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Procedia Computer Science 72 (2015) 209 – 216

Procedia Computer Science

The Third Information Systems International Conference

Automated Scheduling System for Thesis and Project Presentation Using Forward Chaining Method With Dynamic Allocation Resources

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Abstract

This paper presents a practical method for modeling and solving a dynamic resource allocation of automatic scheduling problem using forward chaining heuristic approach, in the case of undergraduate Student's Thesis and Project presentations timetable. Poor scheduling practices would cause double-assignations of lecturers, prolonged postponement and cancellations of presentations as well as inefficient use of time and resources. This method will follow a pre-assigned logic rules and algorithm to fit the optimization criteria's. The output of this research will be an automatic set of presentation schedule alternatives that will take into account all the constraints. The proposed algorithm for this automatic scheduling system could generate optimal presentation timetable and enables direct interaction with lecturers in order to gather data of their availability time among other its functionalities. The proposed system performs satisfactorily in term of accuracy, data handling and adaptability on helping the faculty to arrange presentations more easily, yield a reliable record and increase efficient use of resources.

Peer-review under responsibility of organizing committee of Information Systems International Conference (ISICO2015)

Keywords: Automatic Scheduling System; Forward Chaining, Dynamic Resource Allocation

1. Introduction

In a general educational timetabling problem, a set of events (e.g. courses and exams, etc) are assigned into a certain number of timeslots (time periods) subject to a set of constraints, which often makes the

Peer-review under responsibility of organizing committee of Information Systems International Conference (ISICO2015)
doi:10.1016/j.procs.2015.12.133

problem very difficult to solve in real-world circumstances [1]. There are large numbers of commercial software packages available to assist with timetabling problem. However, due to the variety of characteristic , procedure and complexity of each university in the scheduling process make the study in this research area still interesting. In order to solve the best solution for this timetabling problem, a widely research area has been studied in various complexity problems with different algorithm solution [2,3,4].

This research will focus on how to build automated scheduling system for Thesis and Project Presentations on the Department of Information System in Institut Teknologi Harapan Bangsa (ITHB) that could also handle dynamic resource allocation problem. Both the department and students are facing challenges in scheduling these presentations due to many constraints. Presentations have limited period every semester and the number of applying students also varied. There are only several rooms assigned for presentation and their availability varied every day. The number of presentations is also limited to maximum 4 sesions for each day. Lecturers who are part of the committee also have high variability in their time availability. Presentation is scheduled manually by the student, department administrator and the corresponding lecturers using a white board. But this three-party system often faces problems. Many times presentations are cancelled because of double-assignations of lecturers or unavailability of rooms. While in the other cases there are actually available schedules but not used due to misinformation. Moreover sometimes students who have not completed all the requirements and conditions could be assigned for presentation due to lack of control.

To overcome those challenge and constraint as that have been identified and state above, this research will design and implement an Automated Scheduling System for Thesis and Project Presentation to minimize conflict of constraints while handling dynamic resource allocation. This paper describes the use of forward chaining method of the expert systems methodology to help finding the most suitable presentation schedule automatically. The rules composed as the basic logic of the system will incorporate all the constraints. The structure of this paper is as follows. Section 2 will describe the research methods for this proposed system, treated with problem analysis and end with the literature review for algorithms of the proposed system. Section 3 introduces the architecture of the proposed system, and in section 4 we will describe the design and implementation of the proposed system. Finally, section 5 we will present our conclusion of this research on how the system will help the department and student to arrange schedules optimally.

2. Research Methods

2.1. Problem Analysis

In this section we will analyze the problem on thesis and project presentation scheduling. Institut Teknologi Harapan Bangsa (ITHB) is one of higher educational institution located in Bandung, Indonesia. One of the departments in ITHB is the Information System Department. In order to complete their study, the students need to complete 144 credits of subjects in 8 semesters, and they also need to participate in an internship program in the form of a Project and finally a Thesis. Upon the completion of these programs students will present their result in a formal presentation attended by the assessment committee consisted of their promoters and lecturers assigned as examiners [5]. Basically, scheduling is a resource allocation problem, and given by this problem, manual solution based on trial an error has been adopted by IS Department is time consuming and prone to allocation conflicts.

