Second Student Workshop
on Computer Science & Software Engineering

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Abstract. This is an introductory text to a collection of selected papers from the Second Student Workshop on Computer Science & Software Engineering (CS&SE@SW 2019), which was held in Kryvyi Rih, Ukraine, on the November 29, 2019. It consists of short summaries of selected papers and some observations about the event and its future.

Keywords: computer science, software engineering, student workshop.

1 CS&SE@SW 2019 at a glance

Student Workshop on Computer Science & Software Engineering (CS&SE@SW) is a peer-reviewed international Computer Science workshop focusing on research advances, applications of information technologies.

CS&SE@SW topics of interest since 2018 [5]:

─ Computer Science (CS):
  - Theoretical computer science
    - Data structures and algorithms
    - Theory of computation
    - Information and coding theory
    - Programming language theory
    - Formal methods
  - Computer systems
    - Computer architecture and computer engineering
    - Computer performance analysis
    - Concurrent, parallel and distributed systems
    - Computer networks
    - Formal methods

- ○ Databases
- Computer applications
  - ○ Computer graphics and visualization
  - ○ Human-computer interaction
  - ○ Scientific computing
  - ○ Artificial intelligence
- Software Engineering (SE):
  - Software requirements
  - Software design
  - Software construction
  - Software testing
  - Software maintenance
  - Software configuration management
  - Software engineering management
  - Software development process
  - Software engineering models and methods
  - Software quality
  - Software engineering professional practice
  - Software engineering economics
  - Computing foundations
  - Mathematical foundations
  - Engineering foundations

This volume represents the proceedings of the 2nd Student Workshop on Computer Science & Software Engineering (CS&SE@SW 2019), held in Kryvyi Rih, Ukraine, on November 29, 2019. It comprises 2 invited talks, 5 CS-related and 10-SE related contributed papers that were carefully peer-reviewed and selected from 30 submissions. Each submission was reviewed by at least 2, and on the average 2.7, program committee members. The accepted papers present the state-of-the-art overview of successful cases and provides guidelines for future research.

The volume is structured in three parts, each presenting the contributions for a particular workshop track.

2   Invited talks

Professor Nadiia Kozachenko (Fig. 1) is chair of Department of Philosophy at Kryvyi Rih State Pedagogical University. She got PhD in logic from the Institute of Philosophy of the NAS of Ukraine in 2010. The main directions of Dr. Kozachenko' research is logic and philosophy of information society.

In her talk (Fig. 2) Dr. Kozachenko trying to combine two main traditions of belief revision: the so-called AGM-approach and Dynamic Doxatic Logic (DDL) approach [9]. She consider doxastic actions as modal operators partly like DDL-style and compare their features with AGM postulates. Then construct axiomatical systems for the operator of the expansion and the operator of the contraction. Within the system

based on this interpretation, we can express and prove the corresponding postulates of expansion and contraction AGM. It demonstrates that these modal operators correspond to the functions of expansion and contraction described in AGM, about that the representational theorem has been formulated.

Fig. 1. Dr. Nadiia Kozachenko

Fig. 2. Presentation of paper [9]

Professor Andrii Striuk (Fig. 3) is chair of Department of Modelling and Software Engineering at Kryvyi Rih National University. He got PhD in educational technology from the Institute of Information Technologies and Learning Tools of the NAES of Ukraine in 2012. The main directions of Dr. Striuk' research is computer simulaton and software engineering education.

