IMPLEMENTATION OF GENETIC ALGORITHM FOR SUBJ ECT SCHEDULING IN SMAN 1 CIWIDEY

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ABSTRACT

Scheduling subjects is teaching and learning activities into complex problems in school. Scheduling the preparation of the subjects carried out by the vice principal part of the curriculum using Microsoft Excel tools. Search for gain scheduling with the best results at the completion of the preparation of scheduling by the vice principal part of the curriculum reap popping problem. It takes the right solution in the completion of the preparation of the scheduling of subjects. Implementation of the genetic algorithm is expected to be the right solution in the search process for the preparation of the scheduling of subjects in order to obtain optimal scheduling. The results obtained in the implementation of scheduling algorithms on subjects SMAN 1 Ciwidey is a genetic algorithm can be implemented either on scheduling but did not reach the same fitness value to 1.

***Keywords**: Implementation, Genetic Algorithm, Subjects Scheduling.*

1. INTRODUCTION

Genetic algorithm is an heuristic method that developed based on the principles of genetics and the process of natural selection from Darwin's theory of evolution. genetic algiritm for completion of the process of search or election is similar with the election of an individual to survive in the evolutionary process. Genetic algorithms have been successfully solved the problem and modeling in various fields such as engineering, business, and entertainment to generate optimal value or as expected. In addition to the fields already mentioned, the genetic algorithm has also been successfully applied in various studies such as the completion of the bin packing problem, the completion of knapsack problem, the use of genetic algorithms for image segmentation, as well as a wide range of solutions to scheduling [1].

Scheduling is often used as research material by many researchers with the level of difficulty in the preparation of the schedule. Scheduling itself is the placement of resources (resource) one time prepared in accordance with requirements [2]. Scheduling has many aspects need in the preparation of appropriate scheduling activities that require the existence of a scheduling. The more complex scheduling problems, if required aspects are not taken into consideration for the preparation of a scheduling. The aspects that have been developed can be used as restrictions in the preparation of schedules that are met (hard constraints) and is not met (soft constraints) which will be a reference in the drafting process of scheduling.

Based on observations made at the public high school 1 Ciwidey and interviews with Mr. Caca Wiarsa, S.Pd as vice principal part of the curriculum can be informed about the preparation of the subjects performed scheduling. 1 Ciwidey high school has three levels, namely X, XI, XII and has two types of majors for class XI and XII are majoring in science and social studies. Teaching and learning activities carried out in the morning for all levels. Scheduling subjects were prepared using Microsoft Excel as a tool in the preparation. Scheduling subjects composed consists of indicators scheduling, ie subjects (17 subjects), teacher (54), classes (27 classes), the number of teaching hours, the time slot, and the active day learning from Monday to Saturday (6 days). In addition, the subjects are scheduling special times which time the flag ceremony every Monday in the first slot study, rest, time for the midday prayer, as well as the Duha prayer time each Friday at the first slot of learning. Indicators scheduling arranged by the vice principal of curriculum to produce a teaching assignment. Difficulties arise using Microsoft Excel is looking for an empty field in each time slot to put his teaching duties in accordance with the availability of teachers mengajar.Penjadwalan sometimes experienced many changes by not fitting the schedule prepared by the teacher. Optimal scheduling desirable that in the absence of change. However, optimal scheduling difficult to obtain in the absence of agreement on the availability of day for teacher. Scheduling ideal compiled obtained after doing some repair times so that the total time required from the beginning of the preparation of the schedule approximately one month. Based on the explanations that have been described, it will be implemented genetic algorithms in scheduling subjects in SMAN 1

Ciwidey as heuristic method used for settlement scheduling optimal search.

1.1 GENETIC ALGORITHM

The genetic algorithm is a heuristic method that was developed based on the principles of genetics and the process of natural selection Darwin's Theory of Evolution. Optimization method developed by John Holland around 1960 and popularized by one of his students, David Goldreg in the 1980s. Completion of the search process or the process of the election of an individual to survive in the evolutionary process.

