Analysis of Crossover Probability on Genetic Algorithm Performance in Optimizing Course Scheduling in the Unimed Electrical Engineering Study Program

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Abstract. Genetic Algorithm (GA) speed is determined by computation time. Computing time in GA for finding the optimum value is strongly influenced by the following parameters: population size, Crossover Probability (Pc), Mutation Probability (Pm), and the selected selection method. Determining the appropriate and correct Pc value indicates how large the parent chromosome will experience crossover. The method used to analyze the effect of Pc on GA performance is changing the Pc value between 0.80-0.95. The simulation used MATLAB R2012a to obtain the best computational time for each Pc value.
The test results show that the fastest computing time is in the range of Pc values between 0.85-0.95 with an average computation time of 0.14564s. This indicates that for the case of optimizing the scheduling of courses in the Unimed Electrical Engineering study program, the Pc value between 0.85-0.95 will provide the fastest computation time.

Keywords: Crossover Probability, Genetic Algorithm, Computation Time, Optimization, Course Scheduling

1 Introduction

The genetic algorithm (GA) is a search algorithm based on the mechanisms of natural selection and genetics. This algorithm has three leading genetic operators: population size, crossover probability (Pc) and mutation probability (Pm). Pc is an essential operator for creating new offspring from selected parental chromosome pairs [11][9][3]. These operators have the function of producing a solution that is close to optimal [1][7][8]. GA also creates a new population through a continuous iteration process over the initial population until a population is obtained that is closer to the optimal solution [2][14]. In GA, several operations support its success in finding the most optimal solution, such as generating the initial population, fitness value for each chromosome, chromosome selection, Crossover and mutation. The crossover

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technique is one of the most basic operations in GA evaluation [11][12]. The crossover process is the process of forming child chromosomes [9][10]. Each chromosome will be evaluated based on its fitness value. The fitness value will determine the quality of the chromosome. This process runs iteratively until the best chromosome is obtained. Chromosomes with the best fitness values have a high probability of reproducing to produce new chromosomes in the next generation. Thus, the next generation will be better than the previous generation. This will show how GA performs.

Course scheduling is allocating resources in a certain period by meeting predetermined limits. Arranging a course schedule is a challenging job. There are several cases related to course scheduling; namely, lecturers cannot teach because the course schedule conflicts with other courses, there are courses held in the same room and at the same time and so on. For this reason, it is necessary to optimize course scheduling. In this research, optimizing course scheduling uses a GA. In finding the optimal value, GA depends on one of the genetic operators, Crossover. Crossover functions to produce new individuals that are different from the parent chromosomes with better quality [11][9]. The influence of Pc on GA performance was analyzed by varying the Pc value and the number of generations [9][10]. Changes in the value of Pc will be seen in the effect on computing time. Computing time dramatically determines the performance of the GA. Thus, selecting the appropriate Pc value will significantly determine the performance of the GA.

2 Method

Here is a flowchart showing how to use a genetic algorithm to schedule simulations. The first stage is to create the basic population based on the flowchart. Assessing each member of the population's fitness value is the second step. The parent chromosome must be chosen in the third stage. Crossing across and changing the parent chromosome is the fourth stage. Lastly, in the fifth phase, do the child's chromosomes match the desired criteria? If so, the procedure is finished. If not, the procedure will go back to the first stage.

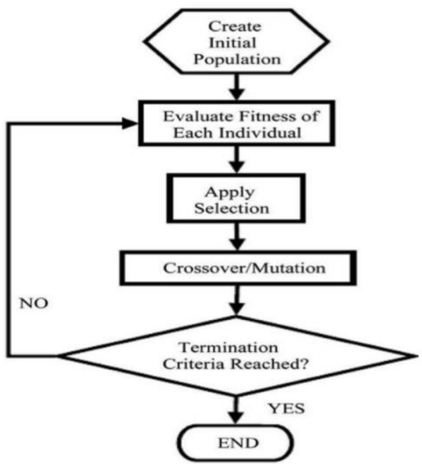

Fig.1 Flowchart of Genetic Algorithm

3 Results and Discussion

The simulation results of the Effect of Crossover Probability (Pc) on the performance of the Genetic Algorithm in scheduling optimization are by varying the value of the crossover probability (Pc) between 0.80-0.95, Mutation probability = 0.05 and population size = 100, so the average computation time is 0.14564s. In contrast, the fastest time is 0.1440 s at Pc=0.85.

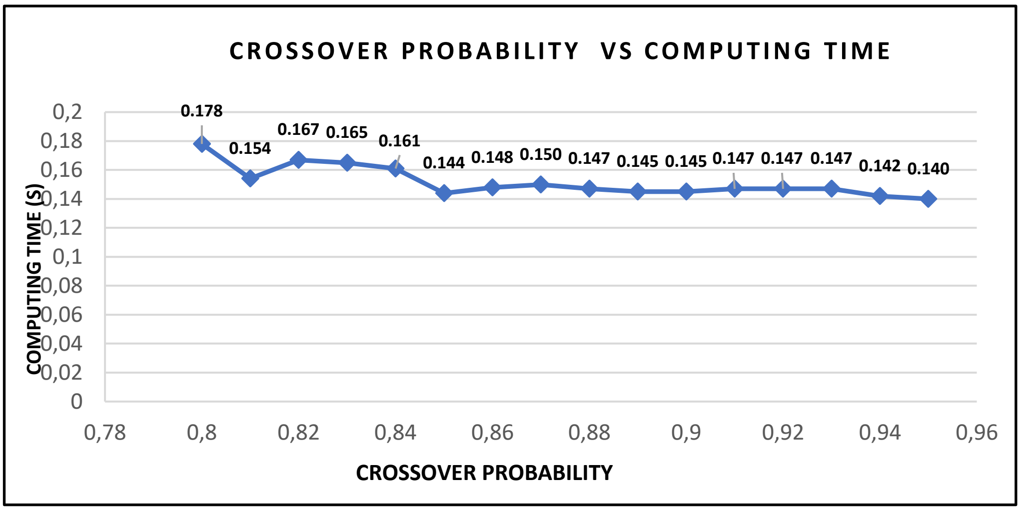

Fig.2. Computing Time with variation of Crossover Probability

This research aims to analyze the computational speed of genetic algorithms by changing one of the parameters, namely the crossover probability. The choice of crossover probability value determines the percentage of crossovers that occur on the parent chromosomes so that it will affect the computing time. Other parameters that greatly influence the computing time of genetic algorithms are population size, mutation probability, and the selection method used. However, this needs to be discussed in this research.

4 Conclusion

According to the research results, it can be concluded that with Crossover probability (Pc) between 0.85-0.95, Mutation probability (Pm) = 0.05 and population size = 100 obtained an average computing time of 0.14564s while the fastest time is 0.1440s at Pc = 0.85 in the problem of optimizing course scheduling in Unimed Electrical Engineering Study Program.

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