Assignment-5

The due date for submitting this assignment has passed.

Due on 2021-02-24, 23:59 IST.

As per our records you have not submitted this assignment.

1) The pseudo-inverse of a tall full column rank matrix $\mathbf{A}$ is given as *1 point*

- $(\mathbf{A}\mathbf{A}^T)^{-1}\mathbf{A}^T$
- $\mathbf{A}^T(\mathbf{A}\mathbf{A}^T)^{-1}$
- $\mathbf{A}(\mathbf{A}\mathbf{A}^T)^{-1}$
- $(\mathbf{A}^T\mathbf{A})^{-1}\mathbf{A}^T$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$(\mathbf{A}^T\mathbf{A})^{-1}\mathbf{A}^T$

2) Consider the least-squares (LS) problem $\min \|\bar{\mathbf{y}} - \mathbf{A}\bar{\mathbf{x}}\|^2$, where $\mathbf{A}$ is a tall matrix with full column rank. The solution $\hat{\mathbf{x}}$ for this LS problem is *1 point*

- $\bar{\mathbf{y}}(\mathbf{A}\mathbf{A}^T)^{-1}\mathbf{A}^T$
- $\bar{\mathbf{y}}^T\mathbf{A}^T(\mathbf{A}\mathbf{A}^T)^{-1}$
- $(\mathbf{A}^T\mathbf{A})^{-1}\mathbf{A}^T\bar{\mathbf{y}}$
- $\mathbf{A}(\mathbf{A}\mathbf{A}^T)^{-1}\bar{\mathbf{y}}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$(\mathbf{A}^T\mathbf{A})^{-1}\mathbf{A}^T\bar{\mathbf{y}}$

3) The least-squares (LS) principle can be used for *1 point*

- Only channel estimation in wireless systems
- Only linear regression in machine learning
- Only polynomial fitting for mathematical modelling
- All of these applications

No, the answer is incorrect.
Score: 0

Accepted Answers:
All of these applications

4) Consider the matrix $\mathbf{A}$ below *1 point*

$$\mathbf{A} = \begin{bmatrix} 1 & 1 \\ 1 & -1 \\ 1 & -1 \\ 1 & 1 \end{bmatrix}$$

The pseudo-inverse of the matrix $\mathbf{A}$ is

- $\frac{1}{4}\begin{bmatrix} 1 & 1 \\ 1 & -1 \\ 1 & -1 \\ 1 & 1 \end{bmatrix}$
- $\frac{1}{4}\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -1 & -1 & 1 \end{bmatrix}$
- $\frac{1}{4}\begin{bmatrix} 1 & -1 & 1 & -1 \\ 1 & 1 & -1 & -1 \end{bmatrix}$
- $\frac{1}{4}\begin{bmatrix} 1 & 1 \\ -1 & 1 \\ 1 & -1 \\ -1 & -1 \end{bmatrix}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{1}{4}\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -1 & -1 & 1 \end{bmatrix}$

5) Consider the linear system of equations $\bar{\mathbf{y}} = \mathbf{A}\bar{\mathbf{x}}$, where *1 point*

$$\mathbf{A} = \begin{bmatrix} 1 & 1 \\ 1 & -1 \\ 1 & -1 \\ 1 & 1 \end{bmatrix}, \bar{\mathbf{y}} = \begin{bmatrix} 1 \\ -2 \\ 3 \\ 2 \end{bmatrix}$$

The least-squares (LS) solution for the system of equations is

- $\frac{1}{2}\begin{bmatrix} 1 \\ -2 \end{bmatrix}$
- $\frac{1}{2}\begin{bmatrix} 2 \\ 1 \end{bmatrix}$
- $\begin{bmatrix} 1 \\ 2 \end{bmatrix}$
- $\frac{1}{3}\begin{bmatrix} 2 \\ -3 \end{bmatrix}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{1}{2}\begin{bmatrix} 2 \\ 1 \end{bmatrix}$

6) Principal Component Analysis (PCA) is used in machine learning for *1 point*

- Dimensionality reduction
- Signal Estimation
- Direction of Arrival determination
- Covariance classification

No, the answer is incorrect.
Score: 0

Accepted Answers:
Dimensionality reduction

7) Consider an Alamouti coded system with channel coefficients $h_1 = -2 - 3j, h_2 = 3 + 2j$ *1 point*
The effective channel matrix for this system is given as

- $\begin{bmatrix} -2-3j & 3+2j \\ 3-2j & 2+3j \end{bmatrix}$
- $\begin{bmatrix} -2-3j & 3+2j \\ 3-2j & 2-3j \end{bmatrix}$
- $\begin{bmatrix} -2-3j & 3+2j \\ -3-2j & 2-3j \end{bmatrix}$
- $\begin{bmatrix} -2-3j & 3-2j \\ 3-2j & 2-3j \end{bmatrix}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\begin{bmatrix} -2-3j & 3+2j \\ 3-2j & 2-3j \end{bmatrix}$

8) Let the covariance estimate of the data vectors obtained during Principal Component Analysis (PCA) be denoted by $\mathbf{R}$. The vector $\bar{\mathbf{v}}_1$ corresponding to the direction of the largest principal component is given as *1 point*

- Eigenvector of $\mathbf{R}$ corresponding to the smallest eigenvalue
- Dominant vector in the nullspace of $\mathbf{R}$
- Eigenvector of $\mathbf{R}$ corresponding to the largest eigenvalue
- Right singular vector of $\mathbf{R}$ corresponding to any zero singular value

No, the answer is incorrect.
Score: 0

Accepted Answers:
Eigenvector of $\mathbf{R}$ corresponding to the largest eigenvalue

9) The determinant of a unitary matrix $\mathbf{U}$ satisfies the property *1 point*

- $\det(\mathbf{U}) = \pm 1$
- $\det(\mathbf{U}) = 1$
- $\det(\mathbf{U}) \geq 0$
- $|\det(\mathbf{U})| = 1$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$|\det(\mathbf{U})| = 1$

10) Let the covariance matrix $\mathbf{R}$ estimated during the Principal Component Analysis (PCA) be given as *1 point*

$$\mathbf{R} = \begin{bmatrix} -2 & -2 \\ 2 & -2 \end{bmatrix}\begin{bmatrix} 2 & 0 \\ 0 & 4 \end{bmatrix}\begin{bmatrix} -1 & 1 \\ -1 & -1 \end{bmatrix}$$

Let $\bar{\mathbf{v}}_1$ denote the unit-norm vector corresponding to the direction of the largest principal component extracted from the above covariance matrix. Then, the quantity $\bar{\mathbf{v}}_1^H\mathbf{R}\bar{\mathbf{v}}_1$ equals

- 6
- 12
- 16
- 8

No, the answer is incorrect.
Score: 0

Accepted Answers:
16