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A Survey on Automation of University Examination System

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ABSTRACT

Examination timetabling is one of the most important administrative activities that take place in all academic institutions. It is a typical combinatorial optimization problem which is of vital importance to modern business. It is concerned with scheduling a certain number of events into a specified time frame. If solved manually, timetabling problems are extremely hard and time consuming and hence the need to develop tools for their automatic generation. Each year the number of students in a particular university increases and the timetabling problem for examinations becomes slightly more difficult. The process involves attempting to assign exams to time slots and rooms while satisfying a certain number of constraints. In this paper, we will be giving the historical background of this Examination Timetabling problems ? When and why it came into existence. Then we give the Motivation and the literature survey on the Examination timetabling problem and at last we give the scope and future work to be done .

KEYWORDS :

INTRODUCTION :

The timetabling problems arise as various real-world problems, such as educational timetabling, sports timetabling, and transport timetabling. The timetabling problem is a traditional combinatorial optimization problem. Manually designed timetables are not only inconvenient but also prove costly in terms of time and money. Frequently, a timetable that has been used previously and found to be acceptable is recycled and used again in the next semester (term). Some minor adjustment may need to be made and this can be done manually or with the help of a decision support system. As the difficulty of the problem increases, due to a large number of students, courses and examinations and room and invigilator constraints, (amongst others), an automated timetabling system that can produce feasible, high quality timetables quickly is often required.

MOTIVATION :

Most academic institutions face the problem of scheduling both courses and examinations for every semester. As the difficulty of the problem increases, due to a large number of students, courses and examinations and room and invigilator constraints. An automated timetabling system that can produce feasible and high quality timetables is often required. The timetabling procedure at universities and schools varies from manual timetabling, semi –automated timetabling to fully automated timetabling. A survey conducted by Burkeet al. [9] received feedback from 56 registrars of British Universities with regards to the nature of their examination timetabling problem, how they solved it (manual or automated) and what qualities were considered for a good examination timetable. They discovered that only 58% (32 universities) of their respondents use a computer at some stage in producing their examination timetable and 21% (11 universities) of these have a scheduling system. Only two universities use commercial software whilst the other systems were developed in house. Thus, whilst commercial software is available, such as, EXAMINE (Carter[12]), SyllabusPlus (Elliman[14] and CelCAT (Kahar[3]), many universities are yet to be convinced that an automated system will provide a satisfactory solution. Universities may need to develop their own system or customise a commercial system to fulfill their specific needs and requirements in timetabling. Once a customised system is developed, it will also require full support with frequent updates and maintenance due to changes in academic policy or education structure. An early survey by Mathaisel involving 1,494 U.S. college registrars concluded that there was a large market for a computerized timetabling system and most registrars were unhappy with their current systems. The survey showed that a computerized system must produce good quality timetables allowing some user intervention; it must be easy to use, comprehensive and compatible with any previous systems. JISC (Joint Information System Committee) Technology Applications Programme (JTAP 1998) published findings from a questionnaire from which they received replies from 16 universities in the U.K. The universities were asked whether a central computerized system was in use and for their views on its effectiveness. The report concluded that centralizing the whole process of room bookings, examination timetabling and lecture timetabling was done in phases using a wide variety of software packages and there was a need for a full and complete management support for such systems.

The exam timetabling problem is essentially concerned with scheduling a number of exams into a limited number of timeslots or periods in order to satisfy, as much as possible, a set of specified constraints. These constraints vary from institution to institution. A detailed analysis and study of institutional requirements in over 50 British universities is presented in [Burke et al[9]. It is often essential that some constraints are completely satisfied. Such constraints are called hard constraints. Usually these constraints relate to operational limitations that cannot be bypassed in the real world, such as the constraint that one person cannot be in two places at once or that there is a maximum number of people that can be accommodated in a particular room. We call a timetable that satisfies all hard constraints a feasible timetable. Another class of constraints that occur in timetabling problems is those that are deemed desirable, but that are often either difficult or impossible to fully satisfy. This could include providing study time for each student between any two exams, or making more efficient use of rooms. These constraints are usually called soft constraints. Such constraints often determine the quality of a timetable. In general we would think of a good quality timetable as one that is (firstly) feasible and that (secondly) satisfies the soft constraints to an acceptable level. Of course, the quality of a solution is very much subjective. One institution's idea of a good timetable could very well be a poor timetable for another institution. For example, it may be that one institution insists on having a clear day in between exams for all of its students (i.e. it makes this a hard constraint). Another institution may be more concerned with holding all of the exams as quickly as possible in which case the inclusion of the above constraint would be detrimental to the quality of the timetable.

LITERATURE SURVEY :

Over the last forty years or so, there has been a wealth of literature on automated timetabling and there have been several review papers that discuss the major approaches to timetabling [Burke et al.[9], Carter[15], Carter and Laporte[12], de Werra,[16], Schaerf,[6]]. The early approaches to exam timetabling tended to employ heuristic ordering where a heuristic is used to measure the difficulty of scheduling a particular exam . These heuristics are often based upon graph colouring heuristics [Burke et al.,[14], de Werra, [16].The overall idea is that the difficult exams are scheduled first to get them out of the way and the easier exams are scheduled towards the end of the process. This general approach has proved to be very effective, particularly when backtracking is added to the process [Carter et al.[15]]. The backtracking procedure is called upon when it is not possible to place a particular exam into the timetable because of earlier placements. This should then allow the problem exam to be scheduled. The recently unscheduled exams can then be rescheduled at alternative times. Carter, Laporte and Lee [12] [Carter et al[15]] presented some very competitive results on a range of benchmark problems. These results are generated by the employment of graph colouring based heuristics and backtracking.

