



RECI 2020

Book of Abstracts of

the International Workshop on Reliability Engineering and Computational Intelligence

October 27-29, 2020
Žilina, Slovakia

 Co-funded by the
Erasmus+ Programme
of the European Union

 A@SYRI



SRDA

The international workshop on Reliability Engineering and Computational Intelligence organized by IEEE Chapter of Reliability Society of the Czechoslovakia Section in cooperation with the European Safety and Reliability Association will be an online discussion in relevant trends of Reliability Engineering with application of methods of Artificial Intelligence, Data Mining, Knowledge Discovery and Computational Intelligence.

Web-site: <https://ki.fri.uniza.sk/RECI2020>

Organized by



In cooperation with



The workshop has been implemented in frames of the following projects:

- *Advanced Centre for PhD Students and Young Researchers in Informatics (ACeSYRI) (Project EACEA.CBHE no.: 610166-EPP-1-2019-1-SK-EPPKA2-CBHE-JP supported by the European Union's Erasmus+ programme)*
- *New Methods Development for Reliability Analysis of Complex System (Project APVV-18-0027 supported by the Slovak Research and Development Agency)*



Workshop Program Committee

Chairs

- **Coen van Gulijk**, *Institute of Railway Research, University of Huddersfield, UK*
- **Miroslav Kvassay**, *University of Žilina, Slovakia*

Members

- **Serge Ablameyko**, *Belarusian State University, Belarus*
- **Nicolae Brnzei**, *Université de Lorraine, France*
- **Radim Bris**, *VSB - Technical University of Ostrava, Czech Republic*
- **Aleksandr Cariow**, *West Pomeranian University of Technology, Poland*
- **Marko Cepin**, *University of Ljubljana, Slovenia*
- **Frank Coolen**, *Durham University, United Kingdom*
- **Stanislaw Czapp**, *Gdansk University of Technology, Poland*
- **Jozef Kapusta**, *Constantine the Philosopher University, Slovakia*
- **Vyacheslav Kharchenko**, *National Airspace University, Ukraine*
- **Jozef Kostolny**, *University of Žilina, Slovakia*
- **Andrey Kovalenko**, *Kharkiv National University of Radio Electronics, Ukraine*
- **Marek Kvet**, *University of Žilina, Slovakia*
- **Michal Kvet**, *University of Žilina, Slovakia*
- **Vitaly Levashenko**, *University of Žilina, Slovakia*
- **Martin Lukac**, *Nazarbayev University, Kazakhstan*
- **Andriy Luntovskyy**, *BA Dresden University of Technology, Germany*
- **Volodymir Lytvynenko**, *Kherson National Technical University, Ukraine*
- **Ravil Muhamedyev**, *Kazakh National Research Technical University, Kazakhstan*
- **Eugeny Nikulchev**, *University of Technology, Academy of Education, Russia*
- **Antoine Rauzy**, *Norwegian University of Science and Technology, Norway*
- **Jan Rabcan**, *University of Žilina, Slovakia*
- **Sergey Stankevich**, *Scientific Centre for Aerospace Research of the Earth, Ukraine*
- **Janos Sztrik**, *University of Debrecen, Hungary*
- **Mikhal Tatur**, *State University of Informatics and Radioelectronics, Belarus*
- **Elena Zaitseva**, *University of Žilina, Slovakia*

Organizing Committee

Chair: Patrik Rusnak, *University of Žilina, Slovakia*

Miroslav Kvassay, **Jozef Kostolny**, **Vitaly Levashenko**,

Jan Rabcan, **Peter Sedlacek**, **Elena Zaitseva**

Martin Lukac, *Nazarbayev University, Kazakhstan*

Ravil Muhamedyev, *Kazakh National Research Technical University, Kazakhstan*

Table of Contents

Workshop Program Committee.....	3
System reliability analysis and assessment by means of graph models issued from Hasse diagram	7
Quantification of system reliability using the survival signature	7
Making Reliability Engineering SMARTER with Computational Intelligence.....	8
Big Accidents and Markov's Chains Based Assessment of Safety Critical IT-Systems	8
New Challenges and Opportunities in Reliability Engineering of Complex Technical Systems.....	8
Methods of reliability analysis based on logic differential calculus.....	9
Generation of Structure Function Based on Uncertain Data by Fuzzy Decision Tree.....	9
Ocean of the Redundancy for the Hyper Reliable FPGAs.....	10
COVID-19 pandemic risk analytics: Data mining with reliability engineering methods for analyzing lockdown strategies	10
Minimal Filtering Algorithms for Convolutional Neural Networks	11
Method for determining the structural reliability of a network based on a hyperconverged architecture.....	11
Assessment of upraising risks within product fleets in use: The influence and interdependencies of the Weibull threshold parameter	12
Network of autonomous units for the complex technological objects reliable monitoring.....	12
Neural Network Training Acceleration by Weight Standardization in Segmentation of Electronic Commerce Images	13
Energy Efficiency for IoT	13
Knowledge-based multispectral remote sensing imagery superresolution	14
Generation of Structure Function Based on Uncertain Data by Fuzzy Decision Tree	14
Unavailability Optimization of a System Undergoing a Real Ageing Process under Failure Based PM.....	15
Radar data product super resolution under parameter variation	15
A correlative method to ranking sensors via information reliability criterion: interval-valued numbers case.....	16
Topic-wise sentiment analysis of Kazakhstani news articles.....	16
Hybrid approach to classification of remote sensing data.....	17

