A Four Stages Approach for Post Enrolment University Course Timetabling Problems

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Abstract.
Problem Identification
We consider the post enrolment course timetabling problem as an assignment of all events to the set of rooms and timeslots taking into considerations all constraints posed to them. We define a set of "resources" as the cartesian product of the set of timeslots and the set of rooms. The problem is then reformulated as the assignment of each event to the set of resources. Some matrices data structure were utilised to cope with the hard constraints.
The timetabling process is carried out in four stages. The first two stages deal with the feasibility problems, i.e. the problems of finding a timetable with no hard constraints violations, and the last two stages deal with the optimisation problems, i.e; the problem of minimising the soft constraints violations.
Stage 1. Constructive Heuristic
A Constructive Heuristic (CH) is used to try to find a feasible solution. For each instance, the CH tries to generate an initial solution with an increasing number of timeslots started with the number of given timeslots + 1 until a "feasible" solution is found. A "feasible" solution in this case is a solution with no hard constraint violations, possibly using some extra timeslots. This solution is then passed to next stage.
Stage 2. Simulated Annealing (SA) for Feasible Solutions
We define the number of students assigned to the extra timeslots as the objective of the minimisation process in our SA schema. The process is terminated if a global optimum solution is found or if the time limit allocated to this stage is reached. The best solution found (complete or uncomplete) in this process is then passed to Stage 3.
Stage 3. Simulated Annealing for Improving the Solutions
This stage is aimed to minimise the soft constraints violations. The SA in this stage only deals with those events that have been put in the timetable. The process is terminated when a global optimum solution is found or if the time limit is reached.
Stage 4. Kempe Chain-based Hill Climbing
In this stage, an effort to improve the best solution found in Stage 3 is carried out. A Kempe-chain neighbourhood structure is used, and the heuristic only accept an improving solution. The process is stopped if the total time limit granted is reached.
Computational Experiments and Results

We tested our approach using a PC pentium 4 - 3.0 GHz and 256 MB of RAM running under ms-windows xp. We tested 20 to 60 runs for each instance. Each run takes at most 429000 seconds. This time limit is obtained after benchmarking the machine using the program provided by the organiser of the competition. The solutions can be found in the .sln files and the quality of the solutions can be found in the file PostResultMT.txt.