The Automated Scheduling System for Thesis and Project Presentation will help user to generate the timetable schedule automatically by referring to the constraints, which are :

1. Period of Thesis and Project Presentation Session, which differ on each semester;
2. Rooms availability;
3. Lecturers availability. Thesis presentation need 4 lectures (2 as supervisor and 2 as examiner), and project presentation need 2 lectures;
4. Max presentation on each day;

5. Time duration. In order to complete thesis process, each undergraduated student's has to get through 3stages of presentation (progress, content and final),which each of them has different duration.

This proposed system will generate timetables for each lecturers to attend presentation (whether it thesis or project). Administrator will manage the schedule scheduling for any required changes in two methods, which are one-by one input of lecturer availability, or by period of thesis and project presentation season. With the proposed system, we also developing the services logic that controls the concepts of managing the complexity of generate thesis and project presentation scheduling automatically. In this research we used forward chaining and decision tree to formulate the algorithm for the proposed automatic scheduling system. This automated scheduling system will built using web based application as a platform for the integrated distribution system function.

2.2. Proposed Solution for Automatic Scheduling System

A scheduling problem for Thesis and Project Presentation is definedby a set of resources that are being allocated to a set of activities ina certain time period. As explained in the previous part, for this research problem, we built an automatic scheduling system that could produce schedules for project and thesis presentations for a certain time period and could follow the rules and constraints dynamically. We proposed a dynamic allocation, resource because the total numbers of lecturer, students and rooms are varied and change dynamically for each time periods of presentation session. The table 1 show the diferent rules and constraint for each presentation.

Table 1. Rules and constrains for Thesis and Project Presentation

Type of Presentations	Constraints	Rules
Thesis	1. Each student have 2 supervisors and 2 examiners for thesis presentation 2. Room availability 3. Time period are 10 weekdays	The maximum presentation slots for a day is four. With time slot for progress and final thesis presentation is an hour, and time slot for content thesis presentation is 1,5 hours.
Project	1. Each student have a supervisors and a examiners. 2. Room availability 3. Time period are 5 weekdays	The maximum presentation slots for a day is six. Time slot for a presentation is an hour.

Rules and constraints as shown on table 1 will be used in the forward chaining heuristic approach that adopted in this proposed system. The proposed system also must follow the hard constraints that are: two scheduled presentation cannot use the same This approach leads to a set of good solution that will be used interactively in a proposed system in order to find the most suitable solution, which means a user could interfere with the process. Initially a decision tree which maps the way of thinking of experts are formulated. This forward chaining of expert system decision tree arrangement is adapted from the priorities and scheduling rules in the Department of Information Systems in ITHB. Decision tree is one knowledge representation tool that is frequently used in expert systems[6]. Solutions on the decision tree generated from a series of possible solutions through a series of decisions or questions that would reduce the search area of solution. The issue that is related to use the decision tree is a problem that has been providing answers to the problem from a set or multiple possible answers. In general, the decision tree uses several criteria to choose which branch to be traversed so that later the only one branch will be chosen to make result in the decision. Reasoning techniques to construct a decision tree can be classified

into two, namely forward reasoning or trace forward (forward chaining) and backward reasoning or trace backward (backward chaining). Decision tree can then be converted into a set of rules which is represented by a different path in the decision tree. Then, the rules generated from the decision tree are used as a knowledge base that is needed on the expert system [7]. Trace forward (forward chaining) means using a set of condition-action rules. Operation of a forward chaining system starts by inserting a set of known facts into working memory, and then lower the new facts based on the premise rules match with known facts. This process is continued until reaching a goal or no longer rules the premise fits the known facts. Defining the structure of data control rules written in the structure of If - Then and given a number of rules to distinguish the rules with each other. The rules will be written in a text file using the syntax prologue [4].