Systems reliability analysis and assessment by means of logical differential calculus and Hasse diagram.....	17
Assessment of filtration properties of host rocks of uranium deposits in Kazakhstan using machine learning methods	18
Research Topics in eCommerce Fraud Detection.....	18
High Performance Computing for Big Data Clustering.....	19
Software reliability model based on syntax tree.....	20
Path Planning the flock of UAVs for precise agriculture.....	20
A gamified system programming.....	21
Real-time object detection using Yolo	21
Development of service-oriented applications in technology .NET and JAVA	22
Development of a data collection system for further analysis and forecasting of a student's personal learning track.....	23
Development of control technology for an interactive robot Meccanoid.....	23
Using replication method to increase reliability in distributed information systems	24
Development of an Information Training System Based on Cross-Platform Technologies	24
Development of an automated system for assessing the quality of the provision and organization of the educational process with distance learning technology	25
Impact of Neural Network Optimization on Accuracy and Safety of Processing	25
Time dependent reliability analysis of the data storage system based on the structure function and logic differential calculus.....	26
OLAP technology in the enterprise information structure	26
The Regulatory Framework, as a Set of Documents, United by the Sign of The Processes Provision in the System.....	27
Algorithm and structural and functional organization of the decision support system in state youth policy based on the theory of clubs.....	28
Perspectives of robotics.....	29
Waterproofing membranes reliability analysis by embedded and high-throughput deep-learning algorithm	29
Classifying socially significant news using topic modelling.....	30
Development of IoT solution for collecting disposable plastic bottles in private Kazakhstani university	30
Digital methods for processing images of noctilucent cloud fields to determine the structural and temporal parameters of the polar vortex.....	31

IT information system in management of teachers' in-service education in the aspect of reducing the gap between the best and the lagging school	32
Information entropy in the system for identifying patterns of multilingual texts ..	34
Development of a Complex of Practical Works on Programming Technology in the Android Studio Environment.....	34
Modeling and Control of Plant Growth Productivity Based on Experimental Data Under Conditions of Hydroponic Systems.....	35
Analysis of the effectiveness of using the space of cognitive modelling in historiography	36
Research Topics in eCommerce Fraud Detection.....	36
Geospatial Intelligence (GeoAI) and Explainable Machine Learning (EML) for Healthcare decision-making support	37
Methodology for teaching students programming by creating computer games....	38
Development of Structured Arguments for Assurance Case.....	41
"Smart City" technology: conception, security issues and cases.....	41

System reliability analysis and assessment by means of graph models issued from Hasse diagram

Nicolae Brinzei

CRAN - Centre de Recherche en Automatique de Nancy, Université de Lorraine, France

For system that can be described by a reliability structure function, we present an approach to assess the systems reliability relying on concepts of graph models. This approach exploits the partial order relation on the set of system components' states which is represented by the Hasse diagram. Representing the system state on the Hasse diagram, we obtain a ordered graph of system states and, so, this approach is a first step to unify the modeling of systems represented both by structure functions or stochastic processes. The monotony property of the reliability structure function of coherent systems allows us to automatically obtain this ordered graph of system states from only the knowledge of the minimal path-sets or minimal cut-sets of the system that can be obtained previously by logic differential calculus or other methods. In a first time, this approach is developed in the case of binary systems for which it gives a way to obtain a minimal disjoint form of their structure functions based on a reduction method of the ordered graph. Also, this ordered graph allows to develop an algorithm to directly obtain the analytical expression of system reliability without resorting to an intermediate Boolean polynomial. Next, this algorithm is extended to the case of non-coherent systems which no longer respect the monotony property of the structure function. Thereafter these graphs and this approach are extended to multi-state systems. The system probabilities to be in each of its progressive (perfect or degraded) operating states can be assessed using a proposed extension of the algorithm defined for binary systems, and consequently reliability of multi-state systems can be determined also. These algorithms are applied to some case studies, for both binary and multi-state systems, coherent or non-coherent, and the results compared with those computed using standard reliability block diagram or fault tree models.

Quantification of system reliability using the survival signature

Frank P.A. Coolen

Department of Mathematical Sciences, Durham University, Durham, United Kingdom

The structure function describes the functioning of a system dependent on the states of its components, and is central to theory of system reliability. The survival signature is a summary of the structure function which is sufficient to derive the system's reliability function. Since its introduction in 2012, the survival signature has received much attention in the literature, with developments on theory, computation and generalizations.

This presentation will be an introductory overview of the survival signature, including some recent developments. We will also discuss considerations and challenges for practical use of survival signatures for large systems and networks.

Making Reliability Engineering SMARTER with Computational Intelligence

Coen van Gulijk

Institute of Railway Research, University of Huddersfield, United Kingdom

Computational Intelligence has a huge potential for improving reliability of systems and the safety of systems. Promising cost savings and efficiency in practical working environments it can facilitate tremendous progress in engineering systems. But this is not just a matter of making better CI methods; it has to fit in with daily practice and add value there. This paper addresses this point by briefly discussing of a vision of digital safety delivery for the future, enterprise architecture as a means to assess the added value of tools and a fairly straightforward approach to help CI designers assess the value of their systems in the wider enterprise environment: the SMARTER mnemonic for the design of projects.

Big Accidents and Markov's Chains Based Assessment of Safety Critical IT-Systems

Vyacheslav Kharchenko

National Aerospace University "KhAI"; RPC Radiy, Kharkiv, Ukraine

Objective of the talk is to discuss the influence of Big Data Analytics (BDA), Internet of Things (IoT)) on safety and security of human and industry domains. The benefits and limitations of application of BDA and IoT technologies in safety critical systems to avoid, monitor and minimize consequences of severe accidents are analysed. Markov's chain (MC) based techniques for assessment of safety critical IT-systems (parametrization, models development and simulation results) and problems caused by complexity and accuracy are discussed. The examples of MC applications for safety critical systems (reactor trip system, accident monitoring system of NPP, IoT based health system) are considered.

New Challenges and Opportunities in Reliability Engineering of Complex Technical Systems

Antoine Rauzy

Faculty of Engineering, Norwegian University of Science and Technology, Norway

The impacts of technological transformations currently at work on reliability engineering of complex technical systems have been discussed. Transformations both in systems and in means to study them have been considered. We reviewed challenges to meet in order to manage the current technological paradigm shift. We advocate the potential benefits of the so-called model-based approach in probabilistic risk assessment. This approach has been exemplified by presenting the S2ML+X modeling technology.

Methods of reliability analysis based on logic differential calculus

Miroslav Kvassay

Faculty of Management Science and Informatics, University of Žilina, Slovakia

Logic differential calculus is a mathematical methodology developed for analysis of dynamic properties of Boolean and logic functions. This methodology can also be used in reliability analysis to analyze properties of structure function. It allows us to find situations in which a component of the system is critical for operation of the system. Based on knowledge of these situations, we can evaluate importance of the system components and identify those that have the greatest or the least influence on system operation. In this lecture, we will focus on the basic terms of reliability analysis and logic differential calculus. We will present how Boolean and logic derivatives can be computed based on the structure function and how they can be used in evaluation of importance of the system components.

Generation of Structure Function Based on Uncertain Data by Fuzzy Decision Tree

Jan Rabcan

Faculty of Management Science and Informatics, University of Žilina, Slovakia

Any system analysis requires a mathematical representation of the system. In reliability engineering, such representation is called mathematical model of the system. One of these models is the structure function. The structure function determines system performance according to the states of its components. In this paper, the new method of structure function construction is considered. The fuzzy decision tree is used to transform data about real-world system behavior to structure function. The main novelty of this method is in the handling of incompletely specified and uncertain data.

Ocean of the Redundancy for the Hyper Reliable FPGAs

Sergey F. Tyurin

Perm State University, Perm, Russia, tyurinsergfeo@yandex.ru

The reliability of Artificial Intelligence systems directly depends on the reliability of the element base. Especially if these systems operate in aggressive environments, for example, in space conditions. Currently FPGA (Field-Programmable Gate Array) is one of the most important components of intelligent systems. Single-programmable FPGAs by Microsemi Corporation have Triple Modular Redundancy (TMR) flip-flops and SRAM (Static Random Access Memory) cells. Multi-programmable FPGAs of Intel, Xilinx and others now uses Triple Modular Redundancy logic too. This is the so-called Systemic Redundancy. Further deepening of the redundancy level leads to Deep Triple Modular Redundancy at the level of individual nodes and elements. However, this type of redundancy is insufficient when the system with elements of artificial intelligence works in an extremely aggressive environment, for example, in the conditions of Venus. Therefore, recently there has been an increasing interest in redundancy at the transistor level — at the nanoscale level. In the article proposed fault tolerant FPGA's base elements – LUTs (Look up Table), SRAM cells, Flip-Flops, 3-State Buffers with the redundancy at the transistor level.

Objective: The synthesis and analysis of the fault-tolerant FPGA's base devices, simulation and evaluation of its efficiency.

COVID-19 pandemic risk analytics: Data mining with reliability engineering methods for analyzing lockdown strategies

Stefan Bracke, Alicia Puls and Lars Grams

University of Wuppertal, Germany, bracke@uni-wuppertal.de

The world is confronted with the COVID-19 pandemic since 12.2019, caused by the Coronavirus SARS-CoV-2. The COVID-19 pandemic with its incredible speed of spread shows the vulnerability of a networked world. First months of pandemic were characterized by heavy burden and severe restrictions on public life within a lot of countries, like local or comprehensive lockdowns. The goal of the presented research study is the analysis of the development of infection occurrence in the early COVID-19 pandemic time period (12.2019 – 08.2020), using reliability engineering methods like Weibull models, Verhulst saturation model and significance tests. A brief introduction gives an overview regarding the data quality and the impact on uncertainty. The focus of the research study is the analysis of the COVID-19 spreading behavior with respect to the time periods “first wave” (before/after lockdown) and “second wave” (07.2020). These topics are discussed based on the data sets of China (province Hubei), Italy, Germany, France and New Zealand, considering different lockdown strategies.

Minimal Filtering Algorithms for Convolutional Neural Networks

Aleksandr Cariow and Galina Cariowa

West Pomeranian University of Technology Szczecin, Poland, acariow@wi.zut.edu.pl

In this paper, we present several resource-efficient algorithmic solutions regarding the fully parallel hardware implementation of the basic filtering operation performed in the convolutional layers of convolution neural networks. In fact, these basic operations calculate two inner products of neighbouring vectors formed by a sliding time window from the current data stream with an impulse response of the M-tap finite impulse response filter. We used Winograd's minimal filtering trick and applied it to develop fully parallel hardware-oriented algorithms for implementing the basic filtering operation for M= 3, 5, 7, 9, and 11. A fully parallel hardware implementation of the proposed algorithms in each case gives approximately 30% savings in the number of embedded multipliers compared to a fully parallel hardware implementation of the naive calculation methods.

Method for determining the structural reliability of a network based on a hyperconverged architecture

Igor Ruban^a, Heorhii Kuchuk^b, Andriy Kovalenko^a, Nataliia Lukova-Chuiko^c and Vitalii Martovytskyi^a

^a) Kharkiv National University of Radio Electronics, Ukraine, ihor.ruban@nure.ua, andriy_kovalenko@yahoo.com

^b) National Technical University "Kharkiv Polytechnic Institute", Ukraine, kuchuk56@ukr.net

^c) Taras Shevchenko National University of Kyiv, Ukraine, lukova@ukr.net

The features of a network operation, which is based on a hyperconverged architecture, are considered. A hierarchical graph is built, isomorphic to the network structure, in which the network hypervisor is the center. The graph vertices are stratified depending on the length of the path to the center. Sets of graph branches are constructed for each level of stratification. Utilization rates for the nodes and branches of the graph are calculated. On their basis, the level of network operation quality is determined, depending on the availability of workable branches and the reliability of the nodes and communication channels. Logical functions are constructed that describe the performance of the branches. To obtain a scalar indicator of the structural reliability of a network, the distribution of a discrete random variable of the number of operable branches is considered. An iterative algorithm for obtaining its numerical characteristics is proposed. The algorithm is based on finding the generating polynomial of the distribution. The mathematical expectation of a given random variable is chosen as an indicator of the structural reliability of the network. The analysis of the results of the structural reliability calculation for a network based on a hyperconverged architecture, depending on the functional redundancy, the number of levels of stratification, the degree of system complexity is performed.

Assessment of upraising risks within product fleets in use: The influence and interdependencies of the Weibull threshold parameter

Stefan Bracke and Alicia Puls

University of Wuppertal, Germany, bracke@uni-wuppertal.de

Risk analytics of product fleets in the use phase are based on life span distribution models. The use of a Weibull distribution model for calculation of failure probabilities is common in reliability analytics: The problem is the scatter ranges of the estimated Weibull parameters threshold t_0 , characteristic life span T and shape b , which depend on the underlying data base. The estimation of confidence intervals is obligatory, but methods for the calculation of the threshold parameter scatter range are very rare. However the impact of the threshold scatter behaviour on risk analytics is high, e.g. planning of field campaigns or maintenance packages. This paper shows an empirical study regarding the threshold scatter behaviour in comparison to general approaches in literature. Furthermore, the interdependencies of threshold, characteristic life span and shape parameter are shown. The overarching goal is the reduction of uncertainty regarding the begin of an uprising risk in a product fleet in the use phase, based on Weibull analytics.

