IMPLEMENTATION OF GENETIC ALGORITHM WITH TOURNAMENT SELECTION FOR COURSE SCHEDULES

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Abstract

Genetic Algorithms can help human work, one of which is compiling course schedules. Preparation of course schedules, if done manually, will take a long time because you have to make a schedule where there are no schedule conflicts between one course and another. Therefore, this study will implement a Genetic Algorithm for the preparation of course schedules, so that it will speed up the preparation of course schedules compared to manual scheduling. In this study, the Genetic Algorithm with Tournament Selection was carried out with the input of control parameters, namely Population Size = 10, Crossover Rate (CR) = 0.75, and Mutation Rate (MR) = 0.01. In this study, the Genetic Algorithm has succeeded in obtaining the desired solution, namely scheduling courses where there are no schedule conflicts between one course and another. This search process took 88 generations to find the best solution.

Keywords: *Genetic Algorithm, Tournament Selection, Scheduling*

1. INTRODUCTION

Timing an activity is an important thing to do so that these activities take place smoothly. This timing is usually called scheduling. The preparation of an activity schedule is related to various constraints that must be met so that it requires a lot of consideration to support these activities [5]. In scheduling courses, a number of courses must be scheduled in a certain space and time slot, where a number of courses may not clash, lecturers can only teach at attendance, students can get courses without clashes, as well as other limitations that are adjusted to conditions on that campus [6].

The genetic algorithm is a heuristic method. The first stages of the genetic algorithm process are initialization of the initial population which is used to create random individuals who have a certain gene arrangement, formed based on population size and chromosome length. The next step is crossover which is done by cross-swapping between two randomly selected parents to produce offspring. After that, the mutation process is done by choosing one random parent. Then the evaluation process and continued with the selection [1].

Selection is used to select which individuals will be selected for interbreeding and mutation processes. Selection is used to get good prospective parents. The selection process is carried out to screen all individuals resulting from the genetic algorithm process to form a new generation. The individual with the greatest fitness value is the choice that will be used in the next generation [2]. In this study, the selection technique used was Tournament selection. Because in the Tournament selection the chromosomes with the highest fitness value are likely to be maintained for the next generation, each generation will experience an increase in fitness values faster so that it will be faster to find solutions and also save time and memory more than other selection techniques [4].

Genetic Algorithms can help human work, one of which is compiling course schedules. Preparation of course schedules, if done manually, will take a long time because you have to pay attention to several factors such as time, space, and so on so that there are no schedule conflicts between one course and another. Therefore, this study will implement the Genetic Algorithm for the preparation of course schedules, so that it will speed up the preparation of course schedules compared to manual scheduling.

2. RESEARCH METHODOLOGY

The flow of this research can be seen in Figure 1 below:

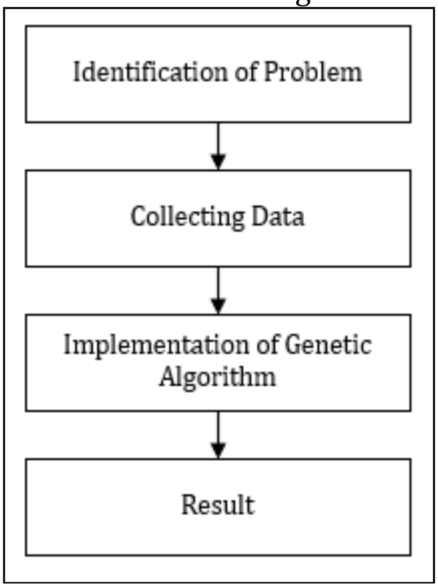

Figure 1. Research Methodology

2.1 Identification of the problem

The process of compiling class schedules using Genetic Algorithms will be implemented with the PHP programming language. By using data information such as course data, lecturer data, and so on, it will be compiled to get a course schedule for one week. The aim of compiling course schedules using Genetic Algorithms is to get a solution for course schedules that do not collide with one another and also to speed up the scheduling process because it is done with a computer system.

