Ph.D. research topic

- Title of the proposed topic: Learning Hidden Constraints
- Research axis of the 3IA: 1 and 4
- Supervisor (name, affiliation, email): Jean-Charles Régin, UCA – I3S, jean-charles.regun@univ-cotedazur.fr
- Potential co-supervisor (name, affiliation):
- The laboratory and/or research group: I3S/MDSC, Constraints & Applications

Apply by sending an email directly to the supervisor.

The application will include:
- Letter of recommendation of the supervisor indicated above
- Curriculum vitae.
- Motivation Letter.
- Academic transcripts of a master’s degree(s) or equivalent.
- At least, one letter of recommendation.
- Internship report, if possible.

- Description of the topic:

Modeling real problems is a task that is proving more difficult than it seems.

The person in charge of writing the model that will automatically solve the real instances faces many problems
- some constraints are difficult to express and for the same problem can be formulated differently by different teams;
- some constraints cannot be defined explicitly because they are awkward (i.e. Mary does not want to work with Betty);
- some constraints are so implicit in the domain that they are forgotten by the person in charge of the actual problem solving;
- the objective function is often complex and based on many parameters. Some preferences are actually constraints and some constraints are preferences. The combination of parameters has little mathematical basis and is often obtained by trial and error;
- finally, the main interlocutor in the company, who has a great knowledge of the business and its various aspects, looks unfavorably on the arrival of automation of part of his work.
For all these reasons, many constraints are poorly or not very well expressed. They are referred to as hidden constraints. Explaining these constraints can be extremely difficult and very costly, at least in terms of time.

However, a lot of data is often available, such as the history of problems solved. The goal of this thesis is to extract these constraints from the data.

It is not a question of learning completely the models from the data. Indeed, a large part of the model is already known. So, we want to learn structured information from structured knowledge.

An approach based on Multi-Decision Diagrams (MDD) will be considered. Indeed, MDDs allow to represent, compress and manipulate sets of solutions easily. We will thus seek the parameters that will allow an MDD representing constraints to subsume the examples of solutions. The idea is to intelligently explore the possible combinations taken by the parameters of the constraint without explicitly listing all possible combinations.

Then we will try to generalize this method to various constraints.

Particular attention will be paid to the objective function of optimization problems which is often poorly defined or defined in a somewhat empirical way. Special attention will be paid to multi-criteria optimization problems. The goal is to better understand and express the objective functions of multi-criteria problems in order to generate better solutions.

A collaboration with Canada is strongly envisaged (C-G Quimper, Univ Laval, Quebec).

Consideration will also be given to the problems of patient transport and a collaboration with Singapore on this subject is also envisaged (Prof. A. Lim, National Univ. Singapore).

REFERENCES: