FIT5216: Modelling Discrete Optimization Problems
Inclass Task 14: Exam Study Timetable

1 Problem Statement

You have a number of exams to study for and only D days remaining before the exam period begins each with H hours (an even number) available for study, split into a morning session and afternoon session. The requirement is to create a study plan that starts as late as possible, so you can slack off as long as possible.

The constraints of the problem are:

- There are set of topics to study `TOPIC`.

- Each topic t requires $hours[t]$ continuous hours of study (although you can start one afternoon, and continue the next morning; or start)

- Some topics must be completed, before others are begun.

- Some topics have to be started first thing in the morning when you are freshest.

- Some days only the morning is available since you have sporting commitments in the afternoon.

Data for the problem is defined as follows:

```
enum TOPIC;
array[TOPIC] of int: hours;   % hours study per topic
int: m;                       % no of precedences
set of int: PREC = 1..m;
array[PREC] of TOPIC: before; % topic that must be finished before
array[PREC] of TOPIC: after;  % topci after starts
set of TOPIC: morning;        % which topics must start at morning
int: D;                       % number of days
int: H;                       % hours per day (even)
constraint assert(H mod 2 = 0,"Hours per day H must be even\n");
set of int: DAY = 1..D;
set of DAY: HALF;             & days where only morning is available
```

Build a MiniZinc model `examstudy.mzn` The main decision are

```
set of int: TIME = 0..D*H;
array[TOPIC] of var TIME: start;
```

The aim is to maximize the earliest start time for a study.

For example a small dataset is

```
TOPIC = { BMATHS, AMATHS, ENGLISH, CHEM, PHYS };
hours = [2,5,4,3,6];
m = 2;
before = [BMATHS,CHEM];
after  = [AMATHS,PHYS];
morning = {AMATHS,CHEM};
D = 5;
H = 8;
HALF = {3,4};
```

for five topics over 5×8 hour days, where the afternoon of days 4 and 4 is unavailable.

One possible solution is `start = [6, 32, 24, 8, 11];` where we start at hour 6 on day 1. The schedule is visualized as

```
| day 1 | day 2 | day 3 | day 4 | day 5 |
      bbcccpppppp    ....eeee....aaaa
```

Note how AMATHS starts at the beginning of day 4, and similarly for CHEM on day 2. BMATHS completes before AMATHS, and CHEM completes before PHYS. The afternoons of day 3 and day 4 are not used (shown dotted).

1.1   Extension

Actually you have realised that if you break a study session overnight, its not effective. In the sample solution Physics is started on day 2 but concludes in the first hour of day 3. Modify your model to create `examstudyx.mzn` which enforces that no TOPIC is studied across the break in a day.

With this constraint the solution shown previously is not valid, since PHYS starts on dat 2 and finishes on day 3. A solution to the same problem with the new constraint is `start = [5, 8, 24, 16, 32];`. This schedule is visualized as

```
| day 1 | day 2 | day 3 | day 4 | day 5 |
      bb aaaaa    ccc ....eeee....ppppp
```

2   Instructions

Edit the provided `mzn` model files to solve the problems described above. Your implementations can be tested locally by using the *Run* icon in the MINIZINC IDE or by using,

```
minizinc ./modelname.mzn ./datafile.dzn
```

at the command line.