Network of autonomous units for the complex technological objects reliable monitoring

Oleksandr Chemerys^a, Oleksandr Bushma^b, Oksana Lytvyn^b, Alexei Belotserkovsky^c and Pavel Lukashevich^c

^a) Pukhov Institute for Modelling in Energy Engineering National Academy of Sciences of Ukraine, Kiev, Ukraine, a.a.chemeris@gmail.com

^b) Borys Grinchenko Kyiv University, Ukraine, a.bushma@ukr.net

^c) United Institute of Informatics Problems of the National Academy of Sciences of Belarus, Minsk, Belarus, alex.belot@gmail.com

Autonomous and remote monitoring and control systems are necessary to ensure the smooth operation of complex technological objects and systems for various purposes (agriculture; the concept of a "smart" enterprise and city; environmental protection, etc.), as well as to make operational technological or management decisions.

The use of a network of automatically interacting autonomous devices (the concepts of the Internet of Things and the Industrial Internet of Things, IoT and IIoT, respectively) in such systems allows solving several problems such as increasing the quality of situation assessment, system performance, scalability, reliability, and energy efficiency.

Thereby, the paper goal is to show a new concept for the development of a multi-level architecture of an IoT network for monitoring the state of geographically distributed technological objects, consisting of a heterogeneous set of nodes (stationary and mobile) equipped with various sensors and video cameras.

Neural Network Training Acceleration by Weight Standardization in Segmentation of Electronic Commerce Images

Viktorina Sorokina and Sergey Ablameyko

Belarusian State University, Minsk, Belarus, viktorina.sorokina.96@gmail.com

Over the past few years, the segmentation research has witnessed rapid progress. However, existing approaches suggest either the models requested non-trivial computations that are unable to achieve real-time speed, or real-time models that could not achieve greater accuracy. In this paper, the usage of weight standardization in segmentation of electronic commerce images, the main idea of which is neural network training acceleration, is proposed. This approach is based on the usage of YOLACT (real-time convolutional neural network for solving the image segmentation task) that is modified by weight standardization.

It was shown that the use of weight standardization gives a significant improvement in metrics training with micro-batches that is typical for solving the segmentation task. Compared to training the classical YOLACT network, usage of weight standardization gives an improvement of 3% for classification problem, 4% for the object detection problem and 3% for the segmentation problem.

The demonstrated method could be applied to other neural network architectures, and also used for YOLACT when increasing the size of the input image and, as a result, the output mask.

We propose the usage of weight standardization in segmentation of electronic commerce images, the main idea of which is neural network training acceleration. The aim of weight standardization is micro-batch training which is characterized by 1-2 images per GPU that makes it possible to obtain the results comparable to or superior to those received during training with batch normalization.

Energy Efficiency for IoT

Andriy Luntovskyy^a and Bohdan Shubyn^b

^a) BA Dresden University of Coop. Education, Saxon Study Academy, Germany,
andriy.luntovskyy@ba-dresden.de

^b) Lviv Polytechnic National University, Ukraine, boshubin@gmail.com

The given paper is aimed to investigation of the energy efficiency issues for IoT solutions, based on combined sensor and contactless systems. The combined energy-efficient solutions are namely the hierarchical organized infrastructure WSNs and self-organized ad-hoc WSNs, which are widely interoperable with the 4G/5G base stations and micro-cells, the backboned Wi-Fi access points as well as with inexpensive and energy-efficient RFID/ NFC reader farms.

In regard to provide the energy-efficient WSN protocols, an holistic multi-layered approach is used, which is based on Low-Duty-Cycle-Principle, energy-harvesting, LEACH Clustering and topology optimization, efficient OS and software frameworks, enabling data reduction.

Knowledge-based multispectral remote sensing imagery superresolution

Sergey Stankevich, Nick Lubskyi, Iryna Piestova and Artur Lysenko

Scientific Centre for Aerospace Research of the Earth, National Academy of Sciences of Ukraine, Kyiv, st@casre.kiev.ua, nickolo1990@gmail.com, pestovai@ukr.net, lysenko@casre.kiev.ua

Software techniques for remotely sensed imagery superresolution enhance data reliability and veracity. The most common approach for superresolution is the processing of a few images of the same scene captured simultaneously with subpixel shift relatively each other. These conditions exclude radiometric inconsistency between images, and subpixel shift allow extracting additional land surface details. General superresolution approach can be adopted to multispectral remote sensing imagery registered in different spectral bands. In this case, the intrinsic radiometric inconsistency can be overpassed by translating the input band images into some additional virtual one, joint for all inputs. Typically, such additional band overlaps all input ones in the spectrum. Necessary knowledge for bands translation are all bands spectral responses, as well as the subpixel shifts between restored images. So, the spectral radiance for the new spectral band is estimated. Therefore, each input band image transforms into new images in the same spectral range. Obtained images are appropriate for any existing superresolution techniques, for example, using Gaussian regularization.

The superresolution technique based on multiple imagery registered in different spectral ranges processing using band spectral translating has been proposed. Each input band image transforms into new images in the same spectral range. Necessary knowledge for bands translation are all bands spectral responses, as well as the subpixel shifts between restored images. Obtained images are appropriate for any existing superresolution techniques.

Generation of Structure Function Based on Uncertain Data by Fuzzy Decision Tree

Jan Rabcan and Elena Zaitseva

University of Žilina, Slovakia, jan.rabcan@fri.uniza.sk

Any system analysis requires a mathematical representation of the system. In reliability engineering, such representation is called mathematical model of the system. One of these models is the structure function. The structure function determines system performance according to the states of its components. In this paper, the new method of structure function construction is considered. The fuzzy decision tree is used to transform data about real-world system behaviour to structure function. The main novelty of this method is in the handling of incompletely specified and uncertain data.