2.2 Collecting Data

The data collection stage is collecting data that will be used to compile a lecture schedule, including the following:

a. Day Data

Table 1. Day Data

Day ID	Day Name
H01	Monday
H02	Tuesday

Day ID	Day Name
H03	Wednesday
H04	Thursday
H05	Friday

b. Clock Data

Table 2. Clock Data

Clock ID	Hour
J01	08.00
J02	08.50
J03	09.40
J04	10.30
J05	11.20
J06	13.00
J07	13.50
J08	14.40
J09	15.30
J10	16.20
J11	17.10

c. Room Data

Table 3. Room Data

Room ID	Room Name
R01	Apoteker 3.1
R02	Apoteker 3.2
R03	Apoteker 3.3
R04	Ibnu Sina
R05	Aula Einstein
R06	Lab. Komputer

d. Course Data

Table 4. Course Data

Course ID	Course Name	SKS	SMT
M01	Pemrograman Dasar	3	1
M02	Aljabar Linier	3	1
M03	Program Komputer Aplikasi	3	1
M04	Teori Bahasa dan Otomata	3	5
M05	Analisis Numerik	2	3
M06	Pengantar Teknologi Informasi	2	1
M07	Matematika Diskrit	3	1
M08	Statistika Dasar	2	3
M09	Ilmu Kealaman Dasar	3	1
M10	Pendidikan Agama	2	1
M11	Kewirausahaan	2	5
M12	Kecakapan Antar Personal	3	3
M13	Ilmu Sosial dan Budaya Dasar	3	1
M14	Bahasa Indonesia	3	3
M15	Metode Penelitian	2	5
M16	Sistem Basis Data	4	3
M17	SIstem Informasi	3	5
M18	Kecerdasan Buatan	3	3
M19	Jaringan Nirkabel dan Sistem Bergerak	3	7
M20	Proyek Perangkat Lunak	3	7
M21	Rekayasa Perangkat Lunak	3	5
M22	Kalkulus I	3	1
M23	Etika Profesi	2	7
M24	Interaksi Manusia dan Komputer	2	3
M25	Pemrograman Berbasis Objek	3	3

Course ID	Course Name	SKS	SMT
M26	Sistem Pakar	3	7
M27	Pengantar Ilmu Komputer	3	1
M28	Rekayasa Web	3	7
M29	Kapita Selekta	3	5
M30	Fisika Dasar	2	1
M31	Algoritma Data Mining	3	7
M32	Algoritma dan Struktur Data	3	3
M33	Pemrograman Web	2	5
M34	Sistem Operasi	2	3
M35	Jaringan Komputer	2	5
M36	Pengenalan Pola dan Analisis Citra	3	7
M37	Strategi Bisnis Informasi	3	7
M38	Pemrograman Visual	3	3

e. Lecturer Data

Table 5. Teacher Data

Lecturer ID	Lecturer Name
D01	Andi Farmadi, S.Si., M.T.
D02	Mohammad Reza Faisal, S.T., M.T., PH.D.
D03	Irwan Budiman, S.T., M.Kom.
D04	Muliadi, S.Kom., M.Cs.
D05	Dodon Turianto Nugrahadi, S.Kom., M.Eng.
D06	Radityo Adi Nugroho, S.T. M.Kom.
D07	Fatma Indriani, S.T., M.I.T.
D08	Dwi Kartini, S.Kom., M.Kom.
D09	Muhammad Itqan Mazdadi, S.Kom., M.Kom.
D10	Friska Abadi, S.Kom., M.Kom.
D11	Triando Hamonangan Saragih, S.Kom., M.Kom.
D12	Ahmad Rusadi, S.Kom., M.Kom.
D13	Rudy Herteno, S.Kom., M.Kom.
D14	Heru Kartika Candra
D15	Dr. Ninis Hadi Haryanti, M.S.
D16	Dr. Ichsan Ridwan, M.Kom.
D17	Rahmat Ramadhani, S.Kom
D18	Saman Abdurrhaman, S.Si., M.Si.
D19	M. Ashar Karim, S.Si., M.Si.
D20	Fahruddin, S.Si., M.T.
D21	Anang Kadarsah, S.Si., M.Si.
D22	Awad
D23	Totok Wainto, S.Si., M.Si.
D24	Susi Apriana, M.Si.
D25	Marina Dwi Mayangsari
D26	Nina Budiwati
D27	Musdzalifah
D28	Isnu Wahyono, M.Pd
D29	Suparti, M.Pd
D30	Semua Dosen PS Ilkom

