ICTERI-2019: THE 15TH INTERNATIONAL CONFERENCE ON ICT IN EDUCATION, RESEARCH, AND INDUSTRIAL APPLICATIONS

PROGRAM FOR WEDNESDAY, JUNE 12TH

08:30-12:30 Session 1: Registration

Registered participants to come to the registration counter at the conference venue to receive their badge and conference bundle.

09:00-10:30 Session 2A: WS ITER Session I: Neural Networks and Economic Modeling

CHAIR: *Robert Rickards*

LOCATION: 256

09:00 *Andriy Matviychuk*, *Inna Strelchenko*, *Serhii Vashchaiev* and *Halyna Velykoivanenko*

Simulation of the crisis contagion process between countries with different levels of socio-economic development

ABSTRACT. The paper contains a detailed analysis of the occurrence and contagion of crisis phenomena in countries with different levels of economic development. As part of the study, a correlation analysis of classification characteristics was carried out for the preliminary division of countries into classes. The usage of neural networks tools for the mathematical modelling of the processes of transboundary contagion of crisis is substantiated. A general scheme of the system of models of transboundary distribution of crisis phenomena between countries has been built. At the first level of the scheme for dividing countries into separate groups according to types of reaction to crisis phenomena, it was proposed to cluster them using self-organizing maps. At the second level of the scheme it was decided to use a perceptron-type neural network to predict the effects of crisis transfers.

09:20 *Marina Bilinets*, *Lidiia Hladchenko* and *Tetiana Paientko*

Government Financial Support of Higher Education and its Role in Economic Prosperity of a Society

PRESENTER: *Marina Bilinets*

ABSTRACT. This study focuses on the role of government higher education funding in building the economic capacity of national economy. Contemporary development and competitiveness of any country crucially depends on innovations.

The ability of business to provide them is directly connected with available human capital resources. Government financial support of education ensures human capital development. Government budget funding of education is one of the biggest sources of higher education funding, and thus influences economic prosperity fostering GDP per capita growth. The article purpose is to examine government higher education expenditures impact on GDP per capita growth. The research methodology uses panel data analysis based on R statistics. The data sources are the World Bank and OECD. Literature review reveals methods of education funding and the role of government. Then, five hypotheses are posited that describe possible impact of government education funding on GDP per capita growth. To test them, four models are used. The appropriate model to reveal the government higher education funding role is the fixed-effect model. It validates the strong impact of the share of higher education expenditures in the total government expenditures on the GDP per capita growth.

09:40 *Igor Atamanyuk*, *Yuriy Kondratenko*, *Anastasiya Poltorak*, *Natalia Sirenko*, *Vyacheslav Shebanin*, *Inna Baryshevska* and *Valeriia Atamaniuk*
Forecasting of Cereal Crop Harvest on the Basis of an Extrapolation Canonical Model of a Vector Random Sequence
PRESENTER: *Igor Atamanyuk*

ABSTRACT. The work is devoted to the solving of an important economic problem of the forecasting of cereal crop harvest. A stochastic character of the change of crop yield figures because of the influence of random weather-related factors is an essential peculiarity of this problem. Therefore, to forecast the cereal crop harvest, the methods of random sequence analysis are proposed to use. The developed extrapolation method doesn't impose any restrictions on a forecasted random sequence of the change of crop yield figures (linearity, stationarity, Markov behavior, monotony, etc.). Taking into full account stochastic peculiarities of the conditions of cereal crop production and crop yield figures allows to achieve maximum accuracy of a forecasting problem solving. The block diagram of an algorithm introduced in the work represents the peculiarities of the calculation of the predictive model parameters. The expression for calculation of an extrapolation error allows to determine necessary volume of a priori and a posteriori information for achieving required quality of a forecasting problem solving. The results of a numerical experiment confirmed high efficiency of the suggested method of forecasting of the cereal crop harvest.

10:10 *Leonid Melnyk*, *Oleksandr Derykolenko*, *Oleksandr Kubatko* and *Oleksandr Matsenko*
Business models of reproduction cycles for

digital economy
PRESENTER: *Leonid Melnyk*

ABSTRACT. The intensive use of non-renewable resources and torn technological cycles is the cause for the total destruction of the planet's ecosystems. The transition of production systems to renewable resources and closed circular cycles can ensure long-run sustainability of economic activities. Circular technologies as the basis of business processes guarantee sustainable transformation of the usual economy to digital one. The reproduction of economic activities in the closed integral cycle "production-interfacing-consumption-recycling-production" is the principal condition for the successful functioning of business processes. The scientific grounding, design and practical implementation of reproductive circular business processes create the platform for building a digital economy and ensures ecosystems sustainability. The research focuses on the modeling, design and practical implementation (introduction, testing, refinement, and adaptation to specific conditions) of reproductive circular business processes. The research models economic activity and communication of the economic agents in the main areas of the digital economy.

09:00-10:30 Session 2B: WS TheRMIT Session I: Models and Tools for Systems Reliability and Safety

CHAIR: *Vyacheslav Kharchenko*
LOCATION: Coworking Hall

09:00 *Vyacheslav Kharchenko*, *Yuriy Ponochovnyi*, *Artem Boyarchuk* and *Anton Andrashov*
Multi-fragmental Markov models of functional safety of information and control system considering elimination of hardware-software faults
PRESENTER: *Vyacheslav Kharchenko*

ABSTRACT. The information and control systems of Nuclear Power Plant and other safety critical systems are considered as a set of three independent hardware channels including online testing system. Nuclear Power Plant information and control systems design on programmable platforms is rigidly tied to the V-model of the life cycle. Functional safety and availability during its life cycle are assessed using Markov and multi-fragmental models. Multi-fragmental models are used to assess the availability function and proof test period. The multi-fragmental model MICS31 contains an absorbing state in case of hidden faults and allows evaluating risks of "hidden" unavailability. The MICS41 model simulates the "migration" of states with undetected failures into states with detected faults. Results of multi-fragmental modeling (models MICS31 and MICS42) are compared to evaluate proof test period taking into account requirements for SIL3

level and limiting values of hidden fault probabilities.

09:30 *Anastasiia Strielkina*, *Serhiy Volochiy* and *Vyacheslav Kharchenko*

Discrete-Continuous Stochastic Model of Insulin Pump Functioning for Health IoT System Using Erlang Phase Method

PRESENTER: *Anastasiia Strielkina*

ABSTRACT. The paper deals with exponentially growing technology – Internet of Things (IoT) in the field of healthcare. The goal of this paper is to develop and research a discrete-continuous stochastic model (DCSM) of a functional behavior of a networked healthcare device in a form of a structural automaton model (SAM) using the Erlang phase method. It is spoken in the brief details about the networked insulin pump behavior with description of functional procedures, indicators and parameters of functionality are given. Much attention is given to the development process of the DCSM using exponential and Erlang's distribution laws, description of basic events and structure of a state vector, development of the SAM's. The procedures of validation of the developed models for exponential and Erlang's distribution laws are presented and include three research cases to check the relevance of the obtained results.

09:50 *Oleksandr Shkiliuk*, *Bohdan Volochiy* and *Ivan Petliuk*

Discrete-Continuous Stochastic Model of Behavior Algorithm of Surveillance and Target Acquisition System

PRESENTER: *Oleksandr Shkiliuk*

ABSTRACT. This paper presents discrete-continuous stochastic model for solving tasks of multivariate analysis of efficiency index and synthesis of functionality indexes of ground surveillance and target acquisition system. Surveillance and target acquisition system consists of passive and active radio electronic subsystems – reconnaissance units. As an efficiency index it is considered the probability of successful execution of task (detection and recognition of an object that is situated on controlled territory) within specified time interval. In the proposed model it is considered such features of the surveillance and target acquisition system as structure of the investigated system, the functionality indexes of its units and functional behavior. For construction of this model the advanced technology for modeling algorithms of information systems behavior was used. This technology represents a researched object by a structural automatic model. Available software tool automates the processes of constructing the graph of states and transitions and formation of an analytic model in the form of system of linear Chapman-Kolmogorov differential equations. The acceptable level of particularization of behavior of the surveillance and target acquisition system is determined only by known information about it. This discrete-continuous stochastic model enables increasing certainty for development of information-driven system for automation of the process of detection and recognition of objects for reconnaissance.

10:10 *Oleksandr Makarichev*, *Peter Horbachov*, *Oleksandr Voronkov* and *Stanislav Svichynskyi*
Reliability of adaptive traffic lights ensured by warm standby with estimation of its use
PRESENTER: *Peter Horbachov*

ABSTRACT. For the case when quantitative characteristics of traffic flows and the failure rates of traffic lights' elements are known, quantitative relationships for the feasibility analysis of warm standby of the adaptive traffic lights at intersections have been found. The equations and recurrence relations of their probability distributions are obtained as the Laplace transform of sequences of times of limited permissive phases of alternative movement directions. The intelligent system of traffic control with the adaptive traffic lights as the main control unit is considered as a single-line queuing system with the FIFO (first in, first out) service discipline for the Markov flow of recoverable components' failures.

As a result, two-way estimate for the failure probability of the adaptive traffic lights is obtained and the effect of warm standby use for the traffic lights at two-way stop-controlled intersection is assessed. In the presented example waiting time for the vehicles at the intersection with adaptive controlled traffic appeared to be considerably less than in the case when there is no adaptive traffic control. It allows to highlight advantages of warm standby use as a mean to ensure the reliability of the adaptive traffic lights.

09:00-11:00 Session 2C: WS CoSinE Session I: Learning and Instruction with Computer Simulations

CHAIR: *Serhiy Semerikov*
LOCATION: Conference Hall

09:00 *Serhiy Semerikov*, *Illia Teplytskyi*, *Yuliia Yechkalo*, *Oksana Markova*, *Vladimir Soloviev* and *Arnold Kiv*
Computer Simulation of Neural Networks Using Spreadsheets: Dr. Anderson, Welcome Back
PRESENTER: *Serhiy Semerikov*

ABSTRACT. The authors of the given article continue the series presented by the 2018 paper "Computer Simulation of Neural Networks Using Spreadsheets: The Dawn of the Age of Camelot". This time, they consider mathematical informatics as the basis of higher engineering education fundamentalization. Mathematical informatics deals with smart simulation, information security, long-term data storage and big data management, artificial intelligence systems, etc. The authors suggest studying basic principles of mathematical informatics by applying cloud-oriented means of various levels including those traditionally considered supplementary – spreadsheets. The

article considers ways of building neural network models in cloud-oriented spreadsheets, Google Sheets. The model is based on the problem of classifying multi-dimensional data provided in “The Use of Multiple Measurements in Taxonomic Problems” by R. A. Fisher. Edgar Anderson’s role in collecting and preparing the data in the 1920s-1930s is discussed as well as some peculiarities of data selection. There are presented data on the method of multi-dimensional data presentation in the form of an ideograph developed by Anderson and considered one of the first efficient ways of data visualization.

