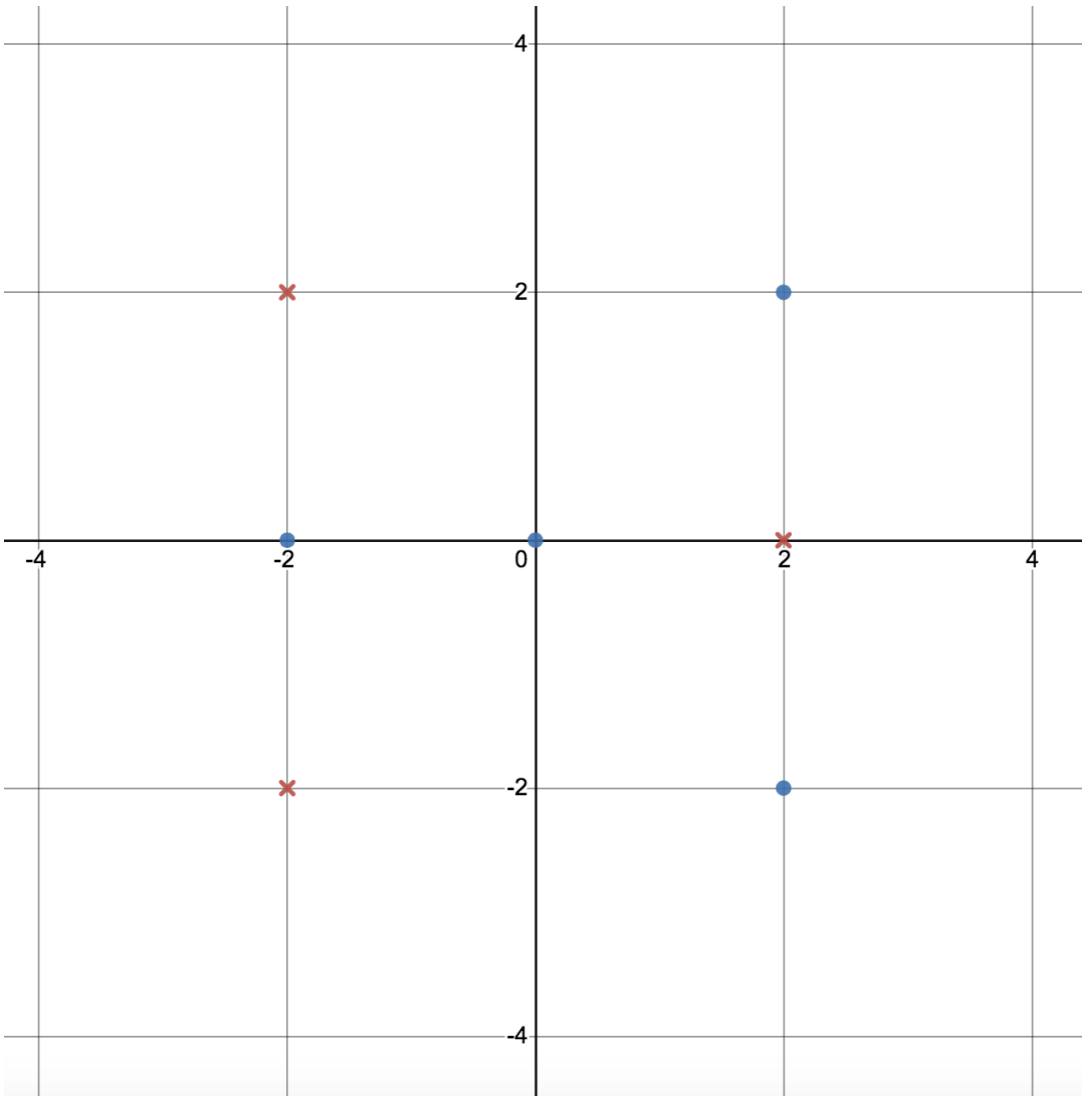
0 words



#### Question 5

5 pts

For each of the following classifiers, state whether or not they will be able to correctly classify the following training. If the answer is no, explain why not. If the answer is yes, make sure to indicate the particular hyperparameters/setting under which the model would be able to classify the data.



