

# SCHEDULING USING GENETIC ALGORITHM AND ROULETTE WHEEL SELECTION METHOD CONSIDERING LECTURER TIME

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**Abstract**—Scheduling lectures is not something easy, considering many factors that must be considered. The factors that must be considered are the courses that will be held, the space available, the lecturers, the suitability of the credits with the duration of courses, the availability of lecturers' time, and so on. One algorithm in the field of computer science that can be used in lecture scheduling automation is Genetic Algorithms. Genetic Algorithms can provide the best solution from several solutions in handling scheduling problems and the selksi method used is roulette wheel. This study produces a scheduling system that can work automatically or independently which can produce optimal lecture schedules by applying Genetic Algorithms. Based on the results of testing, the resulting system can schedule lectures correctly and consider the time of lecturers. In this study, the roulette wheel selection method was more effective in producing the best individuals than the rank selection method.

**Keywords:** Scheduling; Genetic algorithms; Roulette wheel

## I. INTRODUCTION

The scheduling process involves lecture, lecturers, time and day slots, and lecture rooms. In addition to these factors, in the scheduling of lectures it is also necessary to pay attention to the suitability between course credits with the length of lecture time and the availability of lecturers' time in teaching. Space management or in this case is scheduling education institutions more difficult compared to other institutions. Therefore the management of space and facilities in an organization is important and must be handled efficiently [1].

In a previous study conducted by [2], the factors that have been written into consideration in the process of making a class schedule. The application generated from the study scheduling lectures automatically and producing class schedules according to the factors under consideration. However, the resulting schedule has not been efficient from the lecturer side because it cannot make time requests. This certainly makes the lecturer a difficulty, especially lecturers who have positions, given the lecturers' busy life in addition to teaching time. The conclusions from the study also showed that the selection method used was ineffective which resulted in repeated scheduling processes. On this basis, the authors conducted research scheduling lecture by considering the lecturer time and making improvements to the selection method.

In this study, the authors used Genetic Algorithms. This is

based on [3] which states that Genetic Algorithms have good resistance, not only can solve scheduling problems but also can provide satisfactory results. According to [3], Genetic Algorithms have speed in carrying out calculations.

Regarding efficiency issues in scheduling, several researchers have conducted research using Genetic Algorithms. Kurniawan et al. [4] used Genetic Algorithms in scheduling the use of parallel machines to minimize costs, one of which was electricity costs. The resulting schedule was improved by a mechanism of work delays that shifted work to other periods to avoid high electricity costs. The same is done by [5], which uses Genetic Algorithms to perform parallel machine scheduling with the aim of optimizing energy consumption in iron and steel mills. The same was done by [6], where in his research applied Genetic Algorithms to solve the problem of scheduling bus vehicles in urban areas.

In this study a selection method using roulette wheel was used. This is based on research conducted by [4] which is able to produce individuals or solutions to parallel machine scheduling with electricity cost efficiency. The roulette wheel method can retain individuals or the best solution when selecting from several solutions.

## II. METHOD

The system built in this study consisted of 2 parts of the scheduling process, namely scheduling the theoretical subjects and scheduling the lab lecture. The first step is to schedule a theoretical lecture and then proceed with scheduling the lab lecture. The description of the system, shown in Figure 1. Separation of the scheduling process of the theoretical and lab lecture is done to get the student's schedule in the lab course which is not collision with the theoretical class schedule. Before conducting the scheduling process, first the data collection process or inputting the data needed in the lecture scheduling process, where this has been discussed in previous research. The last part of the system design is Output. After the scheduling process is done, the best schedule generated from the Genetic Algorithm is stored in the database. The best schedules stored on the database can be displayed on the monitor screen.

