The evolving landscape of computer science and software engineering: Trends, challenges, and future directions

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Abstract

The 7th Workshop for Young Scientists in Computer Science & Software Engineering (CS&SE@SW 2024) brought together researchers, practitioners, and experts to explore the latest advancements, trends, and challenges in the rapidly evolving fields of computer science and software engineering. The workshop covered a wide range of topics, including software engineering processes, theoretical computer science, computer systems, and cutting-edge computer applications. The papers presented at the workshop showcase the innovative research being conducted by young scientists, highlighting the potential for groundbreaking developments in areas such as artificial intelligence, machine learning, data analytics, and human-computer interaction. This proceedings volume provides a comprehensive overview of the research presented at the workshop, organized into four main chapters: Software Engineering, Theoretical Computer Science, Computer Systems, and Computer Applications. The Software Engineering chapter focuses on requirements, design, construction, testing, and methodologies, emphasizing the importance of robust and efficient software development practices. The Theoretical Computer Science chapter explores advancements in algorithms, data structures, theory of computation, and formal methods, providing a foundation for future innovations. The Computer Systems chapter discusses developments in computer architecture, performance, and databases, underlining the critical role of hardware and data management in modern computing. Finally, the Computer Applications chapter showcases the practical applications of computer science and software engineering, with a particular focus on graphics, visualization, human-computer interaction, scientific computing, and artificial intelligence.

Keywords

computer science, software engineering, artificial intelligence, machine learning, human-computer interaction, data analytics, algorithms, database systems, computer architecture, software development methodologies, interdisciplinary research, scientific computing, visualization, formal methods, theory of computation

1. CS&SE@SW 2024: at a glance

Workshop for Young Scientists in Computer Science & Software Engineering (CS&SE@SW) is a peer-reviewed workshop focusing on research advances applications of information technologies.

CS&SE@SW topics of interest since 2018 [1, 2, 3, 4, 5, 6] are:

1. Software engineering

   - Software requirements [7, 8]
   - Software design [7, 8, 9, 10, 11, 12]
   - Software construction [12]
   - Software testing [13]
   - Software maintenance [7]
   - Software engineering management [10]

- Software development process [14, 8, 9, 10, 11, 12]
- Software engineering models and methods [15]
- Software quality [7, 8]
- Software engineering professional practice [9]

2. Theoretical computer science

- Data structures and algorithms [16, 17, 18, 19]
- Theory of computation [19]
- Information and coding theory [20]
- Formal methods [20, 15]

3. Computer systems

- Computer architecture and computer engineering [21]
- Computer performance analysis [21]
- Databases [7]

4. Computer applications

- Computer graphics and visualization [20, 22, 14, 15, 23, 24, 25]
- Human-computer interaction [8, 13, 11, 12, 26]
- Scientific computing [20, 22, 21, 27]
- Artificial intelligence [22, 16, 28, 14, 17, 13, 10, 29, 27, 24, 25, 19, 30, 31, 32, 33, 34]

This volume represents the proceedings of the 7th Workshop for Young Scientists in Computer Science & Software Engineering (CS&SE@SW 2024), held in Kryvyi Rih, Ukraine, on December 27, 2024. It comprises 28 contributed papers that were carefully peer-reviewed and selected from 64 submissions. At least two program committee members reviewed each submission. The papers included in this volume demonstrate the immense potential for ground-breaking advancements and inspire further research in these dynamic and essential fields.

2. CS&SE@SW 2023 Program Committee

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- *Dragoş-Daniel Iordache*, National Institute for Research and Development in Informatics - ICI Bucuresti, Romania [39, 40]
- *Orken Mamyrbayev*, Institute of Information and Computational Technologies, Kazakhstan [41, 42]
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Additional reviewers:

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- *James B. Procter*, University of Dundee, UK [87, 88]
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- *Etibar Seyidzade*, Baku Engineering University, Azerbaijan [93, 94]
- *Andrii Striuk*, Kryvyi Rih National University, Ukraine [95, 96]
- *Volodymyr Voytenko*, Athabasca University, Canada [97, 98]

3. CS&SE@SW 2024 organizers

The 6th edition of the CS&SE@SW was coordinated by the Academy of Cognitive and Natural Sciences (ACNS), a non-governmental organisation dedicated to nurturing the growth of researchers' expertise in the cognitive and natural sciences arena. ACNS's mission encompasses enhancing research, safeguarding rights and liberties, and catering to professional, scientific, social, and other interests.

ACNS is engaged in a spectrum of activities, including:

- Spearheading research initiatives within the cognitive and natural sciences domain and fostering collaborative ties among researchers.
- Orchestrating conferences, workshops, training sessions, internships, and other platforms for exchanging and disseminating knowledge in the realm of cognitive and natural sciences.
- Publishing conference proceedings, collections of scholarly works, and scientific journals (https://acnsci.org/cms/journals/):
  - Educational Dimension (https://acnsci.org/ed)
  - Educational Technology Quarterly (https://acnsci.org/etq)
  - CTE Workshop Proceedings (https://acnsci.org/cte)
  - Science Education Quarterly (https://acnsci.org/seq)
  - Journal of Edge Computing (https://acnsci.org/jec)

Among ACNS's prominent publications is the Diamond Open Access *Science Education Quarterly* (SEQ), a peer-reviewed academic journal dedicated to advancing research and practice in science education across all educational levels. The journal publishes original empirical studies [99, 100], theoretical frameworks, literature reviews [101, 102], and innovative teaching methodologies [103, 104] that contribute to the understanding and improvement of science teaching and learning.

4. CS&SE@SW 2024 articles overview

4.1. Software engineering

In their paper "Optimizing the process of ER diagram creation with PlantUML", Kurotych and Bulatetska [7] explore the capabilities of PlantUML, a popular open-source tool for generating diagrams based on textual descriptions, in the context of creating Entity Relationship Diagrams (ERDs) for relational databases. The authors identify several shortcomings in PlantUML's basic functionality for ERD creation and propose solutions to improve the quality and readability of the generated diagrams.
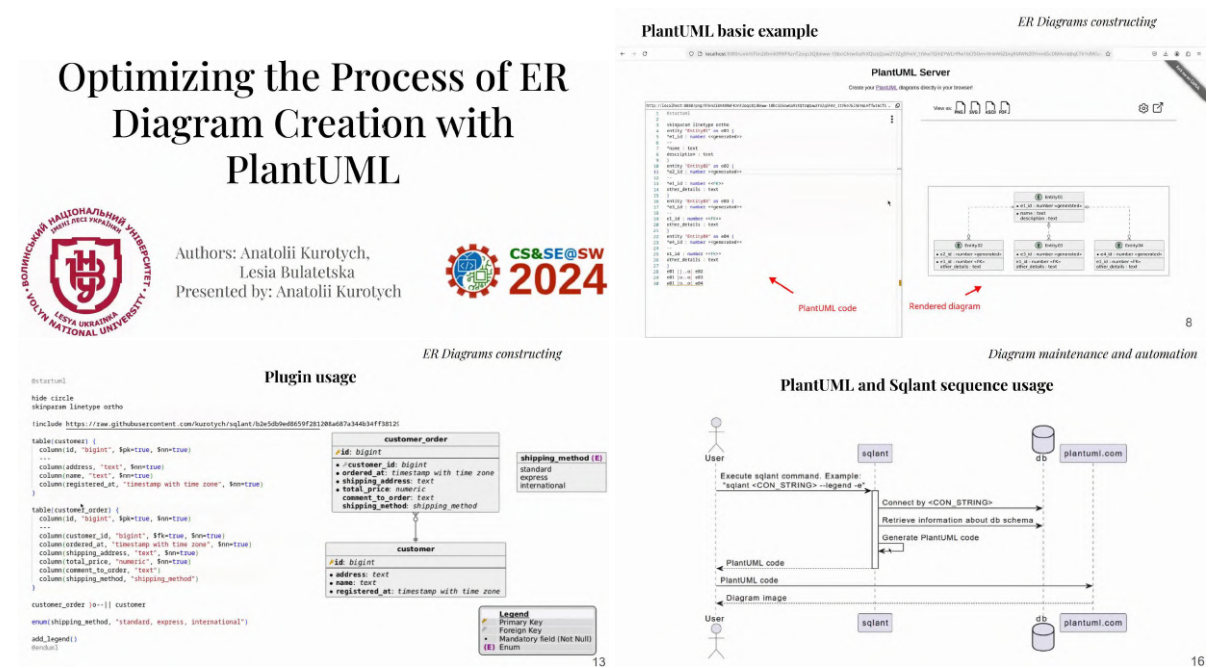
Figure 1: Excerpts from the paper presentation [7].

The paper describes techniques for enhancing the appearance of ERDs, such as highlighting primary and foreign keys, removing unnecessary elements, and creating legends for user convenience. The authors also introduce a plugin module to improve the structure and maintainability of the PlantUML code (PUML) by organizing it into functions and procedures. This modular approach offers benefits like standardized styles and reduced code duplication.

Furthermore, the paper presents Sqlant, a tool developed by the authors to automate the generation of PUML code directly from a PostgreSQL database. Sqlant retrieves database schema information and generates PUML code that can be used to visualize ERDs in the PlantUML environment. The integration of PlantUML with automation tools like Sqlant is particularly beneficial in environments where database structures undergo frequent changes.

Despite the limitations in PlantUML's official documentation, the authors demonstrate its significant potential for creating high-quality ERDs and streamlining the database modeling process. The proposed approaches and tools contribute to the efficiency and effectiveness of development teams working with relational databases.

In their paper "Design and evaluation of a personalized digital mathematics tutor for grade 6 learners", Shokaliuk and Kavetskyi [8] present the development and assessment of an adaptive mathematics tool aimed at enhancing the learning experience and outcomes for sixth-grade students. The authors highlight the limitations of traditional assessment methods in catering to the diverse needs of learners and the potential of technology-enhanced solutions to address these challenges.

The proposed system leverages Python and CustomTkinter to create an engaging and intuitive user interface that generates adaptive questions, provides immediate feedback, and tracks student progress
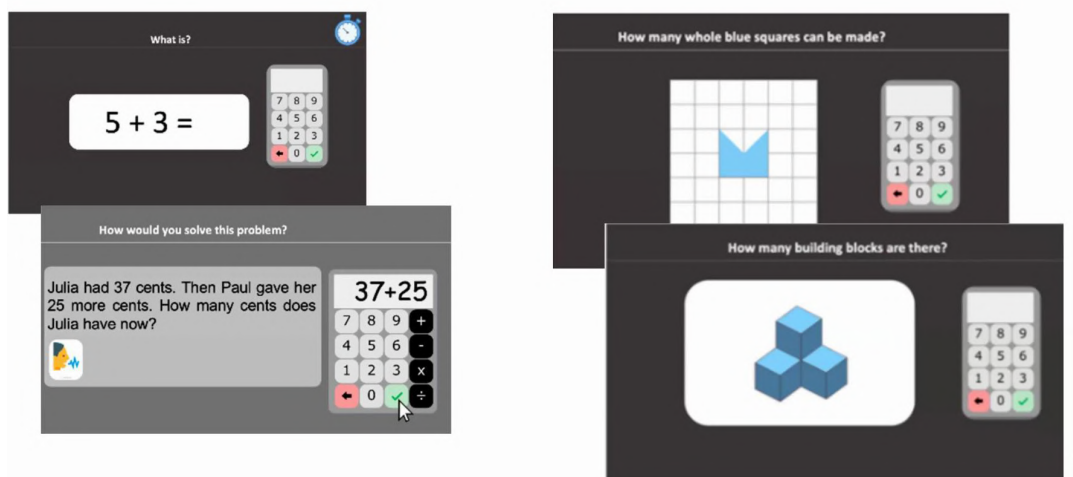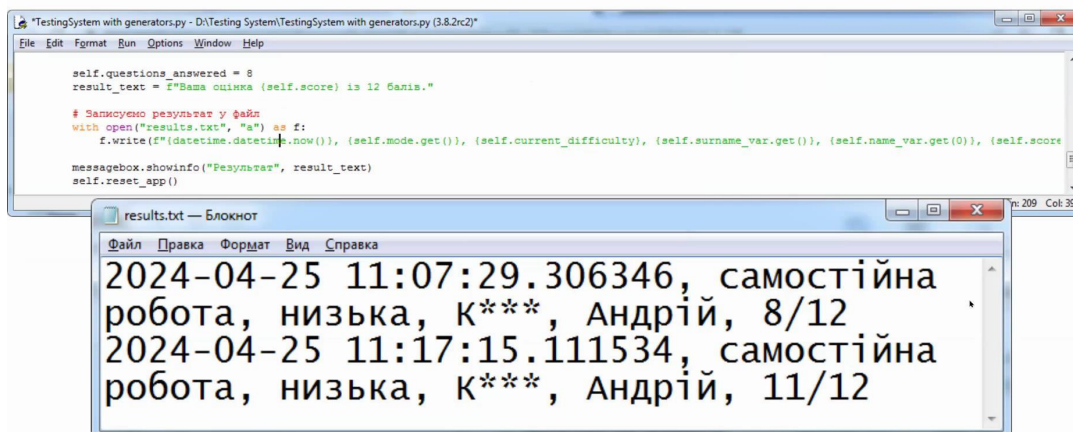
Figure 2: Excerpts from the paper presentation [8].

in real-time. The tool's architecture consists of three main components: a test generator, a user interface, and a student performance tracker. The test generator employs rule-based and probabilistic algorithms to create questions tailored to the student's ability level and target areas of weakness identified from performance data.

To evaluate the effectiveness of the adaptive assessment tool, the authors conducted a quasi-experimental study comparing the experimental group using the tool with a control group receiving traditional instruction. The study assessed the impact on students' problem-solving skills, attitudes towards mathematics, and overall academic achievement. Data were collected through the tool's log files and semi-structured interviews, and analyzed using mixed methods, including data mining techniques and thematic analysis.

