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(Administrador-De-Horarios) - Timetable Scheduling Using Metaheuristic Adaptive- Elitist Genetic Algorithm

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Introduction: -

Timetable scheduling is the process of creating timetables that fit the constraint of the scenario. It is used in a magnitude of industry from scheduling transportations up to creating complex schedule for highly optimized automated factories. Majority of small scale scheduling are done manually while larger operations require computer assisted scheduling.

Artificial intelligence is one of the rising computing solution due to an increase in computing power. It can be applied to different types of problems which can help optimize existing solutions or create never been tried solutions due to multiple limitations. Artificial intelligence helps create solutions for non-deterministic polynomial time problems which businesses and organizations will always have.

Genetic algorithm is a metaheuristic that mimics the process of natural selection. It can be performed in multiple different ways with different types but it will all follow the same concept. This research aims to create an artificial intelligence through the use of evolutionary algorithm, specifically genetic algorithm combined with adaptive and elitist traits that can generate a university schedule timetable with the goal of generating a valid and as optimal as possible solution with certain constraints.

Literature Review

Scheduling classes in an institution is one of the tasks that can be categorized under operations management. Operations management aims to maximize efficiency in a certain area. Scheduling classes is often done by humans which proves to be efficient but does not mean it is perfect. Using computers to find the best solution for this problem using conventional method is extremely inefficient. Computers were therefore ignored for a time when solving such problem. However, rise in computing power and usage has opened ways in solving scheduling problems.

Operations management is often considered as backbone of many companies. Getting the most efficient work means higher profit. In an educational institution scenario, getting the most efficient schedule does not only help reduce expense but mainly to cater to students. Often, better schedules give students and instructors better control on their time. Creating schedules is done better by humans than conventional computing techniques because humans have powerful brain to assess constraints and combinations better. However, scheduling is known to be non-deterministic polynomial time (NP) complete problem where in order to find the best solution, every possible combinations should be executed. Humans cannot compute every possible combination and therefore solves

the problem by just filling up and making sure that the constraints are met. This is known to be “good enough” solution. This process is prone to errors, inefficiency and violation of constraints especially when working in a highly tight scenario. Replicating the human way of solving the problem (Greedy algorithm) in computers is extremely inefficient due to its computing cost.

Computers are rarely used for solving this problem because of the stigma that it is unreliable and inefficient. However, this is back when computers are slow and not intended to solve compute intensive problems. With the explosion of big data and exponential increase in computing power, using computers to solve new sets problems that previously can only be solved by humans became easy. Scheduling is one of the problems that can now be solved by computers with solutions acceptable or even better. Artificial intelligence has become more common today brought by the growth in computing industry. Several solutions fall under artificial intelligence such as machine learning, deep learning and genetic algorithms. All of these processes have their own pros and cons. Genetic algorithm is fit for scheduling problem as it creates a solution over time based on rules and criteria.

Methodology

Artificial intelligence is a computer science field that is being used mostly on problems that includes precision or optimization. The research falls under optimization problem and evaluation of performance in an extensive verification is not a feasible solution. It is important to select an appropriate research design and methodology to get the viability of the research.

Research Design Methodology

The selected method for collecting and analyzing data for testing the system is quantitative. The data to be collected are sets of school configuration (e.g. subjects, instructors and rooms). These datasets will be profiled after being used in the system. The profiling results shall determine the performance of the system by performing artificial intelligence systems based evaluation.

Method of Software Development

Iterative development as a method for creating the software fits for continuously changing environment for artificial intelligence development. This enables the developer to learn every iteration and apply it to future instance. This methodology is fit for the research as the system relies on tweaking and managing constraints. Each iteration is an enhancement to the system which will repeat until the system delivers its expected result.

