

Developing an A-star and Genetic Algorithm-based
Class Scheduling for Ateneo de Zamboanga
University to Enhance Efficiency and Reduce
Conflicts for students and teachers

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Agenda

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Background of the Study

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Scope and Limitations

Background of the study

- Class scheduling is a crucial process of managing a university that affects the academic performance and satisfaction of both students and faculty members(Campbell et al., 2009; Rettig & Canady, 2013).
- Class Scheduling involves multiple problems that need to be addressed, such as assigning classes to specific time slots and rooms while taking into account scheduling conflicts, instructor availability, and room capacity.

Background of the study

- A-star algorithm is a heuristic search algorithm designed to optimize a path by finding the shortest and cheapest paths in graphs or networks(Blanco, A., 2021).
- Genetic algorithm is a type of heuristic search algorithm that uses natural genetic principles and the concept of survival of the fittest to adaptively find solutions which makes it commonly used for timetabling problems due to its search-based optimization technique(Vivekanandhan, K., Lakshmi R. & Brintha, R., 2012).

Problem Statements



Genetic Algorithm



A-star Algorithm



Create a Class Scheduling
System

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Ateneo de Zamboanga University



Problem Statements



Constraints

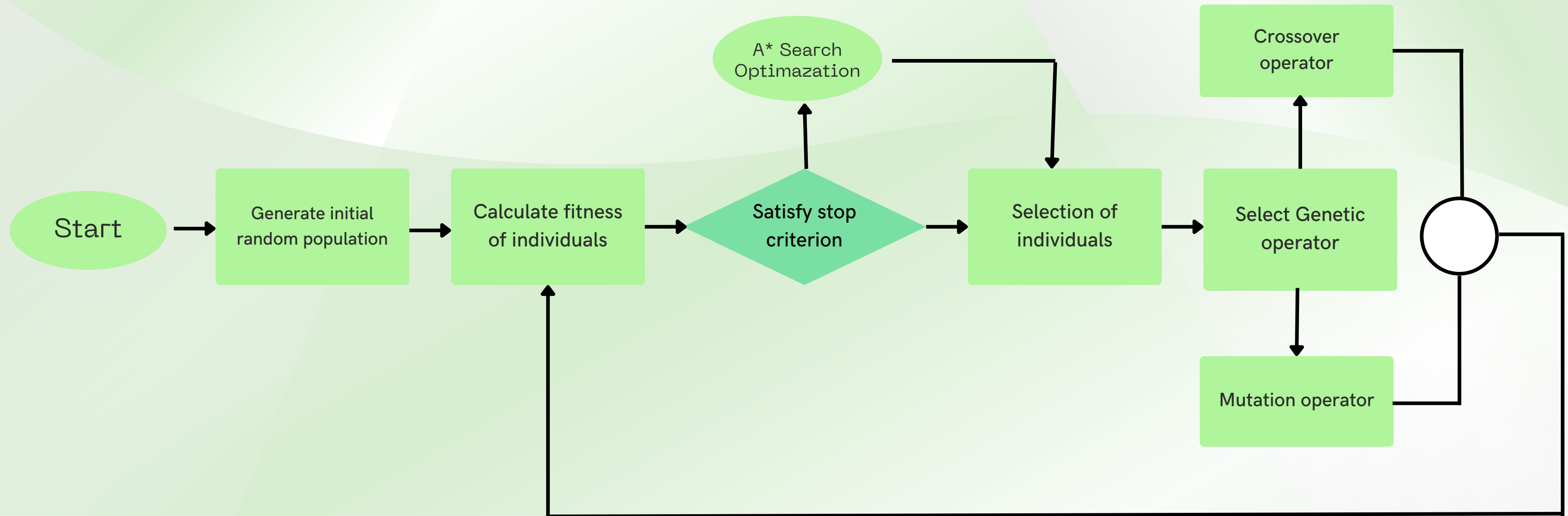
- Classroom availability
- Faculty availability
- Online classes
- Room capacity
- Time schedule Dispersion

Solution?





Conceptual Framework: Genetic Algorithm



Purpose and Description

- To develop a class scheduling system with the combination of A-star and Genetic Algorithm
- Enhance the university's scheduling process in order to lessen errors and problems regarding the class scheduling of the university
- Improve the experience of both students and teachers by reducing conflicts and optimizing resource allocation.

Target Market



College Registrar

Responsible for creating class schedules for college students



Department Chairs and Faculty

assigned to deliver high-quality academic programs, conduct research, and provide student support.



