Q1

1 Point

What is the maximum number of eigenvectors for a matrix with dimensions 4×5?

- ○ 4
- ○ 5
- ○ 20
- ◉ 0

Eigenvectors are only defined for square matrices.

Q2

1 Point

What is the maximum rank for a matrix with dimensions 4×5?

- ◉ 4
- ○ 5
- ○ 20
- ○ 0

Since the row and column ranks of a matrix are identical, the rank can be no larger than the smaller dimension.

Q3

1 Point

Which of the following values of a would make the matrix

$$\begin{pmatrix} 1 & 1 & 3 \\ -1 & -1 & 2 \\ 2 & 2 & a \end{pmatrix}$$

full rank?

(*Check all that are correct.*)

- [ ] 5
- [ ] 6
- [ ] -4
- [ ] 0

No value makes this matrix full rank. The first two columns are not linearly independent, so the matrix must be rank deficient.

Q4

1 Point

The union of two sets is the set of all points that are in **either** of the two sets. Is the union of two convex sets also a convex set?

- ○ Yes
- ◉ No

See the counter example below, which is the union of two convex triangles. One can draw a line connecting points in the two triangles that leaves the union.

Q5

1 Point

Are the vectors $\begin{pmatrix}3\\2\end{pmatrix}$, $\begin{pmatrix}-1\\0\end{pmatrix}$, and $\begin{pmatrix}1\\-1\end{pmatrix}$ a basis?

- ○ Yes
- ⊙ No

Three vectors cannot be a basis in a two-dimensional space.

Q6

1 Point

The vector $\begin{pmatrix}3\\2\end{pmatrix}$ can be decomposed as $-\frac{1}{3}\begin{pmatrix}1\\-1\end{pmatrix}+\frac{5}{3}\begin{pmatrix}x\\1\end{pmatrix}$.

The value of x is _____.

$x = 2$

Q7

1 Point

Let $\mathbf{A}$ be an 5×5 matrix with rank 4. How many solutions are there to the **homogeneous** system of equations $\mathbf{Ax} = \mathbf{0}$?

- ○ 0
- ○ 1
- ⊙ infinitely many
- ○ not enough information

We know this system has a trivial solution. This cannot be a unique solution since there is no inverse for rank-deficient matrices. Therefore, there must be infinitely many solutions.

Q8

1 Point

Let $\mathbf{A}$ be an 5×5 matrix with rank 4. How many solutions are there to the **inhomogeneous** system of equations $\mathbf{Ax} = \mathbf{b}$?

- ○ 0
- ○ 1
- ○ infinitely many
- ⊙ not enough information

We do not know if the rank of the augmented matrix [**A b**] also equals four, so we cannot say if there is a solution.

Q9

1 Point

The dot product between any two eigenvectors is zero.

- ○ True
- ⊙ False

Eigenvectors are linearly independent but not necessarily orthogonal.

Q10

1 Point

The multivariate Newton's method will terminate at a local maximum, minimum, or inflection point.

- ○ True
- ⊙ False

Newton's method will terminate at a root (when **f**(**x**) = **0**). This is not always an extreme point.