

Automatic scheduling using Forward Chaining for Ethics Protocol Review

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Abstract

Research involving humans as the object has to follow ethics protocol. This protocol has to be reviewed by the research ethics committee before the research can be conducted. Though the mechanism for determining the protocol reviewer is simple, there are several obstacles, including the unbalanced workload of each reviewer, the empty schedule because the reviewer is busy or has other tasks, and the length of time it takes to determine the schedule manually. There needs to be a system that can see various obstacles and challenges in scheduling protocol reviewers and resolve them automatically. This paper proposes an automatic scheduling mechanism with a Heuristic Forward Chaining approach that can adjust the rules for determining reviewers from real experts and avoid the constraints that exist in the manual scheduling system. The proposed method is made in the form of a web application and can practically generate accurate schedules automatically.

Keywords: ethics protocol review, forward chaining, automatic scheduling.

1 Introduction

Research involving humans, whether in medical, social or other fields, has to follow research ethics contained in the research ethics protocol. This document must state clearly any possible ethical issues such as subject approval, data protection, equality, accessibility and other ethical issues [1]. According to the World Health Organization (WHO), a review of ethical protocols must be conducted by following the seven ethical standards [2]. This review was carried out by a research ethics committee [3].

Nowadays, the number of research involving humans as a subject has increased significantly. Thus, the need for a massive review process with adequate reviewers has also increased. However, the availability of each ethics reviewer is different because a reviewer also has their respective activities. In addition, reviewing incoming protocols must also run properly according to applicable regulations. If the scheduling is done manually, errors may occur in the preparation, and when there are too many incoming protocols, it will be inconvenient. Therefore, an automatic scheduling model is needed for reviewers so that each reviewer can get a review schedule according to their availability and can also distribute the protocol to each reviewer more evenly.

Many researchers have proposed various automatic scheduling mechanisms with different algorithms. Optimizing scheduling methods that compare the Earliest Due Date (EDD) scheduling method, Critical Ratio (CR), and First Come First Serve (FCFS) were used for optimizing production processes [4]. Scheduling exams using a Genetic Algorithm was proposed to create a genetic model of exam scheduling problems. A genetic algorithm can be an alternative solution to exam scheduling problems. The test schedule is obtained from the best fitness value chromosome [5]. Automatic lecture scheduling using Fuzzy Logic and Genetic Algorithm has been proposed [6]. In that study, Fuzzy Logic for scheduling applications can be concluded that adding fuzzy logic to the crossover and mutation operators in the genetic algorithm can improve the performance of the genetic algorithm. The Particle Swarm Optimization (PSO) algorithm has also proposed automatic course scheduling. It was used as a scheduler tool that produces a schedule table meeting all mandatory criteria and can accommodate lecturers' preferences in choosing teaching time. This model is very helpful for scheduling tasks that are quite complex so that scheduling tasks can be done automatically faster [7].

Research protocol describes what will be done in the research and has to meet seven ethical standards. In each section, the protocol describes in detail the research components and how it will be carried out [8]. The research protocol is prepared in as much detail as possible. It can be said to be more detailed than the proposal because it is a medium to equalize the understanding of all parties involved in the research and becomes a guideline for research members or other parties in carrying out research. The steps and points that must be reviewed also vary. There are six stages of the review protocol framework [9], namely: (1) identifying research questions, (2) identifying relevant studies, (3) selecting studies, (4) mapping data, (5) compiling, summarizing, and reporting results, and (6) consulting.

With so many protocols to review, reviewers need time to do a review. On the other hand, the review process should be done within a certain time so the researcher can conduct their research on time. It has become a challenge for the ethics review committee to schedule the review process. Moreover, the availability of each reviewer is different. Some reviewers can review daily during workdays, and some can only be given a protocol for review on certain days. The speed and capacity of each reviewer also vary depending on each reviewer's capacity and experience. Due to the complexity of protocol review requirements, a system that can automate scheduling will be very helpful.

No previous research has discussed the manufacture of automatic scheduling for protocol review. Therefore, this research focuses on the automatic scheduling method for reviewing research protocols by approaching the forward chaining method and several rules that will be discussed in section 2. The source of the reviewer scheduling rules comes from experts in the field of protocol review. Then from the predetermined scheduling methodology design, a database is created and applied to a website with several inputs and generates a schedule automatically with predetermined rules.

