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

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Unit 14 - Week 12: Application: Convex optimization for Big Data Analytics, Recommender systems, User Rating Prediction and Optimization for Finance

Assignment-12

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

Due on 2018-10-24, 23:59 IST.

1) Let the Lagrangian of an optimization problem be denoted by $L(\bar{\mathbf{x}}, \bar{\boldsymbol{\lambda}}, \bar{\boldsymbol{\nu}})$. The Lagrange dual function for the optimization problem is given by *1 point*

- $g_d(\bar{\boldsymbol{\lambda}}, \bar{\boldsymbol{\nu}}) = \max_{\bar{\mathbf{x}}} L(\bar{\mathbf{x}}, \bar{\boldsymbol{\lambda}}, \bar{\boldsymbol{\nu}})$
- $g_d(\bar{\mathbf{x}}, \bar{\boldsymbol{\nu}}) = \min_{\bar{\boldsymbol{\lambda}}} L(\bar{\mathbf{x}}, \bar{\boldsymbol{\lambda}}, \bar{\boldsymbol{\nu}})$
- $g_d(\bar{\boldsymbol{\lambda}}, \bar{\boldsymbol{\nu}}) = \min_{\bar{\mathbf{x}}} L(\bar{\mathbf{x}}, \bar{\boldsymbol{\lambda}}, \bar{\boldsymbol{\nu}})$
- $g_d(\bar{\mathbf{x}}, \bar{\boldsymbol{\lambda}}) = \min_{\bar{\boldsymbol{\nu}}} L(\bar{\mathbf{x}}, \bar{\boldsymbol{\lambda}}, \bar{\boldsymbol{\nu}})$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$g_d(\bar{\boldsymbol{\lambda}}, \bar{\boldsymbol{\nu}}) = \min_{\bar{\mathbf{x}}} L(\bar{\mathbf{x}}, \bar{\boldsymbol{\lambda}}, \bar{\boldsymbol{\nu}})$

2) Let $g_d(\bar{\boldsymbol{\lambda}}, \bar{\boldsymbol{\nu}})$ denote the Lagrange dual function for an optimization problem. The dual optimization problem for the given optimization problem is *1 point*

- $\max g_d(\bar{\boldsymbol{\lambda}}, \bar{\boldsymbol{\nu}})$
- $\max g_d(\bar{\boldsymbol{\lambda}}, \bar{\boldsymbol{\nu}})$

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No, the answer is incorrect.
Score: 0

Accepted Answers:

$\max g_d(\bar{\boldsymbol{\lambda}}, \bar{\boldsymbol{\nu}})$

s.t. $\bar{\boldsymbol{\lambda}} \succcurlyeq 0$

3) Let p^*, d^* denote the optimal values of the primal and dual optimization problems, respectively. Then *1 point*

- $p^* \geq d^*$
- $p^* \leq d^*$
- $p^* < d^*$
- $p^* > d^*$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$p^* \geq d^*$

4) Consider the min norm optimization problem $\min \|\bar{\mathbf{x}}\|$, s.t. $\mathbf{A}\bar{\mathbf{x}} = \bar{\mathbf{b}}$. The corresponding dual optimization problem is given as *1 point*

- $\max -\frac{1}{4}\bar{\boldsymbol{\nu}}^T\mathbf{A}\mathbf{A}^T\bar{\boldsymbol{\nu}} - \bar{\boldsymbol{\nu}}^T\bar{\boldsymbol{b}}$
- $\max -\frac{1}{4}\bar{\boldsymbol{\nu}}^T\mathbf{A}\mathbf{A}^T\bar{\boldsymbol{\nu}} - \bar{\boldsymbol{\lambda}}^T\bar{\mathbf{b}},\ \bar{\boldsymbol{\lambda}} \succcurlyeq 0$
- $\max -\frac{1}{4}\bar{\boldsymbol{\lambda}}^T\mathbf{A}\mathbf{A}^T\bar{\boldsymbol{\lambda}} - \bar{\boldsymbol{\lambda}}^T\bar{\mathbf{b}},\ \bar{\boldsymbol{\lambda}} \succcurlyeq 0$
- $\max -\frac{1}{4}\bar{\boldsymbol{\lambda}}^T\mathbf{A}\mathbf{A}^T\bar{\boldsymbol{\lambda}} - \bar{\boldsymbol{\nu}}^T\bar{\mathbf{b}},\ \bar{\boldsymbol{\lambda}} \succcurlyeq 0$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$\max -\frac{1}{4}\bar{\boldsymbol{\nu}}^T\mathbf{A}\mathbf{A}^T\bar{\boldsymbol{\nu}} - \bar{\boldsymbol{\nu}}^T\bar{\boldsymbol{b}}$

