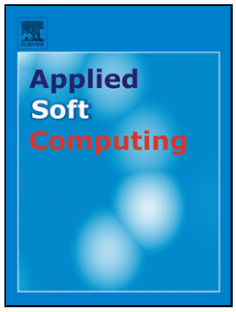

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Effective local search algorithms for high school timetabling problems

Landir Saviniec[a,*], Ademir Aparecido Constantino[b]

[a]*Instituto de Ciências Matemáticas e de Computação, Universidade de São Paulo, Avenida Trabalhador São-carlense 400, 13566-590, São Carlos, São Paulo, Brazil*
[b]*Departamento de Informática, Universidade Estadual de Maringá, Avenida Colombo 5790, 87020-900, Maringá, Paraná, Brazil*

Abstract

This paper addresses the high school timetabling problem. The problem consists in building weekly timetables for meetings between classes and teachers with the goal of minimizing violations of specific requirements. In the last decades, several mixed-integer programs have been proposed and tested for this family of problems. However, medium and large size instances are still not effectively solved by these programs using state-of-the-art solvers and the scientific community has given special attention to the devising of alternative soft computing algorithms. In this paper, we propose a soft computing approach based on Iterated Local Search and Variable Neighborhood Search metaheuristic frameworks. Our algorithms incorporate new neighborhood structures and local search routines to perform an effective search. We validated the proposed algorithms on variants of the problem using seven public instances and a new dataset with 34 real-world instances including large cases. The results demonstrate that the proposed algorithms outperform the state-of-the-art approaches in both cases, finding the best solutions in 38 out of the 41 tested instances.

Keywords: Class-Teacher Timetabling, Iterated Local Search, Variable Neighborhood Search, Minimum Cost Assignment Problem, Conflict Graph.

1. Introduction

Educational timetabling problems consist in building timetables for meetings between teachers (or exams) and students. The scientific literature has branched educational timetabling problems in three main categories: University Course Timetabling Problems [1], Examination Timetabling Problems [2, 3] and High School Timetabling Problems (HSTP) [4, 5, 6]. Each category contains a rich set of specific constraints.

In this paper, we deal with the HSTP. Decision versions of the HSTP can be solved in polynomial time by a min-cost network flow algorithm, provided that there is neither unavailability of teachers nor cases of co-teaching [7]. In addition, if the unavailability of teachers is considered, then the problem becomes NP-Complete [8]. Moreover, if the problem includes

*Corresponding author.
Email addresses: landir.saviniec@gmail.com (Landir Saviniec), ademir@din.uem.br (Ademir Aparecido Constantino)