The algorithm was prepared by using forward chaining rules sequentially in order to obtain a conclusion. The first thing to do is started from checking whether the students have already taken the credits for Project and Thesis, then checking the completeness presentation documents. If the documents are complete, the students can apply for a presentation session according to the academic calendar of the Information Systems Department. Projects only have 1 stage of presentation while Thesis has 3 stages. The next step is to check availability of the lecturers committee which consists of promoters and examiners. The administrator has to look at a possible asked date for session with the limitations of maximum 4 presentation sessions per day. As illustrate on Figure 1, the schedule can be arranged based on the following algorithm, with Fig 1(a) is Scheduling for project presentation and Fig (b) is for thesis presentation

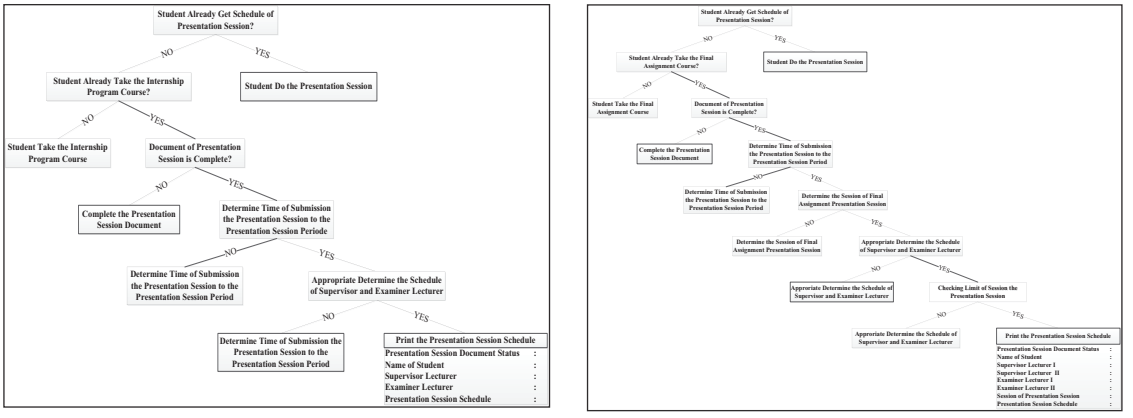

Fig. 1. (a) Forward Chaining Decision Tree for Project Presentation; (b) Forward Chaining Decision Tree for Thesis Presentation

The forward chaining heuristic approach used are aimed to find a good feasible solution following the rules and constraints as set-out on table 1, where every scheduled presentation has assigned its start time and a set of resources that allocated dynamically, which are needed for each presentation slot. Applying the heuristic procedure is as follows:

1. Start with an initial state
2. Start with the first student who has completed all the requirementsfor project/thesis presentation (FIFO)
3. The System will check the availability time of supervisors and examiners of the student.
4. Find the matching availability time of supervisors and examiners, according to the type of presentation as illustrated on Fig.2

5. Check room availability
6. Allocated to the time period (prioritize for the first day of the week)
7. Check wheater the allocation for this time period complete or not. If not, repeat step 2 to 6 until:
   a. All the time slots for the time period is done checking
   b. The presentation session for that time period not exceed to four sessions
8. Check wheter all time periods already being used (10 weekdays), if not go back to step 7, if yes, go back to step 2 until all the student has been scheduled
9. Produce the resulting schedule and end the procedure

