EL7363, Spring 2018: Homework #4

Please submit this homework electronically through newclasses as one zip file. For each problem involving AMPL, please generate a run file, and submit your ampl code, data and run files, so that the TA can check your code by running the run file directly in AMPL.

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1. Convert the following Linear Programming (LP) problem into its standard form:

$$\max_{x,y,z} \quad -x + 2y - 3z$$

subject to

$$x - 3y - z \leq 10,$$
$$2y - 7z \geq 3,$$
$$x - 2y - 3z = 6,$$
$$y \geq 0, \text{ x, z are unconstrained in sign}$$

2. For a maximization Integer Programming problem with integer cost function coefficients (c vector), if the corresponding Linear-Relaxation solution is f_1, and one feasible integer solution is f_2, what are the upper and lower bounds of the original Integer Programming problem?

3. Using AMPL to solve the following binary programming problem:

$$\max \quad x_1 + 3x_2 + 4x_3 + 5x_4$$

subject to

$$8x_1 + 2x_2 \leq 9;$$
$$3x_1 + 5x_3 \leq 7;$$
$$2x_3 + 3x_4 \leq 4,$$

a). First use AMPL to solve it directly by defining x_1, x_2, x_3, and x_4 as binary variables, submit the AMPL code and results.

b) solve it use Branch-and-Bound algorithm, use AMPL to solve the linear relaxation problem at each step. Write down the branching process in a way similar to the example in the lecture. Also need to submit the AMPL code at each step.

(*Hint: to relax a binary variable x to a continuous variable, you need to introduce two additional constraints:* $0 \leq x \leq 1$)

4. Develop an AMPL model for the general D/SDP problem defined in 4.1.6 (page 109) with additional link capacity bound (i.e., add (4.1.11d) to the constraint set of 4.1.6)

5. Apply the developed model in Q4 to solve a small network illustrated in the following figure, the numbers on links are unit cost of each link, assume links are all symmetric, the traffic demand is as following:

(a) from node 3 to node 1: 3 units;

(b) from node 4 to node 3: 4 units;

(c) from node 2 to node 4: 3 units;

capacity bounds on all links are 3 units. Your solution should include the optimal network cost and flow allocation for all demands.

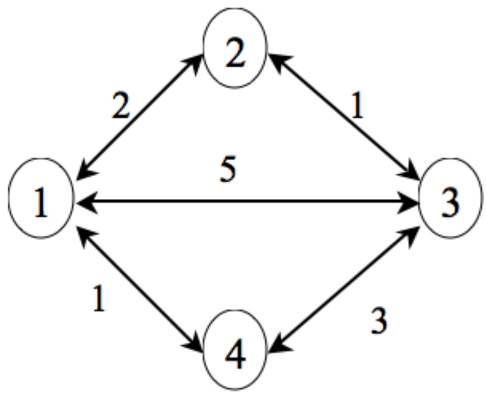

Figure 1: Network Topology for Q5