Application of Hyperheuristics to the Nurse Rostering Problem in Belgian Hospitals

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The nurse rostering problem involves the assignment of shifts to nurses over a schedule period with respect to a wide range of constraints. The constraints, including coverage constraints, counters, series, successive series, and employee requests, increase the complexity and hardness of the problem. The nurse rostering problem in Belgian hospitals is a complicated version of the problem, which has been tackled with various solution methods, including tabu search, variable neighbourhood search, and memetic algorithms.

Hyperheuristics are high level search and optimisation strategies which deploy a set of low level heuristics. Hyperheuristics do not operate directly over a problem domain and they do not utilise problem specific information. If an appropriate set of low level heuristics is provided, hyperheuristics can be applied to any problem with only a few parameter adjustments. Examples to such parameters are the cooling schedule in simulated annealing hyperheuristic, and the tabu list length in tabu search hyperheuristic. Hyperheuristics utilise the strengths of the heuristics, avoid their weaknesses, and maintain a synergy between them. Hyperheuristics have been successfully applied to several real world problems such as exam and course timetabling, space allocation, open shop scheduling, sales summit scheduling, and vehicle routing problems.

The diversity of nurse rostering problem instances among different hospitals and among different wards in hospitals requires a generic model. We build upon a generic model that was previously developed. It enables planners to define their particular problem instances. A variable neighbourhood search algorithm and some problem specific neighbourhoods are yet available to solve the model.

In this study, we implemented problem specific low level heuristics to operate on the same model. We applied various hyperheuristics like simulated annealing and great deluge on top of these low level heuristics. The performance of the resulting solution methods is evaluated empirically on a set of real world benchmark instances. Preliminary results show a significant performance improvement by hyperheuristics over variable neighbourhood search.