UNIVERSITY TIMETABLE USING GENETIC ALGORITHM

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UNIVERSITY TIMETABLE USING GENETIC ALGORITHM

LOO HEN SHEN

This report is submitted in partial fulfillment of the requirements for the Bachelor of Computer Science (Artificial Intelligence) with Honours.

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2023

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I hereby declare that this project report entitled

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STUDENT : *LOO HEN SHEN* Date : 7/9/2023
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DEDICATION

To my beloved parents, thank you for everything you have done and continue to do. You are my inspiration, my guiding light, and my greatest blessing. I am honored to be your child, and I will forever cherish the love and memories we share.

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ABSTRACT

This report presents the development and implementation of a university timetable using a genetic algorithm. The main problem addressed in this study is the manual and time-consuming process of creating timetables for university courses. The solution proposed involves the use of a genetic algorithm to optimize the allocation of classes, rooms, and resources, while satisfying various constraints and preferences. The research process begins with the collection of data on course requirements, room availability, and lecturer preferences. A genetic algorithm is then used to generate possible timetable solutions, which are evaluated based on their feasibility and efficiency. The algorithm is iteratively improved to find the most optimal timetable that meets all requirements. The results obtained from the implementation of the genetic algorithm show significant improvements in the efficiency of timetable generation, reducing the time and effort required by university administrators. Additionally, the generated timetables are more balanced and satisfying for both students and lecturers.

ABSTRAK

Laporan ini adalah berkenaan dengan pembangunan dan pelaksanaan penghasil jadual waktu universiti menggunakan algoritma genetik. Masalah utama yang dibincangkan dalam kajian ini adalah proses manual dan memakan masa dalam penyusunan jadual waktu kursus universiti. Cadangan penyelesaian melibatkan penggunaan algoritma genetik untuk mengoptimumkan pengagihan kelas, bilik, dan sumber, sambil memenuhi pelbagai kekangan dan keutamaan. Proses penyelidikan bermula dengan pengumpulan data mengenai keperluan kursus, ketersediaan bilik, dan keutamaan pensyarah. Algoritma genetik digunakan untuk menghasilkan pelbagai penyelesaian jadual waktu yang mungkin, yang dinilai berdasarkan kelayakan dan kecekapan mereka. Algoritma ini diperbaiki secara berulang untuk mencari jadual waktu yang paling optimum yang memenuhi semua keperluan. Hasil yang diperoleh daripada pelaksanaan algoritma genetik menunjukkan peningkatan yang signifikan dalam kecekapan penyusunan jadual waktu, mengurangkan masa dan usaha yang diperlukan oleh pentadbir universiti. Selain itu, jadual waktu yang dihasilkan lebih seimbang dan memuaskan untuk pelajar dan pensyarah.

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LIST OF ABBREVIATIONS

FYP	-	**Final Year Project**
UTeM	-	**Universiti Teknikal Malaysia Melaka**
FTMK	-	**Faculty of Information Technology & Communication**
GA	-	**Genetic Algorithm**
SDLC	-	**Software Development Lifecycle**
IDE	-	**Integrated Development Environment**
GUI	-	**Graphical User Interface**

LIST OF ATTACHMENTS

CHAPTER 1: INTRODUCTION

1.1 Introduction

Timetabling, often known as scheduling, is the practice of allotting time for scheduled operations in an organized way to produce an outcome that is satisfying and unrestricted. Transportation, sports, the workforce, courses, and exam scheduling are a few examples. Two sorts of timetables, for instance, are used in educational institutions such as universities. The lecture and lab schedules are what they are.

Given the individual lecture rooms and labs best suited for each course and the total number of enrolled students, courses should be assigned to specified timeslots for five working days of the week. Thus, a practical timetable in a university outline how students and faculty go from a single lecture room to the next, as well as where the lecture rooms are located and when they are open. A university must deal with a number of constraints while constructing a timetable. These constraints can be categorized as either "hard" or "soft" constraints based on whether or not they are necessary or desirable.

1.2 Problem statement(s)

The first subproblem based on the first objective in Section 1.3 is the existing timetable of academic university can be improved further. When scheduling is not done effectively and systematically, it frequently results in timetables with conflicts for both students and lecturers, overlapping lectures, and underused resources.

The second subproblem is the existing technique of current academic universities' traditional timetable-making procedures frequently rely rule-based

approaches, which can be inefficient and time-consuming. This technique might not take into account the countless alternative combinations and constraints involved in creating a timetable.

The third subproblem is that academic universities' current procedures for creating timetables frequently using manual or paper works and don't have an intuitive and effective approach. It may be difficult for faculty, administrators, and students to read the generated timetables, manage their schedules, and make the required adjustments. A user-friendly interface, dynamic visualization, and interaction with other university systems is lacking in the current system.

1.3 Objective

This project embarks on the following objectives:

- To formulate an optimal timetable in academic universities.
- To implement genetic algorithm in order to create an efficient timetable.
- To develop a website-based system to generate timetable.

1.4 Scope

The system's scope is purposefully constrained to three years, two programs which are BITI and BITS, and four batches which are S1G1, S1G2, S2G1, and S2G2 for a variety of reasons. First of all, broadening the system to include all years, programs, and batches would considerably raise the complexity and computational demands, which would have an impact on the effectiveness and performance of the genetic algorithm module. Secondly, concentrating on a certain scope enables a more targeted and controllable design of the user interface and genetic algorithm modules. It makes it possible for the system to meet the current scheduling requirements and limitations of the chosen years, programs, and batches. As a result, within the boundaries of the established scope, efficiency and effectiveness are given priority in the system.

