

SFI Centre for Research Training in AI Week #1: Constraints & Optimisation Project

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Organisation. Students will be arranged into groups of three people. Each group will work on a model of the problem specified below, with an additional update provide each day. At the end of the week each group is required to present their solution to the full module group in a 15 minute slot, inclusive of time for questions. Each team should use MiniZinc to complete this work.¹

1 Problem

You have been asked to provide a tool that helps match students to companies in an interview session at the next major Constraint Programming conference.² A number of companies have expressed interest in participating, there are currently 15 companies in the scheme.

Each student from set S can express a preference to interview with each company, with values ranging from 1 (very interested) to 5 (not at all interested). We provide a MiniZinc datafile and an associated model file that shows the answers that have been collected through a Google Forms document (`test.dzn` and `test.mzn`).

Each student should have three interviews during the conference, with different companies. The companies have expressed limits on how many interviews they want to perform during the conference.

We want to find an assignment of students to companies that stays within the capacity limits for each company, while providing the best match to the student preferences. Overall quality will be measured by two quality indicators:

1. If the preference of student i for company j is p_{ij} , and the three companies selected for student i are s_{ik} with $k \in [1, 3]$, the first overall quality indicator is the sum of the preferences for the selected assignments, i.e.

$$\sum_{i \in S} \sum_{k=1}^3 p_{is_{ik}}.$$

We want to minimize this sum.

¹<https://www.minizinc.org>

²This is a totally made-up problem. None of the companies mentioned have been contacted, there are no interviews that will be arranged. Sorry! But there are conferences which run such a scheme, as well as some universities. The companies mentioned are interested in Constraint Programming, many are sponsors of one or more CP conferences, or have participants in the Association for Constraint Programming Summer School.

Table 1: Company Data		
Nr	Company	Capacity
1	AIMMS	5
2	SAS	5
3	Keelvar	3
4	Microsoft	10
5	Google	10
6	IBM	10
7	Cadence	5
8	Quintiq	10
9	Siemens	10
10	Cosling	3
11	COSYTEC	3
12	LocalSolver	3
13	N-side	3
14	UTRC-I	5
15	Zoomer	5

2. We do not want to have a solution that satisfies all preferences for some students, but not for others. As a secondary criterion, we want to minimize the maximum of the total preference costs per student, adding the preference values for their assignments, i.e.

$$\min \max_{i \in S} \sum_{k=1}^3 p_{is_{ik}}.$$

The capacities for the companies are given in Table 1.

1.1 Data Format

The input data is given in the spreadsheet `test.mzn` and `test.dzn`. Feel free to manually adjust the input format to your preferred solver platform. The output should be a listing of the matching of student number to company. Student numbers start from one and are given in the order of the rows in the input file. Company numbers also start from one and are given in the column order that they are defined. We provide an array to map company numbers to company names.

An example solution output is given below:

```
Student:Company
1:Microsoft
1:Google
1:LocalSolver
2:AIMMS
2:SAS
2:Keelvar
...
```

If you have any questions about the competition please send an email to `helmut.simonis@insight-centre.org` and `b.osullivan@cs.ucc.ie`

Contents of test.mzn

```
% Number of interviews per student
int: k;

% Number of students and companies undertaking interviews
int: number_of_students;
int: number_of_companies;

% Capacity and name of each company
array[1..number_of_companies] of int: capacity;
array[1..number_of_companies] of string: company_name;

% Student preferences for each company (1 is best, 5 is worst)
array[1..number_of_students,1..number_of_companies] of int: preference;
```

Contents of test.dzn

```
k = 3;
number_of_students = 26;
number_of_companies = 15;

capacity      = [5,5,3,10,10,10,5,10,10,3,3,3,3,5,5];
company_name = [ "AIMMS", "SAS", "Keelvar", "Microsoft", "Google", "IBM",
                  "Cadence", "Siemens", "Cosling", "COSYTEC", "LocalSolver",
                  "N-side", "UTRC-I", "Zoomer", "Quintiq" ];

preference    = [|3,4,1,1,1,1,2,2,2,4,4,2,2,3,2
                  |2,4,4,1,1,3,1,1,1,2,1,1,1,5,1
                  |3,4,3,5,5,5,3,3,4,3,4,4,3,3,3
                  |5,2,3,1,1,1,4,4,2,4,4,4,2,3,2
                  |2,2,1,5,2,3,4,4,5,4,2,2,3,5,5
                  |3,4,3,2,2,1,3,3,4,4,4,2,3,3,3
                  |4,3,4,2,2,2,3,4,3,3,3,2,3,4,3
                  |5,5,2,1,1,1,5,5,3,5,5,5,5,2,5
                  |5,5,5,1,1,1,5,5,5,5,5,5,5,5,5
                  |5,3,5,1,1,1,5,5,3,5,5,2,5,3,5
                  |4,2,4,4,2,2,3,4,2,3,3,4,3,2,3
                  |5,5,5,3,3,3,3,5,3,5,5,5,5,5,5
                  |5,5,5,1,1,3,5,5,5,5,5,5,5,5,5
                  |4,4,4,4,2,2,3,4,4,4,4,4,3,3,4
                  |2,2,2,1,1,1,2,2,2,2,1,2,2,2,2
                  |5,5,5,5,5,5,5,5,5,5,5,5,5,5,5
                  |5,5,5,5,4,4,5,5,3,5,4,5,5,3,4
                  |2,2,4,5,5,5,2,2,5,2,1,3,3,2,2
                  |2,3,1,3,2,2,4,1,2,1,2,1,1,2,4
                  |5,4,3,3,3,3,5,5,4,5,3,4,5,3,5
                  |5,5,5,2,1,2,5,5,3,3,5,5,5,5,5
                  |4,2,3,3,2,4,4,3,4,5,4,4,4,3,4
                  |3,3,3,2,1,2,5,3,5,3,2,3,1,5,4
                  |3,4,3,4,4,4,3,3,4,3,3,4,4,5,3
                  |2,2,2,3,4,2,5,2,2,4,4,1,1,2,4
                  |2,3,2,5,1,1,5,5,4,2,2,5,4,2,4|];
```