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COURSE TIME-TABLING FOR A DEVELOPING COLLEGE: A PROPOSED STUDY

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ABSTRACT

Time-tabling is an essential asset that a growing college, which deals with students, manpower and resources, needs. This study details what a proper course time-tabling software should cover by looking into different time-tabling related scenarios with the objective of identifying a local search algorithm essential for the development of a prototype time-tabling software.

1.0 Introduction

SEGi College Penang opened its door for business in the 1980s. Initially, the College had focused on courses on business management, accounting, LCCI and ACCA. Today, it offers a wide range of diploma, degree, postgraduate and professional courses in the fields of business management, accounting, marketing, human resource, early childhood education, mass communication, nursing, computing, hotel management, allied health and tourism. Currently, the College has a total of over 1000 students and occupies a seven storey city campus building and several floors over the same row of buildings in Georgetown, Penang (www.segi.edu.my).

Due to the fast expansion of the College, the planning of the course time-table has to cope with the influx of new intake classes for different courses. The planning of resources used in course time-tabling has been the main issue. There is an urgency to rent more floor space in nearby buildings for classrooms, lecturers' rooms, teaching equipment and other resources such as discussion rooms, student' areas, extension of the library, etc. These resources are needed to fulfill the requirements and guidelines stipulated by the Malaysian Qualifying Agency or MQA and the Malaysian Ministry of Higher Education or MOHE (www.segi.edu.my).

2.0 Literature Review

2.1 Course Time-Tabling

Mihali *et al*. (2000) voiced out concerns over course time-tabling which requires actions to resolve course pre-requisites or co-requisites, which in turn add to the volume of the hard constraints. The hard constraints are mandatory conditions in a time-tabling creation. The complexities of constraints are increased with the number of credits needed to be obtained per semester and the limited number of semesters. Rudova *et al*. (2007C) indicated that the complexities of the real world situations will impose challenges to the development of course time-tabling due to the course structure, variety of constraints and distributed responsibilities of the end user.

Burke *et al*. (1994C) agreed that class size drew complexities due to the large range of student numbers. Wasfy and Alouf (2007), however, added that considerations for course time-tabling should include class size, number of enrolled students and number of available

courses for the semester. Thus, the Wasfy and Alouf (2007) study provided results that showed that good class performance was related to a minimal class size.

Bagatourova and Mallya (2004) admitted that there were inherent variables to be considered, for example, volume of work, productivity and work arrival pattern during course time-tabling. Even what was proposed did not mean that similar variables would not exist for scheduling courses.

MacCollum (2006) had worked on bridging the theory to the practical, by means of making course scheduling for a university the main focus.. The research discussed the scheduling for students and information modeling to house the constraints faced, institutional modeling of room allocation and solution modeling for specific issues. The approach to course scheduling was no different from examination scheduling except for the need to model the course structures and approaches. Considerations on soft constraints should be highlighted as there were differences from one education institution to another (Burke, *et al.* (2003), Burke, *et al*, (2004)).

Rudova and Murray (2003) worked on maximizing the fulfillment of student course requests by constraint logic programming with highlights on soft constraints. The repair search method that was applied boosted the process efficiency. But the environment imposed further issues by setting constraints which were linked to certain classes. Rudova *et al*. (2007C) stressed that implementation of a real scheduling system should go beyond the basic solution methods.

2.2 Local Search Algorithms

In the 1960s, Burke *et al*. (2003) mentioned that the Hill Climbing algorithm was brought to light as the premier algorithm to use for solving time-tabling problems. This was due to its speed in generating a solution but soon it too was overtaken by another better algorithm. The key weakness shown by the Hill Climbing algorithm was that it tended to revolve around the local optima. This algorithm could not provide return of results with better quality in the search without first resolving the escape from the local optima (Burke,*et. al*. 2004).

Wasfy and Alouf (2007) applied local search methods for university course time-tabling based on integer linear programming. Rudova, *et. al* (2007C) proposed to breakdown the soft constraints further and deal with them in a decomposition approach. They knew that soft constraints were secondary conditions which could be complex and it was easier to fulfill them if they were broken down into simple forms. By including a constraint solver, it should be part of an algorithm to resolve matters between hard constraints and soft constraints. Michel and Hentenryck (2002) came up with architectures with similar strengths.

Paechter and Rossi-Doria (1998) researched on course time-tabling using local search approaches to demonstrate the effectiveness of the algorithm to uncover knowledge and to reduce violation in both constraints. Bartak *et al*. (2004) focused on conflict-based statistics for iterative search using local approaches as comparison. Shaerf and Moscato (1998) researched on various types of local search algorithms and made comparisons

across different techniques. They came up with a tutorial for handling local search techniques when scheduling problems occurred.

Rudova, *e.t al*. (2007B) might share similar goals with Kendall, *et. al* (2006) in applying a structural framework to govern the scheduling environment but they researched the use of grid scheduling to improve the global schedule for optimization. In the case of a time-driven solution, Rudova *et al*. (2007A) recommended queuing up the scheduling tasks for process optimization. Boyan and Moore (2000) made efforts to improve optimization of the many local search techniques by making comparisons, and claimed that the random restart Hill Climbing can be out-performed by the STAGE algorithm due to the abilities of the STAGE algorithm to learn and predict trajectories of outcomes.