3. Implementation of Genetic Algorithms

3.1 Parameters of Control

a. Population Size = 10

b. Crossover Rate (CR) = 0.75 (75%)

c. Mutation Rate (MR) = 0.01 (10%)

3.2 Initialization of Chromosomes

This process generates random chromosomes or individuals. For example, the random generation of 1 gene is H03J02R02M01D06. The gene is composed of a combination of Day ID, Clock ID, Room ID, Course ID, and Lecturer ID. After the genes are formed into one chromosome, they will then be evaluated by checking the number of error values first then calculating the fitness value using the following equation [3]:

$$\text{Fitness} = \frac{1}{1+error\ value} \times 1000 \quad (1)$$

The number of error values on the chromosomes is calculated by changing the codes in the gene arrangement into course data by looking at the data in Table 1 to Table 5. Then a lecture schedule will be formed in 1 week, after which it is checked how many colliding schedules are. The following are the results of the formation of chromosomes into one population:

Table 6. Initialization of Chromosomes

Individual	Gene	Fitness
1	H03J02R02M01D06 - H02J03R05M02D08 - H03J07R06M03D07 - H04J03R05M04D07 - H04J10R01M05D01 - H02J04R05M06D12 - H02J09R01M07D19 - H02J10R05M08D14 - H05J07R03M09D21 - H05J01R05M10D22 - H01J03R02M11D24 - H02J01R04M12D25 - H04J08R06M13D27 - H03J02R02M14D29 - H01J10R04M15D07 - H05J07R03M16D08 - H04J08R05M17D04 - H04J01R04M18D04 - H01J03R05M19D12 - H01J02R05M20D02 - H02J03R06M21D13 - H02J03R04M22D07 - H02J08R03M23D14 - H01J01R05M24D05 - H01J08R05M25D13 - H02J06R04M26D01 - H03J07R03M27D11 - H04J02R01M28D06 - H05J09R01M29D30 - H01J04R03M30D16 - H04J02R01M31D07 - H03J02R03M32D01 - H03J06R03M33D10 - H01J01R03M34D11 - H01J01R05M35D05 - H05J08R02M36D17 - H01J08R01M37D04 - H05J01R06M38D10	45.45
...	...	...
10	H02J09R01M01D06 - H04J01R04M02D08 - H03J09R06M03D08 - H02J01R06M04D07 - H02J01R06M05D01 - H04J10R02M06D12 - H05J07R04M07D01 - H05J03R05M08D01 - H01J08R04M09D20 - H02J01R01M10D22 - H02J06R04M11D23 - H01J02R02M12D25 - H04J07R04M13D26 - H05J03R04M14D29 - H05J08R06M15D07 - H01J02R05M16D10 - H01J01R03M17D08 - H03J02R03M18D11 - H03J08R05M19D09 - H02J07R05M20D13 - H01J02R06M21D02 - H05J09R03M22D07 - H05J03R01M23D14 - H04J06R06M24D03 - H03J07R05M25D06 - H02J07R05M26D01 - H03J01R05M27D05 - H04J01R03M28D06 - H02J08R03M29D30 - H05J10R04M30D15 - H01J01R01M31D07 - H04J07R03M32D01 - H04J09R06M33D17 - H02J10R05M34D11 - H03J06R05M35D09 - H01J07R05M36D17 - H01J08R06M37D03 - H02J01R02M38D10	66.67

3.3 Tournament Selection

After the initial population is formed, the next step is that the population will be selected using the Tournament Selection method. Select 3 chromosomes or random individuals from the previous population, then compare the fitness values of these individuals. The individual with the greatest fitness value will be selected to become a new individual. Do it as much as the population size so that a new population will be formed. Here's an example for the first selection process. Then for the next selection process the steps are the same as the first selection process The randomly selected individuals are:

