# EXAM TIMETABLE FOR UNIMAS - ENHANCEMENT OF SISTEM JADUAL WAKTU UNIMAS

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## DECLARATION

No portion of the work referred to in this report has been submitted in support of an application for another degree or qualification of this or any other university or institution of higher learning.

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## ABSTRACT

For the current exam timetabling system in Unimas, some problems and weakness arise. The procedure of booking the venue for final exam is complicated and is done manually. In addition, current Sistem Jadual Waktu Unimas has some weakness. A proper searching method and algorithm is not applied for that system. Hence, the Unimas Examination Timetabling System is developed. It is a computerized system to help the Academic department to simplify the process of arranging the examination timetable. The timetable will be generated through the adoption of the genetic algorithm. This is a web-based system which is developed using Object Oriented Methodology, PHP and MySQL. The main feature of this system is the automation generation of the examination timetable from the course information. Hopefully, this system will help to decrease and solve the problem such like clashing among timeslots, clashing among venue and clashing among lecturer's timetable.

## ABSTRAK

*Untuk sistem jadual waktu peperiksaan di Unimas sekarang, terwujudnya masalah dan kelemahan. Langkah untuk menempahkan tempat untuk peperiksaan akhir adalah rumit dan dilaksanakan secara manual. Selain itu, Sistem Jadual Waktu Unimas sekarang mempunyai kelemahan. Kaedah dan algoritma yang sesuai adalah tidak diaplikasikan untuk sistem itu. Selaras dengan itu, Sistem Jadual Waktu Peperiksaan Untuk Unimas telah dibina. Sistem tersebut ialah sistem berkomputer yang dibina untuk membantu pihak Akademik untuk meringkaskan proses penyusunan jadual waktu peperiksaan. Jadual Waktu tersebut akan dibina melalui penggunaan algoritma genetik. Ini adalah system berasaksan web yang dibina dengan menggunakan metodologi berorientasikan objek, PHP dan MySQL. Ciri utama system ini adalah pembinaan jadual waktu peperiksaan daripada maklumat kursus secara automatik. System ini diharapkan dapat membantu dalam mengurangkan dan mengatasi masalah seperti pertindihan antara jadual waktu, pertindihan antara tempat dan pertindihan antara jadual waktu pensyarah.*

# Chapter 1: Introduction

## 1.1 Introduction

Scheduling event plays an important goal in human daily life. Scheduling deals with the satisfactory allocation of resources over time to achieve organization's tasks (Heizer and Render, 1996). Timetabling is a general scheduling problem and can manifest itself in several different forms. The term timetabling is referring to the assignment of time slot subject to constraints, times to activities or events. Many complex constraints and objectives are involved upon the underlying combination problem. A feasible and good timetabling system will help in organizing timetable and the constraints are satisfied. It ensures that all events are assigned to a timeslot and a room. The constraints include no clashing or only one event is taking place in each place at a given time, and the room's capacity is suitable for the attending users and satisfies all the features required by the event. In addition, no users attend more than one event at the same time. Besides that, it simplifies the process of organizing the timetable, which replaces the manpower to do it manually and may take weeks. Sometimes it cannot avoid the occurrence of errors which is brought by last minute change.

The examination timetable required to schedule the examination in a given set of exam session (time slots). It is a difficult combinatorial optimization problem. Constraints have to be satisfied. For instance, no student can attend two exams at the same time, and no two exams can be hold at the same venue. In other words, no clashing is expected.

In this project, the timetable is used to organizing and allocating timeslots and venues for the examination for Unimas, which is enhancement of the existing timetabling system, Sistem Jadual Waktu Unimas (SJWU).

## 1.2 Problem statement

The scheduling for examination timetable is not a simple affair. With examination scheduling, set of constraints have to be satisfied. For instance, clashing and conflict have to be avoided. Appropriate technique is required to place or allocate the exams in rooms.