5) Consider the standard form of the optimization problem given below *1 point*

$\min g_0(\bar{\mathbf{x}})$

s.t. $\min g_i(\bar{\mathbf{x}}) \leq 0, i = 1, 2, \cdots, l$

$\tilde{g}_j(\bar{\mathbf{x}}) = 0, j = 1, 2, \cdots, m$

The KKT conditions for the above problem are

i. $g_i(\bar{\mathbf{x}}) \leq 0, i = 1, 2, \cdots, l,\ \tilde{g}_j(\bar{\mathbf{x}}) = 0, j = 1, 2, \cdots, m$

ii. $\bar{\boldsymbol{\lambda}} \succcurlyeq 0$

iii. $\lambda_i g_i(\bar{\mathbf{x}}) = 0$

iv. $\nabla_{\bar{\mathbf{x}}} L(\bar{\mathbf{x}}, \bar{\boldsymbol{\lambda}}, \bar{\boldsymbol{\nu}}) = 0$

- i, ii, iii only
- ii, iii, iv only
- i, iii, iv only
- i, ii, iii, iv

No, the answer is incorrect.
Score: 0

Accepted Answers:
i, ii, iii, iv

6) Consider the set of n parallel communication channels with power gain of the i^{th} channel given by α_i. If the noise power for each channel is σ^2 , what is the optimal power to be allocated to each channel to maximize the sum rate, given a total transmit power of P *1 point*

- $\frac{1}{\nu} - \frac{\sigma^2}{\alpha_i}$
- $\left(\frac{1}{\nu} - \frac{\sigma^2}{\alpha_i}\right)^+$
- $\left(\frac{1}{\nu} - \frac{\alpha_i}{\sigma^2}\right)^+$
- $\frac{1}{\nu} - \frac{1}{\alpha_i \sigma^2}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\left(\frac{1}{\nu} - \frac{\sigma^2}{\alpha_i}\right)^+$

7) Consider a MIMO channel matrix with singular values $2, 1, 1.$ If the noise power for each channel is $\sigma^2 = 3dB$, what are the optimal powers to be allocated to the respective channels to maximize the sum rate, given a total transmit power of $0\ dB$? *1 point*

- $\frac{1}{2}, \frac{1}{4}, \frac{1}{4}$
- $\frac{1}{3}, \frac{1}{3}, \frac{1}{3}$
- $1, 0, 0$
- $0, \frac{1}{2}, \frac{1}{2}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$1,\ 0,\ 0$

8) The dual norm of the l_1 norm is *1 point*

- l_0 norm
- l_1 norm
- l_2 norm
- l_∞ norm

No, the answer is incorrect.
Score: 0

Accepted Answers:
l_∞ norm

9) Consider the linear program given below *1 point*

$$\min \bar{\mathbf{c}}^T\bar{\mathbf{x}} \text{ s.t. } \mathbf{G}\bar{\mathbf{x}} \preccurlyeq \bar{\mathbf{h}},\ \mathbf{A}\bar{\mathbf{x}} = \bar{\mathbf{b}}$$

