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## Quiz 7

#### Problem 1

1/1 point (graded)

Suppose we use a basis expansion  $\Phi(x)$  for the purposes of getting a quadratic decision boundary. For two-dimensional data, we can do this by expanding to five features. What decision boundary is represented by  $w\cdot\Phi\left(x\right)+b=0$  for w = (2, 1, 2, -1, 0) and b = -1?

$$\bigcirc 2x_1^2 + x_2^2 + 2x_1 - x_2 - 1 = 0$$

$$\bigcirc 2x_1^2 + x_1 + 2x_2^2 - x_2 - 1 = 0$$

$$\bigcirc 2x_1 + x_1^2 + 2x_2 - x_2^2 - 1 = 0$$



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## Problem 2

1/1 point (graded)

True or false: When using a basis expansion of  $x \in \mathbb{R}^6$  to get a quadratic boundary, the expanded feature vector  $\Phi(x)$  has 36 pairwise features of the form  $x_1x_6$  or  $x_2x_4$ .







#### Problem 3

1/1 point (graded)

We want to use basis expansion of two-dimensional inputs  $x=(x_1,x_2)$  to get a quadratic boundary. If the target boundary is given by the equation  $(x_1-2)^2+(x_2-1)^2=16$  , what is the coefficient vector, w , and constant, b , such that the boundary has the form  $w\cdot\Phi\left(x
ight)+b=0$ ?

$$lackbox{0.5}{\bullet} w = egin{pmatrix} -4 & -2 & 1 & 1 & 0 \end{pmatrix}, \ b = -11$$

$$igcup w = egin{pmatrix} -4 & -2 & 1 & 1 & 0 \end{pmatrix}$$
 ,  $b = -16$ 

$$\bigcirc w = egin{pmatrix} 1 & 1 & -4 & -2 & 5 \end{pmatrix}$$
 ,  $b = -11$ 

$$w = (1 \quad -2 \quad 1 \quad -11 \quad 0), \ b = 16$$



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### Problem 5

1/1 point (graded)

For 12-dimensional x, what is the dimension of the basis expansion  $\Phi\left(x\right)$  that we use for getting a quadratic boundary?











#### Problem 6

1/1 point (graded)

Given a data set with n data points, each of d dimensions, what is the dimension of the vector,  $\alpha$ , which is used in the dual form of the perceptron algorithm?

 $\bigcirc d$ 







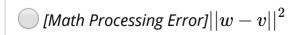


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## Problem 7

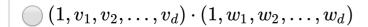
1/1 point (graded)

Given vectors  $v,w\in\mathbb{R}^d$ , which of the following expressions can be used in place of  $\Phi\left(v\right)\cdot\Phi\left(w\right)$ , where  $\Phi$  is the basis expansion used for a quadratic boundary?



$$\bigcirc 1 + (v \cdot w)^2$$

$$lefter{} lefter{} (1+v\cdot w)^2$$





#### Problem 8

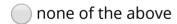
1/1 point (graded)

Which vector are we solving for when using the dual form of the SVM?











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# Problem 9

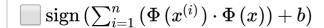
1/1 point (graded)

Which expression(s) can be used to classify a new point with the kernel SVM? Select all that apply.

$$lacksquare ext{sign}\left(\sum_{i=1}^{n}lpha_{i}y^{(i)}\left(\Phi\left(x^{(i)}
ight)\cdot\Phi\left(x
ight)
ight)+b
ight)$$

$$\prod \operatorname{sign}\left(\sum_{i=1}^n w \cdot \Phi\left(x^{(i)}
ight) + b
ight)$$

$$ightharpoonsign \operatorname{sign}\left(w\cdot\Phi\left(x
ight)+b
ight)$$





#### Problem 10

1/1 point (graded)

If you are finding a degree 4 decision boundary and if  $x \in \mathbb{R}^7$  , then the term  $x_1x_3x_4x_7^2$ is part of the expanded feature vector,  $\Phi(x)$ .







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## Problem 11

1/1 point (graded)

Which is/are the correct kernel function(s), k(x, z), that is used to find a degree 3decision boundary? (Here  $\Phi$  refers to the basis expansion for a degree-3 polynomial boundary.)

$$\bigcap k\left( x,z
ight) =x\cdot z$$

$$k(x,z) = \Phi(x) \cdot \Phi(z)$$

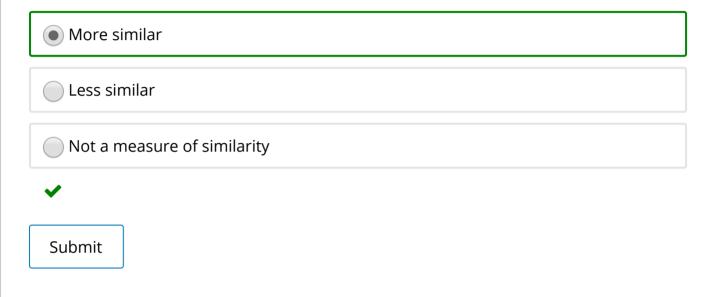
$$k(x,z) = (1 + \Phi(x) \cdot \Phi(z))^3$$



## Problem 12

1/1 point (graded)

Vectors that produce high values with the kernel function are more similar or less similar than vectors that produce low values?



## Problem 13

1/1 point (graded)

True or false: Decision trees typically perform best when they are grown until the training error is 0%.





#### Problem 14

1/1 point (graded)

Overfitting the data with a decision tree will result in which of the following?

decision boundary is linear.







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