Some of the most common forms of constraints include:

- Clashing
    - ➢ A student cannot sit for two exams at the same time
    - ➢ A venue should be prevented from having more than one exam at the same time
    - ➢ Lecturer should not involved in two examinations at the same time
- Capacity
    - ➢ Each venue or room must fix the number of students who sit for the exam. No over limit is allowed
    - ➢ There must have enough rooms or venue for holding the examination

With the current exam timetabling system in Unimas, some problems and weakness arise. This includes:

- The procedure of booking the venue for final exam is complicated. The staffs have to fill in the forms for booking the venue manually, and send to the section in charge to be approved. An approval has to be confirmed before the timetable can be obtained. Since the process is done manually, it is time consuming and error-prone. Last minute changes sometimes are inevitable.

- Current SJWU has some weakness. After inputting data for allocating venue of lecture and tutorial, it takes a couple period of time in compiling and generating the result for getting a timetable. Appropriate search and optimization techniques are not implemented.
- The arrangement of booking the venue for final exam is done by manpower or manually. There is a risk that the staff will overlook in arranging the timetable. Thus, clashing may arise.

## 1.3 Objective

The objectives of this project include:

- To study, understand and identify the algorithm and search technique. Suitable technique and algorithm will be reviewed. The advantages and the disadvantages of each will be identified. Current SJWU will also be studied to identify the problems and weakness.
- To simplify the procedure of booking the venue for final exam. This will ensure less time and work is needed for the process of booking the venue for the final exam
- To find out the most suitable and best performance algorithm in searching and allocating the venue and timeslot. This will help in minimizing the time in generating the result (exam timetable) of the timetabling system.

- To design a system for final exam based on SJWU. The appropriate and most suitable technique and search algorithm will be proposed as well.

## 1.4 Scope

The algorithms and techniques that have been applied in other existing system will be studied. Comparison will be done for those existing system and the algorithm and technique used as well.

Current SJWU will be studied, enhanced and improved. Based on the current SJWU, the examination timetabling system will be developed. An algorithm or technique that helps in searching will be proposed and be adapted. This search algorithm will enable the timetabling system to generate timetable, especially allocating the venue and timeslot without clashing. Furthermore, it will be much efficient in generating the result for the system compared to the current SJWU (in term of the time used for generating the timetable and the allocation of timeslot).

## 1.5 Procedures/ Methodology

A good planning is required to ease the process of completing this project. The reuse-based development process model will be applied for this project. This approach is based on the existing of SJWU and integrating it to the exam timetabling system rather than develop the system from scratch. Object Oriented System Development Life Cycle (OOSDLC) will be applied to carry out this project. OOSDLC will be enable the system to be developed more easily and support greater design and easier to maintain. The main stages include object-oriented analysis (OOA), object-oriented design (OOD) and object-oriented implementation (OOI).

During the OOA, actors of the system will be identified. Actors are those people who will use the system. Use case is the functionality that provided by the system. The functionality will interact with the actors.

During OOD, the relationship among classes will be represented. View layer and access layer will be designed as well. View layer is concern about the user interface, while access layer will concern about the communication with the database.

In the OOI process, the system will be implemented using object-oriented programming language. User satisfaction and usability is important. Refine may have to be done if satisfaction is not reached.

Testing is also very important in OOSDLC. Incremental testing will be done through the whole process, which is from OOA until OOI. This is to ensure that each stage is going well during the process.

Unified Modeling Language (UML) will be used to model the system. PHP and MySQL will be applied to generate the result.

## 1.6 Expected outcome

At the end of this project, the system proposed will be able to organize the timetable for final exam for Unimas. A better performance algorithm can be applied or adapted and will help in reducing the processing of generating the timetable. Clashing problems may be minimized as well since it is no more done manually. Besides that, the procedures for booking the venue and allocating timeslot for final exam will be simplified as well.

The lecturer will input the relevant data. These include the course code of the examination and the number of student that will sit for the exam. After this, the data will be retrieved and be generated. From the input data, the proposed algorithm and technique will search for the slot that is available and suitable for the number of student who sits for the exam. After all the slots have been finished allocated, the timetable will be generated.

## 1.7 Significant of research

This project will help solving the problems that are faced now. The system will:

- Simplify the procedure of booking the venue for final exam. Paper work may be less since the procedure will be done through the system.
- The staff does not have to arrange the timetable manually or by manpower. All the processes will be generated by the system.
- Avoid clashing in allocating the venue and timeslot. Since the timetable is generated by the system, error of wrongly allocating can be eliminated which may be overlook by doing it through manpower.
- The timetable will be generated through the adoption of the algorithm and the search technique. This will decrease the timetable generation time and also the increase the efficiency in term of timeslots allocation

## 1.8 Conclusion

The proposed system is important for generating the examination timetable for Unimas. It will be developed after reviewing some of the existing systems. The system will be generated by considering all the existing constraints. Finally, this system will help in decreasing the current problems faced in term of arranging the timetable for examination.