2 Research Method

Figure 1 illustrates the research method. First, we did a literature review on the method that can be used to solve the scheduling problem of ethics protocol reviews by the ethics committee. Secondly, we design the system using the forward chaining method. Subsequently, the database design was conducted to create an Entity Relationship Diagram. Then, we implemented the scheduling system and did some experiments using a study case. Finally, the result of the experiment will be analyzed.

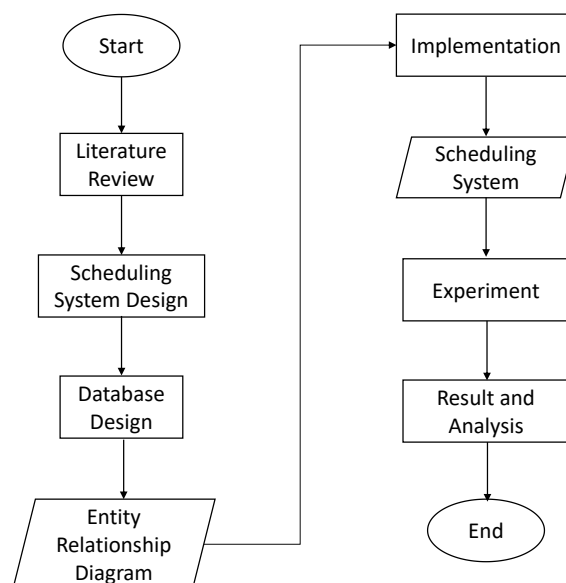


Figure 1. Research Method

2.1. Problem Analysis

In this section, we will analyze problems with scheduling review protocols. Scheduling is a technique that supposes to organize leaving assets. Scheduling proposes to sort out or allocate [10]. The scheduling mechanism aims to organize or give existing resources to operate some tasks within a certain timeframe [11]. Before conducting research, researchers must meet certain rules so that the research carried out is in accordance with procedures and can be accounted for. A proper research protocol is one of the important aspects that need to be considered by researchers, especially if the research subject is human. At an institution, the research will be in large numbers, and various topics will be studied, so it requires a scheduling system that can accommodate automatically. The main rules for the automatic scheduling system in this study are as follows: (1) The schedule availability for each reviewer is different; (2) Every incoming protocol must be reviewed within five working days of the protocol submission; (3) Each protocol has to be reviewed by 5 reviewers where it takes 2-5 days to review; (3) Each reviewer receives a maximum of 3 protocol reviews at a time; (4) The division of the review burden is made equally for all reviewers in a year; (5) The maximum limit for the protocol that has been reviewed is 20 working days since it was submitted and if the protocol has not been reviewed within 20 working days from the date of entry, a recommendation is given to add more other reviewers.

The proposed system will generate a timetable for each reviewer to review several protocols assigned within a certain period. The administrator will set the schedule for each necessary change, namely one-by-one input of reviewer availability. In this study, forward chaining is used to formulate the algorithm of the proposed automatic scheduling system. This automatic scheduling system will be built using a web-based application as a platform for the function of the integrated distribution system.

2.2. Forward Chaining

A forward-chaining algorithm is a method that uses inference (a decision-making engine) and can logically be described as an application of modus ponens (a set of inference rules and valid arguments) [12]. The opposite of forward chaining is backward chaining. We use forward chaining because we must use data first to make the schedule. The schedule is based on the data given. The rule of schedule is obtained from experts in the field of protocol review.

Forward-chaining uses inference rules to get a certain decision or conclusion using available data or information. The inference engine will search for inference rules until the true antecedents were found (hypothesis proposition or IF-THEN clause). When the rule is found, a conclusion or consequence (THEN clause) can be produced where the additional information is generated from the data provided. This process will be repeated until the target is found.

The simplicity of forward chaining algorithms made this algorithm widely used in expert systems such as for diagnosing disease [13], motorcycle damage [14], or determining student learning styles [15]. In addition, this algorithm has also been used for lecturer scheduling [16] and project presentation scheduling [17].

2.3. Automatic Scheduling

1) *Scheduling Mechanism*

Figure 2 explains that the protocol review scheduling mechanism starts when a protocol enters. After the protocol enters the scheduling system, it will automatically look for available reviewers for five working days and then look for those available that day. If it does not meet the required number of reviewers, it will take the available reviewers on another day which means they are available within four working days. However, if it still does not meet the required number of reviewers, a search process for available reviewers is carried out in 3 working days. Still, if it does not meet the required number of reviewers, a search is carried out within a minimum of 2 working days. If the search for two working days does not find the correct number of reviewers, the incoming protocol will be included in the queue the next day.

