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DEVELOPMENT OF A TRAINING SIMULATOR FOR SYSTEM ANALYSIS IN THE FORM OF A CHAT-BOT

The strategic goal of educational institutions is the development of an electronic educational resource for learning, where all participants in the educational process will have equal access to mastering and practical testing of the studied materials. One of the effective methods for improving the assimilation of theoretical material and practical skills is the use of exercise programs during the educational process. The article deals with the development of an educational simulator for the distance learning course "System Analysis and Theory of Decision-Making". Methodology. Theoretical materials of the distance course, the PyCharm integrated software environment, and the Python programming language have been used. Results. In the work, a simulator program for the distance learning course "System Analysis and Decision Making Theory" has been implemented. Design and development is carried out in the PyCharm integrated environment in the Python programming language. The simulator program includes a theoretical reference, a condition of the problem, which is a task, and a number of sequential questions to solve it. Scientific novelty. The developed software product performs educational and monitoring functions. The simulator is implemented in the form of a chat bot in Telegram. The study proves that this application format is the most common among education seekers and does not require additional instructions. The methodology for developing program elements also demonstrates the step-by-step process to creating a simulator. Practical significance. The developed software product is implemented in the corresponding course of the distance learning system on the Moodle platform of the Poltava University of Economics and Trade and is recommended for use by applicants in the specialty "Computer Science" in the educational process when studying the discipline "System Analysis and Decision Making Theory"

Innovative teaching methods help applicants to fill knowledge gaps on their own without the use of additional classroom time or the help of a teacher.

Key words: distance learning, simulator-bot, higher educational institution.

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РОЗРОБКА НАВЧАЛЬНОГО ТРЕНАЖЕРУ З СИСТЕМНОГО АНАЛІЗУ У ВИГЛЯДІ ЧАТ-БОТУ

Стратегічною метою навчальних закладів є розробка електронного освітнього ресурсу для навчання, де всі учасники освітнього процесу матимуть рівний доступ до освоєння та практичної перевірки вивчених матеріалів. Одним з ефективних методів для підвищення засвоєння теоретичного матеріалу та практичних вмінь і навичок є використання програм-тренажерів під час навчального процесу. У статті розглянуто розробку навчального тренажеру дистанційного навчального курсу «Системний аналіз та теорія прийняття рішень». Методика. Використано теоретичні матеріали дистанційного курсу, інтегроване програмне середовище PyChart, мова програмування Python. Результати. У роботі реалізовано програму-тренажер дистанційного навчального курсу «Системний аналіз та теорія прийняття рішень». Проектування та розробка здійснена в інтегрованому середовищі PyChart мовою програмування Python. Програма-тренажер включає теоретичну довідку, умову завдання, що представляє собою задачу та низку послідовних запитань по її розв'язанню. Наукова новизна. Розроблений програмний продукт виконує навчальну та контролюючу функції. Тренажер реалізовано у вигляді чат-боту в телеграмі. Дослідження доводить, що саме такий формат додатку є найбільш поширеним серед здобувачів освіти та не потребує допоміжних вказівок. Методологія розробки елементів програми також демонструє покрововість в створенні тренажеру. Практична значимість. Розроблений програмний продукт імплементовано у відповідний курс системи дистанційного навчання на платформі Moodle Полтавського університету економіки та торгівлі та рекомендовано для використання здобувачам освіти за спеціальністю «Комп'ютерні науки» в навчальному процесі під час вивчення дисципліни «Системний аналіз та теорія прийняття рішень». Інноваційні методи навчання допомагають здобувачам освіти самостійно ліквідувати прогалини у знаннях без використання додаткового аудиторного часу чи викладача.

Ключові слова: дистанційне навчання, тренажер-бот, вищий навчальний заклад.

Formulation of the problem

Currently, there has been a fundamental change in the methods of dissemination and use of information, which has led to the development of educational technologies and contributed to the active implementation of distance education – one of the directions of reforming the education system in Ukraine [1].

Every modern teacher faces the problem of creating one's own electronic resources that organically fit into the classical system, improve and rationalize it, create new opportunities for the organization of parallel learning and knowledge management, and also provide real opportunities for individual educational practices.

Creating a simulator for mastering educational material or solving problems allows providing effective and interactive learning, a personalized approach, motivation, progress tracking and accessibility for users. It creates a favorable environment for effective assimilation of knowledge and development of skills [2].

Analysis of recent research and publications

An important task in teaching mathematical disciplines is a visual demonstration of problem solving. To solve this problem, it is possible to develop and implement simulator programs in a distance course. The implementation of such simulators is an actual direction of development and research for mathematical disciplines in particular.

