Genetic algorithm for optimization of lecturer schedule preparation

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Abstract. Scheduling has an important role in the management of a college where scheduling problems including complex problems become an important part of its operations. The core of the course scheduling is scheduling a number of components which consist of classes, courses, faculty, space and time with a number of restrictions and certain conditions. Lecturer scheduling courses that had been running at Sekolah Tinggi Teknologi Dumai made by the chairman and secretary of study program courses at the beginning of each semester manually and randomly take a lot of time and resources. This resulted in lectures at the beginning of the semester is less effective because they have to reschedule with the circumstances and needs of the campus. Therefore, we need a form of scheduling system subjects where the system can be structured to help draw up a schedule of courses based determinants and space existing populations, and enable change schedule that is more dynamic, faster by taking into account determinants of the same and can give you an idea the complexity of the load of the problem of the availability of resources in each subject. To simplify the process of scheduling the distribution and manufacture of lecturer of the course and prevent the collision between the scheduling of courses, faculty, space and time that is needed a method that can be used to solve scheduling problems, namely with Meta-heuristic approach. One that includes Meta-heuristic namely genetic algorithms. Enable change schedule that is more dynamic, faster with the same attention to the deciding factor and can give you an idea of the complexity of the problems burden the availability of resources in each subject.

1. Introduction
Lecturer is an important support in higher education that implement Tridharma high workload of at least twelve (12) credits and a maximum of 16 (sixteen) credits. Course scheduling a regular activity in the academic system in Higher Education has always done in the face of the new semester and has an important role in the management of higher education institutions in which the problem of scheduling including complex problems become an important part of its operations. The purpose of scheduling is to optimize one or more goals. All this time, course scheduling arrangements that have been running at STT Dumai conducted randomly by day and session by the chairman and secretary of each study program at the beginning of each semester that takes a lot of time and resources. This resulted in lectures at the beginning of the semester is less effective because they have to reschedule with the circumstances and needs of the campus. Therefore, we need a form of courses scheduling system where the system can be structured to help draw up a schedule of courses based determinants and populations existing space, enabling a more dynamic schedule changes, fast with the same attention to the deciding factor and can give you a load of the complexity of the problems of the availability of existing resources. One method that can be used to solve scheduling problems, namely
with Meta-heuristic Approach. Meta-heuristic is the approach that is based on a heuristic method is a method for finding a solution to the computational approach that combines the interaction between search procedure of local and strategies higher to create a process that is able to get out of the local spots optimum and do a search room solution to find a solution global manner iteratively try to improve the candidate preferred solution.[1] In addition, the genetic algorithm is the right choice for scheduling optimization. Jobshop scheduling problem automatically generate schedules based on the input matrix are adjusted. So that the work can be equitable burden sharing well.[2] Genetic algorithms can be used to solve problems that do not have a settlement procedure with the right formula, or if there is a formula, it still takes a long time to solve, these problems usually are very diverse and complex. An optimal algorithm, in the worst case, may a make an exhaustive search that is computationally intractable. In order to the make the algorithm computationally tractable even in the worst case, a heuristic approach is better. The use of genetic algorithms as an Appropriate properties tool for optimizing the lecture's schedule.[3]

2. Genetic Algorithm

Basically, Genetic Algorithms are computer programs that simulate the process of evolution, by producing the chromosomes of each population randomly and allow those chromosomes reproduce in accordance with the laws of evolution that might be expected to produce prime or better chromosome. This chromosome represents a solution of the issues raised, so that when the good chromosome is generated, it is expected that a good solution to these problems are also obtained.[4] There are five main components of the settlement of the problem by using a genetic algorithm, namely:

a. Encoding Technique
   Encoding techniques include encoding gene from chromosome. Genes are part of the chromosome. One single gene will typically represent one variable. Genes can be represented in the form of: a string of bits, a tree, array of real numbers, rule, permutation elements, program elements, or other representation that can be implemented for genetic operators.

b. Initialization Population
   The population size depends on the problem to be solved and the type of genetic operators that will be implemented. Once the population size is determined, then have to do the initialization of the chromosomes present in the population. Initialization is done randomly by taking into account solutions and constraint domain is used. Built the initial population randomly generated, whereas the next population is the result of the evolution of chromosomes through iteration is called a generation. A process which produces a number of individuals at random (random). The number of the population depends on the problem to be solved and the type of genetic operators to be applied. After the number of population is determined, then do the initialization of the chromosome that is within the population.[5]

c. Selection Function
   In every generation, the chromosomes will go through an evaluation process using a measuring instrument called a fitness function. The fitness function may be a mathematical function or other functions who want to see the problem resolved. Selection aims to provide a greater opportunity for the reproduction of the most fit members of the population. Fitness value of a chromosome will show the quality of the chromosomes of the population.

d. Operator Genetics
   Genetic algorithm is a heuristic search process and the selection of random so that the emphasis operators are used to determine the success of genetic algorithms in finding the optimum solution a given problem. The thing to note is to avoid the occurrence of premature convergence, reaching the optimum solution is not yet time, in the sense that the obtained solution is a local optimum results. There are two types of carriers used in the genetic algorithm, namely the operator to perform recombination and mutation operators.