The results demonstrate the tool's positive impact on student learning and engagement. The system's adaptive feedback and personalized recommendations led to a 25% reduction in the average number of attempts required to solve problems correctly. Students also reported increased enjoyment and confidence in mathematics, with the experimental group showing significantly greater improvements compared to the control group. The tool's user-friendly interface, built using Python and CustomTkinter, was well-received by students, with 85% finding it easy to use and 90% reporting it as motivating.

While the findings highlight the potential of adaptive assessment tools in mathematics education, the authors acknowledge the study's limitations, such as the small sample size and the lack of long-term evaluation. They also outline future research directions, including the integration of machine learning techniques to further enhance adaptability and the expansion of content coverage to higher grade levels and more advanced mathematical topics.

In the paper "Methodology for implementing electronic audit projects (SAF–T UA) for large taxpayers in Ukraine", Chernukha et al. [9] delve into the intricacies of developing and implementing software for generating the electronic audit file (SAF–T UA) in the context of large commercial enterprises in Ukraine. The authors highlight the significance of this transition towards standardizing accounting practices and aligning with European norms.

The study provides a comprehensive analysis of the challenges and considerations involved in the SAF-T implementation process. It outlines the main problems, such as the lack of off-the-shelf software solutions, the need for integration with existing accounting systems, resource allocation, staff training,
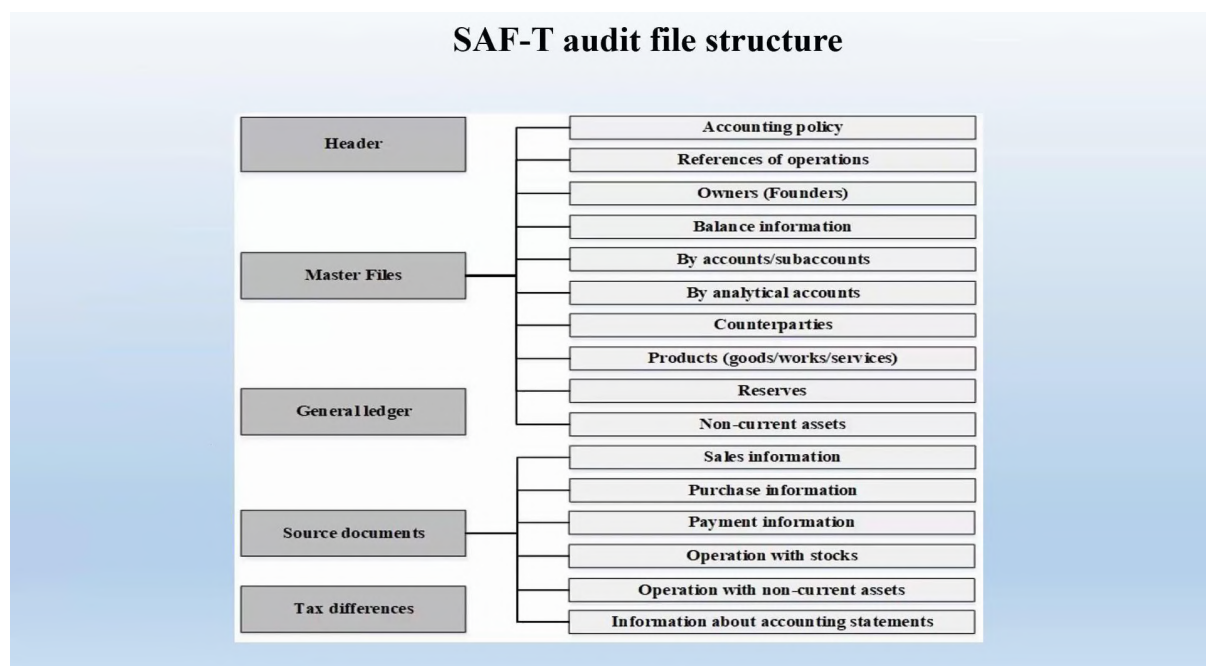
Figure 3: Excerpts from the paper presentation [9].

and compliance with audit conditions specific to Ukraine. The authors propose a general architecture concept for the software development, emphasizing the importance of a dedicated project team and the integration of data from various sources, including ERP and CRM systems.

To gain insights into the perceptions and expectations of key stakeholders, the researchers conducted a survey involving officials from different functional areas within large enterprises. The findings reveal a generally positive outlook towards the SAF-T implementation, with anticipated benefits such as optimized accounting processes, reduced administrative costs, and increased transparency in interactions with tax authorities. However, the survey also highlights challenges, such as the lack of familiarity with tax authorities' requirements and the need for extensive staff training.

The paper offers practical recommendations for the project team, covering aspects such as data control, information security, archiving, and collaboration with fiscal authorities. The authors stress the importance of involving specialists from various domains, including accounting, IT, merchandising, and management, to ensure a comprehensive approach to the implementation process.

The study underscores the potential of SAF-T in simplifying tax control, enhancing transparency, and facilitating Ukraine's harmonization with European accounting practices. However, it also acknowledges the technical, organizational, and methodological complexities that must be addressed for successful implementation.

In the paper "Designing and evaluating an affordable Arduino-based lie detector prototype", Pravytskyi et al. [13] present the development and assessment of a low-cost lie detection system that combines physiological sensors with machine learning techniques. The authors highlight the importance of lie detection in various contexts and the limitations of existing methods, such as polygraphs and fMRI.

The proposed lie detector prototype utilizes an Arduino UNO development board and integrates temperature, humidity, and pulse sensors to measure physiological responses. The system architecture consists of three main components: an Arduino sketch for sensor data acquisition, a data collection program for labeling and storing the data, and a machine learning model for classifying the data sequences as truth or lies.

The machine learning component employs a long short-term memory (LSTM) neural network implemented using the Keras library. The model is trained on overlapping sequences of sensor readings to predict the probability of each sequence corresponding to a lie. The authors describe the data preprocessing steps, model architecture, and training process in detail.

The lie detector prototype was evaluated on a set of 20 questions designed to elicit a mix of truthful and deceptive responses. The results showed an accuracy of 55% in classifying true statements and 45% in classifying lies, with an overall accuracy of 50%. While these results demonstrate the challenges in developing an accurate lie detection system, they are comparable to the performance of average human lie detectors and other machine learning approaches reported in the literature.

The authors discuss the limitations of the study, including the controlled laboratory setting, the limited set of physiological measures, and the use of a single machine learning model for all participants. They also highlight the ethical considerations surrounding lie detection technologies, such as reliability, privacy, informed consent, and the potential for misuse or misinterpretation.

The paper concludes by emphasizing the need for further research and development to improve the accuracy, reliability, and generalizability of affordable lie detection systems. The authors suggest potential enhancements, such as incorporating additional sensors, developing personalized models, and integrating behavioral measures. They also stress the importance of addressing the ethical challenges and considering the appropriate role of lie detectors in various contexts.

In the paper "Development of the Student Simulator game: From concept to code", Oleksiuk et al. [12] present their experience in designing and developing an educational game application that simulates a student's journey through various computer science disciplines. The authors emphasize the relevance of using games in the educational process to engage and motivate learners.

The study begins by analyzing different types of educational games employed in computer science education, such as simulation games, puzzle-based learning games, and role-playing games. Through a SWOT analysis, the authors justify the choice of simulators and combined gaming applications for their project. They identify several basic requirements for the Student Simulator game, including a 3D
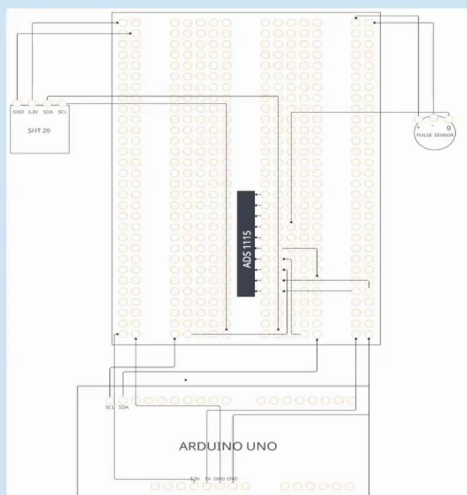
Figure 4: Excerpts from the paper presentation [13].

interface, multiple game locations, manipulation of object models, and player registration and rating.

The game development process is described in detail, following a project methodology that involves students and faculty members. The authors create a matrix of game elements to map the main system components to game features and design a comprehensive game model that combines all the game locations and player actions.

After a comparative analysis, the authors select Godot as the game engine, Blender for creating 3D graphics, and Firebase for data storage and management. They provide insights into the decision-making process, considering factors such as affordability, system requirements, team experience, and tool capabilities.

The paper delves into the technical aspects of game development, including the implementation of
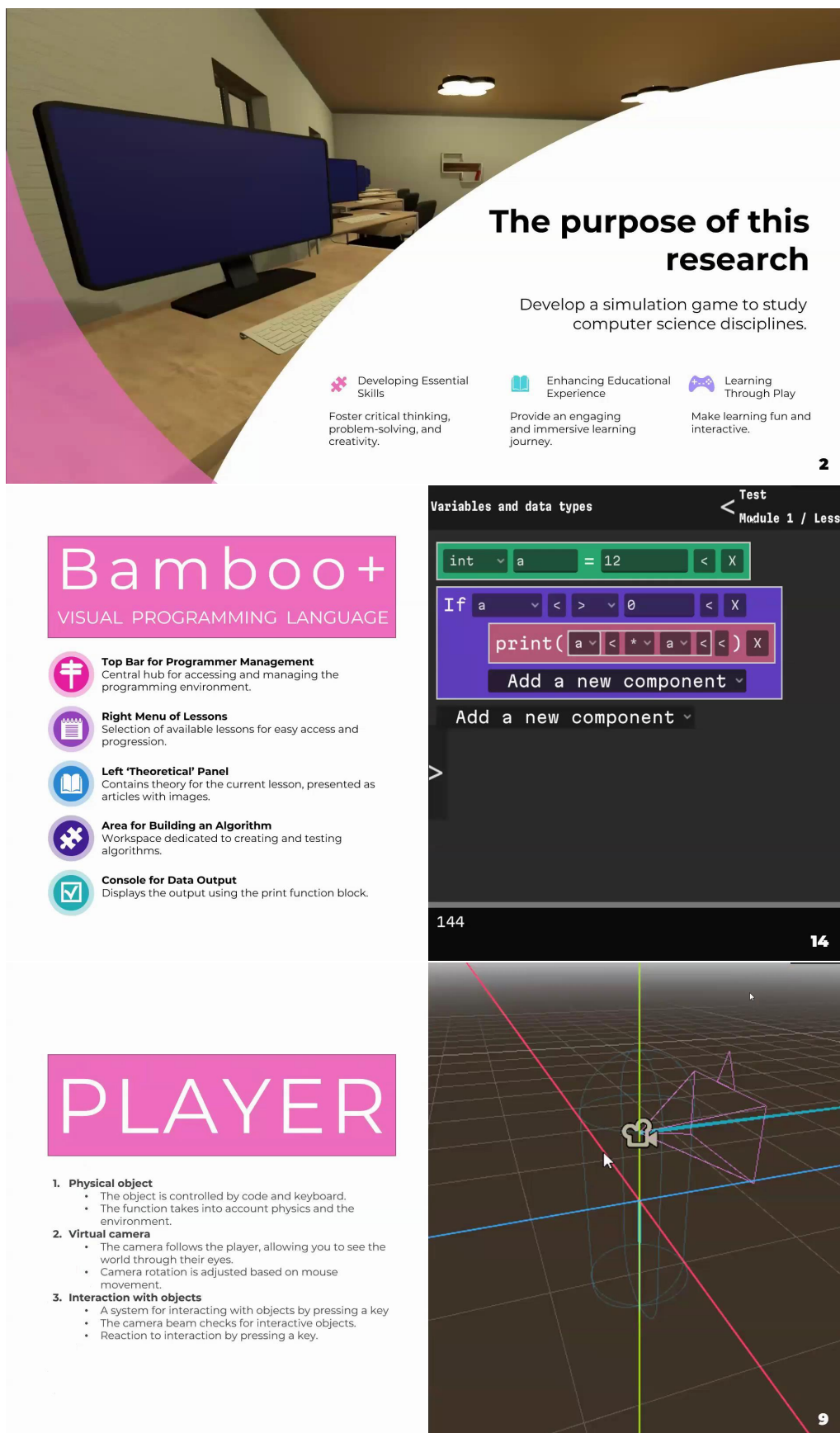
Figure 5: Excerpts from the paper presentation [12].

player movement, interaction systems, location management, and a virtual operating system called PandaOS. The authors also discuss the integration of mini-games, such as the Bamboo+ visual programming language and a test system using 3D tablet models.

User registration and authentication are handled using Firebase Authentication, while player data and progress are stored in the Firestore database. The game also incorporates a rating system to encourage healthy competition among players.

The authors reflect on the challenges and lessons learned during the development process, highlighting the importance of teamwork, communication, and the use of project management tools like GitHub. They also discuss the prospects and potential improvements for the Student Simulator game, such as the integration of artificial intelligence for personalized learning and the implementation of multiplayer and collaboration modes.

The paper concludes by emphasizing the modular structure of the Student Simulator game and its potential for further expansion and improvement. The authors underscore the significance of involving various specialists in the development process and the importance of promoting the game through a dedicated website.

In their paper "Information system for generating recommendations for risk-oriented trading strategies based on deep learning", Rudnichenko et al. [14] present a comprehensive study on the development and technical aspects of an information system that leverages deep learning models to generate recommendations for risk-oriented trading strategies on stock exchanges. The authors emphasize the growing need for specialized tools to automate the analysis of alternatives, identify trends, and evaluate trading strategies in the face of the increasing volume and complexity of financial data.