Unavailability Optimization of a System Undergoing a Real Ageing Process under Failure Based PM

Radim Briš and Pavel Jahoda

VSB - Technical University of Ostrava, Czech Republic, radim.bris@vsb.cz

This article deals with the exploration of the system, which acts on demand in case of emergency matter. To verify functionality the system must be regularly inspected with a given period and tested to find latent failures. A failure-based preventive maintenance is considered, in context with the imperfect corrective maintenance model. This means that preventive maintenance brings full renewal which is realized after a prescribed number of failures. If a failure occurs, it is detected during the first follow-up inspection and the restoration process starts. The imperfect corrective maintenance model is intended where each restoration deteriorates the system lifetime whose probability distribution is gradually changed via step by step rising failure rate. Reliability mathematics for unavailability analysis is briefly outlined in this paper. The new renewal process model, including the failure-based preventive maintenance, has been designated here as a real ageing process. The imperfect corrective maintenance as well as increasing period between inspections result in undesired rise of unavailability which can be corrected by the properly selected failure based preventive maintenance. This optimization process is demonstrated on a selected system adopted from references.

Radar data product super resolution under parameter variation

Sergey Stankevich, Iryna Piestova and Artur Lysenko

Scientific Centre for Aerospace Research of the Earth, National Academy of Sciences of Ukraine
Kyiv, Ukraine, st@casre.kiev.ua, pestovai@ukr.net, lysenko@casre.kiev.ua

The spatial resolution of radar images and their derived data products is very important in radar remote sensing applications. We have previously proposed a physically constrained model for dual-polarization radar data super-resolution using the land surface dielectric permittivity data. The problem is the model adjusting with the land surface statistical characteristics – both granularity and correlation radius – that can vary for different land cover types. Now we propose the following technique: First, the unsupervised land cover classification using radar data. To improve the classification accuracy, additional radar-derived data are used, such as polarization ratios, polarization coherence distributions, GLCM statistics, etc. Then, an iterative calculation of the land surface dielectric permittivity is performed within each of the land cover classes for two polarizations separately to provide the obtained values as close as possible. The granularity/correlation radius is used as a control parameter. Next, a table of the land cover classes characteristics is formed, which is used to calculate the distributions of the dielectric permittivity for two polarizations. Last, the superresolution of the obtained pair of subpixel-shifted images is carried out using any of the known methods.

A correlative method to ranking sensors via information reliability criterion: interval-valued numbers case

Mykhailo Popov^a, Oleksandr Zaitsev^b, Ruslana Stambirska^b, Oleksandr Kondratov^c
and Sofia Alpert^a

^a) Scientific Centre for Aerospace Research of the Earth, National Academy of Sciences of Ukraine, Kyiv, Ukraine, mpopov@casre.kiev.ua, sonyasonet87@gmail.com

^b) Military Diplomatic Academy named Evgen Bereznyak, Kyiv, Ukraine a.zaysev@gmail.com, rusya.stamb@gmail.com

^c) Scientific Research Institute, Kyiv, Ukraine, col.kondratov@gmail.com

Every year multisensor systems are increasingly used to obtain information when solving problems of investigating incidents and incidents, risk assessment, etc. However, as the complexity of the tasks being solved grows, the volume of data grows too, what leads to the well-known Big Data problem. One of the ways to overcome existing difficulties is to expand the functionality of sensors, but this requires knowledge of the information reliability of sensors. The paper proposes a method to ranking sensors via information reliability criterion, which is based on the idea that the information reliability of any sensor can be calculated based on estimates of the proximity of its data to the data of other sensors.

To assess the information reliability of the sensors, it is proposed to use the correlation approach, at that the case is considered when the data has the form of interval-valued numbers. The developed method makes it possible to determine the information reliability of the sensors in an ordinal scale. To facilitate the practical application of the developed method, a numerical example is given.

Topic-wise sentiment analysis of Kazakhstani news articles

Iskander Akhmetov and Rustam Mussabayev

Institute of Information and Computational Technologies, Satbayev University, Almaty, Kazakhstan, iskander.akhmetov@gmail.com, rmusab@gmail.com

This work was devoted to the topic-wise sentiment analysis problem, which is thought to bring more accurate results than sentiment analysis performed without paying attention to the topic mix of the documents. Experiments were run on three sets of data: (1). Kazakhstani news aggregator articles scraped from Tengrinews.kz (~200K articles) – used for training the topic classification model as the urls of the articles contained category names. (2). Kaggle competition sentiment analysis corpus (8,3L articles labeled for sentiment). (3). KZ News corpus – Institute of Information and Computation Technologies dataset with expert sentiment labeled news articles' texts.

The algorithms applied were Random forest and Convolutional Neural network. The best sentiment analysis results were achieved on KZ News corpus subset of kz news using the CNN model. Generally the hypothesis of more accurate results with topic wise sentiment analysis is worth further research with a larger dataset labeled for sentiment.

Hybrid approach to classification of remote sensing data

Artem Andreiev

Scientific Centre for Aerospace Research of the Earth, National Academy of Sciences of Ukraine,
Kyiv, Ukraine, artem.a.andreev@gmail.com

Remote sensing engages two well-known approaches for data classifying: supervised and unsupervised ones. Supervised classification requires training samples of classes selected by an expert. However, those classes, as a rule, are subjective as well as selected training samples are not accurate. On the other hand, unsupervised classification needs no training samples and forms objective clusters. The disadvantage of the unsupervised approach is that formed clusters, unlike the training samples selected by an expert, could not be interpreted reasonably. A hybrid approach to classification is developed to solve the problem described above.

The proposed approach to classification consists of three steps: 1) subdividing training samples of expert-selected classes into objective subclusters by unsupervised classification; 2) performing supervised classification of remote sensing data using subdivided training samples; 3) merging obtained subclasses into the expert-selected classes. This approach reduces the inaccuracy and subjectiveness of selected samples. Therefore, it increases the final classification accuracy in comparison with both of the mentioned types of classification.