Fig. 3. Dr. Andrii Striuk

Serhiy Semerikov (Fig. 4) is professor of Department of Computer Science and Applied Mathematics at Kryvyi Rih State Pedagogical University. He got both PhD and DSc in education (informatics) from the National Pedagogical Dragomanov University in 2001 and 2009, respectively. The main directions of Dr. Semerikov' research is methods of learning and educational technology.
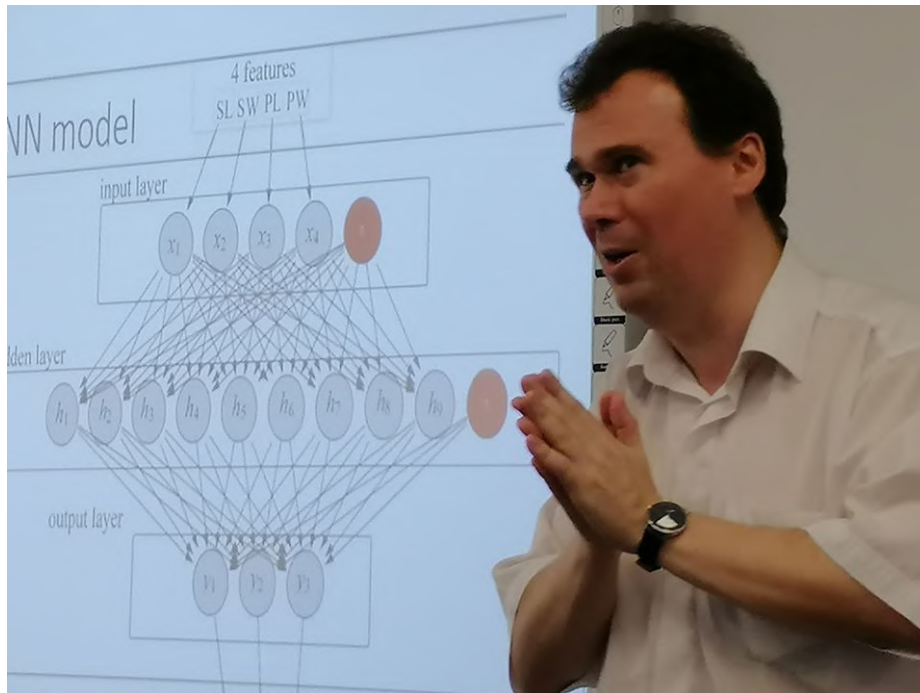

Fig. 4. Dr. Serhiy Semerikov

In a joint talk, Andrii Striuk and Serhiy Semerikov presented a retrospective analysis of the first model of training software engineers developed in the early 1970s (Fig. 5) and its compliance with the current state of software engineering development as a field of knowledge and a new the standard of higher education in Ukraine, specialty 121 "Software Engineering" [15]. It is determined that the consistency and scalability inherent in the historically first training program are largely consistent with the ideas of evolutionary software design. An analysis of its content also provided an opportunity to identify the links between the training for software engineers and training for computer science, computer engineering, cybersecurity, information systems and technologies. It has been established that the fundamental core of software engineers' training should ensure that students achieve such leading learning outcomes: to know and put into practice the fundamental concepts, paradigms and basic principles of the functioning of language, instrumental and computational tools for software engineering; know and apply the appropriate mathematical concepts, domain methods, system and object-oriented analysis and mathematical modeling for software

development; put into practice the software tools for domain analysis, design, testing, visualization, measurement and documentation of software. It is shown that the formation of the relevant competencies of future software engineers must be carried out in the training of all disciplines of professional and practical training.

Fig. 5. Presentation of paper [15]