The study utilizes a dataset representing exchange trading information on Apple assets obtained from the Yahoo Finance system. The authors develop a conceptual design for a software system comprising three functionally independent modules and provide a formal schematization of these modules. They also create a project of the system, including a diagram of the main components displaying the relationships between the elements. The development process is carried out in the PyCharm environment, with a well-organized structure of directories and files to manage the system software.

A graphical user interface with interactive widgets is implemented to facilitate data entry, processing, and visualization. The authors conduct a thorough analysis of the developed modules, describing the strategic recommendations they generate for making trading decisions. The obtained results are interpreted, and their key features are identified. The paper concludes by outlining promising areas for further research and possible ways to improve the system.

The study's novelty lies in the adaptation, aggregation, and hybrid software implementation of various approaches to forming recommendations for trading decisions within a single system built on a modular architecture, as well as in the development and optimization of different deep learning models with an assessment of their effectiveness. The proposed system has the potential to enhance the accuracy and adaptability of trading decisions by integrating deep learning methods and providing a comprehensive tool for data analysis and strategy evaluation.

In the paper "Modeling and simulating of Duffing pendulum in the moved coordinate system", Zemlianukhina et al. [15] propose a mathematical framework for designing novel discrete-time chaotic systems based on existing ones. The authors' approach involves applying coordinate transformations to the domain where the initial system dynamic is defined, focusing on the shift of the 2D system coordinate origin to define new system state variables that account for this shift.

The authors treat the resulting dynamical system as an interval system with piecewise linear interval boundaries, enabling them to consider possible uncertainties caused by changes in system parameters and the presence of nonlinear functions. This approach allows them to rewrite the system into a linear-like form, simplifying the process of performing coordinate transformations compared to the initial nonlinear systems. The study transforms the continuous-time system dynamic into a discrete-time domain to facilitate its implementation in modern digital devices.

The discrete-time transformation enables the authors to define system dynamics using its previous states to determine the piecewise constant factors in the system equations. The system equation is designed to leverage information about previous system motions, its motion in the moved coordinate
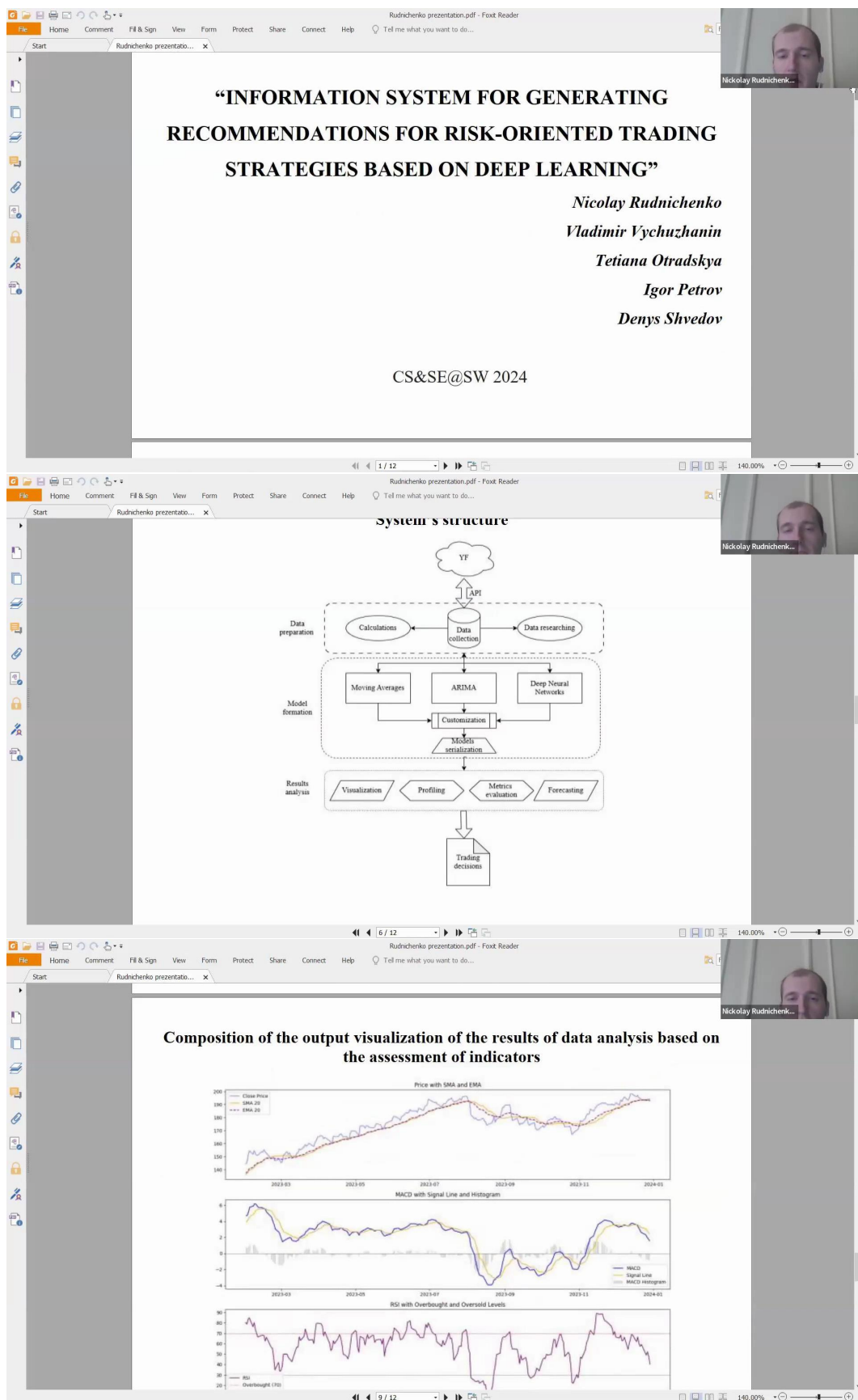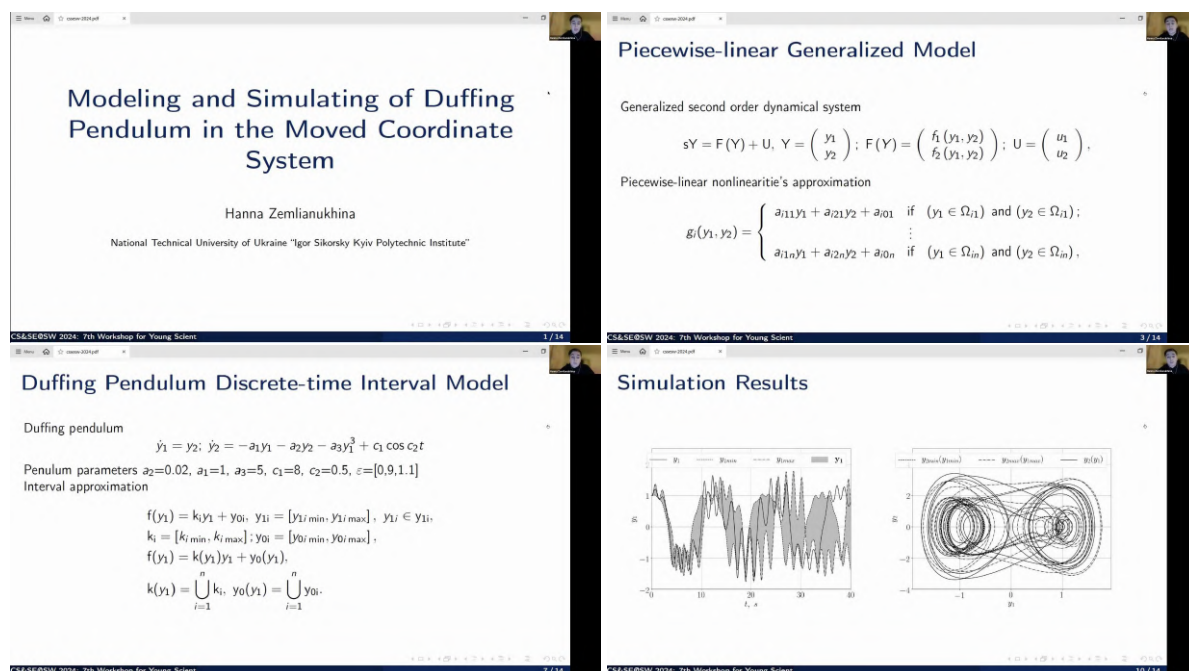
Figure 6: Excerpts from the paper presentation [14].

Figure 7: Excerpts from the paper presentation [15].

system, and the motions of the considered moved coordinate system. To increase the complexity of the system dynamic, the authors propose considering its perturbed motions as the difference between motions in the moved and stationary coordinate systems.

The study demonstrates the application of the proposed approach by considering the Duffing pendulum equations, a well-known chaotic system. The authors show that combining the motion equations of the core system and the motions of the coordinate system's origin can lead to the design of novel chaotic systems with more complex dynamics. The systematic approach presented in this paper offers a solid foundation for chaotic system design and has the potential to advance the field of secure communication using chaotic signals.

In their paper "A web-based Kanban application for enhancing agile project management practices", Moiseienko et al. [10] present a comprehensive analysis of agile project management in the digital era, focusing on a comparative study of popular tools and methodologies. The authors examine the evolution of agile practices from their roots in software development to their application in diverse contexts.

The study provides a detailed comparison of Scrum and Kanban methodologies, highlighting their strengths, weaknesses, and suitability for different project types. The authors emphasize that the choice between Scrum and Kanban depends on various factors, such as project size, complexity, team composition, and organizational culture. They also discuss the potential benefits of hybrid approaches that combine elements of both methodologies.

Additionally, the paper analyzes three prominent agile project management tools: Trello, Jira, and Worksection. The authors evaluate their features, usability, and effectiveness in supporting agile practices. They provide insights into the factors that organizations should consider when selecting an agile project management tool, such as project complexity, team size, industry, and organizational maturity.

To further contribute to the field, the authors present the development and user evaluation of Kards, a web-based Kanban application designed to facilitate agile adoption. Kards aims to provide a simple and accessible tool for individuals and teams to manage their projects using the Kanban methodology. The application incorporates key features and functionalities that support the effective implementation of Kanban principles, such as a visual Kanban board, task management, collaboration, and analytics.

The study's findings highlight the potential of Kards to facilitate the adoption of agile project
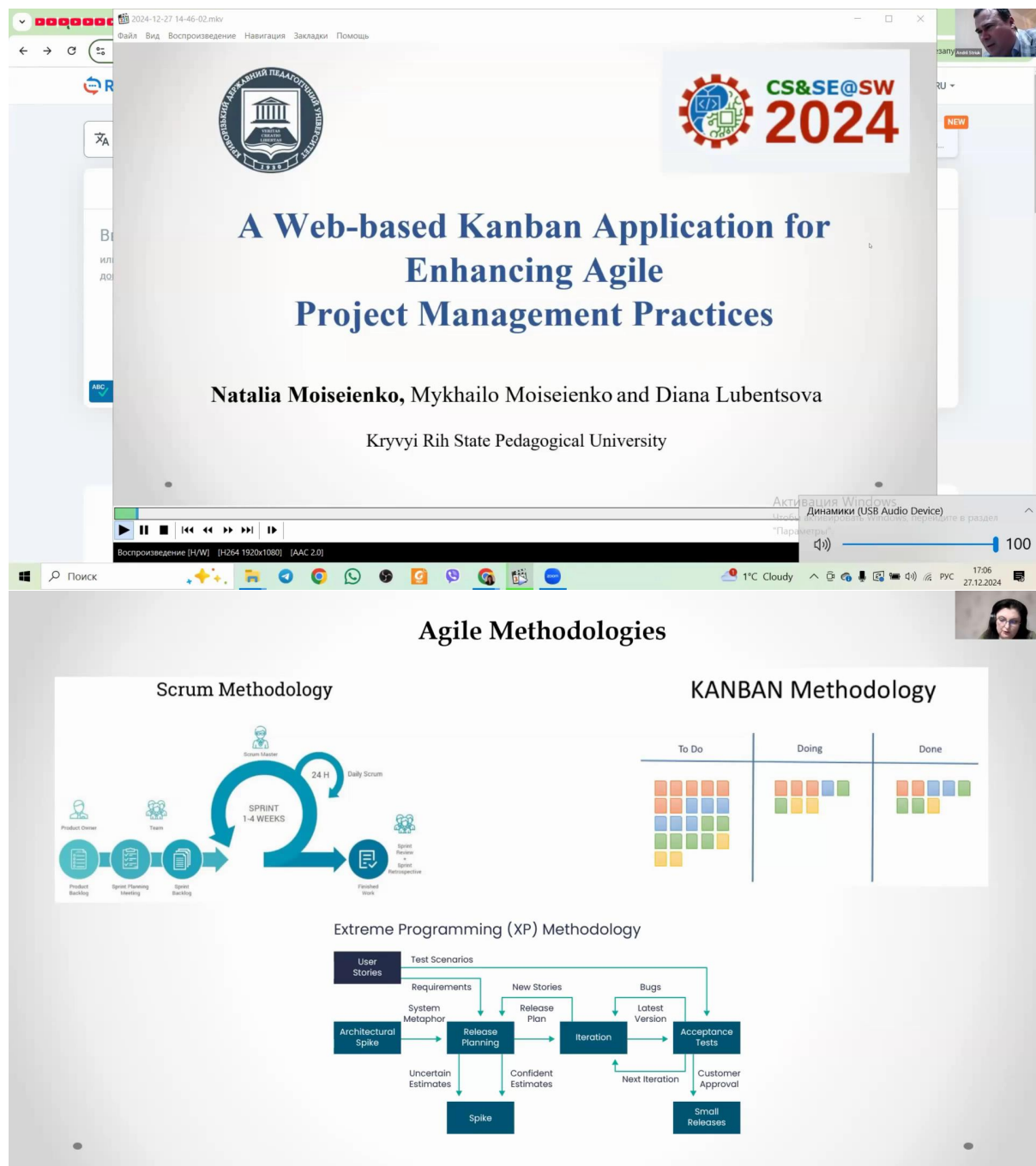
Figure 8: Excerpts from the paper presentation [10].

management practices, particularly among teams and individuals new to Kanban. By providing a simple and accessible tool, Kards can help organizations overcome some of the barriers to agile adoption and realize the benefits of increased transparency, collaboration, and continuous improvement in their project management efforts.

