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Course Scheduling Information System Using Genetic Algorithms

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ABSTRACT

University X is a private university which has 8 faculties, namely Economics, Engineering, Social Sciences, Faculty of Social and Political Sciences, Fikes, Law, Islam and Vocational Studies. One of the leading study programs at the University X is the Informatics Engineering Study Program at the Faculty of Engineering which is currently experiencing problems when the process of dividing space and hour schedules is still manual. The problems that arise include the accumulation of lecture hours for a lecturer who takes more than one course. Another problem is the disruption of the lecture process at the beginning of the semester due to the tentative scheduling system. The preparation of lecture schedules at the Faculty of Engineering, University X is still done semi-manually using Microsoft Excel, so it will take several days to make a schedule. Meanwhile, making a schedule must be done quickly and optimally because it is used for lecture activities, the solution that can overcome the above problems is by creating a Course Scheduling Information System Using Genetic Algorithms.

The genetic algorithm is one of the most appropriate algorithms used in solving complex optimization problems, which are difficult to do with conventional methods. The nature of genetic algorithms is looking for possibilities from potential solutions to get the optimal for solving problems. The scope of all viable solutions, i.e. the objects between matching solutions, is called the search space. Each point in the search space represents a viable solution.

The limitations of the built problem are: This system is operated by the administrative staff of the study program at the Faculty of Engineering, University X. This system is made using the Codeigniter framework, Responsive Bootstrapping (display) and MySQL as the database and the method used by this system is the genetic algorithm method.

The final result of this research is that it is helpful and easy to apply as a tool in helping the optimization process of lecture scheduling in order to minimize schedule collisions in lectures at the Faculty of Engineering, University X.

Keywords : Genetic Algorithms, Course Scheduling, Systems

1. INTRODUCTION

1.1 Background of the Problem

Advances in information technology are now being used in various aspects of life. Information technology is used as a data processing tool that can produce a variety of useful information to support a decision. The right decision will result in a change to an activity for the better at every step. One of the current activities that have used information technology is activities in the college environment. Higher education institutions utilize technology starting from administrative activities, learning and teaching processes that begin with the process of compiling a course schedule

The optimal course scheduling process will support the successful implementation of the teaching and learning process. According to Dian Novianti, M.Kom as the Head of the Informatics Engineering Study Program, the course scheduling system carried out without using an appropriate method results in various kinds of problems. The problems that arise include the accumulation of lecture hours for a lecturer who takes more than one course. Another problem is the disruption of the lecture process at the beginning of the semester due to the tentative scheduling system. The preparation of lecture schedules at the Faculty of Engineering, University X is still done semi-manually using Microsoft Excel, so it will take several days to make a schedule.

1.2 Problem Identification

The problems identified in this study are as follows.

- a. The process of compiling a course schedule is still semi-manual.
- b. The process of compiling a course schedule with limited space, sessions, and the lecturers who are responsible for each subject.
- c. The course scheduling system process at the Faculty of Engineering, University X has not implemented a method.

1.3 Problem Formulation

From the identification of the above existing problems, the authors formulate the following problems:

- a. How to make a computerized and systematic course scheduling information system?
- b. How to allocate lecturer time and room availability so that the teaching and learning process does not occur in a collision?
- c. How can a genetic algorithm be used as a method to be used in making a course scheduling information system?

1.4 Problem Limitation

So that the discussion of the problem can be well directed, the authors limit the problems to be discussed, namely:

- a. This system is operated by the administrative staff of the study program at the Faculty of Engineering, University X.
- b. This system is built using Codeigniter framework, Bootstrap Responsive (display) and MySQL as database.
- c. The method used in this system is the genetic algorithm method.

1.5 Research Objectives

The purpose of this research is to build an effective and efficient course scheduling information system at the Faculty of Engineering, University X using genetic algorithms.

2. BASIC THEORY

2.1 Scheduling

Scheduling is the sorting of making or processing a product as a whole which is done on several machines. Thus the problem of sequencing always involves working on a number of components which are often referred to as jobs. Job is a composition of a number of basic elements called activities or operations. Each of these activities or operations requires the allocation of certain resources over a certain period of time which is often referred to as processing time (Ginting and Rosnani, 2009).