3 Computer Science

Oksana Klochko and Vasyl Fedorets present an empirical comparison of machine learning clustering methods in the study of Internet addiction among students majoring in Computer Sciences (Fig. 6). The article [6] describes the technology of empirical comparison of methods of clustering problem solving using WEKA free software for machine learning. Empirical comparison of data clustering methods was based on the results of a survey conducted among students majoring in Computer Sciences and dedicated to detecting signs of Internet addiction as behavioural disorder that occurs due to Internet misuse. Empirical comparison of Expectation Maximization, Farthest First and K-Means clustering algorithms together with the application of the WEKA machine learning system had the following results. It described the peculiarities of application of these methods in feature clustering. The authors developed data instances' clustering models to detect signs of Internet addiction among students majoring in Computer Sciences. The study concludes that these methods may be applicable to development of models detecting respondent groups with signs of Internet addiction related disorders.
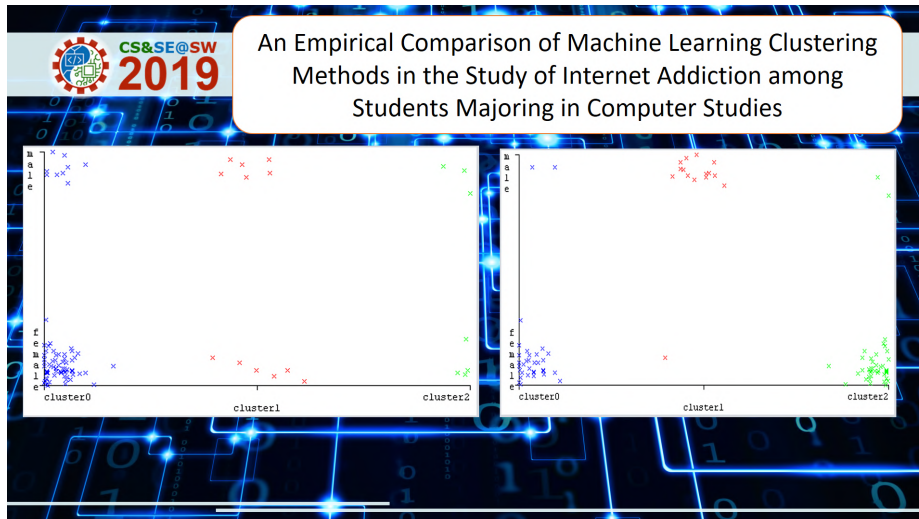
Fig. 6. Presentation of paper [6]

Kateryna Ovchar, Andrii Borodin, Ivan Burlachenko and Yaroslav Krainyk in the paper [11] present an alternative approach to automatic recognition and sorting of the agricultural objects (Fig. 7). The objects are sorted, based on their color. The sorting algorithm works with pictures, captured by a web camera, pre-processes them, determines the mass centers of the recognized objects, and calculates distances to the points which were found. Afterward, the recognized objects are sorted by a hand-manipulator with four degrees of freedom. The manipulator is powered by Arduino Uno Rev 3 and servo motors of two types. The sorting algorithm has been implemented in Python, with the use of the OpenCV library. For image pre-processing, the spatial anti-aliasing, filtering, and morphological opening and closing have been used. Color maps have been created to determine the mass centers of the recognized objects. To calculate the rotation angle of the manipulator's elbow based on the shoulder position, linear regression model is trained. The practical value of the research and development results is the possibility of their use in the harvesting of the agricultural objects with further extend to manufacture with conveyor sorting tapes.

The article [14] of Vladimir N. Soloviev, Symon P. Yevtushenko and Viktor V. Batareyev demonstrates the comparative possibility of constructing indicators of critical and crash phenomena in the volatile market of cryptocurrency and developed stock market (Fig. 8). Then, combining the empirical cross-correlation matrix with the Random Matrix Theory, authors mainly examine the statistical properties of cross-correlation coefficients, the evolution of the distribution of eigenvalues and corresponding eigenvectors in both markets using the daily returns of price time series. The result has indicated that the largest eigenvalue reflects a collective effect of the whole market, and is very sensitive to the crash phenomena. It has been shown that introduced the largest eigenvalue of the matrix of correlations can act like indicators-predictors of falls in both markets.

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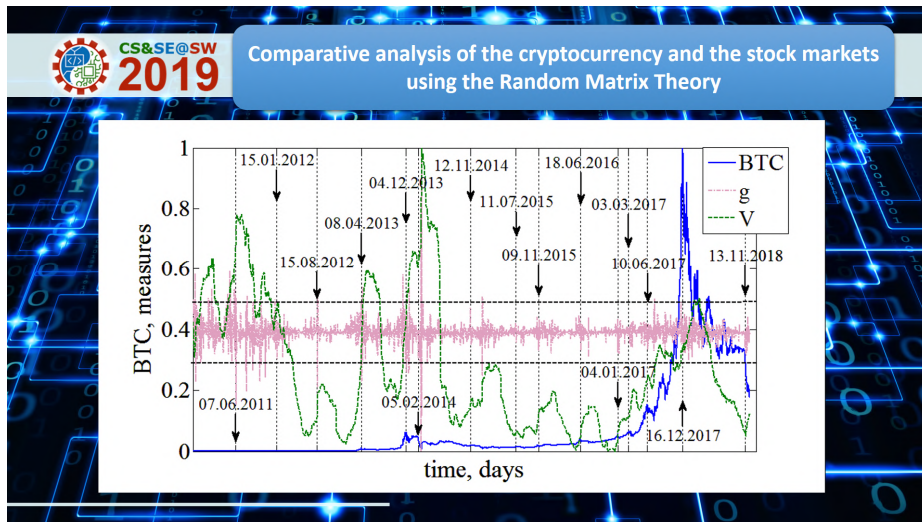