In their paper "An interactive online trainer for primary school computer science education: Design, implementation, and theoretical foundations", Zhdaniuk et al. [11] present an interactive online trainer designed to address the challenges of introducing computational thinking and digital literacy skills to young learners. The authors emphasize the importance of exposing students to computer science concepts and skills from an early age to foster computational thinking, problem-solving abilities, and digital literacy.

Figure 9: Excerpts from the paper presentation [11].

The study highlights the challenges of integrating computer science education into primary school curricula, such as the lack of qualified teachers, shortage of age-appropriate learning resources, and the need to make computer science concepts engaging, interactive, and accessible to children with diverse learning styles and backgrounds. The authors propose interactive online trainers as a promising solution to address these challenges, providing an engaging and accessible platform for students to learn and practice computer science concepts at their own pace.

The interactive online trainer presented in this paper incorporates game-based learning, multimedia elements, and self-regulated learning principles to promote student engagement, motivation, and knowledge construction. The system features three main types of learning activities: image-text matching, puzzle assembly, and multiple-choice quizzes, which are designed to progressively build students' understanding of computer science concepts.

The paper discusses the design principles, software architecture, and key features of the trainer, as well as the theoretical foundations underpinning its design, including constructivist learning, game-based learning, multimedia principles, and self-regulated learning. The authors also outline a plan for evaluating the effectiveness of the trainer in terms of student learning outcomes, engagement, and motivation using a mixed-methods, quasi-experimental research design.

The study's findings suggest that the interactive online trainer has the potential to support the integration of computer science education into primary school curricula and promote early exposure to computational thinking and digital literacy skills. By providing a simple and accessible tool, the trainer can help address the challenges of limited teacher expertise and access to age-appropriate learning materials, thus promoting the widespread adoption of computer science education in primary schools.

4.2. Theoretical computer science

The paper "Overview of modern algorithms for world procedural generation in computer games" by Laitaruk and Hryshanovych [16] provides a comprehensive survey of popular algorithms used for procedurally generating game worlds. The authors emphasize the importance of procedural content generation (PCG) in creating varied and immersive gaming experiences while optimizing development resources.

The paper systematically examines several key algorithmic approaches:

- Graph grammars and rewriting systems for generating structured game elements like cities, dungeons, and trees. The time complexity of these methods is analyzed in depth.
- Voronoi diagrams for partitioning game spaces into distinct regions, with a focus on the Fortune's algorithm and the impact of using different distance metrics like Manhattan, Euclidean, and Minkowski.
- Gradient noises, particularly Perlin noise and fractional Brownian noise, for creating natural-looking terrain, textures, and environmental effects. The usage of these techniques in games like Minecraft is discussed.
- Cellular automata for generating cave-like structures, mazes, and simulating fluid dynamics, with an analysis of neighborhood types and transition rules.
- Genetic algorithms for optimizing game world parameters based on desired gameplay features, represented as a genotype-to-phenotype mapping.

The authors provide a comparative table summarizing the characteristics, use cases, and time complexity of each method. They also discuss the combination of these techniques and the application of physics-based simulation to enhance the realism and interactivity of the generated worlds.

The paper concludes by highlighting the trade-offs between computational complexity and the quality and controllability of the generated content, as well as identifying promising areas for future research in PCG for games.

The paper "Overview of small language models in practice" by Popov et al. [17] delves into the emerging field of small language models (SLMs) and their practical applications. The authors highlight
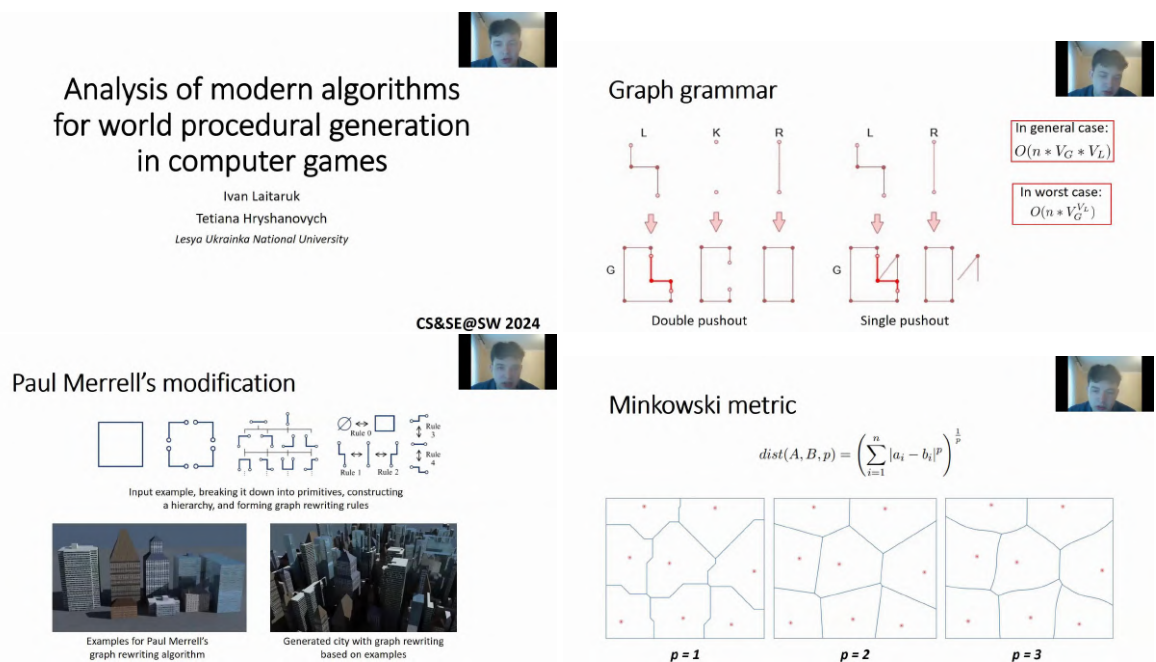
Figure 10: Excerpts from the paper presentation [16].

the limitations of large language models (LLMs) in terms of computational resources, privacy concerns, and generalization capabilities, which have motivated the development of SLMs.

The paper provides an in-depth analysis of the key features and advantages of SLMs, including their resource efficiency, data privacy, and potential for fine-tuning to specific domains. The authors discuss the main techniques for obtaining SLMs, such as pruning, knowledge distillation, and quantization, along with their respective strengths and weaknesses.

The experimental evidence for SLM performance is critically examined, with a focus on recent benchmarks and case studies. The authors note the challenges in comparing SLMs to LLMs due to differences in model architectures, training data, and evaluation metrics. They also conduct a novel question-answering experiment using a set of carefully designed sanity questions to assess the reliability and common-sense reasoning capabilities of several state-of-the-art SLMs.

The paper addresses the terminological ambiguities surrounding AI and language models, proposing refined definitions for terms like "SLM", "local", and "remote" models to facilitate clearer communication within the research community.

Finally, the authors provide an overview of the current ecosystem of tools and platforms for managing and deploying SLMs, highlighting their accessibility and potential for widespread adoption.

The paper concludes by emphasizing the promise of SLMs as a practical and efficient alternative to LLMs in various applications, while also acknowledging the need for further research to fully understand their capabilities and limitations.

The paper "Topic modelling of Ukrainian folk songs: A case study on Podillia region" by Petrovych [18] explores the application of computational methods, particularly Latent Dirichlet Allocation (LDA), to uncover thematic structures and motifs in the folk songs of the Podillia region in Ukraine. The authors aim to bridge the gap between traditional folkloristic analysis and modern data-driven approaches.

The study utilizes a dataset of 2,762 folk songs, which undergoes preprocessing steps such as tokenization, lemmatization, and stopword removal. The author construct a document-term matrix and apply LDA to identify the top 20 latent topics, each characterized by a set of keywords representing distinct thematic clusters.

The results reveal recurrent themes in Podillia folk songs, including seasonal cycles, family relationships, social rituals, and emotional experiences. The author provide an in-depth interpretation of each topic, discussing the cultural significance and narrative patterns associated with the identified

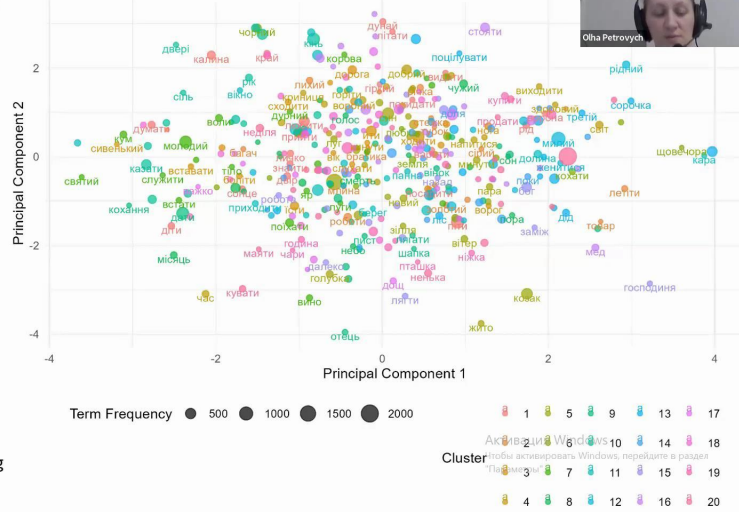**Figure 11:** Excerpts from the paper presentation [17].

Figure 12: Excerpts from the paper presentation [18].

keywords.

The paper also addresses the challenges of adapting computational methods to Ukrainian folk song corpora, such as dealing with colloquial language, regional dialects, and metaphorical expressions. The author propose strategies for overcoming these obstacles, such as using language-specific preprocessing tools and incorporating domain knowledge.

To assess the quality of the generated topics, the author employ coherence evaluation metrics and compare their findings with traditional folkloristic classifications. She find that the computational approach complements and enriches existing knowledge, providing new insights into the thematic richness of Podillia folk songs.

The paper concludes by highlighting the potential of computational folkloristics in deepening our understanding of cultural heritage and oral traditions, while also acknowledging the limitations and areas for future research, such as refining methodologies and integrating hybrid approaches.

The paper "Bibliometric analysis and experimental assessment of chatbot training approaches" presents a comprehensive analysis of chatbot training approaches through both bibliometric analysis and experimental evaluation. The authors, Liashenko and Semerikov [19], make several key contributions:

1. Conduct an extensive bibliometric analysis of 549 publications from Scopus, identifying four key research clusters:

   - Natural language processing
   - Application of NLP technologies in society
   - Use of machine learning for NLP
   - Chatbots in education and service sectors

2. Create and evaluate two novel datasets for chatbot training:

   - A 1.9GB corpus from CEUR Workshop Proceedings (predominantly English)
   - A 107MB corpus from Information Technologies and Learning Tools journal (predominantly Ukrainian)

3. Provide a thorough examination of chatbot training approaches:

   - Supervised learning (Seq2Seq and Transformer architectures)
   - Reinforcement learning (including RLHF)
   - Transfer learning methods

4. Present practical fine-tuning experiments:

   - Fine-tune GPT-2-XL on the English corpus
   - Fine-tune GPT2-uk on the Ukrainian corpus
   - Demonstrate working implementations using transformers library

The methodological approach is rigorous, with clear documentation of the bibliometric analysis process using VOSviewer and careful selection of models and evaluation metrics. The experimental results validate the effectiveness of transfer learning for domain-specific chatbot development.

The paper's main limitation is that it doesn't provide quantitative evaluation metrics for the fine-tuned models' performance, though it does present a working prototype interface. However, this is balanced by the comprehensive theoretical framework and practical implementation details provided.

The paper "Channel extractor for UAV PPM signals" by Smolij et al. [20] addresses the challenge of efficiently transmitting control signals and data in unmanned aerial vehicle (UAV) communication systems using pulse-position modulation (PPM). The authors propose a novel hardware solution for extracting individual pulse-width modulation (PWM) channels from a single PPM signal line, enabling multi-channel control of UAVs while minimizing wiring complexity.

The paper begins by providing a comprehensive background on UAV communication systems, signal modulation techniques, and the advantages of PPM for transmitting multiple control signals over a shared medium. The authors highlight the importance of reliable and responsive communication for

Figure 13: Excerpts from the paper presentation [19].

precise UAV control in various applications, such as reconnaissance, environmental monitoring, and rescue operations.

The proposed PPM channel extractor system consists of three main components: a counter register, a user-input channel register, and a compare circuit. The authors present a detailed schematic of the circuit, implemented using inverters, XOR gates, JK flip-flops, and other logic elements. The operation of the extractor is thoroughly explained, with a focus on the conversion of the PPM signal to individual PWM channels based on user-defined channel indices.

The paper also analyses the DC component of the PPM signal and provides mathematical formulas for its calculation. The authors discuss the relationship between pulse width, frequency, and the modulating signal, as well as the power spectral density and signal-to-noise ratio of PPM.

