Prioritized Schedule Algorithm : Time Table Generation

Rutuja Popale*, Veeresh Hiremath**, Nityanand B Nishanimath***, Anil Rathod****, Vandana Kale*****,

Jayalaxmi G.N****** and Sujata C******

* ****** Department of Computer Science Engineering, BVB college of Engineering and Technology, Hubli Karnataka,

India

 $\{ rutujapopale, muttu 1789, nbnishanimath, rathoda 125, kalevandana 002 \} @gmail.com$

jaya_gn@bvb.edu, sujata_c@bvb.edu

Abstract: Author's have taken into consideration issues of task allocation and resource selection problem with respect to the minimum processing cost to be an NP-hard problem. The problem of timetable scheduling is described as a highly constrained NP-hard problem. A lot of complex constraints need to be addressed for development of an efficient algorithm to solve this problem. The hand operated system of Time table preparation in college is very monotonous and time consuming which results in either the same teacher ending up with more than one class at a time or a number of classes conflicting at the same classroom. Due to non-automatic perspective absolute utilization of resource has proven ineffective , In order to deal with such problem , mechanized system can be designed with computer aided Time table generator which will serve in many applications .The proposed design of algorithm has the ability to manage Students ,Lecturers, venues, slot and courses of the department, the data given as input is saved in a MYSQL database using a configurable database module and report generation module to generate the best combination of courses and slot for creating a feasible timetable for working days of week, making excellent application of all resource in a way which will be best suited for the constraints.

Keywords: Genetic algorithm, Heuristic algorithm, Prioritized schedule algorithm (PSA).

Introduction

Resource Scheduling and Managing is part of every system and it governs the system. Resource scheduling and management is a NP- hard problem, such problems do not have hundred percent solution. Gaming project assignment, decision subset sum problem, time table formation are examples for NP hard problem. In this article time table formation is taken as the case study for Resource Scheduling problem with the proposed novel algorithm. The main purpose of this research work is to generate a time table with available resources, and has to manage the resources effectively in allocating the time slots.

Even though most college administrative work has been computerized, the lecture timetable scheduling is still mostly done manually due to its inherent difficulties. Most of the institutions are spending a lot of time in preparing the time table for their academic activities. Generating a time table manually is a tedious task and is a time consuming process, automating it will reduce the human efforts involved and will save enormous amount of time. In order to overcome this problem the author has designed an algorithm named PSM Algorithm to automate the process of time table generation.

The automated time table generator can be used in various fields may it be a school, college, IT Company or may be for a personal purpose. As a case study, the algorithm has been tested using the database of Computer Science and Engineering Department of author's institute. Provision is provided to modify the application based on the requirements of the user.

The application handles issues such as collision of resources, fixed slot allocation, allocation of labs and optimal utilization of the resources is done while generating the time table. At first the fixed slots in the time table are allocated manually, the provision of doing this is given only to the administrator. After the completion of this assignment the theory classes are allocated and then the labs are assigned. In the next section of the article the literature survey made during the research is discussed.

Organization of article is as follows: the ordering of article is as follows, section 2 describes survey on time table generation algorithms. The proposed novel algorithm is narrated in section 3 comparative study of different Algorithm in section 4 and article is concluded in section 5.

Literature Survey

Literature survey for this research paper is made on NP-hard problem, Resource management and Scheduling problem.

Anisha Jain, Ganapathy S C Aiyer et el. [1] Methodologies of genetic algorithm is used in combination for the implementation in this article. Genetic algorithms (GAs) are search algorithms that begin with a set of potential solutions. This set then evolves towards a set of more optimal solutions. The proposed paper takes four parameters as input: Person – name of lecturers; Subject – name of courses in the class, Room – name of classes and capacity of each and Time interval – starting time and end time. The system selects one rule with the highest priority to fire, or arbitrarily selects one rule to fire if

there is more than one with the same priority. Intermediate and final reports are generated, the workload is equally distributed among the lecturers, prioritizes time slots according to customized priority are few of the issues handled.

Dipti Shrinivasan [2] This article presents an Evolutionary Algorithm (EA) based approach in solving a heavily constrained university timetabling problem. The approach uses a problem-specific chromosome representation. Heuristics and contextbased reasoning have been used for obtaining feasible timetables in a reasonable computing time. An intelligent adaptive mutation scheme has been employed for speeding up the convergence. The comprehensive course timetabling system presented in this paper has been validated, tested and discussed using real world data from a large university.

