Scheduling Regular Classrooms using Heuristic Genetic and Tabu Search Algorithms

N F Fauziah* and Y H Putra
Department of Magister Information System, Universitas Komputer Indonesia, Indonesia

*nfildafauziah@gmail.com

Abstract. The purpose of this study was to scheduling regular classrooms using heuristic genetic and tabu search algorithm. Scheduling in the university environment is very important, as it pertains to the number of students, limited spaces, lecturer limited, as well as the time available. With all these parameters should get the best solution in terms of timetable by observing any limitations. Heuristic algorithms of optimization strategy is one that can be used in a search schedule. In practice heuristic algorithms in scheduling using genetic algorithm and tabu search. Genetic engineering is used to find the value of a high probability, while tabu search to optimize the number of searches and maintaining the high value that is already generated. The results of this research, namely scheduling using genetic and tabu search algorithm for schedule a number of students who are scheduled, as well as a fitness value with a high number of iterations that bit, so make scheduling with quality better and less time.

1. Introduction
Scheduling at the university is a very complex problem in terms of setting the room into a certain time [1]. Existing scheduling in general are still manual, which gives rise to difficulties in complexity and a long time [2]. Genetic algorithm is a heuristic algorithms that can solve problem tasks [3]. Tabu search is a meta heuristic approach to explore local solutions optimally every [4]. Tabu search method has become popular for the ability of providing solutions that are very close to optimally [5].

Research using genetic algorithm and tabu search have a lot done to optimize the scheduling of which Alberto colorni et all conducted research using genetic algorithms to solve the problems of scheduling, the genetic algorithms that produce was able to produce a better schedule but with the number of steps that are more [6]. Tanzila Islam et al using tabu search for scheduling the university produces a shorter scheduling solutions [5].

Then, from that problem at this research aims to produce design scheduling can schedule good and less time by combining heuristic algorithms, namely genetic algorithm and tabu search.

2. Method
On the stage of scheduling is done, will use three types of scheduling heuristic algorithm i.e. genetic algorithms, tabu search, and combine genetic algorithms with tabu search.
2.1. Genetic algorithm
Genetic algorithm is a computational approach to solving problems that are modelled as a process of evolutionary biology [7]. Genetic algorithm is a method of problem solving based on an abstraction of the process of natural selection [8]. Genetic algorithms in general consists of three operations namely reproduction, crossover, and mutation [11].

2.2. Tabu search algorithm
Tabu search algorithm [10, 12] is an evolutionary heuristic solution that improve a single solution. It starts from a random solution and sequentially move it to one of its neighbors [9].

2.3. Genetic – Tabu search algorithm
To get optimum results in scheduling, that is complement any flaws that exist on each of the methods in a manner mutually complementing each other to get the best scheduling with the amount of time a little then required the incorporation of both methods of genetic algorithm and tabu search. In combining these two methods can be seen in Figure 1.

In the process of merging genetic algorithm and tabu search as shown Figure 1, there are some steps that are done that is by doing an initial population of initialization. After that is done the process evaluation finds a match with determining the value of fitness. If the value of proper fitness, it will produce a good scheduling, but if its value has yet to be fulfilled, then will be the next best choice process and parent process followed by the crossover and mutation. After the initial process by genetic algorithm is complete, it will be done the fitness value checks back to ensure that value remains the best. If the value of fitness are met, then procedure a good scheduling, but if it doesn’t meet it will be done the process using tabu search algorithms.

The process of with tabu search this is a process of benchmarking between solutions already stored on the tabu with unfinished scheduling solution. All the scheduling solution, formed by the genetic algorithm comparison will be made, if the scheduling solution already exists in the list of tabu then the
solution will not be evaluated again or miss. But, if the scheduling solutions have not registered then will be evaluated with use restrictions and overall value. Tabu search is used to maintain a good fitness value with a small number of iterations.

The process of the use of the algorithm of combined measurement will be done against some of the value of the resulting fitness against a number of students, the number of lecturers, the amount of teaching, as well as the amount of availability. In addition to the value of fitness will also be done number of iterations that are generated by the combined use of the method of genetic algorithm and tabu search.

3. Results and discussion
At the previous stages of the testers have tested the influence of the number of students, the number of lecturers, the number of hours of teaching, as well as the number of rooms of fitness is produced. In addition, the test will be performed also the parameters against a number of iterations were produced.

3.1. The number of students against the value of fitness
On the stage of an experiment to test the fitness value resulting from changes in the number of students with Figure 2.

![Figure 2](image)

**Figure 2.** Influence number students against value fitness.

Figure 2 describes the influence of the number of students towards fitness. The higher the number of students the value of fitness is getting down.

3.2. The number of lecturer of fitness
On the stage of an experiment to test the fitness value resulting from changes in the number of lecturers with Figure 3.

