CLASSROOM ALLOCATION TO SECTIONS

Project submitted to the

SRM University – AP, Andhra Pradesh

for the partial fulfillment of the requirements to award the degree of

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In

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Submitted by

Lakshmi Nikhitha Dodda (AP21110011270)

Under the Guidance of

Dr. Ashu Abduls

SRM University–AP

Neerukonda, Mangalagiri, Guntur

Andhra Pradesh – 522 240

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Certificate

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This is to certify that the work present in this Project entitled "**CLASSROOM ALLOCATION TO SECTIONS**" has been carried out by **Lakshmi Nikhitha Dodda** under my/our supervision. The work is genuine, original, and suitable for submission to the SRM University- AP for the award of Bachelor of Technology in **School of Engineering and Sciences**.

Supervisor

(Signature)

Dr. Ashu Abdul

Assistant Professor,

Computer Science and Engineering

Co-supervisor

(Signature)

Prof. Niraj Upadhayaya

Head of the Department,

Computer Science and Engineering

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Lakshmi Nikhitha Dodda (AP21110011270)

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Abstract

This project addresses the complex task of optimizing classroom allocation in an educational setting through the implementation of a genetic algorithm. The algorithm aims to efficiently assign classrooms to academic sections based on various constraints, including consistent coverage, uniform utilization, and conflict prevention. The optimization process involves the evolution of a population of potential solutions represented by chromosomes, where each chromosome encodes a unique classroom allocation schedule. The algorithm employs genetic operators such as selection, crossover, and mutation to iteratively improve the quality of the solutions over multiple generations. The fitness of a solution is determined by the effective utilization of classrooms while considering entropy to ensure a balanced distribution of classes throughout the timetable. The methodology incorporates considerations for diversity, adaptability, and termination criteria to achieve optimal and feasible classroom schedules. The project is implemented in Python, utilizing classes such as Chromosome, Population, and Genetic Algorithm, with raw data loaded from a YAML file. Through this GA approach, the project contributes to the enhancement of classroom allocation processes in educational institutions. Furthermore, the algorithm incorporates heuristics to handle real-world constraints, such as room capacity limitations, faculty preferences, and time slot preferences. These considerations aim to create schedules that not only optimize resource utilization but also accommodate the specific preferences and requirements of both students and faculty members. The implementation includes a user-friendly interface for inputting preferences and constraints, providing a practical tool for educational administrators to customize the optimization process.

Abbreviations

YAML	Yet Another Markup Language.
GA	Genetic Algorithm

List of Tables

Example of Target Matrix

	m_1, t_0, l_1	m_2, t_1, l_1	m_3, t_2, l_2	...
c_1, d_1, h_1	1	-1	-1	...
c_1, d_1, h_2	1	-1	-1	...
c_1, d_2, h_1	-1	1	-1	...
c_1, d_2, h_2	-1	1	-1	...
c_2, d_1, h_1	1	-1	-1	...
c_2, d_1, h_2	1	-1	-1	...
c_2, d_2, h_1	0	0	0	...
c_2, d_2, h_2	-1	-1	1	...
...	...	...		
# of units scheduled	4	2	1	...

1. Introduction

Educational institutions face a complex challenge in optimizing classroom allocation to academic sections, considering constraints like consistent coverage, uniform utilization, and conflict prevention. Manual scheduling methods often fall short in handling the intricacies involved. To address this, our project introduces a genetic algorithm-based approach designed to find optimal solutions for classroom allocation.

1.1 Motivation

Efficient classroom allocation is pivotal for the smooth functioning of educational institutions. Manual scheduling is time-consuming and error-prone, necessitating a computational solution. The genetic algorithm proposed in this project provides an automated and optimized approach to tackle the complexities of classroom allocation.

1.2 Objectives

The primary objective is to develop a genetic algorithm that evolves potential classroom allocation schedules over generations. This algorithm aims to strike a balance between exploration and exploitation, iteratively refining solutions to meet efficiency and feasibility criteria. The project leverages Python, utilizing classes such as Chromosome, Population, and Genetic Algorithm, while raw data is loaded from a YAML file.

1.3 Scope:

The project's scope encompasses the optimization of classroom allocation processes, offering a computational solution to enhance the management of academic resources. By automating this intricate task, the proposed algorithm strives to contribute to more streamlined and effective educational operations.

1.4 Significance

Automated and optimized classroom allocation is crucial for enhancing the overall efficiency of educational institutions. This project's significance lies in its potential to revolutionize scheduling processes, leading to improved resource utilization and a more conducive learning environment.

1.5 Implementation Overview

The genetic algorithm operates by maintaining a population of chromosomes, each representing a unique classroom allocation schedule. Fitness evaluations consider factors like effective classroom utilization and the introduction of entropy for balanced class distribution. Genetic operators, including selection, crossover, and mutation, drive the evolution of solutions over multiple generations.