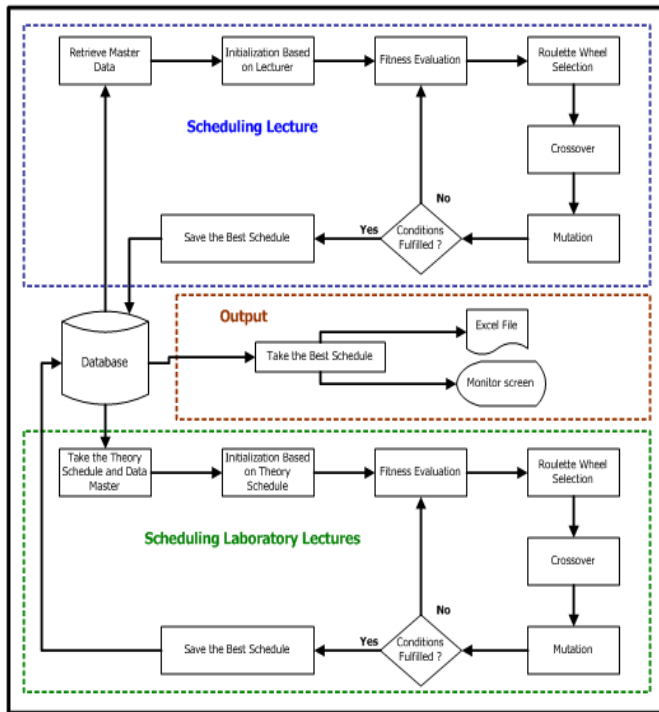


Fig. 1. Flow of lecture scheduling system

The process of scheduling lectures on the system built consists of several processes, namely: data retrieval process, initialization process, fitness value evaluation process, selection process based on fitness value, crossover process, mutation process, and the last is storing scheduling results in the database. To get the fitness value used equation (1).

$$fitness(i) = \frac{1}{1+no\_collisions} \quad (1)$$

After the fitness value is obtained for each individual, then the next is the selection process using the Roulette Wheel Selection method. For example, suppose that in one population there are 5 individuals with each having a fitness value of  $f(1) = 0.4$ ,  $f(2) = 0.1$ ,  $f(3) = 0.16$ ,  $f(4) = 0.6$ , and  $f(5) = 0.5$ , so the total fitness value is 1.76.

Individual probabilities obtained  $p[1] = 0.23$ ,  $p[2] = 0.057$ ,  $p[3] = 0.091$ ,  $p[4] = 0.34$ , and  $p[5] = 0.28$ . Next is to generate random numbers  $[0,1]$  to get individuals as parents in the next generation. Large probability values have a great opportunity to be chosen as the parent of the next generation. An overview of the opportunities of each individual is shown in Figure 2.

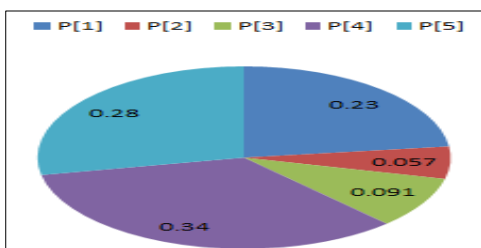


Fig. 2. Opportunities for each individual  
For example random numbers generated are 0.81, 0.32, 0.01,

0.42 and 0.65. based on random values generated, the selected individuals are individuals 5, 3, 1, 4, and individuals 4. Illustrations of determining individuals based on random values are shown in Figure 3.

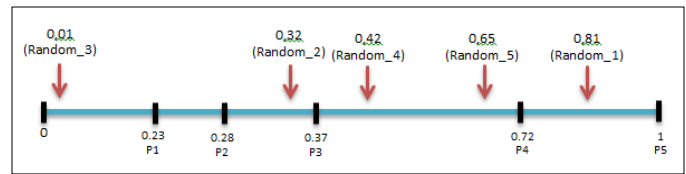


Fig. 3. Illustration of individual selection

### III. RESULT AND DISCUSSION

Testing of Genetic Algorithms in the lecture scheduling system is done with 2 approaches. The approach in question is testing of the results of scheduling by paying attention to the lecturer, and the second is testing from the side of the selection method used.

To streamline the lecture process, departments will usually ask lecturers, especially lecturers who have busy activities such as lecturers who have positions or are placed in certain units / institutions to determine the days and hours that are not used for teaching. In the system created, the menu / interface for the availability of lecturers' time and choosing the name of the lecturer and unwanted days and hours are provided. For example, a lecturer named Herman could not teach on Thursday and Tuesday from 10 to 12:00. Figure 4 shows the scheduling results that did not provide teaching schedules to Herman's lecturers on Thursday and Tuesday at 10 to 12.