Mei Rui[3] mathematical model for the course timetable system is proposed. At the same time, through the use of the pattern recognition technology in artificial intelligence, aiming at this mathematical model a new university course timetable system design program is proposed and realized. This program not only can well solve the shortages of the existing course timetable system, but also is simple and easy to operate, has strong versatility.

Bhaduri A [4] evolutionary techniques have been used to solve the time table scheduling problem. Methodologies like Genetic Algorithms (GAs), Evolutionary Algorithms (EAs) etc have been used with mixed success. In this paper, we have reviewed the problem of educational time table scheduling and solving it with genetic algorithm. We have further solved the problem with a mimetic hybrid algorithm, genetic artificial immune network (GAIN) and compare the result with that obtained from GA. Results show that GAIN is able to reach the optimal feasible solution faster than that of GA

The survey motivates the author to recognize the issues and challenges to solve time table generation on NP hard problem and it is presented in next section.

Proposed System

In order to deal with timetable generation issues the Author's are proposing a system which would mechanically generate timetable for institute. After doing detail study about the literature survey Author's have designed an algorithm which is effective as compared to the one that already exists in [1]. PSM Algorithm is component of research work which produces he HTML based timetable even / odd semester sheet as the output. The project takes various inputs from the user such as Teacher List, Course List, Semester List, Room List, Day List and Timeslot as well as various rules, facts and constraints using web based forms. During design of algorithm the challenges faced by author in designing the algorithm are as follows'

- First problem was, from where to start?
- Second problem was, does it really going to work?

PS Algorithm is generally designed to automate the generation of time table preparation in order to reduce the manual effort and time required in manual preparation. The proposed system is web based to automate the time table preparation. The main modules of the proposed system are Administrator, Data base management & Report generation which are explained in further subsections 3.1, 3.2 and 3.3 respectively

Administrator module

The security feature is very strong, therefore record can be only inserted, updated by Admin & assigning related faculty to that subject. Admin has to login with Password screen includes the username and password. On being entered, the password is evaluated and the entry is given only to the correct password entry and can perform operations and also view Time table. Whereas Staff and Student are not provided with the login and can directly view the master time table & staff time table. 3.1.1 PS Algorithm.

Explanation: In Line 1 Semester and Division is loaded for which the time table has to be generated, line 2 takes all the fixed slots ad calculates the contact hours, Line 3 takes initial weekday as Monday and In line 4 while loop is taken that should execute until weekday=sat, In line 7 initialization of daycount variable takes place, In line 8 it is checking whether daycount is lesser than 4, which means maximum 4 subjects can be allocated on a day. From line 9 to 20 it checks whether slot is free, faculty is free and Resource is free, if all of them are free than allocate it to time table, If either of them is not free than swap it with some other slot or faculty or resource, In line 21 if daycount>4 than increment the weekday to Tuesday and continue from line 4.

Data base management module

The database module[7] handles all Input and output operations to MYSQL database backend such as read, write and delete. It contains all the Tables used by PSM for the storage and retrieval of courses, lectures, venues and other necessary data. ER Diagram for PSM.

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Figure 3.2 PS Algorithm



Figure 3.3 ER Diagram for PSA

TABLES USED FOR PSA

COURSE	Ccode	Sem	Credit	Cname	category	ABBR	Contact	hours	Course_type
COURSE_HANDLE									
RESOURCE	Course	code Staff	id	Sem D	Divname				
DIVISION	Rid	Rloca	tion						
TIME_TABL	Div_id • Tid	<u>Dna</u>	ame <u>Sem</u>	Div name	Slotc coo	<u>de Fs</u>	id <u>R</u> es i	d	



Author has designed tables (Course, Course_handler, Division, Resourse and timetable) as per the requirement for storing the data before and after processing the Algorithm.In course table Primary key considered is Ccode since the code for particular subject is unique, In couse_handler table ccode, sem and div are taken primary key in order to uniquely identify particular course taken by staff for instance same staff may engage same course for both the division so here staffid will not act as primary key.In timetable table all the fields are taken as Primary key except tid in order to uniquely identify each record which represents record after the Algorithm processing which performs the assingment ,here each record should be unique to take care of clashes and tid is used in case of deleting any record.