Systems reliability analysis and assessment by means of logical differential calculus and Hasse diagram

Nicolae Brinzei^a, Jean-François Aubry^a, Miroslav Kvassay^b and Elena Zaitseva^b

^{a)} University of Lorraine, Nancy, France, nicolae.brinzei@univ-lorraine.fr, jean-francois.aubry@univ-lorraine.fr

^{b)} University of Žilina, Slovakia, miroslav.kvassay@fri.uniza.sk

The aim of this research work concerns the development of an integrated approach based on logical differential calculus and Hasse diagram. Logical differential calculus is a powerful mathematical tool that allow to determine the minimal path/cut sets of systems represented by Boolean structure functions. Minimal path/cut sets are important in reliability analysis because they describe the minimal component configurations in which the system operates or fails. Hasse diagram is a mathematical diagram allowing the representation of the partially order between the system states. It has the advantage of unifying in the same kind of model (graph describing the state diagram) the modeling of systems represented both by Boolean structure functions or stochastic processes. Such state diagram can be generated automatically from minimal path-sets obtained previously by logical differential calculus. Afterwards, the analytical expression of system reliability is computed from this state diagram.

Assessment of filtration properties of host rocks of uranium deposits in Kazakhstan using machine learning methods

Yan Kuchin, Ravil Mukhamediev and Kirill Yakunin,

Institute of Information and Computational Technologies, Satbayev University, Almaty, Kazakhstan, ykuchin@mail.ru

When uranium is mined by in-situ leaching, the filtration properties of the host rocks are a key parameter that determines not only profitability, but also the very possibility of mining. The methodology which is currently accepted in Kazakhstan is based on one parameter (apparent resistance) and often does not provide the required accuracy, especially for acidified blocks, where the resistance is underestimated due to the action of acid. The authors proposed a model based on machine learning, which assumes the construction of a regression based on all available geophysical data. The proposed model showed, on a small dataset, results that are in better agreement with the actual data obtained during the exploration stage compared to the existing methodology. In addition, a set of regressors for different sets of input data will make it possible to correctly evaluate the filtration properties of the host rocks in cases of rejection of certain types of logging or their distortion due to the action of acid.

Research Topics in eCommerce Fraud Detection

Akylbek Zhumabayev

Satbayev University, Almaty, Kazakhstan, akylbekz@gmail.com

The article examines the problem of bank card fraudulent transactions in electronic payment systems (eCommerce). The main approaches and requirements for detecting and preventing unauthorized financial operations are analyzed.

Overall, the global level of fraud in e-Commerce systems was 3.80% in 2016 and 4.09% in 2017, according to Signified Global Fraud Index. Despite the significant achievements in the protection of financial transactions and the availability of advanced systems for detecting unauthorized actions, the increase in fraud is explained by the following factors: the development of new types of services in the financial technologies industry and the constant improvement of fraud instruments by attackers.

The methods of fraud monitoring systems can be divided into two major groups. The first group includes systems that rely on clear rules for verifying transaction characteristics (rule-based systems). The second group includes systems that analyze customer behavior (deep learning systems).

The topics of the study are: (a) Algorithms ensembling from both groups. (b) Dataset preparation to train algorithms. (c) The interpretability problem of algorithms.

High Performance Computing for Big Data Clustering

Rustam Mussabayev^a, Nenad Mladenovic^b and Alexander Krassovitskiy^a

^a) Institute of Information and Computational Technologies, Satbayev University, Almaty, Kazakhstan, rmusab@gmail.com

^b) Khalifa University, United Arab Emirates, nenad.mladenovic@ku.ac.ae

Flaky Clustering Library (Minimum Sum-Of-Squares Clustering) is the power tool for BigData Clustering using High Performance Computing and advanced global optimization approaches like Variable Neighbourhood Search (VNS). Flaky Clustering Library is freely available: <https://github.com/R-Mussabayev/flakylib>. Different use cases and tutorials can be found in the following Jupyter Notebook: https://github.com/R-Mussabayev/flakylib/blob/master/flakylib_demo.ipynb

Clustering is one of the main methods for getting insight on the underlying nature and structure of data in unsupervised way. The purpose of clustering is organizing a set of data into clusters, such that the elements in each cluster are similar and different from those in other clusters.

K-means is one of the most used and fastest clustering algorithms. Actually, in nowadays K-means represents a big family of algorithms aimed to solving Minimum Sum-of-Square Clustering problem. FlakyLib is a Python library of K-means algorithm family optimized for Big Data clustering. Most of the algorithms in the FlakyLib are parallelized and optimized for high-performance computing with Numba, which translates Python functions to optimized machine code at runtime using the industry-standard LLVM compiler library. All FlakyLib algorithms are aimed to solving Minimum Sum-Of-Squares Clustering problem.

In solving large size problems, there are two major drawbacks of standard K-means technique: (i) since it has to process the Large/Big input dataset, it has heavy computational costs and (ii) it has a tendency to converge to one of the local minima of poor quality. In order to reduce the computational complexity, we collect a clustering techniques that utilize parallelization, memory and computational optimizations. To avoid the local minima convergence problem the different Variable Neighbourhood Search (VNS) techniques was used. Using FlakyLib it is possible to clusterize a tens/hundreds of millions of entities in a reasonable amount of time with efficient memory usage.

In most of the cases the naive K-means algorithm is not provide the best possible solution getting stuck in the nearest pit of local minimum. But using different VNS-based approaches (metaheuristics) it is possible to force K-means moving forward and on every iteration increasing solution quality. VNS allow us to transform the local search algorithms (like naive K-means) to global ones.

Software reliability model based on syntax tree

Peter Sedlacek

Faculty of Management and Informatics, University of Žilina, Slovakia,
peter.sedlacek@fri.uniza.sk

In this paper new model for software reliability is suggested. There are several software reliability models, however most of them cannot be used for analysis of system components, such as importance measures calculation. Therefore new model was proposed. The creation of this model is based on source code, that is in the next step used to generate syntax tree. Syntax tree is a hierarchical representation of the given source code, that is independent on programming language. This tree is then used to create reliability model, in this case fault tree. The process of creating reliability model from source code is demonstrated in this paper. The created reliability model can be then used to calculate system characteristics, such as importance measures. The main advantage of suggested model is the possibility to use traditional methods for system evaluation such as logic differential calculus. However this model has also several disadvantages, for example its large dimension.

Path Planning the flock of UAVs for precise agriculture.

