Homework 3 Advanced Analytics and Metaheuristics

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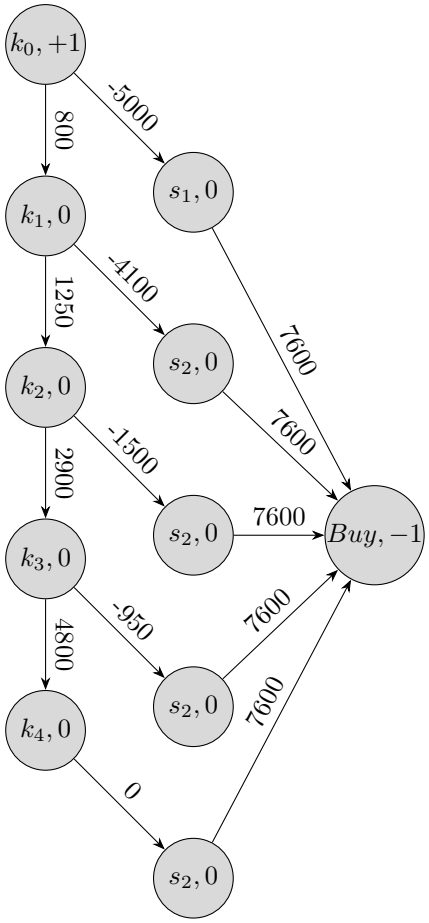
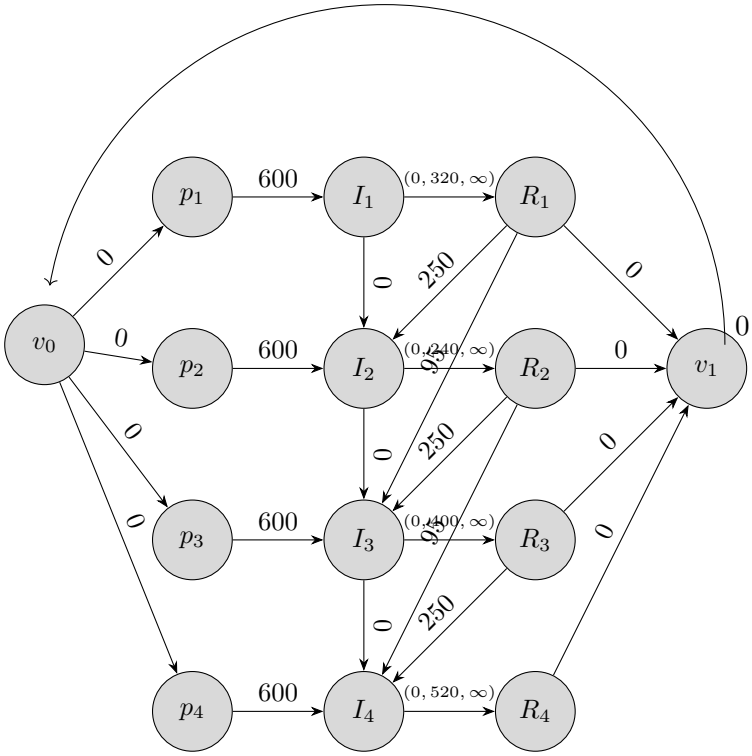
February 14, 2024

1. Team Building
   (a)
   (b)
2. Outdoor Grilling



3. Here is my flow model:



Here is my model file:

```
# AMPL model for the Minimum Cost Network Flow Problem
#
# By default, this model assumes that b[i] = 0, c[i,j] = 0,
# l[i,j] = 0 and u[i,j] = Infinity.
#
# Parameters not specified in the data file will get their default values.
reset;

options solver cplex;

set NODES;                          # nodes in the network
set ARCS within {NODES, NODES};     # arcs in the network

param b {NODES} default 0;          # supply/demand for node i
param c {ARCS}  default 0;          # cost of one of flow on arc(i,j)
param l {ARCS}  default 0;          # lower bound on flow on arc(i,j)
param u {ARCS}  default Infinity; # upper bound on flow on arc(i,j)

var x {ARCS};                       # flow on arc (i,j)
```

