Application of linear congruent method in try out examination based on web application

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Abstract. Passing the national examination is the main target for all students who are going to finish their high school. There are a lot of ways to get it, such as: taking course, get private learning, and do try out examination. Try out examination is a mechanism that is used as an exercise for students before carrying out the actual examination. But there are limitations of time, place, and money in having it. Not all students have a change to do it in a specified time or place, or have money to take it. In order to overcome these problems, we offer an application that could be used anytime and anywhere in low cost as long as they have internet connection with them. The application would be based on web and could be repeated whenever they want. Due it could be taken repeatedly, the questions should not be same every time they would do it. That’s why we propose linear congruent method as this method could produce random number. Practical advantages from these methods are: speed, ease of implementation, and availability of portable codes, parameters, and test results.

Keywords: linear congruent method, examination, application, try out, website

1. Introduction

Examination is intended to measure the knowledge of a person or student. It is also used as an evaluation tool to assess how far the knowledge has been mastered and the skills that have been acquired. Every student could pass it before they get into an higher level. A lot of exercises should be done to achieve the passing grade in an examination, that’s usually called try out examination. Try out examination is made just like the actual examination and it is intended to make students get familiar it. Of course there are time and money needed also a place should be allocated to make it happen.

And the problem would come if we talk about those three things above. Some students do not have an ability to get in a specified time or place that the try out examination would be taken. Or even worst, they do not have enough money to take it repeatedly. There should be any ways to figure this out, and one of them is making the examination dynamic and in a low cost.

Nowadays, internet is used in everything and it’s not an expensive thing to have. We could share information through internet so everyone in all over the world could know it. It is dynamic not static. We could use the internet to do the try out examination so students could do it in anytime and anywhere. The only thing they need is internet connection to access it and it would not cost them much. Just place the examination on a website, let the students doing the exercises.
As it could be accessed anytime and repeatedly, there are a lot of questions should be placed in the application. The questions come differently for each time students access the website. They are randomized and arranged like the actual examination. So the students really have the examination like the actual one. There is a method that we suggest to set the appearance of each question, it’s called linear congruent method.

Linear congruent method allows us to have random number to perform. It is easy to be implemented, fast, and provide the availability of portable codes, parameters, and test results. This method would be implemented in an application of the try out examination where has 120 questions in it, majoring Bahasa, English, and Maths.

2. Theory

2.1. Linear Congruent Method
Linear Congruent Method (LCM) is a method of generating random numbers that is widely used in computer programs. One of the characteristics of this method is that there is a repetition in a certain period of time or after several times of generation (Sulindawaty, 2011).

According to Zeenat Mahmood, et al (2012), “Linear congruent method is the most well-known and most widely used algorithm to generate random numbers. Its practical advantages are speed, ease of implementation, and availability of portable codes, parameters and test results.”

DH Lehmer in 1948 proposed a linear congruent generator as a source of random numbers. In this generator, each single number determines its replacement by placing of a simple linear function followed by a modular reduction. Although this generator is limited to its ability to produce flows of very long numbers that seems to be independent realization of a similar process, it is the other basic element, the generator is more adequate. Understanding the characteristics is needed in order to use them to build better generators (James E. Gentle, 2003).

The form of a linear congruent generator is:

\[ X_{i+1} = (a \cdot X_i + c) \mod m \]  

where:
- \( X_{i+1} \) = New random number
- \( X_i \) = Initial random number or previous random number
- \( a \) = constant multiplier
- \( c \) = increment number
- \( m \) = modulus number

Source: James E. Gentle, 2003

To overcome the occurrence of repetitions over a certain period of time, the determination of the LCM constants (a, c and m) greatly determines whether random numbers obtained are suitable or not in the sense of obtaining random numbers as if there are no repetitions. In this linear congruent method the random number will have a full period and vary if it meets the following requirements:

1. A constant must be greater than \( m^{1/2} \)
   And usually stated by the terms:
   \[ \frac{m}{100} < a < (m - m^{1/2}) \]
2. Constants \( c \) must be an odd number if \( m \) is of the power of two. It must not be a multiple of \( m \)
3. Modulo, prime numbers are recommended so that the calculations in the computer make it easier to run smoothly
4. Number \( X_0 \) must be an integer number.

