УДК 528.8.04, 373.1

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ПРОЕКТНЫЙ ПОДХОД К РЕАЛИЗАЦИИ ЛОГИЧЕСКОЕ ПРОГРАММИРОВАНИЕ В СРЕДНЕЙ ШКОЛЕ

С развитием технологий искусственный интеллект становится неотъемлемой частью нашей повседневной жизни и оказывает большое влияние на многие аспекты жизни общества. В частности, в сфере образования искусственный интеллект предоставляет бесчисленные возможности. В статье рассматриваются основные характеристики современного образования, охватывающие искусственный интеллект, интегрированное обучение, критическое мышление, навыки решения проблем, а также навыки активного общения и работы в команде. Представляет новую стратегию развития проекта, целью которой является предоставление студентам необходимых навыков для участия в технологических инновациях путем применения научных и технологических знаний, актуальных для реального мира.

Ключевые слова: *образование, искусственный интеллект, логическое программирование, проектное обучение, STEM.*

Исследование выполнено при финансовой поддержке научному проекту КП-06-М62/2 „МОДЕЛИРОВАНИЕ ЗНАНИЙ В ОБЛАСТИ БОЛГАРСКОГО ФОЛЬКЛОРА“, финансируемому Фондом „Научные исследования“.

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A PROJECT-BASED APPROACH TO THE IMPLEMENTATION OF LOGIC PROGRAMMING IN THE MIDDLE SCHOOL

With the development of technology, artificial intelligence is becoming an indispensable part of our daily lives and has a great impact on many aspects of society. In education in particular, artificial intelligence provides countless opportunities. The article examines the main characteristics of a modern education, covering artificial intelligence, integrated learning, critical thinking, problem-solving skills, as well as active communication and teamwork skills. Presents a new project development strategy that aims to provide students with the necessary skills to engage in technological innovation by applying scientific and technological knowledge relevant to the real world.

Keywords: *education, artificial intelligence, logic programming, project-based learning, STEM.*

The definition of "Artificial Intelligence System" (AI system) as software developed with one or more of the techniques and appropriate specified in Annex I is given in the European Commission's [1] draft Artificial Intelligence (AI) legislation. This software can, with respect to a given set of goals, defined by a person, produce results, such as content, predictions, suggestions, or decisions, that act on the action of the environments with which they interact. Annex I contains a second list of logical and knowledge-based methodologies, such as expert systems, knowledge bases, inductive (logic) programming, knowledge representation, inference and deduction machines, and (symbolic) judgments. In this sense, our group has begun teaching secondary school students logic programming in the Prolog language. AI and logic programming have been taught to students of all ages and in several nations in recent years. Working with a group of scientists from all over the world, our team

introduced Prolog logic programming to secondary school students with the activity "Digital Bulgaria in Prolog" (part of the international project known as "Prolog Education and Thinking"). Robert Kowalski, one of the language's inventors, is also included in this group. Prolog programming is easy and understandable because it is close to natural language. This leads to easy understanding by students of all ages and its use in various secondary school subjects. For example, [2] argued that logic programming is a viable and desirable choice of paradigm for elementary school children, experimenting with 8- to 10-year-old children in two public elementary schools in Argentina. In [3], the authors suggest that using and learning Prolog for most of the topics in the high school mathematics curriculum (probability, algebra, analysis, or geometry) allows for better mastery of course concepts. Article [4] presents our activities to introduce Prolog programming education. Middle School in article [5] provides an overview of the use of Prolog and its derivatives that support research and development in bioinformatics and computational biology. An overview of automated reasoning tools in geometry developed in Prolog is briefly given in article [6]. All this motivates us to choose the Prolog language as the main tool for implementing project-based learning and learning in STEM. And through it to include secondary schools in Bulgaria in the global initiative "Prologue Education and Thinking.".

The project-based approach. The project-based approach is a pedagogical method in which students learn through active participation in real and meaningful projects. This approach:

- Supports active learning: Students actively participate in the learning process by working on specific projects.
- Develops key skills: Students develop collaboration, communication, critical thinking and problem-solving skills.
- Provides context: Learning material is taught in the context of real-world applications, making it easier to understand and remember.

Implementation of a project-based approach to introduce logic programming in secondary school. Our group implements a project-based methodology to teach Prolog logic programming at the Plovdiv-based Vocational High School of Electrical Engineering and Electronics (PGEE). "Plants in Space Save the Earth" is the project topic that the kids have selected. The project's primary objective is to look into the problems surrounding artificial intelligence and its integration into education. The definition of the first particular goal is: To illustrate the advantages of artificial intelligence, such as its quick analysis of vast amounts of data. It is defined as follows for a second specialized purpose: combining imperative and declarative programming languages to provide project-based learning that will aid in the knowledge consolidation of "Applied Programming" specialization students. Simultaneously, the potential of STEM education in the future of learning will be illustrated. And as a third particular goal is presented: To use the Prolog programming language to develop a logic-based database that interacts with the user and offers helpful data.