1.1.1 CYCLE GENETIC ALGORITHM

Cycle genetic algorithm is needed in each case, the cycle is a cycle first instance introduced by David Goldberg. The following cycles genetic algorithm according to David :

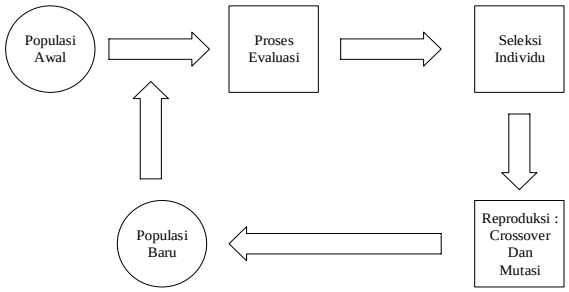


Figure 1. Cycle Genetic Algorithm David Goldberg

Cycle genetic algorithm in Figure 1 will be the reference for the implementation cycle of the genetic algorithm in scheduling subjects.

1.1.2 Main Components Of Genetic Algorithms

The main components of genetic algorithm interdependent and related to one another, the following explanation of these components [3] :

1. Encoding Technique

Coding techniques is an important part in the genetic algorithm. This process is necessary in relation to the role of chromosomes as the representation of problem solving. Chromosome combination of genes that make up the tertentu.Gen values can be represented in the form of: a string of bits, real number, a list of rules, a permutation of elements, elements of the program, or other representations that can be implemented for genetic operators.

2. Membangkitkan Populasi Awal

Generate initial population is a process raises a number of individuals at random or through a certain procedure. Techniques in the generation of the initial population, there are several ways, which are as follows:

a. Random search

Search solutions starting from a particular test point. The test points are considered as an alternative solution called as a population.

b. Random Number Generator

Random generator involves the generation of random numbers to the value of each gene according to the representation of chromosomes that will be used.

c. Specific approach

In this way by inserting a gene into a specific value of the initial population is formed.

d. Permutations Gen

In this way the use of Josephus in combinatorial permutations.

3. Value Fitness

An individual or chromosome is evaluated based on a certain function as ukutan performainya. In the evolution of nature, individual worth of high fitness will survive. While low-value fitness will die.

On the issue of optimization, if a solution is sought is to maximize a function h (known as a maximization problem), then the fitness value used is the value of the function h, ie f = h (where f is the fitness value). But if the problem is to minimize the function h, then the function h can not be used directly. This is due to a rule that individuals with high fitness values are better able to survive in the next generation. Therefore, the fitness value used is f = 1 / h, which means that the smaller the p value, the greater the value f. But this would be a problem if h can be 0, resulting f infinite worth. To overcome this, h should be added a number that is considered to be very small so that the fitness value can be seen in equation 1:

$$f = \frac{1}{(h + a)}$$

where a is a number which is considered very small and varies according to the problem to be solved. The determination of the value of fitness is very influential on overall performasi genetic algorithm.

Fitness value which is used to achieve optimal value in this study are: 1. The results of the fitness value is of the rules that have been set by providing a value of 0 for the rules are not violated and 1 for the rules are violated. So, when administered in equation 1 will yield a fitness value 1, where h is the rules that have been set and a is the smallest value is 1.

4. Selection

Each chromosome contained in the population will go through a selection process to choose parenthood. There are several methods of selection, including:

a. Roulette Wheel Selection

Selection methods commonly used are roulette wheel selection, as the name suggests, this method mimicking the roulette wheel. Where each chromosome occupies a circle on a piece of wheel roulette wheel in proportion to the value fitnessnya. Chromosomes have a greater fitness value occupies chunks larger circle than the low fitness valuable chromosome.

b. Selection Ranking

Selection improve the previous selection process for the selection of roulette wheel is likely to have a chromosome other than the one that dominates the fitness value of up to 90%. Another fitness values will have a very small probability of being selected. Selection rankings are used to overcome the problem of shortage of selection roulette wheel. First of all, the entire chromosome sorted based on whether or not a good solution based on its fitness value. Once sorted, the worst chromosome rated new fitness of 1, the second chromosome worst rated new fitness by 2, and so on. Chromosome best rated new fitness by n where n is much chromosome in a population.

c. Selection Steady State

This method is not widely used in the selection process because it is done by maintaining the best individual. At each generation, will be chosen several chromosomes which have the worst fitness value will be replaced with a new offspring. So that in the next generation there will be some populations are maintained

d. Selection Tournament

Other selection methods are based on natural phenomena such as tournaments between individuals in a population. Performed by randomly selected from the population of some chromosomes. Best individuals in this group will be selected as the parent.

e. Random Truncation

This method is easier to implement when compared with the method of the roulette wheel, the selection is done randomly chromosome but not all chromosomes get a chance, only the best chromosome are likely.

