Unit 9 - Week-7:Optimization for signal estimation, LS, WLS, Regularization. Application: Wireless channel estimation, Image Reconstruction-Deblurring,Representation of Convex Optimization problem

Course outline

How to access the portal

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

DOWNLOAD VIDEOS

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

Week 3 : Convex/

Assignment-7

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2018-09-19, 23:59 IST.

1) $h(g(x))$ is convex if *1 point*

i) g is convex, h is convex and non-decreasing
ii) h is convex, g is convex and non-decreasing
iii) g is concave, h is convex and non-increasing
iv) h is concave, g is convex and non-increasing

- i and ii
- ii and iv
- i and iii
- iii and iv

No, the answer is incorrect.
Score: 0

Accepted Answers:
i and iii

2) Bit-error rate (BER) of a wireless channel is much higher than that of a wireline channel due to *1 point*

- Higher data rate in wireless systems

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 Convexity, Examples,Beamforming in Multi-antenna Wireless Communication

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

- Lec 41- Linear modeling and Approximation Problems: Least Squares
- Lec 42-Geometric Intuition for Least Squares
- Lec 43- Practical Application: Multi antenna

Score: 0

Accepted Answers:
Fading nature of wireless channel

3) Pointwise maximum of a set of convex functions is *1 point*

- Convex
- Concave
- Quasi-convex only
- Quasi-concave only

No, the answer is incorrect.
Score: 0

Accepted Answers:
Convex

4) Consider the log sum of exponentials given as $f(\bar{\mathbf{x}}) = \log \sum_{k=1}^{n} e^{x_k}$ on $\mathbf{R}^n$. Let $z_k = e^{x_k}$. Then, $\nabla^2 f(\bar{\mathbf{x}})$ equals *1 point*

- $\frac{\bar{\mathbf{z}}\bar{\mathbf{z}}^T}{(\bar{\mathbf{1}}^T\bar{\mathbf{z}})^2}$
- $\frac{\mathrm{diag}(\bar{\mathbf{z}})}{\bar{\mathbf{1}}^T\bar{\mathbf{z}}} - \frac{\bar{\mathbf{z}}\bar{\mathbf{z}}^T}{(\bar{\mathbf{1}}^T\bar{\mathbf{z}})^2}$
- $\frac{\bar{\mathbf{z}}\bar{\mathbf{z}}^T}{\bar{\mathbf{1}}^T\bar{\mathbf{z}}} - \frac{\bar{\mathbf{1}}\bar{\mathbf{z}}^T}{(\bar{\mathbf{1}}^T\bar{\mathbf{z}})^2}$
- $\frac{\mathrm{diag}(\bar{\mathbf{z}})}{(\bar{\mathbf{1}}^T\bar{\mathbf{z}})^2}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{\mathrm{diag}(\bar{\mathbf{z}})}{\bar{\mathbf{1}}^T\bar{\mathbf{z}}} - \frac{\bar{\mathbf{z}}\bar{\mathbf{z}}^T}{(\bar{\mathbf{1}}^T\bar{\mathbf{z}})^2}$

5) Consider the harmonic mean given as $f(\bar{\mathbf{x}}) = \left(\frac{1}{x_1} + \frac{1}{x_2} + \cdots + \frac{1}{x_n}\right)^{-1}, x_i > 0.$ *1 point*

Let $\bar{\mathbf{z}}^{(k)} = \left[\frac{1}{x_1^k} \ \frac{1}{x_2^k} \cdots \frac{1}{x_n^k}\right]^T$. Then, $\nabla^2 f(\bar{\mathbf{x}})$ equals

- $2\frac{\mathrm{diag}(\bar{\mathbf{z}}^{(3)})}{(\bar{\mathbf{1}}^T\bar{\mathbf{z}}^{(1)})^2}$
- $2\left(\frac{\bar{\mathbf{z}}^{(2)}(\bar{\mathbf{z}}^{(2)})^T}{(\bar{\mathbf{1}}^T\bar{\mathbf{z}}^{(1)})^2} - \frac{\mathrm{diag}(\bar{\mathbf{z}}^{(3)})}{(\bar{\mathbf{1}}^T\bar{\mathbf{z}}^{(1)})^3}\right)$

channel estimation

Lec 44- Practical Application:Image deblurring

Lec 45- Least Norm Signal Estimation

Lec 46- Regularization: Least Squares + Least Norm

Lec 47- Convex Optimization Problem representation: Canonical form, Epigraph form

