Mittuniversitetet
MID SWEDEN UNIVERSITY

Försättsblad Prov Original

Kurskod	Provkod	Tentamensdatum
DT059A	T101	2019-04-23

Kursnamn	Datateknik AV, Tillämpad optimering
Provnamn	Skriftlig tentamen
Ort	Sundsvall
Termin	
Ämne	

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Exam in Applied Optimization DT059A, 20190423, 6hp

Only pen, paper and pocket calculator is allowed, Max: 40p, A 36p B 32 p C 28p D 24p E 20p, Fx 16p Time: 4 hours, Author: Leif Olsson 072-5818886, every exercise is 10p distributed as indicated below.

1. For the optimization problem

$$\min z = 3x_1^2 + 6x_1 + 2x_2^2 - 6x_2 - 4$$

$$s.t$$

$$x_1 + 3x_2 = 6$$

   a) Show mathematically that this optimization problem is convex (2p)
   b) Make the optimization problem unconstrained (2p)
   c) Set up the Lagrange function for this problem (2p)
   d) Solve the problem analytically (3p)

2. For the LP problem below

$$\max z = 6x_1 + 5x_2 + 4x_3$$

$$s.t$$

$$2x_1 + x_2 + x_3 \le 180$$

$$x_1 + 3x_2 + 2x_3 \le 300$$

$$2x_1 + x_2 + 2x_3 \le 240$$

$$x_1, x_2, x_3 \ge 0$$

   a. Calculate the optimal solution z using the simplex method and the value of x_1, x_2, x_3 (6p)
   b. What is the value of the slack variables and what does it mean? (2p)
   c. Formulate the dual problem (2p)

3. Explain the concepts below
   a. The complementary slackness condition (2p)
   b. the KKT conditions condition and why it sufficient when we have a convex optimization problem but only necessary otherwise (4p)
   c. Why two convex sets can be separated with the help of a hyperplane and why it is not in general true for a non-convex sets (2p)
   d. Why an integer linear programming problem not in general are a convex optimization problem (2p)

4. For the optimization problem

$$\min z = x_1^2 + x_2^2$$

$$s.t$$

$$1 - x_1 \le 0$$

$$x_2 \ge -1$$

   a. Formulate the problem as an unconstrained optimization problem using a log barrier function approximation (3p)
   b. Calculate the optimal solution analytically through a limit procedure (3p)
   c. Calculate the Lagrange dual multipliers analytically through a limit procedure (3p)
   d. The algorithm for the barrier method is stepwise instead of directly calculating the optimum as we do in b. and c. Give on reason for that solution strategy. (1p)