Ravil Mukhamediev, Yan Kuchin, Ilyas Assanov, Kirill Yakunin, Sanzhar Murzakhmetov, Maryam Ospanova and Marina Yelis

Institute of Information and Computational Technologies, Satbayev University, Almaty, Kazakhstan, ravil.muhamedyev@gmail.com, assanov.z@gmail.com yakunin.k@mail.ru, sanzharmrz@gmail.com, maryam.ospanova@gmail.com, k.marina92@gmail.com

In this study, we propose an algorithm for a precision agriculture spraying. The flock of UAVs can spray custom areas effectively. For controlling the flock, we use a ground station placed on a transport car. The car moves along the road next to the field, we are generating a different number of stops for the car with equal distances in between. Another waypoint we generate by placing them on the field with equal distance, that distance depends on the width of UAV spraying. For solving this problem we use back-and-forth/zamboni (Zamboni refers to the machines that repair the ice in hockey arenas) [1]. Furthermore our approach includes additional paths for recharging UAV and individual parameters for each drone (battery capability, velocity, carrying capacity). Algorithm calculates optimal path for spraying field (waypoints on field) and recharging UAVs (car stops). The goal is to minimize fly time for the flock and make precise spraying for the field. In addition, we tried to solve this problem using GA. Simulation results of both methods are presented in the report.

[1]. Cabreira, Taua & Brisolara, Lisane & Ferreira Jr, Paulo. (2019). Survey on Coverage Path Planning with Unmanned Aerial Vehicles. Drones. 3.4.10.3390/drones3010004.

A gamified system programming

Vladimir Kulikov and Saduakas Baizhumanov

M. Kozybayev North Kazakhstan State University, Petropavlovsk, Kazakhstan,
qwertyrant@mail.kz, b_saduakas@mail.ru

Gamification is used in a wide variety of fields, including marketing, healthcare, human resources management, training, and others. Gamification is an interdisciplinary concept that encompasses a range of theoretical and empirical knowledge. Gamification tools that are used to manage the system, which can include common elements that are used in many games, such as points, ratings, time limits, badges, rewards, and others. One of the main goals of gamification is the ability to attract attention, motivate participants, and get them to perform the desired activity.

The introduction of game elements in the learning process allows students to motivate themselves to master the material.

In this study, gamification is considered as a technology for managing a programming training system. This technology is used to encourage motivation, friendly competition, and collaboration in learning a programming language.

This paper reviews research on the use of gamification technology. Study of the stability of subjects' involvement as a result of information management of the game situation. A system management model is developed using gamification elements.

The result of the research is methodological recommendations for building a gamification system in programming and an effective management mechanism.

Real-time object detection using Yolo

Maryam Ospanova and Marina Yelis

Satbayev University, Almaty, Kazakhstan, maryam.ospanova@gmail.com

The goal of this workshop was to test the effectiveness of using the Yolo algorithm to recognize instances of the specified classes in real time. The task is one of the main ones in the field of computer vision and deep machine learning and involves determining the existence, location, and classification of objects in a given image or video stream. YOLO is a state-of-the-art algorithm. Compared to other algorithms, it considers object detection as a single regression problem. Therefore, the speed of a base YOLO model to detect images in real-time is estimated at 45 frames per second. To work with Keras and Tensorflow deep learning libraries we convert the weights of the pre-trained model – DarkNet data MSCOCO, which includes more than 200,000 marked images, 80 classes of objects of everyday scenes. Real time image data is supplied by videostream obtained via a webcam. As a result, the program predicts bounding boxes and class probabilities directly from full images in one evaluation.

Development of service-oriented applications in technology .NET and JAVA

Shopan Bahytova and Gaukhar Kamalova

Higher School of Information Technologies of the Institute of Economics, Information Technologies and Professional Education of Zhangirkhan West Kazakhstan Agrarian Technical University, Uralsk, Republic of Kazakhstan, bahytova0806@mail.ru, gokhakam@gmail.com

Currently, due to the rapid spread of mobile devices, mobile applications that perform a wide variety of work are very relevant. Mobile apps are mainly designed to interact with a corporate database. The easiest way to organize such interaction is to use a web service and the Internet for message transport. When developing mobile applications, as practice shows, preliminary modeling is very important, which allows you to evaluate both architectural solutions and features of the mobile application functioning in real conditions.

The purpose of this work is to improve the efficiency of developing web services and systems focused on the use of web services, based on the study of existing methods and software tools for development and modeling used in the composition of web services and creating mobile applications.

There are two types of developing web services "top - down"-service development, starting with its interface, and "bottom-up", starting with program development, or based on existing software components. When developing a web service using a top-down types, first of all, you need to develop a WSDL description, then implement the service in some programming language. At the same time, it is important that the implementation exactly corresponds to the declared interface. Modern development tools, such as NetBeans and Eclipse, allow the WSDL description of web services to create a so-called "skeleton" (skeleton) - the basis for future implementation, on which the programmer must build "muscles" by adding the necessary functionality to class methods. In the "bottom-up" types, first of all, a software component is implemented that carries the functionality of the web service. Then, using a ready-made implementation and modern development tools, automatically generate a WSDL description of the web service.

Development of a data collection system for further analysis and forecasting of a student's personal learning track

Alibek Abdurazakov

Institute of Information and Computational Technologies, Satbayev University, Almaty, Kazakhstan, abdurazakov.alibek13@gmail.com

Today, adaptive learning is one of the most promising areas for the development of distance learning. Adaptive learning systems are systems that take into account the individual characteristics of the learner, on the basis of which algorithms build personalized learning paths. One of the main problems for implementing such systems is getting information about the learners. In existing adaptive learning systems, data is collected through multiple choice questions, where the probability of guessing the answer depends on the number of suggested answers. The purpose of this work is to develop a system that can be used to minimize or even eliminate guessing answers and get real information about the learner's knowledge.