09:30 *Leonid Flehantov* and *Yuliia Ovsiienko*

THE SIMULTANEOUS USE OF EXEL AND GEOGEBRA TO TRAINING THE BASICS OF MATHEMATICAL MODELING

PRESENTER: *Leonid Flehantov*

ABSTRACT. The main objective of this study is testing the hypothesis that the visualization of simulation results creates the conditions for improving students' knowledge, taking into account the specifics of their professional training. In this article we are exploring how the simultaneous use of Excel and GeoGebra can improve the learning outcomes of engineering students in agricultural universities when learning the basics of mathematical modeling (using as example the mathematical model of mechanical movement of two bodies with their elastic collision). We worked with our students as follows. First, we build and interpret the mathematical model. Then we obtain two alternative computer models: we use Excel spreadsheets for numerical modeling as well as GeoGebra software for analytical-geometrical modeling. By this models we visualize and explore the processes closely related to topics that plays an important role in the training of agricultural production engineers, in particular, with study the movement and interaction of particles during the loading / unloading of seeds, the description of industrial processes of seed scarification, with study of the movement of particles of yeast suspension in a plate separators, modeling the processes of shot-blast cleaning of metal surfaces etc. We have tested this approach in teaching the 163 students enrolled in the specialties «Agroengineering» and «Industry Engineering» in Poltava State Agrarian Academy. According to data we collected our students demonstrated a better understanding of the conceptual issues of mathematical modeling and acquired significant abilities in using this method to solve real problems.

10:00 *Tatyana Zaytseva*, *Lyudmyla Kravtsova* and *Anna Puliaieva*

Computer Modeling of Educational Process as Way to Modern Learning Technologies

PRESENTER: *Anna Puliaieva*

ABSTRACT. Today's young people, who make up the student community, are very experienced in many issues that affect their surroundings. Therefore, each educational institution should be able to introduce new forms and methods of communication with young people, their learning, that widely involve innovative technologies, activate the creative component of education, increase the independence of students, preparing them for the future profession. This is especially true for the preparation of maritime industry specialists, whose professionalism and competence not only the preservation of the vessel and the performance of its tasks at hand depend, but also the health and, even, the life of the entire crew. Modern educational innovations offer a wide range of different software tools. But it

is the teacher who should to choose his own method of discipline-teaching based on what trajectory most closely matches the maximum effect of this training. The modeling of such method needs in deep analyze of both the learning support systems and the student's attitude towards using of the latest information technologies in the educational process.

10:30 *Liubov Panchenko*

Methodology of Using Structural Equation Modeling in Educational Research

ABSTRACT. The article deals with the problem of using SEM methodology in educational re-search. An important point in preparing specialists for using SEM is to select or obtain the necessary data sets that are representative and valid. During the re-search the Ukrainian teacher's self-efficacy model with SEM methodology was checked, and the obtained results were compared with the research data of the worldwide teacher's survey – The Teaching and Learning International Survey. The lower self-efficacy of Ukrainian teachers, especially in the student engagement block, was showed.

09:00-10:30 Session 2D: WS 3L-Person Session I: System Models and Methods for Forming Competences

CHAIR: *Hennadiy Kravtsov*

LOCATION: 507

09:00 *Michael Lvov*, *Sergiy Kuzmenkov* and *Hennadiy Kravtsov*

About One Approach to Building Systems for Testing Physical Knowledge

PRESENTER: *Michael Lvov*

ABSTRACT. The paper presents an approach to building a system for testing procedural physical knowledge, i.e. knowledge of basic physical laws and the ability to use them. This approach consists in constructing mathematical models for each academic module in a physics course. The main constructive objects are test patterns, which are mathematical models of tests based on physical models of systems, processes and phenomena. The template of the class of physical tests for checking knowledge of the physical laws and abilities of transformations of a physical system is represented by a set of geometric drawings, diagrams, graphs of functional dependencies, a system of formulas for transforming physical values, templates of scenarios for changing the states of a physical system and a response template. Each such template can be used both in generating similarity algorithms for specific multiple tests, and in algorithms for automatically checking the correctness of answers. The proposed method allows to describe a relatively simple class of specific tests. An important feature of the system

is the ability to automatically check not only the final answer, but also the parameters of the intermediate states of the physical system. The implementation of a procedural physical knowledge testing system can be performed by creating software interactive multimedia objects using computer mathematics methods and algebraic programming technology.

09:30 *Hanna Chemerys*, *Kateryna Osadcha*, *Viacheslav Osadchyi* and *Vladyslav Kruhlyk*
Increase of the Level of Graphic Competence Future Bachelor in Computer Sciences in the Process of Studying Three-Dimensional Modeling
PRESENTER: *Vladyslav Kruhlyk*

ABSTRACT. The article is devoted to the examination of separate aspects of the application of technologies of three-dimensional modeling as the promising trend, which found its application in the process of creation of models for three-dimensional print, virtual (virtual reality) and augmented reality (augmented reality), in the process of development of gameplay (gameplay), in modeling of the objects for educational aims so on. The actuality of study by the bachelors of computer sciences of the process of processing of three-dimensional models considering the conditions, nominated by competitive environment of labor market was defined. The necessity of improvement of the methods of teaching of graphical disciplines was grounded and the actuality of the introduction of study of technologies of three-dimensional mod-eling in the process of professional training of future bachelors of computer sciences as a promising trend considering the demands of labor market and as the factor raising the level of motivation of students to professional activi-ty in general and on the formation of graphical competence in particular. The methodological support of the course was described, the aim and content of the study of the discipline “Computer Graphics” were presented. The struc-ture and content of theoretical and practical parts of the course were provid-ed, which are oriented to the use of three-dimensional graphical processor Autodesk Maya. The algorithm was examined and the stages of creation of objects of organic forms were described on the example of modeling of game personage and the algorithm of creation of three-dimensional sur-rounding on the example of modeling of the interior of game level. The separate aspects of informational and communicational support of the course of the discipline “Computer Graphics” were examined, within the frames of which the approbation of developed educational and methodological complex was performed.

09:50 *Bogdan Buyak*, *Ivan Tsidylo*, *Serhiy Kozibroda* and *Victor Repskyi*

Ontological model of representation of university resources

PRESENTER: *Ivan Tsidylo*

ABSTRACT. The article substantiates the expediency of using the ontological model of presentation of knowledge, which combines the properties and advantages of other models of presentation of knowledge and data in the process of construction, development, processing and application of ontologies. The analysis of application of systems of computer ontologies has been analyzed and the criteria of their selection are selected: software architecture and tools development; functional compatibility; intuitive interface. Determined to be the most optimal with regards to the training of future pedagogical engineers in the field of computer technology Protege OWL. The requirements, which are put in the process of designing an ontological model of representation of educational resources of the university, are singled out. The ontological model of representation of university resources used for unified description of knowledge bases from the point of view of competency requirements (knowledge, skills, skills) to student learning outcomes with the possibility of constructing repositories of electronic and educational resources was designed. The set of concepts and set of relations of computer ontology are presented. The method of filling the ontological base of knowledge of educational resources of the University is proposed. Experimentally, the efficiency of using the proposed ontological model for representing the University's learning resources in the process of training future engineers-educators in the field of computer technologies has been proved by the indicators: speed of construction under ontologies; number of defects; the speed of completion of the already created ontology.

10:10 *Michael Lvov*, *Ludmila Shishko*, *Irina Chernenko* and *Evgen Kozlovsky*

Mathematical Models and Methods of Supporting the Solution of the Geometry Tasks In Systems of Computer Mathematics for Educational Purposes

PRESENTER: *Irina Chernenko*

ABSTRACT. The article is devoted to the problem of supporting the course of solving tasks in geometry in systems of computer mathematics of educational purposes. In the work: - the mathematical model of the learning geometric task is defined; - the object-oriented approach to the description of mathematical models of geometric training modules is presented; - the methods of supporting step-by-step solving of learning geometric task are proposed; - the classification of elementary transformations in geometric subject modules is proposed; - the implementation of the concept of support for the solution of geometric tasks in the systems of computer mathematics of educational purposes is illustrated. Object-oriented analysis of the problem revealed three

major classes of transformations of geometric objects. These are constructors, selectors, and converters (elementary geometric tasks).

09:00-10:30 Session 2E: WS RMSE Session I

CHAIR: *Vladimir Peschanenko*

LOCATION: 512

09:00 *Volodymyr G. Skobelev*

On Some Classes of Problems on Graphs

ABSTRACT. At present Graph Theory is widely applied for resolving theoretic and applied problems. For this reason, classications of the problems of Graph Theory according to the complexity of their resolving is one of the actual problems. In the given paper this problem is investigated on the base of space complexity dened in terms of data structures used for the representation of analyzed graphs, orgraphs, and directed graphs. The following two non-trivial the simplest sets of problems of Graph Theory are investigated in detail. The rst set consists of problems that can be resolved by some algorithm with space complexity that is linear relative to the size of memory necessary for the data structure that represents the analyzed graphs. The second set consists of problems that can be resolved by some algorithm that operates on space that is linear relative to the size of memory necessary for the data structure that represents the analyzed graphs but additionally uses some additional memory of the same size intended for sequential generation of the designed object or objects. Some characteristics for the problems of Graph Theory that are in or out of these classes are given.

09:30 *Michael Lvov*

Computations in extensions of multisorted algebras

ABSTRACT. Development of algorithms of algebraic computations is one of the main problems, which arises with realization of mathematical software based on symbolic transformations. Multi-sorted algebraic systems (MAS) are mathemat-ical model for this problem. Present paper deals with the solution of this problem. We propose the approach to realization of interpreters of multi-sorted algebraic operations by its specifi-cations, based on constructive improvement of notion of extension of multi-sorted algebraic system. This approach is illustrated by examples of realization of interpreters of operations in the field of rational numbers, ringing of one variable polynomial over the field, algebra of Boolean functions. Practice of this approach using for development of mathematical educational software shows its effectiveness and even universality

10:00 *Alexander Weissblut*

Computational Modeling and Structural Stability

ABSTRACT. The structural stability of a mathematical model with respect to small changes is a necessary condition for its correctness. The same condition is also necessary for the applicability of numerical methods, a computational experiment. But after S. Smale's works it became clear that in smooth dynamics the system of a general form is not structurally stable, therefore there is no strict mathematical basis for modeling and numerical analysis of systems. The contradiction appeared in science: according to physicists dynamics is simple and universal. The paper proposes a solution to this problem based on the construction of dynamic quantum models (DQM). DQM is a perturbation of a smooth dynamical system by a Markov cascade (time is discrete). The dynamics obtained in this way are simpler than smooth dynamics: the structurally stable DQM realizations are everywhere dense and open on the set of all DQM realizations. This dynamics in contrast to the classical one has a clear structural theory, which makes it possible to construct effective algorithms for study of concrete systems. For example this paper shows the use of computer simulation for rigorous proof of hyperbolicity of the Henon system attractor. On the other hand, when fluctuations tend to zero, i.e. in the semiclassical limit, the dynamics of the DQM goes into the initial smooth dynamics. In this paper the equivalence of structural stability and hyperbolicity for smooth discrete dynamical systems is established along this path.

