Quiz 9

Problem 1

1/1 point (graded)

What is the projection of the i'th coordinate direction onto the j'th coordinate direction, for $i \neq j$?

- (●) 0
- ( ) 1
- ( ) $\sqrt{2}$
- ( ) 2

✔

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Problem 2

1/1 point (graded)

What is the unit vector in the direction of $(4, 1, 1, 9, 1)$?

- ( ) $(\frac{1}{4}, \frac{1}{16}, \frac{1}{16}, \frac{9}{16}, \frac{1}{16})$

- ○ $(\frac{1}{4}, \frac{1}{12}, \frac{1}{12}, \frac{1}{2}, \frac{1}{12})$
- ◉ $(\frac{2}{5}, \frac{1}{10}, \frac{1}{10}, \frac{9}{10}, \frac{1}{10})$
- ○ $(\frac{1}{5}, \frac{1}{20}, \frac{1}{20}, \frac{9}{20}, \frac{1}{20})$

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Problem 3

1/1 point (graded)

Given a data set with the covariance matrix, $\Sigma = \begin{pmatrix} 1 & 0.6 \\ 0.6 & 0.25 \end{pmatrix}$, find the variance in the direction of $(1, 1)$.

- ○ 0.655
- ◉ 1.225
- ○ 2.450
- ○ 1.667

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Problem 4

1/1 point (graded)

Given a data set, X, represented by the covariance matrix Σ, which of the following expressions gives the variance of X in the direction of u?

- ○ $\Sigma^{-1}u$
- ◉ $u^T\Sigma u$
- ○ $u^T u|\Sigma|$
- ○ $u\Sigma u^T$

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Problem 5

1/1 point (graded)

Which of the following are characteristics of a set of orthonormal vectors?

- ☐ All of the vectors point in the same direction
- ☑ All of the vectors have length 1
- ☑ All of the vectors are orthogonal to each other
- ☐ All of the vectors have exactly one non-zero component, e.g. $(0, 0, 1, 0, 0)$

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Problem 6

1/1 point (graded)

Say you want to project points $x \in \mathbb{R}^4$ onto three directions u_1, u_2, and u_3. This projection can be realized by multiplying x by a matrix of what dimension?

- 4×3
- 4×4
- 3×4 ✔
- 3×1

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Problem 7

1/1 point (graded)

True or false: An MNIST projection from 784-dimensional space into 50-dimensional space reconstructs into an image that is not recognizable.

- True
- False ✔

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Problem 8

1/1 point (graded)

True or false: A $d \times d$ matrix M can be perfectly reconstructed just from its d eigenvectors.

- ○ True
- ◉ False

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Problem 9

1/1 point (graded)

Which of the following are properties of eigenvectors?

- ☐ Eigenvectors are necessarily of unit length
- ☐ Unit length eigenvectors are all proportional to each other
- ☑ There are d orthogonal, unit length eigenvectors for a $d \times d$ matrix, M

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Problem 10

1/1 point (graded)

For the matrix, $M = \begin{pmatrix} 1 & 1 & 4 \\ 1 & -1 & 0 \\ 0 & 1 & 3 \end{pmatrix}$, is the vector $w = \frac{1}{\sqrt{17}}(0, 4, -1)$ an eigenvector?

If so, what is the eigenvalue for that eigenvector?

- ◉ Yes, eigenvalue = -1

- Yes, eigenvalue = 2
- Yes, eigenvalue = $-\frac{1}{2}$
- No, not an eigenvector

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Problem 11

1/1 point (graded)

Suppose M is a symmetric matrix. Let U be the matrix whose columns are the eigenvectors of M, and let Λ be the diagonal matrix whose entries are the eigenvalues of M. Which of the following expressions is equivalent to the matrix product Mx?

- $Mx = UU^T x$
- $Mx = U\Lambda U^T x$
- $Mx = U\Lambda Ux$
- $Mx = U\Lambda^{-1}U^T x$

✔

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Problem 12

1/1 point (graded)

When we represent data in the basis given by the eigenvectors of the covariance matrix, are the features less correlated or more correlated than when representing the same data in the standard basis?

Less correlated ✔

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