Report generation module

Report generation module takes the inputs and processes it in order to consider the following features and constrainst

- Hard constraints-
 - A Student should have only one class at a Time
 - A Teacher should have only one class at a time
 - A classroom should be booked only for one class at a time
- Soft Constraints-
 - Courses must be eventually distributed
 - Scheduling of teachers should be well spread in the week.
- Fair distribution of classes to staff
- NO slot clashes
- Always considers the other department slots first
- Considers all the constraints such as resource available, staff available and contact hours.

Snapshots of generated timetable

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		BV	B CSE	TIME TABLE	S			
Clas	sroom :LHC203 08.00 AM TO	09.00 AM TO	10.15 AM TO	11.15 AM TO	12.30 PM TO	01.30 PM TO	02.45 PM TO	03.45 PM TO
MON MON	09.00 AM PCD:CSC222 KARIBASAPPA K G LHC203-4Sem-(B)	10.00 AM JAVA:CSC223 MANJULA PAWAR LHC203-4Sem-(B)	11.15 AM MC:CSC208 A S NAYAK LHC203-4Sem-(B)	12.15 PM ADDS:CSE350 PARIKSHIT P HEGDE LHC203-6Sem-(B)	01.30 PM	02.30 PM	03.45 PM	04.45 PM
TUE	JAVA:CSC223 MANJULA PAWAR LHC203-4Sem-(B)	MC:CSC208 A S NAYAK LHC203-4Sem-(B)	CN:CSC320 VIJAYLAKSHMI M LHC203-6Sem-(A)	ADBMS:CSE308 VIJAY S BIRADAR LHC203-6Sem-(B)	BR	L L L L L L L L L L L L L L L L L L L	3	
WED	MC:CSC208 A S NAYAK LHC203-4Sem-(B)	CN:CSC320 VIJAYLAKSHMI M LHC203-6Sem-(A)	E OS:CSC321 A SHANTALA G K LHC203-6Sem-(A)	CN:CSC320 PADMASHREE DESAI LHC203-6Sem-(B)	E A K	1	E X	
THU	CN:CSC320 VIJAYLAKSHMI M LHC203-6Sem-(A)	OS:CSC321 SHANTALA G LHC203-6Sem-(A)	CN:CSC320 PADMASHREE DESAI LHC203-6Sem-(B)	OS:CSC321 NAGARATHNA D KULENAVAR LHC203-6Sem-(B)				
FRI	LI:CSE432 G S HANCHINMANI LHC203-8Sem-(B)	NS:CSE429 S I BATTUR LHC203-8Sem-(B)						
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Figure 3.5 view of class time table

From the above snapshot it gives a view of number of subjects schedule in the week along with the details of staff who is taking a particular subject, staff who is intended to take, Subject code, duration(slot), semester and division so that one can get an idea of scheduled classes in a particular classroom for the week.

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SCRURGET	BVB CSE TIME TABLES							
STAFF IDBFBCSE014 STAFF INAMEUALDEPIT M QUALFICATION-MSRITALIVT PROF DESIGNARTIONMSRITALIVT PROF								
TIME WEEK	08.00 AM TO 09.00 AM	09.00 AM TO 10.00 AM	10.15 AM TO 11.15 AM	11.15 AM TO 12.15 PM	12.30 PM TO 01.30 PM	01.30 PM TO 02.30 PM	02.45 PM TO 03.45 PM	03.45 PM TO 04.45 PM
MON			MC:CSC208 UMADEVI F M LHC201-4Sem-(A)					
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Figure 3.6 view of staff time table

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From the above snapshot a staff can get a view of the schedule classes which particular staff is intentded to take with information that contain staff id,staff name,staff Qualification,Staff designation, subject name,Subject code,duration(slot),semester ,division and class room number so that one can get an idea of scheduled classes in a particular classroom for the week.



Figure 3.7 Statistics view

Statistics view gives a view of whether number of particular subjects are allocated as per the contact hours specified or its overloaded /under loaded and specifies it as "UNDER FIT" if less classes are allocated than the contact hours, "OVER FIT" if excess classes are allocated than the contact hours and "BEST FIT" allocated classes are equal to contact hours.

Author has tested the Algorithm using data from CSE department in the Authors Institute, Author has solved 80% of the issues which come under automatic time table generator with very least human interaction. The proposed system provides simple data entry, reduces time consumption and the effort in framing the timetable manually. The benefits of this approach are simplified design and reduce development time .After analyzing the result and comparing with existing algorithm ,Algorithm suggested by Author take various advantage over the existing one which can be seen in further page.