10:30-11:00 Coffee Break

11:00-12:30 Session 3A: WS ITER Session II: Computational Economics and Economic Modeling

CHAIR: *Vitaliy Kobets*

LOCATION: 256

11:00 *Viktoria Yatsenko* and *Yevhen Kudriavets*

Budgeting Integration with a Business Strategy and Accounting System in Business Process Management - Case Study of Ukrainian Company

ABSTRACT. A client, quality and time should become the priority targets of the company's budget process in the post-industrial era. Therefore, sales of products should be priority process rather than production process. Moreover, budgeting is no longer a function of a separate department, but transforms into a cross-functional process. In order to model the business process «Implementation» based on the previous description we used the concept of BPM and the tools of the Workflow class. Budgeting becomes more integrated into the company's general information system rather than ever before, since budgets for the next calendar year include target indicators which are oriented to implementation of the business strategy, also they establish direct link and feedback with accounting system data, analysis and controlling. This approach presupposes the responsibility of specific executors and timing of implementation, it can be promptly managed and evaluated as a business process. The value of the BP "Budgeting" is to provide concrete

recommendations to practitioners and identify open research areas for academics, thereby expanding and enriching traditional frameworks of BPM. Nowadays, budgeting is not one-time and coordinated set of actions but rather a transparent, easy-to-transform, integrated business process that contributes to the company's strategic growth.

11:30 *Daria Kilinich* and *Vitaliy Kobets*
Support of Investors' Decision Making in Economic Experiments Using Software Tools
PRESENTER: *Daria Kilinich*

ABSTRACT. During making decision the logit and probit patterns serve to resolve different issues based on statistical data regarding expediency or inappropriateness: opening LTD, investing funds, hiring employees, entering a new market, introducing innovations, etc. The purpose of the research is to support the decision making in economic experiments using software tools and logit and probit analysis. To achieve this goal, the following tasks are defined: investigation of the range of application of the logit and probit models; calculation of open data using the RStudio; development of decision support models using open data sources.
Methods and technologies of research: logit and probit models to predict the probability of dealing between traders of cryptocurrencies, cluster analysis of investor profiles through principal component analysis.
To distinguish different types of investors we can use cluster analysis which help us to reveal main types of risk-attitude investors. After that we can construct correspondence between specific users and financial instruments.

11:50 *Jan-Hendrik Meier*, *Stephan Schneider* and *Chan Le*
Short-term electricity price forecasting using Generalized Additive Models

ABSTRACT. If one examines the spot price series of electrical power over the course of time, it is striking that the electricity price across the day takes a course that is determined by power consumption following a day and night rhythm. This daily course changes in its height and temporal extent in both, the course of the week, as well as with the course of the year. This study deals methodologically with this intra-day and seasonal behaviour. We contribute the usage of Generalized Additive Models (GAM) and apply these models with European Data.

12:20 *Liubov Pankratova*, *Tetiana Paientko* and *Yaroslav Lysenko*
Forecasting Prices on the Stock Exchange Using a Trading System
PRESENTER: *Tetiana Paientko*

ABSTRACT. For successful trading on stock exchanges, it is important to use trading tools that will ensure success in trading operations and

provide competitive advantages. The purpose of the article is to develop an algorithm for the creation of a trading system and selecting a research object whose shares may subsequently become the object of real trade. The basis of the developed trading system is the consoli-dated mathematical model based on several models (multipliers, neural network and discounted cash flows). The consolidated model estimates the stock price of NIKE Inc., which has a lower deviation from the actual price than the price is predicted by other mathematical models, including linear regression models, etc. The results of the work also identified directions for improving the trading algo-rithm: to extend the horizon of the forecast; to include TakeProfit at the predicted value; to form a stock portfolio; to cover more factors in the model.

11:00-12:30 Session 3B: WS TheRMIT Session II: Checkability and Fault-tolerance of Safe and Secure Systems

CHAIR: *Volodymyr G. Skobelev*

LOCATION: Coworking Hall

11:00 *Leonid Ozirkovskyy*, *Bohdan Volochiy*, *Mykhailo Zmysnyi* and *Andriy Maschak*

Methodology of defining the accident rate function for fault tolerant system with high responsibility purpose

ABSTRACT. In this paper we propose new term - accident rate function. Such proposition gave a possibility of providing the quantative assessment for operational safety in the fault tolerant systems with high responsible purposes. Also, we propose a binary structural automata model. Using the proposed binary structural automata model in the ASNA software, we provide a possibility to build the fault tolerant systems models in the form of a graph of states and transitions, in an automatic way. Obtained graph of states and transition is used to define the accident rate function. The authenticity of the accident rate function is confirmed by the coincidence two calculated values. One value is obtained based on accident rate function on determined time interval and the other value is a the probability of a minimal cut sets obtained based on fault tree for a similar time interval. Usage the ASNA software for getting the accident rate function and the usage of new methodoly of forming the accident rate function from the subarray of non-working states makes the process of obtaining the results in an automatic way. As result the proposed approach gives a possibility to perform multivariant analysis of functional safety for the systems with high responsibility purpose.

11:30 *Volodymyr G. Skobelev* and *Volodymyr V. Skobelev*

On-Line Checking of Faults in Cyber-Physical

Systems
PRESENTER: *Volodymyr G. Skobelev*

ABSTRACT. Numerous applications of cyber-physical systems in safety-critical spheres of human activity are the main reason for the fact that the development of methods intended for on-line faults diagnoses in these systems is one of the actual problems. One of the essential sub-problems for this problem is the elaboration of models and methods intended for on-line checking of faults in cyber-physical systems. In the given paper this sub-problem is investigated under the supposition that these systems can be modeled by the 1-dimensional hybrid automata dened in the given paper. On the base of this model-based approach, some completely distributed system intended for on-line monitoring and fault components isolation in cyber-physical systems is proposed. This system consists of controllers of two types. Controllers of the first type are intended for checking the dynamics of physical processes, and controllers of the second type are intended for checking switching between dynamics. The structure of both types of proposed controllers is defined in detail. Necessary and sufficient conditions that guarantee for both types of proposed controllers that they carry out correct on-line checking are established and proved.

11:50 *Oleksandr Drozd*, *Viktor Antoniuk*, *Miroslav Drozd* and *Hanna Stepova*
Power-Oriented Checkability of Matrix and Pipeline Circuits in FPGA-Based Digital Components of Safety-Related Systems
PRESENTER: *Viktor Antoniuk*

ABSTRACT. The checkability of the circuits is considered as a necessary condition for ensur-ing functional safety for safety-related systems based on the use of fault-tolerant solutions. The features of logical checkability, which is essential for testing, test-able design and on-line testing of digital components of safety-related systems, are analyzed. Logical checkability is represented as structural, structurally func-tional and dual-mode, typical of critical applications. The problem of hidden faults is noted, which shows the lack of dual-mode checkability in the design of digital components based on matrix structures. The resource-based approach identifies this problem as a growth problem, the solution of which requires the reduction of matrix structures. The maximum reduction is achieved in bitwise pipelines. The limitations of logical checkability are shown in solving the problem of hidden faults under the conditions of the dominance of matrix structures and in the moni-toring of faults in chains of the common signals. The success of green technolo-gies in FPGA design created the conditions for the development of power-oriented checkability, which significantly complements the

logical checkability of the circuits. An analytical evaluation of power-oriented checkability was obtained. The results of power-oriented checkability evaluation experiments are shown to be important for faults in chains of the common signals. Experiments were car-ried out for matrix and bitwise pipeline circuits using the example of multipliers of numbers. A comparative analysis of the results obtained.

12:10 *Sahibay Tynymbayev*, *Viktoriia Sydorenko*, *Sergiy Gnatyuk* and *Margulan Ibraimov*
Polynomials Multiplier Under Irreducible Polynomial Module
PRESENTER: *Margulan Ibraimov*

ABSTRACT. Hardware cryptographic devices are oriented on confidentiality ensuring put some actual problems must be solved. For the purpose to raise the performance of computing devices productivity, it is necessary to use number systems without the disadvantages of the radix numeration system. This is due to the fact that while performing on multi-digit numbers arithmetic operations represented in the positional system, it becomes necessary to take into account inter-bit transfers that far slows down the computation speed and complicates the calculator structure. The new ways search to improve the computing devices performance led researchers to an objective conclusion that in this direction of the positional number system all possibilities have been exhausted. In order to boost productivity of computing devices, it is necessary to use number systems without such disadvantages

11:00-12:30 Session 3C: WS CoSinE Session II: How Computer Simulation of Socio-economic Processes Transforms Education and Training

12.20 – 12.30. Memories of Professor Illia O. Teplytskyi

CHAIR: *Vladimir Soloviev*
LOCATION: Conference Hall

11:00 *Vladimir Soloviev*, *Natalia Moiseenko* and *Olena Tarasova*
Modeling of Cognitive Process Using Complexity Theory Methods
PRESENTER: *Vladimir Soloviev*

ABSTRACT. The features of modeling of the cognitive component of social and humanitarian systems are considered. An example of using multiscale, multi-fractal and network complexity measures has shown that these and other syner-getic models and methods allow us to correctly describe the quantitative differ-ences of cognitive systems. The cognitive process is proposed to be regarded as a separate implementation of an individual cognitive trajectory, which can be represented as a time series and to investigate its static and dynamic features by the methods of

complexity theory. Prognostic possibilities of the complex sys-tems theory will allow to correct the corresponding pedagogical technologies.

11:30 *Oleg Pursky*, *Tetiana Dubovyk*, *Iryna Gamova* and *Iryna Buchatska*
Computation algorithm for integral indicator of socio-economic development
PRESENTER: *Oleg Pursky*

ABSTRACT. The computation algorithm for determination of the socio-economic development integral indicator based on the methods of factor analysis and expert evaluations has been described in the paper. By taking into account the knowledge and experience of experts, the factor model for evaluation of the level of socio-economic development has been improved. Based on the joint use of the methods of factor analysis and expert evaluation, the algorithm of automated computation for integral indicators has been developed. The approach has increased the reliability of the results of calculations and made it possible to analyze the correlations between indicators in terms of their influence on the overall socio-economic situation. The developed computation algorithm is used in the educational process within the framework of teaching the discipline "Prognostics of socio-economic processes".

12:00 *Vitalii Pazdrii*, *Petr Banschykov*, *Victoria Kosyk* and *Irina Tropina*
Simulation System in Educational and Career Guidance State Policy of Ukraine

ABSTRACT. This research described experience of realized educational and career guidance state policy for help of business-simulation. We are talking about All-Ukrainian business-tournament “Firm’s strategy”, which open opportunity for mass entrepreneurial education and career guidance for young 13-17 years old. And continuation of Firm’s strategy became state experiment project “Development business education in Ukraine as part of entrepreneurial state policy”, which had started from secondary school in Kropyvnyckii (Central Ukraine.