Analyzing the existing software [3–7] (simulators, manuals, etc.), one can single out both the positives of each of them and their shortcomings. It is very important to closely monitor what is happening in the world of web development: the relevance of existing frameworks, the choice of the best among them, development and design trends. Relevant today are the initial simulators implemented in the form of chat bots.

It is very important to carefully monitor what is happening in the world of web development: the relevance of existing frameworks, the choice of the best among them, development and design trends. Educational simulators implemented in the form of chat bots are relevant today.

The purpose of the work is to develop simulator software in the form of a chat-bot on the topic “Expert assessment of the advantages in the problem of choosing a university” for the distance learning course “System Analysis and Decision Making Theory”.

Presenting main material

The following statement of the problem is proposed: A Ukrainian family solves the problem of choosing a higher educational institution for their child entering. The family formulates requirements in the form of criteria characterizing certain qualities of universities.

Criterion 1: the presence of a large number of licensed universities in this specialty;

Criterion 2: distance from the place of residence;

Criterion 3: university’s image;

Criterion 4: the desire of friends to enter this exact university;

Criterion 5: convenience of transportation with the city where the university is located;

Criterion 6: the cost of contract training for the desired specialty;

Criterion 7: availability of a sufficient number of places in the dormitory;

Criterion 8: availability of budget places in desired specialties.

The main goal set by the family to solve the problem is formulated as follows: “choose a university that would best meet all criteria at the same time.”

Three universities (A, B, C) with such characteristics were considered as alternative ones.

University A. It has the largest licensed volume, significantly larger than B and almost completely surpasses the level of C. In terms of distance from the place of residence, A significantly exceeds B, and it is slightly worse than C. The prestige of A among universities absolutely exceeds B and more than strongly exceeds C.

Regarding the preference of friends to enter the chosen university, A almost completely outperforms B and more than strongly outperforms C.

The location of universities, in terms of transport links convenience, is very much dominated by university B. The cost of contract training in the chosen specialty at the university A is twice as high as at B and C. The number of places in the hostel is sufficient. In the specialty that is given preference, the A university has the smallest number of state-funded places.

University B. The licensed volume is slightly smaller than that of A, but it significantly exceeds C. It is in the worst conditions in terms of the distance from the place of residence. The prestige of the university is the lowest. The desire among the friends to enter this university is the lowest. In terms of the convenience of transport connections with the city where the university is located, it is also the lowest. The cost of contract training for the desired specialty is the same as in C, and half as less as in A. The number of places in the dormitory is sufficient. In terms of the number of budget places for the desired specialties, it is very much superior to the A university and not so much to B.

University C. It has the smallest licensed volume. In terms of distance from the place of residence, C has a slight advantage over B. In terms of prestige, the C university exceeds B. At the request of friends to enter the chosen university, C significantly exceeds B. In terms of convenience of transport connections with the place of residence, the location of the university is significantly better than that of A and almost absolutely surpasses B. The cost of contract training for the desired specialty is the same as in B and half as much as in A. The number of places in the hostel is sufficient. In terms of the number of budget places for the desired specialties, the university is significantly ahead of others.

The final project of this work is the implementation of a simulator on the topic “Expert assessment of advantages in the problem of choosing a university.” The main goal of developing the simulator is to help students master this topic and help them carry out calculations in an accessible and most popular format.

Step 1. The panel displays a message containing the following text: *Hello, I’m a simulator bot, I will help you understand the topic “Expert assessment of advantages in the problem of choosing a university.”* When you’re ready, click ‘Get Started’ and I’ll provide you with the theoretical material.

The user clicks the Start button.

Step 2. The user is presented with a file called Theory.docx, which contains the theoretical information contained in the distance course. The user is introduced to the topic. Under the theoretical file is displayed: *When the review is completed, click the "Continue" button.*

The student clicks Continue and proceeds to step 3.

Step 3. The message sends the Problem Statement.docx file, which highlights the condition of the problem on which the student will work further. This file contains an inscription: *Read the condition of the problem and click the "Continue" button, it is recommended to use Microsoft Excel for calculations.* After reviewing the materials in this file, the student presses the "Continue" button and proceeds to step 4.