Individual 8 : score fitness = 37.04
Individual 1 : score fitness = 45.45
Individual 9 : score fitness = 25

The individual with the greatest fitness value is individual 1 with a fitness value of 45.45. Repeat the process for the population size of 10 times. After the selection process was carried out 10 times, the individuals selected as new individuals were individuals 1, 3, 3, 10, 10, 6, 10, 8, 3, and 5. So that individual will be used as an individual in the new population, then the individual numbers are changed to serial numbers 1 to 10. Here are the results after the selection process:

Table 7. Selection

Individual	Gene	Fitness
1	H03J02R02M01D06 - H02J03R05M02D08 - H03J07R06M03D07 - H04J03R05M04D07 - H04J10R01M05D01 - H02J04R05M06D12 - H02J09R01M07D19 - H02J10R05M08D14 - H05J07R03M09D21 - H05J01R05M10D22 - H01J03R02M11D24 - H02J01R04M12D25 - H04J08R06M13D27 - H03J02R02M14D29 - H01J10R04M15D07 - H05J07R03M16D08 - H04J08R05M17D04 - H04J01R04M18D04 - H01J03R05M19D12 - H01J02R05M20D02 - H02J03R06M21D13 - H02J03R04M22D07 - H02J08R03M23D14 - H01J01R05M24D05 - H01J08R05M25D13 - H02J06R04M26D01 - H03J07R03M27D11 - H04J02R01M28D06 - H05J09R01M29D30 - H01J04R03M30D16 - H04J02R01M31D07 - H03J02R03M32D01 - H03J06R03M33D10 - H01J01R03M34D11 - H01J01R05M35D05 - H05J08R02M36D17 - H01J08R01M37D04 - H05J01R06M38D10	45.45
...	...	...
10	H04J01R05M01D06 - H01J06R06M02D18 - H01J09R03M03D08 - H03J03R06M04D07 - H05J03R03M05D01 - H04J02R01M06D12 - H01J07R03M07D01 - H03J01R02M08D01 - H05J08R03M09D20 - H02J04R05M10D22 - H01J07R01M11D24 - H03J07R03M12D25 - H04J07R06M13D27 - H02J01R02M14D29 - H05J10R05M15D04 - H02J01R03M16D10 - H03J06R01M17D08 - H04J06R05M18D11 - H01J03R06M19D05 - H05J07R02M20D13 - H05J03R02M21D02 - H02J06R01M22D11 - H01J01R04M23D14 - H04J01R01M24D03 - H05J07R03M25D13 - H05J01R03M26D04 - H01J06R04M27D05 - H02J01R02M28D13 - H05J03R04M29D30 - H01J04R06M30D16 - H01J09R05M31D07 - H01J03R04M32D17 - H01J03R04M33D06 - H02J03R05M34D11 - H01J08R06M35D05 - H01J07R01M36D17 - H03J08R05M37D03 - H05J01R05M38D10	40

3.4 Crossover

The crossover process is carried out after a new population is formed as a result of the selection process by crossing or exchanging genes in the 2 parent chromosomes or individuals. The number of crossovers depends on the specified CR value which is 0.75. The crossover steps are as follows:

a. Random value [0-1]
   Generate random values with intervals [0-1] as much as the population size. If the random value < CR (0.75) then the individual will be used as the parent

Table 8. Selection of the parent

Individual	Random Value	Information
1	0.87	-
2	0.02	parent
3	0.7	parent
4	0.96	-
5	0.78	-
6	0.93	-
7	0.09	parent
8	0.62	parent
9	0.07	parent
10	0.6	parent

Individuals who are selected as parents will be crossed with other parents. So, individuals who will carry out the crossover process are as follows:

1) Individual 2 is crossed with individual 3
2) Individual 3 is crossed with individual 7
3) Individual 7 is crossed with individual 8
4) Individual 8 is crossed with individual 9
5) Individual 9 is crossed with individual 10
6) 10 individuals are crossed with individual 1

b. Determine the point of intersection at random [1-37]

The following is an example of the first crossover process for individuals 2 and 3, the random value generated is 10 which will be used as the intersection point. The process is that in individual 2 the 1st to 10th genes (intersection point) are taken, then in the 3rd individual the 11th gene (after the intersection point) is taken to 38. Then the genes are combined which will become chromosomes or new individuals. After the crossover process is complete, the fitness value is recalculated using equation (1). For the next crossover process, the process is the same as the first crossover process.