11:00-12:30 Session 3D: WS 3L-Person Session II: Cloud-based Learning Environment

CHAIR: *Maria Shishkina*
LOCATION: 507

11:00 *Olena Kuzminska*, *Mariia Mazorchuk*, *Nataliia Morze* and *Oleg Kobylin*
Attitude to the Digital Learning Environment in Ukrainian Universities
PRESENTER: *Olena Kuzminska*

ABSTRACT. Needs of digital transformation

requires specific flexibility from modern universities to ensure the society demands implementation through innovative teaching and IC-technologies. Modern universities create a digital learning environment to support studying activities. This research presents an experts' estimate of the current condition and perspectives of universities digital studying environments in Ukraine. We verified the theoretical model structure of the university digital studying environments by means of the empirical data factor analysis. We studied the components of the existing learning environment and enabling environment and compared them to the results of our previous research. We proved the digital learning environment theoretical model was correct. We proved that visions of students and teachers correspond to the key trends accelerating higher education technology adoption. We assume the digital learning environment development benefits overcoming significant challenges impeding higher education technology adoption.

11:30 *Oleg Spirin*, *Vasyl Oleksiuk*, *Nadiia Balyk*, *Svitlana Lytvynova* and *Sergiy Sydorenko*
The blended methodology of learning computer networks: cloud-based approach
PRESENTER: *Vasyl Oleksiuk*

ABSTRACT. The article considers the use of blended learning as an effective methodology of encouraging students' cooperation in the process of solving practical problems and as a means of developing their essential professional skills. The following pedagogical approaches and techniques of blended learning are discussed: combination of face-to-face and distance learning, group members' partnership, development of group work skills, heterogeneous grouping, combined use of individual and peer assessment, teacher's monitoring of the students' work, task-oriented approach, chance for every member to be a leader, essential feedback. The authors suggest using private and public cloud technologies in an integrated academic cloud to support the implementation of group methodology in the teaching process. The analyzed academic cloud includes Apache CloudStack and EVE-NG Community platforms. This cloud environment was deployed at Physics and Mathematics Department of Volodymyr Hnatiuk National Pedagogical University of Ternopil. The developed methodology is used in course "Computer Networks". It has been verified experimentally by using appropriate statistical methods

11:50 *Uliana Kohut* and *Mariya Shyshkina*
THE METHOD OF OPERATIONS RESEARCH LEARNING USING MAXIMA SYSTEM
PRESENTER: *Mariya Shyshkina*

ABSTRACT. In the article the problems of using the systems of computer mathematics (SCM) as a tool to support the teaching and research activities in the field of informatics and mathematics disciplines training are investigated. The role of SCM in the process of bachelors of informatics training and special aspects of pedagogical applications of these systems in the “Operations research” study is defined. The main characteristics of SCM MAXIMA and the ways of access organizing to it both in local and the cloud-oriented implementation are considered. The results of the pedagogical experiment on MAXIMA application to support the investigative approach to operation research study and the analysis of its conclusions are reported

12:10 *Mariya shyshkina*, *Uliana Kohut* and *Maiia Popel*
The Comparative Analysis of the Design and Application of the Cloud-based Components for Mathematics Learning
PRESENTER: *Maiia Popel*

ABSTRACT. In the article, the problems of the systems of computer mathematics use as a tool for the students learning and research activities support are investigated. The promising ways of providing access to the mathematical software in the university learning and research environment are considered. The special aspects of pedagogical applications of these systems to support mathematics and computer science disciplines study in a pedagogical university are considered. The design and evaluation of the cloud-based learning components with the use of the systems of computer mathematics (on the example of the Maxima system and CoCalc) as enchasing the investigative approach to and increasing pedagogical outcomes is justified. The set of psychological and pedagogical and also technological criteria of evaluation is used to compare different approaches to the environment design. The results of pedagogical experiment are provided. The analysis and evaluation of existing experience of mathematical software use both in SaaS and IaaS cloud-based settings is proposed.

11:00-12:30 Session 3E: WS RMSE Session II

CHAIR: *Grygoriy Zholtkevych*
LOCATION: 512

11:00 *Liudmyla Omelchuk* and *Olena Shyshatska*
Extending the SMT-Lib Standard with Theory of Nominative Data
PRESENTER: *Liudmyla Omelchuk*

ABSTRACT. We describe the theory of nominative data, formulate the basic principles of the composition-nominative approach, and define the class of nominative data and functions. By using nominative data, we can increase the level of adequacy of setting data structures, functions, and compositions that are used in programming languages. Thus, in terms of composition-nominative approach, we can build systems of verification of programs based on a uni-fied conceptual basis. Computer-aided verification of

computer programs often uses SMT (satis-fiability modulo theories) solvers. A common technique is to translate pre-conditions, postconditions, loop conditions, and assertions into SMT formu-las in order to determine if all properties can hold. The SMT-Lib Standard was created for forming a common standard and library for solving SMT problems. Now, it is one of the most used libraries for SMT systems. Formu-las in SMT-LIB format are accepted by the great majority of current SMT solvers. The theory of nominative data is of interest for software modelling and verification, but currently lacks support in the SMT -Lib format. In the arti-cle, we propose the declaration for the theory of nominative data for the SMT-Lib Standard 2.6. The long-term goal is the development of SMT solv-ers with nominative data support.

11:30 *Mykola Nikitchenko*, *Oksana Shkilniak* and *Stepan Shkilniak*

Program Logics of Renominative Level with the Composition of Predicate Complement

ABSTRACT. Program logics are wildly used for software verification. Such logics are based on formal program models and reflect main program properties. Among various program logics, Floyd-Hoare logic and its variants take a special place because of its naturalness and simplicity. But such logics are oriented on total pre- and post-conditions, and in case of partial conditions they become unsound. Different methods to overcome this problem were proposed in our previous works. One of the methods involves extension of program algebras with the composition of predicate complement. This permits to modify rules of the logic making them sound. Such modification requires introduction of undefinedness conditions into logic rules. In this paper we continue our research of such logics. We investigate a special predicate logic called logic of renominative (quantifier-free) level with the composition of predicate complement. This logic is a constituent part of a program logic. We introduce a special consequence relation for this logic, con-struct a sequent calculus, and prove its soundness and completeness.

12:00 *Vitalina Babenko*

Formalization of the Model of Management of the Technological Innovations

ABSTRACT. *Research goals and objectives*: to describe the discrete dynamic system consisting of technological innovation (TI), to formulate a meaningful statement of the goal of managing TI taking into account risks, to develop a formal statement of the task of TI-management with risks. It is subject to the influence of controlled parameters (controls) and uncontrolled parameter (vector of risk or interference).

Subject of research. The process of formalization of management of technological innovations is investigated. To describe the process of managing technological innovation, it is needed to know the parameters of the system. The process of management of technological innovations is

described by a discrete vector (recurrent) equation. The phase vector characteristic of management of technological innovations includes three components: the same unrealized products for the period, products for the period, and flow rates for the next period.

Research methods used: to build an economic and mathematical model, a class of deterministic models is used. Its dynamics is described by a vector linear discrete recurrent relation.

Results of the research: The obtained model of management of the TI can be used for economic-mathematical modeling and the practical use of optimal processes for predicting data management. The development of modular models can serve as the basis for the development of software and hardware systems for training programs that are effective in the operational strategies of innovative technologies.

12:30-14:00 Lunch Break

14:00-15:30 Session 4A: WS ITER Session III: Evolutionary and Simulation Economics

CHAIR: *Jan-Hendrik Meier*

LOCATION: 256

14:00 *Vladimir Soloviev*, *Andrii Bielinskyi* and *Viktoria Solovieva*

Entropy analysis of crisis phenomena for DJIA index

PRESENTER: *Andrii Bielinskyi*

ABSTRACT. The goal of this study is to investigate and predict serious falls that took place in stock market. For these purposes, we analyze which are related to daily time series data which is related to the Dow Jones Industrial Average in-dex for the period from 2 January 1920 to 18 March 2019. The classification of the most significant crises has been proposed. The articles and scientific papers related to our research have been investigated. The theory of complex systems and entropy measures have been explored and discussed. Primarily, relating to our classification, proposed methods and algorithms, we construct indicators and precursors of critical states. Then, to obtain scale invariant characteristics about examined time series, we apply Multiscale entropy. The results have indi-cated that the proposed measures of complexity can serve as reliable indicators and precursors of abnormal phenomena in complex systems.

14:30 *Vitaliy Kobets*, *Valeria Yatsenko* and *Mykhaylo Voynarenko*

Cluster Analysis of Countries Inequality due to IT Development

PRESENTER: *Valeria Yatsenko*

ABSTRACT. The choice between economic efficiency and social equity has become a key objection in economic development, since in the current economic system, which has become close to the Pareto optimum, the achievement of both of these goals is mutually exclusive. There is only one way to reach both of these goals – the fundamental change of current system of

economic relations and getting access to new curves of production capabilities, which may become quite real within development of Industry 4.0 and 6th technological wave. Nevertheless, nobody can predict the social impact of Industry 4.0 on society, which in the context of future technological changes transforms into Society 4.0. The purpose of this paper is to prepare cluster analysis of countries inequality due to IT development using software package. We researched impact of gross capital formation, research and development expenditure to create innovations, intellectual property and high-technology exports on inequality of countries using principal component analysis based on open data 2012-2015. We found 4 main clusters of 45 countries which have convergence and divergence attributes due to IT development. It was also revealed the countries which had inequality due to other reasons which are not connected with IT development.

15:00 *Olena Liashenko* and *Tetyana Kravets*
The Relationship between Oil and Gas Prices, Dow Jones and US Dollar Indexes: A Wavelet Co-movement Estimation and Neural Network Forecasting

ABSTRACT. In this study, we consider the relationship between oil and gas prices, the Dow Jones index, the US dollar index and their volatility indicators. Application of wavelet analysis allows to reveal regularities of dynamics of selected time series at different periods. The Wavelet approach makes it possible to determine how these variables interact at different frequencies, and how this interaction evolves over time on different frequency scales. Common revenue movements of the studied time series characterize the behavior of the relevant markets. The levels of high volatility at similar intervals explain that there is a link between the changes in these markets, and the global economy is vulnerable to oil and gas prices, the value of the dollar index and the Dow Jones index. At the next stage of the research, a comparison of the predictive capabilities of Long Short Term Memory and Wavelet based Back Propagation neural networks for co-movement leaders is made.

14:00-15:30 Session 4B: WS TheRMIT Session III: Quality and Reliability of Software System

CHAIR: *Tetiana Shmelova*

LOCATION: Coworking Hall

14:00 *Tetiana Hovorushchenko*, *Artem Boyarchuk*, *Olga Pavlova* and *Kira Bobrovnikova*
Agent-Oriented Information Technology for Assessing the Initial Stages of the Software Life Cycle
PRESENTER: *Olga Pavlova*

ABSTRACT. The paper presents the development of agent-oriented information technology (AOIT) for assessing the initial stages of the software life cycle. This AOIT performs automatic assessing and provides improving the level of sufficiency information of requirements for determination of each non-functional characteristic separately and all non-functional characteristics together, with the result that the gap in knowledge about non-functional characteristics for software projects is reduced. In addition, the developed AOIT minimizes the impact of the human factor and simplifies the performance of this assessment both by the developer and the customer. The developed agent-oriented information technology also provide: automation of the tedious, time-consuming, fatiguing and error-prone task of parsing the SRS; instantly show where re-work of requirements is needed; speed training for new systems engineers and project managers; the authoring of high-quality requirements; the correction and elimination of the requirements errors where they originate – during the early stages of the project; the tool for choosing the more qualitative software requirements specification; free online access, at any time, without any registration.

