Fall 2020
EE 236A
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EE236A Linear Programming
Quiz 5
Thursday December 10, 2020

NAME: _____ **UID**: _____

This quiz has 3 questions, for a total of 20 points.

Open book. The exam is for a total of 1:00 hour. **Please, write your name and UID on the top of each sheet.**

Good luck!

Problem	Mark	Total
P1		6
P2		7
P3		7
Total		20

Problem 1 (6 points) Consider the following tableau

		x_1	x_2	1
y_1	=	-2	1	0
y_2	=	5	5	5
y_3	=	2	-2	2
z	=	2	1	-5

1) Find an LP this tableau corresponds to and then, find the associated dual program.

2) Find the optimal solutions for your primal; are there multiple or a unique solution for the primal?

3) Find the optimal solutions for your dual; are there multiple or a unique solution for the dual?

Problem 2 (7 points)

Assume that $x \in R^n$; A_1, A_2, A_3 are constant matrices of dimension $m_1 \times n$, $m_2 \times n$ and $m_3 \times n$; and b_1, b_2, b_3, and c are constant vectors of appropriate dimension. Prove that the problem (1):

$$\begin{aligned} \min_x \quad & c^T x \\ \text{subject to} \quad & A_1 x = b_1 \\ & A_2 x \leq b_2 \\ & A_3 x \geq b_3 \\ & x \geq 0 \end{aligned} \tag{1}$$

is infeasible if and only if there exists a vector $y = (y_1, y_2, y_3)$, where each subvector y_i has m_i elements, $i = 1, \ldots 3$, such that:

$$\begin{aligned} & b_1^T y_1 + b_2^T y_2 + b_3^T y_3 > 0 \\ & A_1^T y_1 + A_2^T y_2 + A_3^T y_3 \leq 0 \\ & y_2 \leq 0 \\ & y_3 \geq 0 \end{aligned} \tag{2}$$

Problem 3 (7 points): Facebook is looking to expand their TerraGraph network by installing mmWave nodes in 2354 cells. 513 of these cells already host 5 such nodes each; and no cell can host more than 10 nodes. Can you write an ILP that identifies how many nodes should Facebook install in each cell, so that the average number of nodes per cell is between 6 and 7, the minimum number of nodes per cell is 3, and we minimize the number of cells that have an odd number of nodes?