- a) Perceptron
- b) Decision Tree
- c) KNN
- d) K-Means

Edit View Insert Format Tools Table

12pt ▾ Paragraph ▾ | **B** *I* U A ▾  ▾  $T^2$  ▾ | :

p



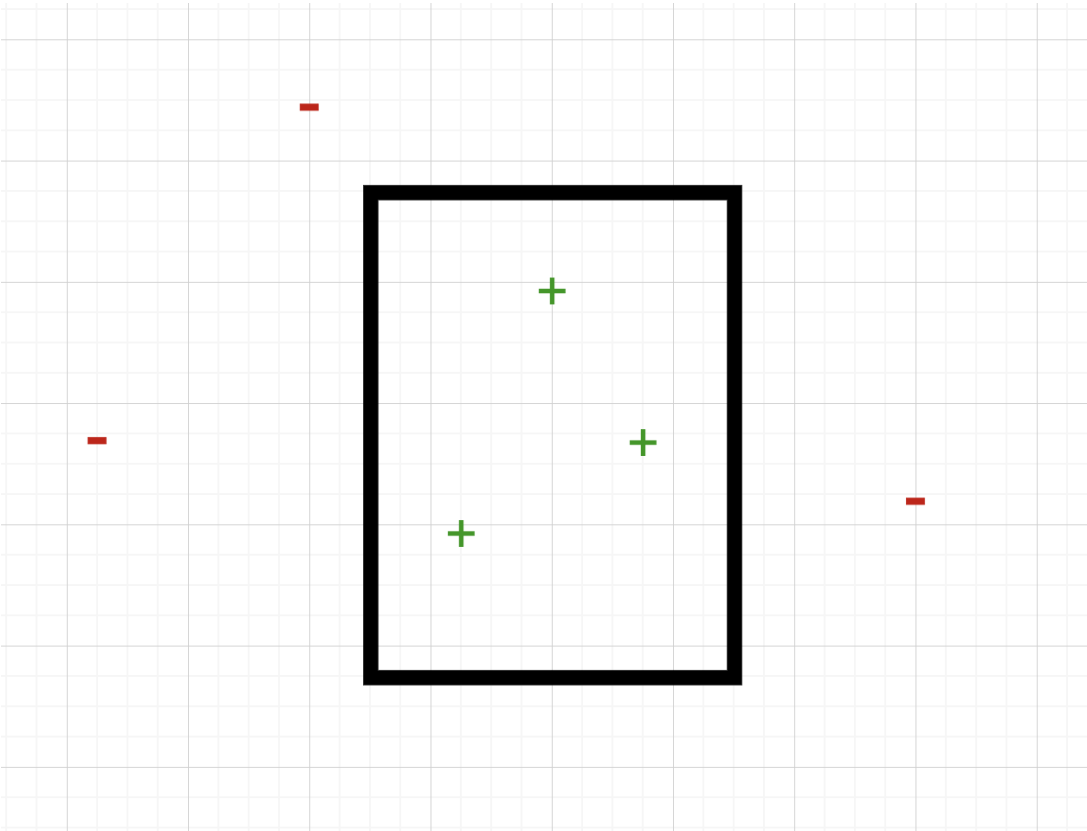
0 words



## Question 6


10 pts

Prove that the VC dimension of rectangle classifiers is at least 3. A rectangle classifier is simply a rectangle in 2D where the points inside of the rectangle are predicted as positive and the points outside of the rectangle are predicted as negative. See the image below as an example of a rectangle classifier. This is just an example so you can visualize the rectangle classifier.



Edit View Insert Format Tools Table

12pt ▾ Paragraph ▾ | **B** *I* U A ▾  ▾ T² ▾ | ⋮

p   | 0 words |   ⋮

**Question 7****10 pts**

Explain the similarities and differences between Imitation and Reinforcement Learning to someone outside of CS. That is, don't use technical jargon. Explain in plain English.

