

# Solving complex personnel scheduling problems using context-free grammars Stage Master 2015

Equipe-projet Inria RealOpt  
Université de Bordeaux

This “stage” (internship) deals with a multi-activity personnel scheduling problem in which we need to compute a schedule for a fixed number of employees in order to minimize the over-coverage and under-coverage of different parallel activity demands along a planning horizon.

Efficient algorithms for this problem are based on decomposition methods in which individual employee plannings are constructed independently. This decomposition allows one to take into account complex individual planning rules arising from regulation agreements and ergonomic considerations. These rules can be described using formal language, based on context-free grammars.

Context-free grammars have already been used to solve personnel scheduling problems, see [1, 2]. However, instances treated in these papers have a short planning horizon (one day).

The goal of this internship is to implement and test efficient algorithms that use context-free grammars for solving personnel scheduling instances with long planning horizon (at least one week). Our team disposes such instances, which come from the industry (personnel scheduling in supermarkets).

Also, our team disposes an internally developed C++ library called BaPCod (Branch-and-Price Code) to facilitate implementation of decomposition algorithms. Therefore, the internship subject mainly concerns solving the sub-problem, which constructs individual employee plannings. It is expected that the algorithms developed during the internship will be integrated to the BaPCod library.

## **Student profile**

Student of Master 2 or engineering school

Required skills

- Knowledge of Integer Linear Programming
- Programming in C++

Desirable skills

- Knowledge of decomposition methods in linear programming (Danzig-Wolfe reformulation, column generation)
- Knowledge of dynamic programming

The internship will take place within the Inria team ReAlOpt situated in the Mathematics Institute of Bordeaux (Talence campus).

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## References

- [1] Vincent Boyer, Bernard Gendron, and Louis-Martin Rousseau. A branch-and-price algorithm for the multi-activity multi-task shift scheduling problem. *Journal of Scheduling*, 17(2):185–197, 2014.
- [2] Marie-Claude Côté, Bernard Gendron, and Louis-Martin Rousseau. Grammar-based column generation for personalized multi-activity shift scheduling. *INFORMS Journal on Computing*, 25(3):461–474, 2013.