5. Crossover

A chromosome that leads to a good solution can be obtained from the move-cross the two chromosomes. Crossovers can be bad if the size of the population is very small. Crossovers can be done only if a random number [0,1] which raised less than the specified pc. In general, the pc is set close to 1, for example 0.8.

6. Mutation

Mutation is the operator of the genetic algorithm that aims to turn specific genes on a chromosome. These mutations contribute to replace the missing genes from the population due to selection that allows the re-emergence of genes that do not appear in the initial population.

7. Requeirments Stop

The optimization process performed by the genetic algorithm will stop after a stop condition is fulfilled. Some commonly used stop condition is the limit value of fitness function, limit computing time, many generations and convergence. Terms stops frequently used is many generations, but it is possible to choose a combination of several conditions stop [4].

8. Determination of Parameter Algorithms

Parameter algorithm is one important part of the application gentika algorithm that is not easy to be determined exactly. There is no definite rules to determine the parameters of the algorithm, both the probability of crossover (Pc), the probability of mutation (Pm), as well as the size of the population. It is inseparable from the principle of genetic algorithm that relies on random numbers almost in every step, from the formation of the initial population, the process of crossing or mutation process. Different random numbers will inevitably lead to different results [3]. There are some recommendations that can be used, among other things:

a. For The problems that have quite a large area of the solution, De Jong merekomdasikan to control parameter values:
   (Popsize; Pc; Pm) = (50; 0.6; 0.001)
b. When the average fitness of each generation is used as an indicator, then Grefensttete recommends:
   (Popsize; Pc; Pm) = (30; 0.95; 0.01)
c. When the fitness of the best individual is monitored in each generation, the proposal is:
   (Popsize; Pc; Pm) = (80; 0.45; 0.01)
d. The population size should be no smaller than 30, for any kind of problem.

In this research used recommendation is a recommendation c, c because the selected recommendations to achieve the desired objectives with fitness = 1, should be monitored every generation. Then selected c recommendations with Popsize (population size) 80, Pc (crossover probability) of 0.45. For the size of the population is not used due to have used a lot of checking and want to achieve with fitness = 1.

1.2 Scheduling

Scheduling is the process of sorting the manufacture of products thoroughly on some machines. Scheduling can also be seen as the process of allocating resources on a specific period of time to perform a set of tasks.
Scheduling issues arise when multiple jobs (job) will be done simultaneously, while resources like machinery or equipment that is owned by a limited number. To achieve optimum results with limited available resources, it is necessary to scheduling these resources efficiently.

2. RESEARCH CONTENTS

2.1 Implementation and Analysis of Algorithms

2.1.1 Variable Research

Variable research is a data input to the preparation of the scheduling of the subjects in SMAN 1 Ciwidey. Data input is as follows:
a. teacher data
b. Data class
c. Data subjects, subjects include the name and amount of weight each subject
d. Time slot data, including time clock and room lessons available
e. Data teaching duties
f. Data availability teacher (teacher availability of data is the availability of data that is visible from the schedule even / odd at the previous scheduling).

2.1.2 Rules Pinalty

In the genetic algorithm there is an evaluation process that will judge the good or bad of a chromosome for survival, here are the rules pinalty:

1. There is a soft constraint rule is the duty of teachers who do not teach according to the availability of teachers.
2. There is a hard constraint rules is the task of teaching the subjects that has a weight of 4 hours of lessons subjects not within 2 days.
3. There is a hard constraint rules that teachers who teach in one time / clash.
4. There is a hard constraint rules that teaching duties have excess weight teaching duties due to the crossover.