2.2 Definition of Genetic Algorithm

According to Desiani and Arhami (2006) the genetic algorithm is a search algorithm based on natural and genetic selection mechanisms. The genetic algorithm is one of the most appropriate algorithms used in solving complex optimization problems, which are difficult to do with conventional methods. The nature of genetic algorithms is looking for possibilities from potential solutions to get the optimal for solving problems. The scope of all viable solutions, i.e. the objects between matching solutions, is called the search space. Each point in the search space represents a viable solution. Each viable solution can be marked with a fitness value.

The genetic algorithm moves from a population of chromosomes (a bit string represented as a potential solution to a problem) to a new population using 3 operators, namely selection, crossover and mutation. Chromosomes are selected according to their respective fitness values. Strong chromosomes have a high chance of surviving in the next generation, but it does not rule out weak chromosomes to survive. The selection process is then determined by the new chromosomes (offspring) through a process of crossover and mutation of the selected chromosomes (parents). From the two processes mentioned above, a new generation is formed which will be repeated continuously until it reaches a convergence, namely as many generations as desired.

2.3 General Structure of Genetic Algorithms

Genetic Algorithms Genetic algorithms provide an option for determining parameter values by imitating genetic reproduction, the formation of new chromosomes and natural selection as occurs in living things. The variables and parameters used in the genetic algorithm are

- a. The fitness function (objective function) which is owned by each individual to determine the level of suitability of the individual with the criteria to be achieved.
- b. Population The number of individuals involved in each generation.
- c. The probability of a crossover occurring in a generation.
- d. The probability of mutation occurring in each individual.
- e. The number of generations to be formed determines the duration of the genetic algorithm application.

2.4 Coding of Genetic Algorithms

Encoding is a technique for expressing the initial population as a potential solution to a problem into a chromosome as a key issue when using genetic algorithms. Based on the type of symbol used as the value of a gene, the coding method can be clarified as follows: binary coding, real numbers, integers and data structures (Mitsuo Gen and Runwei Cheng, 1997).

2.5 Genetic Algorithm Operators

Genetic operators are used after the first stage of the evaluation process to form a new population of the current generation. These operators are selection, crossover and mutase operators (Desiani and Arhami, 2006).

Selection aims to provide greater reproductive opportunities for the fittest members of the population. The first step in this selection is finding the fitness value. Each individual in a selection vessel will receive a reproduction probability that depends on his or her own objective value against the objective value of all individuals in that selection vessel. This fitness value will later be used in the next selection stages (Kusumadewi, 2003).

Several methods of how to select chromosomes (Desiani and Arhami, 2006) that are often used include roulette wheel selection, rank selection, and tournament selection. Crossover aims to increase the diversity of strings in a population by crossing between strings obtained from previous reproductions. The mutation operator is an operation involving one specific chromosome. Several methods of mutation operation are applied in genetic algorithms according to the type of phenotype coding, including mutations in binary coding, permutation coding, value coding, and tree coding.

3. RESEARCH METHOD

3.1 Data Collection Methods

Several data collection methods were used for this research, namely:

a. Study of literature

Data collection methods are carried out by reading, studying and understanding existing problems from various books or other references.

b. Observation

The data collection method is done by directly observing the object under study.

c. Interview

Methods of data collection by conducting direct interviews of the academic community of the Faculty of Engineering, University X.

3.2 Systems Development Method

System Development Life Cycle (SDLC) method. This method is a classic methodology used to develop, maintain and use information systems. This method uses a systems approach called the waterfall approach, which uses several stages in developing the system (Supriyanto, 2005).

1. ANALYSIS AND SYSTEM DESIGN

4.1 System Analysis

The analysis carried out in implementing the genetic algorithm in the course scheduling system at the Faculty of Engineering, University X includes problem analysis, running system procedures, the system to be developed and the method of making the system.