Fig. 7. Presentation of paper [11]

Fig. 8. Presentation of paper [14]

Andrii O. Tarasenko, Yuriy V. Yakimov and Vladimir N. Soloviev in paper [16] shows the theoretical basis for the creation of convolutional neural networks for image classification and their application in practice (Fig. 9). To achieve the goal, the main

types of neural networks were considered, starting from the structure of a simple neuron to the convolutional multilayer network necessary for the solution of this problem. It shows the stages of the structure of training data, the training cycle of the network, as well as calculations of errors in recognition at the stage of training and verification. At the end of the work the results of network training, calculation of recognition error and training accuracy are presented.

Fig. 9. Presentation of paper [16]

Svitlana O. Yaroshchuk, Nonna N. Shapovalova, Andrii M. Striuk, Olena H. Rybalchenko, Iryna O. Dotsenko and Svitlana V. Bilashenko in [18] present the model for scoring assessment of microfinance institution borrowers, which allows to increase the efficiency of work in the field of credit (Fig. 10). The result of the work is a neural network scoring model with high accuracy of calculations, an implemented system of automatic customer lending.

4 Software Engineering

The article of Andrii O. Priadko, Kateryna P. Osadcha, Vladyslav S. Kruhlyk and Volodymyr A. Rakovych [12] escribes the process of developing a chatbot to provide students with information about schedules using the Telegram mobile messenger (Fig. 11). During the research, the following tasks have been performed: the analysis of notification systems for their use in the educational process, identification of problems of notifying students about the schedule (dynamic environment, traditional presentation of information, lack of round-the-clock access), substantiation of the

choice of mobile technologies and Telegram messenger, determination of the requirements to the software, generalization of the chatbot functioning features, description of the structure, functionality of the program to get information about the schedule using a chatbot. The following tasks have been programmatically implemented: obtaining data from several pages of a spreadsheet (faculty / institute, red / green week, group number, day of the week, period number, discipline name, information about the teacher); presentation of data in a convenient form for the messenger (XML); implementation of the mechanism of convenient presentation of data in the messenger (chatbot). Using Python and the Telegram API, the software has been designed to increase students; immediacy in getting the information about the schedules, minimizing the time spent, and optimizing of planning of student activities and higher education institution functioning.

Fig. 10. Presentation of paper [18]

Fig. 11. Presentation of paper [12]

Galina Kirichek, Vladyslav Harkusha, Artur Timenko and Nataliia Kulykovska [4] present the realization method of attacks and anomalies detection with the use of training of ordinary and attacking packages, respectively (Fig. 12). The method that was used to teach an attack on is a combination of an uncontrollable and controlled neural network. In an uncontrolled network, attacks are classified in smaller categories, taking into account their features and using the self-organized map. To manage clusters, a neural network based on back-propagation method used. Authors use PyBrain as the main framework for designing, developing and learning perceptron data. This framework has a sufficient number of solutions and algorithms for training, designing and testing various types of neural networks. Software architecture is presented using a procedural-object approach. Because there is no need to save intermediate result of the program (after learning entire perceptron is stored in the file), all the progress of learning is stored in the normal files on hard disk.