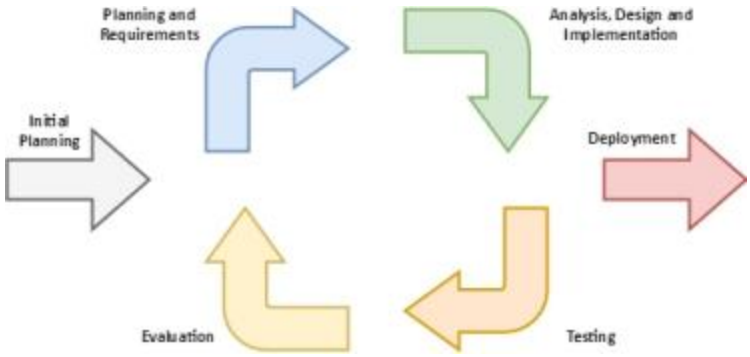


Figure 4.0 Iterative Development Methodology

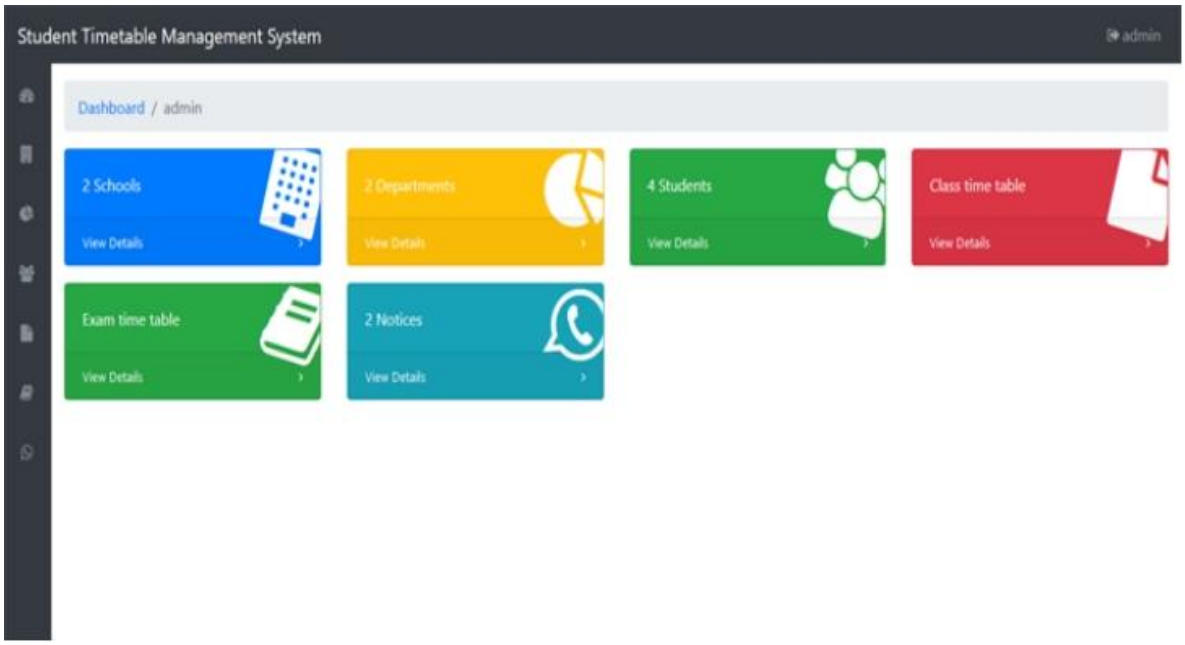
Initial planning has been done by designing system architecture, data schematic and models. Upon entering an iteration, the feature to be done is decided and planned. There are two types of iterations used; adding a feature or a model and tweaking values. Each iteration's goal is then implemented and then manually tested.

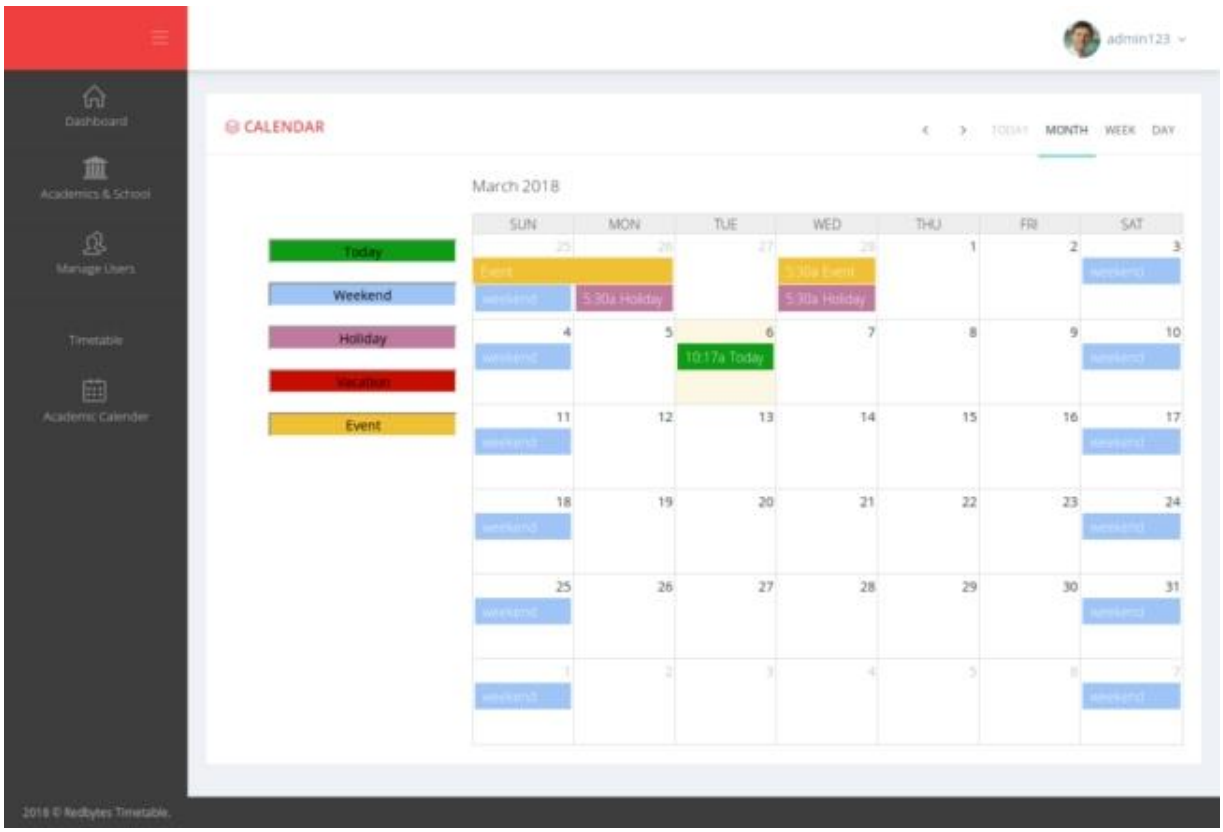
Method of Software Evaluation

The selected evaluation methodology for the research is a combination of Monte Carlo methods and surrogate modelling. It is an experimental methodology as evaluation for evolutionary computation based scheduling systems are yet to be done.
The Monte Carlo methods are a class of computational algorithms that uses repeated random sampling to obtain numerical results. It is often used under the optimization and probability problem sets. It works by. tweaking the initial value and trying to produce a solution from it. The surrogate modelling is often used in science and engineering field where the outcome cannot be easily measured directly so a model is used instead. An example of this is finding the optimal design for a car's aerodynamics. Computing the design's performance with real life like simulations is expensive so instead, an emulator model is used. This generally works by creating an approximation of models which mimics the behavior of real model as closely as possible without the need for a more expensive evaluation.
Implementation of Monte Carlo method and surrogate modelling for evaluation of artificial intelligence based scheduling system, specifically the researcher's study shall follow the following steps:

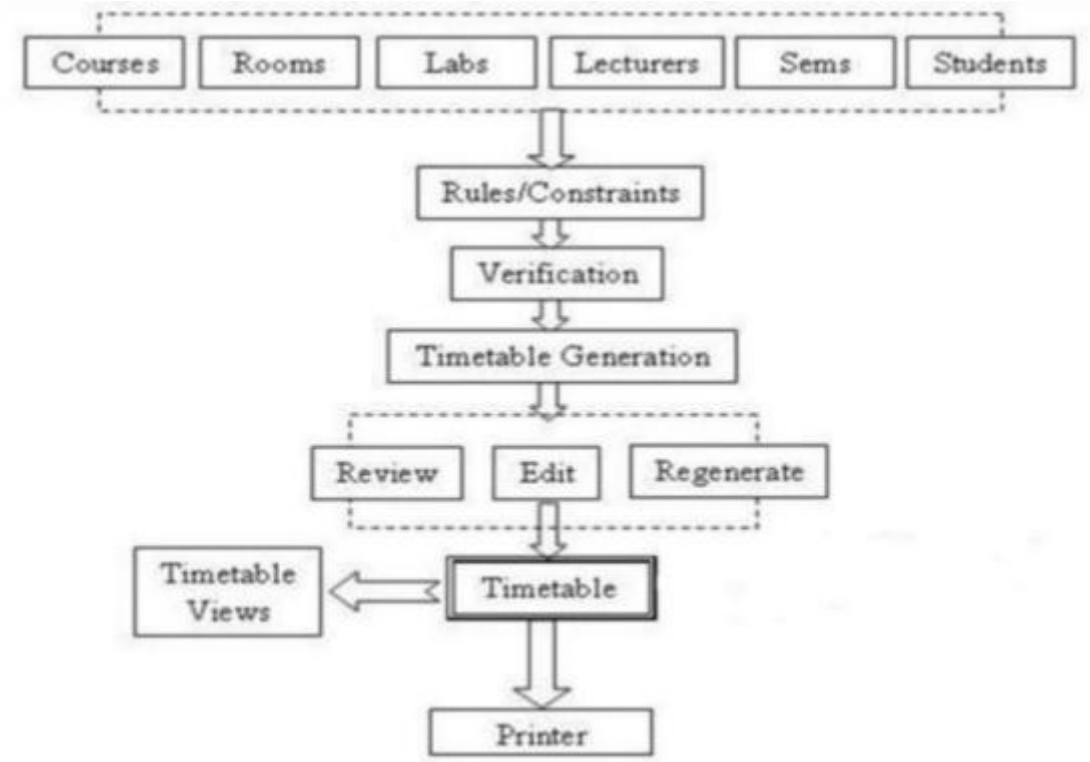
1. Generation of a set of solutions using Monte Carlo method with genetic algorithm settings as variables that can be tweaked.
2. Creation of a surrogate model which only uses the evaluation matrix as basis.
3. Computation of each set of solutions generated by the Monte Carlo method difference to surrogate model.
4. Providing the mean of the result as basis for performance of the artificial intelligence (Scenario based).

Usage of Monte Carlo method in system is for generation of random genetic algorithm configuration. The surrogate modelling usage for this research makes use of an imaginary 1-dimensional metric basing on the
evaluation matrix. The model will serve as a basis for evaluating the closeness of the solution to the ideal one. In conjunction with software evaluation methodology using the proposed steps above, data gathering would then lean towards data-centric approach. This is to provide correct conclusions towards the conclusion of the research. The proposed data to be gathered are the ones to be used by the evaluation above which will be composed of mostly result performance grade (fitness).