3.0 College Time-Tabling Scenarios

In this study, fact finding activities were carried out to seek information related to the course time-tabling for SEGi College Penang. The methods of information gathering were related interviews and observations conducted with different staff and students from their respective departments, schools and courses. Details of the discussions are as follows.

3.1 Scenarios Relating to Coordinators

The planning of the time-table was done by the coordinators. Their job was to manage manpower, room resources, and computer resources for the subjects taught in each semester. The issues became a nightmare when dealing with many coordinators from different schools who offered multiple diploma and degree courses within a semester. Coordinators from each school presented their final time-tables spreadsheets which they send to the senior service officer for room allocation as well as to the senior technical support for computer allocation. Allocation of resources could pose problems on occasions due to shortages.

3.1.1 Time-Tabling of Course Subjects

Course classes were restricted to be held one class per day which came about, among other issues, to cater to parental complaints that there were too few days with classes. So, strict instructions were given by the College management, to have at least a single class a day meaning that there were four to five class days in a week. Moreover, a further time-tabling constraint was that tutorial or practical classes must be between 9 am to 5pm on a week day.

3.2 Scenarios Relating to Courses, College and MOHE

A diploma course or bachelor degree course must be conducted in accordance with the approved course syllabuses stipulated by the MQA which ensures compliance.

3.3 Scenarios Relating to Lecturers

Every lecturer is the key person who leads and manages the entire learning process for the group of students in the class. The authorities demand a staff composition of about 70% full-time lecturers and 30% part-time lecturers. Lecturers are allowed to request for changes to room, equipment, day/time of classes in their time-table. Based on guidelines given by MQA, a lecturer is supposed to teach up to a maximum of four subjects in any given semester with eighteen lecturing hours a week. There does not appear to be any specification of hours for setting examination papers, marking scripts, laboratory classes,

tutorials, research, academic counseling and pastoral care. With the mushrooming of new colleges' staff turnover can be problematic for the management.

3.4 Scenarios Relating to Students

The College management had set up policies that oversee the handling of student issues in order to provide pastoral care and good service to the customers. Students are allowed to make request for changes to room, equipment, day or time in their time-tables. But there are certain measures, policies and rules of conduct that must be upheld to ensure good governance of a college.

Student attendance in class is monitored closely by both the lecturer and the coordinator. If a student were to be absent for four times without any valid reason, he will be barred from sitting an examination and that particular student must repeat that subject in the next semester. The consequence of being barred will affect the duration to complete the diploma or bachelor course which is that it must not exceed the maximum given period given of five years.

Each student will be reminded that he is responsible to complete all the subjects in the diploma or bachelor course before graduating. For example, a single diploma course student should be taking a minimum of five fresh subjects in a long semester and three fresh subjects in a short semester. The maximum subjects an individual student is allowed to take in a long semester is seven, which is made up of a mixed of fresh and repeated subjects and a maximum of four subjects in a short semester. At the end of each semester a new course time-table is issued to the intake class for the next semester. MQA requires the respective students to attend tutorials or practical classes aside from the normal lecturing classes.

3.5 Scenarios Relating to Room Allocation

Room allocations are the duties of the senior service officer. The allocation of rooms includes normal class rooms and computer laboratories. Availability of rooms changes on a weekly or monthly basis so that requests for changes must be made in good time. As demand for rooms grows owing to the introduction of new courses, the management will have to source for them by renting or building its own premises.

3.6 Scenarios Relating to Resources

Desktop computers, notebooks, projectors, routers, servers, laboratory equipment, library resources, etc, will be necessary when new courses are introduced. Juggling their usages on a just-in-time basis can be very challenging indeed.

An Education Management System (EMS) is vital in the functioning of the college and it is necessary that an existing system is well maintained. It may become necessary to invest in a new one if the existing EMS ceases to meet demanding requirements.

4.0 Conclusion

This paper discusses certain approaches for the use of a local search algorithm in course time-tabling for a growing college with the intention to propose the development of a prototype time-tabling software.

This study points out the many areas which have to be looked into such as students' needs, staff and resource usages.

The local search algorithm that was discussed is not new in the time-tabling field but had regain interest since there are some recent developments. This is due to local search algorithms capabilities that can churn out fast results when needed most. The prototype software should be able to increase the productivity and efficiency in handling the various scenarios faced by the management of the education institution when scheduling the course time-table for lecturers and students.

The objective is to develop a common time-tabling architecture that will allow the integration of the different courses among the different schools within the College. Design of the prototype software should be based on chosen local search algorithms and techniques with adaptability to the College culture and issues. Future studies will be to implement and evaluate the effectiveness of the prototype and whether the approaches are suitable or not to improve the course time-tabling system currently in used by SEGi College Penang. There may be a need to reshape the organization work-flow and information management between College management, staff, the different schools and students. In short, the course time-tabling in a growing college will be a challenge of adaptation to on-going practices.

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