2.1.3 Flowchart Algorithm Implementation

A series of processes at the stage genetic algorithm is done for the implementation of a genetic algorithm for scheduling subjects in SMAN 1 Ciwidey can be seen in Figure 2:

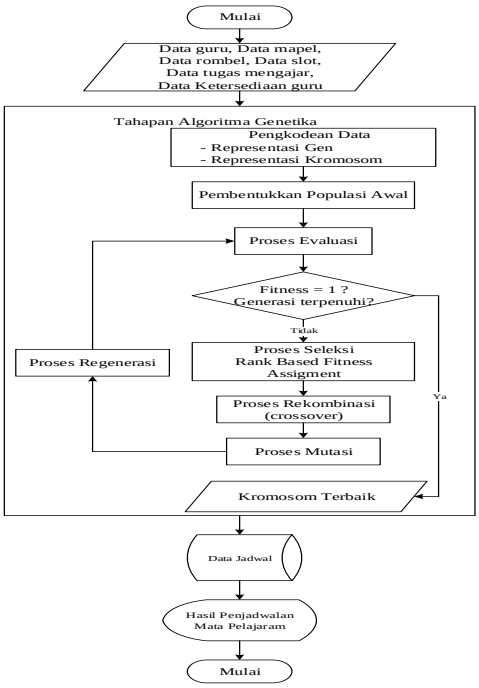


Figure 2. Genetic Algorithm Implementation Flowchart To Scheduling Lesson In SMA Negeri 1 Ciwidey

2.1.4 Analysis Algorithms

Analysis is done is to determine the results of the subjects that are implemented scheduling genetic algorithm can achieve optimal value. The stages - steps being taken:

1. Determine the number of chromosomes that is used in the generation and the maximum number of generations. In this study within one generation using chromosome 9 in accordance with the number of the class to class X in SMAN 1 Ciwidey and do a maximum of 50 generations although the fitness value does not reach the optimal value is equal to 1.
2. initialize the determining factors of chromosomes that exist in the preparation of scheduling subjects. The determining factors that made the study of chromosomes in the data slot and teaching duties. Chromosomes are formed from a combination of genes that represent one variable, gene formed from the teacher data, the data subject, the data will be the data rombel teaching duties.
3. Perform initial population establishment / generate chromosomes that have been formed based on random numbers. In this study, using the initial formation of random search.
4. The results of the initial population formation evaluation process is carried out by counting the number pinalty for checking violations that occur in every chromosome. In this study, how to calculate the amount of pinalty to get the fitness value is the following formula:

$$F(i) = \frac{1}{1 + (\sum p1 + p2 + p3 + p4)}$$

Description:
F (i) = i is a chromosome
p1..p4 = rules described pinalty

5. This research has two requirements: first stop doing generate generation until the fitness value equal to 1 and a second that is to generate the generation of up to a specified number of generations.
6. Perform the next process is the selection. Selection used in this research is the selection rank, rank selection is done in a way to sort the smallest to largest fitness value by delivering the smallest fitness value 1 and the largest fitness value of n (the number of chromosomes).
7. Perform the next process is crossover. Crossover is done in this research is to use the selection of two points for the crossover and the probability of crossover used is 0:45.
8. hereinafter that mutation. Mutations were performed in this study is a mutation intenger.

2.2 Result

The results obtained from the implementation of the genetic algorithm in scheduling subjects in SMAN 1 Ciwidey is obtained fitness value in each generation has the best individual scores but the results did not achieve optimal value is equal to 1.

2.3 Result In Program

Here's how genetic algorithm implementation for each stage of a genetic algorithm:

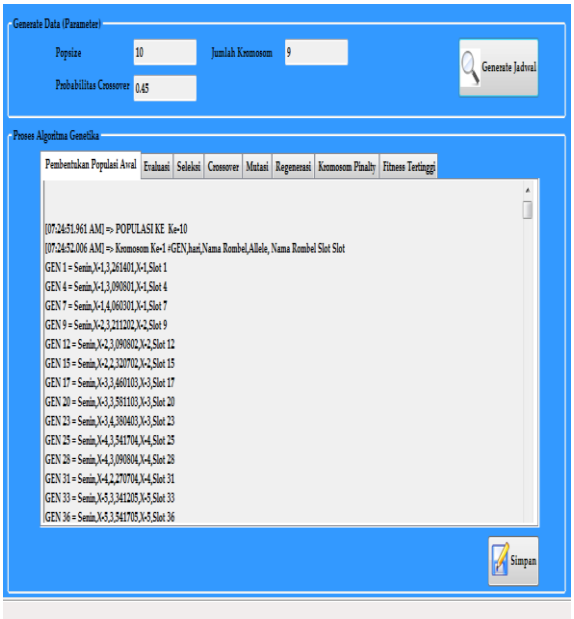


Figure 3. Formation of Initial Population

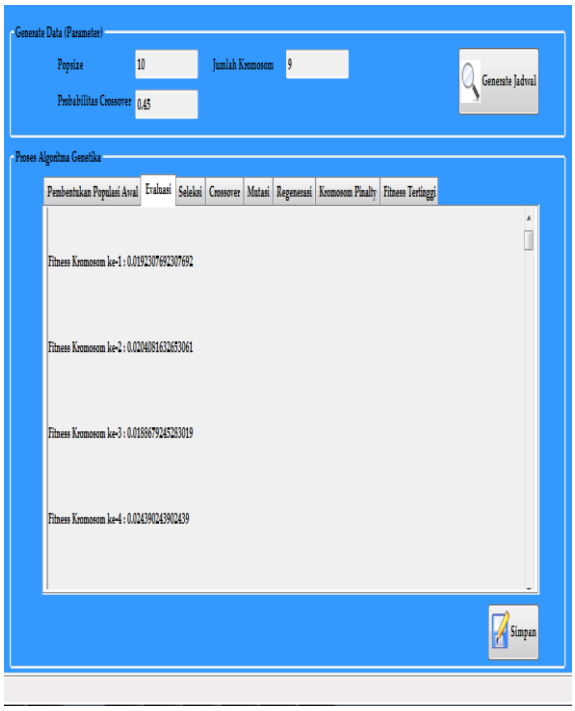


Figure 4. Evaluation Process

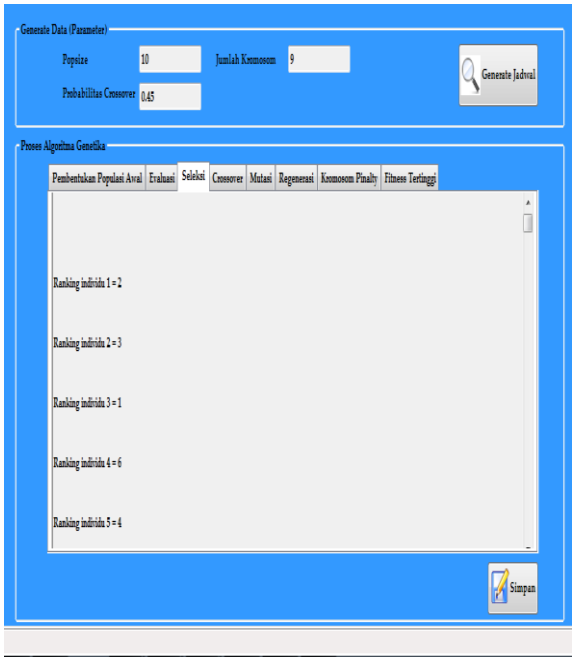


Figure 5. Selection Process

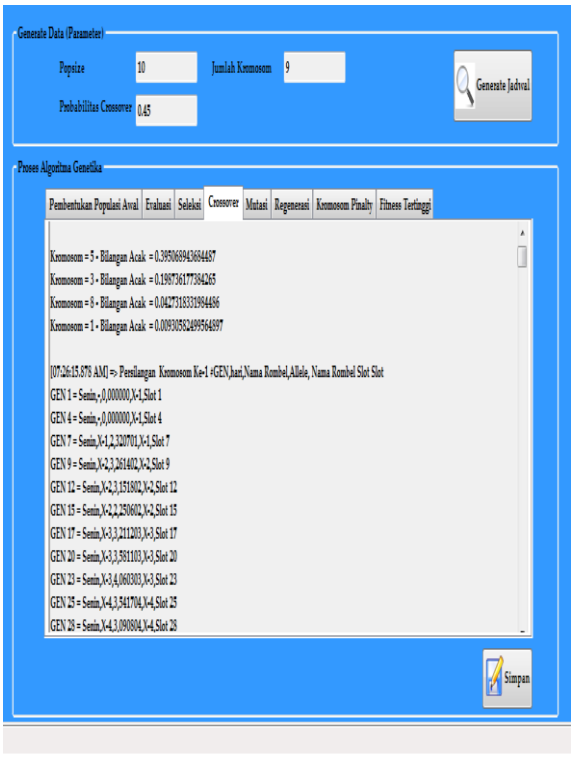


Figure 6. Crossover Process

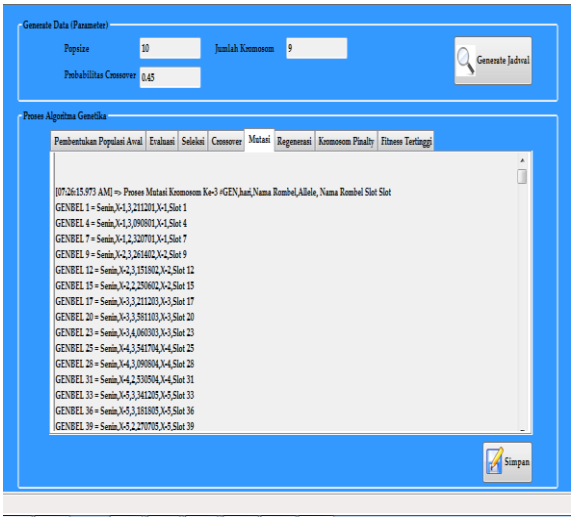


Figure 7. Mutation Process

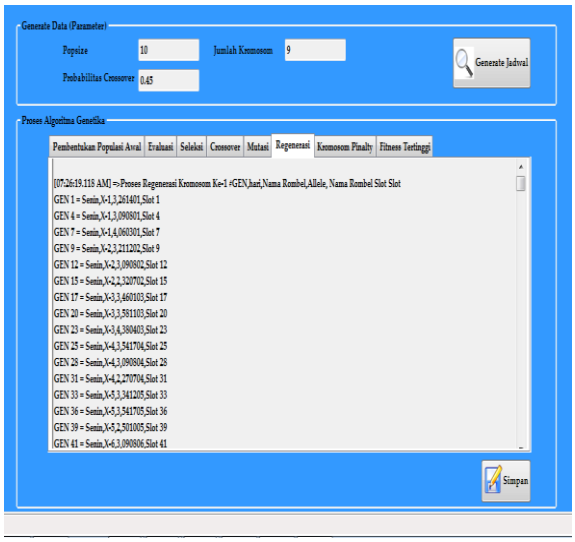


Figure 8 Proses Regenerasi

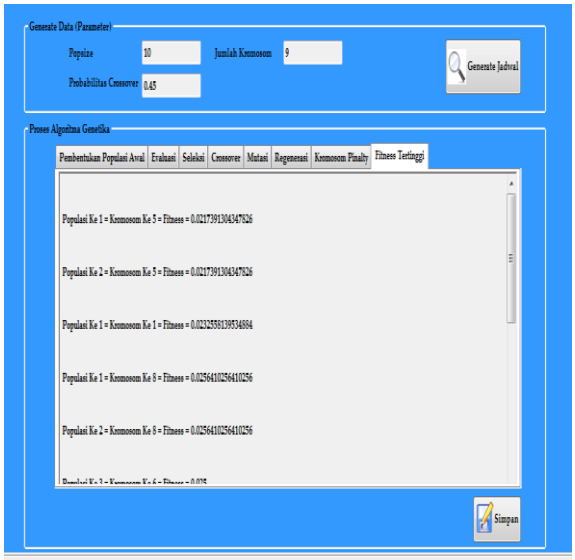


Figure 9. Fitness Top Value Every Generation

3 CONCLUDING

1. Conclusion

Based on the test results in the implementation of a genetic algorithm for scheduling the subjects of class X that has been done of this thesis, it can be concluded that the scheduling results obtained did not reach optimal fitness value by not reaching the fitness value equal to 1. This happens because there constraint- constraints are still exposed pinalty in the evaluation process. Besides not using crossover probability dynamically affect the number of chromosomes that carry out cross and the crossover is done on two points.

2. Suggestions

Based on the results of the testing that has been done, then the advice is expected that carried a genetic algorithm development to implementation for

scheduling subjects in SMAN 1 Ciwidey are as follows:
a. Using heuristic methods other than Genetic Algorithms like Tabu Search, Bee Colony, Ant Colony, etc.
b. Making changes dynamically crossover probability.

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