Table 9. Crossover Process

Individual	Gene	Fitness
2	H04J08R02M01D06 - H01J01R05M02D08 - H03J03R04M03D12 - H01J09R01M04D08 - H03J01R03M05D12 - H03J01R05M06D09 - H02J09R04M07D01 - H02J04R05M08D01 - H01J07R02M09D21 - H03J07R04M10D22 - H04J06R06M11D24 - H01J07R03M12D25 - H02J02R04M13D26 - H03J03R04M14D29 - H01J06R05M15D04 - H05J01R02M16D10 - H01J03R03M17D08 - H04J02R05M18D11 - H05J02R04M19D12 - H04J07R05M20D13 - H01J06R06M21D13 - H01J01R06M22D07 - H05J07R06M23D14 - H04J06R03M24D05 - H02J02R02M25D06 - H04J09R03M26D01 - H04J01R01M27D11 - H03J02R01M28D13 - H02J06R03M29D30 - H02J07R04M30D16 - H01J06R04M31D07 - H01J01R04M32D17 - H04J04R05M33D17 - H05J10R06M34D11 - H02J07R02M35D05 - H03J06R05M36D17 - H04J02R02M37D03 - H03J02R06M38D10	83.33
3	H04J08R02M01D06 - H01J01R05M02D08 - H03J03R04M03D12 - H01J09R01M04D08 - H03J01R03M05D12 - H03J01R05M06D09 - H02J09R04M07D01 - H02J04R05M08D01 - H01J07R02M09D21 - H03J07R04M10D22 - H04J06R06M11D24 - H01J07R03M12D25 - H02J02R04M13D26 - H03J03R04M14D29 - H01J06R05M15D04 - H05J01R02M16D10 - H01J03R03M17D08 - H04J02R05M18D11 - H05J02R04M19D12 - H04J07R05M20D13 - H01J06R06M21D13 -	83.33

	H01J01R06M22D07 - H05J07R06M23D14 - H04J06R03M24D05 - H02J02R02M25D06 - H04J09R03M26D01 - H04J01R01M27D11 - H03J02R01M28D13 - H02J06R03M29D30 - H02J07R04M30D16 - H01J06R04M31D07 - H01J01R04M32D17 - H04J04R05M33D17 - H05J10R06M34D11 - H02J07R02M35D05 - H03J06R05M36D17 - H04J02R02M37D03 - H03J02R06M38D10	
	Crossover Result	
2	H04J08R02M01D06 - H01J01R05M02D08 - H03J03R04M03D12 - H01J09R01M04D08 - H03J01R03M05D12 - H03J01R05M06D09 - H02J09R04M07D01 - H02J04R05M08D01 - H01J07R02M09D21 - H03J07R04M10D22 - H04J06R06M11D24 - H01J07R03M12D25 - H02J02R04M13D26 - H03J03R04M14D29 - H01J06R05M15D04 - H05J01R02M16D10 - H01J03R03M17D08 - H04J02R05M18D11 - H05J02R04M19D12 - H04J07R05M20D13 - H01J06R06M21D13 - H01J01R06M22D07 - H05J07R06M23D14 - H04J06R03M24D05 - H02J02R02M25D06 - H04J09R03M26D01 - H04J01R01M27D11 - H03J02R01M28D13 - H02J06R03M29D30 - H02J07R04M30D16 - H01J06R04M31D07 - H01J01R04M32D17 - H04J04R05M33D17 - H05J10R06M34D11 - H02J07R02M35D05 - H03J06R05M36D17 - H04J02R02M37D03 - H03J02R06M38D10	83.33