# Chapter 2: Literature review

## 2.1 Introduction

In order to enhance the SJWU and create an exam timetable for Unimas, a review and analysis on a set of benchmark real-world exam timetabling problems will be carried out. The behavior of different approaches with the solutions and objectives functions will be compared. The most suitable system will be chosen among the reviewed system and be proposed or adapted for creating the exam timetabling system for Unimas. The algorithm and search technique that are applied in other universities and will be reviewed here include the genetic algorithm, ant algorithm and hybrid algorithm.

## 2.2 Ant algorithm for University Course Timetabling Problem (UCTP) (applied in Universite Libre de Bruxelles)

### 2.2.1 Introduction

Ant Colony Optimization (ACO) is a metaheusistic. It is based on foraging behavior of real ants. The ant algorithm applies a lot of parameters that define its operation, in order to deliver best possible performance. Trial and error procedure is used in choosing the parameter. Limited time is used by each algorithm to run since the number of trials to find the best parameter is high. If the parameter fine-tuning done with run-times is shorter than actual problem solving runs, the suboptimal parameters may be chosen.

The University Course Timetabling Problem (UCTP) is a type of constraint satisfaction problem. It consists:

Events: E = {e1, . . . , en}

Timeslots: T = {t1, . . . , tk}

Rooms: R = {r1, . . . , r|R|}

Furthermore, it consists of set of student S who attend the event and set of features F satisfied by rooms and needed by events. Every student is pre-assigned to a subset of events. There are two types of constraints that have to be satisfied which are hard constraint and soft constraint. The examples of hard constraint include:

- A student cannot attend more than one event at one time
- The room capacity can afford the number of student who attend the event
- Each place can be taken only for one event at a given time

On the other hand, the example of soft constraint is student has more than two events in a row. In a feasible timetable, the soft constraint violations are obtained to be minimized.

### 2.2.2 Algorithm description

Each of the m ants constructs a complete assignment C of events into timeslot and rooms every time the algorithm iterates. The ant will choose the timeslot and room for the given event based on the pre-ordered list of events and the stigmergic information, which is in the form of a matrix of pheromone value $\tau$: E x T x R $\rightarrow$ $R^+$, where E is the set of events, T is the set of timeslots and R is a set of rooms. To simplify the notation, the matrix becomes $\tau$: E x P $\rightarrow$ $R^+$, where P is the set of k places, and $k = |P| = |T| \cdot |R| = i \cdot j$.

Specific knowledge or heuristic information will be applied in the algorithm. Choice will be made only if it is suitable and will not violate any hard constraint in placing for an event. If there is no place available for allocating an event, a list of timeslot is extended by one, and then the event will be placed at this additional timeslot. As the timeslot from now on exceed i, it is infeasible. The pheromone matrix has to be extended by creating an extended set T' of I' timeslot, and new extended set P' of k' places. Now the pheromone matrix become $\tau$: E x P' $\rightarrow$ $R^+$, assumed that i'=i and k' = k.

After constructing the events into places, local search routine will be used to improve the solution. Best solution of iteration will be compared with the global best solution. If the iteration best solution is better, then it will replace the global best solution.

Local search (LS) that is used can improve two major modules. First, it tries to improve an infeasible solution and does not contain any hard constraint violation and fits into i timeslot. This is defined as HardLS. Secondly, the LS is run only if feasible solution is available. It tries to reduce the number of soft constraint violation, called as SoftLS. It tries to rearrange the event in the timetable. Local search is very depend on the time the algorithm run, and also applies to other algorithm parameter. Best results are found from sets of parameter. Average best algorithm change if run-time change allowed.

## 2.3 Genetic algorithm (GA) based university timetabling system (applied in University of Nottingham)

### 2.3.1 Introduction

Genetic algorithm is a general purpose optimization tool and heuristic or approximate algorithm which takes principle of natural selection and evolution. (Ho