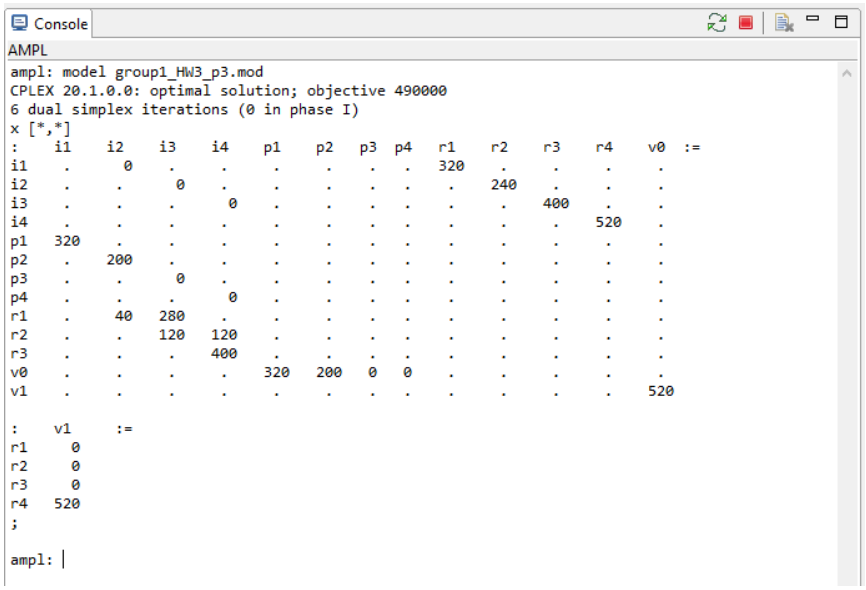
```
minimize cost: sum{(i,j) in ARCS} c[i,j] * x[i,j];  #objective: minimize arc flow cost

# Flow Out(i) - Flow In(i) = b(i)

subject to flow_balance {i in NODES}:
sum{j in NODES: (i,j) in ARCS} x[i,j] - sum{j in NODES: (j,i) in ARCS} x[j,i] = b[i];

subject to capacity {(i,j) in ARCS}: l[i,j] <= x[i,j] <= u[i,j];

data group1_HW3_p3.dat;

solve;

display x;
```

Here is my data file:

```
#MCNFP Problem - data file for problem instance
#Charles Nicholson, ISE 5113, 2015

#use with MCNFP.txt model
#note: default arc costs and lower bounds are 0
#      default arc upper bounds are infinity
#      default node requirements are 0


set NODES :=          v0, p1, p2,p3,p4, i1,i2,i3,i4,r1,r2,r3,r4,v1 ;

set ARCS := (v0,p1),(v0,p2),(v0,p3),(v0,p4), #start the flow
                        (p1,i1),(p2,i2),(p3,i3),(p4,i4), #purchase new tires each race
                        (i1,r1),(i2,r2),(i3,r3),(i4,r4), #move inventory to race
                        (r1,v1),(r2,v1),(r3,v1),(r4,v1), #move spent tires not fixed to
                        (i1,i2),(i2,i3),(i3,i4), #move unused inventory
                        (r1,i2),(r1,i3), #race 1 quick and slow fix
                        (r2,i3),(r2,i4), #race 2 quick and slow fix
                        (r3,i4), #race 3 quick fix
                        (v1,v0) #move from virtual to virtual to complete flow
                        ;



param:        c  l u :=
                [p1,i1] 600  . . #purchase new tires each race
                [p2,i2] 600  . .
```

