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Time-Table Generator Using Genetic Algorithm

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ABSTRACT: Creating timetables for institutes which deal with transport, sport, workforce, courses, examination schedules, and healthcare scheduling is a complex problem. It is difficult and time consuming to solve due to many constraints. Depending on whether the constraints are essential or desirable they are categorized as ‘hard’ and ‘soft’, respectively. Two types of timetables, namely, course and examination are designed for academic institutes. A feasible course timetable could be described as a plan for the movement of students and staff from one classroom to another, without conflicts. Being an NP-complete problem, many attempts have been made using varying computational methods to obtain optimal solutions to the timetabling problem. Genetic algorithms, based on Darwin's theory of evolution is one such method. The aim of this study is to optimize a general university course scheduling process based on genetic algorithms using some defined constraints.

KEYWORDS: Genetic algorithm, timetable, constraints, chromosomes.

I. INTRODUCTION

The class timetabling problem is a typical scheduling problem that appears to be a tedious job in every academic institute once or twice a year [3]. In earlier days, time table scheduling was done manually with a single person or some group involved in task of scheduling it manually, which takes a lot of effort and time. Planning timetables is one of the most complex and error-prone applications. Timetabling is the task of creating a timetable while satisfying some constraints. There are basically two types of constraints, soft constraints and hard constraints. Soft constraints are those if we violate them in scheduling, the output is still valid, but hard constraints are those which if we violate them; the timetable is no longer valid [1].

The search space of a timetabling problem is too vast, many solutions exist in the search space and few of them are not feasible. Feasible solutions here mean those which do not violate hard constraints and as well try to satisfy soft constraints. We need to choose the most appropriate one from feasible solutions. Most appropriate ones here mean those which do not violate soft constraints to a greater extent [1]. Using Genetics Algorithm, a number of trade-off solutions, in terms of multiple objectives of the problem, could be obtained very easily. Moreover, each of the obtained solutions has been found much better than a manually prepared solution which is in use.

population and are then mated to form a new individual (child). The child is further mutated to introduce diversity into the population [10]. Rather than starting from a single point within the search space, GA is initialized to the population of guesses. These are usually random and will bespread throughout the search space. A typical algorithm then uses three operators, selection, crossover and mutation, to direct the population toward convergence at global optimum. A GA, as shown in figure 1 requires a process of initializing, breeding, mutating, choosing and killing. It can be said that most methods called GAs have at least the following elements in common: Population of chromosomes, Selection according to fitness, Crossover to produce new offspring, and random mutation of new offspring.

II. RELATED WORK

Creating timetables for institutes which deal with transport, sport, workforce, courses, examination schedules, and healthcare scheduling is a complex problem. It is difficult and time consuming to solve due to many constraints. Depending on whether the constraints are essential or desirable they are categorized as ‘hard’ and ‘soft’, respectively. Two types of timetables, namely, course and examination are designed for academic institutes. A feasible course timetable could be described as a plan for the movement of students and staff from one classroom to another, without conflicts. Being an NP-complete problem, many attempts have been made using varying computational methods to obtain optimal solutions to the timetabling problem. Genetic algorithms, based on Darwin's theory of evolution is one



such method. The aim of this study is to optimize a general university course scheduling process based on genetic algorithms using some defined constraints

III. METHODOLOGY

Exemplar based Inpainting technique is used for inpainting of text regions, which takes structure synthesis and texture synthesis together. The inpainting is done in such a manner, that it fills the damaged region or holes in an image, with surrounding colour and texture. The algorithm is based on patch based filling procedure. First find target region using mask image and then find boundary of target region. For all the boundary points it defined patch and find the priority of these patches. It starts filling the target region from the highest priority patch by finding the best match patch. This procedure is repeated until entire target region is inpainted.

The algorithm automatically generates mask image without user interaction that contains only text regions to be inpainted.

IV. EXPERIMENTAL RESULTS

The hard constraints were tested to ensure that all the solutions obtained were valid. The optimized solution for the timetable consisted of the following factors and their values. The population size was 100 with a mutation rate of 0.01%, a crossover rate of 0.9%, the number of elite individuals was 2 and the tournament size was 5. With these values the resulting timetable had zero number of clashes with the fitness value of 1.

4.1 Architectural specifications JAVA version 8 was used on a 6th Generation Intel(R) Core (TM) i7 Quad Core (6M Cache, upto 3.5 GHz) 16GB Dual Channel DDR4 256GB PCIe Solid State Drive with NVIDIA GTX960M 2GB DDR5 for the design of the Course Scheduler

4.2 Performance Analysis

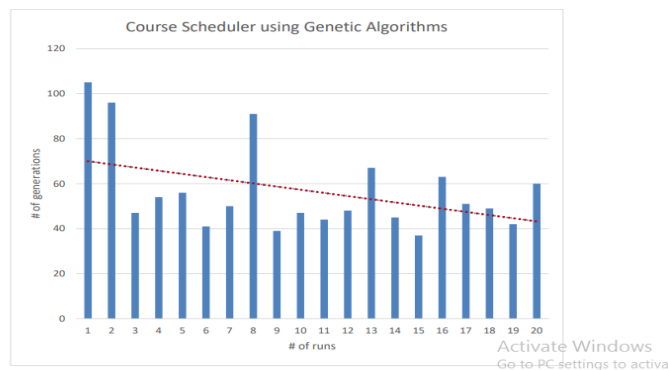


Figure XI: The number of generations the Course Scheduler takes to reach an optimal solution

