Genetic Algorithm For Timetable Generation

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***Abstract*—In this paper, we have proposed a software which generates timetable using genetic algorithm. Timetable is generated for various purpose like for Educational institutions, Hospitals, Coaching, Railways and many more fields. Our software generates timetable for Educational Institutes where number of entities like Instructors, Courses, departments etc. has to be scheduled by following constraints. Generating a timetable manually is a very rigorous and error-prone task. Our project not only saves time but need minimal manual assistance and assures error free results. We have used Genetic Algorithm as a core which provides accurate solutions in less time by implementing various genetic operators and provides feasible solutions with satisfying provided constraints. The comprehensive software named tigen presented in this paper has been validated, tested and discussed using real world data from our college data.**

***Index Terms*—Chromosome, GeneticAlgorithm, Gene, Timetable,Schedule.**

I. Introduction

Tigen is a Timetable scheduler developed using the concept of genetic algorithm. Genetic Algorithm is used to find solutions for problem using various operators which is inspired by biological field. Genetic Algorithm (GA) is a search-based optimization technique based on the principles of Genetics and Natural Selection. It is frequently used to find optimal or near-optimal solutions to difficult problems which otherwise would take a lifetime to solve. It is frequently used to solve scheduling problems, and to find feasible solutions. Generating timetable is also a scheduling problem in which various entities such as Instructors, Courses, Departments etc. has to be assigned in proper slots without causing time-clashing between any two slot. [5] If we schedule a timetable manually, then this task is laborious as well as time taking and there are high chances of error. Tigen can rapidly generate a non-conflicted timetable which is free of errors and ensures to provide feasible solution. Feasible solutions mean those which do not violate hard constraints as well try to satisfy soft constraints. Hard constraints concern issues that are physically impossible – such as a Instructor being in two places at the same time. Similarly, two teachers are not permitted to teach two separate courses to the same group of students in a given time slot. Further, allocations of two or more classrooms are not made for the same course for a given group of students. The same room is allocated to two different classes. Genetic operators such as selection, crossover, mutation are used to find feasible solutions. We need to choose the most appropriate one from feasible solutions. Adding to more functions, Tigen has the cross-plateform functionality, Database integration feature for data management. Tigen can run on both Graphical user interface and terminal user interface. From the main perspective, the ultimate goal is to design the format of the timetable and utilize genetic algorithm to get desired output in the form of timetable. [2]

II. Review Of Literature

The existing systems which are currently in use are Either an individual performs timetable scheduling manually or some of the existing software which is present on the internet like a Class schedule generation using genetic algorithm is developed by Mohit Kumar and Jaggi Singh [1]. An Automated timetable scheduler using genetic algorithm by Shraddha Thakare , Tejal Nigam , Prof. Mamta Patil [2]. A very close solution to our proposed approach is Timetable scheduler on java by Pranav Khurana on GitHub [7]. A survey on automatic timetable was presented by Schaerf [8]. Kenekayoro applied Machine Learning to solve Timetabling problem for university. Tavakoli, et al. [9] All the above-mentioned software uses different approaches. Tigen is developed by taking some fixed entities into the consideration. Entities such as Instructors, Courses, Departments, class time, room are used in order to generate a timetable.

III. Proposed Approach

Tigen is developed to ease the timetabling problem of universities. Tigen can take dynamic data as input and can provide desired timetable as output. An interactive input interface is developed on both GUI and TUI . Tigen can generate error free timetable using various genetic operators such as selection, crossover, mutation. Tigen eliminates paperwork, increases productivity and saves time. Tigen follows below steps during timetable scheduling.

- Data is taken as input and proper encoding of data is done.
- Generating an initial population of chromosomes on encoded data.
- Evaluating the suitability of each chromosome (individual) that forms the population using fitness function.
- Selecting the chromosomes for mating based on the above results.
- Producing offspring by mating (cross over) the selected chromosomes.
- Mutating genes randomly for diversity in population.
- Repeating steps 3-6 until a new population is generated.
- Ending the algorithm when the best solution is obtained according to predefined termination criteria. [3]

IV. System Design

The whole method of scheduling based on genetic algorithm is explained in detail in this section. Complete flow of genetic operators are used in Tigen is described below:

- Data encoding
- Initial population
- Fitness function
- Selection
- Crossover
- Mutation
- Termination criteria

Data encoding: Data encoding is the first step before starting Genetic Algorithm cycle. It converts the data into encoded form that is used to improve the speed of the algorithm. A simple way to do is to give data unique ID's. Data is then combined to form a chromosome. A Gene is a part of Chromosome and it is converted to a string of encoded ID's.

