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Quiz 3

Problem 1

1/1 point (graded)

What is the dimension of A^T, where A is the $1 \times n$ "row vector" $[1, 2, 3, \ldots, (n-1), n]$?

○ 1×1

○ $1 \times n$

● $n \times 1$

○ $n \times n$

✓

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Problem 2

1/1 point (graded)

True or false: $((A^T)^T)^T = A^T$

● True

○ False

✓

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Problem 3

1/1 point (graded)

Let $M = \begin{pmatrix} 1 & 5 \\ 2 & 2 \end{pmatrix}$ and let $N = \begin{pmatrix} 0 & 2 \\ 5 & 5 \end{pmatrix}$, what is $M + N$?

● $M + N = \begin{pmatrix} 1 & 7 \\ 7 & 7 \end{pmatrix}$

○ $M + N = \begin{pmatrix} 0 & 10 \\ 10 & 10 \end{pmatrix}$

○ $M + N = \begin{pmatrix} 3 & 10 \\ 2 & 7 \end{pmatrix}$

○ $M + N = \begin{pmatrix} 3 & 5 \\ 6 & 7 \end{pmatrix}$

✓

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Problem 4

1/1 point (graded)

Give the transpose of $M = \begin{pmatrix} 3 & 1 & 2 \\ 2 & 1 & 8 \\ 4 & 4 & 4 \end{pmatrix}$

○ $M^T = \begin{pmatrix} 2 & 8 & 4 \\ 1 & 1 & 4 \\ 3 & 2 & 4 \end{pmatrix}$

○ $M^T = \begin{pmatrix} 4 & 4 & 4 \\ 2 & 1 & 8 \\ 3 & 1 & 2 \end{pmatrix}$

● $M^T = \begin{pmatrix} 3 & 2 & 4 \\ 1 & 1 & 4 \\ 2 & 8 & 4 \end{pmatrix}$

○ $M^T = \begin{pmatrix} 4 & 8 & 2 \\ 4 & 1 & 1 \\ 4 & 2 & 3 \end{pmatrix}$

✓

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Problem 5

1/1 point (graded)

Given $\mathbf{x} = \begin{pmatrix} 1 & 4 \end{pmatrix}$ and $\mathbf{y} = \begin{pmatrix} 4 \\ 1 \end{pmatrix}$, what is $\mathbf{x} - \mathbf{y}^\mathbf{T}$?

● $\mathbf{x} - \mathbf{y}^\mathbf{T} = \begin{pmatrix} -3 & 3 \end{pmatrix}$

○ $\mathbf{x} - \mathbf{y}^\mathbf{T} = \begin{pmatrix} 3 & -3 \end{pmatrix}$

○ $\mathbf{x} - \mathbf{y}^\mathbf{T} = \begin{pmatrix} 0 & 0 \end{pmatrix}$

○ Cannot subtract these two vectors

✓

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Problem 6

1/1 point (graded)

If the dot product of two vectors, $\mathbf{a}^{\cdot}\mathbf{b}$, is equal to 0, what must be true? Select all that apply.

☐ $\mathbf{a}$ equals $\mathbf{b}$

☑ $\mathbf{b}^{\cdot}\mathbf{a} = \mathbf{0}$

☐ either $\mathbf{a} = \mathbf{0}$ or $\mathbf{b} = \mathbf{0}$

☑ $\mathbf{a}$ is orthogonal to $\mathbf{b}$

✓

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Problem 7

1/1 point (graded)

Given a vector, $\mathbf{x} \in \mathbb{R}^{\mathbf{d}\times\mathbf{1}}$, the product $\mathbf{x}\mathbf{x}^{\mathbf{T}}$ is equal to which of the following:

