



## Search Language for Constraint Programming

Master internship.

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### Context

Huawei is one of the world leading company in information and communication technology. Our products and solutions include processor development, servers, 5G base stations, network services, cloud services and mobile phones, serving more than one third of the world's population in more than 170 countries. Our innovations and partnerships are motivated by customer satisfaction and providing the best user experience. The Declarative Computing team is part of the Paris Research Center in Boulogne-Billancourt and focuses on fundamental and applied research on Constraint Programming and related paradigms (CP, SAT, SMT, Logic-based formalisms, etc.), and also on applications like scheduling, routing, configuration, etc.

### Project

Constraint Programming (CP) is a generic tool to represent and solve combinatorial problems and has found its way into industrial applications. As a declarative paradigm, it has been the subject of many years of research to improve its efficiency. Constraint Programming is composed of search and inference. In large industrial problem, it is often the case that the user has to program complex search techniques in order to explore the search space. It can include the classic redefinition of the variable and value selectors, but also much more complex strategies like restarts, sequencing, probing, launching parallel or concurrent processes, resuming searches, etc. These dynamic strategies require to monitor the solver and the search and take decisions. Most of the time, the user has to program these behaviors in the solver's programming language and this control may require thousands of lines of code.

Search languages have been investigated already [3, 2], and also coordination mechanisms [1]. Current search strategies should also allow for randomization, learning and hybrid solving. The goal of this project is to define a search language and integrate this language in a constraint solver.

### Candidate

We are looking for a highly motivated Engineering School or Master's degree candidate in Computer Science who is motivated by the following fields: artificial intelligence, theory of computing, algorithms, constraint reasoning, high-performance implementation, parallel programming, machine learning, deep learning, reinforcement learning. Strong programming abilities are mandatory (we use C++).

Please contact us at the email addresses below. Include a detailed CV and motivation letter, undergraduate and graduate marks, list of the courses followed, project or internship reports, name of two

person who can recommend you and/or recommendation letters, link to personal GitHub if any.

## Working environment

Supervision in the Paris Research Center will be done by Prof. Arnaud Lallouet and the Declarative Computing team. The Paris Research Center of Huawei Technologies provides a high level scientific environment hosting many researchers on different topics ranging from communication theory to machine learning and cutting-edge hardware facilities. It enjoys also a nice working environment on the Seine riverside with excellent restaurant (free for interns) and leisure zone with snooker table and videogames.

## Contacts

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## References

- [1] Eric Monfroy and Farhad Arbab. Constraints solving as the coordination of inference engines. In Andrea Omicini, Franco Zambonelli, Matthias Klusch, and Robert Tolksdorf, editors, *Coordination of Internet Agents: Models, Technologies, and Applications*, pages 399–419. Springer, 2001.
- [2] Andrea Rendl, Tias Guns, Peter J. Stuckey, and Guido Tack. Minisearch: A solver-independent meta-search language for minizinc. In Gilles Pesant, editor, *Principles and Practice of Constraint Programming - 21st International Conference, CP 2015, Cork, Ireland, August 31 - September 4, 2015, Proceedings*, volume 9255 of *Lecture Notes in Computer Science*, pages 376–392. Springer, 2015.
- [3] Tom Schrijvers, Guido Tack, Pieter Wuille, Horst Samulowitz, and Peter J. Stuckey. Search combinators. *Constraints An Int. J.*, 18(2):269–305, 2013.