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NPTEL

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Courses » Applied Optimization for Wireless, Machine Learning, Big-Data

Announcements Course Ask a Question Progress Mentor FAQ

Unit 2 - Week 1 : Introduction to properties of Vectors, Norms, Positive Semi-Definite matrices and Gaussian Random Vectors

Course outline

How to access the portal

Week 1 :
Introduction to properties of Vectors, Norms, Positive Semi-Definite matrices and Gaussian Random Vectors

Lec 01- Vectors and Matrices- Linear Independence and Rank

Lec 02 - Eigenvectors and Eigenvalues of Matrices and their Properties

Lec 03 - Positive Semidefinite (PSD) and Postive Definite (PD) Matrices and their Properties

Lec 04 - Inner

Assignment-1

The due date for submitting this assignment has passed.

As per our records you have not submitted this assignment. **Due on 2018-08-15, 23:59 IST.**

1) The l_2 norm of a possibly complex vector \bar{x} is

1 point

- $|x_1|^2 + |x_2|^2 + \dots + |x_n|^2$
- $\sqrt{|x_1|^2 + |x_2|^2 + \dots + |x_n|^2}$
- $|x_1| + |x_2| + \dots + |x_n|$
- $\sqrt{x_1^2 + x_2^2 + \dots + x_n^2}$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$\sqrt{|x_1|^2 + |x_2|^2 + \dots + |x_n|^2}$$

2) The unit-norm vector along $[1 \ 2 \dots \ n]^T$ is

1 point

$\frac{1}{\sqrt{n}} \begin{bmatrix} 1 \\ 1 \\ \vdots \\ 1 \end{bmatrix}$

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Product Space and its Properties: Cauchy Schwarz Inequality

Lec 06 - Properties of Norm, Gaussian Elimination and Echleon form of matrix

Quiz : Assignment-1

Assignment-1 Solution

WEEK 1 - FEEDBACK

DOWNLOAD VIDEOS

Week 2: Introduction to Convex Optimization – Convex sets, Hyperplanes/ Half-spaces etc. Application: Power constraints in Wireless Systems

Week 3 : Convex/ Concave Functions, Examples, Conditions for Convexity. Application: Beamforming in Wireless Systems, Multi-User Wireless, Cognitive Radio Systems

Week 4 : Convex Optimization problems, Linear Program, Application: Power allocation in Multi-cell cooperative OFDM

Week 5: Jensen's Inequality, Operations that preserve

ce De

$$\frac{1}{\sqrt{\frac{n(n+1)(2n+1)}{6}}} \begin{bmatrix} 1 \\ 2 \\ \vdots \\ n \end{bmatrix}$$



$$\frac{1}{\sqrt{\frac{n(n+1)}{2}}} \begin{bmatrix} 1 \\ 2 \\ \vdots \\ n \end{bmatrix}$$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$\frac{1}{\sqrt{\frac{n(n+1)(2n+1)}{6}}} \begin{bmatrix} 1 \\ 2 \\ \vdots \\ n \end{bmatrix}$$

3) The vectors $\bar{w}_1, \bar{w}_2, \dots, \bar{w}_n$ are linearly dependent if

1 point



There exist c_1, c_2, \dots, c_n , none of which is zero, such that $c_1 \bar{w}_1 + c_2 \bar{w}_2 + \dots + c_n \bar{w}_n = 0$



There exist c_1, c_2, \dots, c_n , not all zero, such that $c_1 \bar{w}_1 + c_2 \bar{w}_2 + \dots + c_n \bar{w}_n \neq 0$



There exist c_1, c_2, \dots, c_n , none of which is zero, such that $c_1 \bar{w}_1 + c_2 \bar{w}_2 + \dots + c_n \bar{w}_n \neq 0$



There exist c_1, c_2, \dots, c_n , not all zero, such that $c_1 \bar{w}_1 + c_2 \bar{w}_2 + \dots + c_n \bar{w}_n = 0$

No, the answer is incorrect.

Score: 0

Accepted Answers:

There exist c_1, c_2, \dots, c_n , not all zero, such that $c_1 \bar{w}_1 + c_2 \bar{w}_2 + \dots + c_n \bar{w}_n = 0$

1.4) The eigenvector \bar{x} of matrix \mathbf{A} corresponding to eigenvalue λ satisfies

1 point



$$\mathbf{A}\bar{x} = \lambda\bar{x}$$



$$|\mathbf{A}\bar{x} - \lambda\bar{x}| = 0$$



$$\mathbf{A}\bar{x} = \lambda$$



$$\mathbf{A} = \lambda\bar{x}$$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$\mathbf{A}\bar{x} = \lambda\bar{x}$$

5)

1 point

Convexity,
Examples, Beamforming
in Multi-antenna
Wireless
Communication

The eigenvalues of the matrix $\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$ are

- 1,2,3
 1,1,1
 3,0,0
 1,0,0

No, the answer is incorrect.

Score: 0

Accepted Answers:

3,0,0

Week-6: Maximal
Ratio Combiner
(MRC), Multi-
antenna
Beamforming
with Interfering
User,
Zero-Forcing
(ZF)
beamforming, Robust
beamformer
Design

Week-7: Optimization
for signal
estimation, LS,
WLS,
Regularization.
Application:
Wireless
channel
estimation,
Image
Reconstruction-
Deblurring, Representatic
of Convex
Optimization
problem

6) The matrix $\begin{bmatrix} 3 & 2 \\ 2 & x \end{bmatrix}$ is positive semi-definite only for

1 point

- $x \geq 2$

 $x \leq 3$

 $x \geq \frac{4}{3}$

 $x \leq 4$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$x \geq \frac{4}{3}$

Week 8 :
Application:
Convex
optimization for
Machine
Learning,
Principal
Component
Analysis (PCA),
Support Vector
Machines

7) Which of the following properties are true for a real positive semi-definite matrix \mathbf{A}

1 point

- $\bar{\mathbf{x}}^T \mathbf{A} \bar{\mathbf{x}} \geq 0$ for all $\bar{\mathbf{x}}$

All eigenvalues of $\bar{\mathbf{x}}$ are non-negative

 \mathbf{A} can be represented as the covariance matrix of a random vector
 All of the above

No, the answer is incorrect.

Score: 0

Accepted Answers:

All of the above

Week 9-
Application:
Compressive
Sensing, Sparse
Signal
Processing,
OMP
(Orthogonal
Matching
Pursuit), LASSO
(Least Absolute
Shrinkage and
Selection
Operator) for
signal
estimation, SVM

8) Given a Gaussian random variable X with mean μ and variance σ^2 , 1 point
the quantity $\frac{X - \mu}{\sigma}$ is

- an Exponential RV
 a Standard Normal RV

Week 10-
Application:
Compressive
Sensing, Sparse
Signal

Processing, OMP (Orthogonal Matching Pursuit), LASSO (Least Absolute Shrinkage and Selection Operator) for signal estimation

Week 11 : Application: Radar for target detection, Array Processing, MUSIC, MIMO-Radar Schemes for Enhanced Target Detection

Week 12: Application: Convex optimization for Big Data Analytics, Recommender systems, User Rating Prediction and Optimization for Finance

Transcripts

a Laplacian RV

a Gaussian RV with mean μ and variance σ

No, the answer is incorrect.

Score: 0

Accepted Answers:

a Standard Normal RV

9) The multi-variate Gaussian distribution of random vector $\bar{\mathbf{x}}$ with mean $\bar{\boldsymbol{\mu}}$ and covariance matrix \mathbf{R} is

1 point

$$\frac{1}{\sqrt{(2\pi)^n |\mathbf{R}|}} e^{-\frac{1}{2}(\bar{\mathbf{x}}-\bar{\boldsymbol{\mu}})^T \mathbf{R}(\bar{\mathbf{x}}-\bar{\boldsymbol{\mu}})}$$

$$\frac{1}{\sqrt{(2\pi)^n |\mathbf{R}|}} e^{-\frac{1}{2}(\bar{\mathbf{x}}-\bar{\boldsymbol{\mu}})^T \mathbf{R}^{-1}(\bar{\mathbf{x}}-\bar{\boldsymbol{\mu}})}$$

$$\frac{1}{\sqrt{(2\pi)^n |\mathbf{R}|}} e^{-\frac{1}{2}|\bar{\mathbf{x}}-\bar{\boldsymbol{\mu}}|^2}$$

$$\frac{1}{\sqrt{(2\pi)^n}} e^{-\frac{1}{2}|\bar{\mathbf{x}}-\mathbf{R}\bar{\boldsymbol{\mu}}|^2}$$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$\frac{1}{\sqrt{(2\pi)^n |\mathbf{R}|}} e^{-\frac{1}{2}(\bar{\mathbf{x}}-\bar{\boldsymbol{\mu}})^T \mathbf{R}^{-1}(\bar{\mathbf{x}}-\bar{\boldsymbol{\mu}})}$$

10) Consider the complex Gaussian random

1 point

vector $\bar{\mathbf{X}} = [X_1 \ X_2 \ \dots \ X_n]^T$ with i.i.d. elements X_i . Let the real and imaginary parts of each X_i be i.i.d. with mean $\frac{\mu}{2}$ and variance $\frac{\sigma^2}{2}$ each. The quantity $E\{\bar{\mathbf{X}}\bar{\mathbf{X}}^T\}$ is

0

$\sigma^2 \mathbf{I}$

$\sigma^2 \mathbf{I} + \mu^2 \bar{\mathbf{1}}\bar{\mathbf{1}}^T$

$j \frac{\mu^2}{2} \bar{\mathbf{1}}\bar{\mathbf{1}}^T$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$j \frac{\mu^2}{2} \bar{\mathbf{1}}\bar{\mathbf{1}}^T$$