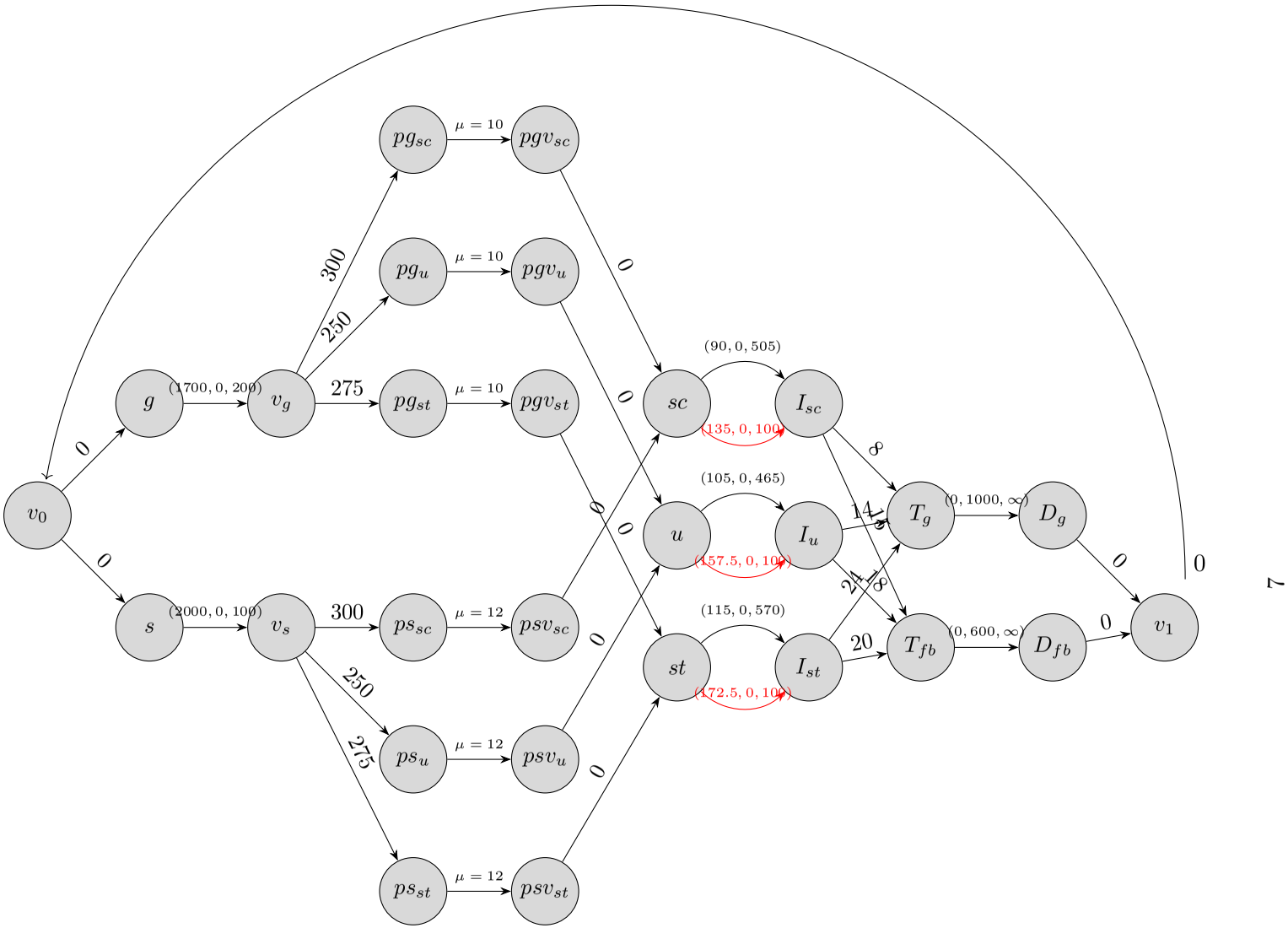
```
                [p3,i3] 600   . .
                [p4,i4] 600   . .
                [i1,r1] .         320 . #minimum tires needed each race
                [i2,r2] .         240 .
                [i3,r3] .         400 .
                [i4,r4] .         520 .
                [i4,r4] 1    .        .
                [r1,i2] 250  .         . #quick fix
                [r2,i3] 250  .        .
                [r3,i4] 250  .        .
                [r1,i3] 95   .        .#slowfix
                [r2,i4] 95         .        .
;
```

Here is my output:



We look to be purchasing new tires for both the needs of the first two races, 320 and 200 respectively. This is the maximum number of tires needed. We use the normal service on 280 tires from the first race and quick on the other 40. In second race we use the normal service on 120 but quick fix 120. For the third race we quick fix all 400 tires used. We end up with exactly the number of tires needed in the fourth race. Total cost is $490 000.

4. Dunder Mifflin


v_0
g
s
v_g
v_s
pg_{sc}
pg_u
pg_{st}
ps_{sc}
ps_u
ps_{st}
pgv_{sc}
pgv_u
pgv_{st}
psv_{sc}
psv_u
psv_{st}
sc
u
st
I_{sc}
I_u
I_{st}
T_g
T_{fb}
D_g
D_{fb}
v_1
$\mu = 10$
$\mu = 12$
(1700, 0, 200)
(2000, 0, 100)
(90, 0, 505)
(105, 0, 465)
(115, 0, 570)
(135, 0, 100)
(157.5, 0, 100)
(172.5, 0, 100)
(0, 1000, ∞)
(0, 600, ∞)
300
250
275
0
∞
20
7