3.5 Mutation

The mutation process is carried out after a new population is formed as a result of the crossover process by randomly exchanging 1 gene in the chromosome. The number of mutations depends on the specified PM value which is 0.01. The mutation steps are as follows:

a. Count total genes:

Total gene = Population size × Number of genes
= 10 × 38
= 380

b. Count the number of mutations:

Number of mutations = Total genes × MR value
= 380 × 0,01
= 3,8
= 4

The mutation process is carried out by generating random values [1-380] which will be used as the position of the genes of all genes in the population. Then look for the point of the mutation in which individual and to what gene. Furthermore, these genes are exchanged with new genes obtained randomly. After that, the fitness value is calculated again using equation (1).

The following is an example of the first mutation process with a generated random value of 85, which means that the position of the 85th gene is in the 3rd individual and the 9th gene. The gene to be mutated is H01J07R02M09D21, the gene will be replaced with a new gene that was randomly obtained, the new gene that is formed is H04J06R06M09D21. The composition of genes after undergoing a mutation process can be seen in the table below. The next mutation process is the same as the first mutation process.

Table 10. Mutation

Individual	Gene	Fitness
3	H04J08R02M01D06 - H01J01R05M02D08 - H03J03R04M03D12 - H01J09R01M04D08 - H03J01R03M05D12 - H03J01R05M06D09 - H02J09R04M07D01 - H02J04R05M08D01 - H01J07R02M09D21 - H03J07R04M10D22 - H04J06R06M11D24 - H01J07R03M12D25 - H02J02R04M13D26 - H03J03R04M14D29 - H01J06R05M15D04 - H05J01R02M16D10 - H01J03R03M17D08 - H04J02R05M18D11 - H05J02R04M19D12 - H04J07R05M20D13 - H01J06R06M21D13 - H01J01R06M22D07 - H05J07R06M23D14 - H04J06R03M24D05 - H02J02R02M25D06 - H04J09R03M26D01 - H04J01R01M27D11 - H03J02R01M28D13 - H02J08R03M29D30 - H05J10R04M30D15 - H01J01R01M31D07 - H04J07R03M32D01 - H04J09R06M33D17 - H02J10R05M34D11 - H03J06R05M35D09 - H01J07R05M36D17 - H01J08R06M37D03 - H02J01R02M38D10	55.56
	Mutation Result	
3	H04J08R02M01D06 - H01J01R05M02D08 - H03J03R04M03D12 - H01J09R01M04D08 - H03J01R03M05D12 - H03J01R05M06D09 - H02J09R04M07D01 - H02J04R05M08D01 - H04J06R06M09D21 - H03J07R04M10D22 - H04J06R06M11D24 - H01J07R03M12D25 - H02J02R04M13D26 - H03J03R04M14D29 - H01J06R05M15D04 - H05J01R02M16D10 - H01J03R03M17D08 - H04J02R05M18D11 - H05J02R04M19D12 - H04J07R05M20D13 - H01J06R06M21D13 - H01J01R06M22D07 - H05J07R06M23D14 - H04J06R03M24D05 - H02J02R02M25D06 - H04J09R03M26D01 - H04J01R01M27D11 - H03J02R01M28D13 - H02J08R03M29D30 - H05J10R04M30D15 - H01J01R01M31D07 - H04J07R03M32D01 - H04J09R06M33D17 - H02J10R05M34D11 - H03J06R05M35D09 - H01J07R05M36D17 - H01J08R06M37D03 - H02J01R02M38D10	50

After the mutation process is complete, it means that the first generation has been formed based on the processes that have been carried out. The process of finding solutions from genetic algorithms will continue for several generations until the solution being sought is found. In this study, the solution sought is that one of the chromosomes or individuals has a fitness value of 1000. Which means that the class schedule arrangement does not have an error value or there are no colliding schedules.