Initial population: Creating an initial population is the first step of genetic algorithm cycle. A number of chromosomes is created on the given dataset, which combines to form a population set. Population is created having hard constraints into consideration.

Fitness function: Fitness function uses below formula for calculating fittest chromosome.

Fitness = 1 / Number of conflicts.

Selection: Selection is the next step after the creation of initial population. Tigen uses Tournament selection for the selection of chromosomes from the population and send them for further operations.

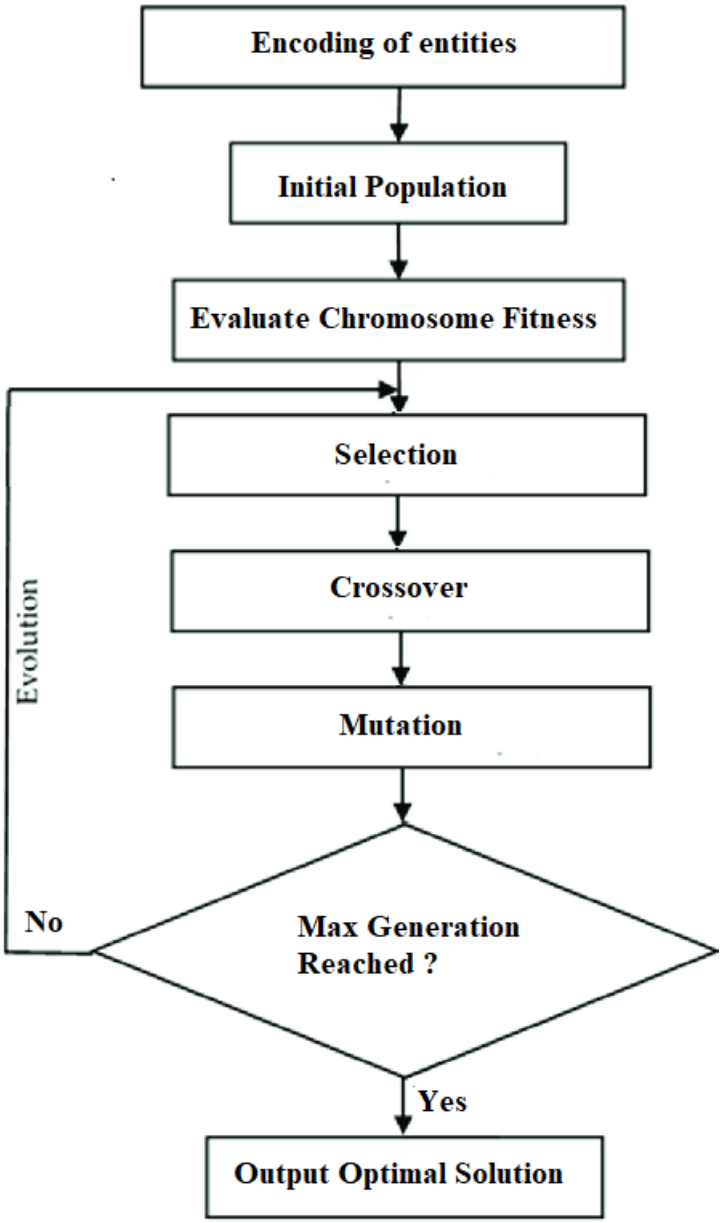

Fig. 1. Example of a figure caption.

Crossover: Crossover method is used to create different offspring based on selected chromosomes. Tigen uses Multipoint crossover method for creating offsprings. This crossover uses two chromosomes and creates X new chromosomes. It splits two chromosomes at multiple points and joint with all different points and creates offsprings.

Mutation: Mutation operator is used to provide diversity in the initial population. Tigen uses Scramble mutation for this action. This mutation selects number of genes and shuffle their values randomly.

Termination Criteria: A defined criterion is set in Tigen for terminating the algorithm. Tigen as the number of conflicts becomes zero as soon as the non-conflicted chromosome is found, algorithm gets terminated.

After all the steps when a timetable is generated sucessfully and which is encoded in form of chromosomes. we parse the result and decode into human readable format.

V. Future Scope

- Tigen can extend to test research of different genetic operators within the algorithm.
- Different universities or colleges can have different entities as data, hence Tigen can make dynamic input for entities according to organization requirements.
- Tigen can have hardware support for increasing manual dependencies.

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VII. Conclusion

Scheduling is the very core working of any department or organization to perform well. Tigen is the project which is going to provide a great help and benefit regarding this task. It will help in doing this important task as an automated process with very minimal manual interaction. So, in this era of increasing technology and automation, Tigen is another automation tool and helper for human so that they can leave this important task to the project and just focus on other important aspect of their jobs and lives.

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