4.2 Problem Analysis

The process of making a course schedule at the Faculty of Engineering, University X is still done semi-manually. Some of the obstacles that arise are the occurrence of conflicting schedules, the scheduling process is taking longer, the lecture process is delayed at the beginning of the semester for the schedule improvement process.

Based on the above conditions, it can be concluded that there is a need for a computerized system that can carry out the process of recording data, making course schedules automatically. This system was built with the aim of being able to assist the academic department of each study program in the engineering faculty in carrying out course scheduling activities.

4.3 Analysis of Current System Procedures

In the data processing process carried out by the academic department, there are several activities carried out in the course scheduling process. Some of the activities carried out by the academic section include.

- a. Record lecturer data, courses, rooms, lecture time.
- b. Provides information about the course schedule at the beginning of each semester.
- c. Making reports to be archives that will be used as a reference in lecture activities.

4.4 Analysis of the system being developed

IdeaThe input and output data specifications that will be processed in this system are as follows:

1. IdeaData Input verification

In the use of genetic algorithms in the course scheduling system, the data that must be entered by the admin to the system are lecturer data, lecturers, courses, room, lecture time.

2. IdeaData Output Verification

Seadmin has entered the data needed by the system, the system will display data information in accordance with what has been entered into the system. Then the system will automatically generate the course schedule. Below is an overview of the system to be developed:

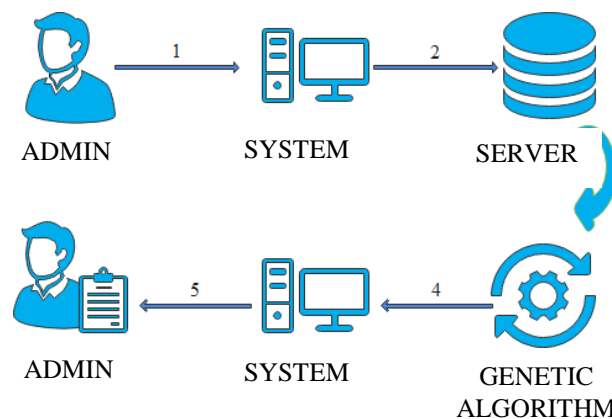


Figure 1 Overview of the system to be developed

The following is an explanation of the picture above:

1. Admin input user data, lecturer data, courses, rooms, time into the system.
2. The data that has been inputted is stored on the server.
3. The genetic algorithm generates automatically the course schedule.
4. The system displays the processed data in the form of a course schedule.
5. Admins can print a course schedule to make a report.

4.5 System Design Architecture

This course scheduling system design process consists of processing input data such as master data in the form of lecturer data, courses, room, and lecture time. The system can run on computers or smartphones using a browser as an HTML file translator, Bootstrap (system view), PHP (data processor) and MySQL as the database stored on the server.

The process of designing a genetic algorithm application in lecture scheduling consists of input data processing, chromosome coding of the population, fitness evaluation, elitism, linear fitness ranking, selection process, cross-breeding (crossover), mutation and regeneration processes (creation of new populations). Genetic algorithm flowchart to determine course scheduling problems as follows.