From the results of the first generation, it is checked whether there are individuals who have a fitness value of 1000, if there is, the genetic algorithm has found a solution, but if there is not, the population of the first-generation results will enter the next generation process, namely the selection, crossover, and mutation processes are carried out again until there are individuals with a fitness value of 1000.

4. RESULT

This study requires 88 generations of the population to get chromosomes or individuals with a fitness value of 1000.

Table 11. Best Chromosomes

Individual	Gene	Fitness
2	H02J09R01M01D06 - H04J09R04M02D18 - H03J03R05M03D12 - H02J01R06M04D07 - H03J01R03M05D12 - H03J01R05M06D09 - H05J01R03M07D19 - H02J04R05M08D01 - H01J07R02M09D21 -	1000

Individual	Gene	Fitness
	H03J07R04M10D22 - H04J06R06M11D24 - H01J07R03M12D25 - H02J02R04M13D26 - H03J03R04M14D29 - H01J09R06M15D07 - H05J01R02M16D10 - H03J08R01M17D04 - H02J08R02M18D11 - H01J01R02M19D05 - H02J08R06M20D13 - H01J06R01M21D13 - H01J01R06M22D07 - H05J07R06M23D14 - H04J06R03M24D05 - H02J01R01M25D06 - H04J09R03M26D01 - H04J03R03M27D05 - H03J02R01M28D13 - H02J06R03M29D30 - H02J07R04M30D16 - H01J06R04M31D07 - H01J01R04M32D17 - H04J04R05M33D17 - H05J10R06M34D11 - H05J08R02M35D05 - H03J06R05M36D17 - H04J02R02M37D03 - H04J09R06M38D10	

Once there are chromosomes or individuals as desired as above. Then the gene arrangement in the chromosomes is converted into course data by looking at the data in Table 1 to Table 5. Then a class schedule will be formed in 1 week. Scheduling results can be seen in the table below:

Table 12. Scheduling Results

Day	Hour	Room	Course	SKS	SMT	Lecturer
Monday	08:00 - 10:30	Apoteker 3.2	Jaringan Nirkabel dan Sistem Bergerak	3	7	Dodon Turianto Nugrahadi, S.Kom., M.Eng.
Monday	08:00 - 10:30	Lab. Komputer	Kalkulus I	3	1	Fatma Indriani, S.T., M.I.T.
Monday	08:00 - 10:30	Ibnu Sina	Algoritma dan Struktur Data	3	3	Rahmat Ramadhani, S.Kom
Monday	13:00 - 15:30	Apoteker 3.1	Rekayasa Perangkat Lunak	3	5	Rudy Herteno, S.Kom., M.Kom.
Monday	13:00 - 15:30	Ibnu Sina	Algoritma Data Mining	3	7	Fatma Indriani, S.T., M.I.T.
Monday	13:50 - 16:20	Apoteker 3.2	Ilmu Kealaman Dasar	3	1	Anang Kadarsah, S.Si., M.Si.
Monday	13:50 - 16:20	Apoteker 3.3	Kecakapan Antar Personal	3	3	Marina Dwi Mayangsari
Monday	15:30 - 17:10	Lab. Komputer	Metode Penelitian	2	5	Fatma Indriani, S.T., M.I.T.
Tuesday	08:00 - 10:30	Lab. Komputer	Teori Bahasa dan Otomata	3	5	Fatma Indriani, S.T., M.I.T.
Tuesday	08:00 - 10:30	Apoteker 3.1	Pemrograman Berbasis Objek	3	3	Radityo Adi Nugroho, S.T. M.Kom.
Tuesday	08:50 - 11:20	Ibnu Sina	Ilmu Sosial dan Budaya Dasar	3	1	Nina Budiwati
Tuesday	10:30 - 12:10	Aula Einstein	Statistika Dasar	2	3	Andi Farmadi, S.Si., M.T.
Tuesday	13:00	Apoteker	Kapita Selekta	3	5	Semua Dosen PS

