Modeling Discrete Optimization Workshop: **Temperature**

1 Introduction

The aim of this workshop is to see how to model state change.

Temperature - `temperature.mzn`

Warning: this question is significantly harder than earlier ones!

A temperature controller for a building must keep the temperature within the building between 16 and 22 degrees. Given a sequence of hourly readings of outside temperatures, and a starting temperature for the building (which we can assume is in the range 16 to 22), 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 buildings 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 = 18; readings = [30,30,18,18,16];` the expected output would be `temp = [18, 24, 27, 22, 20, 18];`
Next, assuming the controller can choose to:

1 heat the building to raise temperature by 1 degree for 10$

2 strongly heat the building to raise the temperature by 4 degrees for 50$

3 cool the building to lower the temperature by 2 degrees for 30$, or

4 strongly cool the building to lower the temperature by 5 degrees for 90$.

5 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. 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 = [18, 22, 21, 19, 18, 17];
choice = [3, 4, 5, 5, 5];
cost = 120;
```

showing cooling in the first hour, strong cooling in the second hour and nothing thereafter.
Test your model on the following data sets:

- readings = [16,18,20,22,24,26,24,20,18]; start = 20;

- readings = [20,20,20,26,28,20,16,14,14,14,14,14]; start = 16;
- readings = [32,30,30,30,14,14,14,14,17,21,12]; start = 22;
- readings = [34,34,34,34,34]; start = 16;

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/`).