14:30 *Ol'ha Bashyns'ka*, *Volodymyr Kazymyr* and *Sergii Nesterenko*

Quality assessment of unmanned aerial systems using Bayesian Trust Networks processing of testing data

PRESENTER: *Sergii Nesterenko*

ABSTRACT. The article proposes a method for forecasting quality metrics (QM) of unmanned aerial systems (UAS) based on technical diagnostics data. The use of Bayesian Trust Networks (BNTs) allows one to evaluate the UAS' quality indicators at the stages of UAS testing and exploitation by measuring parameters, also in real time. Described method allows to calculate the relative impact of factors, to improve the UAS test procedure and to increase the validity of the findings regarding their compliance

14:50 *Tetiana Shmelova*, *Arnold Sterenharz* and *Oleksand Burlaka*

Optimization of flows and flexible redistribution of autonomous UAV routes in multilevel airspace

PRESENTER: *Tetiana Shmelova*

ABSTRACT. The authors present a problem of the performance of Unmanned Aerial Vehicles (UAV)'s flight plan group flights for the decision of different tasks in the city (for example, monitoring) using information air navigation technology, graph theory, and mathematical models. The configuration and optimization of group flight

routes for UAVs depend on the target tasks. The Algorithm of building Expert System for estimation performance of UAVs flights in smart-town was obtained. Optimization of flight routes for UAVs using dynamic programming methods, GRID analyses, methods of decision making in risk and fuzzy-logic were presented

15:10 *Vladimir Sklyar* and *Vyacheslav Kharchenko*
Reliability of Big Data in Hotels Management

ABSTRACT. The paper contains results obtained in area of big data analysis for hotel revenue management. We use comparatively the new tool “Booking.com Analytics” developed by the company Booking.com B.V. in 2016 for hotels involved in a global partnership program. We learned available features and data of the “Booking.com Analytics”. After that we tried to find statistical dependencies between a managed value of room daily rate and available big data. In conclusion, the obtained results are discussed.

14:00-15:30 Session 4C: WS CoSinE Session III: Modelling systems in education

CHAIR: *Oleksandr Kolgatin*

LOCATION: Conference Hall

14:00 *Lyudmyla Bilousova*, *Oleksandr Kolgatin* and *Larisa Kolgatina*
Computer Simulation as a Method of Learning Research in Computational Mathematics
PRESENTER: *Oleksandr Kolgatin*

ABSTRACT. The paper deals with a problem of students’ independent work through learning research. Research method do the learning process the most nearest to the real scientific study. Student does not receive the "ready" knowledge and decisions, but the teacher puts for him the goal, the cognitive problem that this student should solve during independent research activity. To provide such learning re-search in the "Computational Mathematics" course we suggest appropriate com-puter models in MathCAD environment - dynamic support conspectus. Students research some problems of global polynomial interpolation, spline interpolation, choose the appropriate function for approximation, verify the efficiency (accuracy and convergence rate) of some methods of numerical calculation of integrals and solving of non-linear equations. The results of approbation this learning methods in the training process of Kharkiv National Pedagogical University named after G.S.Skovoroda are shown and discussed. Checking the efficiency of our ap-proach was done by such criteria: knowledge level, depth of knowledge, research competency. Statistical analysis of obtained data shows advisability of implemen-tation of learning research in training process.

14:30 *Nonna Shapovalova*, *Olena Rybalchenko*, *Iryna Dotsenko*, *Svitlana Bilashenko*, *Andrii Striuk* and *Levan Saitgareev*

Adaptive Testing Model as the Method of Quality Knowledge Control Individualizing

PRESENTER: *Andrii Striuk*

ABSTRACT. The mission of the work is to develop and theorize the efficiency of application of the knowledge control system on the basis of adaptive testing technology, which combines the specifics of the professional and educational activity and the monitoring of the quality of training and the possibility of self-control of students, to develop a set of test assignments in the discipline "Artificial Intelligence Systems". Object of research is a software tool for monitoring students' knowledge in higher educational establishment. The subject of research is the development of software for an adaptive knowledge control system using machine learning device. Research goals: to develop a set of test case of different levels of complexity; to determine the structure, architecture and specificity of the application of the machine learning algorithm for the formation of a variable level of testing complexity for each student; develop appropriate software, guidelines and recommendations for adjusting and distributing issues by level of complexity. The result of the work is a complex of split-level application-oriented tasks for current and module control in the discipline "Artificial Intelligence Systems", web-oriented software that allows you to quickly monitor the quality of students' knowledge and is appropriate for use in online and mixed mode of training

15:00 *Aleksander Spivakovsky*, *Lyubov Petukhova*, *Vira Kotkova* and *Yuriy Yurchuk*

Historical Approach to Modern Learning Environment

PRESENTER: *Vira Kotkova*

ABSTRACT. The article is devoted to review system-organizing approaches and the development trends to the learning environment. Learning environment is explored according to the used information technology. Six stages of learning environment development are described. The transformation of the term ‘technology in education’ to ‘pedagogical technology’ is analyzed according its changes in content. The relationship between e-learning, Information Technology (IT) and Information and Communication Technologies (ICT) is identified. E-learning is understood as an umbrella term that covers web-based instruction, online learning, networked learning, computer-assisted learning and computer-mediated learning. The comparative characteristics of traditional and e-learning are made. Three levels (1.0, 2.0, 3.0) of the Web are analyzed. The quantitative results of the survey asked about the type of e-learning institutions use are presented. Eight trends of e-learning industry for 2019 are described. It is pointed out that the future development of technology will change the delivery modes used, the cost effectiveness and the acceptance and recognition of the new learning environment.

14:00-15:30 Session 4D: WS 3L-Person Session III: Virtual and Smart Technologies, STEM and Robotics

CHAIR: *Svitlana Lytvynova*

LOCATION: 507

14:00 *Svitlana Lytvynova*

Electronic Textbook as a Component of Smart Kids Technology of Education of Elementary School Pupils

ABSTRACT. The article sets out to analyze national and foreign experience of use of electronic textbooks in the system of education; to justify the use of Smart Kids technology as a system of methods, forms, and electronic educational game resources, electronic textbooks for educational process in the system of elementary school. Four forms of implementation of Smart Kids technology (Smart Case, Smart Teacher, Smart Class, and Smart Kids) were described considering the facilities of every school as well as the level of information and communication technology qualification of the elementary school teach-er. The aim of introduction of the technology for each form of teaching, the necessary equipment, and means for its implementation in elementary school environment were determined. Based on the procedural approach to work of an elementary school teacher, six stages of introduction of the technology were justified. Specific aspects of introduction of blended teaching using the principles of Smart Kids technology were defined. The experience of intro-duction of electronic textbooks to the system of elementary education of Ukraine was described, the choice of electronic textbooks by elementary school teachers was justified, the comments and suggestions of teachers re-garding the arrangement of electronic content in E-textbooks were summa-rized, the main approaches of teachers to the choice of an

electronic text-book and development of their information and communication competence were specified. It was identified that the forms, methods, and techniques of use of electronic textbooks in teaching elementary school pupils require fur-ther justification.

14:30 *Nataliia Osipova*, *Hennadiy Kravtsov*, *Olga Gnedkova*, *Tetiana Lishchuk* and *Kateryna Davidenko*

Technologies of Virtual and Augmented Reality for High Education and Secondary School

PRESENTER: *Kateryna Davidenko*

ABSTRACT. Every year there are new technologies that are used in the education of the younger generation. The introduction of mobile and portable devices in the educational process helps to improve the quality of educational materials through the use of software that complements or expands the content of textbooks and task books. The most promising direction of our time in the development of software for educational purposes is the system of virtual and augmented reality. VR and AR-technologies provide an opportunity to interact with various branches of science, ranging from virtual excursions and object studies to experiments and experiments in physics, biology, chemistry, astronomy, etc. Virtual and augmented reality are unique learning environments in various fields of science that allow you to reproduce virtual models with very precise detail. There are ready-made products designed for use in specific subject areas. Most of all programs for learning in virtual and augmented reality have the English language interface, so there remains a need for applications developed for Ukrainian-speaking students and pupils.

14:50 *Tatiana Goncharenko*, *Nataliya Kushnir*, *Nataliia Valko* and *Nataliya Osipova*

Activity Plan Template for Supporting Study Science with Robotics and Programming

PRESENTER: *Nataliya Osipova*

ABSTRACT. Today, specialists in engineering specialties are becoming increasingly popular on the labor market. In accordance with the requirements of society, the educational system is looking for ways to interest children in the study of subjects in the natural and mathematical cycle. The article presents the experience of holding a summer camp for children for the purpose of attracting them to scientific research and acquaintance with the subjects of STEM (science, technology, engineering, and math). The teachers of the STEM-school of the Kherson State University developed the "Summer Intensive" course to familiarize children with the basics of robotics, programming and physics. The course is designed for five days, each of which includes 4

lessons: from physics in experiments and experiments, the basics of robotics, the basics of programming, needlework, as well as active games, walks in the park, excursions. During two years of training passed 188 children, the article contains the justification for the selection of experiments in physics for children 6-14 years old, a detailed description of their conduct, organization of acquaintance with the basics of robotics using Lego Education WeDo 2.0, programming with Scratch. Particular attention is paid to the peculiarities of the organization and the generalization of the results of training in the summer camp in general and in the context of each subject

15:10 *Viacheslav Osadchyi*, *Nataliia Valko* and *Natalya Kushnir*
Determining the Level of Readiness of Teachers to Implementation of STEM-Education in Ukraine
PRESENTER: *Nataliia Valko*

ABSTRACT. Research of existing models of professional development of future teachers of natural and mathematical disciplines and professional teacher has shown that the creation of an educational environment for STEM-oriented learning affects the formation and further improvement of the system of their values. In this paper, the concept of STEM-education in terms of inter-discipline is considered. An attempt was also made to identify the factors that influence the readiness of teachers to support STEM-education and implement it in educational institutions.. This study is concerned with determining the level of formation of teachers' readiness for the implementation of STEM-education in Ukraine. Here we propose a methodology and a model for determining the level of readiness through surveys and analysis of results. On the basis of the obtained results, further prospects of the research are proposed and recommendations for involving young people in scientific activities, which may improve learning of Science, Technology, Engineering, Mathematics (STEM).