	- 15:30	3.3				Ilkom
Tuesday	13:50 - 15:30	Ibnu Sina	Fisika Dasar	2	1	Dr. Ichsan Ridwan, M.Kom.
Tuesday	14:40 - 17:10	Apoteker 3.2	Kecerdasan Buatan	3	3	Triando Hamonangan Saragih, S.Kom., M.Kom.
Tuesday	14:40 - 17:10	Lab. Komputer	Proyek Perangkat Lunak	3	7	Rudy Herteno, S.Kom., M.Kom.
Tuesday	15:30 - 18:00	Apoteker 3.1	Pemrograman Dasar	3	1	Radityo Adi Nugroho, S.T. M.Kom.
Wednesday	08:00 - 09:40	Apoteker 3.3	Analisis Numerik	2	3	Ahmad Rusadi, S.Kom., M.Kom.
Wednesday	08:00 - 09:40	Aula Einstein	Pengantar Teknologi Informasi	2	1	Muhammad Itqan Mazdadi, S.Kom., M.Kom.
Wednesday	08:50 - 11:20	Apoteker 3.1	Rekayasa Web	3	7	Rudy Herteno, S.Kom., M.Kom.
Wednesday	09:40 - 12:10	Aula Einstein	Program Komputer Aplikasi	3	1	Ahmad Rusadi, S.Kom., M.Kom.
Wednesday	09:40 - 12:10	Ibnu Sina	Bahasa Indonesia	3	3	Suparti, M.Pd
Wednesday	13:00 - 15:30	Aula Einstein	Pengenalan Pola dan Analisis Citra	3	7	Rahmat Ramadhani, S.Kom
Wednesday	13:50 - 15:30	Ibnu Sina	Pendidikan Agama	2	1	Awad
Wednesday	14:40 - 17:10	Apoteker 3.1	SIstem Informasi	3	5	Muliadi, S.Kom., M.Cs.
Thursday	08:50 - 11:20	Apoteker 3.2	Strategi Bisnis Informasi	3	7	Irwan Budiman, S.T., M.Kom.
Thursday	09:40 - 12:10	Apoteker 3.3	Pengantar Ilmu Komputer	3	1	Dodon Turianto Nugrahadi, S.Kom., M.Eng.
Thursday	10:30 - 12:10	Aula Einstein	Pemrograman Web	2	5	Rahmat Ramadhani, S.Kom
Thursday	13:00 - 14:40	Lab. Komputer	Kewirausahaan	2	5	Susi Apriana, M.Si.
Thursday	13:00 - 14:40	Apoteker 3.3	Interaksi Manusia dan Komputer	2	3	Dodon Turianto Nugrahadi, S.Kom., M.Eng.
Thursday	15:30 -	Ibnu Sina	Aljabar Linier	3	1	Saman Abdurrhaman, S.Si.,

	18:00					M.Si.
Thursday	15:30 - 18:00	Apoteker 3.3	Sistem Pakar	3	7	Andi Farmadi, S.Si., M.T.
Thursday	15:30 - 18:00	Lab. Komputer	Pemrograman Visual	3	3	Friska Abadi, S.Kom., M.Kom.
Friday	08:00 - 10:30	Apoteker 3.3	Matematika Diskrit	3	1	M. Ashar Karim, S.Si., M.Si.
Friday	08:00 - 11:20	Apoteker 3.2	Sistem Basis Data	4	3	Friska Abadi, S.Kom., M.Kom.
Friday	13:50 - 15:30	Lab. Komputer	Etika Profesi	2	7	Heru Kartika Candra
Friday	14:40 - 16:20	Apoteker 3.2	Jaringan Komputer	2	5	Dodon Turianto Nugrahadi, S.Kom., M.Eng.
Friday	16:20 - 18:00	Lab. Komputer	Sistem Operasi	2	3	Triando Hamonangan Saragih, S.Kom., M.Kom.

5. CONCLUSION

In this study, the Genetic Algorithm with Tournament Selection was carried out with the input of the control parameters, namely Population Size = 10, Crossover Rate (CR) = 0.75, and Mutation Rate (MR) = 0.01. In this case, the Genetic Algorithm has succeeded in obtaining the desired solution in the 88th generation, namely scheduling courses where there are no schedule conflicts between one course and another.

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