Design and Development of Course and Education Scheduling Using Genetic Algorithm

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Abstract This study discusses the problems that occur in Warmadewa College Training and Course Institutions. The problems that occur are the presence of instructors who mostly work as lecturers resulting in the difficulty of determining and scheduling courses and training in accordance with the time of each instructor. Another problem is the process of making a course schedule and training that is still done manually resulting in difficulties in processing student data and schedules. This system is designed to facilitate academic, instructor and student access to information on course scheduling and training. The method used to solve these problems is by using Genetic Algorithms and using the PIECES method to analyze problems and use the Rapid Application Development (RAD) method as a system development model. The results of this study provide convenience in managing the process of scheduling courses and training efficiently and effectively in accordance with the instructor's time and available space so that the process of making the schedule can run well.

Keywords— **Scheduling, Genetic Algorithm**

I. INTRODUCTION

Warmadewa College is one of the Training and Course Institutions engaged in the field of Informal Education. Warmadewa College has four courses and training programs namely Entrepreneurship, Accounting, Leader and Administrator, Foreign Language. In carrying out their duties as a Course for Training and Course, in the academic field Warmadewa College requires qualified instructors in terms of teaching and learning who currently still use lecturers from Warmadewa University and lecturers from outside Warmadewa College. The presence of internal and external instructors makes it difficult to determine the right course schedule and training according to the instructor's readiness as a teacher and locally available. Therefore, the difficulty in determining the course schedule and training is due to the unavailability of a system that is capable of making course schedules and training. The difficulty is caused because in making scheduling is still done manually and has not been applied to an automated system. This results in greater number of errors and requires considerable time to organize and create schedules and often scheduling conflicts that occur and result in the teaching and learning process being hampered [1]. The impact was also felt by students because of the difficulties when there was a change in schedule.

Steps taken to facilitate the scheduling process, namely the need to create a system that is able to do the process of making scheduling automatically to determine the instructor readiness time available locally that is optimally available. The author uses genetic algorithms as a method to find solutions related to the problems of scheduling courses and training related to room optimization and limited instructor readiness.

A. System Design

According to Stair and Reynolds, system design is a system development phase that defines how information systems will design to get problem solving solutions [2]. According to Laudon and Laudon, System design is an overall plan or model for a system consisting of all system specifications that give shape and structure [3].

B. Scheduling

Scheduling is the sequencing of the manufacture or execution of the product as a whole that is done on several machines. Sorting problems always involve working on a number of components which are often referred to as jobs. Job itself is still a composition of a number of basic elements called activities or operations. Each activity or operation requires the allocation of certain resources over a period of time which is often referred to as processing time [4].

C. Information System

Understanding Information Systems according to Jacob is a network of interconnected procedures, collected together to carry out an activity or for a particular purpose [5].

D. Genetic Algorithms

Genetic algorithms are evaluations or developments in the computer world in the field of artificial intelligence. The emergence of this genetic algorithm was inspired by Darwin's theory and theories in biology, so that many biological terms and concepts are used in genetic algorithms, because as the name implies, the processes that occur in genetic algorithms are the same as what happens in biological evaluations [6].

II. RESEARCH METHODOLOGY

A. Research Location

Observations made are by conducting a direct review of the Warmadewa College Course and Training Institute. The review was conducted in the IT and Academic fields. The purpose of the observation is to find out the running of the manual system and find out what problems arise when using a manual system. The results of observations related to the problem using a manual system, then analyzed and become a solution to plan the system that will be developed to help the process of making a schedule of classes at Warmadewa College Training and Course Institutions.