The proposed system is simulated using the Micro-Cap software, and the results demonstrate the successful extraction of PWM signals for single and multiple channels. The authors also observe and discuss the presence of a minor "glitch" in the output signal, attributing it to the reset time of the flip-flops and concluding that it does not adversely affect the control process.
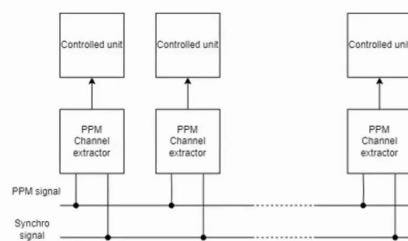
The paper concludes by highlighting the flexibility, scalability, and robustness of the proposed PPM
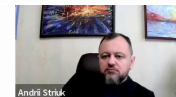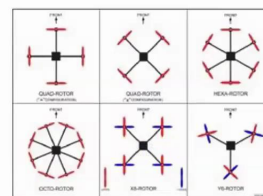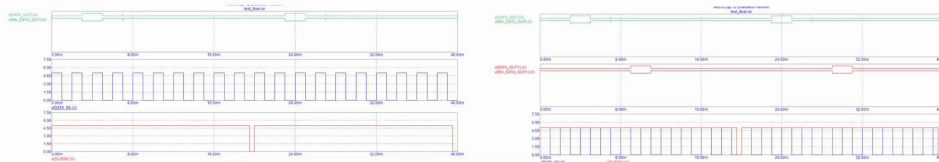
Figure 14: Excerpts from the paper presentation [20].

channel extractor, as well as its potential for integration into existing UAV communication systems. The authors suggest further improvements, such as eliminating the need for a separate synchronization signal by incorporating an additional block for automatic circuit reset.

4.3. Computer systems

The paper "Development of an automated system for preparing mineral raw material samples for discrete analysis" presents an innovative automated system for preparing mineral raw material samples for analysis in the mining industry. The authors, Krapyvnyi et al. [21], make several notable contributions:

1. Develop a comprehensive automated sample preparation system integrating:

   - Arduino-based embedded control with real-time data processing
   - Hydraulic press with precision pressure control
   - Custom firmware implementing PID control and state machine logic
   - Modular hardware design for flexibility

2. Achieve significant performance improvements over manual methods:

   - 65% reduction in processing time (70s vs manual methods)
   - 50+ samples/hour throughput
   - 0.53% RSD in bulk density measurements
   - Equivalent analytical quality (65.4% vs 65.5% Fe content)

3. Create a robust control system demonstrating:

   - <2% pressure overshoot
   - ±0.1 bar steady-state error
   - 500ms response time
   - High repeatability across operating range

4. Validate system performance through:

   - Extensive pressure control testing
   - Bulk density consistency analysis
   - Comparative studies with manual methods
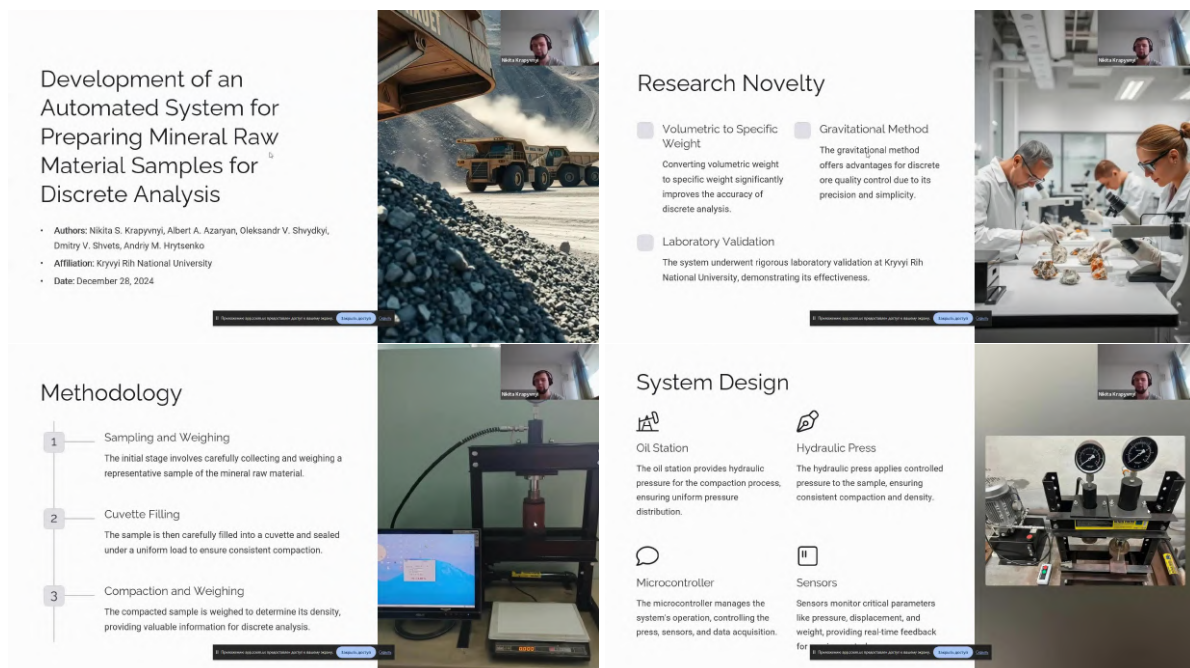   - XRF analysis of prepared samples

Figure 15: Excerpts from the paper presentation [21].

The methodology is thorough, with detailed documentation of the hardware design, control algorithms, and experimental validation. The results convincingly demonstrate the system's advantages in throughput, consistency and quality.

The main limitation is the focus on iron ore materials specifically, though the authors note the system's adaptability to other sample types. The modular design and flexible control software should facilitate such extensions.

The paper "Methods of data analysis to study the effectiveness of scientific journal promotion" by Korotun et al. [23] presents a comprehensive analysis of promotion strategies for a new scientific journal focused on edge computing. The authors examine data collected from email invitations sent to researchers worldwide to evaluate the effectiveness of the journal's outreach efforts.

The study employs various statistical methods and machine learning techniques to analyze patterns in researcher engagement. The methodology includes six key stages: data collection from ScienceDirect publications, data cleaning, descriptive analysis, analytical analysis using regression and clustering, interpretation of results, and formulation of recommendations.

The authors utilize the R programming language to perform their analysis, implementing linear regression to model the relationship between emails sent and journal visits. They also apply k-means clustering to segment countries into three distinct groups based on engagement levels:

> Cluster 1: Countries showing low interest with minimal mailings and visits
>
> Cluster 2: Countries with outlier behavior, showing either very high or very low engagement relative to outreach efforts
>
> Cluster 3: Countries with moderate engagement levels requiring further segmentation

Key findings include a strong positive correlation between email invitations and journal visits (demonstrated through Spearman correlation), with some countries showing conversion rates exceeding 100%. The study provides valuable insights for journal promotion strategies, suggesting targeted approaches based on regional response patterns.

The paper "Information systems development in accounting: A systematic network study" by Horodyskyi et al. [27] presents a comprehensive scientometric analysis of research trends in accounting information systems (AIS). The authors analyze 5,442 scholarly publications from the Web of Science database, focusing on the intersection of information systems and accounting across multiple disciplines including computer science, management, business finance, economics, and business.

The study employs sophisticated bibliometric analysis using the "bibliometrix" package in R to identify key research trends, methodologies, and emerging themes. The authors' findings reveal several important developments in the field:

First, the conceptual structure analysis demonstrates two primary research clusters: one focusing on technological implementation and performance measurement, and another examining financial transparency and corporate governance. The research shows that while "information" serves as a central bridging concept between these clusters, there is no dominant research paradigm, suggesting the field is still evolving.

Second, the authors identify emerging research trends, particularly in blockchain technology, artificial intelligence, and machine learning during 2020-2024. The study also highlights growing interest in big data analytics and sustainable development as crucial future directions for AIS research.

Third, the geographical analysis reveals significant contributions from Ukraine, USA, and China, with increasing participation from developing economies like Indonesia, Malaysia, and Brazil, indicating the global relevance of AIS research.

4.4. Computer applications

The paper "A modified 3D-2D convolutional neural networks for robust mineral identification: Hyperspectral analysis in Djebel Meni (Northwestern Algeria)" by Attallah et al. [22] presents an innovative

Figure 16: Excerpts from the paper presentation [23].

Figure 17: Excerpts from the paper presentation [27].

approach to mineral classification using hyperspectral imaging data. The authors address the challenging task of identifying minerals in remote, geologically complex terrains through the integration of deep learning techniques with hyperspectral remote sensing.

The research focuses on the Djebel Meni region in Northwestern Algeria, utilizing data from NASA's Hyperion EO-1 sensor to classify three key clay minerals: illite, kaolinite, and montmorillonite. The authors propose a hybrid 3D-2D CNN architecture that effectively combines spatial and spectral feature extraction capabilities. The methodology includes comprehensive preprocessing steps, including bad bands removal, radiometric calibration, and atmospheric correction using the QUAC module.

A notable contribution is the detailed optimization of the CNN architecture, featuring four 3D convolutional layers followed by three 2D convolutional layers. This hybrid approach enables the network to capture both spectral dependencies and spatial features effectively. The model achieves impressive results with an overall accuracy of 94.26% and a Kappa coefficient of 0.9401, outperforming traditional methods like SAM and standalone 2D or 3D CNNs.

The experimental validation is thorough, utilizing a balanced dataset split across training (70%), validation (10%), and testing (20%) sets. The authors implement various optimization techniques, including batch normalization, L2 regularization, and dropout, to enhance model generalization. The results are comprehensively evaluated using multiple metrics, including precision, recall, and F1-score for each mineral class.

The paper makes significant contributions to the field of hyperspectral mineral mapping by:

- Introducing a novel hybrid CNN architecture specifically optimized for mineral classification
- Providing a comprehensive framework for preprocessing hyperspectral data
- Demonstrating superior classification performance compared to existing methods
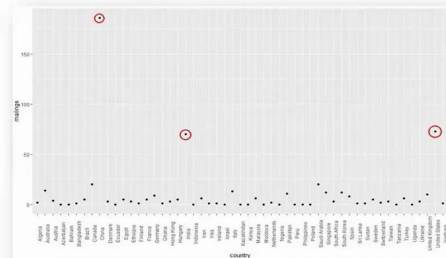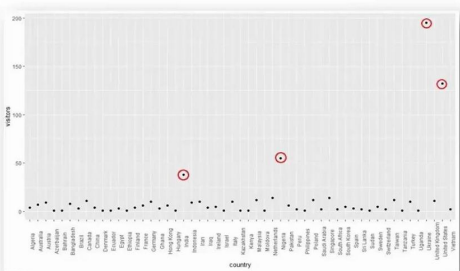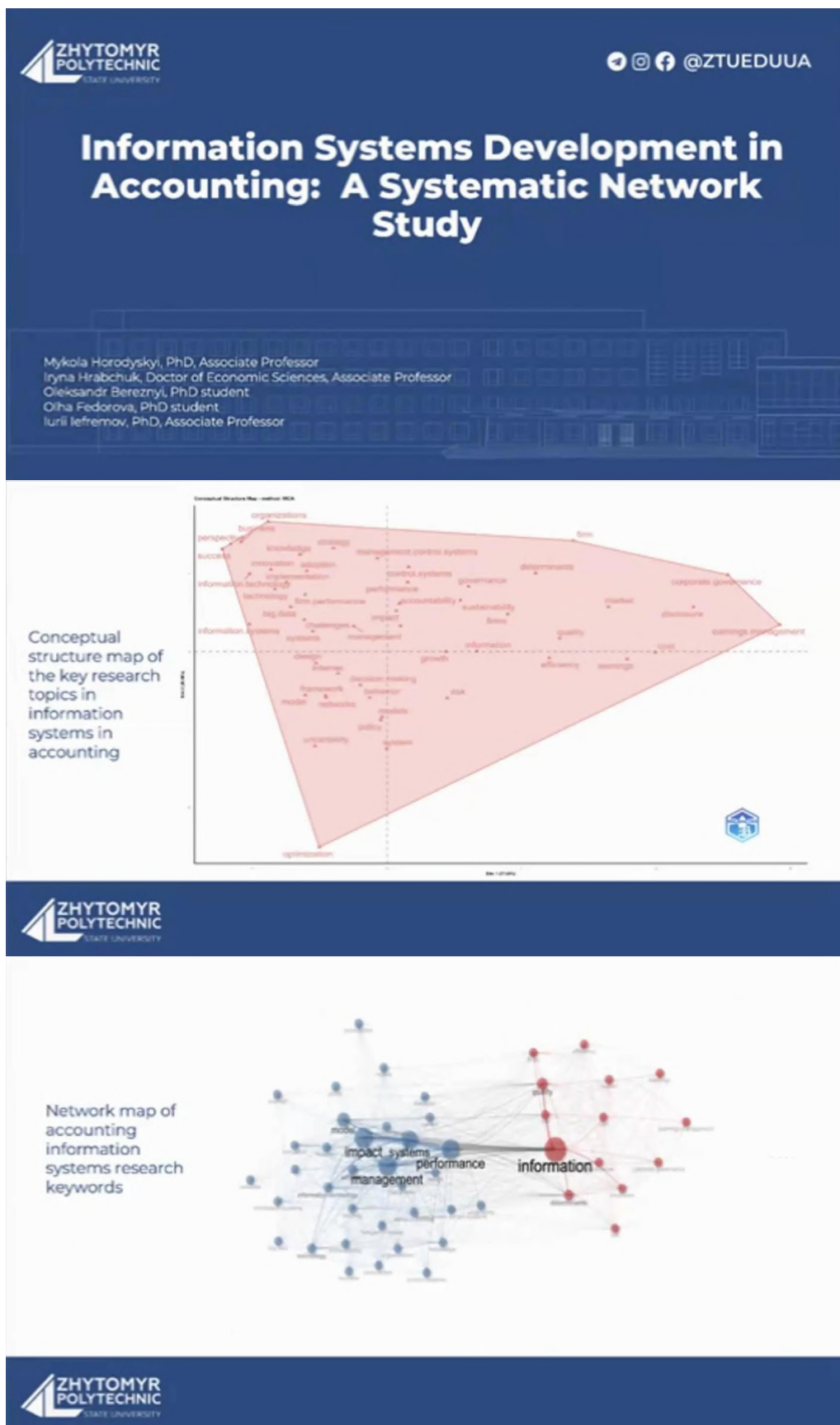- Establishing a reproducible methodology for mineral identification in complex geological settings

This research advances the application of deep learning in geological remote sensing and opens new possibilities for automated mineral mapping in challenging terrains. The authors' approach could be particularly valuable for mineral exploration and geological surveys in remote or inaccessible regions.