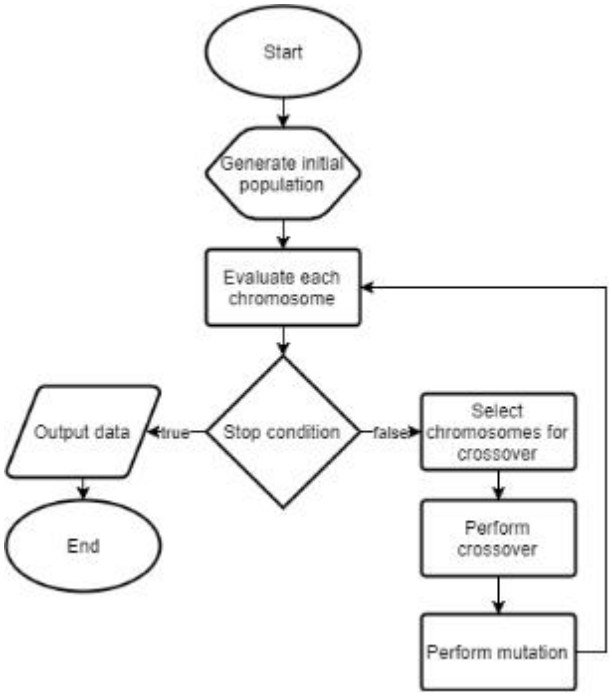




Process Flow



Basic Genetic Algorithm Process:



Hardware

Minimum System Requirements	
Operating System:	Windows 7 and Above
CPU:	2.0+ GHz with multithreading support
RAM:	1 GB* **This still relies on the scenario size and algorithm configuration* *see Chapter 5 for assessment of consumption.*
Disk Space:	At least 1 GB Available Space* **User generated files are excluded in assessment and minimum space is also subject to application* *usage.*

Programming Languages:

i. Django (Python Framework for web development)
ii. Genetic alogrithm
iii. HTML, CSS, JSON

Limitations: -

This research aims to create an artificial intelligence that can create timetable schedules. This only covers processing input data and generating human sensible results. The process to be used in creating schedules is adaptive-elitist genetic algorithm. A type of evolutionary algorithm that involves keeping the best set of solutions over next generations to preserve high level solution but at the same time, variables such as the population count, mutation rate and selection pressure, change in order to avoid premature convergence that leads to poor output.
Computing the schedule would involve validation for each constraint. Constraints are set of rules that directs the acceptance of the output. There will be three types of constraints to be used;

1. **Soft Constraints** – A set of rules that can be broken without affecting the validity of the output.
2. **Medium Constraints** – A set of rules that can be broken with an effect to the validity of the output. However, this can only be broken if the scenario is logically invalid or impossible.
3. **Hard Constraints** – A set of rules that would produce an invalid solution if broken.

Result Discussion

This system can convert the less security into more security transaction. This system creates a more reliable communication means user and bank system. Also, it generates face at the end of transaction which is verify by various algorithm.

1. payment system for online transaction is based on face recognition provides authenticate user data privacy and prevents misuse of data in world.
2. . This technique identify theft and prevent customer data which improve security.

3. This system can convert the less security into more security transaction. This system creates a more reliable communication means user and bank system.

4. This is useful to reduce or totally remove fake transaction, i.e. to read OPT then it required face of user which is provide for transaction. Then the transaction is done.

5. . It will also go a long way in ensuring that innocent people are not wrongly arrested based on previous crimes

Conclusion: -

The results have shown that the system can provide valid solutions that can be used. However, it does not provide complete automation. There are still scenarios that would require the operator to adjust some entries to create a perfect solution.

The system was also designed to be simple and straightforward. This eliminates any confusion caused by scattered user interface controls and makes usage of the software fully utilized.

The simplicity of the system and introduction of configurable algorithm's goal and performance reduced the need for so much constraints as solutions are made dynamically. This enables users to easily use and experiment with the application until they find perfect fit for their scenario.

The large amount of combinations for testing in order to find an accurate evaluation for the application has proven to be far from possibility. However, it can be concluded that from the models provided, the system was able to generate results that despite being imperfect still remains valid and acceptable given the number of constraints imposed to it.

The solutions that the system will provide will heavily depend on the running configuration and evaluation matrix. One may find a perfect solution if the application was given enough time and computing power. The complete evaluation for the system will remain hard to solve as the freedom for the configuration of the algorithm has provided a large amount of combinations. It can also be inferred that evaluation using other methodologies will yield the same amount of result.

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