The dual of this optimization problem is

- $\max \bar{\mathbf{b}}^T\bar{\boldsymbol{\lambda}} + \bar{\mathbf{h}}^T\bar{\boldsymbol{\nu}} \text{ s.t. } \bar{\mathbf{c}} + \mathbf{G}\bar{\boldsymbol{\lambda}} + \mathbf{A}\bar{\boldsymbol{\nu}} = 0, \bar{\boldsymbol{\lambda}} \succcurlyeq 0$
- $\max \bar{\mathbf{b}}^T\bar{\boldsymbol{\nu}} + \bar{\mathbf{h}}^T\bar{\boldsymbol{\lambda}} \text{ s.t. } \bar{\mathbf{c}} + \mathbf{A}^T\bar{\boldsymbol{\lambda}} + \mathbf{G}^T\bar{\boldsymbol{\nu}} = 0, \bar{\boldsymbol{\nu}} \succcurlyeq 0$
- $\min -\bar{\mathbf{b}}^T\bar{\boldsymbol{\nu}} - \bar{\mathbf{h}}^T\bar{\boldsymbol{\lambda}} \text{ s.t. } \bar{\mathbf{c}}^T\bar{\boldsymbol{\lambda}} + \mathbf{G}^T\bar{\boldsymbol{\nu}} = 0, \bar{\boldsymbol{\nu}} \succcurlyeq 0$
- $\max -\bar{\mathbf{b}}^T\bar{\boldsymbol{\nu}} - \bar{\mathbf{h}}^T\bar{\boldsymbol{\lambda}} \text{ s.t. } \bar{\mathbf{c}} + \mathbf{G}^T\bar{\boldsymbol{\lambda}} + \mathbf{A}^T\bar{\boldsymbol{\nu}} = 0, \bar{\boldsymbol{\lambda}} \succcurlyeq 0$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\max -\bar{\mathbf{b}}^T\bar{\boldsymbol{\nu}} - \bar{\mathbf{h}}^T\bar{\boldsymbol{\lambda}} \text{ s.t. } \bar{\mathbf{c}} + \mathbf{G}^T\bar{\boldsymbol{\lambda}} + \mathbf{A}^T\bar{\boldsymbol{\nu}} = 0, \bar{\boldsymbol{\lambda}} \succcurlyeq 0$

10) Consider the ML decoder $\|\mathbf{y} - \mathbf{H}\mathbf{x}\|^2$ for the MIMO channel matrix $\mathbf{H}$ where symbols in $\bar{\mathbf{x}}$ are drawn from the BPSK constellation $\{+1, -1\}$. The relaxed SDP for the same is given as *1 point*

- $\min \operatorname{Tr}(\mathbf{S}) \text{ s.t. } \operatorname{diag}(\mathbf{S}) = \bar{\mathbf{1}},\ \mathbf{S} \succcurlyeq 0$
- $\min \operatorname{Tr}(\mathbf{LS}) \text{ s.t. } \operatorname{diag}(\mathbf{S}) = \bar{\mathbf{1}},\ \mathbf{S} \succcurlyeq 0 \text{ where } \mathbf{L} = \begin{bmatrix} \mathbf{H}^T\mathbf{H} & -\mathbf{H}^T\bar{\mathbf{y}} \\ -\bar{\mathbf{y}}^T\mathbf{H} & \bar{\mathbf{y}}^T\bar{\mathbf{y}} \end{bmatrix}$
- $\min \operatorname{Tr}(\mathbf{LS}) \text{ s.t. } \mathbf{S} \succcurlyeq 0 \text{ where } \mathbf{L} = \begin{bmatrix} \mathbf{H}\mathbf{H}^T & -\mathbf{H}^T\bar{\mathbf{y}} \\ -\bar{\mathbf{y}}^T\mathbf{H} & \bar{\mathbf{y}}^T\bar{\mathbf{y}} \end{bmatrix}$
- $\min \operatorname{Tr}(\mathbf{LS}) \text{ s.t. } \operatorname{diag}(\mathbf{S}) = \bar{\mathbf{1}},\ \mathbf{S} \succcurlyeq 0 \text{ where } \mathbf{L} = \begin{bmatrix} \bar{\mathbf{y}}\bar{\mathbf{y}}^T & -\mathbf{H}^T\bar{\mathbf{y}} \\ -\bar{\mathbf{y}}^T\mathbf{H} & -\bar{\mathbf{y}}^T\bar{\mathbf{y}} \end{bmatrix}$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$$\min \operatorname{Tr}(\mathbf{LS}) \;\; \text{s.t.} \;\; \operatorname{diag}(\mathbf{S}) = \bar{\mathbf{1}}, \; \mathbf{S} \succcurlyeq 0 \text{ where } \mathbf{L} = \begin{bmatrix} \mathbf{H}^T\mathbf{H} & -\mathbf{H}^T\bar{\mathbf{y}} \\ -\bar{\mathbf{y}}^T\mathbf{H} & \bar{\mathbf{y}}^T\bar{\mathbf{y}} \end{bmatrix}$$

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