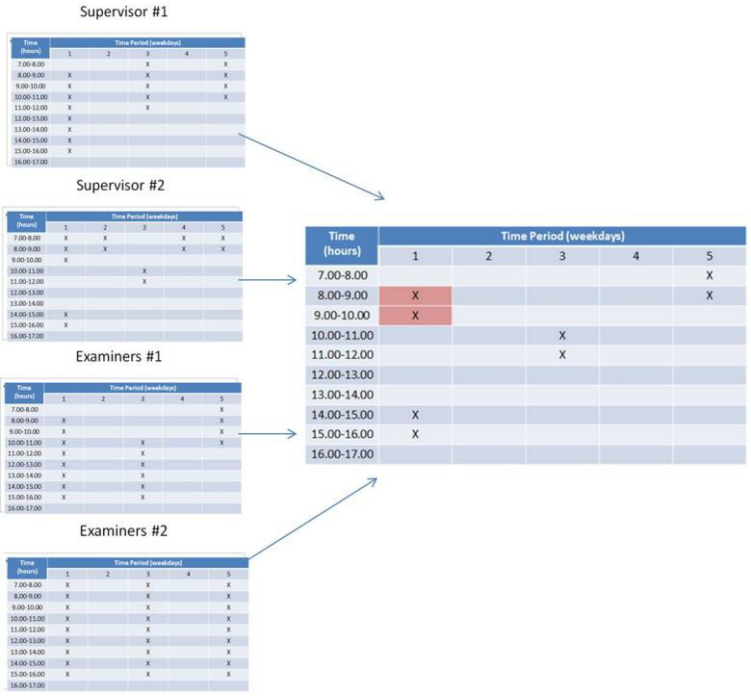

Fig. 2 The goal state of the scheduling algorithm of proposed system

This method is then incorporated into the logic of a proposed information system (application). The empirical evaluation of heuristic approach we used is based on accuracy, data handling and adaptability of the proposed system.

3. System Architecture

The proposed system will help four type users such as students, lecturers (supervisors and examiners), the session coordinator (internship program and final assignment), and administrators. Application user will enter the data required by the system. Then the system will store the data that will be used in the schedules recommendation process for students. The system flowchart is illustrated in figure 3. The students will use the system to input required data of presentation application process. The lecturers can input their availability through the period. The coordinator can give approval of presentation application and check whether all the conditions have been fulfilled. And finally the department administrator can administer all the process and maintain the record of presentation schedules. The main constraints are necessary to be fulfilled, namely the period of the presentation session, the maximum limit of the session, the presentation stage, the availability of lecturers and recapitulation of the presentation documents.