The paper "Method of semantic features estimation for political propaganda techniques detection using transformer neural networks" by Krak et al. [24] presents a novel method for detecting political propaganda techniques using transformer neural networks enhanced with semantic feature analysis. The authors address the critical challenge of identifying propaganda in media content, which has become increasingly important in today's information-rich society.

The proposed method introduces several key innovations:

- Integration of semantic features (text emotionality, bullying, fear, and hate speech) to improve propaganda detection accuracy
- Modified transformer neural network architecture that processes both text data and numerical semantic feature vectors
- Enhanced explainability of the model's decisions through semantic feature analysis

The experimental results demonstrate significant improvements in detection accuracy for several propaganda techniques. Notable gains were achieved for techniques such as "Red Herring" (9% improvement), "Whataboutism" (4% improvement), and "Thought Terminating Cliches" (3% improvement). The method achieved an average accuracy of 89%, with maximum accuracy reaching 97% for certain techniques.

The authors also emphasize the method's contribution to Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education) and SDG 16 (Peace, Justice and Strong Institutions), through its potential to enhance media literacy and strengthen democratic institutions.

The work represents a significant advancement in automated propaganda detection, though there remain opportunities for further optimization, particularly for techniques where accuracy decreased or remained unchanged. Future research directions include expanding the set of detected semantic features to improve detection accuracy for underperforming techniques.

Figure 18: Excerpts from the paper presentation [22].

Figure 19: Excerpts from the paper presentation [24].

The paper "Method for neural network cyberbullying detection in text content with visual analytic"

by Krak et al. [25] presents an innovative approach to detecting and interpreting cyberbullying in text using neural networks and visual analytics. The authors recognize the growing significance of cyberbullying detection systems, particularly given the increasing number of social media users and decreasing age of users.

The proposed method combines a BERT-based neural network for multi-label classification of cyberbullying types with visual analytics to explain the model's decisions. A key contribution is the implementation of three complementary visualization approaches:

1. Color palette visualization – highlighting influential words with varying color intensities based on their impact on classification

2. Local word importance diagrams – showing the contribution of individual words to specific cyberbullying classifications

3. General word importance diagrams – presenting the overall significance of words across all cyberbullying types

The authors trained and evaluated their model using the "Cyberbullying Classification" dataset, achieving impressive performance metrics: Accuracy (0.956478), Precision (0.963677), Recall (0.956478), and F1-Score (0.960019). These results demonstrate significant improvements over previous approaches, with accuracy gains of 2.49-9.05% compared to similar studies.

A particular strength of the paper is its focus on explainability in AI decision-making, especially crucial for sensitive applications like cyberbullying detection. The method integrates LIME (Local Interpretable Model-agnostic Explanations) for generating interpretable visualizations that help users understand why specific text segments are classified as cyberbullying.

The authors also connect their work to broader societal impacts, noting its alignment with multiple UN Sustainable Development Goals (SDGs), including those related to well-being (SDG3), education (SDG4), gender equality (SDG5), reducing inequalities (SDG10), and promoting justice (SDG16).

The paper concludes by suggesting future research directions, including adaptation for multiple languages, user studies to assess the impact of visual analytics on human decision-making, and exploration of alternative interpretation methods.

The paper "Design and implementation of a mobile health application for physical activity tracking and exercise motivation" by Stepanyuk et al. [28] presents a novel mHealth application aimed at promoting physical activity and exercise adherence. The authors develop a modular system that incorporates evidence-based strategies for behavior change, including real-time activity tracking, personalized goal-setting, and motivational elements.

The paper's architecture section details five key modules: core, tracking, planning, motivation, and user interface, along with a synchro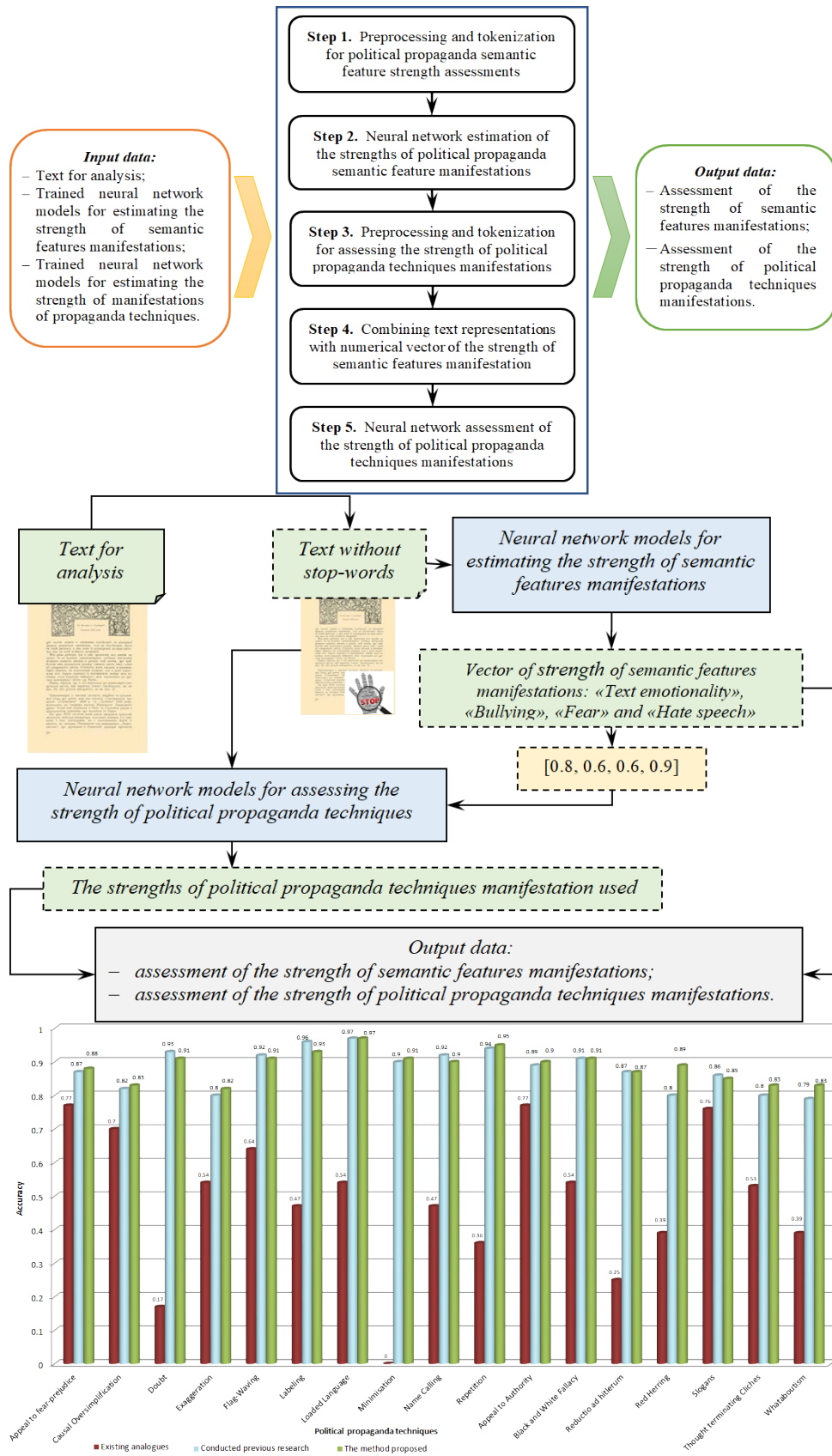nization component. The system employs the Model-View-Presenter (MVP) architectural pattern to ensure modularity and extensibility. Notable implementation features include sophisticated data privacy measures using SSL/TLS protocols and AES-256 encryption, along with robust data anonymization techniques.

The authors conducted a preliminary evaluation with 2 participants over a 4-week period, measuring daily step count, weekly active minutes, and goal achievement rates. While the study showed promising results in terms of increased physical activity levels and user satisfaction, the extremely small sample size (n=2) significantly limits the generalizability of the findings.

A key strength of the paper lies in its comprehensive technical documentation and thoughtful system architecture. However, the evaluation section presents a major limitation due to its minimal participant pool. The authors acknowledge this limitation and propose several directions for future work, including larger-scale studies, integration of machine learning algorithms, and adaptation for specific populations such as older adults or individuals with chronic conditions.

The paper "AI-agent-based system for fact-checking support using large language models" by Kupershtein et al. [29] presents a timely solution for automated fact-checking using Large Language Models (LLMs). Given the increasing prevalence of disinformation and its societal impact, the authors propose an AI-based architecture to enhance the efficiency and accuracy of fact verification processes.
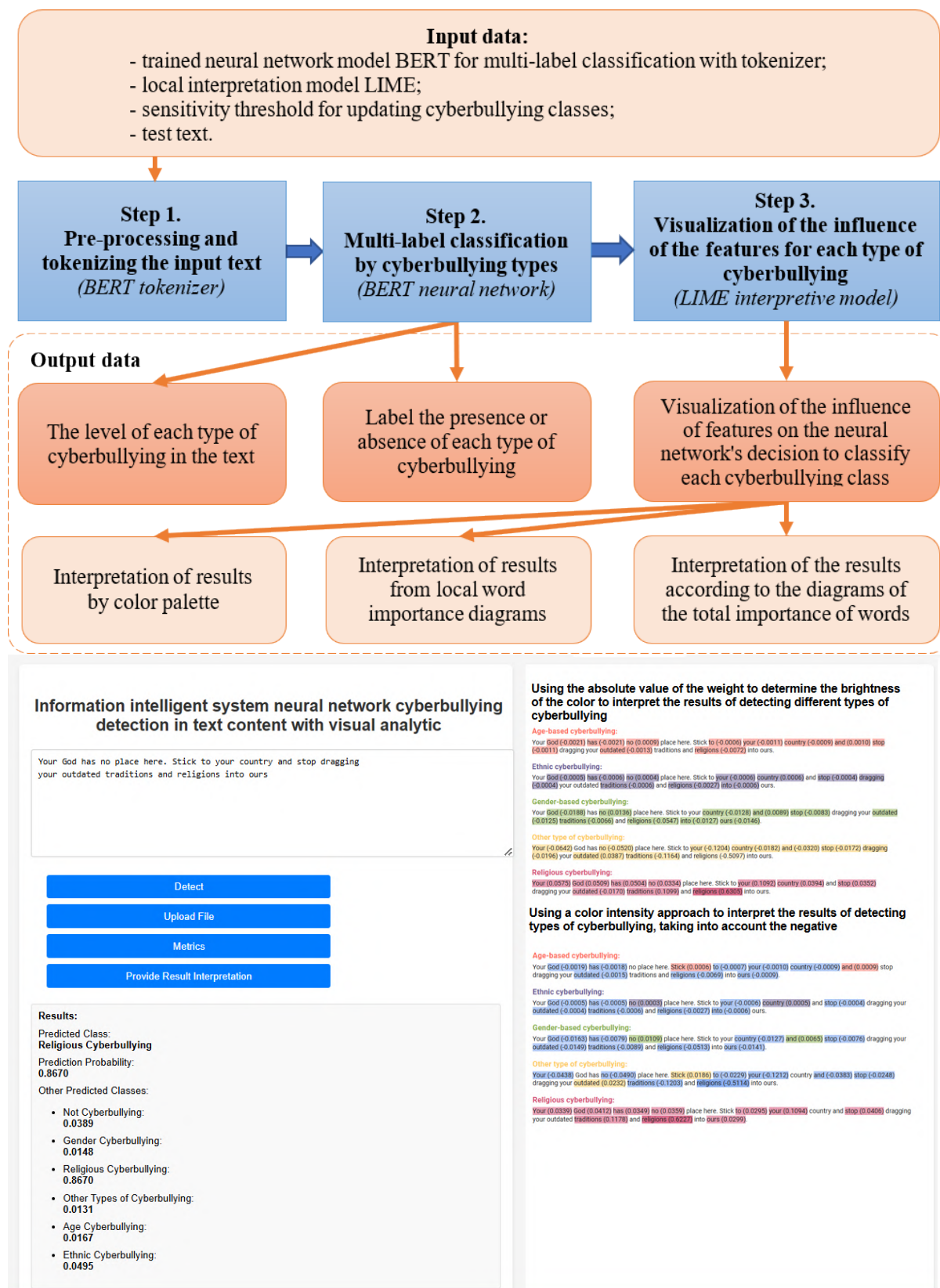
Figure 20: Excerpts from the paper presentation [25].

The paper provides a thorough analysis of disinformation's impact, particularly focusing on Ukraine's experience with targeted misinformation campaigns. The authors present compelling statistics from the European External Action Service's report, showing that 21.3% of analyzed disinformation incidents

Figure 21: Excerpts from the paper presentation [28].

were directed against Ukraine during 2022-2023.