AdZU Students

Students of the Ateneo de Zamboanga University

Objectives

- The objective of the project is to develop and implement A-star and Genetic Algorithm based timetabling system for the Ateneo de Zamboanga University with the goal to solve constraints regarding the class schedules for students and teachers and enhance efficiency for class scheduling



Constraints



A-star Algorithm



Genetic Algorithm



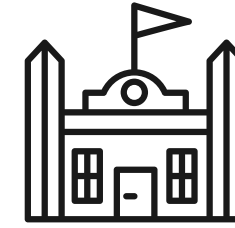
Accuracy



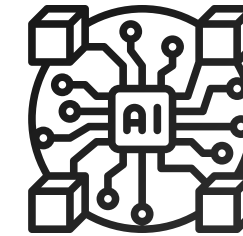
Satisfactory

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Scope and Limitation



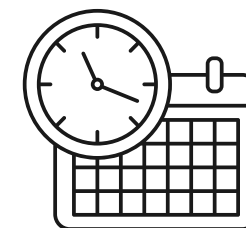
Ateneo de Zamboanga
University



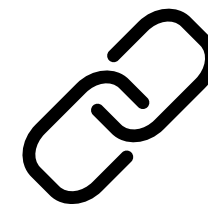
A-Star and Genetic
Algorithm



College Students
and Faculty



Class Schedule



Constraints

REVIEW OF RELATED LITERATURE

Timetabling

- According to Chen (2021), Timetabling is an important process in many organizations, including schools, universities, businesses, and healthcare facilities, for it is defined as the process of assigning a set of events and resources to specific time slots in order to optimize scheduling.
- Vrielink (2017) - The goal for timetabling is to satisfy desirable objectives while also following any constraints that are in place.

Timetabling

School Timetabling

- Andersson (2015) - School Timetabling is utilized to indicate to both students and teachers the specific classroom where classes will take place and their corresponding schedule and the goal is to allocate all classes over a week, match them with a teacher, and ensure that all the necessary criteria are met. This is accomplished by ensuring that no two classes are assigned to the same classroom during overlapping time periods and that no student is required to attend two classes at the same time.
- Due to various constraints, The complexity of timetabling and specific requirements make it harder to find a solution that works well for every situation. Thus, making timetabling a type of scheduling problem(Petrovic, S., 2004).

Constraints

- According to Sun, Z. (2023), there are two categories of constraints, Hard constraints and Soft Constraints. Hard constraints must be satisfied to obtain a valid solution, whereas soft constraints can be violated but assigned a penalty.

Hard Constraints

- According to Abdullah (2009), Hard constraints refers to constraints that must be strictly adhered to and cannot be violated in any circumstances.
- Naderi (2016) - hard constraints are issues that are physically impossible to happen. Further solutions that do not violate hard constraints are being added and those solutions are called feasible solutions.

Constraints

A list of hard constraints have been introduced by Socha et al:

- No student can be assigned to more than one course at the same time.
- The room should satisfy the features required by the course.
- The number of students attending the course should be less than or equal to the capacity of the room.
- No more than one course is allowed to be assigned to a timeslot in each room

Constraints

Soft Constraints

- According to Abdullah (2009), Soft Constraints are the constraints that are not of much greater concern, or can be avoided, but still are taken into account to obtain the satisfactory output.
- Chen (2021) - Although it is not optional, soft constraints can have an impact regarding the quality of the schedule. A good schedule needs to be fast, feasible, and high-quality. Feasibility means that it meets all the hard constraints, while quality is determined by how well it meets the soft constraints.

Constraints

A list of soft constraints have been introduced by Socha et al:

- A student has a course scheduled in the last timeslot of the day.
- A student has more than 2 consecutive courses.
- A student has a single course a day.

Another list is introduced by Kakkar, M et al(2021):

- Teaching hours or workload of every teacher should be well spread over a week.
- There should not be consecutive lectures of the same teacher in the class.
- Assign fixed time slots for particular subjects.
- Minimize continuous lectures of the same course in a day.

Heuristics Method

- Kanade (2022) - Heuristic is a method of problem solving or decision making that involves the use of necessary information, previous outcomes, and personal experiences to generate a practical and feasible solution to a problem within a reasonable timeframe.
- In a survey study by the University Malaysia Sarawak (UNIMAS), University course timetabling is a nondeterministic polynomial time hard problem, meaning it cannot be solved exactly in polynomial time due to the exponential growth in both the problem's size and complexity.
- Over the last two decades a variety of heuristic approaches such as simulated annealing, tabu search, genetic algorithms and hybrid approaches have been investigated for timetabling (Burke, E.K., 2002).