14:00-15:30 Session 4E: WS RMSE Session III

CHAIR: *Michael Lvov*
LOCATION: 512

14:00 *Ievgen Ivanov* and *Mykola Nikitchenko*
On the Kleene Algebra of Partial Predicates with Predicate Complement

ABSTRACT. In this paper we investigate the question of expressibility of partial predicates in the Kleene algebra extended with the composition of predicate complement and give a necessary and sufficient condition of this expressibility in terms of the existence of an optimal solution of an optimization problem. The obtained results may

be useful for development of (semi-)automatic deduction tools for an extension of the Floyd-Hoare logic for the case of partial pre- and postconditions.

14:30 *Grygoriy Zholtkevych*
Event Universes: Specification and Analysis Using Coq Proof Assistant

ABSTRACT. In the paper, the formal specification of event universes theory developed with using Coq Proof Assistant is presented. The main attention is paid on the discussion of the definition and obtained facts. In the same time, a proof technique is not the subject of this discussion. The reader can get acquainted with the details of the proof technique, referring to the source text of Coq-scripts hosted on the GitHub, using the links provided in the text of the paper.

15:00 *Oleksandr Letychevskyi*, *Volodymyr Peschanenko*, *Viktor Radchenko*, *Maksym Poltoratskyi* and *Yuliia Tarasich*
Formalization and Algebraic Modeling of Tokenomics Projects

ABSTRACT. This article provides a brief description of the technology and the methods and tools developed by the authors for token economy modeling and for the analysis and study of its properties. The article also describes the formalization of the tokenomics model on the example of the SKILLONOMY project and presents the specific and symbolic SKILLONOMY models and its simulation results.

15:30-16:00 Coffee Break

16:00-17:30 Session 5A: WS ITER Session IV: Intelligent Manufacturing and Information Systems 1

CHAIR: *Kateryna Proskura*
LOCATION: 256

16:00 *Mazurok Igor*, *Pienko Valerii* and *Leonchyk Yevhen*
Economic-based Fault-Tolerant Consensus Algorithm
PRESENTER: *Leonchyk Yevhen*

ABSTRACT. This paper describes an integrated parallel fault-tolerant consensus algorithm for systems of distributed processing and storage of information with low latency. An essential characteristic of this algorithm is the integration with an economic model, ensuring its sustainable development in accordance with the goals of functioning. The proposed algorithm is called WWH (What, Where, How much), because it allows for one pass of the protocol to obtain consistent solutions on the following issues: what information will be stored; to which place of the synchronized storage it will be recorded;

determination of nodes reward for fair functioning. The algorithm is based on the ideas of the SBFT algorithms, Raft and the basic principles of the Computable general equilibrium to construct the internal economy of the system functioning. The algorithm assumes resistance to two types of errors - Byzantine errors and equipment failures.

16:20 *Tetiana Paientko* and *Viktor Fedosov*
Can Information Technology Increase Government Effectiveness?
PRESENTER: *Tetiana Paientko*

ABSTRACT. The article deals with government effectiveness in central and eastern European countries. In 1990, eastern European countries began to transition from communism to free market capitalism. After more than twenty years of reform, central and eastern European countries are showing different results in economic development because of widely contrasting levels of government effectiveness. Recently government effectiveness was tied to e-governance services and their growth. The purpose of the article is to analyze how information technology can increase government effectiveness.
Firstly, the main ideas of government effectiveness and its indicators were de-scribed. Secondly, trends of government effectiveness in selected countries are analyzed using R. Thirdly, impact of e-governance on government effectiveness was analyzed. Fourthly, ideas to improve government effectiveness are proposed. The methodology of research includes both qualitive and empirical methods. The data used was from World Bank sources.

16:50 *Andrii Roskladka*, *Nataliia Roskladka*, *Ganna Kharlamova* and *Roman Baglai*
CLOUD BASED ARCHITECTURE OF THE CORE BANKING SYSTEM
PRESENTER: *Roman Baglai*

ABSTRACT. The article contains a study of cloud technology and standards applicable to Core Banking System (CBS). National regulators often require storage of the data on physical servers of the country where the bank is registered. This is probably due to the lack of awareness of cloud technology data protection capabilities on the regulator side. Although main cloud service providers comply with international security standards, such as Payment Card Industry Data Security Standard (PCI DSS), International Organization for Standardization (ISO 9001:2015, ISO/IEC 27001:2013, ISO/IEC 27017:2015) and many other national security standards [3]. This means they offer much higher degree of information security that the bank can afford within own infrastructure. Modern mathematical systems and methods have been used to define an optimal

configuration of cloud based platform for CBS. An analytical model was built based on the EC2 memory optimized class instances configuration.

17:20 *Olga Popova*, *Liubov Pankratova* and *Inesa Mikhno*
Application of geographic information systems in the field of domestic waste management

ABSTRACT. The algorithm of the application of Google Earth software tools for the processing of satellite data about storage facilities of domestic waste is described. The authorized areas of domestic waste and spontaneous dumps have been identified by number, area and characteristics in the city of Kyiv and in the suburban area. It was found that most dumps are located at a dangerously close distance from residential development, which in some cases exceeds the norma-tive indicators. The authors used the methodical approach in defining the area which is unsuitable for housing development and growing of agricultural crops as well as the area of environmentally destructive influence around the dumps. The sequence of actions, participation of stakeholders and their functions is substantiated in order to form a modern utilization industry of domestic waste. It is offered to use the public welfare function to define the effect of waste pro-cessing. Collected and systematized cartographic images of garbage landfills, spontaneous dumps and its ecologically destructive influence on the environment are a formed demonstration and evidence base for proving the importance of reorientation of waste management in Ukraine, the transition from storage on landfills to the proper processing of domestic waste.

16:00-17:30 Session 5B: WS TheRMIT Session IV: Security and Privacy of IT Infrastructures

CHAIR: *Sergiy Gnatyuk*

LOCATION: Coworking Hall

16:00 *Oleg Savenko*, *Andrii Nicheporuk*, *Ivan Hurman* and *Sergii Lysenko*
Dynamic Signature-based Malware Detection Technique Based on API Call Tracing
PRESENTER: *Andrii Nicheporuk*

ABSTRACT. The paper presents a method for a malware's signature generation based on API call tracing. Technique allows malware detection using a proposed form of signature. The main idea of proposed signature generation is a difference between frequency and interaction of a critical API calls performed by malicious program and benign applications in the process of their own execution. Accordingly the program's behavior signature based on API call tracing consists of two components: the call frequency and the nature of the interaction of critical API calls. An analysis of the first component allows determining the distribution of the critical API calls by groups concerning theirs malicious activity and displays the quantitative component of the signature. An analysis of the second component of the signature provides an opportunity to distinguish malware from benign applications not only in the presence of critical API calls, but also in their interaction with each other. The experimental results showed that the effectiveness of the malware detection using

proposed signatures is up to 96.56%.

16:30 *Sergiy Gnatyuk*, *Zhengbing Hu*, *Vasyl Kinzeryavyy*, *Tetyana Okhrimenko* and *Maksim Iavich*

High-Speed Privacy Amplification Method for Deterministic Quantum Cryptography Protocols Using Pairs of Entangled Qutrits

PRESENTER: *Tetyana Okhrimenko*

ABSTRACT. With the measureless, huge and rapid data exchange in network environments and increasing the attackers capabilities, quantity and quality of violations in cyberspace, information security has become the most important process for data storage and communication. Reliability of traditional methods for ensuring confidentiality is questionable, taking into account contemporary threats. Thereby, search of alternative methods and means for security is urgent issue. Significant interest causes quantum cryptography, which do not depend on computing or other capabilities of intruder, uses specific unique properties of quantum particles, and based on the inviolability of quantum physics laws. One of the most advanced quantum cryptography technology is quantum secure direct communication, which can transmit information directly by open channel, but it has only asymptotic security to non-coherent attacks and, certainly requires some methods for security amplification. In this regard, high-speed privacy amplification method for quantum cryptography protocols was developed. To evaluate the effectiveness of this method was developed a methodology for experimental research, under which comparing of its performance with known method was made. According to the obtained results, the proposed method has a speed faster against analogs at the same level of security against non-coherent attacks.

16:50 *Viktor Gnatyuk*, *Marek Aleksander* and *Sergiy Gnatyuk*

Intelligent Method for CSIRT Performance Evaluation in Critical Information Infrastructure

PRESENTER: *Viktor Gnatyuk*

ABSTRACT. In this paper authors have developed a method for Computer Security Incident Response Team (CSIRT) performance evaluation, which is implemented in the following stages: determining the performance of the CSIRT, defining the Key Performance Indicators (KPI), building a panel of indicators. The developed method can be used to monitor, manage, analyze and enhance the effectiveness of the CSIRT in critical information infrastructure as well as in common (general) information and communication systems. The experimental study of developed method realization for domestic cellular provider

was also presented. Given results can be useful for information security audit of company, region or state.

17:10 *Vladimir Peschanenko*, *Oleksandr Letychevskyi*, *Viktor Radchenko*, *Volodymyr G. Skobelev*, *Andrey Sobol* and *Maxim Orlovsky*
Random Re-Ordering of the Parties in the Consensus Protocol

ABSTRACT. Generation of a publicly verifiable bias-resistant distributed randomness is one of the actual problems in blockchain and its various applications. The complexity of this problem increases significantly for consensus algorithm operating on a decentralized network topology on the assumption that there are neither a trusted third party nor a trusted dealer. Such situation is caused by the fact that the logical structure of algorithms intended to solve the subtasks typical for this problem be- comes much more complicated. Besides, there arise some subtasks caused by the complete distribution of the analyzed blockchain network. One of such nontrivial subtasks is the implementation of random re-ordering of the parties, based on generated randomness. This random reordering de- fines the roles of the parties in the next epoch, and is intended to support equal access of the parties to the functioning of the blockchain network. We present a simplified version of the generation of a publicly verifiable reliable distributed randomness for the consensus protocol operating on a decentralized network topology on the assumption that there are nei- ther a trusted third party nor a trusted dealer. On this base we solve the problem of the random re- ordering for parties which will participate in the implementation of the next epoch.

16:00-18:00 Session 5C: WS CoSinE Session IV: Learning Virtualization

17.50 – 18.00. Closing, CoSinE 2020 Announcement, and Farewell

CHAIR: *Andrii Striuk*
LOCATION: Conference Hall

16:00 *Yuliia Yechkalo*, *Viktoriia Tkachuk*, *Tetiana Hruntova*, *Dmytro Brovko* and *Vitaliy Tron*
Augmented Reality in Training Engineering Students: Teaching Techniques
PRESENTER: *Viktoriia Tkachuk*

ABSTRACT. *The research aim*. The research is intended to theoretically substantiate, develop and test methods of applying augmented reality to training future engineers. *The research tasks* include adaptation of augmented reality tools to apply them to laboratory classes while training future engineers; visualization of theoretical models of physical phenomena and processes using augmented reality tools; theoretical substantiation and development of methods of applying augmented reality to training future engineers. *The research object* is training future engineers at engineering universities. *The research subject* is methods of applying augmented reality to training future engineers. *The*

research results are the following. There are analyzed national and foreign researches into issues of applying augmented reality to training future engineers at engineering universities. The augmented reality tools (HP Reveal) is adapted to be used in laboratory classes in physics while training future engineers. There are created augmented reality objects in the form of educational videos in which the structure of laboratory machines and procedures of working with them are explained. Methods of applying augmented reality to training future engineers at engineering universities are developed.