Comparison of the occurrence of repetitions on the LCM between the selections of LCM constants that do not meet the requirements for determining constants with other that meet can be done by conducting an experiment.

Examples:
a. Generate random numbers 8 times, where:
   \[ a = 2; c = 7; m = 10 \text{ and } X(0) = 2 \]
   
   \[
   \begin{align*}
   X(1) &= (2 \times 2 + 7) \mod 10 = 1 \\
   X(2) &= (2 \times 1 + 7) \mod 10 = 9 \\
   X(3) &= (2 \times 9 + 7) \mod 10 = 5 \\
   X(4) &= (2 \times 5 + 7) \mod 10 = 7 \\
   X(5) &= (2 \times 7 + 7) \mod 10 = 1 \\
   X(6) &= (2 \times 1 + 7) \mod 10 = 9 \\
   X(7) &= (2 \times 9 + 7) \mod 10 = 5 \\
   X(8) &= (2 \times 5 + 7) \mod 10 = 7
   \end{align*}
   \]

   The random numbers that are generated are:
   
   1, 9, 5, 7, 1, 9, 5, 7

   Could be seen in the experiment above there is a periodic loop at the LCM.

b. Generate random numbers 8 times, where:
   \[ a = 2; c = 7; m = 13 \text{ and } X(0) = 3 \]
   
   \[
   \begin{align*}
   X(1) &= (2 \times 3 + 7) \mod 13 = 0 \\
   X(2) &= (2 \times 0 + 7) \mod 13 = 7 \\
   X(3) &= (2 \times 7 + 7) \mod 13 = 8 \\
   X(4) &= (2 \times 8 + 7) \mod 13 = 10 \\
   X(5) &= (2 \times 10 + 7) \mod 13 = 1 \\
   X(6) &= (2 \times 1 + 7) \mod 13 = 9 \\
   X(7) &= (2 \times 9 + 7) \mod 13 = 12 \\
   X(8) &= (2 \times 12 + 7) \mod 13 = 5
   \end{align*}
   \]

   The random numbers that are generated are:
   
   0, 7, 8, 10, 1, 9, 12, 5

   Could be seen in the experiment above there is no periodic loop.

2.2. Application

According to Hendrayudi (208: 143), "Application is a collection of program commands that are made to carry out certain jobs". Another definition of the application is a collection of programs that are made to do certain jobs instructed by users, or it can also be said that the application is software that is made to help human works. Besides being able to help and accelerate the human work process, applications can also produce more accurate results in solving a problem.

Before applications on computers can run as sophisticated as they are today, all software used to rely on Boolean Algebra. Algebra uses binary digit code (bit) which consists of two numbers, namely 1 (true / on) and 0 (wrong / off). The complexity of using this binary digit code made people start making bit groups. The presence of bit groups was quite helpful in various activities carried out on computer software. With various bit groups available, people began to assemble these codes into various instructional structures such as transfer, logic operations, and storage, so that eventually new codes were formed which we know as assemblers. These assembler codes are pioneer of the development of various kinds of applications that can facilitate various human activities now.

2.3. World Wide Web (WWW)

World Wide Web (WWW), which much known as the web is one of the services obtained by computers users which connect to the internet with hypertext facilities to display data in the form of text, images, sounds, animations and other multimedia data. So, web is information space on the internet, using hypertext technology, users are guided to find information by following the links provided in web documents which is displayed in web browsers (Yeni & Devie, 2010: 3).

The advantage of web applications is it can be accessed anytime and anywhere as long as there is internet connection only by using a web browser. Meanwhile the disadvantage is its interfaces can be limited to standard specifications for creating web documents and the limitations of the web browser's ability to display them. Another disadvantage is the limitation of internet speed that might be makes slow response of the application.
The difference between desktop-based applications and web-based applications is the way they should have to optimize their speed and performance. In desktop-based applications, increasing speed and performance of applications could be done by optimizing memory usage, process management and input-output settings. Meanwhile in web-based applications, the factors that determine application performance are database access speed and internet connection access speed.