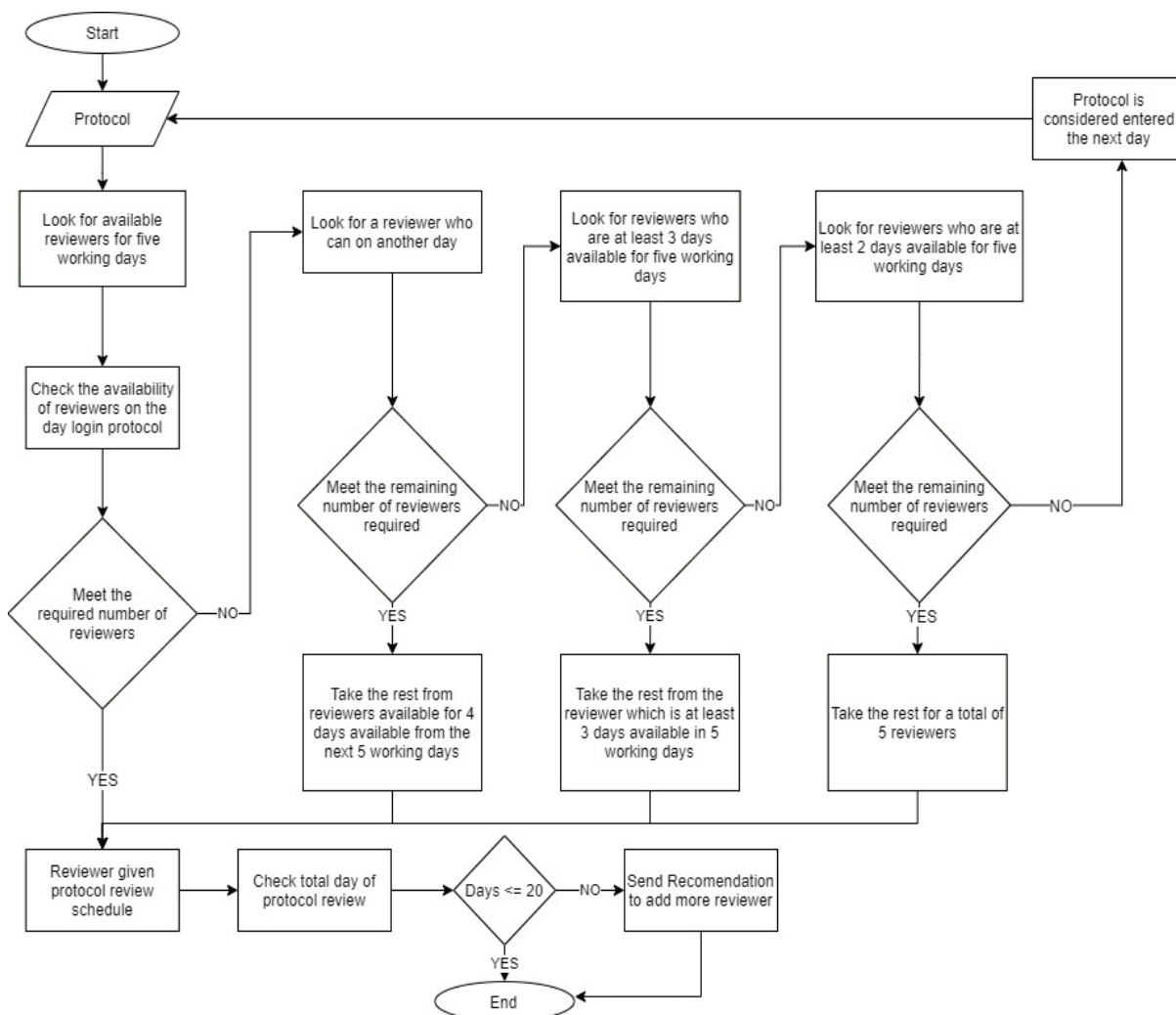


Figure 2. Automatic Scheduling Mechanism

In this study, the minimum duration for reviewers to review the protocol was two days. As mentioned earlier, a reviewer also has other activities, giving them at least two days to review the protocol. It would be impossible if the protocol were given for review on that day, but it must be completed on the same day. Therefore, a minimum of 2 working days to review a protocol is worth implementing.