16:20 *Evgeniy Lavrov* and *Olga Lavrova*

Intellectual Adaptation Method for Human-Machine Interaction in Modular E-Learning Systems

PRESENTER: *Evgeniy Lavrov*

ABSTRACT. The article describes ergonomic problems in e -learning systems. A new method for ensuring ergonomics of electronic educational resources, including ergonomic expertise and multilevel adaptation to the capabilities of trainees was developed. A model approach based on an anthropocentric concept is proposed, which takes into account the requirements of system analysis for the e-learning system as a man-machine complex, namely: multivariance and detailing of the functional structures of the dialogue man-machine interaction in the learning process; parameters, preferences and conditions for individual operators working with the system; the possibility of dynamic optimization of human-machine interaction in real time, providing mechanisms for multi-level adaptation to the human operator.

16:40 *Pavlo Nechypurenko*, *Tetiana Selivanova* and *Maryna Chernova*

Using the Cloud-Oriented Virtual Chemical Laboratory VLab in Teaching the Solution of Experimental Problems in Chemistry of 9th Grade Students

PRESENTER: *Pavlo Nechypurenko*

ABSTRACT. The article discusses the importance of the skills of primary school students to solve experimental problems in chemistry and the conditions for the use of virtual chemical laboratories in the process of the formation of these skills. The concept of “experimental chemical problem” was analyzed, classifications were considered, and methodological conditions for using experimental chemical problems in the process of teaching chemistry were described. The essence of the concept of “virtual chemical laboratories” is considered and their main types, advantages and disadvantages that define the methodically reasonable limits of the use of these software products in the process of teaching chemistry, in particular, to support the educational chemical experiment are described. The capabilities of the virtual chemical laboratory VLab to support the process of solving experimental problems in chemistry in grade 9 have been determined. The main advantages and

disadvantages of the virtual chemical laboratory VLab on the modeling of chemical processes necessary for the creation of virtual experimental problems in chemistry are analyzed. The features of the virtual chemical laboratory VLab, the essence of its work and the creation of virtual laboratory work in it are described. The results of the study is the development of a set of experimental tasks in chemistry for students in grade 9 on the topic "Solutions" in the cloud-oriented virtual chemical laboratory VLab.

17:10 *Nadiia Balyk*, *Yaroslav Vasylesnko*, *Vasyl Oleksiuk* and *Galina Shmyger*
Designing of Virtual Cloud Labs for the Learning Cisco CyberSecurity Operations Course
PRESENTER: *Vasyl Oleksiuk*

ABSTRACT. The article is devoted to the study of the problem of the cybersecurity basics teaching. The training of the ICT-specialties students using the course "CCNA Cyber Operations" of the network academy Cisco is considered. At present, many universities have similar academies, while others can open them. On the basis of free software platforms Apache CloudStack and EVE-NG Community authors designed and implemented a virtual cloud laboratory. It operates according to the "IaaS" model. Thanks to the technology of embedded virtualization, the work of many virtual machines, storing of their status, traffic analysis and visualization of network topologies are maintained. The article describes the experience of teaching students of the specialty "Pedagogical education. ICT" in the course "CCNA Cyber Operations" with the use of virtual cloud laboratories. The authors have been conducted a survey of students who studied at the course. Its purpose was to determine how much they satisfied were with the course. Statistical processing of the results was performed on the basis of the Rasch model using the software Winsteps (MiniSteps). It allows to establish a link between the level of respondents' preparation and the results of the survey. The most important indicators in the survey were: the technical accuracy of the training material, the accuracy and ease of perception of the material, the availability of equipment virtual cloud laboratories, the ability to analyze the cybersecurity of Windows and Linux.

17:30 *Muhammet Demirbilek* and *Durmus Koc*
Using Computer Simulations and Games in Engineering Education: Views from the Field

ABSTRACT. The purpose of this research is to determine the views of the faculty of engineering and architecture academic staff on the use of educational computer simulations and games in engineering education. The research data were

collected using semi-structured interview technique in qualitative data collection method and analyzed conducting the context analysis method. The analysis of the data revealed that academic staffs of engineering and architecture faculties have positive approach to the use educational computer simulations and games in their courses; however they could not be able to employ the games in their class due to deficiencies of the games and simulations appropriate for the curriculum and lack of games in Turkish. Furthermore, using educational computer games and simulations in the engineering courses may improve the quality of instruction, motivate students and make courses more enjoyable according to academic staff views

16:00-17:30 Session 5D: WS 3L-Person Session IV: ICT in Education and 3L Retraining

CHAIR: *Oleksandr Burov*

LOCATION: 507

16:00 *Vladimir Kukharenko* and *Tatyana Oleinik*

Open Distance Learning For Teachers

PRESENTER: *Vladimir Kukharenko*

ABSTRACT. Research Laboratory of Distance Learning (RLDL) NTU "KhPI" offers teachers of educational institutions The purpose of the work is to demonstrate of the results of the study on the role of open education for the system of professional development (advanced training) of distance and blended learning teachers. Awareness of the benefits of open practice by educators will allow to resolve the strong contradiction between (1) expanding the scope of the open educational resource (OER) and MOOC in the professional activity of teachers and the existing practice of distance learning in advanced training courses (insufficient attention is paid to the innovative pedagogical methodology in compare to the orientation towards mastering, mainly, the simplest user toolkit of LMS Moodle); (2) the presence of modern OER and open educational practice (OEP) as well as the ineffectiveness of their implementation in the conditions of the traditional training system. Research Laboratory of Distance Learning (RLDL) NTU "KhPI" offers teachers of educational institutions and corporate trainers distance courses "Introduction into distance learning", "Distance education for managers", "Technology of design distance course", " Tutor’s Practicum ", "Blended learning", "Distance Course Expertise", "Content Curator". Teachers from universities, institutes of postgraduate pedagogical education and teachers of schools of Ukraine took part in the open distance courses of the RLDN. Since 2014, more than 2,400 students have been enrolled in courses. The survey of students of courses showed that open distance courses change the teacher's personality (45.7%), the quality of

developing distance courses (60%), use in the educational process (67%), use of materials for the course to create a system of training in their organization (21.4%), studying in the course affects their career (18.6%). Besides, the article presents important research results concerning the long-term of molding formative kit at the KhNPU (based on the educational technology portfolio) in the context of the integration of open digital resources into the blended learning. It's no doubt, experience shows that at the initial stage of study a majority of students aren't ready to consciously use the wide possibilities of these means for independent evaluation themselves, the realization of meaning, reflection, regulation of their own activities. In this way, the development of the educational environment aimed at taking means of interaction and professional identity of students as well as active research position, development of critical thinking should be recognized among the important conditions. In order to solve the problems of improving the quality of pedagogical research on distance learning of masters, postgraduate students in particular, and the training of teachers and scholars in general, it is necessary to draw attention to the review of innovative technologies for the processing of information, pedagogical design and assessment of individual achievements (using portfolio), the formation of the respective competencies (content curator, pedagogical designer, tutor, etc.). Thereby open education is determined as disruptive innovation studies (on a mind of some researchers) we're sure that open distance courses promote the dissemination of modern pedagogical methodology for wide access to quality distance and blended learning as well as temporal changes in the national digital education strategy in Ukraine.

16:30 *Oleksandr Burov*, *Svitlana Lytvynova* and *Olga Slobodyanyk*

The Technique to Evaluate Pupils' Intellectual and Personal Important Qualities for ICT Competences

PRESENTER: *Oleksandr Burov*

ABSTRACT. The paper presents the ICT technique for assessment of schoolchildren abilities and intellectual and personal important qualities for ICT competences formation, as well as research in this domain. The results of comparative analysis of abilities of pupils with mathematical and IT abilities in non-profiled schools in relation to "average" abilities are presented after results of pilot study. Examples of methodical developments are given. Some expected and unexpected results of the experimental research are discussed.

16:50 *Yuliya Nosenko* and *Alisa Sukhikh*

The Method for Forming the Health-Saving Component of Basic School Students' Digital Competence

PRESENTER: *Alisa Sukhikh*

ABSTRACT. The article describes the method for forming the heath-saving component (HSC) of basic school students' digital competence that involves the purposeful acquis-tion of the ability to health-saving use of ICT in educational process. The basis for named method implementation is the author's course of training session, covering 12 academic hours and designed for 5-9 grades classes (10(11)-15 years old students). The training session can be conducted within the compulsory subjects or electives in groups of up to 15 students. In the article the named course tasks are defined, the content units, principles and methods are represented. The recommendations for the final control (group project) are given. An empirical study showed that in the experimental group that studied under the author's method, the number of students with a low level decreased significantly, while the number of students with average and high levels of HSC increased. These results are much ahead of those obtained in the control group. Consequently, the results of the experiment showed the effectiveness of the author's method for forming HSC of basic school students' digital competence.

17:10 *Yevheniia Spivakovska*, *Tetyana Vinnyk*, *Liudmula Perminova* and *Vira Kotkova*

ICT IN PROFESSIONAL EDUCATION OF FUTURE PRIMARY SCHOOL TEACHERS: MODELING OF SCIENTIFIC AND RESEARCH WORK

PRESENTER: *Vira Kotkova*

ABSTRACT. The usage of ICT has become an integral part of the learning process. It provides such benefits as improving learning efficiency, developing thinking culture, sharing knowledge and collaborating in the fast-paced digital society. The article is devoted to summarize the pedagogical conditions for future primary school teachers' research competences formation with the usage of ICT in education. The results of the survey of students' usage of different ICT are analyzed. The basic directions of modern students' scientific work are analyzed. The main directions of students' research work are discussed. On the basis of the analysis of students' usage of the ICT in scientific work, a five-step model of activity was created and tested, in particular, research planning, information phases, experiments, analytics, as well as the stage of project execution and presentation of research results.

16:00-17:30 Session 5E: WS RMSE Session IV

CHAIR: *Mykola Nikitchenko*

LOCATION: 512

16:00 *Ivan Dychka* and *Olga Sulema*

Data Compression and Representation as Multicolor Barcodes

PRESENTER: *Olga Sulema*

ABSTRACT. A method for data compression and representation of textual information in the form of a barcode is proposed in the paper. The main idea of the proposed method is preliminary data compressing along with the use of three colors. Increasing the number of colors used in a barcode symbol allows to encode data with higher density in comparison with two-color barcodes. Thus, the advantage of the proposed method is that it enables either representation of the same amount of input data on a smaller area or a larger amount of data in a barcode symbol of the same size. The matter of a color contrast is also discussed in the paper. Since an information carrier (e.g. goods package) can have an arbitrary background color depending on a use case, a contrast ratio value should be considered while choosing a specific set of colors for barcode elements in each particular use case to make the barcode reading procedure more accurate.

