

Constraint Satisfaction Problem

The aim of this project is to develop a CSP model and program to allocate students on education projects proposed every school year. These projects are one year long and need to be performed by a group of students. Currently, the student representatives are the one who allocate students among the proposed projects, that leads to: unbalanced groups' sizes, not enough gender and ethnic mix and some tensions between students.

As a consequence, the goal is to propose an automated projects allocation program meeting a set of constraints that tries to optimize the class and teacher satisfaction.

This work could be carried out by team of **max 2** Students. Your program and report must be uploaded in SAVOIR in the dedicated section before **21th November (18:00)**. To complete this project, you have to use Minizinc software.

Problem and constraints definition

Input data

An education project is proposed by a professor who describes this one (goal and context) and selects among a list of keywords 5 of them to shortly underline the domain and task expectation related to the project (for example: "mechanics", "optimization", "finite elements", "python programming", "additive manufacturing"). In addition, in the organization of Arts et Métiers school, the students are split into two different semesters: GIM and GIE (mechanical or industrial major courses); the teacher can precise which one he wants for his project: GIE, GIM or any of them.

A professor can propose several projects without any limitation.

The students as well, can precise 5 keywords they want to work on. In addition, they can propose a list of 3 other students they prefer to work with on the project.

Constraints definition

A valid allocation is a student's allocation meeting several constraints:

- The size of a student group can go from 4 to 6 students (included)
- A professor needs to have at least one project allocated
- The group can only contain students from the same semester that meets the expectation expressed by the teacher
- At least one keyword of the project was selected by each student allocated to the project (not necessary the same one)
- The group should be mix that's to say it should contain:
 - o Both genders (not necessarily balanced)
 - o Several origins (from several training programs and/or double degree)

Optimization problem

In addition to these constraints that should be met, we want to consider some extra parameters to have the best allocation regarding students' expectations.

To do so, we want to consider for each student his satisfaction that depends on:

- How many of his keywords are common with the project definition
- How many friends he has inside his group.

In order to have fair allocation that won't lead to have one group or member that is fully satisfy and

the other members aren't, it could be interesting to consider not only the global satisfaction but to keep it balanced:

- Inside a group (all students of a group are as homogeneously satisfied as possible)
- Between the student's groups (all groups have similar satisfaction)

Work to do

Don't try to solve everything at once, work step by step by proposing 3 dedicated Minizinc models:

- The first one that generates solutions meeting only the constraints expressed in this statement
- The second one that considers only the optimization (maximization) of the global satisfaction
- The last one that considers the optimization of the balanced satisfactions

A report should be added to explain your choices and strategy. As well, you will have to propose a case study to show (with limited students and projects) how efficient is your work and model.