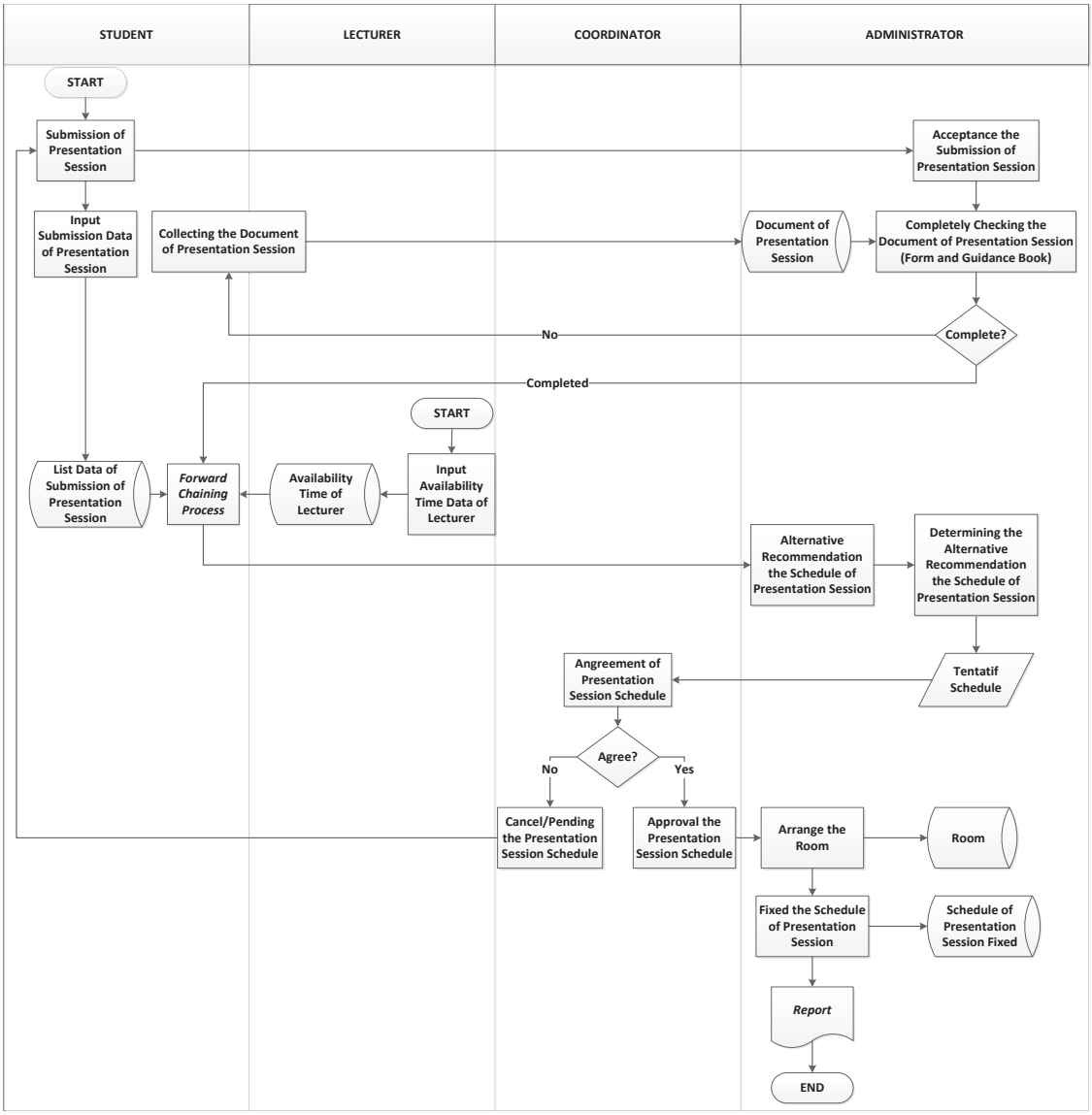

Fig. 3 Flowchart of the proposed system

4. Design and Implementation

The Automated Scheduling System for Thesis and Project Presentation is a recommendation system that is developed as a web-based program using PHP. This proposed system consists of five main modules as describe on Fig 3. The first module is document management, which is checked for all required documents of each presentation session. Project and Thesis scheduling system contains the recapitulation of presentation session documents (forms and guidance book) subsystem that can assist administrators in the process of recapitulation of student documents' completeness, so it can more ease in determining which students are eligible to participate in the presentations. Seconds module is for adjusting all constraint for scheduling parameters and managing information. Next module is data input module, which store all of the data for the constraint parameters in a rational database. Figure 4 shows the

corresponding ERD used in designing the system. The fourth module is the schedule recommendation, which will be accessed by each lecturer to approve before it finalized. And finally the report module, which would print the final schedule

If all constraints are met at each process, the schedule alternative will be generated by the system. If it does not meet the constraints on any such process, then the internship Project and Thesis presentation session schedule cannot be arranged. After the data processing and analysis of the data processing is complete, then it can be seen an example schedule matrix as in table 2.