16:30 *Peschanenko Vladimir*, *Poltorackiy Maksym* and *Pryimak Karina*
Formalization and Algebraic Modeling of University Economics

ABSTRACT. The article discusses the approach to modeling economic processes at the university using the methods of algebraic modeling and insertional modeling. The formal model of the economic processes of the university is presented in the article.

17:30-18:00 Coffee Break

18:00-19:30 Session 6A: WS ITER Session V: Intelligent Manufacturing and Information Systems 2

CHAIR: *Tetiana Paientko*
LOCATION: 256

18:00 *Irina Nyzhnyk* and *Viktor Lysak*
THE MAIN ASPECTS OF THE INTRODUCTION OF ERP-SYSTEMS AT THE MACHINE-BUILDING ENTERPRISES
PRESENTER: *Irina Nyzhnyk*

ABSTRACT. *Research goals and objectives:* to carry out the analysis of the market of ERP-systems and to make scientific and practical recommendations for their choice for successful introduction at domestic machine-building enterprises.

Subject of research: design, implementation and use of ERP-systems at the machine-building enterprises of Ukraine.

Research methods: statistical, systematic and comparative analysis, modular design, analytical and expert methods.

Results of the research: The advantages of

implementing ERP-systems at the machine-building enterprises have been evaluated, the most significant impact on individual indicators of enterprises has been determined and the advantages and disadvantages of automation of business processes at machine-building enterprises, depending on their separate types, are described. Examples of integration of subsystems on the basis of information flows and interaction of automated systems with external entities are given. It is proved that the success of the implementation of ERP-systems depends on the correct choice of the system class, the type of production, set priorities for the automation of business functions, taking into account the factors of criticality, readiness, speed and value. As a result, the maximum effect from the implementation of the ERP system potentially depends on: the completeness of its compliance with national legislation, the user interface's convenience and clarity, the ability to adapt to the industry-specific features and the specifics of the operation of a particular enterprise, the possibilities of integration into the system of external and internal modules, etc. It is important to involve the consulting companies, industry specialists and employees of the enterprise in the process of implementation.

18:20 *Mykola Odrekhivskyy*, *Nataliia Kunanets*, *Volodymyr Pasichnyk*, *Antonii Rzheuskyi* and *Danylo Tabachyshyn*

Information-analytical Support for the Processes of Formation of "Smart Sociopolis" Truskavets

PRESENTER: *Antonii Rzheuskyi*

ABSTRACT. The projects of the creation of "Smart sociopolis" contribute to the transformation of territorial structures into the open market for investments and provides for the use of modern technologies for the reorganization of the existing fundamentals of ownership into a more flexible, capable of adapting to any changes in the external sector. The urgent issues of informational and analytical support of the processes of formation of recreational innovative structures on the example of the sociopolis of Truskavets are analyzed. The socio-economic background and methodological aspects of construction of recreational innovative structures, approaches to their management with the purpose of transformation into "smart sociopolis" are highlighted. The methodological principles of organization and integration of sociopolises to modern economic conditions are suggested. The mathematical models of estimation and forecasting of states, stability and efficiency of sociopolis development are proposed. The effectiveness of innovative and technological processes for the formation of the sociopolis of Truskavets mainly depends on the states of their organizational management

structures. Innovative approaches to intellectualization and optimization of the management of sanatorial technologies of the sociopolis of Truskavets are proposed in order to transform it into a "smart sociopolis" as an integrated system capable of efficient functioning, to provide for a sustainable development and to win the competition among analogous structures of Ukraine and abroad. The model of the structure of sociopolis with taking into account its potential possibilities is suggested. The modern tools of organizational management of the sociopolis of Truskavets based on modern information technologies and providing effective processes for the development of the sociopolis of Truskavets, providing it with adaptive ability, resistance to environmental conditions are suggested.

18:50 *Victor Selyutin*

Simplified Model of Bank Balance Sheet Management

ABSTRACT. The central issue of bank management is obtaining maximum yield while complying with prudential supervision requirements to reliability and good standing. Particular attention should be given to liquidity risks, whose fully-fledged analysis and management require to approach the bank as a dynamic system. The developed mathematical model includes three asset components (loans; bonds and another low risk securities; liquid assets – accounts, reserves, cash) and two liabilities components (equity and borrowed capital – deposits). Main management parameters of the bank's balance sheet that support choosing adequate combination of returns and liquidity risk include turnover times of the loan portfolio and the securities portfolio, loan and deposit rates, the cash reserve ratio. This approach allows to clearly describe the transformation mechanism of core cash flows and formalize various rules of assets and liabilities management. The findings include analytical expressions allowing to research the impact of main constraints on the bank's yield. Computer-aided implementation of this model may be used for computational studies of dynamics of balance sheet items and efficiency of different algorithms of asset placement decision-making.

19:10 *Yuliia Lola*, *Svitlana Prokopovych* and *Olena Akhmedova*

Influence of the country's information development on its tourist attractiveness

ABSTRACT. A number of studies have researched the effects of tourism on transportation system, hotel industry, economic efficiency and environment. This paper examines the influence of the information and communication technologies development on the inbound tourism intensity. The correlation and regression analysis

has been used to identify the relationship between the Travel and Tourism Competitiveness Index, the Information and Communication Technology Development Index and International tourism arrivals. The results demonstrate that there is a close link between the countries' tourist attractiveness and the level of their information and communication development. However, it is not equal for different countries, which are grouped by the level of intensity of tourism arrivals, the level of the country's attractiveness and its information and communication technologies development. Besides, the country's information and communication technologies development has little effect on the inbound tourism intensity.

18:00-19:30 Session 6B: WS TheRMIT Session V: Security and Privacy of IT Infrastructures. Clothing

CHAIR: *Vyacheslav Kharchenko*

LOCATION: Coworking Hall

18:00 *Igor Shostak*, *Yashar Rahimi*, *Mariia Danova*, *Olena Feoktystova* and *Olga Melnyk*
Ensuring the Security of the Full Logistics Supply Chain Based on the Blockchain Technology
PRESENTER: *Yashar Rahimi*

ABSTRACT. Issues related to ensuring the security of the functioning of the full logistic supply chain of dried fruit (SCDF) in Ukraine are considered. It is shown that the creation and function of the SCDF, compared to other supply chain management (SCM) class systems, raises a number of specific problems caused by the complexity of the interaction of raw material suppliers (fresh fruit), manufacturers of final products (drying, packaging), storage terminals, distributors, 3PL and 4PL providers (retailers). These problems are due to the fact that the interaction of participants in business processes in the SCDF generates a lot of material, financial and information flows, as well as flows of services from sources of raw materials to the final consumer. An important aspect of improving the performance of the SCDF is the development of methods and tools, and on their basis the applied information technology to ensure the reliability and security of the SCDF. To solve this problem, it was proposed to use the Blockchain technology to protect the telecommunication channels connecting the circuit elements from unauthorized access. The method of identification and authentication of digital objects of the SCDF, which guarantee the security of SCDF elements and provide them with the necessary level of confidentiality, is described.

18:00-19:30 Session 6C: WS 3L-Person Session V: Learning tools for Research and Forming Competences

CHAIR: *Yuliya Krylova-Grek*

LOCATION: 507

18:00 *Nadiia Balyk*, *Galina Shmyger*, *Yaroslav Vasylenko* and *Vasyl Oleksiuk*
Design of Approaches to the Development of Teacher's Digital Competencies in the Process of Their Lifelong Learning

PRESENTER: *Yaroslav Vasylenko*

ABSTRACT. At present, various strategies and initiatives focused on innovation of educational technologies in higher pedagogical education are offered in Ukraine. The study of the state of the formation of teachers' digital competences in the process of their professional development has been carried out on the basis of Ternopil Volodymyr Hnatiuk National Pedagogical University (TNPU). The article analyzes foreign and national approaches and strategies to the development of teachers' digital competences. The results of the study, aimed to determine the features of mastering digital competencies in the process of teachers' professional development and their lifelong learning, are presented. In total, 258 teachers from Ternopil and Ternopil region (Ukraine) took part in this research. The study combines a variety of statistical tools and techniques in the real contexts of higher education. The research has been carried out to determine the characteristics of elements that measure the digital competency of the professional development. The results were processed based on the theory of modeling and parametrization of IRT tests. This article demonstrates the utility of the standardized LD χ2 statistic and the M2 statistic as provided in IRTPRO, but not available readily in most IRT programs and not discussed commonly in pedagogical papers for IRT. On the basis of the research carried out at the TNPU, the strategy for the professional development of digital competencies of teachers in the process of their lifelong learning has been developed, which takes into account the results of the analysis of the criteria and indicators inherent for the qualitative improvement of qualifications, that have been determined by international standards and studies of professional institutions.

18:30 *Aleksander Spivakovsky*, *Maxim Vinnik*, *Maksym Poltorackiy*, *Yevheniia Spivakovska*, *Yulia Tarasich*, *Greg Gardner* and *Kateryna Panova*
Information System of Scientific Activity Indicators of Scientific Organizations: Development Status and Prospects
PRESENTER: *Kateryna Panova*

ABSTRACT. Nowadays ICT are one of main ways to arrange and create effective tools for organizing the interaction and processing large amount of information. In our opinion, information of university's scientific activity should be presented in the rating form, which gives an opportunity to analyze development in different directions and changes. The key idea of the article is presenting of our experience in developing rating system for universities based on scientist's scientometric indices. The system provides open data from different scientometric systems, such as Google

Scholar, Scopus, Web of Science and Semantic Scholar. The possibility to construct a rating of scientists, research groups and organizations (as well as their structural subdivisions) even in other universities by using the API is described.

19:00 *Yuliya Krylova-Grek*

ADVANCED INFORMATION TECHNOLOGY TOOLS FOR MEDIA AND INFORMATION LITERACY TRAINING

ABSTRACT. Media and information literacy is an essential skill in the Digital Age. Indeed, the lack of knowledge and skills in media literacy is one of the reasons people are unable to analyse and evaluate information, thus creating a fertile breeding ground for unfair use of the World Wide Web. These days, people use information technologies to develop necessary insights and mindsets in order to appreciate adequately the overwhelming amount of information. Our purpose-designed Media and Information Literacy course lies at the core of freedom of expression and information. Prioritized information technologies empower learners to understand the functions of online resources, to critically assess their content, and to make decisions as users and producers of information and media content. The benefits from these technologies are obvious. They are extremely affordable, and the devices to implement them are always at hand. This paper is in response to a call for input to a study of media and information literacy at the State University of Telecommunication (Kyiv, Ukraine). It covers the issues of applying information technologies to study media literacy. The effective implementation of the course is based on the author's unique approach, which includes the active use of a "media-creator" computer game, fact-checking methods, and special software. The media and information literacy course is regarded as a set of steps, as manifest in the paper. The obtained results demonstrate that having attended an array of classes, having learnt theory, and having fulfilled practical tasks, students become more informed, sensitive, and aware of the information they receive on the Internet.