Fig. 12. Presentation of paper [4]

In the paper [3], Ruslan Cherniavskyi, Yaroslav Krainyk and Anzhela Boiko (Fig. 13) establish an investigation on the development of university 3D-model and its possible applications for educational and research fields. Authors assume that 3D-model of university can help in various scenarios and should be used to adopt modern immersing technologies into to university processes. Different means are employed for the development of the model. Bottom-up approach for using these means and their connection with each other are shown in the work. Then, details of the 3D-model design process are provided with peculiarities related to the university building location and corpuses positions. Finally, assembled models of university are shown in 3ds Max and

Unity environments. In the final part of the paper, authors suggest scenarios of model usage for educational and research fields. Universities can gain various benefits from integrating their research efforts to employ new technology and identify new development opportunities for both science and education in university. In case of the developed 3D-model, it is planned to use it in the projects connected with client-server applications, Internet-of-Things, Smart Grid, etc. In the educational process it will be a part of case-studies for learning 3D-modeling, development in Unity environment, training for emergency situations.

Fig. 13. Presentation of paper [3]

The article of Nadiia Balyk, Vasyl Oleksiuk and Anatolii Halas [2] explores the issues of designing and developing a support system for corporate network users (Fig. 14). The authors analyzed existing user support systems, including the concepts of ServiceDesk and HelpDesk. The study describes the process of designing and developing the software "Network user support tool" (NetSupport). This tool stores data in the Google Calendar Cloud Service. The results of the study are: analysis of the functioning of the Google Calendar service, review of the API for working with Google cloud services, development and testing of software to support the work of users. Functionality of Network user support tool allows you to create events on your system administrator or support teams` calendar with a detailed description of the user problem. The article describes the process of developing a network support tool using C# 6.0 programming language and .NET 4.6 technologies. The developed software has been tested in Ternopil Volodymyr Hnatiuk National Pedagogical University.

In this study [13] Oleg Pursky, Anna Selivanova, Tetiana Dubovyk and Tamara Herasymchuk present the software development method for e-trade business process management information system (Fig. 15). As a software platform for implementation of the e-trading business process management system has been selected MSSQL database and software component implemented with the use of ASP.NET MVC Framework. The developed Web-application includes the following functional blocks: user authentication module; administration module; block implementing the functions

of domain mathematical model and information processing procedures; database intended to store initial data, trading activity indicators and calculation results, as well as the content of the Web-application interface components; logistics module; server end, which implements the procedures for the database access, the formation of the view modes of the models and functions of the domain mathematical model; interface that provides an interactive user access to the Web-application features. The connection between the Web-application and the database is performed on the basis of the GET http-protocol method and is provided by generating database queries and query results. The developed e-trade business process management information system has a three-level software and hardware structure and is designed to manage the processes of interaction between the online store and on-line consumers.

Fig. 14. Presentation of paper [2]

In the article [8] of Olha V. Korotun, Tetiana A. Vakaliuk and Viacheslav A. Oleshko the database was designed and implemented in accordance with the requirements of the relational model, which ensures the storage and collective access to the information of the auto-filling system and CMS WordPress data (Fig. 16). Algorithms of system functioning were developed, the order of interaction of classes during program code execution was determined, as a result of which the application was implemented. Template Method architectural pattern was chosen to implement the web-based automatic content filling system. The following tools and technologies were selected to create the software package HTML markup language for HTML documents; programming language PHP; MySQL database management environment; Apache web server; the OpenServer package. The algorithms of the basic processes of content filling automation were considered and the interaction of the system classes during the processes of parsing, filtering and storing of information were analyzed. The developed system does not require specialized hardware, additional settings and deployment tools other than the standard ones for such plugins. This application is mostly for the site administrator and does not have user interface. That is why the features of the plugin