Genetic Algorithm

- Wang (2002) - Genetic algorithm is a heuristic algorithm which is based on the natural law of evolution, such as selection, crossover, and mutation.
- Ambole (2013) - Genetic Algorithm is used to solve class scheduling problems with custom selection methods.
- A study on Genetic Algorithm applied to class scheduling by Lima, M.(2001) states that the result for generating a schedule shows a reasonably good timetable where most of the restrictions of the problem are satisfied.
- It has been shown that by using domain dependent operators good, if not better, results may be achieved(Burke, E., 1994).

Tabu-Search Algorithm

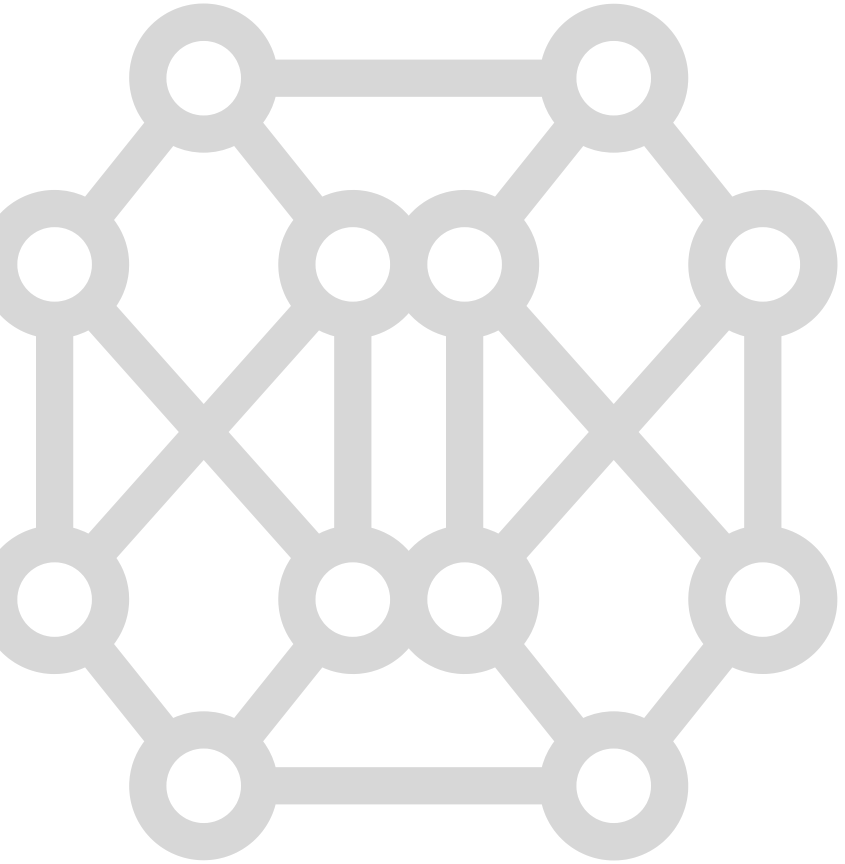
- Lian (2020) - Tabu Search Algorithm is a meta-heuristic approach to explore the solution space beyond local-optimality.
- In a study conducted by Bajeh A.O. and Abolarinwa, K. O(2011), both Genetic Algorithm And Tabu Search Algorithm have effectively demonstrated the ability to solve complex optimization problems of which examination timetabling is part of.
- Another study conducted by Sonawane, P.(2014) shows that Genetic Algorithm and Tabu Search algorithm provide a great flexibility of use when it comes to solving combinatorial problems.

Graph Coloring Approach

- Poddar (2018) - Graph coloring is one such heuristic algorithm that can deal with timetable scheduling satisfying changing requirements, evolving subject demands and their combinations.
- According to Dandashi. A.(2010), The class scheduling problem can be modeled by a graph where the vertices and edges represent the courses and the common students, respectively.
- In a study conducted by Assi, M.(2018), the graph coloring based scheduling algorithm offers an effective and automated approach to generate college course timetables. However, there may still be challenges in situations where constraints are highly complex or conflicting, requiring additional considerations and modifications to ensure satisfactory timetables.

A* Algorithm

- Konakalla (2014) - The A* algorithm combines features of uniform-cost search and pure heuristic search to effectively compute optimal solutions.
- In a study conducted by Pokorny, K.(2013), A* algorithm is used to solve a constraint satisfaction problem, specifically solving an extended version of the classroom scheduling problem which assigns courses to rooms with constraints of times and instructor availability.
- The result of the study shows that A* algorithm produces similar results as to other search algorithms.



THANKYOU!

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