B. Pieces Analysis Method

Before designing an information system, first an analysis of the problems that occur at Warmadewa College Training and Course Institutions. The PIECES method can be used as a suggestion to overcome existing system weaknesses [7]. The results of the analysis of the problem and the solutions obtained are as follows:

TABLE 1
ANALYSIS OF CONVENTIONAL SYSTEM

No.	Conventional System Pieces Analysis	Problem
1	Performance	The work process is done manually so the risk of error is high
2	Information	Not all students know about course information and training
3	Economy	There is no registration system and online scheduling
4	Control	The course data and training are not well managed
5	Eficieny	Registration and scheduling of courses and training requires a longtime process
6	Service	Services to students and the general public are not optimal

TABLE 2
INFORMATION SYSTEM ANALYSIS

No.	Pieces Analysis of Course and Training Institution Information Systems	Solution
1	Performance	Errors that occur because the manual process can be reduced
2	Information	Students are able to access course and training information easily
3	Economy	Students can register online
4	Control	The course data and training are well managed.
5	Eficieny	The registration and scheduling process requires a shorter time process
6	Service	Services to students maximally

C. Method of Development System

Rapid Application Development is a process of developing linear sequential software that emphasizes the development cycle in a short time. RAD uses an iterative (repetitive) method in developing a system where the model works the system is constructed at the beginning of the development stage with the aim of defining user needs and subsequently being removed. In developing a normal information system, it requires a minimum of 180 days, but by using the RAD method, the system can be completed within 30-90 days [8].

(source: www.google.com)
Figure 1 RAD System Development Cycle Model

D. Genetic Algorithms

The application of Genetic Algorithms in this lecture scheduling system in general can be illustrated in the following diagram:
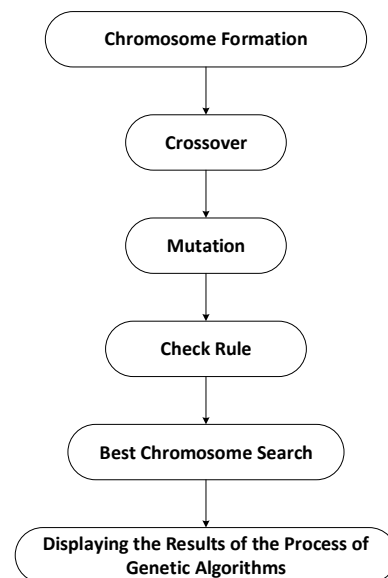

Figure 2 Flow Chart of Genetic Algorithms

Figure 2 explains the process requirements for this scheduling system, namely in the process of forming a genetic algorithm at the stage of parent chromosome formation. For example, for

this process the program schedule is arranged sequentially paired with space, days and hours of training randomly using codes so that it is easy to distinguish between one gen and another [9].

III. ANALYSIS AND RESULTS

A. Requirement Planning

This phase is a phase to identify the objectives, requirements and system requirements. All needs and data are collected to identify the objectives and requirements of the system requirements to be designed. The process of making a course schedule and training carried out by the academic section as shown in Figure 3.
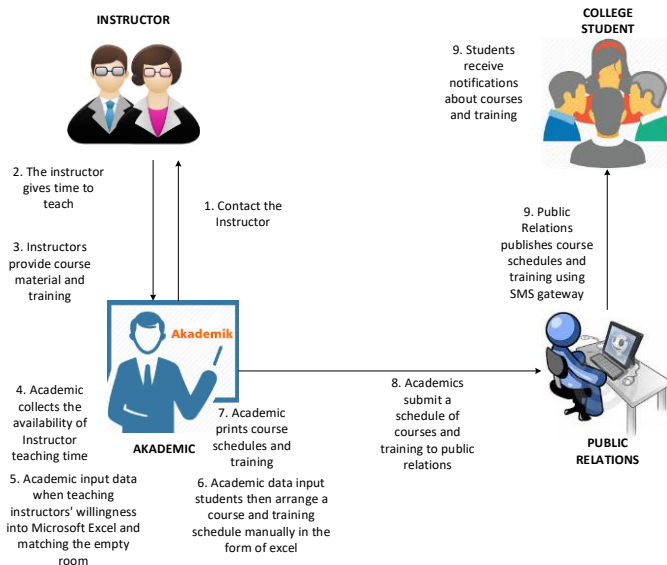