Edit View Insert Format Tools Table

12pt ▾ Paragraph ▾ | **B** *I* U A ▾  ▾  $T^2$  ▾ | ⋮

p



0 words

**Question 8****10 pts**

Which of the following models can form a linear decision boundary? For each model, provide a brief explanation for your yes or no answer.

a) Decision Tree

b) K Means

c) K-NN

d) Neural Network

e) SVM




f) PCA

g) Kernels

Edit View Insert Format Tools Table

12pt ▾ Paragraph ▾ | **B** *I* U A ▾  ▾  $\tau^2$  ▾ | ⋮

p

  | 0 words |   ⋮

## Question 9

10 pts

Let's say I have a large dataset, with 20 million samples. Each sample is represented by a 15-dimensional feature vector consisting of real values. What would be the best ML model for this problem? What would be the worst? How would your answers change if the numbers were swapped (15 samples, with 20 million features each)? Explain.

Edit View Insert Format Tools Table

12pt ▾ Paragraph ▾ | **B** *I* U A ▾  ▾  $\tau^2$  ▾ | ⋮



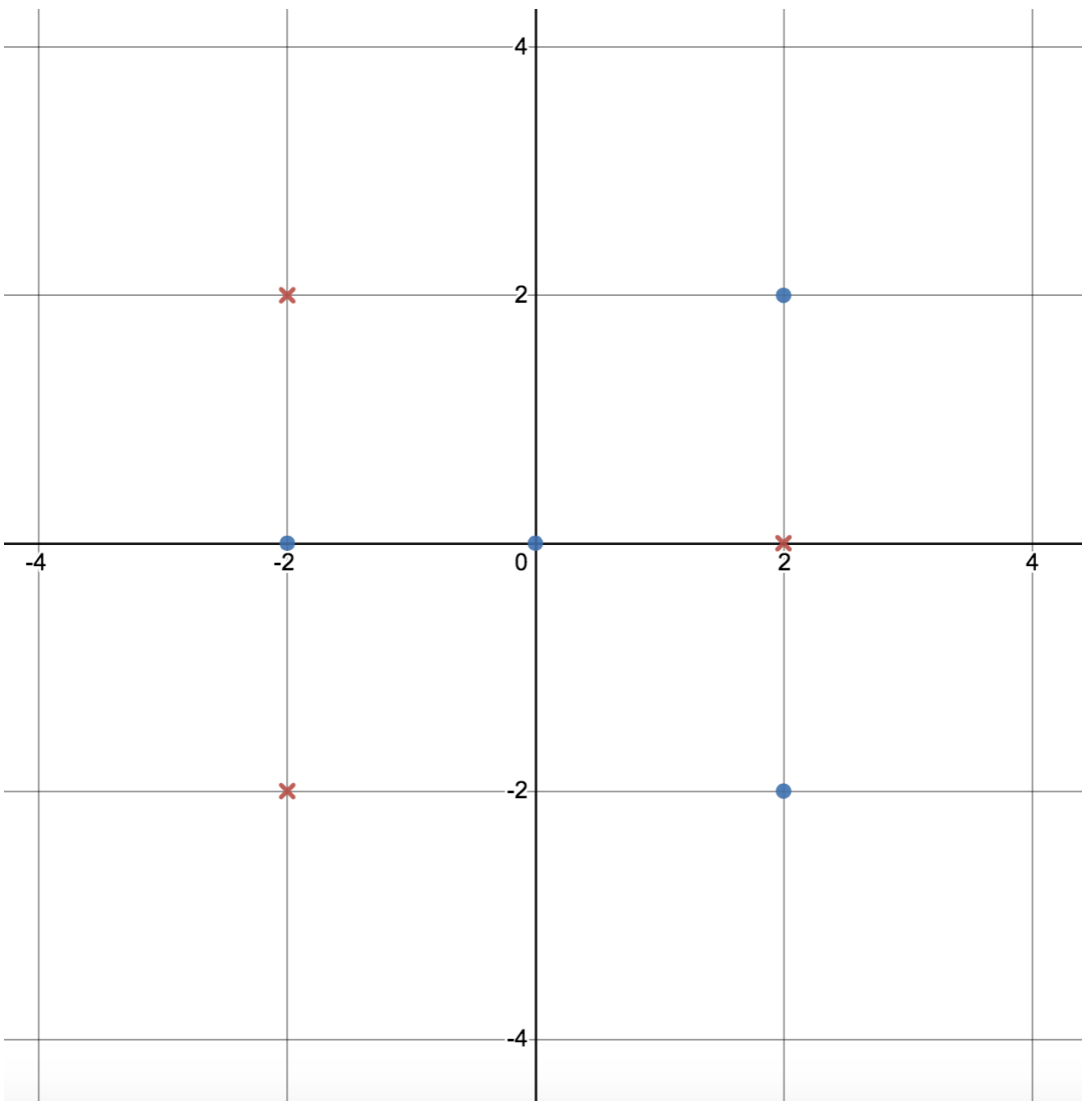
p



0 words

**Question 10****15 pts**

Assume you have the following training data (red Xs are negative and blue circles are positive). We want to use Adaboost to train an ensemble classifier. Let's assume our classifiers are ellipses, where the points inside the ellipse are classified as positive and the points outside are classified as negative. Answer the following questions. You should be able to answer these questions without explicitly using the formulas in Adaboost. That is, if you're doing a bunch of math, you might be thinking about this the wrong way.



- a) What classifier would Adaboost choose in the first iteration? Draw it. And explain in one sentence or less.
- b) What would be the weights of each sample after the first iteration of Adaboost (after re-weighting)?
- c) What classifier would Adaboost choose in the second iteration? Draw it and explain in one sentence or less.
