**Homework 5 (50 points) Due: April 10, 2019**

**COMPSCI 735: OPTIMIZATION: TECHNIQUES AND APPLICATIONS**

Formulate the following problems as GAMS (LP) models and solve them. Submit this assignment electronically to Canvas. You should hand in exactly 4 ﬁles with the following names: hw8-1.gms, hw8-1.lst, hw8-2.gms, hw8-2.lst. The “lst” ﬁles are produced automatically when you execute “gams” model ﬁle.

Problem 1 The Electric Company

The network in Figure 1 represents an electrical power distribution network connecting power generating points with power consuming points.

4

1

5

3

2

6

7

The arcs are undirected; that is, power may ﬂow in either direction. Points 1,4 and 7 are generating points with generating capacities and unit costs given in Table 1

Table 1: Generating Plant Characteristics

|  |  |  |  |
| --- | --- | --- | --- |
| Point | 1 | 4 | 7 |
| Capacity (in thousands of kilowatt hours) | 100 | 60 | 80 |
| Unit cost ($ per thousand KWH) | 15.0 | 13.5 | 21.0 |

Points 2, 5 and 6 are consuming points with demands of 35,000, 50,000, and 60,000 KWH respectively. There is no upper bound on transmission line capacity and the unit cost of transmission on each line segment is $11.00 per 1000 KWH. Set up and solve this problem to minimize the cost of meeting demand as a minimum cost network ﬂow (linear program) in GAMS. Make sure you have directed arcs in your formulation. (obj= 4055.00)

2.

In Tiger Electronic’s handheld solitaire game Lights Out, the player strives to turn out all 25 lights that make up a 5 x 5 grid of cells. On each turn, the player is allowed to click on any one cell. Clicking on a cell activates a switch that causes the states of the cell and its (edge) neighbours to change from on to off, or from off to on. Corner cells are considered to have 2 neighbours, edge cells to have three, and interior cells to have four.

Formulate and solve an integer program for ﬁnding a way to turn out all the lights in as few turns as possible (starting from the state where all lights are on).

Hints: The order in which the cells are clicked doesn’t matter. A cell should not be clicked more than once.

What if each cell has a three-way bulb? (Repeatedly clicking on a single three way bulb changes its state from off to low, from low to medium, from medium to high, from high to off, and so on.)

Tweak and solve the model to to turn out all the lights in as few turns as possible (starting from the state where all lights are on) for the following cases.

(a) turning off all the lights when they’re all on their high setting,

(b)turning them off when they’re all on medium,or

(c)turning them off when they’re all on low?

Answers:

Total clicks

simple 15

high 39

med 30

low 29

You may use the following template.

option limrow=0, limcol=0, solprint = off;

$setglobal n 5

set i /1\*%n%/;

alias (i,j);

integer variables click(i,j);

variables totclicks;

integer variables cancels(i,j);

equations turnoff(i,j), cost;

scalar initclicks "how many clicks to turn off from init state",

period "how many clicks to get back to same state";

turnoff(i,j)..

initclicks + period\*cancels(i,j) =e=

click(i,j) + click(i-1,j) + click(i+1,j) + click(i,j-1) + click(i,j+1);

cost..

totclicks =e= sum((i,j), click(i,j));

model lightsout /all/;

lightsout.optcr = 0;

lightsout.optca = 0.999;

lightsout.reslim = 4000;

lightsout.iterlim = 1000000000;

parameter soln(\*,\*);

period = 2;

cancels.up(i,j) = period;

click.up(i,j) = 1;

initclicks = 1;

solve lightsout using mip min totclicks;

option click:0:0:1; display click.l;

soln('simple','totclicks') = totclicks.l;

$ontext

Your code goes here

$offtext

option soln:0:1:1; display soln;