Quiz : Assignment-7

Assignment -7 Solution

WEEK-7 FEEDBACK

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

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

Week 10- Application: Compressive Sensing, Sparse Signal Processing, OMP (Orthogonal Matching Pursuit), LASSO

$$2\left(\frac{\bar{\mathbf{z}}^{(3)}(\bar{\mathbf{z}}^{(3)})^T}{(\bar{\mathbf{1}}^T\bar{\mathbf{z}}^{(1)})^2} - \frac{\mathrm{diag}(\bar{\mathbf{z}}^{(2)})}{(\bar{\mathbf{1}}^T\bar{\mathbf{z}}^{(1)})^3}\right)$$

$$2\left(\frac{\bar{\mathbf{z}}^{(2)}(\bar{\mathbf{z}}^{(2)})^T}{(\bar{\mathbf{1}}^T\bar{\mathbf{z}}^{(1)})^3} - \frac{\mathrm{diag}(\bar{\mathbf{z}}^{(3)})}{(\bar{\mathbf{1}}^T\bar{\mathbf{z}}^{(1)})^2}\right)$$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$$2\left(\frac{\bar{\mathbf{z}}^{(2)}(\bar{\mathbf{z}}^{(2)})^T}{(\bar{\mathbf{1}}^T\bar{\mathbf{z}}^{(1)})^3} - \frac{\mathrm{diag}(\bar{\mathbf{z}}^{(3)})}{(\bar{\mathbf{1}}^T\bar{\mathbf{z}}^{(1)})^2}\right)$$

6) The function $f(\mathbf{X}) = \log\det(\mathbf{X})$ on the set of positive definite matrices $\mathbf{X}$ is *1 point*

- Convex
- Concave
- Quasi-convex only
- Quasi-concave only

No, the answer is incorrect.
Score: 0

Accepted Answers:
Concave

7) The conjugate function $f(x) = x^p$, $x > 0$ for $p > 1$ is *1 point*

- 0
- $(p-1)\left(\frac{y}{p}\right)^{\frac{p}{p-1}}$
- $\begin{cases} 0, & \text{if } y \le 0 \\ (p-1)\left(\frac{y}{p}\right)^{\frac{p}{p-1}}, & \text{if } y > 0 \end{cases}$
- $\begin{cases} 0, & \text{if } y \ge 0 \\ \frac{p}{p-1}\left(\frac{y}{p}\right)^{(p-1)}, & \text{if } y < 0 \end{cases}$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$$\begin{cases} 0, & \text{if } y \le 0 \\ (p-1)\left(\frac{y}{p}\right)^{\frac{p}{p-1}}, & \text{if } y > 0 \end{cases}$$

8) The function $f\left(\begin{bmatrix}\bar{\mathbf{x}} \\ t\end{bmatrix}\right) = \frac{\|\bar{\mathbf{x}}\|^2}{t}$ is *1 point*

(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

- Convex
- Concave
- Quasi-convex
- Quasi-concave

No, the answer is incorrect.
Score: 0

Accepted Answers:
Convex

9) Beamforming is used in wireless communication systems for *1 point*

- Enhancing the SNR
- Suppressing the interference
- Multiplexing several users
- All of the above

No, the answer is incorrect.
Score: 0

Accepted Answers:
All of the above

10) Consider the wireless system model $\bar{\mathbf{y}} = \bar{\mathbf{h}}x + \bar{\mathbf{n}}$ where the noise vector $\bar{\mathbf{n}}$ contains i.i.d. noise samples with mean 0 and variance σ^2. The beamformer that maximizes the SNR is termed the *1 point*

- Zero-forcing Beamformer
- Maximal Ratio Combiner
- Orthogonal Beamformer
- Robust Beamformer

No, the answer is incorrect.
Score: 0

Accepted Answers:
Maximal Ratio Combiner

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