![Figure 3](image)

**Figure 3.** Influence number teacher against value fitness.
Figure 3 shows the higher number of lecturers thus, higher fitness value or the better.

3.3. Number of room against the value fitness
On the stage of an experiment to test the fitness value resulting from changes in the number of lecturers with Figure 4.

![Figure 4. Influence number room against value fitness.](image)

Figure 4 shows the influence of the number of rooms affects the fitness value. The higher the number, the value of the resulting higher fitness.

3.4. The number of students against the number of iterations required
On the stage of an experiment to test the number of iterations that resulted from changes in the number of students with a table 1.

| Amount students | Fitness Value | Iteration |
|-----------------|---------------|-----------|
| 2400            | 1             | 180       |
| 4600            | 1             | 238       |
| 6200            | 0.8           | 267       |
| 7400            | 0.7           | 292       |

Table 1 shows that the number of students in the higher value besides affect fitness also influences the number of iterations performed. The higher the number of college students increasingly need many iterations.

3.5. The number of lecturers against the number of iterations required at the stage of an experiment to test the number of iterations that resulted from changes in the number of lecturers with a table 2

| Amount of Lecturer | Nilai Fitness | Iteration |
|--------------------|---------------|-----------|
| 45                 | 1             | 130       |
| 43                 | 1             | 148       |
| 41                 | 0.9           | 167       |
| 39                 | 0.9           | 188       |
| 37                 | 0.8           | 196       |
Table 2 shows that, the higher the number of lecturers in addition to affecting the fitness value also affects the number of iterations performed. The higher the number of lecturers are increasingly in need of a bit of iteration.

3.6. The number of the room against the number of iterations required
On the stage of an experiment to test the number of iterations that resulted from changes in the number of a room with a table 3.

| Amount of Room | Fitness value | Iteration |
|----------------|---------------|-----------|
| 30             | 1             | 110       |
| 27             | 1             | 142       |
| 24             | 0.8           | 167       |
| 21             | 0.7           | 174       |
| 18             | 0.7           | 195       |
| 15             | 0.6           | 215       |

Table 3 shows that, the amount of room that the higher value besides affect fitness also influences the number of iterations performed. The higher the number of indoor growing requires a bit of iteration.

4. Conclusion
From the results obtained can be drawn the conclusion that, the number of students, lecturers, and the room can affect the value of fitness is produced. The number of students increased fitness value can result in a decreased, but the greater number of lecturers then become high fitness value, and the more room there is the value the higher fitness. If the value of the higher fitness, then scheduling the better.

Acknowledgements
We acknowledged UNIKOM for supporting and funding this study.

References
[1] Aladağ Ç H and Hocaoğlu G 2007 “A tabu search algorithm to solve a course timetabling problem,” Hacettepe journal of mathematics and statistics 36 (1) 210-219.
[2] Dagade R V, Hassan S S, Devhare P, Khilari S and Sarda S “Timetable Scheduling Using Genetic Algorithm”.
[3] Lukas S, Aribowo A and Muchri M 2012 “Solving timetable problem by genetic algorithm and heuristic search case study: universitas pelita harapan timetable,” In Real-World Applications of Genetic Algorithms. InTech.
[4] Glover F, Kelly J P and Laguna M 1995 “Genetic algorithms and tabu search: hybrids for optimization,” Computers & Operations Research 22 (1) 111-134.
[5] Islam T, Shahriar Z, Perves M A and Hasan M 2016 “University Timetable Generator Using Tabu Search,” Journal of Computer and Communications 4 (16) 28.
[6] Colorni A, Dorigo M and Maniezzo V 1992 “A genetic algorithm to solve the timetable problem,” Politecnico di Milano, Milan, Italy TR, 90-060.
[7] Wilkinson B and Allen M 1999 Parallel programming.
[8] Ansari A and Bojewar S 2014 “Genetic Algorithm to Generate the Automatic Time-Table–An Over View,” International Journal of Recent and Innovation Trends in Computing and Communication 2 (11) 3480-3483.
[9] Sonawane M P A and Ragha L 2014 “Hybrid Genetic Algorithm and TABU Search Algorithm to Solve Class Time Table Scheduling Problem,” *International Journal of Research Studies in Computer Science and Engineering* 1 (4) 19-26.

[10] Adamuthe A C and Bichkar R S 2012 “Tabu search for solving personnel scheduling problem,” In *Communication, Information & Computing Technology (ICCICT), 2012 International Conference on* (pp. 1-6). IEEE.

[11] Sivanandam S N and Deepa S N 2008 *Introduction to Genetic Algorithms* (Springer Berlin Heidelberg New York).

[12] Gen M and Cheng R 2000 *Genetic algorithms and engineering optimization* (John Wiley & Sons).