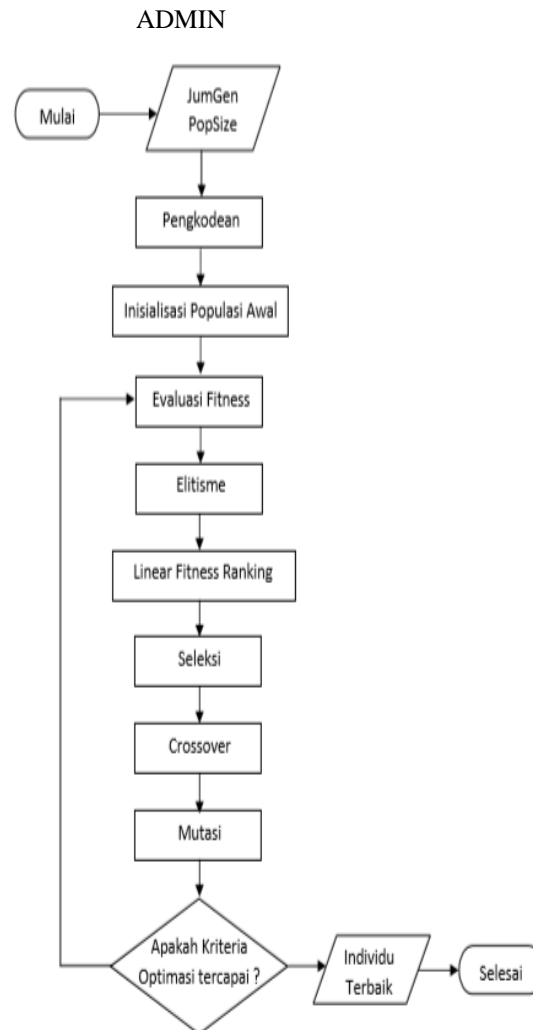


Figure 2 Flowchart of Scheduling Genetic Algorithm

4.6 System Overview

The course scheduling information system using the genetic algorithm method is a website-based application that can be used by academic staff as administrators. Administrators use this system to enter master data in the form of lecturer data, courses, lecture time, room. The system can store the master data so that lecture schedules can be made automatically using genetic algorithms. Admin can print reports in the form of one semester course schedule.

5. ANALYSIS OF SYSTEM REQUIREMENTS

5.1 Functional Requirements Analysis

From the analysis, it can be concluded that some of the functional requirements of the system to be built are as follows.

- a. The system can record lecturer data, courses, rooms, time into the system.
- b. The system can carry out the process of compiling a course schedule.

- c. The system can provide a course schedule report that will be used as a reference in making decisions for future lecture activities.

5.2 Analysis of Non-Functional Requirements

Non-functional requirements are requirements outside the functional requirements of the system. Some of the non-functional requirements needed in the construction of this system are as follows.

- a. Using codeigniter framework.
- b. Using Bootstrap as display.
- c. Using MySQL as the database.
- d. Use *Visual Studio Code* as a text editor for writing PHP syntax with the CodeIgniter Framework and MySQL Queries.

6. SYSTEM PLANNING

6.1 Use Case Diagram

Use case diagrams in the course scheduling information system using genetic algorithms at the Faculty of Engineering, University X, which will be made by one actor, namely admin. This actor's access rights are restricted by using a login to enter the system. The use case diagram for this system can be seen in the figure