Figure 3 Manual System Flow

Figure 3 describes the process manually carried out by the academic section using Microsoft Excel. The existence of 4 courses and training programs, 20 instructors and 5 rooms is very influential in making course schedules and training. The number of instructors who work as lecturers is an obstacle because the academic part must adjust the instructor's time with regard to making the schedule. The following figure 4 is the proposed system flow.
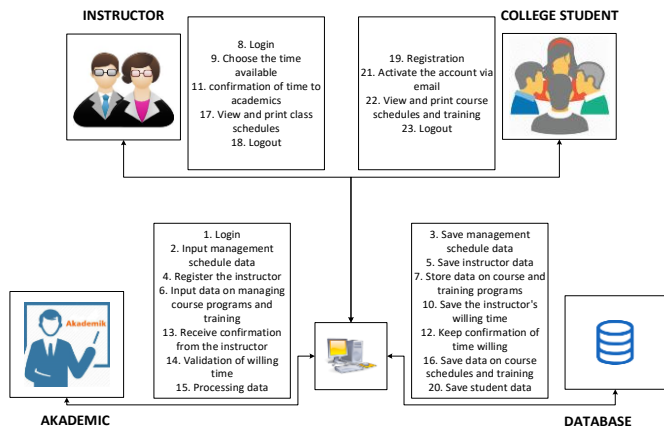
Figure 4 Proposed System Flow

B. Workshop Design

1) Encoding Technique

This process initializes the willingness to teach instructors. This stage has three gens that will be juxtaposed, namely instructors, programs, and instructors.

TABLE 3
INSTRUCTOR DATA

No	Code	Name
1	I001	Dewa Made Surayadnya, SS
2	I002	Ni Putu Riski Martini, SE., M.Si
3	I003	A.A. Amlayasa, SE., M.Si.
4	I004	Ni Kadek Nova Tarasita, SS.

TABLE 4
PROGRAMS DATA

No	Code	Programs
1	P001	Entrepreneurship
2	P002	Accounting
3	P003	Leader and Administrator
4	P004	Foreign Languange

TABLE 5
DATA ON INSTRUCTOR WILLING TIME

Availability							
Code Instructor	Code Programs	Monday	Tuesday	Wednesday	Thursday	Friday	Availability
I001	P001	1	0	0	0	0	10000
I002	P002	1	0	0	0	0	10000
I003	P003	1	0	0	0	0	10000
I004	P004	0	1	0	0	0	01000

Table 5 explains the three variables (gens) above will be combined into chromosomes, namely, Code_Instructor, Code_Activities, Availability.

I001	P001	10000
(Gen 1)	(Gen 2)	(Gen 3)

Chromosome = I001P00110000

The explanation of the above chromosomes is the Instructor in the name of Dewa Made Surayad, SS is willing to teach the Entrepreneurship Program on Monday.

2) Fitness Function

In this system, optimization becomes a problem when optimizing the instructor with n programs in the existing room. Process the fitness value based on rank-based fitness by sorting the willingness to teach instructors according to their objective values (instructor teaching time).

3) Initialization Procedure

The process of initializing the instructor's willingness based on the data of the instructor's name, program and instructor's time.

Code_Instructure : I001
Instructor_name : Dewa Made Surayadnya, SS
Code_Program : P001
Program : Entrepreneurship

TABLE 6
INITIALIZATION PROCEDURE

Hari/shift	Senin (1)	Selasa (2)	Rabu (3)	Kamis (4)	Jumat (5)
I (08.00-09.40)	X				
II (10.00-11.40)	X				
III (12.00-13.40)					
IV (14.00-15.40)					

4) Initial Population Generation

This process generates the initial population (instructor's teaching time) that has been initialized in the previous process.

TABLE 7
INITIAL POPULATION DEVELOPMENT

Code_ Instructor	Name_ Instructor	Code_ Program	Programs	Day	Shift
I001	Dewa Made Surayadnya, SS	P001	Entrepreneurship	1	I
I002	Ni Putu Riski Martini, SE., M.Si	P002	Accounting	1	II
I003	A.A. Amlayasa, SE., M.Si.	P003	Leader and Administrator	1	I
I004	Ni Kadek Nova Tarasita, SS.	P004	Foreign Languange	1	II

5) Evaluation Function

The time the instructor is raised is then evaluated by summing the available time from each instructor.

