

The second International Nurse Rostering Competition

Sara Ceschia · Nguyen Thi Thanh
Dang · Patrick De Causmaecker ·
Stefaan Haspeslagh · Andrea Schaerf

Abstract Announcement of the second international nurse rostering competition.

Keywords Nurse Rostering · Competition

1 Introduction

Nurse rostering is a very important problem in healthcare management. Early papers date from the seventies, but especially in the last decade, it has drawn significant attention, see [3, 4] for a review of literature and a classification.

The First International Nurse Rostering Competition (INRC-I) [7] was run in 2010. The competition welcomed 15 submissions in three categories (sprint, medium and long tracks). Since then, several groups also took this formulation and the corresponding instances as a challenge [1, 2, 5, 6, 8, 9] and

Work supported by the Belgian Science Policy Office (BELSPO) in the Interuniversity Attraction Pole COMEX. (<http://comex.ulb.ac.be>)

Sara Ceschia, Andrea Schaerf
Dipartimento di Ingegneria Elettrica, Gestionale e Meccanica
Università di Udine, via delle Scienze 206, 33100, Udine, Italy
Tel: +39 0432 55 8280, fax: +39 0432 55 8251
E-mail: {sara.ceschia,schaerf}@uniud.it

Nguyen Thi Thanh Dang, Patrick De Causmaecker
KU Leuven, Department of Computer Science, CODeS & iMinds-ITEC, KULAK, E. Sabbe-
laan 53, 8500 Kortrijk, Belgium
Tel.: +32 56 24 60 02, Fax: +32 (0) 56 246052,
E-mail: {nguyenthithanh.dang, patrick.decausmaecker}@kuleuven-kulak.be

Stefaan Haspeslagh
Technologie en informatica - VHTI, Doorniksesteenweg 145, 8500 Kortrijk, Belgium
Tel: 056 26 41 20, fax: 056 21 98 67,
E-mail: stefaan.haspeslagh@vives.be

produced remarkable results. Optimal solutions as well as new best solutions have also been found and reported [2,8,9].

The problem considered for INRC-I was the assignment of nurses to shifts in a fixed planning horizon, subject to a large number of hard and soft constraint types.

For the Second International Nurse Rostering Competition (INRC-II), we propose a smaller set of constraint types, but within a *multi-stage* formulation of the problem. That is, the solvers of the participants are requested to deal with a sequence of cases, referring to consecutive weeks of a longer planning horizon (4 or 8 weeks).

The search method designed by the participants has to be able to solve a single stage of the problem corresponding to one week. Some information, called *history*, is carried out between consecutive weeks, and the one coming from the previous week has to be taken into account by the solver. The history includes *border* data, such as the last worked shift of each nurse, and counters for cumulative data, such as total worked night shifts. Counters' value has to be checked against global thresholds, but only at the end of the planning period.

The organizers provide a simple command-line simulation/validation software to be used to evaluate the quality of the solver. The *simulator* invokes the participant's solver for each stage iteratively, then updating the history after each single execution. The provided *validator* concatenates the solutions for all weeks, and evaluates them all together, along with the cumulative data coming from the final history.

The solver should take into account the following separate input sources:

Scenario: Information that is global to all weeks of the entire planning horizon, such as nurse contracts and shift types.

Week data: Specific data of the single week, like daily coverage requirements and nurse preferences for specific days.

History: Information that must be passed from a week to the other, in order to compute constraint violations properly. It includes border information and global counters.

The solver must deliver an output file, based on which, the simulator computes the new history file, to be passed back to the solver for the solution of the next week.

The rules and early instances of INRC-II will be made available at the day of the presentation. The competition will be run during the fall of 2014 till summer of 2015 and its results will be presented at MISTA 2015 in Prague. Winners will be awarded a financial prize, as well as free conference fees.

References

1. Mohammed A Awadallah, Ahamad Tajudin Khader, Mohammed Azmi Al-Betar, and Asaju La'aro Bolaji. Nurse rostering using modified harmony search algorithm. In *Swarm, Evolutionary, and Memetic Computing*, pages 27–37. Springer, 2011.

2. Edmund K Burke and Tim Curtois. New approaches to nurse rostering benchmark instances. *European Journal of Operational Research*, 2014.
3. Edmund K Burke, Patrick De Causmaecker, Greet Vanden Berghe, and Hendrik Van Landeghem. The state of the art of nurse rostering. *Journal of scheduling*, 7(6):441–499, 2004.
4. Patrick De Causmaecker and Greet Vanden Berghe. A categorisation of nurse rostering problems. *Journal of Scheduling*, 14(1):3–16, 2011.
5. Federico Della Croce and Fabio Salassa. A variable neighborhood search based matheuristic for nurse rostering problems. *Annals of Operations Research*, pages 1–15, 2010.
6. Martin Josef Geiger. Personnel rostering by means of variable neighborhood search. In *Operations Research Proceedings 2010*, pages 219–224. Springer, 2011.
7. Stefaan Haspeslagh, Patrick De Causmaecker, Andrea Schaerf, and Martin Stølevik. The first international nurse rostering competition 2010. *Annals of Operations Research*, pages 1–16, 2012. Online first.
8. HG Santos, TAM Toffolo, S Ribas, and RAM Gomes. Integer programming techniques for the nurse rostering problem. In *Proceedings of the 9th International Conference on the Practice and Theory of Automated Timetabling (PATAT-2012)*, pages 256–283, 2012.
9. Ioannis P Solos, Ioannis X Tassopoulos, and Grigoris N Beligiannis. A generic two-phase stochastic variable neighborhood approach for effectively solving the nurse rostering problem. *Algorithms*, 6(2):278–308, 2013.