Result Analysis

Author's are using various tools[6] during the implementation of the Algorithm which includes the following.

- Data base used is MYSQL, since it is a open source database system, occupies less space on disk and can be installed in all major operating system.
- JavaScript is used for providing alert message and pop up message if any invalid entry.
- PHP is used for server side scripting since one can connect to database easily and it is relatively fast.
- Jquery and CSS are used for creating Animation for WebPages and also border and shadow applied for data submission form.
- Graph for comparison of GA,HA and PSA in terms of performance and working



Algorithms

Figure 3.9 Comparison of GA,HA and PSA in terms of time

Parameters	Genetic Algorithm	Heuristic Algorithm	PS Algorithm.		
Performance	Good	Better	Better		
Time taken	High	-Less when plenty resource -high when less resource	Least		
Deployment status	NO	Yes	Yes		
Availability of number of resource handled	NO	Yes, Two approaches proposed, one to be used when scarce resource and other when plenty of resources available	All resources are consider fixed		
Weekday Consider	Generalized	Works for 5 days in a week.	Works for 6 days in a week.		
Constraints under consideration	-Most trivial: Teacher must not be present in more than one class during the same time slot - Classroom should not be double booked - Classroom must be large enough to hold the strength for each class -Labs should not be double booked	-Most trivial: Teacher must not be present in more than one class during the same time slot -There is a limit on the number of people that can be accommodated in a room	 The system generates intermediate level as well many final reports including weekly time table, teacher timetable, room wise time table, student time table, department level time table etc. It distributes workload of lectures equally among all the specified time -avoid the conflict or overlapping class slots. To take care of assigning classes so that overlapping of class should not happen, since the number of class rooms and labs are fixed To handle reserved slots (Humanity department, Math's or other departments) which will have reserved time slots so the regular classes should not overlap. 		

Table 1. Comparison study of authors algorithm(PSA) with existing ones that is GA and HA

The Genetic algorithm solution is time consuming. Also, in cases where resources are scarce, the time required maybe considerably high. The HA proposes a practically implemented approach that deals with both, the abundance as well as scarcity of resources. The third PSA based algorithm reduces time taken for generation of timetable.



Figure 3.10 Comparison of GA, HA and PSA in terms of performance

This Graph depicts the working efficiency of GA,HA and PS Algorithm, The GA is not deployed and provides only 65% of solution. The HA is providing 72% of working solution and has been deployed. Whereas PSA provides 85% of solution considering all the constraints.

This graph depicts GA does not consider any resource to be handled ,HA provides 2 solution one when scarce resource and another solution when plenty of resources are used, and PSA uses all the available resources.



Figure 3.11 comparison study in terms of resource usage

Conclusion

As discussed PS algorithm for automatic time table generation has been proposed. The intention of the algorithm to generate a time- table schedule automatically is satisfied .By automating this process with the help of computer assistance timetable generator can save a lot of precious time of administrator who are involved in creating it and are much more accurate ,precise than the ones created manually. The proposed algorithm considers all the soft and hard constraints and assigns classes so that overlapping of class never happen, since the number of class rooms and labs are fixed and also enables fair distribution of classes to staff.

Author's have used real data of CSE department of Authors Institute to test the method and have derived the conclusion that it is functioning efficiently.

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References

- [1] Anisha Jain, Ganapathy S C Aiyer et el. A Literature Review on Timetable generation Algorithms based on Genetic Algorithm and Heuristic approach, Computer Engineering, MPSTME, Mumbai, India
- [2] Dipti Shrinivasan "automated time table generation using multiple context reasoning for university modules" Published in: evolutionary computation, 2002. cec '02. proceedings of the 2002 congress on (volume:2)
- [3] Mei Rue Computer and Automation Engineering (ICCAE), 2010 The 2nd International Conference on (Volume.4)
- [4] Bhaduri a "university timetable scheduling using genetic algorithm". Advances in Recent Technologies in Communication and Computing, 2009. ARTCom '09. International Conferenc
- [5] Simon Robinson, Christian Nagel, Jay Glynn, Morgan Skinner, Karli Watson, Bill Evjen "Professional C#", 3rd Edition, Wiley Publishing, Inc 2004 [7] Silberschatz, H. Korth and S. Sudarshan, "Database System Concepts", 4rth Edition, McGraw-Hill International, 2002.