- d) How would the final combination of the two classifiers classify the following point: (2,0)? Explain in one sentence or less.

Edit View Insert Format Tools Table

12pt ▾ Paragraph ▾ | **B** *I* U A ▾   ▾  $\tau^2$  ▾ | ⋮

p



0 words

**Question 11****20 pts**

Given the following training data, there are some missing values (gray boxes). Each of the columns in the data represents a feature, except the first, which indicates a sample number. Assume you have labels for your prediction problem, they're just not in this figure. You can also assume there are more than 9 samples and this is just a small subset of the dataset. Answer the following questions.

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE	DIS	RAD	TAX	PTRATIO	B	LSTAT
0	0.00632	18.0	2.31	0.0	0.538	6.575	65.2	4.0900	1.0	296.0	15.3	396.90	4.98
1	0.02731	0.0		0.0	0.469	6.421	78.9	4.9671	2.0	242.0	17.8	396.90	9.14
2	0.02729	0.0	7.07	0.0	0.469	7.185	61.1	4.9671	2.0	242.0	17.8	392.83	4.03
3	0.03237	0.0	2.18	0.0	0.458	6.998	45.8	6.0622		222.0	18.7	394.63	2.94
4	0.06905	0.0	2.18	0.0	0.458	7.147	54.2	6.0622	3.0	222.0	18.7	396.90	5.33
5	0.02985	0.0	2.18	0.0	0.458	6.430	58.7	6.0622	3.0	222.0	18.7	394.12	5.21
6	0.08829	12.5	7.87	0.0	0.524	6.012	66.6	5.5605	5.0	311.0	15.2		12.43
7	0.14455	12.5	7.87	0.0	0.524	6.172	96.1	5.9505	5.0	311.0	15.2	396.90	19.15
8	0.21124	12.5	7.87	0.0		5.631	100.0	6.0821	5.0	311.0	15.2	386.63	29.93
9	0.17004	12.5	7.87	0.0	0.524	6.004	85.9	6.5921	5.0	311.0	15.2	386.71	17.10

a) How could we use a K-NN classifier to fill in the missing feature values?

b) How could you use a neural network to fill in the missing feature values?

c) Is there another way to deal with the missing feature values, without removing the samples or trying to guess their values?

Edit View Insert Format Tools Table

12pt ▾ Paragraph ▾ | **B** *I* U A ▾  ▾  $\text{T}^2$  ▾ | ⋮

p



0 words



Not saved

Submit Quiz