○ *[Math Processing Error]*$||\mathbf{x}||^2$

○ 1

○ The identity matrix, I_d

● a $d \times d$ matrix

✓

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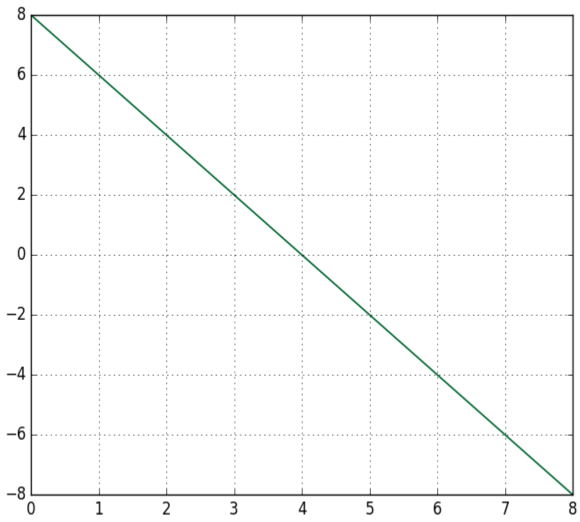
Problem 8

1/1 point (graded)

The following line is given by the equation $\mathbf{w}^{\cdot}\mathbf{x} = c$, where $c = 8$. What are the vectors $\mathbf{x}$ and $\mathbf{w}$?



○ $\mathbf{x} = \begin{pmatrix} x_1 \\ x_2 \end{pmatrix}, \mathbf{w} = \begin{pmatrix} 8 & -8 \end{pmatrix}$

○ $\mathbf{x} = \begin{pmatrix} x_1 \\ x_2 \end{pmatrix}, \mathbf{w} = \begin{pmatrix} -4 & 1 \end{pmatrix}$

○ $\mathbf{x} = \begin{pmatrix} x_1 \\ x_2 \end{pmatrix}, \mathbf{w} = \begin{pmatrix} -1 & 8 \end{pmatrix}$

● $\mathbf{x} = \begin{pmatrix} x_1 \\ x_2 \end{pmatrix}$, $\mathbf{w} = \begin{pmatrix} 2 & 1 \end{pmatrix}$

✓

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Problem 9

1/1 point (graded)

Indicate which of the following properties apply to matrix multiplication:

☑ Associative property (that is, $ABC = (AB)\,C = A\,(BC)$)

☐ Commutative property (that is, $AB = BA$)

☑ Existence of an identity matrix

✓

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Problem 10

1/1 point (graded)

Given two matrices, $A \in \mathbb{R}^{j \times k}$ and $B \in \mathbb{R}^{k \times l}$, what is $(AB)^T$?

○ AB^T

○ $A^T B^T$

○ BA^T

● $B^T A^T$

✓

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Problem 11

1/1 point (graded)

True or false: Given two square matrices, $A \in \mathbb{R}^{d \times d}$ and $B \in \mathbb{R}^{d \times d}$, if $AB = BA = I_d$, then $B = A^{-1}$.

● True

○ False

✓

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Problem 12

1/1 point (graded)

Which of the following are true about singular matrices?

☐ Singular matrices cannot also be diagonal matrices

☑ Singular matrices have a determinant of 0

☑ Singular matrices are not invertible

☐ Singular matrices include the identity matrix

✓

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Problem 13

1/1 point (graded)

Given the 2×2 matrix, $M = \begin{pmatrix} 1 & 5 \\ 1 & 4 \end{pmatrix}$, determine which of the following is the inverse matrix of M.

● $M^{-1} = \begin{pmatrix} -4 & 5 \\ 1 & -1 \end{pmatrix}$

○ $M^{-1} = \begin{pmatrix} 1 & \frac{1}{5} \\ 1 & \frac{1}{4} \end{pmatrix}$

○ $M^{-1} = \begin{pmatrix} 1 & -1 \\ -5 & 4 \end{pmatrix}$

○ Does not have an inverse

✓

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Problem 14

1/1 point (graded)

Which of the following matrices are singular?

☐ $\begin{pmatrix} 1 & 0 \\ 2 & 2 \end{pmatrix}$

☑ $\begin{pmatrix} 3 & 1 \\ 3 & 1 \end{pmatrix}$

☑ $\begin{pmatrix} 4 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{pmatrix}$

☑ $\begin{pmatrix} \frac{1}{3} & 1 \\ 1 & 3 \end{pmatrix}$

✓

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Problem 15

1/1 point (graded)

Given the matrix, $M = \begin{pmatrix} 1 & 3 \\ 2 & 7 \end{pmatrix}$, and the vector $\mathbf{x} = \begin{pmatrix} x_1 \\ x_2 \end{pmatrix}$, what expression below is equivalent to $\mathbf{x}^{\mathrm{T}} M \mathbf{x}$?

