Modeling for Discrete Optimization Assignment: **Gang Warfare**

1 Problem Statement

The principal of Headley Heights has a problem, there are n gangs each consisting of $m_i, 1 \leq i \leq n$ members active in the school. Assume the students are numbered from 1 to $t = \sum_{i=1}^{n} m_i$ with gang members numbered consecutively with $\sum_{i=1}^{k} m_i + 1$ the number of the first member of gang $k+1$ (the leader) and $\sum_{i=1}^{k} m_i$ being the last member of gang k.

One gang is responsible for vandalizing the school chapel and the principal needs to find out who?

The principal has to interview each gang member at a different time in slots 1 to t. No two members of the same gang can be interviewed one after the other as this would allow collusion as the met entering and leaving his office. Some gangs are direct rivals. There are currently r rivalries going on where $g1_i$ and $g2_i, 1 \leq i \leq r$ give the number of two gangs involved in the rivalry. Again no two members of gangs in direct rivalry can be interviewed one after the other as this would result in violence as the met entering and leaving the office.

The principal aims to break down the gang members into confession, this is measured in confession points. A non-leader member interviewed before their gang leader gives 1 point, if interviewed after their leader they see his bravado and give 0 points. Interviewing the leader of a gang after all the members of a gang in a direct rivalry with their gang makes them feel that the principal is working against them and the leader confesses $3 + 2l$ points where l is the number of other members of their own gang not interviewed yet. Otherwise interviewing a gang leader gives 3 points if interviewed in the morning, at time $< t/2$, when the principal is fresh and 0 points otherwise.

The aim is to order the interviews so as to maximize the number of confession points.

2 Data Format Specification

The input is given as a file `data/gangwarfare_`p`.dzn` in MiniZinc data format:

`n =` n`;`
`m = [`$m_1, \ldots, m_n$`];`
`r =` r`;`
`g1 = [`$g1_1, \ldots, g1_r$`];`
`g2 = [`$g2_1, \ldots, g2_r$`];`

The solution should be given as one array of size t and the objective function value,

`order = [` t numbers, being the person interviewed at time t `];`
`obj = value;`

For example when there are four gangs with [3,2,2,3] members each and two rivalries between gangs 1 and 3 and gangs 2 and 4 the data file is,

```
n = 4;
m = [3,2,2,3];
r = 2;
g1 = [1,2];
g2 = [3,4];
```

then one solution is

```
order = [7, 5, 6, 4, 1, 8, 3, 10, 2, 9];
obj = 22;
```

which gains 22 confession points.

3 Instructions

Edit `gangwarfare.mzn` to solve the optimization problem described above. Your `gangwarfare.mzn` implementation can be tested with the command,

```
mzn-gecode ./gangwarfare.mzn ./data/<inputFileName>
```

Resources You will find several problem instances in the `data` directory provided with the handout.

Handin Run `submit.py` with the command, `python ./submit.py`. Follow the instructions to apply your MiniZinc model(s) on the various assignment parts. You can submit multiple times and your grade will be the best of all submissions. However, it may take several minutes before your assignment is graded; please be patient. You can track the status of your submission on the *feedback* section of the assignment website.

4 Technical Requirements

For completing the assignment you will need MiniZinc 2.0 (`http://www.minizinc.org/2.0/`) and the gecode solver (`http://www.gecode.org/download.html`). To submit the assignment for grading, you will need to have python 2.7.x installed on your system (installation instructions, `http://www.python.org/downloads/`).