

# Real-Life Faculty Examination Timetabling to Utilise Room Used

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**Abstract**—Examination timetabling is an important and yet tedious task to do in every semester. The large number of courses and students increase the difficulty of developing a good examination timetable. Furthermore, the examination timeslots and rooms are very limited in this case study. Therefore, an improved version of two-stage heuristic is proposed and developed a web-based prototype (Faculty Examination Scheduling System, FESS 2.0) to solve faculty examination timetabling problem at Universiti Malaysia Sarawak (UNIMAS). The prototype has been practically used starting from Semester II, 2016/2017. The main objective of the proposed solution is to maximise the room utilisation and minimise the number of rooms for a splitting examination. The outcome of research not only outperform the previous prototype FESS 1.0 but also enhance the services given by faculty management.

**Index Terms**—Examination Timetabling; Two-Stage Heuristic; Room Utilisation.

## I. INTRODUCTION

Examination timetabling is assigning a set of examinations into a set of timeslots and rooms with the aim of satisfying a set of constraints [1]. It is an NP-hard problem where it required amount of computation to solve the complexity of the problem [2]. The variables such as course, student, timeslot and room may increase the difficulty of scheduling examination timetable.

Over the last ten years, a variety of methods have been applied successfully on solving the examination timetabling problem. The methods are included sequential method [3], parallel metaheuristic [4], genetic algorithm [5], hill climbing search [1] and hybrid hyper-heuristic [6]. The survey by Burke et al. [7], Rankhambe and Pandharpatte [8] had been done for the examination timetabling which are solving by heuristic methods.

## II. PROBLEM STATEMENT

This case study focuses on solving real-life faculty examination timetabling. In UNIMAS, each faculty is given the responsibility to plan and schedule faculty's courses for a period of 2 examination weeks. Each examination day has 3 examination slots: morning, afternoon and evening. However, evening examination slot is always the least preferable slot. Besides that, each faculty has a number of faculty owned rooms and some limited usage periods for big shared rooms, which managed by Undergraduates Studies Division (BPPs). Due to the drastic increment in number of students from year 2011 to 2015, which is more than 100%, the objective of the examination timetable solution is to maximise the room utilisation.

In Faculty of Computer Science and Information

Technology (FCSIT), the examination timetable was previously scheduled by two experienced planners manually. Due to the size and complexity of the problem nature, it has been unrealistic to solve it manually even just for a feasible timetable. Therefore, Faculty Examination Scheduling System 1.0 (FESS 1.0) which developed by Phang and Sze [9] was introduced and implement to produce a clash-free examination timetable since Semester II 2014/2015. FESS 1.0 is proved not only capable to generate a clash-free examination timetable but also shorten the examination days compared to manually done timetable. However, room utilisation is not considered in FESS 1.0. Some of the examinations were even split into 9 venues which is impractical in real life.

### A. Problem Formulation

In this faculty examination timetabling problem, the following notation is used in mathematical modelling.

Let  $n$  = Number of courses

Thus,

$C$  = Set of courses:  $\{C_1, C_2, \dots, C_n\}$

$S_{C_i}$  = Set of students for course  $C_i$

$R$  = Set of rooms:  $\{r_1, r_2, \dots, r_m\}$

There are two types of constraint involved in faculty examination timetabling problem. Hard constraints (HC) are those satisfaction is a must in order to get a feasible solution. Soft constraints (SC) are optional in fulfilling but satisfaction of soft constraints assures better quality solution.

- HC<sub>1</sub> A student can only have one examination at a time.
- HC<sub>2</sub> Room's capacity must fit in the size of allocated exams.
- SC<sub>1</sub> Minimise the total rooms' capacity wastage
- SC<sub>2</sub> Minimise the number of rooms splitting in a course

### B. Faculty Examination Scheduling System 1.0 (FESS 1.0)

FESS 1.0 was developed based on a two-stage heuristic as shown in Figure 1.

In Stage I, all the courses were sort based on the course size decreasingly. Then, greedy packing method is used to cluster the courses based on the sorted list. At Stage II, a timeslot that fulfilled the total courses capacity is assigned to each cluster from Stage I. After that, room assignment is done by greedy assignment heuristic, based on the room and course size.