Introduction to the project topic. This article examines how a subset of professionals in a certain sector are adjusting to artificial intelligence's (AI) quick rise in popularity. The challenge for today's educators is to keep up with the rapidly increasing use of generative AI tools like ChatGPT. A variety of issues necessitate the development of innovative teaching strategies and instructional materials. Thanks to the partnership between the University of Plovdiv and the Vocational High School of Electrical Engineering and Electronics - Plovdiv, it is possible to work with the Prolog programming language, which is very suitable for the development of artificial intelligence applications using logic. Using Prolog, the programmer can specify a set of facts and rules that the Prolog interpreter subsequently analyses and generates solutions.

AI-STEM projects can be created using the Prolog programming language, which opens up a lot of options. This is the reason this particular project is being used. Projects involving AI-STEM have the ability to gather a lot of data, which AI can quickly assess. This kind of undertaking offers a chance for educational study and improvement.

Methodology. Participating in AI-STEM projects can prepare learners for the demands of future labour markets by developing their technical and analytical skills, critical thinking and other important competencies. The appropriate methods used in this development are:

a) Project-based method
b) Research method

To date, a variety of information has been collected related to several main aspects: plant growth and development; plant physiology; genetic structure of plants; environmental factors such as temperature, humidity, light, etc.

Design and implementation: If several programming languages are combined (imperative: C#, JavaScript, declarative: Prolog, HTML, CSS) it will enable better communication between user and intelligent database, through a suitable interface.

The design goes through the following stages:

First stage: combining several programming languages.

```
public void Add_Data()
{
    Prolog.ConsultFromString(@"
    %
      % Семейство растения
      family(arabidopsis, 'The Arabidopsis plant is part of
      family(palm_tree, palmaceae).
      family(apple, rosaceae).
      family(wheat, 'Family:poaceae').
      family(peas, fabaceae).
      family(sunflower, asteraceae).
      family(basil, lamiaceae).
      family(tomatoes, solanaceae).
      family(cactus, cactaceae).
      family(orchid, orchidaceae).

      % Класификация на частите на растението
      vegetative_part(roots).
      vegetative_part(stems).
      vegetative_part(leaves).
```

Figure 1. Plant information code

```
D:\repos\2023-24\Project_Plant - new\Project_Plant\bin\Debug\Project_Plant.exe
Choice (arabidopsis/wheat): arabidopsis
Available genetic modifications for arabidopsis:
- resistance_to_disease
- faster_growth
- herbicide_tolerance
- drought_resistance
That is all.

true (7,875 sec)
Натисни клавиш и се върни към главното меню.
```

Figure 2. Knowledge base query code

Second stage: Testing the compatibility of the two languages.

Figure 2 also shows the effective execution of the database query with a value of "true", with the execution time in parentheses being 7.875 seconds.

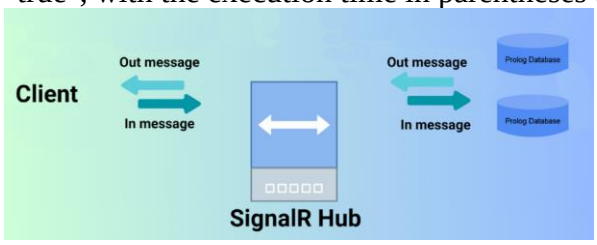


Figure 3. Client/knowledge base communication scheme

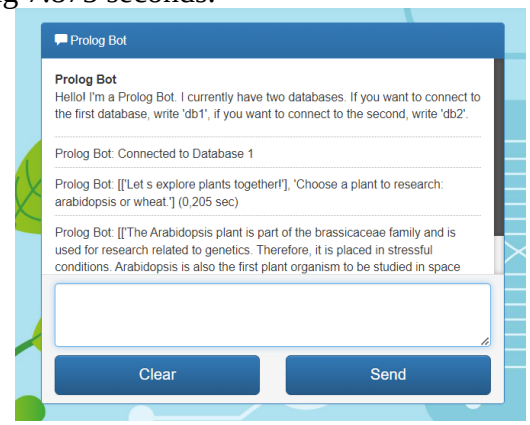


Figure 4. Prolog bot interface

Third stage – expansion and addition.

The next stage is to create a more sophisticated program, a Prolog Bot, that will respond to queries from users. The creators hope that a user would be able to connect to the base and initiate direct communication with the system with just one request. The increasing

popularity of ChatGPT gave rise to the concept for Prolog Bot. The web-based application was made with the ASP.net framework specifically for this purpose. Following investigation, the SignalR library—designed especially for ASP.NET—was selected. Real-time communication between web clients and a server is made possible by SignalR. A plan for establishing client/knowledge base communication is depicted in Figure 3. An attempt is made to establish a second database with information pertaining to a different field after the creation of the class Data, which contains guidelines and details about plants.

Figure 4 shows the interface as well as the responses received from the database.

Fourth stage – testing. During the testing of the application, some problems appeared, which were later fixed.

Conclusion. The project's central concept has been realized. The body of knowledge will grow and more plant genetics research will be done in the future. Many intriguing conclusions and the distinctions between declarative and imperative languages were found throughout the application's development. It is crucial to remember that students must first establish a foundation, in this case their understanding of C#, before they can fully grasp the many Prolog-related competencies. This is another rationale behind the research. Furthermore, facts and rules are "loaded" once in Prolog programming and are then utilized in all ensuing queries. The developers are about to update the plant-related knowledge base.

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