○ $x_1^2 + 3x_1x_2 + 14x_2^2$

○ $x_1 + 5x_1^2x_2^2 + 7x_2$

○ $3x_1 + 10x_2$

● $x_1^2 + 5x_1x_2 + 7x_2^2$

✓

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Problem 16

1/1 point (graded)

Suppose a Gaussian distribution has a covariance matrix that is diagonal, with the same value in each position along the diagonal. Which of the following can we conclude? Select all that apply.

- ☑ The features are uncorrelated
- ☑ The contour lines for the distribution are axis aligned
- ☑ The contour lines for the distribution are in concentric spheres
- ☑ Any point that is a fixed distance away from the mean μ has the same density

✓

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Problem 17

1/1 point (graded)

True or false: the only two parameters needed to define a multivariate Gaussian distribution are the mean, μ, and the covariance matrix, Σ.

- ● True
- ○ False

✓

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Problem 18

1/1 point (graded)

For a spherical Gaussian distribution, defined by $\mu \in \mathbb{R}^d$ and $\Sigma = \sigma^2 I_d$, what is the determinant of the covariance matrix, $|\Sigma|$?

- ○ σ^2
- ● σ^{2d}
- ○ σ^d
- ○ σ

✓

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Problem 19

1/1 point (graded)

Given the following 4 data points in $\mathbb{R}^3$, computer the mean, $\mu \in \mathbb{R}^3$.

Data points: $x_1 = (0, 0, 1)$, $x_2 = (1, 4, 1)$, $x_3 = (2, 2, 1)$, $x_4 = (1, 2, 5)$.

- ○ $\mu = \left(1.5, 2.5, 3 \right)$
- ● $\mu = \left(1, 2, 2 \right)$
- ○ $\mu = \left(1.33, 2.66, 2.66 \right)$
- ○ $\mu = \left(4, 8, 8 \right)$

✓

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Problem 20

1/1 point (graded)

True or false: the covariance matrix of any data set is necessarily symmetric.

● True

○ False

✓

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Problem 21

1/1 point (graded)

True or false: In a binary classification setting, where each class is modeled by a multivariate Gaussian, a data point, x, will always be classified as label 1 instead of label 2 if the distance from x to μ_1 is less than the distance from x to μ_2.

○ True

● False

✓

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Problem 22

1/1 point (graded)

If a Gaussian generative model is used for classification, and the decision boundary for the k classes is linear, which of the following statements must be true?

○ There are exactly two classes, i.e. $k = 2$

○ The class probabilities, π_i, must be equal

○ The means, μ_i, are equidistant from this decision boundary

● The covariance matrices, Σ_i, must be equal

✓

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Problem 23

1/1 point (graded)
If a test error is 0%, what does this indicate about the model?

● None of the data in the test set was misclassified

○ The model will perfectly classify every new data point

○ The data in the test set is not a good representation of all classes

○ 0% test error is not achievable

✓

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Problem 24

1/1 point (graded)

Suppose a generative Gaussian model is used for a binary classification problem with two classes, A and B. If the decision boundary is linear and the class probability $\pi_A > \pi_B$, would you expect the boundary to be closer to μ_A or μ_B?

○ The boundary will be closer to μ_A

● The boundary will be closer to μ_B

○ The boundary will be equidistant to μ_A and μ_B

○ This cannot be determined without the respective covariance matrices

✓

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Problem 25

1/1 point (graded)

True or false: a Gamma distribution is useful for modeling features which are constrained to a specific interval.

○ True

● False

✓

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Problem 26

1/1 point (graded)

Using the Naive Bayes classifier, which of the following are necessarily true?

☐ Each coordinate of the data is modeled by the same distribution

☑ Each coordinate of the data is taken to be independent of the others

☐ Provides a very inaccurate model for classification

☐ Each pairwise set of coordinates are modeled together

✓

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Problem 27

1/1 point (graded)

Which distribution would be useful for specifying the distribution over first names in a phone book for some random city?

○ Gamma Distribution

○ Beta Distribution

○ Poisson Distribution

● Categorical Distribution

✓

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