The increase in population size shows a steady increase in the number of generations that takes to reach a valid solution

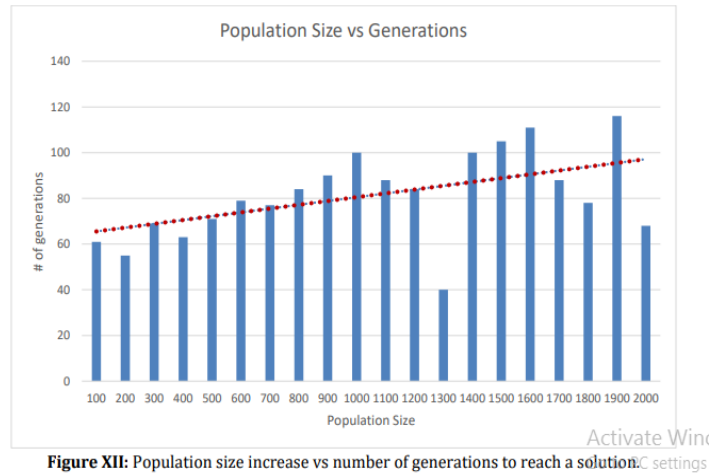


Figure XII: Population size increase vs number of generators to reach solution

Figure XII: Popular size increase vs number of generators to reach solution

Mutation rate plays an important role in genetic algorithms. As a result, the effect of clashes and the fitness value were checked with the course scheduler. Here, the number of generations were limited to 1000, the mutation rate range was from 0.01 to 0.21.

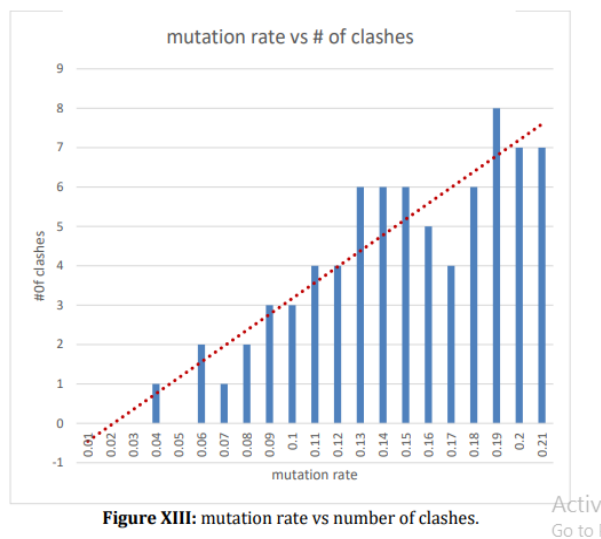


Figure XIII: mutation rate vs number of clashes.

Figure XIII: Mutation rate vs number of clashes

As seen from the graph above, the increase in mutation rate increases the number of clashes. As a result, the mutation rate is optimal at 0.01.

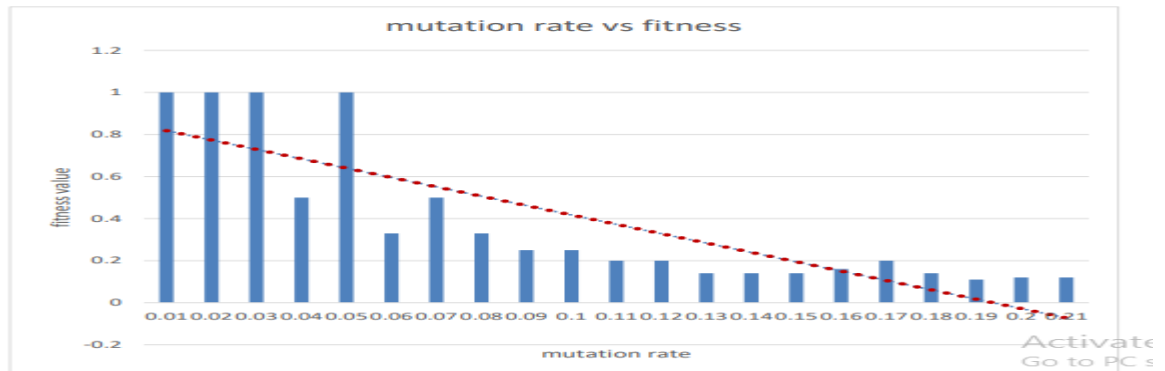


Figure XIV: mutation rate vs fitness value.

The increase in mutation rate decreases the fitness value as seen from the graph in Figure XIV.

V. CONCLUSION

We have shown that a genetic algorithm approach is very effective and useful on the lecture timetabling problems. Using the method we have described and shown a great potential for leading timetable in future which are fairer to students. The framework seems directly applicable to a very wide variety of other timetabling problem. For example, experimental result shows that a key aspect towards its success is the employment of the mutation operator described. The GA in timetabling framework has been shown to be successful on several real problem ‘University Department size’, and so it seem we can justify the expectation for it to work very well on other problems of similar size and nature. That is, there is no reason to suspect that there is anything particularly easy about the problem it was tested on. In comparison to other real problems. Much works remain to do to see how performances scale to larger and otherwise different kinds of timetabling problems.

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