2.4. PHP (Hypertext Preprocessor)
PHP (Hypertext Preprocessor) is a scripting language that is planted and executed on the server side. When a page is opened and contains PHP code, the processor will translate and execute all commands on the page, and then display the results to the browser as a normal HTML page. Because this translation occurs on the server, a page written in PHP can be seen using all types of browsers, in any operating system (Prasetio Adhi, 2012: 17).

2.5. MySQL
MySQL is a Relational Database Management System (RDMS) that is distributed free under the GPL (General Public License) where everyone is free to use MySQL, but may not be made as a closed source or commercial derivative product. MySQL is actually a derivative of one of the main concepts in database for a long time ago, namely SQL (Structure Query Language). SQL is a concept of operating a database, especially for finding, selecting and opening data, which allows operation of data easily and automatically.

MySQL is open source software, so the people can participate in developing the MySQL database engine and this is one of the reasons why its capabilities and performance grow so rapidly. The use of MySQL is not only for desktop-based applications but also web-based ones. There are a lot of websites, whether commercial or not, small range to large one, using MySQL in their applications.

3. DISCUSSION AND RESULTS
The application of linear congruent method on this web-based try out test application is designed with the following stages:
1. Literature
   Reading some literatures related to the theory of linear congruent method, applications, websites, system analysis and design, and try out examinations that are needed in making applications and their implementations.
2. System Analysis
   Conduct an analysis of all system requirements, starting from the analyze the existing system, system requirements, system roles, and system implementation if it has been built.
3. Application design
   Application design includes the design of UML (Unified Modeling Language), database, implementation of Linear Congruent Method, program algorithms, and application interfaces.
4. Application implementation
   Determine the hardware and software that are suitable to run the application, do installation, test and maintain the applications.

The designed try out application is divided into 3 (three) sections, which are: users’ page, examinees’ page, and administrator’s page.

3.1 Users’ Page
This is the first page for user who visit the website, it can be seen in Figure 1.
Figure 1 shows a login form and registration form for users who want to take the try out examinations. The registration form is used by web visitors or prospective examinees to register themselves as examinees. The login form is used by examinees who have registered to enter the examinees’ page.

3.2 Examinees’ Page
This page is a special page for users who have registered on Users’ Page, the examinees. It only can be accessed if the examinees give the right combination of username and password they have registered before. If the examinees have logged in, they can do all the activities related to the try out examination. The appearance of this page is shown in the following Figure 2.

Figure 2 shows the main pages of the examinees’ page where there has 4 (four) menus, which are: Start the Examination (Mulai Ujian), View the Examination Schedule (Lihat Jadwal Ujian), View the Examination Results (Lihat Hasil Ujian), and Log Out.
Figure 3. Start the examination menu

Figure 3 shows examination form that is used to depict questions for the examinees and some buttons to choose in answering the questions.

![Figure 3](image)

Figure 4. Examination schedule menu

Figure 4 shows the examination schedule for examinees who want to take the try out examination. It shows its date, beginning time, and ending time.

![Figure 4](image)

Figure 5. View the examination result menu

Figure 5 shows examination results of the examinees in order they could find out scores of the examinations they have done. To see this score, examinees must choose which schedule to display.

3.3 Administrator’s Page

Administrators’ page is a private page that is confidential, because this is the page where the administrator works. The administrator can add data, edit and delete existing data. Because of its confidentiality, it can be accessed by unauthorized person. There is an identification process to get in it.

![Figure 6](image)

Figure 6. Administrator’s page

Figure 6 is the administrator’s page that has some menus on it. Here with the following menus:
1. Examinees data, is a page for adding, editing and deleting examinees data
2. Test question data, is a page for adding, editing and deleting test questions
3. Test schedule data, is a page for adding, editing and deleting test schedule data
4. Confirmation data, is a page to view data on users who have registered but have not been confirmed
4. Conclusion
Application of try out examination is designed to help students to do exercises in facing national examinations without limitation of time and place with relatively low costs. By applying linear congruent method, the questions displayed for each examinee will be different. In other words, the examination questions displayed will be more varied. Through web-based application for try out examination, examinees can do exams from different places and have flexibility of time according to the schedule provided. Moreover, they can take the try out examinations repeatedly, as much as they want. It’s really save money than they take paper based try out examinations.

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