CS691 Quiz 9 Name ___________________________

1. PCA is a procedure that always reduces the dimensionality of the data. That is, it always reduces the number of features in the data. True or false. Explain in one sentence. (2 points)

False. PCA projects the data into a different space. It only reduces the dimension if you
choose K<D

2. For the following matrix, decide which, if any, of the following vectors are eigenvectors and give the corresponding eigenvalue. (4 points)

$$\begin{bmatrix} 3 & 0 & 1 \\ -4 & 1 & 2 \\ -6 & 0 & -2 \end{bmatrix} \quad \underset{(1)}{\begin{bmatrix} 2 \\ 2 \\ -1 \end{bmatrix}} \quad \underset{(2)}{\begin{bmatrix} -1 \\ 0 \\ 2 \end{bmatrix}} \quad \underset{(3)}{\begin{bmatrix} -1 \\ 1 \\ 3 \end{bmatrix}} \quad \underset{(4)}{\begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}} \quad \underset{(5)}{\begin{bmatrix} 3 \\ 2 \\ 1 \end{bmatrix}}$$

Test by matrix multiplication to see if Av=lv (l is lambda)

(1)No
(2)No
(3)No
(4)Yes 1
(5)No

3. An eigenvector is a vector whose values remain unchanged when a linear transformation is applied to it. True or false. Explain. (2 points)

False. The direction does not change.

4. I have the following eigenvalues corresponding to eigenvectors of the covariance matrix:
$\lambda_1 = 10$, $\lambda_2 = 6$, $\lambda_3 = 4$, $\lambda_4 = 3$, $\lambda_5 = 2$
If I want to explain at least 90% of the variance in my data, how many eigenvectors will I use? (2 points)

(10+6+5+3)/(10+6+4+3+2) = 23/25 =0.92

So we would use 4 eigenvectors

CS491 Quiz 9 Name ____________________________

1. PCA is a procedure that always reduces the dimensionality of the data. That is, it always reduces the number of features in the data. True or false. Explain in one sentence. (2 points)

Same as 691

2. For the following matrix, decide which, if any, of the following vectors are eigenvectors and give the corresponding eigenvalue. (4 points)

$$\begin{bmatrix} 3 & 0 & 1 \\ -4 & 1 & 2 \\ -6 & 0 & -2 \end{bmatrix} \underset{(1)}{\begin{bmatrix} 2 \\ 2 \\ -1 \end{bmatrix}} \underset{(2)}{\begin{bmatrix} -1 \\ 0 \\ 2 \end{bmatrix}} \underset{(3)}{\begin{bmatrix} -1 \\ 1 \\ 3 \end{bmatrix}} \underset{(4)}{\begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}} \underset{(5)}{\begin{bmatrix} 3 \\ 2 \\ 1 \end{bmatrix}}$$

Same as 691

3. Find the covariance matrix for the following data. Do not perform standardization. (4 points) $s_1 = (-1, -1)$, $s_2 = (-1, 1)$, $s_3 = (1, -1)$, $s_4 = (1, 1)$.

Data Matrix:
-1 -1
-1 1
1 -1
1 1

Subtract Mean:
-1 -1
-1 1
1 -1
1 1

ZT=
-1 -1 1 1
-1 1 -1 1

ZTZ =
4 0
0 4