Hari	Sesi	Jam Kuliah	Matakuliah	SKS	Semester	Kelas	Dosen	Ruang	Action
Jumat	(1-3)	07:00-09:30	Struktur Data	3	2	A6	Herman,S,Kom,M,Cs	U-3.01	<input type="checkbox"/>
Jumat	(2-3)	07:50-09:30	Pemrograman Terstruktur	2	4	A6	Ramdan Satra,S,Kom,M,Kom	U-3.03	<input type="checkbox"/>
Kamis	(4-5)	09:40-11:20	Praktikum Pem. Java Lanjut	2	6	A1	Ramdan Satra,S,Kom,M,Kom	LAB 2	<input type="checkbox"/>
Kamis	(1-3)	07:00-09:30	Struktur Data	3	2	A5	Herman,S,Kom,M,Cs	U-3.01	<input type="checkbox"/>
Kamis	(2-3)	07:50-09:30	Praktikum Jaringan Komputer	2	4	A4	Irawati,S,Kom,MT	LAB 2	<input type="checkbox"/>
Kamis	(7-8)	14:40-16:30	Pemrograman Terstruktur	2	4	A1	Ramdan Satra,S,Kom,M,Kom	U-3.02	<input type="checkbox"/>
Kamis	(7-8)	14:40-17:20	Struktur Data	3	2	A3	Herman,S,Kom,M,Cs	U-3.03	<input type="checkbox"/>
Kamis	(8-9)	15:40-17:20	Praktikum Jaringan Komputer	2	4	A2	Irawati,S,Kom,MT	LAB 1	<input type="checkbox"/>
Rabu	(9-10)	16:30-18:10	Basis Data I	2	2	A2	Herman,S,Kom,M,Cs	U-3.02	<input type="checkbox"/>
Rabu	(5-6)	10:30-14:40	Praktikum Pem. Java Lanjut	2	6	A3	Ramdan Satra,S,Kom,M,Kom	LAB 2	<input type="checkbox"/>

Fig. 4. Schedule results for Thursday

Figure 5 displays the results of Tuesday's scheduling. The schedule also displays the schedule of Herman's lecturers not seen Tuesday at 10 to 12

When looking at Figures 4 and 5, it can be seen that the scheduling process immediately schedules the theoretical courses and practical subjects. This gives a good impact on student class schedules because usually in the Department, the scheduling of theory and practicum lecture is carried out separately which results in a schedule of theoretical and practical collisions and this can harm students..

Hari	Sesi	Jam Kuliah	Matakuliah	SKS	Semester	Kelas	Dosen	Ruang	Action
Rabu	(6-7)	13:00-15:30	Praktikum Jaringan Komputer	2	4	A5	Iravati,S,Kom_MJT	LAB 1	
Rabu	(7-8)	14:40-16:30	Pemrograman Terstruktur	2	4	A2	Ramdan Satra,S,Kom_M,Kom	U-3.02	
Selasa	(1-3)	07:00-09:30	Struktur Data	3	2	A1	Herman,S,Kom_M,Cs	U-3.02	
Selasa	(9-10)	16:30-18:10	Basis Data I	2	2	A1	Herman,S,Kom_M,Cs	U-3.02	
Selasa	(2-3)	07:50-09:30	Praktikum Jaringan Komputer	2	4	A1	Iravati,S,Kom_MJT	LAB 1	
Selasa	(6-8)	13:00-16:30	Struktur Data	3	2	A7	Herman,S,Kom_M,Cs	U-3.03	
Selasa	(4-5)	09:40-11:20	Praktikum Jaringan Komputer	2	4	A3	Iravati,S,Kom_MJT	LAB 1	
Selasa	(8-9)	15:40-17:20	Praktikum Jaringan Komputer	2	4	A6	Iravati,S,Kom_MJT	LAB 1	
Selasa	(4-5)	09:40-11:20	Pemrograman Terstruktur	2	4	A3	Ramdan Satra,S,Kom_M,Kom	U-3.03	
Selasa	(9-10)	16:30-18:10	Pemrograman Terstruktur	2	4	A7	Ramdan Satra,S,Kom_M,Kom	U-3.03	

Fig. 5 Schedule results for Tuesday

Often also happens is a collision between class schedules with thesis exam schedule. This will make the lecturers choose between teaching and testing and most lecturers prefer to test. The incident was more or less detrimental to lecturers and students. In the research object it was determined that the schedule of student thesis examinations on Friday and Saturday. Therefore the lecturer is not scheduled to teach on that day. To answer this, a system is provided to disable the day on the system. For example in this case, first on the system select the menu / day interface and select the day to deactivate.

Figure 6 displays the scheduling results that do not include Friday and Saturday. Scheduling results only schedule lectures until Thursday.