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automation system configuration interface; RSS feeds view and management interface, as well as the RSS feed configuration interface are described in detail. In the future, this system can be improved by introducing new functionality and improving the algorithm for reading data.
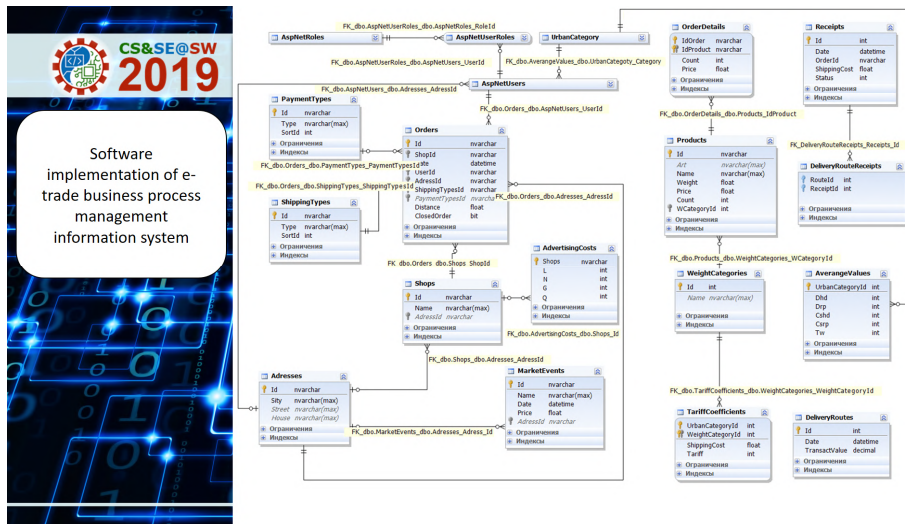

Fig. 15. Presentation of paper [13]

Fig. 16. Presentation of paper [8]

The article [1] of Nadiia Balyk, Svitlana Leshchuk and Dariia Yatsenyak is devoted to designing a smart home educational model (Fig. 17). The authors analyzed the literature in the field of the Internet of Things and identified the basic requirements for the training model. It contains the following levels: command, communication, management. The authors identify the main subsystems of the training model:

communication, signaling, control of lighting, temperature, filling of the garbage container, monitoring of sensor data. The proposed smart home educational model takes into account the economic indicators of resource utilization, which gives the opportunity to save on payment for their consumption. The hardware components for the implementation of the Mini Smart House were selected in the article. It uses a variety of technologies to conveniently manage it and use renewable energy to power it. The model was produced independently by students involved in the STEM project. Research includes sketching, making construction parts, sensor assembly and Arduino boards, programming in the Arduino IDE environment, testing the functioning of the system. Research includes sketching, making some parts, assembly sensor and Arduino boards, programming in the Arduino IDE environment, testing the functioning of the system. Approbation Mini Smart House researches were conducted within activity the STEM-center of Physics and Mathematics Faculty of Ternopil Volodymyr Hnatiuk National Pedagogical University, in particular during the educational process and during numerous trainings and seminars for pupils and teachers of computer science.

Fig. 17. Presentation of paper [1]

The article of Alla Kompaniets, Hanna Chemerys and Iryna Krasheninnik [7] is devoted to the theoretical consideration of the problem and the use of innovative technologies in the educational process in the educational establishment of secondary education in the process of studying the school course of computer science (Fig. 18). The main advantages of using educational simulators in the educational process are considered, based on the new state standard of basic and complete general secondary education. Based on the analysis of scientific and methodological literature and network sources, the features of the development of simulators for educational purposes are described. Innovative tools for simulator development have been investigated, as augmented reality with the use of three-dimensional simulation. The peculiarities of using a simulator with augmented reality when studying the topic of algorithmization in the course of studying a school computer science are considered. The article also describes the implementation of augmented reality simulator for the formation of algorithmic