2) *Reviewer Selection Mechanism*

Previously, a mechanism has been shown to find only available mass reviewers and then select until the number matches the required number. In each protocol review cycle, a minimum number of different reviewers can be determined, which can be 3, 5, 7, and so on. The number of reviewers reviewing the protocol must be odd because it is to determine whether the protocol is eligible to pass or not. If the number of reviewers turns out to be even, then there may be a balanced number of reviewers who passed and did not pass, so it would not be easy to determine. In this study, we use five reviewer cases for evaluating the algorithm.

In the search for available reviewers, it can be seen that the number is more than needed. For example, a protocol needs five reviewers. Still, it turns out that there are ten reviewers available. Thus, a reviewer selection mechanism is needed so that later the number of protocols reviewed by each reviewer is the same or not too far apart.

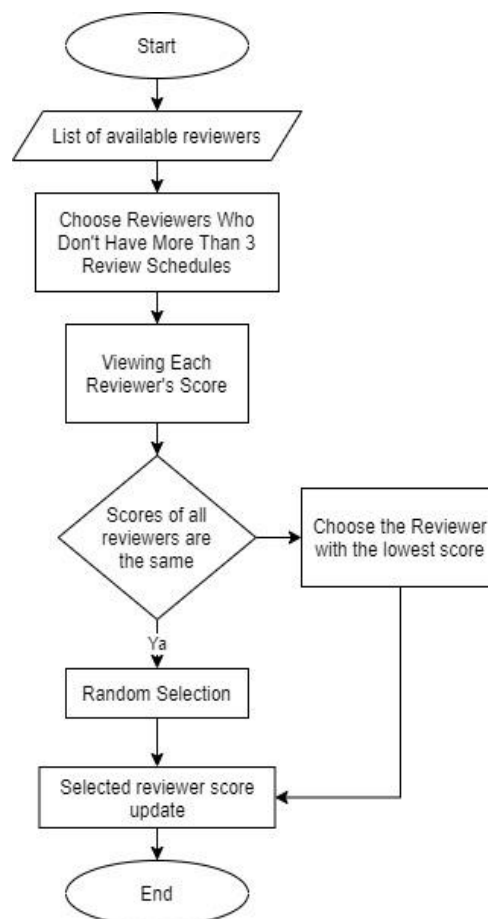


Figure 3 Available Reviewer Selection Mechanism

Figure 3 describes the mechanism for selecting reviewers. When the reviewer search mechanism has been carried out, and it turns out that above five reviewers, it will be seen whether the selected reviewer has received three review schedules on the same day. If the reviewer has received three protocol review schedules, they will not be selected for another schedule. The capabilities and burdens obtained by each reviewer are very important in this automatic scheduling so that the reviewer does not get a review schedule of more than three protocols and the workload received is not too heavy. If all the reviewers have three schedules, the protocol submitted that day would be counted as the next day. Then, after the available reviewers have not received three review schedules, each review's score or the number of protocols will be considered. Then, if it turns out that the total score of each reviewer is the same, a random selection will be made. However, if they are not the same, the reviewer with the lowest score will be selected, followed by the second-lowest score, and so on, until it meets the required number. Subsequently, the selected reviewer will get an additional score of burden, and it will have more scores according to the number of protocols that have been reviewed.

3 Results

3.1. Entity Relationship Diagram (ERD) Design

Figure 4 shows the Entity Relationship Diagram, which was built to store every data needed to implement Automatic Scheduling. Then, the method proposed in this article is applied as a website platform that can be accessed by users, reviewers, and administrators. Each type of login access has its function and access rights. Ordinary users can only add and submit articles to be reviewed. The reviewer can apply for a *day_off* with the aim that on the day the reviewer is absent, he will not receive a scheduled review. Meanwhile, the administrator can access all the functions and features on the website.

