Web based Course Scheduling System using Greedy Algorithm

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Abstract - This study aimed to develop a web-based course scheduling system for College of Computer Studies under FEU institute of Technology, Manila Philippines. The developed system make use of Greedy Algorithm for managing schedules on courses and assigning to faculty. The method of this research was research and development (R&D). The researcher also discusses the scheduling process which is attributed to the Scheduling Module of the system that follows the principle of the Greedy Algorithm. The system has been tested and evaluated using criteria for which includes functionality, usability, reliability, portability and supportability (FURPS). Results and recommendation has been discuss on the last part of this paper.

Keywords - web based; course scheduling; automated; greedy algorithm; furps.

I. INTRODUCTION

A scheduling system is usually a form of software that allows someone to construct schedules in an easier, faster and error minimized way. It is very time consuming and sometimes leads to a disaster if output is not efficient. It is a fact that arranging class schedules, faculty load and room utilization for the students and faculty in every department is one of the many activities that each department heads must prepare before the classes start. However, the school used manual approach of preparing the class schedule. With this procedure, more time and labor force is required to plot, arrange, and revise the class schedules, room utilization and instructors’ load provided by the department heads (Williams, 2012). It is essential for university administrators who are responsible for the creation of the schedule of classes and the assignment of students to these classes to understand the effects of their decisions on the operation of the university. With effective course scheduling that work out relative information such as courses, time, location and faculty will provide desirable resolution to the university or institution.

II. BACKGROUND OF THE STUDY

FEU Tech is known to its innovative systems and various ways to implement solutions to their problems.

For institutions composed of several academic departments, the complexity is worsened by a decentralized preparation of schedule. In this approach, several uncontrolled scheduling elements should be considered, the use of resources such as lecture or laboratory rooms, schedule preferences and constraints implemented by other departments, all of which are affecting schedule preparation processes.

The program coordinator spend too much time scrambling and fitting schedules, mindful of considering every known factor. They need several time-consuming face to face consultations among themselves to settle anticipated conflicts. Aside from these individual exchanges of data, a formal meeting is conducted prior to the registration period of every academic term.

A. Objectives

The general objective of the research is to design and develop a web-based scheduling system for a collaborative preparation of class schedules at the CCS Department of FEU Institute of Technology. This will help the directors and coordinators to manage the creation of course schedules with the use of a web application that will automate the process of plotting courses. Specifically, this study aims to fulfill the following:

- To design a system that will automate the process of plotting courses to specific rooms with predefined time and faculty assignment.
- To develop modules that corresponds to the major process of scheduling system,
- To implement a scheduling behavior that follows the principle of Greedy algorithm that will be used by the system to plot the courses automatically based on given factors.
- To evaluate the system using the FURPS model.

B. Scope and Limitations

The system will be able to create reports and meaningful data interpretation where, for example, if there would be an overlapping of schedules, the system will be able to tell its users. There will be a counter of how many classes are plotted for the morning, afternoon and evening time slots. Also, show the rate of how many classes per specialization were created. The system must be able to provide a good
algorithm of how assignment of courses, time slots and rooms were allotted to each other.

Correspondingly, in this project, each work is handed by a separate module:
- Data Management Module. Ensures integrity of inputs;
- Course Assignment Module. Handles the actual scheduling;
- Scheduling Module. Responsible to create a reliable, conflict-free schedule considering all the set attributes and factors;
- Archive Storage Module. Stores created course schedule;
- View Schedule Module. Display the scheduling result.

This study is limited to use of College of Computer Studies Department Course Offering. The study does not cover off-term courses offered to be generated automatically. For such reason, the proponents included manual and it does scheduling options. This study will only focus on the implementation of Greedy algorithm for scheduling management module and does not seek to include other algorithm.

III. METHODOLOGY

This research used the descriptive and developmental method of research. Descriptive research finds out prevailing conditions of facts in a group under study and usually, variables or conditions studied are not controlled (Calderon & Gonzalez, 1993). According to Best (1981), descriptive research involves hypothesis formulation and testing and uses logical methods of inductive and deductive reasoning in order to arrive at generalization. All of the variables and procedures used in descriptive studies are described as completely and accurately as possible so as to permit future replication. The Developmental type of research is a systematic approach from design to development of the system to the evaluation process until it meets the criteria.

The research and system methodology followed in this study is outlined in Figure 8. It will be discussed systematically in this section.
- Problem definition phase. Where the needs of the department will be evaluated so the current process will be understood.
- Research phase. This will be conducted to understand how other researchers were addressing this problem.
- System Design Phase. In this phase, design and real life inputs will be gathered and populated into the tool.
- Construct a model phase. As the model will be constructed, it will be evaluated to further define alternative methods and succeed with the desired programming approach or possible look for a much simpler than the design to be considered.
- Evaluate solution phase. Once the prototype of the system has been developed, testing will begin. With all the
real inputs for a particular or designated academic year, the project will be tested. For the faculty assignment module, it will be evaluated by the department and the faculty members to provide their feedback and conduct changes if necessary.