Hari	Sesi	Jam Kuliah	Matakuliah	SKS	Semester	Kelas	Dosen	Ruang	Action
Kamis	(1-2)	07:00-08:40	Praktikum Jaringan Komputer	2	4	A4	Iravati,S,Kom_MJT	LAB 1	
Kamis	(9-10)	16:30-18:10	Praktikum Jaringan Komputer	2	4	A5	Iravati,S,Kom_MJT	LAB 1	
Kamis	(7-8)	14:40-17:20	Struktur Data	3	2	A2	Herman,S,Kom_M,Cs	U-3.02	
Kamis	(1-3)	07:00-09:30	Struktur Data	3	2	A7	Herman,S,Kom_M,Cs	U-3.01	
Kamis	(5-6)	10:30-14:40	Praktikum Jaringan Komputer	2	4	A3	Iravati,S,Kom_MJT	LAB 2	
Kamis	(8-9)	15:40-17:20	Pemrograman Terstruktur	2	4	A3	Ramdan Satra,S,Kom_M,Kom	U-3.03	
Kamis	(1-2)	07:00-08:40	Pemrograman Terstruktur	2	4	A7	Ramdan Satra,S,Kom_M,Kom	U-3.03	
Rabu	(2-4)	07:50-10:30	Struktur Data	3	2	A1	Herman,S,Kom_M,Cs	U-3.02	
Rabu	(9-10)	16:30-18:10	Basis Data I	2	2	A1	Herman,S,Kom_M,Cs	U-3.01	
Rabu	(5-7)	10:30-15:30	Struktur Data	3	2	A3	Herman,S,Kom_M,Cs	U-3.03	

Fig. 6. Scheduling results without Friday and Saturday

In the previous study, the selection process used the rank selection method, while this study used the roulette wheel method. This test aims to measure the effectiveness of the roulette wheel method compared to the method previously used.

For example there are 10 individuals and each has got a fitness score. Table I shows the fitness values of each individual.

TABLE I  
The fitness value of each individual

Individual	Fitness Value
1	0.2
2	0.5
3	0.5
4	0.2

5	0.5
6	0.166
7	0.25
8	0.333
9	0.2
10	0.5
<b>Sum <math>f(i)</math></b>	<b>3.349</b>

By using the selection selection method, the individuals in Table I are sorted or ranked based on the highest fitness value. Next is to generate random values and determine the individuals selected for the next generation. Based on the process of calculation and generation of random values, the individuals selected are individuals 8th, 2th, 10th, 10th, 10th, 7th, 8th, 1st, 8th, and 2nd.

Next, testing is done using the roulette wheel selection method with the same data. Based on Table I, the total fitness value is 3.349. The next step is to find the probability value of each individual. Table II shows the probability values of each individual.

TABLE II  
Fitness value and probability of each individual

Individual	Fitness Value	Probability Value
1	0.2	0.059
2	0.5	0.149
3	0.5	0.149
4	0.2	0.059
5	0.5	0.149
6	0.166	0.049
7	0.25	0.075
8	0.333	0.099
9	0.2	0.059
10	0.5	0.149
<b>Sum <math>f(i)</math></b>	<b>3.349</b>	

Then generate a random value [0-1]. Based on the experiment, 10 random values appeared, namely: 0.23, 0.65, 0.82, 0.45, 0.91, 0.32, 0.54, 0.71, 0.22, and 0.43. In Figure 7 an illustration of parent selection is based on probability values and random values generated. Based on Figure 7, the selected individuals are individuals 3rd, 7th, 9th, 5th, 10th, 3rd, 5th, 8th, 3rd, and 5th.

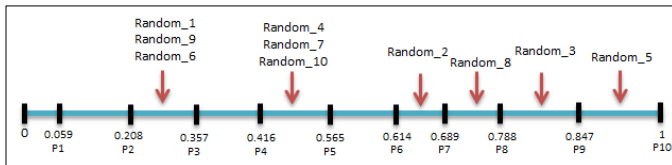


Fig. 7. Selection illustrations based on random values and probabilities

Based on the results of testing of the roulette wheel selection method, it can be seen that this method can maintain the best individuals compared to the selection method used previously. This can be seen from more selected individuals who have the highest fitness value.

#### IV. CONCLUSION

The lecture scheduling system using Genetic Algorithms can solve problems when teaching lecturers. Based on the test results, the method of selecting Roulette Wheels is more effectively used in this study compared to the ranking method.

#### V. ACKNOWLEDGMENT

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