

Course outline

How does an NPTEL online course work?

Week-0

Week-1

Week-2

Week-3

Week-4

Week-5

Week-6

- Lec 26- Computation Mathematics Application: Polynomial Fitting

- Lec 27- Least Norm Solution

- Lec 28- Wireless Application: Multi-user Beamforming

- Lec 29- Singular Value Decomposition (SVD): Definition, Properties, Example

- Lec 30- SVD Application in MIMO Wireless Technology: Spatial-Multiplexing and High Data Rates

- Quiz : Assignment-6

- Feedback for Week 6

- Solution-6

Week-7

Week-8

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Week-11

Week-12

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Assignment-6

The due date for submitting this assignment has passed.

Due on 2021-03-03, 23:59 IST.

As per our records you have not submitted this assignment.

 1) Consider a wide matrix \mathbf{A} , with full row rank. Its pseudo-inverse 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:

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

 2) Consider the least-norm (LN) problem $\min \|\tilde{\mathbf{x}}\|$, with the constraint that $\tilde{\mathbf{y}} = \mathbf{A}\tilde{\mathbf{x}}$, where \mathbf{A} is a wide matrix with full row rank. The solution $\hat{\tilde{\mathbf{x}}}$ for this LN problem is

1 point

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

No, the answer is incorrect.

Score: 0

Accepted Answers:

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

 3) Consider the matrix \mathbf{A} defined as

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

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

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

No, the answer is incorrect.

Score: 0

Accepted Answers:

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

 4) Consider the linear system of equations $\tilde{\mathbf{y}} = \mathbf{A}\tilde{\mathbf{x}}$, where

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

The least norm solution for this system of equations is

1 point

- $\frac{1}{4} \begin{bmatrix} 2 \\ 3 \\ -3 \\ -2 \end{bmatrix}$
 $\frac{1}{4} \begin{bmatrix} 2 \\ -3 \\ -1 \\ 2 \end{bmatrix}$
 $\frac{1}{4} \begin{bmatrix} 1 \\ -5 \\ 5 \\ -1 \end{bmatrix}$
 $\frac{1}{4} \begin{bmatrix} -2 \\ 3 \\ -1 \\ -2 \end{bmatrix}$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$\frac{1}{4} \begin{bmatrix} 1 \\ -5 \\ 5 \\ -1 \end{bmatrix}$$

 5) Consider the matrix $\mathbf{C} = \begin{bmatrix} \tilde{\mathbf{h}} & \tilde{\mathbf{g}} \end{bmatrix}$. The optimal beamformer $\tilde{\mathbf{w}}$, such that $\tilde{\mathbf{h}}$ is the channel vector of the desired user and $\tilde{\mathbf{g}}$ is the channel vector of the interfering user, is given as

1 point

- $\mathbf{C}(\mathbf{C}^H\mathbf{C})^{-1} \begin{bmatrix} 1 \\ 0 \end{bmatrix}$
 $\mathbf{C}(\mathbf{C}^H\mathbf{C})^{-1} \begin{bmatrix} 0 \\ 1 \end{bmatrix}$
 $(\mathbf{C}^H\mathbf{C})^{-1}\mathbf{C} \begin{bmatrix} 1 \\ 0 \end{bmatrix}$
 $(\mathbf{C}\mathbf{C}^H)^{-1}\mathbf{C} \begin{bmatrix} 1 \\ 0 \end{bmatrix}$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$\mathbf{C}(\mathbf{C}^H\mathbf{C})^{-1} \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

 6) The optimal beamformer $\tilde{\mathbf{w}}$, such that $\tilde{\mathbf{h}} = \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$ is the channel vector of the desired user and $\tilde{\mathbf{g}} = \begin{bmatrix} -1 \\ 2 \\ -3 \\ 1 \end{bmatrix}$ is the channel vector of the interfering user, is given as

1 point

- $\frac{1}{59} \begin{bmatrix} 14 \\ 13 \\ 12 \\ 16 \end{bmatrix}$
 $\frac{1}{59} \begin{bmatrix} 14 \\ 17 \\ 19 \\ 16 \end{bmatrix}$
 $\frac{1}{59} \begin{bmatrix} 11 \\ 17 \\ 12 \\ 16 \end{bmatrix}$
 $\frac{1}{59} \begin{bmatrix} 14 \\ 17 \\ 12 \\ 16 \end{bmatrix}$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$\frac{1}{59} \begin{bmatrix} 14 \\ 17 \\ 12 \\ 16 \end{bmatrix}$$

7) The acronym SVD stands for

1 point

- Simple value deconstruction
 Singular value decomposition
 Salient visual demonstration
 Silent vertical Doppler

No, the answer is incorrect.

Score: 0

Accepted Answers:

Singular value decomposition

 8) For a wide full row rank matrix \mathbf{A} of size $M \times N$, with $M < N$, the number of solutions for the system of equations $\mathbf{A}\tilde{\mathbf{x}} = \tilde{\mathbf{b}}$ is

1 point

- 1
 ∞
 0
 2

No, the answer is incorrect.

Score: 0

Accepted Answers:

 ∞

 9) Consider the matrix $\mathbf{C} = \begin{bmatrix} \tilde{\mathbf{h}} & \tilde{\mathbf{g}} \end{bmatrix}$ with the optimal beamformer $\tilde{\mathbf{w}}$ designed such that $\mathbf{C}(\mathbf{C}^H\mathbf{C})^{-1} \begin{bmatrix} 0 \\ 1 \end{bmatrix}$. For this beamformer, the gain corresponding to user with channel vector $\tilde{\mathbf{g}}$ is

1 point

- 1
 0
 2
 ∞

No, the answer is incorrect.

Score: 0

Accepted Answers:

1

 10) In the SVD, the columns of the matrix \mathbf{V} satisfy

1 point

- $\tilde{\mathbf{v}}_i^H \tilde{\mathbf{v}}_j = 0$ for $i \neq j$ but NOT necessarily $\|\tilde{\mathbf{v}}_i\|^2 = 1$
 Both $\tilde{\mathbf{v}}_i^H \tilde{\mathbf{v}}_j = 0$ for $i \neq j$ and $\|\tilde{\mathbf{v}}_i\|^2 = 1$
 $\|\tilde{\mathbf{v}}_i\|^2 = 1$ but NOT necessarily $\tilde{\mathbf{v}}_i^H \tilde{\mathbf{v}}_j = 0$ for $i \neq j$
 Neither $\|\tilde{\mathbf{v}}_i\|^2 = 1$ nor necessarily $\tilde{\mathbf{v}}_i^H \tilde{\mathbf{v}}_j = 0$ for $i \neq j$

No, the answer is incorrect.

Score: 0

Accepted Answers:

 Both $\tilde{\mathbf{v}}_i^H \tilde{\mathbf{v}}_j = 0$ for $i \neq j$ and $\|\tilde{\mathbf{v}}_i\|^2 = 1$