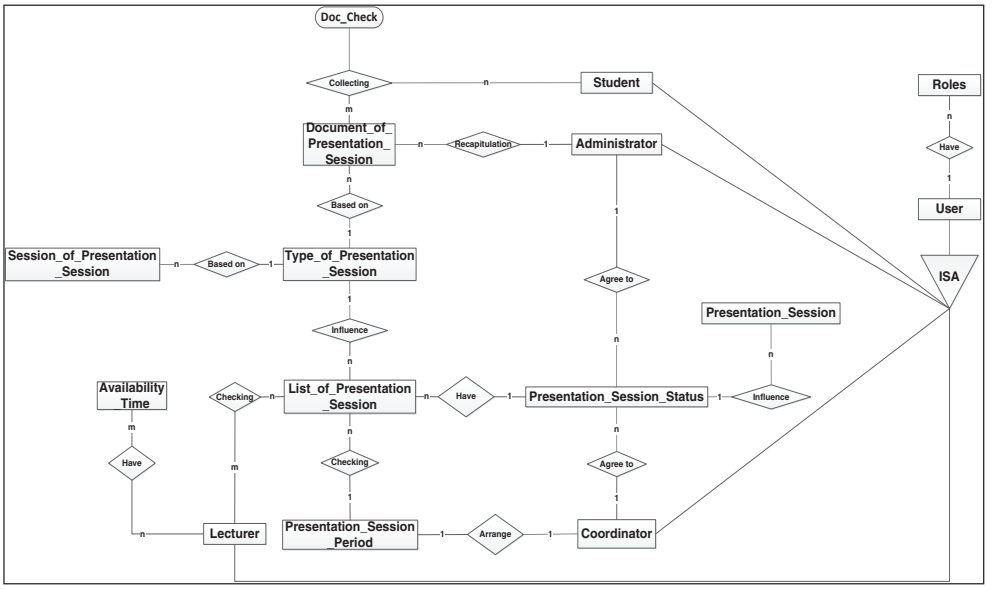

Fig. 4. Entity Relationship Diagram (ERD) of the proposed system

Table 2 is an example of a schedule matrix that has been proposed by students. The matrix is formed in accordance with the output that would be a schedule recommendation for the student. Starting from the submission made by the student in accordance with the specified period as shown in the table above is shown starting from Monday to Friday with the format YYYY / MM / DD and in accordance with the working hours of lecturers from 08.00 to 17.00 in the format HH : MM.

Table 2. Schedule Matrix

Day / Date (May 2014)	**Supervisor I** A	**Supervisor II** B	**Examiner I** C	**Examiner II** D
Monday, 5	10-12 & 13-16	8-12 &13-17	13-17	NOT AVAILABLE
Tuesday , 6	13-16	NOT AVAILABLE	10-12 & 13-17	10-12 & 13-15
Wednesday, 7	11-12 & 13-16	8-12 &13-17	13-17	10-12 & 13-15
Thursday, 8	10-12 & 13-16	8-12 &13-17	10-12 & 13-17	10-12 & 13-15
Friday, 9	10-12 & 13-16	8-12 &13-17	NOT AVAILABLE	10-11 & 13-15
Note : Schedule alternatives : Wednesday May 7th 2014 at 13.00-15.00 and Thursday May 8th 2014 at 10.00-12.00 and 13.00-15.00 .				

The data is then processed by the constraints and rules that exist, so that the results which can be obtained is the session schedule alternative recommendations as shown in Figure 5. The figure shows schedule slots alternatives for each lecturers. This feature also shows that system has superior data handling compared to previously existing data handling. All data records in database systems and could be shown historically to assist the decision maker.

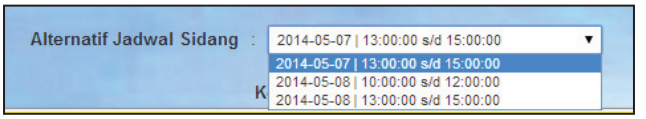

Fig.5 Alternative Recommendations Session

As shown on fig 5, this system has high adaptability by not only giving a complete timetable but also providing alternatives of presentation before it is recorded in a complete timetable. The test on the system shows that the schedule produced by system match with 100 % with the schedule made by expert user, this show high accuracy of the proposed system.

5. Conclusion

In this section, we review the results of the research on The Automated Scheduling System for Thesis and Project Presentation. Project and Final Presentation session scheduling system use forward chaining method, wherein the method is implemented through a sequence of constraints and rules as follows:

a. Recapitulation of presentation session documents in accordance with the stages of the session,
b. Asking the presentation session according to the period which has been decided,
c. Checking the maximum limit of session on day,
d. Determining the session schedule based on the availability of lecturers to attend the session.

Project and Thesis Presentation automatic scheduling system is a web based system in order to handle the collaborative function of this system, so it can be accessed anywhere and at any time it is needed, either through a variety of gadgets that have a web browser (such as mobile phones, tablets, laptops, computers (PCs), and so forth). But the best display resolution still needs to be considered. Based on test of schedule alternative performed on the system (tested manually or in the system), the test results show the schedule produced by the system match 100 % with the schedule made by expert users, and the system also has better data handling and higher adaptability compared to the previous thesis and project presentation scheduling system. The methodology that being adopted in this proposed system can be adopted to other type of dynamic resource allocation, automatic scheduling system as long as it has the same characteristic and complexity rules and constraints.

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