Discrete Optimization Specialization: Workshop 1
Temperature

1 Introduction

During the production of weapons the temperature in the forge must be kept between 25 and 30 degrees. Too cold, and the melted iron starts to congeal. Too hot and the blacksmiths are too sweaty and mistakes are made.

Temperature - `temperature.mzn`

Given a sequence of hourly readings of outside temperatures, and a starting temperature for the building (which we can assume is in the range 25 to 30), the building temperature will, without intervention, move to the average of the current building temperature and the outside temperature rounding down.

First write a model named `temperature_nd.mzn` to determine the building's temperature given the input data. Note there are no real decisions but you may use variables to record the temperature! The expected output will be an array of temperatures, starting with the start temperature, and giving the temperature at each hour. Given data `start=25; readings=[35,35,20,20,20];` the expected output would be `temp = [25, 30, 32, 26, 23, 21];`

Next, assuming the controller can choose to:

heat stoke the forge with wood to heat the building to raise temperature by 1 degree for 1$

strongly_heat stoke the forge with coal to the building to raise the temperature by 4 degrees for 5$

cool set a worker to fan the building to lower the temperature by 2 degrees for 3$

strongly_cool set a group of workers to spray the building with water and fan it to strongly cool the building to lower the temperature by 5 degrees for 9$

do_nothing or do nothing (for no cost)

Write a model named `temperature.mzn` to determine the minimal costs to keep the building temperature within the required range of 25 to 30 degrees. The expected output is the temperature readings at each time, the choices made at each hour, and the total cost. For the data above the optimal solution is

```
temp = [25, 30, 30, 25, 26, 27];
choice = [do_nothing, cool, do_nothing, strongly_heat, strongly_heat];
cost = 13;
```

showing cooling in the second hour, strong heating in the fourth and fifth hour.
Test your model on the following data sets:

- readings = [22,24,26,28,30,32,30,28,16]; start = 27;

- readings = [28,28,28,34,36,28,24,20,20,20,20,20]; start = 25;
- readings = [40,38,38,38,22,22,22,22,25,29,20]; start = 30;
- readings = [42,42,42,42,42]; start = 25;

Provided as `.dzn` files for your convenience.

2 Technical Requirements

For completing the workshop you will need MiniZinc 2.0 (`http://www.minizinc.org/2.0/`).