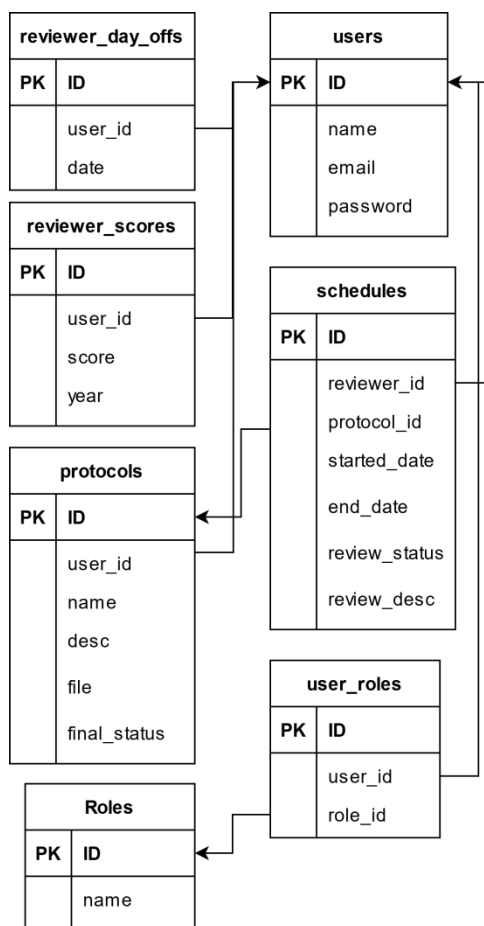


Figure 4. ERD of Automatic Protocol Review Scheduling

3.2. Experiments

The experimental method is to add one administrator, ten reviewers, and nine users. Each reviewer will be given the same initial score, which is 0. Some reviewers will be given a *day_off* which means that the relevant reviewer is unable to review on that day. Some reviewers do not have a *day_off* which means they can review daily. Next, a user mechanism will upload the protocol into the system so that the protocol can be scheduled according to the proposed method.

Out of the nine reviewers, reviewer1 to reviewer5 were given a *day_off* of 1 consecutive day each in the first week. Then reviewer six was given a whole *day_off* mechanism in the second week. Reviewers 7-9 are not given *day_off* to know the total number of protocols accepted in full if the reviewer does not apply for *day_off* at all, he can review every day.

After the reviewer is given the *day_off* mechanism, the process of giving the protocol from users 1-9 is carried out. Each user inputs at least one protocol and can enter more than 1. Then see the results of the Automated Scheduling process with the proposed mechanism.

The trial process of the automatic scheduling mechanism for the Review protocol was carried out using a web-based application. Figure 5 is one of the front-end views that shows examples of protocols that have been entered. The lock icon with a red background indicates that the protocol has been locked and scheduled automatically according to the proposed mechanism. In contrast, the green lock icon means that the protocol has not been locked or scheduled.

Based on the experiments carried out, each protocol that was entered managed to get its schedule and reviewers who were unable to review were not included in the review schedule. Each reviewer who has completed their review schedule will receive an additional score so that the search for the next automatic schedule can be used as a reference so that each reviewer has the same workload.





















No	Protokol	Desc	Status	Masuk	Aksi
1	Pro1	Des	1	2021-07-01 13:13:27	 
2	Pro2	Des	1	2021-07-01 13:13:45	 
3	Pro3	Des	1	2021-07-01 13:14:02	 
4	Pro4	Des	1	2021-07-01 13:14:43	 
5	Pro5	Des	1	2021-07-01 13:15:16	 
6	Pro6	Des	1	2021-07-01 14:04:20	 
7	Pro7	Des	1	2021-07-01 14:04:35	 
8	Pro8	Des	1	2021-07-01 14:04:51	 
9	Pro9	Des	1	2021-07-01 14:05:05	 
10	pro1_2	Des	0	2021-07-05 14:29:45	 

Figure 5. The Example of Submitted Protocols

4 Conclusion

This paper proposes an automatic scheduling mechanism for protocol review by implementing the Forward Chaining method with some predefined rules. In the experiments that have been carried out, the proposed method can implement Automated Scheduling properly according to the conditions that have been given. Reviewers who enter *day_off* on a certain date will not automatically be given a protocol review schedule. Reviewers will also not get a schedule of more than three protocol reviews in one day. However, this scheduling system is still used in a simple case study. Our work is indeed able to schedule review protocols automatically, but it can still be developed for more complex problems. For example, if the reviewer can only receive one review schedule in 1 day or other unique circumstances, it can better adjust the situation in each organization. In addition, it can be tested in several ethics committees to see if there are different conditions in each committee.

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