Step 4. The following picture is displayed on the screen:

choice of university	the presence of a large number of licensed universities in this specialty	distance from the place of residence	university's image	the desire of friends to enter this exact university	convenience of transportation with the city where the university is located	the cost of contract training for the desired specialty	availability of a sufficient number of places in the dormitory	availability of budget places in desired specialties
the presence of a large number of licensed universities in this specialty	1	5	3	7	6	6	1/3	1/4

And the inscription is displayed: *Calculate the components of the main eigenvector of the matrix V_i for the given series and choose the correct answer.*

Suggested answers:

- 1,578;
- 0,364;
- 2,649;
- 2,053.

According to the calculations made by the user, he chooses the correct option. If this option is not the answer 2.053, we go to step 5.

Step 5. The screen displays the following image containing the calculation formula and the inscription: *You have made a mistake, this formula will help you*

$$V_i \approx \sqrt[n]{\prod_{j=1}^n a_{ij}}, i = 1, 2, \dots, n, \text{ де } \prod_{j=1}^n a_{ij} \text{ means the product of } n \text{ factors } a_1, \dots, a_n$$

The suggested answer options do not change until the student chooses the correct answer.

When the student clicks on the correct answer, the program moves to the next step.

Step 6. The bot sends an image with the following message:

distance from the place of residence	1/5	1	1/3	5	3	3	1/5	1/7
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And below it displays the message: *Calculate the components of the main eigenvector of the matrix V_i for the given series and choose the correct answer*

Suggested answer options:

- 0,736;
- 0,841;
- 1,651;
- 0,956.

According to the calculations made by the user, he chooses the correct option. If this answer is not 0.736, then go to step 5.

In steps 7–12 of the algorithm it is proposed to calculate the components of the main eigenvector of the matrix V_i for this series. At step 13, the bot outputs the V_i vector. Next, steps 14–22 train how to calculate the components of the P_i priority vector. The next steps include the calculation of the following quantities: the maximum eigenvalue (value) of the matrix λ_{max} ; consistency index (CI); consistency ratio (CR).

Step 29. A message is displayed on the screen containing a Microsoft Excel file called Task.xlsx. This file contains the progress of solving problems. The following text is also displayed: *Good job!*

Open the Microsoft Excel file to check yourself. Be careful! The results of some calculations in this file differ from those presented in the distance course.

The final step. The “Start” button is displayed to the user. By clicking on it, the user ends work with the program or, if desired, can go through these tasks again.

This algorithm was implemented in the Python programming language in the PyCharm development environment.

In order to start working with the simulator, you need to write /start in the line for entering messages. Immediately after that, a message will appear, from which the user’s work with the simulator will begin (Fig. 1).

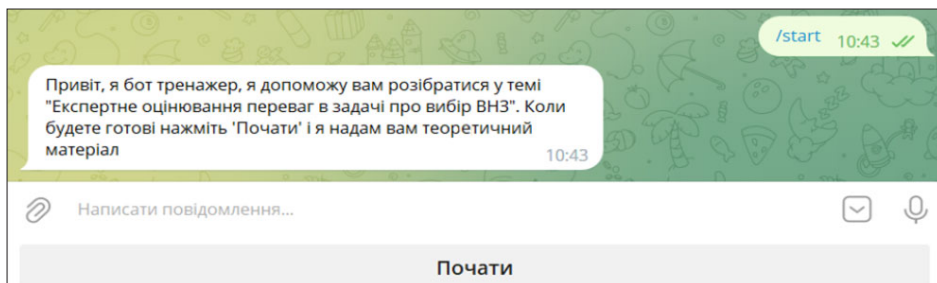


Fig. 1. Getting started with the simulator

After clicking on the “Start” button, the simulator will show the following message, which will contain the theory for the topic “Expert assessment of advantages in the problem of choosing a university.” (Fig. 2).

The theoretical material and the condition of the problem will be presented to the student in .docx format, for easy mastering.

When solving problems, the condition will be presented in the form of text and / or images (Fig. 2), after reading the condition, the student must choose the correct answer, according to his calculations.

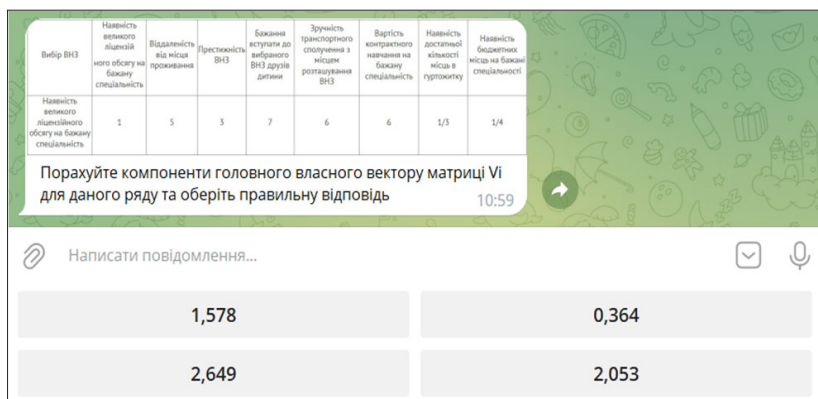


Fig. 2. Highlighting the condition of the tasks and the suggested answers

If the student chooses the wrong answer, the simulator highlights a formula that should help the student in calculations (Fig. 3).