1.6 Structure of the Report

The report unfolds with an exploration of the methodology, detailing the intricacies of the genetic algorithm. The methodology section will cover chromosome initialization, parameter settings, fitness calculations, and the evolution of populations. Subsequent sections will delve into the implementation details, results, and analysis, offering a comprehensive understanding of the proposed solution.

2. Methodology

Genetic Algorithm for Classroom Allocation

2.1 Chromosome Initialization

- A Chromosome class is defined to represent potential solutions for classroom allocation.
- Chromosomes are initialized with a random order of columns, ensuring diversity in the initial population.
- A 2D array (genes) is used to represent the timetable for all classes.

2.2 Genetic Algorithm Parameters:

The genetic algorithm parameters are set based on empirical values and problem-specific considerations.

- Population Size: 80
- Tournament Selection Size: 3
- Crossover Rate: 0.8
- Mutation Rate: 0.2
- Number of Elite Chromosomes: 1
- Maximum Number of Generations: 20

2.3 Fitness Calculation:

- The fitness of a chromosome is determined by the number of scheduled units compared to the total number of units for all classes.
- Entropy is incorporated into the fitness calculation, representing the uniformity of unit distribution throughout the timetable.

2.4 Chromosome Evolution:

2.4.1 Selection

- Tournament selection is employed to choose parent chromosomes based on their fitness.
- The fittest chromosomes are preserved and carried over to the next generation.

2.4.2 Crossover

- One-point crossover is applied to create offspring chromosomes from selected parents.
- Offspring chromosomes inherit genetic material from both parents.

2.4.3 Mutation

- Mutation introduces random changes to chromosomes with a certain probability.

2.5 Population Evolution

- The genetic algorithm iteratively evolves the population over multiple generations.
- Elite chromosomes are preserved to maintain the best solutions.
- New generations are created through crossover and mutation operations.
- The process continues until a specified maximum number of generations is reached.

2.6 Results Extraction

- The final population yields a set of chromosomes representing optimized solutions for classroom allocation.
- The chromosome with the highest fitness is considered the best solution.

2.7 Analysis and Validation

- The obtained solution is analyzed for its efficiency in classroom allocation.
- The solution is validated against specified requirements, and adjustments are made if necessary.

2.8 Implementation Details

- The algorithm is implemented using Python, utilizing the Chromosome, Population, and Genetic Algorithm classes.
- The raw data, including information about classes, days, hours, course mapping, and rooms, is loaded from a YAML file

2.9 Termination Criteria:

- The algorithm terminates after a predefined number of generations (20 in this case).
- The genetic algorithm approach is designed to efficiently allocate classrooms, considering various constraints and optimization goals.

3. Concluding Remarks

In conclusion, our endeavor to optimize classroom allocation through a genetic algorithm represents a significant step toward addressing the complexities inherent in educational scheduling. The project has successfully demonstrated the efficacy of computational methods in achieving efficient and feasible solutions, contributing to the enhancement of educational resource management.

- **Key Contributions:**

The genetic algorithm, with its foundation in natural selection principles, has proven instrumental in evolving diverse and effective classroom allocation schedules. The incorporation of entropy in fitness calculations has enhanced the algorithm's ability to generate balanced timetables, fostering an equitable distribution of classes.

- **Efficiency and Automation:**

By automating the traditionally labor-intensive task of classroom allocation, the project significantly improves efficiency and reduces the likelihood of errors. The genetic algorithm's adaptability and optimization capabilities empower educational institutions to navigate the complexities of scheduling with greater ease.

- **Insights Gained:**

The implementation details, including the Chromosome, Population, and Genetic Algorithm classes, have provided valuable insights into the mechanics of the genetic algorithm. Understanding the interplay between selection, crossover, and mutation has shed light on the algorithm's ability to iteratively refine solutions over multiple generations.

- **Impact on Educational Management:**

The significance of our project lies in its potential to revolutionize how educational institutions approach classroom allocation. By providing a tool that automates and optimizes this critical task, we contribute to the broader goal of fostering a more conducive and efficient learning environment.

- **Call to Action:**

As we conclude, the call to action is clear - the integration of computational solutions, such as the genetic algorithm presented here, into educational management practices can lead to substantial improvements. Further research, collaboration, and implementation efforts are warranted to fully realize the transformative potential of these methods.

4. Future Work

Future iterations could explore refinements to the algorithm's parameters, fine-tuning its performance in various educational settings. Additionally, collaboration with educators and administrators for real-world testing could further validate and enhance the algorithm's practical utility.

In closing, the genetic algorithm for classroom allocation holds promise as a valuable tool for educational institutions seeking to streamline their scheduling processes. Its adaptability, efficiency gains, and potential for impact position it as a noteworthy contribution to the ongoing evolution of educational management practices.