Over the last few years there has been a significant level of interest in evolutionary and genetic approaches to examination timetabling. In 1993, Corne, Fang and Mellish [13] investigated a straightforward genetic algorithm approach for the examination problem at the Department of Artificial Intelligence at the University of Edinburgh. Their approach compared favourably with previously produced manual results. Corne, Ross and Fang [13] discussed the employment of evolutionary algorithms for exam timetabling problems and noted the potential of evolutionary algorithms in this area. They also discussed and presented mutation operators and a delta-evaluation method to speed up the evolutionary approach [Corne et al.[13]]. Burke, Elliman and Weare [7] presented and discussed a series of recombination operators for exam timetabling. Ross and Corne [13] compared three approaches (genetic algorithms, simulated annealing and stochastic hill climbing) on a test suite of 5 exam timetabling problems. The authors point out that this was a rather limited experiment but that simulated annealing and stochastic hill climbing work better than the genetic algorithm in terms of solution quality. Of course, as Ross and Corne point out, the representation used in the genetic algorithm is a particularly important consideration and that comparisons employing different representations may lead to different results. Burke, Elliman and Weare [14] represent the time table directly and incorporate graph colouring techniques into the crossover operators. Hybridization of heuristics and meta-heuristics to solve the problem is a theme that runs through several later papers on the exam timetabling problem. Burke, Newall and Weare [14] presented a memetic algorithm and applied it to benchmark problems. This mematic approach was a hybrid evolutionary algorithm that employed mutation only (no recombination) and a hill-climbing algorithm. It produced good results (at the time) on benchmark data. Corne and Ross [13] looked at "Peckish" initialization strategies. The term peckish is used to represent slightly hungry algorithms rather than greedy ones. They showed that peckish strategies are more effective than greedy or random ones on exam timetabling data from the Department of Artificial Intelligence at the University of Edinburgh. In 1998, Burke, Newall and Weare [14] presented a study of initialization strategies for evolutionary exam timetabling. In particular, they concentrated upon the employment of graph colouring heuristics in the initialization process and showed that such strategies can improve the performance of a memetic approach. The authors pointed out that the algorithm with initialization often started out with solutions which were comparable to the solutions that it finished with when started on a random population. This meant that the evolutionary algorithm could be employed to "fine tune" the solutions.

In 1999, Burke and Newall [9] incorporated a problem decomposition method with a memetic algorithm. The basic idea was to split up large timetabling problems into a series of smaller sub problems and deal with each one in turn. The obvious drawback is that this has the potential to run into difficulties with later sub-problems because of decisions taken in earlier sub problems. The authors addressed this by using graph colouring heuristics to form the sub problems and by employing a look-ahead approach as each of the sub-problems is dealt with. The overall strategy is that the "hardest" exams to schedule (according to the heuristics) are placed into the earlier sub-problems. The development of the decomposition method was motivated by the goal of trying to speed up the evolutionary process. However, it also significantly improved the solution quality and produced the best results that have so far been published on certain benchmark problems. Erben's method was developed for the graph colouring problem and initial modifications to apply it to the exam timetabling problem have shown promise. Burke, Bykov and Petrovic [9] drew on the hill climbing and mutation operators from [Burke and Newall[16]] to develop a multi-criteria approach to examination timetabling. It is not possible to compare such approaches with methods that employ a single cost function but they provide a higher level of flexibility in the handling of constraints. The multi-criteria approach is able to comfortably handle a range of fundamentally different constraints and to establish a balance between them according to whatever quality measure may be applied.

In 1997, Ross, Hart and Corne [13] discussed some of the limitations of genetic algorithms and concluded that a future direction for timetabling research might be to investigate genetic algorithms to choose the right algorithm to solve the given problem rather than being employed directly on the problem itself. In 1999, Terashima-Marin, Ross and Valenzuala-Rendon [13] investigated just such an approach and demonstrated the potential that this shows to raise the level of generality of automated timetabling methods. Indeed this is one of the research themes that the authors are currently investigating with Ross and Hart on a UK research council funded project [Burke et al[9]] to investigate hyper heuristics which can be thought of as "heuristics to choose heuristics".

SCOPE AND FUTURE WORK :

This paper is concerned with examination timetabling problems. A real examination timetabling problem has various constraints specific to the requirement of an institution. Different institutions will place different emphasis upon the various constraints and it would be impossible to model a generic examination timetabling model that is applicable to every institution. Another obstacle that needs to be overcome is the fluidity of problem specification. At the beginning of a project, the problem specification may be agreed but the final solution may not be as required because some implicit processes are not included or there has been a change in management requirements (e.g. Burke et al [14].

In future we will be giving the Mathematical formulation of the problem and the various approaches that are generally used to solve this type of particular problem.

In brief the future objective will be to provide a complete overview of the study, including the theoretical background, methodology, details of the coding, approaches, and analyzing the results in order to schedule the exam timetable problems in a reasonable exam period length.

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