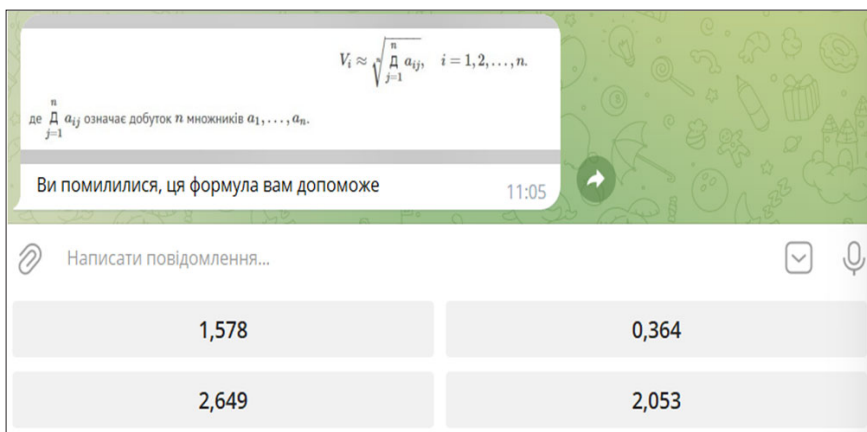


Fig. 3. Highlighting the formula to help the student

When the student answers all the questions correctly, the program sends him a .xlsx file (Fig. 4), where he can check the correctness of his thoughts during the calculations.

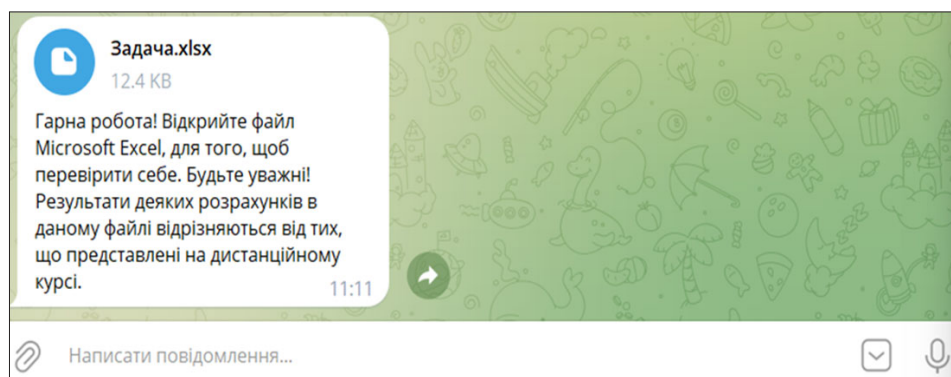


Fig. 4. Sending a file with the extension .xlsx

The last stage of working with this simulator is to press the “Start” button (Fig. 5).

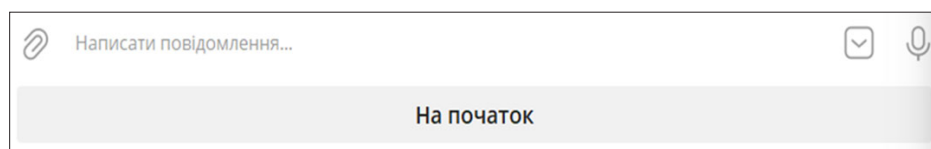


Fig. 5. Finishing work with the simulator

After clicking on this button, the student can complete the work or start it from the beginning.

Conclusions

Thus, a training chat bot in a telegram was implemented to study one of the topics of the educational component “System Analysis and Decision Making Theory”.

Non-standard and interactive methods used in conducting classes motivate applicants for education to better study disciplines and self-education, which ultimately is the main task of a modern teacher.

In the future, the created simulator program will be updated according to the curriculum of the discipline in accordance with the new State Standards and will be used as a component of the educational information environment, which makes it possible not only to approach the problem of effective integration of independent work into the educational process, but also allows without additional costs of classroom time to fill gaps in the knowledge of applicants for education.

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