The core contribution is a comprehensive AI-agent-based system architecture comprising six main components:
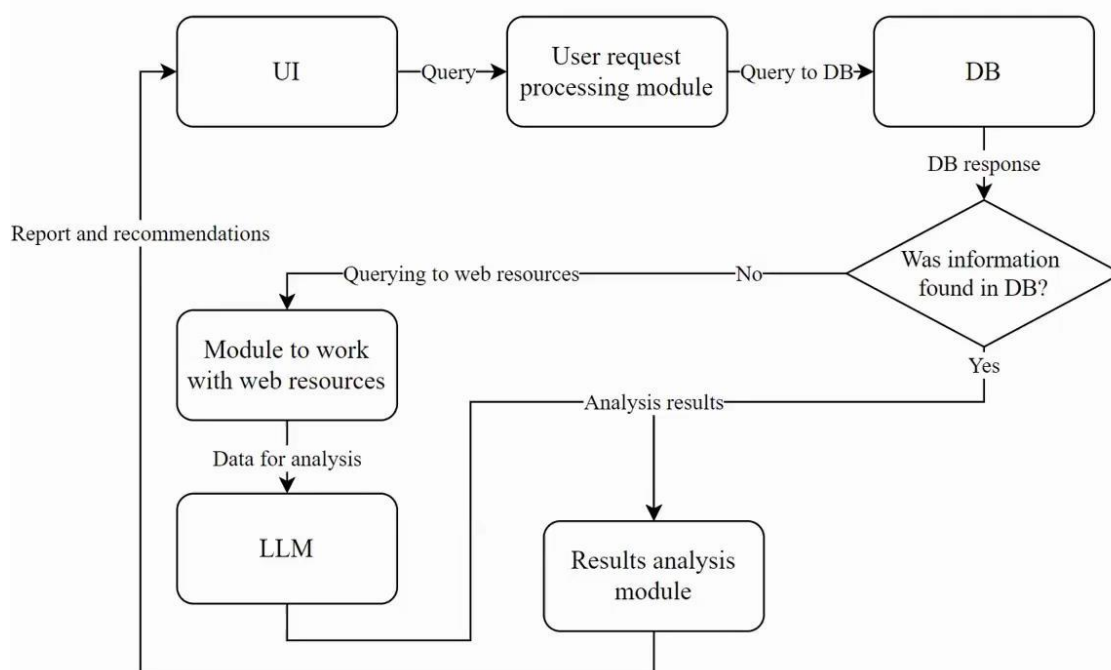
Figure 22: Excerpts from the paper presentation [29].

- User interface
- Request processing module
- Database with RAG implementation
- Web resources module
- Large Language Model integration
- Results analysis module

The experimental results demonstrate the system's effectiveness, achieving 90% accuracy in fake news detection. The authors conducted thorough testing across multiple scenarios, including verification of claims about Ukrainian power outages and language policy changes. Notably, they openly discuss the system's limitations, such as occasional LLM "hallucinations" and the importance of human oversight.

A particular strength of the paper is its practical implementation using modern tools, including OpenAI's GPT-4o, Python libraries for web scraping, and Streamlit for the user interface. However, the evaluation could benefit from a larger sample size of test cases and more rigorous comparative analysis with existing fact-checking systems.

The paper "Advances in neural text generation: A systematic review (2022-2024)" by Slobodianiuk and Semerikov [30] presents a comprehensive systematic review of recent developments in neural text generation. The authors conducted this review to complement an earlier review covering 2015-2021, focusing specifically on advances made between 2022 and 2024. Using the PRISMA methodology, they analyzed 43 articles from the Scopus database to identify current trends, approaches, and methodologies in neural text generation.

The review makes several significant contributions to the field. First, it identifies a clear shift towards innovative model architectures, particularly Transformer-based models like GPT-2, GPT-3, and BERT, while noting that traditional approaches like RNNs and LSTMs continue to serve specific applications. Second, it documents the evolution of evaluation metrics, showing that while BLEU and ROUGE remain standard, new metrics such as BERTScore have emerged to provide more nuanced assessment of generated text quality.

A notable finding is the growing diversity in both datasets and applications. The authors observe increased interest in unlabeled data and the expansion of text generation into specialized domains such as medical text generation and table-to-text generation. The review also highlights an important trend in language coverage – while English remains dominant, there is growing research interest in low-resource languages, indicating a move towards more inclusive language technology development.

Methodologically, the study is robust, employing both automated analysis through large language models (Claude 3 Sonnet and GPT-4) and human verification to ensure accurate data extraction. The authors provide detailed comparisons with the previous review period, enabling readers to track the evolution of the field over time.

The paper is particularly valuable for its systematic categorization of neural network architectures, evaluation metrics, and applications in text generation. The authors present their findings through clear tables and figures, making the information easily accessible to researchers and practitioners in the field.

One of the review's strengths is its thorough examination of methodological trends, revealing that while traditional approaches persist, innovative architectures – particularly those leveraging attention mechanisms and transformer-based models – are becoming increasingly prevalent.

The paper concludes with important observations about future research directions, highlighting open questions regarding quality assessment, domain adaptation, and ethical considerations in text generation technologies. These insights make the review not just a summary of current work but also a valuable resource for identifying promising future research directions.

The paper "Automating machine learning: A meta-synthesis of MLOps tools, frameworks and architectures" by Hanchuk and Semerikov [31] presents a comprehensive meta-synthesis of MLOps practices, tools, and frameworks. The authors address the growing need for effective operationalization of machine learning models in production environments, noting that despite advances in ML algorithms, deployment remains challenging.

The research employs a rigorous meta-synthesis methodology to analyze existing systematic reviews, examining MLOps from multiple perspectives. The authors particularly focus on three key systematic reviews from 2022-2023, supplemented with additional literature to provide a holistic view of the MLOps landscape.

The manuscript makes several significant contributions:

1. Provides a detailed analysis of MLOps definitions, workflows, and core components
2. Identifies common frameworks and architectures facilitating MLOps implementation

3. Examines tools for creating ML pipelines and operationalizing models
4. Proposes a relationship diagram connecting MLOps principles, processes, and practices

A particularly valuable contribution is the authors' systematic breakdown of MLOps practices into key categories including continuous integration/delivery, model versioning, pipeline automation, monitoring, and lifecycle management. They also address critical aspects such as data security, privacy, and model explainability.

The manuscript concludes by identifying future research directions, including the need for detailed implementation recommendations and new tools for automating ML model lifecycles. While comprehensive in scope, the work could benefit from more concrete case studies demonstrating the practical application of the identified practices.
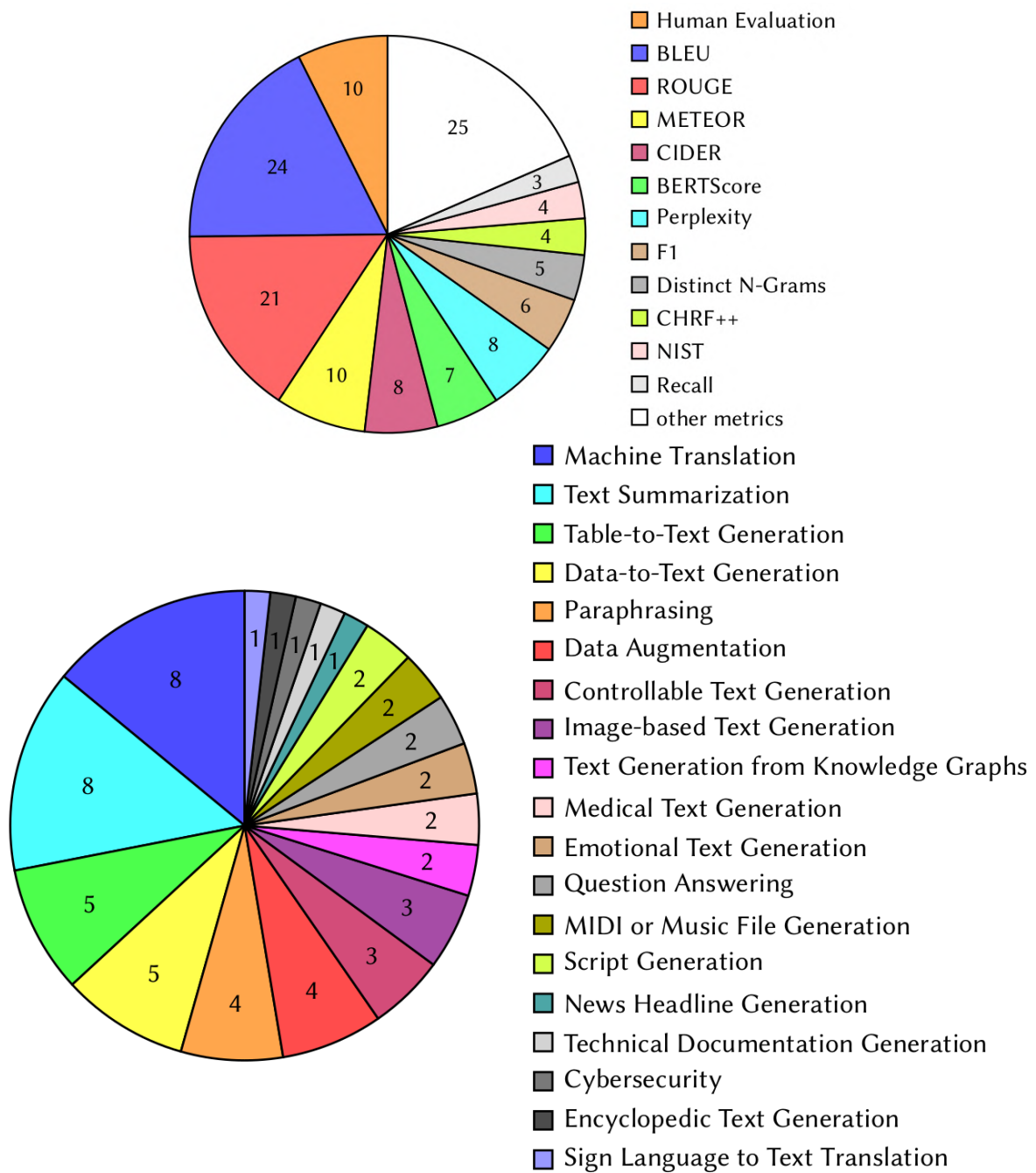

Figure 23: Excerpts from the paper presentation [30].

This paper makes a valuable contribution to the MLOps field by synthesizing existing knowledge and providing a structured framework for understanding and implementing MLOps practices. It serves as both a theoretical foundation and practical guide for organizations seeking to improve their machine learning operations.

The paper "Research and development of a subtitle management system using artificial intelligence" by Striuk and Hordiienko [32] presents an innovative AI-powered system for automating the generation and management of video subtitles. The authors address the critical challenge of making video content accessible to wider audiences, including individuals with hearing impairments and those who don't understand the spoken language, while noting that manual subtitle creation is time-consuming and labor-intensive.

The proposed system leverages state-of-the-art automatic speech recognition (ASR) and machine translation (MT) technologies to generate accurate, synchronized subtitles in multiple languages. The system architecture consists of four main components: a speech recognition module utilizing advanced acoustic and language models, a machine translation module employing encoder-decoder architecture with attention mechanisms, a subtitle segmentation and formatting module, and a user-friendly interface for managing the subtitle generation process.

The paper provides a comprehensive literature review covering key aspects of AI-based subtitle generation, including speech recognition techniques, machine translation approaches, multimodal methods, and evaluation methodologies. The authors analyze various approaches, from traditional hidden Markov models to modern deep learning architectures like CNNs and RNNs, highlighting their applications in different domains such as educational content and entertainment.

The paper concludes by discussing the implications of the proposed system for subtitle generation pipelines and identifying directions for future research, including expanding language coverage, improving domain adaptation, and enhancing contextual understanding. The authors acknowledge current limitations while emphasizing the system's potential to significantly improve the efficiency and accessibility of video content across different domains.

The paper "A comprehensive survey on reinforcement learning-based recommender systems: State-of-the-art, challenges, and future perspectives" by Rossiiev et al. [33] presents an extensive overview of how reinforcement learning (RL) is being applied to recommendation systems. The authors systematically analyze the current state of research in this rapidly evolving field, examining both theoretical foundations and practical applications.

The paper begins by highlighting the limitations of traditional recommendation approaches like
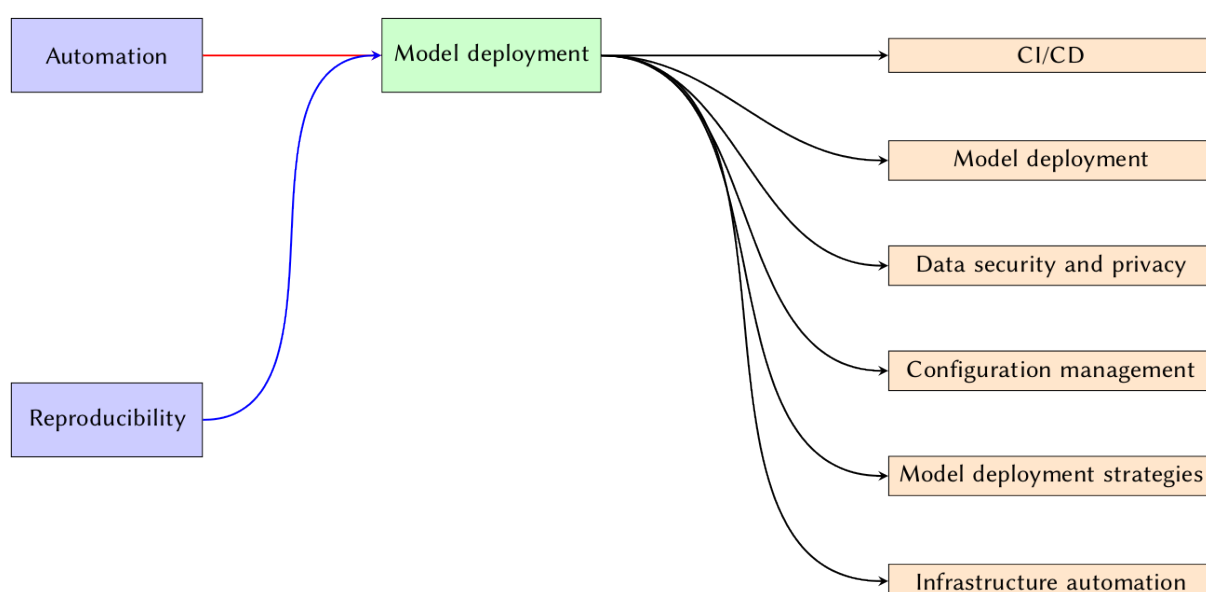
Figure 24: Excerpts from the paper presentation [31].

