

## Programming Assignment: Sports Elimination

Due: March 15, 2019

Given the standings in a sports division at some point during a season, determine which teams have been eliminated from winning their division. A team is mathematically eliminated if it cannot possibly finish the season in first place (or tied for first place). We assume that no games end in a tie and that every scheduled game is played. Consider the following example:

i	Team	w[i] wins	l[i] losses	r[i] remaining	Atl	g[i][j] Phi	NY	Mon
0	Atlanta	83	71	8	-	1	6	1
1	Philadelphia	80	79	3	1	-	0	2
2	New York	78	78	6	6	0	-	0
3	Montreal	77	82	3	1	2	0	-

Montreal is eliminated since it can finish with at most 80 wins and Atlanta already has 83. A more complicated case occurs for Philadelphia. It can finish with 83 wins, as many as Atlanta, but for this to be first place, Atlanta would have to lose all six games against New York, which would then have 84 wins.

As discussed in class, we can determine if a particular team  $x$  is eliminated by constructing a max-flow problem:

We connect the source to each game vertex  $i-j$  and set the arc's capacity to  $g[i][j]$ .

We connect each game vertex  $i-j$  to the two team vertices, team  $i$  and team  $j$ . The capacity is infinite.

Finally, we connect each team vertex to the sink  $t$ . Here, the capacity of the arc from team vertex  $i$  is  $w[x] + r[x] - w[i]$ .

If all the arcs from the source can be saturated, then there is a scenario in which team  $x$  can finish in first place, otherwise it cannot.

(Actual test cases are small enough that CPU time will not be an issue.)

**Input File Format:** (for example)

```
4
Atlanta      83 71  8  0 1 6 1
Philadelphia 80 79  3  1 0 0 2
New_York     78 78  6  6 0 0 0
Montreal     77 82  3  1 2 0 0
```

**Output File Format:** (for the above example)

```
Atlanta is not eliminated
Philadelphia is eliminated by the subset R = { Atlanta New_York }
New_York is not eliminated
Montreal is eliminated by the subset R = { Atlanta }
```