- Implementation Phase. With a tested design, the tool will be refined slightly for the next scheduling term and then will be implemented into the department planning and scheduling process.

C. Project Design

The figure above shows describes the MVC pattern with three major system components; the interface, the database, and the algorithm engine. Its interface handles user data management and report management. Its database is relational and contains the details of created schedules. The algorithm engine detects block-schedule conflicts, faculty-schedule conflicts, and provides available resources for creating schedules. This will provide a decision support capability which has been adapted in this study. The input information module is a database that stores all information relating to courses, lecture and laboratory rooms, and faculty. The user interface module and optimization module are both for system control and modelling mechanisms that produce the scheduling solutions. The report generation module presents the solution results as management reports, including reports on course and room schedules, and schedules for individual faculty.

IV. DEVELOPED SYTEM

In this section the requirements from the analysis phase of the software development process will be used to produce a design of this system. As well the constructions of the model to develop the proposed system.
The scheduling process which is attributed to the Scheduling Module of the system follows the principle of the Greedy Algorithm. This algorithm selects an option by choosing what is most available. There are three sequential sub-processes of the Scheduling Module (Fig. 6). To create a schedule, these processes are repeatedly executed in a one-dimensional forward pattern without backtracking. The first process looks for a time-slot available in the block that can accommodate the assigned course. The first available option that fits is selected. The second process finds a room that is available at the selected time. It also follows that the first available room that can be assigned in the selected time is chosen. The third process looks for an appropriate faculty to handle the given course. In the search for a faculty, the first qualified option that fits is selected.

Based on the constraints provided, the algorithm works by generating series of all possible schedules per course by which the system will choose the best schedule from. For each generated schedules per course, an equivalent points will be attributed to every schedules that matches a constraint. The highest points that shall be assigned to the schedule that matches most of the constraints provided and will be the basis of choosing the best schedule for every courses. Thus, optimal solution has been applied for efficiency.

Accordingly, the scheduling processes for the system is divided into three categories; block scheduling, room scheduling, and faculty scheduling. Each process is executed following a specified order and the results of each are complementary to the complete scheduling output. Thus, this algorithm combines the compatible results of each process to create a complete result. The behavior of the algorithm limits the decision-making of the entire scheduling process to create the most optimal choice.

**D. Proposed System**

The Data Management Module will handle inputting, editing, and deleting data. This feature will make sure that all of the needed data of the scheduling entities were entered and fixed to ensure the integrity of the inputs. The initial step of the actual scheduling is will be controlled by the Course Assignment Module. This module will assign the courses to be enrolled by a certain block. The Scheduling Module will facilitate the management of available time, room, and faculty to fit a certain course assigned to a block. This module is responsible to create a reliable, conflict-free schedule considering all the set attributes and variables. Several options of creating schedule will be featured by this module. The manual-scheduling option can be used
whenever there is a need for a user to fit a desired schedule for the course. The auto-scheduling option lets the algorithm of the system create schedule for the course based from the curriculum considering the current school year and term. The copy-previous-schedule option will create a schedule imitating the most recent previous schedule made for the same course for the past academic term while allowing the user to manipulate room assignment for proper utilization and avoid conflicts. The Archive Storage Module will store the created schedule in the database. The View Schedule Module lets the system display to the user scheduling results and system generated information in the most logical way.

There is an interaction between the Program Coordinator, Administrator which are the users of the system. The Administrator is provided with user name and password that will be used in encoding faculty profile. Also, to be able to encode all the available sections and rooms used by College of Computer Studies. As well as the Curriculum for each course Offerings is to be encoded to by the Administrator. After all those required entities are entered into the system, the Program Coordinator could now manage those inputs using the scheduling management module for the generation of schedules and other pertinent reports.

Below is the general walkthrough of the system from initiation through exit. The sequence and flow of the system below is per user.

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Fig. 4. Administrator’s Homepage.  
Fig. 5 Manage Academic Term Module  
Fig. 6. Manage Course Module.  
Fig. 7. Manage Faculty Module  
Fig. 8. Manage User Log Module.  
Fig. 9. Coordinator’s Homepage.
V. RESULTS AND DISCUSSION

Figure Labels: Use 8 point Times New Roman for Figure labels. Use words rather than symbols or abbreviations when writing Figure axis labels to avoid confusing the reader. As an example, write the quantity “Magnetization”, or "Magnetization".