TABLE 8
EVALUATION OF FITNESS VALUE

Code_ Instructor	Name_ Instructor	Code_ Program	Program	Fitness_Value
I001	Dewa Made Surayadnya, SS	P001	Entrepreneurship	2
I002	Ni Putu Riski Martini, SE., M.Si	P002	Accounting	4
I003	A.A. Amlayasa, SE., M.Si.	P003	Leader and Administrator	6
I004	Ni Kadek Nova Tarasita, SS.	P004	Foreign Languange	2

6) Optimization Criteria Reached

There is a course program schedule and training that is in accordance with the willingness of the instructor's teaching time with the available space by looking at the fitness values found in each instructor.

7) Selection

The selection process makes the instructor's teaching time undergo a selection based on the day and the set shift. This process will select the instructor's fitness value at least than the instructor who has a greater fitness value.

8) Crossover

This process causes the population to experience recombination less. Recombination also results in onepoint crossing for the next day or shift against the instructor's teaching time.

TABLE 9
THE FIRST GENERATION

Code_ Instructor	Name_ Instructor	Code_ Program	Program	Day	Shift	Room
I001	Dewa Made Surayadnya, SS	P001	Entrepreneurship	1	I	Sandat 1
I002	Ni Putu Riski Martini, SE., M.Si	P002	Accounting	1	I	Sandat 2

9) Mutation

The mutation process occurs when instructors who have not received a schedule. The process of evaluation, selection, recombination and mutation will be carried out repeatedly as long as the population is not empty.

TABLE 10
SCHEDULE OF COURSE AND TRAINING PROGRAMS
(LAST GENERATIONS)

Code_ Instructor	Name_ Instruktur	Code_ Program	Program	Class	Day	Shift	Room
I001	Dewa Made Surayadnya, SS	P001	Entrepreneurship	A	1	1	Sandat 1
I002	Ni Putu Riski Martini, SE., M.Si	P002	Accounting	A	1	1	Sandat 2
I001	Dewa Made Surayadnya, SS	P001	Entrepreneurship	B	1	2	Sandat 1
I003	A.A. Amlayasa, SE., M.Si.	P003	Leader and Administrator	A	1	3	Sandat 1
I002	Ni Putu Riski Martini, SE., M.Si	P002	Foreign Languange	B	1	4	Sandat 2

C. Use Case Diagram

Use Case The diagram in this section explains the relationship and interaction between actors with the lecture scheduling information system. Figure 5 below describes the overall use case design.
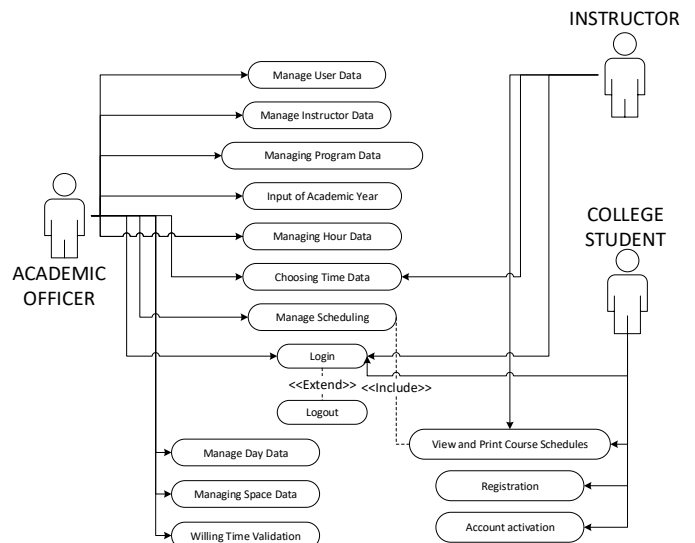

Figure 5 Use Case Diagram

Figure 5 describes the activities carried out by the actor and the response given by the system according to the instructions of the actor

D. Recommendations

Recommendations that can be given are based on the results of existing research in order to implement the information system designed, as follows:
1) To make it easier for users to use this system it should be developed on a mobile based platform.
2) To further optimize this information system it is recommended to complete system weaknesses in stages and integrate with the Academic system.

IV. CONCLUSION

Based on the results of the discussion, conclusions can be drawn as follows:
1) This research produces a Course and Training Scheduling Information System that automatically facilitates the academic in making schedules.
2) The academic department is able to minimize errors and be more efficient in making schedules.

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