thinking skills by students, presents the results of development and describes the functionality of the software product. In the further prospects of the study, it is planned to conduct an experimental study to determine the effectiveness of the use of software development in the learning process.
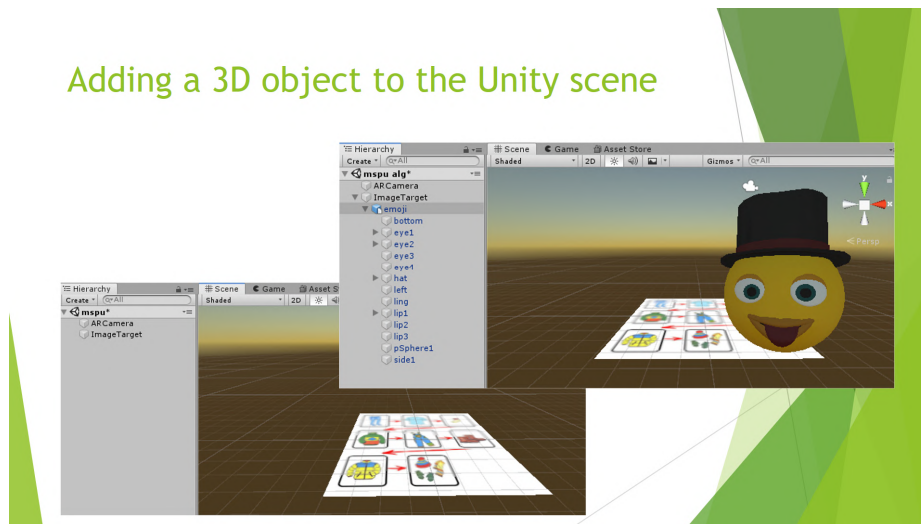

Fig. 18. Presentation of paper [7]

The article of Bohdan Oliinyk and Vasyl Oleksiuk [10] considers the problem of test automation software (Fig. 19). The authors analyze testing tasks that can be automated. They also cite cases where the use of automation is inappropriate. The key factors of using automation are time and cost savings. According to the authors, the advantages of automated tests are: the ability to check the latest changes in the application (regression testing), speed of execution, saving the time of testers, the ability to create self-tests by developers. The disadvantages of automatic tests are: insufficient reliability, need for support, fewer errors detected, a false sense of product quality. The following processes are identified, which can be automated: background processes, file logging, database entry, registration and payment systems, load tests, data entry operations, long-end-to-end scripts, checking complex mathematical calculations, checking correct search. The article provides statistics on the use of programming languages for developing automated tests. A comparative analysis of ready-made software products for automated testing is offered. Based on research analysis and experience, the authors believe that human intelligence is always required to validate the program. So, the authors justify the need to perform a manual and automated test.

The article [17] of Yaroslav Vasylenko, Galina Shmyger and Dmytro Verbovetskyi investigate the principles and technologies of creating such a semantic interconnection system that would be useful and practical for use in areas such as machine translation, search engines and contextual search (Fig. 20). The practical meaning of the results obtained is to create a semantic dictionary of the Ukrainian language that will allow to

better analyze Ukrainian texts by searching not only the words themselves, but also words that are in one way or another related to the primary, and that will significantly increase the speed of search and analysis of information. In the created web-application (thesaurus) the basic functions of similar existing systems and the latest methods of information linguistics are implemented.

Fig. 19. Presentation of paper [10]

Fig. 20. Presentation of paper [17]

5   Conclusion

The vision of the CS&SE@SW 2019 is provides an expert environment for young researchers, who are at the beginning of their career, such as Master or PhD students,

to present and discuss the most recent of ideas and early results of student's projects or other research aiming at receiving a Master or PhD degrees.

Young researchers, who will join us to take part in discussions and/or present their papers, will be offered an opportunity to exchange and discuss their research ideas with their peers, supervisors, and senior scientists working in the fields that are within the scope of CS&SE@SW.

The second instalment of CS&SE@SW was organised by Kryvyi Rih National University, Ukraine (with support of the rector Mykola I. Stupnik) in collaboration with Kryvyi Rih State Pedagogical University, Ukraine (with support of the rector Yaroslav V. Shramko), Institute of Information Technologies and Learning Tools of the NAES of Ukraine (with support of the director Valeriy Yu. Bykov) and Ben-Gurion University of the Negev, Israel (with support of the rector Chaim J. Hames).

We are thankful to all the authors who submitted papers and the delegates for their participation and their interest in CS&SE@SW as a platform to share their ideas and innovation. Also, we are also thankful to all the program committee members for providing continuous guidance and efforts taken by peer reviewers contributed to improve the quality of papers provided constructive critical comments, improvements and corrections to the authors are gratefully appreciated for their contribution to the success of the workshop.

We hope you enjoy this workshop and meet again in more friendly, hilarious, and happiness of further CS&SE@SW 2020 at Kryvyi Rih, Ukraine on November 27, 2020.

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