Figure 25: Excerpts from the paper presentation [32].

The primary objective of this survey is to provide a comprehensive overview of the current state-of-the-art in reinforcement learning-based recommender systems. We aim to address the following research questions:

RQ1: What are the key advantages of using reinforcement learning in recommender systems compared to traditional approaches?

RQ2: How can reinforcement learning be formulated and applied to the recommendation problem?

RQ3: What are the main reinforcement learning algorithms and architectures used in recommender systems?

RQ4: How can reinforcement learning be integrated with other techniques, such as collaborative filtering, content-based methods, and deep learning, to improve recommendation performance?

RQ5: What are the current challenges and future research directions in reinforcement learning-based recommender systems?
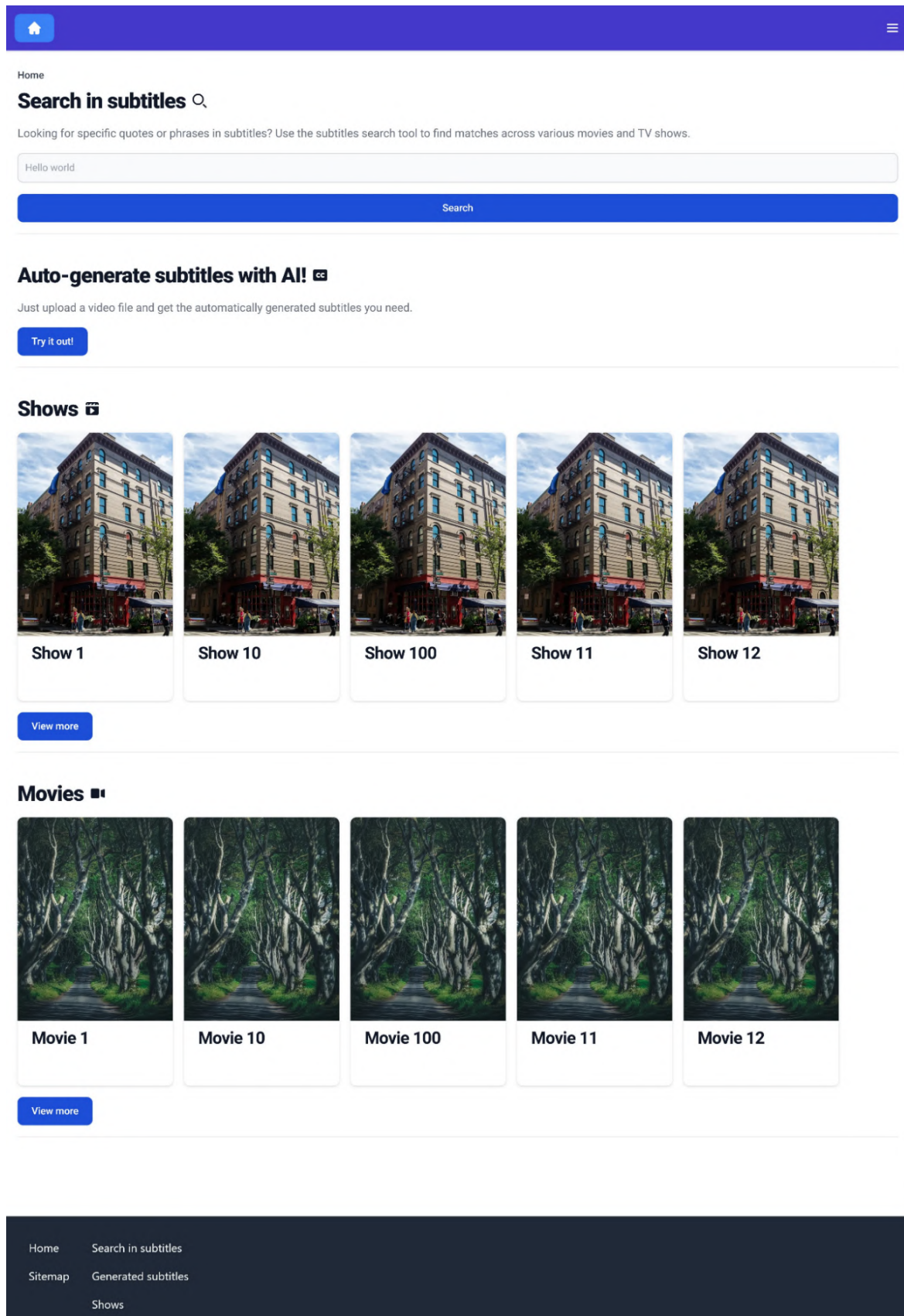
Figure 26: Excerpts from the paper presentation [33].

collaborative filtering and content-based methods, particularly their struggles with dynamic user preferences and sparse feedback. The authors then present reinforcement learning as a promising framework to address these challenges by formulating recommendation as a sequential decision-making process.

The survey provides a thorough examination of how the recommendation problem can be modeled using the Markov Decision Process (MDP) framework, detailing the construction of states, actions, and rewards. It explores various RL approaches including model-free methods (Q-learning, SARSA), model-based methods, policy gradient techniques (REINFORCE, Actor-Critic), and deep reinforcement learning implementations (DQN, DDPG).

A significant contribution of this work is its analysis of how RL can be integrated with other recommendation techniques. The authors discuss hybrid approaches combining RL with collaborative filtering, content-based methods, knowledge graphs, and graph neural networks. This integration allows systems to leverage the strengths of multiple approaches while mitigating their individual weaknesses.

The paper concludes by identifying key challenges and future research directions, including:

- The need for effective offline reinforcement learning methods
- Scalability and computational efficiency concerns
- Improving explainability and interpretability
- Ensuring robustness against adversarial attacks
- Developing better evaluation metrics and simulation environments
- Expanding real-world applications and case studies

The paper "Research and development of software for hydroacoustic signal analysis using machine learning techniques" by Poliaiev et al. [34] presents a comprehensive software system for analyzing hydroacoustic signals using machine learning techniques. The authors address the challenging problem of underwater acoustic signal processing, which has important applications in navigation, marine monitoring, and security systems.

The paper begins by establishing the complexity of hydroacoustic signal analysis, noting how underwater acoustic propagation is affected by various environmental factors including depth, water composition, and bottom topography. The authors highlight how recent advances in machine learning have enabled more sophisticated approaches to processing these complex signals.

The proposed system incorporates multiple components: data acquisition, preprocessing, feature extraction, and machine learning models for classification, regression, and clustering tasks. The preprocessing pipeline includes denoising, normalization, segmentation, and handling of missing values. The feature extraction process considers temporal, spectral, and statistical properties of the signals.

The machine learning methodology employs various models, including Support Vector Machines (SVM), Random Forests, K-Nearest Neighbors (KNN), and Gaussian Mixture Models (GMM). The
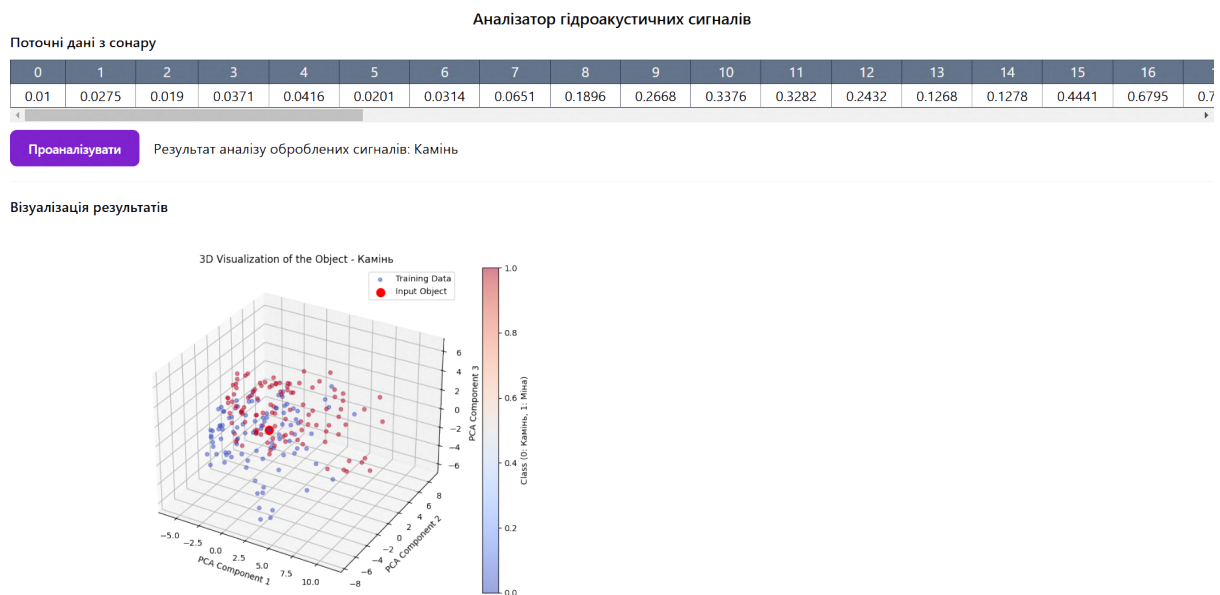
Figure 27: Excerpts from the paper presentation [34].

experimental results demonstrate the effectiveness of these approaches, with SVM achieving 94% accuracy in classification tasks and Support Vector Regression (SVR) showing superior performance in regression tasks with an R-squared value of 0.65.

A notable contribution is the development of a user-friendly web interface that allows for interactive signal analysis and visualization. The system's modular architecture ensures scalability and ease of integration with other applications through a RESTful API.

The authors validate their approach using real-world hydroacoustic data from government sources, providing comprehensive evaluation metrics and analysis. The paper concludes by suggesting future work in areas such as online learning, explainable AI, and distributed computing to further enhance the system's capabilities.

The paper "Investigating vulnerabilities of personal data on financial websites" by Fedorenko et al. [26] explores the critical issue of personal data security on financial websites in the digital age. The authors emphasize the severe consequences of data breaches, ranging from identity theft to long-term reputational damage. They analyze the complex interplay of technological, human, and organizational factors contributing to vulnerabilities.

The paper identifies common attack methods, such as SQL injection, cross-site scripting (XSS), and phishing, which exploit weaknesses in web application security. It also highlights the increasing sophistication of cybercriminals and the proliferation of hacking tools. The authors discuss recent high-profile data breaches, like the Kyivstar incident in December 2023, to underscore the devastating impact of successful attacks.

To address these challenges, the paper proposes a multi-pronged approach involving proactive measures by organizations and vigilance by individual users. It outlines strategies like robust security controls, regular auditing, strong password hygiene, and enabling two-factor authentication. The authors conduct security assessments of two prominent Ukrainian financial websites, OLX.ua and Privat24, providing practical insights into their security measures and areas for improvement.

The paper concludes by emphasizing the need for a comprehensive, multi-layered approach to personal data protection on financial websites. It calls for future research to develop advanced vulnerability detection tools, explore emerging technologies' security challenges, and evaluate data protection regulations' effectiveness.

Figure 28: Excerpts from the paper presentation [26].

5. CS&SE@SW 2024: Conclusion and outlook

The 7th Workshop for Young Scientists in Computer Science & Software Engineering (CS&SE@SW 2024) has once again showcased the impressive depth and breadth of research being conducted by emerging talents in these rapidly evolving fields. The papers presented at this year's workshop have explored cutting-edge topics spanning software engineering, theoretical computer science, computer systems, and computer applications.

In the field of software engineering, authors have proposed novel approaches for optimizing ER diagram creation, developing personalized digital mathematics tutors, implementing electronic audit projects, designing affordable lie detector prototypes, and creating engaging educational games. These contributions demonstrate the potential for software engineering methodologies to address real-world challenges and enhance user experiences across diverse domains.

Theoretical computer science papers have delved into modern algorithms for procedural content generation, the practical applications of small language models, topic modeling of folk songs, and advanced methods for chatbot training. These studies highlight the ongoing evolution of foundational computer science concepts and their increasing relevance to contemporary problems.

In the realm of computer systems, researchers have developed innovative solutions for automating mineral sample preparation, analyzing scientific journal promotion strategies, and conducting scientometric analyses of accounting information systems. These works underscore the critical role of computer systems in enabling efficient data management, analysis, and decision-making across

industries.

Finally, the computer applications track has featured groundbreaking research on hyperspectral mineral classification, propaganda detection using semantic features, cyberbullying identification through visual analytics, mobile health apps for physical activity promotion, AI-based fact-checking systems, and advanced subtitle generation techniques. These papers illustrate the immense potential for computer applications to address societal challenges, improve public health, combat disinformation, and enhance accessibility.

As we reflect on the success of CS&SE@SW 2024, it is evident that the workshop has provided a valuable platform for young scientists to share their research, exchange ideas, and foster collaborations. The high-quality submissions and thought-provoking discussions have not only advanced the state-of-the-art in computer science and software engineering but also laid the foundation for future innovations.

Looking ahead, CS&SE@SW remains committed to nurturing the growth of emerging researchers and facilitating the dissemination of cutting-edge knowledge. As the fields of computer science and software engineering continue to evolve at an unprecedented pace, workshops like CS&SE@SW will play an increasingly crucial role in shaping the future of these disciplines.

We eagerly anticipate the next edition of the workshop, to be held on December 26, 2025, in Kryvyi Rih, Ukraine, where we will once again convene to explore the frontiers of computer science and software engineering research.

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