Practical Assignment

Description: The practical assignment consists of choosing an optimization problem, designing and testing both a mathematical programming (MIP) model and a constraint programming (CP) model for the problem, and reporting on the findings of the analysis of each model and comparison of the two models.

It is divided into two stages: design, implementation and test of the MIP model; and design, implementation and test of the CP model, as well as comparison between the MIP and CP models.

The assignment can be done in groups of three students.

Evaluation: The assignment will be evaluated based on a written **paper**, as well as information regarding **self-evaluation**. The scheduled due dates are presented below:

Choice of topic and work group	10/12/2022
Paper/report	06/01/2023
Self-evaluation	06/01/2023

Choice of topic (10/12/2022): Each group should choose one of the available topics. This should be done in this Google Sheet by placing the name(s) of the student(s) next to the topic, in the white cells. Each topic can only be chosen by a maximum of three groups.

In case you want to suggest a different topic, please contact us (goncalo.figueira@fe.up.pt and dcs@fe.up.pt) with information about the topic and instance dataset to use, for validation.

Final report (06/01/2023): Each group should submit (via Moodle) the final report, containing the MIP and CP models for your chosen problem, as well as an analysis of the models and the obtained results. You should write the models for the chosen problem and test the limitations of the models, starting with smaller instances and successively increasing the dimensions of the instances to be solved (identifying what are the relevant parameters for the instances' dimension). You should also analyze the impact of different search options for CP, and a comparison between MIP and CP models, comparing both the solutions (to check for correctness) and the running times (to check for efficiency) of the models.

The paper should have the following structure:

1. Abstract
2. Introduction (including a description of the problem and the objectives of the paper)
3. The MIP model
4. The CP model
5. An analysis of the tests and results (including some KPI's on the difficulty of the instances and resolution time)
6. Conclusions

The implementation of both models can be done using Cplex Studio or using the CP library and a general-purpose programming language (like Python, Java or C++). An aspect to explore is the kind of constraints that can be used in CP, contrasting them with the linear constraints that you have designed for the MIP model. Note that you are not forced to linearize your model, as the CP Optimizer allows you to use basic constraints on your problem variables but also provides more powerful constraints suited to your problem. You can compare CP models using the basic and the more compact constraints on your problem instances.

Self-evaluation (06/01/2023): Each student must send us (goncalo.figueira@fe.up.pt and dcs@fe.up.pt) an e-mail containing the percentage of contribution from each member of the group. Please use 'SAAD - SelfEval' as the subject of the e-mail.

Assignment Topics: A list of suggested topics follows, including a link to resources (datasets) to be used in the assignment:

- Open Shop and Job Shop (Difficulty level 1)

  http://mistic.heig-vd.ch/taillard/problemes.dir/ordonnancement.dir/ordonnancement.html

- Aircraft landing (Difficulty level 2)

  http://people.brunel.ac.uk/~mastjjb/jeb/orlib/airlandinfo.html

- Extended Cap Warehouse Location (Difficulty level 2)

  http://people.brunel.ac.uk/~mastjjb/jeb/orlib/capinfo.html
  (discuss the problem extension with the course teachers)