1.4.1 Modules

i. AI Module

The main part of the system that creates the university timetables is the genetic algorithm module. In this module, the timetable-generating process is iteratively improved and evolved using a genetic algorithm, a heuristic search technique inspired by the process of natural selection. The required genetic operators, such as population initialization, fitness evaluation, parent and offspring selection, crossover, and mutation, must be defined. These operators are used by the genetic algorithm module to develop and improve prospective timetables while accounting for constraints like lecturer room and lab availability as well as other pertinent criteria. The goal is to create timetables that are optimized to reduce disputes and maximize resource use.

ii. User Interface Module

The front-end of website-based system is the user interface module. It offers a user-friendly interface that enables users to access different features and modules and manage their data. Users should be able to enter their data, view generated timetables, and make changes as necessary through an interface that is simple to use. The primary goal of this module is to ensure a positive user experience by displaying the university's data and timetables in a visually appealing and dynamic way.

iii. Database Module

The system's foundation is the database module, which was created using MySQL Workbench. In order to handle the storage and retrieval of user's data, timetables, and other pertinent information. It offers a reliable and effective database administration system. To guarantee data integrity and quick access, this module is in charge of building and maintaining the relevant tables, relationships, and queries. It keeps records of user information, course availability, lecturer availability, lecturer room and lab availability, and other details that are essential for the scheduling to produce the best optimized timetables.

1.4.2 Target User

The main target users for the university timetable using a genetic algorithm are faculty members and university personnel who are in charge of scheduling lecturers and rooms.

1.5 Project Significance

The significance of this project is to illustrate how effectively genetic algorithms can be used to find the most effective approaches for scheduling timetables in general. Despite the abundance of commercially available software for scheduling, its lack of generality makes it difficult for it to satisfy the needs of varied universities. The main challenge to be conquered is the demand for particular coding as per the distinct universities.

1.6 Expected Output

The expected output is the university staff members who are in charge of timetabling lectures and labs are anticipating receiving a thorough and intelligent university timetable from the genetic algorithm. Improved levels of satisfaction among students and lecturers will arise from the system's provision of an optimized timetable that takes into consideration a variety of factors, including lecturer preferences, lecture room and lab availability, as well as other pertinent constraints.

1.7 Conclusion

The purpose of this research project is to provide an explanation and experimentally validate a genetic algorithm that can be used to solve scheduling issues at universities. Additionally, we hope to use this approach to solve a real-world scheduling issue for UTeM. The goal of this study was to resolve the scheduling issue and come up with a fix that would be embraced by all users. The methodology of the project and the literature review of pertinent publications will then be covered in the following chapter.

CHAPTER 2: LITERATURE REVIEW AND PROJECT METHODOLOGY

2.1 Introduction

Early on in the project's development, a literature analysis was done to investigate the approaches and methods used to address project-related issues. This is crucial because it offers information on subject-matter expertise and potential problem-solving strategies. The explanation of the domain, the methodology, and the project needs are the important points of this chapter.

2.2 Facts and findings

The facts and findings in this section is related to the project domain and the problem domain.

2.2.1 Domain

2.2.1.1 University Timetable Scheduling

The FTMK's class schedules are successfully managed and organized by the Committee at UTeM. The major goal is to efficiently utilize the classrooms, lecturers, and student of sections and groups that are already available by allocating resources and time slots in an ideal way.

There are various key entities in the domain. First, FTMK offers a variety of courses, each of which has its own course code, name, and number of credits. These classes fall under several disciplines or fields of study, including artificial intelligence, software development, computer networking, and others. In order to guarantee that

courses are properly scheduled, prerequisites or corequisite requirements should be taken into account while constructing schedules.

FTMK features a number of classrooms with various seating arrangements and essential facilities. Each classroom is recognized by a certain room number or code, and it could contain particular facilities or specifications, such as computer laboratories, projectors, or specialized equipment, that are necessary for a given course. A group of knowledgeable lecturers working for the faculty is in charge of delivering the courses. Each professor possesses unique qualifications, areas of specialization, and scheduling hard and soft constraints. They might have preferences or limitations when it comes to teaching certain lectures or at particular times.

In FTMK, students are divided into various groups and sections according to their systems of study and academic levels. There are a certain number of students in each group. These student groups have specific academic needs that must be met within appropriate time windows. The academic week is divided into time slots with predetermined lengths, usually between one and four hours, as part of the scheduling process. An organized class schedule is produced by allocating certain days and times during the week to each time slot.

Several hard constraints and soft constraints are taken into account when making the timetable. Conflicts in the timetable, such as lecturers' or students' classes running concurrently, must be avoided. To make sure that courses are arranged in a logical sequence, prerequisites and corequisites must be taken into consideration. There should be consideration for the unique needs of lectures or labs for particular courses. With consideration for their knowledge and availability, the workload among lecturers should be handled equally. The best way to use resources is to make the most of each class period in the lecture and avoid unnecessary pauses. Additionally, if applicable, lecturers' preferences or qualifications should be taken into account. Finally, it is preferable to reduce the amount of time lecturers and students spend travelling between lectures.

A thorough timetable scheduling system for the UTeM FTMK’s can be created by taking these key entities, constraints, and factors into account. This will enable the