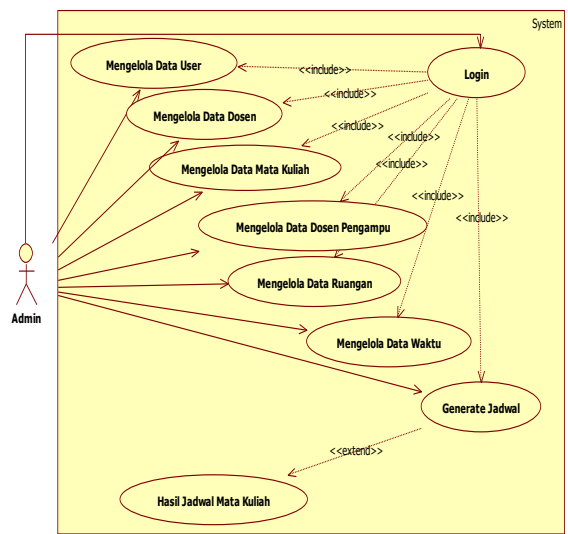


Figure 3 Use Case Diagram

6.2 Sequence Diagram

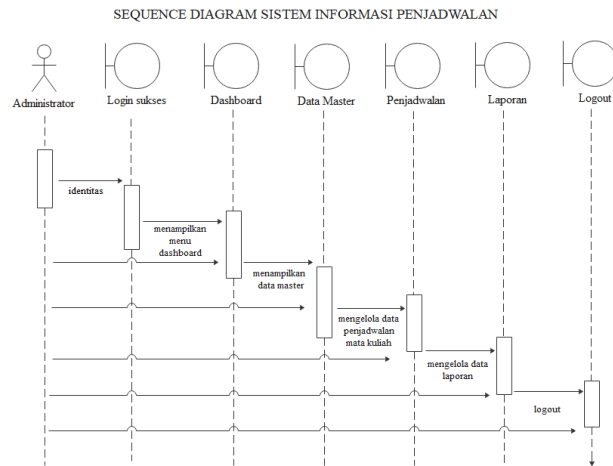


Figure 4 Sequence Diagram

6.3 Class Diagram

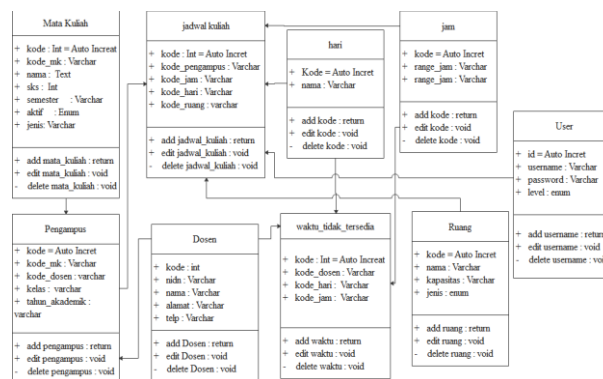


Figure 5 Class Diagram Diagram

7. RESULTS AND DISCUSSION

7.1 Use of Applications

Applications generated from the System Course Scheduling Information Using Genetic Algorithms is a system that makes it easy the process of scheduling courses at the Faculty of Engineering, University X, as well as computerized data so that data storage is not stacked and makes it easier to find data when needed.

Applications made are still within the scope of localhost, so before using this application, a web server such as AppServer, WAMP, or XAMPP must be installed on a PC or laptop, then import the MySQL database from this application, and activate the web server.

Login Page Views

The initial stage of opening the application will appear the main page in the form of a login form. The displayed page is as shown in the following image.

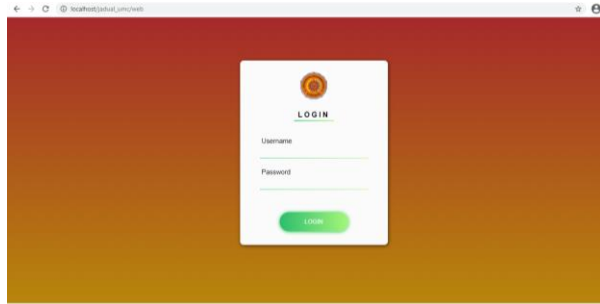


Figure 6: Login Page Display

Admin Page Views

On the admin page, there is a main page, the page that appears after the admin logs in.

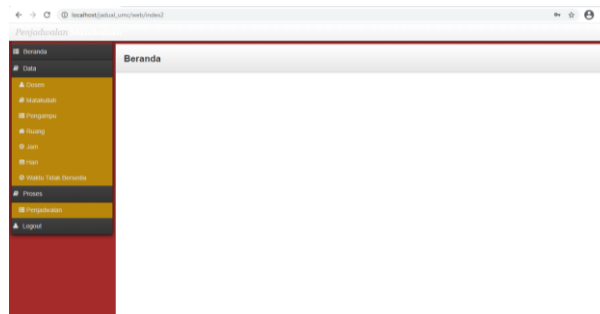


Figure 7 Main Page Display

In Figure 7 is a page that contains the menu in the application provided, such as the lecturer menu, courses, time, room, scheduling and so on.

8. CONCLUSIONS

8.1 Conclusion

Based on the descriptions in the previous chapters, the conclusions that can be drawn are, among others.

1. With this course scheduling information system, users can arrange a computerized and systematic course schedule.
2. By using the genetic algorithm method in this scheduling system can minimize the occurrence of collisions or collisions of lecturers' schedules and the space used.
3. The use of genetic algorithms has made the course scheduling system at the Faculty of Engineering University X time efficient due to the systematic scheduling process.

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