e. Parameter Determination
   Determining parameter in question is a genetic algorithm control parameters are opportunities crossover and mutation. This parameter value is determined based on the problems to be solved.[6]
3. Preparation Schedule

According to Leon Bambrick actual scheduling is scheduling that adapts to a number of constraints. There are two limitations in the preparation of the proposed scheduling lectures, namely: hard constraint (to be fulfilled) and soft constraints (attempted to be fulfilled). Hard constraints are limits that should be applied to scheduling courses and must be met. A solution can only be valid if in such solutions is absolutely no hard constraint is violated.[7] In this case, there are some restrictions that were made in the preparatory process of scheduling, whereby if the limits are violated, will get a penalty associated with the value of fitness. Such limits are:

- A professor can only teach courses at one location at a specific time.
- Active day for the lecture is Monday through Saturday for class in the morning (8:00 to 13:00)
- Active day for the lecture is Monday through Friday for grades afternoon (16:30 to 21:30)
- One credit per Subjects allocated for 50 minutes.
- Lecturers The same cannot teach different subjects at the same time
- Lecturers can request a particular desired time teaching origins do not interfere with the other schedules.
- Placement schedule for the time that has been requested lecturer tailored to the priorities of lecturers.

4. Discussion

The data used to compile the data that lecturers teaching schedule consisting of courses, class, room, faculty and the number of credits. The next step to form chromosomes are represented by an object or an array containing multiple data related to the preparation of the schedule. The framework of the preparatory process scheduling faculty can be seen in Figure 1.

![Figure 1. Framework](image)

- **A. Representation Chromosomes**
  
  Chromosome representation yang formed based on input variables consisting of courses, lecturer, room, day, time, class and number of credits. Each gene consists of six types of the input variables used as an object. Furthermore, each gene is represented by a number. Initial population randomly generated from a number of individuals.

- **B. Fitness Evaluation**
  
  At this stage of the evaluation process of the evaluation on the data chromosome fitness value is used. Fitness value is a measure of whether or not a solution is expressed as an individual, or in other words...
the value of fitness declare the value of the objective function. In this study, the fitness value is
determined by the formula:

\[ F = \frac{1}{\sum Penalty} \]

Where is the explanation of the formula

\[ F = \text{Function Fitness} \]
\[ Penalty = \text{Violations committed} \]

C. Selection
In this selection phase of selecting individuals to be selected for the crossover and mutation. The
selection process is aimed at obtaining a good parent candidate. A good parent will produce good
offspring. Fitness value is what will be used as the initial population in the next generation. The initial
step in the selection process are looking for fitness. Every individual who has calculated the value of
fitness, fitness values will be used for the selection next phase.

D. Crossover
Crossover process performed by to rend chromosomes into two types. The first type of gene in the
form of course object with credits totaling 2 and the other type is a gene in the form of course object
with 3 credits. After separating the two types of genes, the crossover process to be done is to exchange
the gene position of the same type with random lines the gene. Furthermore, the results of crossover
generates new individuals without violating the restrictions that have been made.

E. Mutation
Mutations automatically carrie d out during the formation process prior to the parental chromosomes
crossover mutation type used in this study were swapping mutation. This mutation is done by
exchanging one or more of the value of a gene in a chromosome. The number of chromosomes that
have mutations in a population is determined by the parameters of mutation rate (Pm). This process is
done by replacing the gene values selected at random by a new value obtained is also randomized.

5. Implementation
Implementation lecturer scheduling using genetic algorithm is changeable corresponding scheduling
periods and subjects that opened or used. Therefore, the application must be run with the input of data
subjects that vary according to the needs. Here, in the scheduling data show the course for the
academic year of 2017-2018 semester on informatics engineering study programs on campus STT
Dumai. Next on the menu is available day and time schedule of the lectures are available on campus in
accordance with its provisions. Lectures to the morning class is scheduled from Monday to Saturday
from 08:00 until 13:00. As for college afternoon classes are scheduled every day from Monday to
Friday with a time of 16:30 to 21:30. Next on the menu is composed of a data lecturers lecturers who
will teach the courses that have been determined by the study program. Then there is a menu of
courses tailored to the needs of the semester will be implemented. Furthermore, too many classroom
subjects and spaces reserved for the implementation of the course.
In the process of preparing a schedule using a genetic algorithm, we must first determine the academic year, semester, the initial population size, the number of generations and the mutation rate. Then we choose generated for the process. Furthermore, a schedule of lecturers teaching in figure 3.

6. Conclusion
Based on the results of the implementation and testing in the application of genetic algorithm for scheduling preparatory faculty, it can be concluded that the use of genetic algorithms in the preparation of highly optimized scheduling lecturer helping STT courses Dumai in scheduling lecturers without conflicting with the room, classroom, or time. This is very effective scheduling application used to produce a schedule that is distributed with good lecturers.

These applications can be developed to resolve the problems of other scheduling by using kinds of different crossover and mutation. The data used can be propagated and testing processes carried out in order to be more varied in order to obtain better results.

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