The researcher asked permission to the CCS Director of FEU Institute of Technology to conduct interview and distribute survey questionnaire. The CCS Director took the initiative of the request to the Executive Director of FEU Institute of Technology. After getting the ethical approval from the Director, a pilot study was done.

The questionnaire will be weighted against the database (Microsoft Excel 2007) to check the accuracy of the data entry a minimum of two times. Any error found will be corrected before the actual analysis.

To determine the acceptability of the project, the proponents used the FURPS model to evaluate the system:

- Functionality. Determines the extent of the prototype to satisfy its functional specification and meet the user’s objectives;
- Usability. The extent of which the project can be used by the users’ stated objective with efficiency, effectiveness and satisfaction;
- Reliability. The prototype is expected to perform its intended functions with prescribed output;
- Portability. This measure the ability of the prototype to run on different platforms and environment;
- Supportability. It will measure the ability of the technical personnel in providing support and addressing concerns such as hardware and software bugs, and the system maintenance.

To determine FURPS Model evaluation result from the respondents, weighted mean will be used to find out the average of values. The formula is:

\[ M = \frac{\sum X_i}{n} \]  

Where:
- \( M \) – weighted mean
- \( X_i \) – scores
- \( n \) – total number of frequency

The Lickert Scale will be used to interpret the results on system’s functionality, usability, reliability, portability, and usability. Lickert scale is used to survey researches where respondents specify their level of agreement to a statement. These responses were arbitrarily scaled in this study as follows:

<table>
<thead>
<tr>
<th>Scale</th>
<th>Range</th>
<th>Verbal Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>4.51 – 5.00</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>4</td>
<td>3.51 – 4.50</td>
<td>Agree</td>
</tr>
<tr>
<td>3</td>
<td>2.51 – 3.50</td>
<td>Neutral</td>
</tr>
<tr>
<td>2</td>
<td>1.51 – 2.50</td>
<td>Disagree</td>
</tr>
<tr>
<td>1</td>
<td>1.00 – 1.50</td>
<td>Strongly Disagree</td>
</tr>
</tbody>
</table>
Table 1 specifies the level of agreement or disagreement of the correspondents with a particular statement on the survey form. A scale can be created as the simple sum of questionnaire responses.

Prototype testing has been conducted in FEU Institute of Technology with different associates. Eight system specialists, three respondents from Directors and program Coordinator under the supervision of the College of Computer Studies who are directly responsible for the manual creation of schedules and five associates from the Registrar and MIS Department who are also among the end users has been tasked to test and evaluate the system. Fifteen faculty members and students has also participate in the testing and evaluation.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Mean</th>
<th>Verbal Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functionality</td>
<td>4.62</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>Usability</td>
<td>4.69</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>Reliability</td>
<td>4.49</td>
<td>Agree</td>
</tr>
<tr>
<td>Portability</td>
<td>4.42</td>
<td>Agree</td>
</tr>
<tr>
<td>Supportability</td>
<td>4.67</td>
<td>Strongly Agree</td>
</tr>
</tbody>
</table>

The system has been able to create reports and meaningful data interpretation where, for example, if there would be an overlapping of schedules, the system will be able to tell its users. There is a counter of how many classes are plotted for the morning, afternoon and evening time slots. Also, it shows the rate of how many classes per specialization were created. The system must has also able to provide a good algorithm of how assignment of courses, time slots and rooms were allotted to each other. With this, the system has been evaluated strongly agree and agree.

VI. CONCLUSIONS AND RECOMMENDATION

A web-based scheduling system has been designed and developed for collaborative preparation of class schedules at the CCS Department of FEU Institute of Technology. This is to help directors and coordinators to manage the creation of course schedules with the use of a web application that will automate the process of plotting courses.

The study does not cover off-term courses offered to be generated automatically. For such reason, the proponents included manual creation as scheduling options. This study will only focus on the implementation of Greedy algorithm for scheduling management module and does not seek to include other algorithm.

The researchers recommend that future researchers may improve the current prototype through more thorough research and more investigation. Future researchers may also add more features to the system in order to improve and enhance the capabilities of the system making it more reliable and portable.

The proponents would also recommend that future researchers may create a mobile application in any platforms such as android, iOS and Windows Phone OS. Creating such application in different platforms may accommodate and support more users that uses different mobile platform.

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The first author wishes to state that this research would not have been possible without the guidance and the help of several individuals who in one way or another contributed and extended their valuable assistance in the preparation and completion of this research. Special thanks to my mentor Roman De Angel and Dr. Ace Lagman for their unwavering support, time and dedication. Maria Rona Q. Lobo for helping me with the documentation of my research and encouraging me to pursue this study.

REFERENCES