Development of control technology for an interactive robot Meccanoid

Iliyas Asylgali and Oksana Nass

Higher School of Information Technologies of the West Kazakhstan Agrarian Technical University named after Zhangirkhan; Uralsk, Republic of Kazakhstan, nass55@mail.ru

The current stage in the development of society is characterized by the increasing importance of robotic devices. Therefore, the relevance of the research topic is determined by the need to prepare students for life in a high-tech robotic world. The object of research is an interactive robot based on the Meccanoid G15ks constructor. The French firm Meccano produces two constructors of android robots. This is a large, as tall as a first grader, model Meccanoid G15KS and smaller Meccanoid G15, as tall as a kindergarten pupil. During the research, was used model Meccanoid G15KS. The research process, the following work was carried out: assembly of the robot from the parts of the Meccanoid G15ks; study of the modes of its operation; the following technologies were prepared for controlling the movement of the robot using voice commands: movement forward, backward; walk with a robot; tell a joke; high five; dance; show kung fu and more. Technologies for voice control of the robot were prepared in the form of methodological instructions, which were tested by students of the Zhangir Khan WKATU.

The dissertation work and its materials were reported at the meetings of the department, received approval and posted on the global Internet (<https://www.instagram.com/p/B3uHpKollnc/?igshid=pjlmcpyhzzlx>).

The theoretical and methodological basis of the master's thesis was made up of scientific works of Kazakhstani and foreign scientists, information materials published on the global Internet on the theory and practice of creating and programming robotic devices.

Using replication method to increase reliability in distributed information systems

Roman Čerešňák and Karol Matiasko

Faculty of Management and Informatics, University of Žilina, Slovakia,
ceresnakroman@gmail.com, karol.matiasko@fri.uniza.sk

Nowadays, data replication plays a key role, while increasing system reliability. A huge amount of the data entering the system has to be protected, not only while processing but also while storing the data. Since distributed processing happens in many cases, while processing the data, and the data are placed on various calculation knots, it is necessary to ensure in the case of an error respectively a calculation unit outage, the data loss will not happen, even in the case of a hardware error. This article describes a method based on a reliability index helping us to determine a replication coefficient. Right, on the replication coefficient basis, we can reduce the amount of unimportant data and thus to reduce not only the size of a place taken on the disk but also effectively reduce the calculation complexity of the process.

Development of an Information Training System Based on Cross-Platform Technologies

Saule Akimova

Higher School of Information Technologies of the Institute of Economics, Information Technologies and Professional Education of Zhangirkhan West Kazakhstan Agrarian Technical University, Uralsk, Republic of Kazakhstan, saule_akim@mail.ru

The mobile app market has shown unique growth over the past 3-5 years, creating a constantly growing demand among end users not only in the field of public administration, trade, financial structures, but also in the field of educational services. There is a demand for information training systems that run on various mobile platforms and operating systems. Cross-platform technologies allow you to create a single universal mobile application project for various mobile platforms and operating systems.

In this aspect, the development of a cross-platform information training system is relevant. The aim of the study was to develop a cross-platform application in support of the educational process. The scientific novelty of the research work is that it will analyze existing approaches to solving the problem of creating cross-platform applications, and offer an original application architecture that provides for the creation of mobile and desktop cross-platform applications. The object of the research is a cross-platform development technology based on Xamarin, which allows developing cross-platform applications in the MS Visual Studio environment in C#. Xamarin is an open source platform designed to build modern, high — performance applications for iOS, Android, and Windows with .NET.

Expected result: will be developed a conceptual model of the information training system, based on which will be created a prototype of a cross-platform application, and the application will be tested on various mobile platforms.

Development of an automated system for assessing the quality of the provision and organization of the educational process with distance learning technology

Evgeniya Kukharenko and Anna Shaporeva

M. Kozybayev North Kazakhstan State University, Petropavlovsk, Kazakhstan

Currently, in the context of the modern education reform, the interest of specialists in the problems of education as a social institution, as a public and personal benefit of a special type, in understanding the activities of various subjects of the educational sphere, in interdisciplinary discussion of the prospects for modernizing the national educational system has grown significantly.

The prospect of forming a multi-level integrated continuing education as a whole, a single educational space is currently an urgent task for educational institutions of any type. For the effective management of the educational complexes required the integration of different educational institutions and departments. The effectiveness of the formation and functioning of such integration systems is achieved by linking the content of education and coordinating activities, which will improve the quality of General cultural, humanitarian, fundamental and socio-economic training, and expand the freedom of choice for applicants in determining the individual sequence in education.

A special place in the formation of multi-level integrated continuing education as a whole, a single educational space is occupied by the use of distance learning technology, as the most accessible and least expensive for universities.

It is important to consider the interaction of the educational environment and the student in the educational space, to consider their connections and contradictions that give rise to issues of quality assurance and organization of the educational process.

Impact of Neural Network Optimization on Accuracy and Safety of Processing

Martin Lukac and Kamila Abdiyeva

Nazarbayev University, Nur-Sultan, Kazakhstan, (martin.lukac, kamila.abdiyeva)@nu.edu.kz

Convolutional neural networks are very efficient feature extractors. The main problem however is that CNN is difficult to interpret and the decision making is hard to explain. Therefore their performance cannot be verified or guaranteed contrary to approaches that are using engineered features. We study the problem of neural networks from the point of view of how compression and optimization opens CNNs to security vulnerabilities. In particular, we determine how an optimized and pruned network is more sensitive to perturbations of individual filters. We also show how a pruning introduces instability in the learning by increasing the classification confusion.

Time dependent reliability analysis of the data storage system based on the structure function and logic differential calculus

Patrik Rusnak and Michal Mrena

Faculty of Management and Informatics, University of Žilina, Slovakia,
patrik.rusnak@fri.uniza.sk, michal.mrena@stud.uniza.sk

Nowadays, the data storage system is an integral part of our lives. Therefore, the main focus is in making this system reliable and accessible at all times. Reliability analysis of such system provides insight into the components and topological parts of the system, in which a system is most vulnerable. Several approaches can be chosen to represent the system, one of the most used ins known as the structure function. This approach allows us to represent a system of any complexity and also allows us to use the tools of logic algebra such as logic differential calculus. The aim of this work is to show the use of logic differential calculus and structure function for the calculation of the time-dependent importance measures for components in the time-dependent reliability analysis of the selected data storage system. After the computation of all importance measures, the problem areas of the data storage will be identified from a reliability point of view.

OLAP technology in the enterprise information structure

Ainura Gumarova and Gaukhar Kamalova

West Kazakhstan Agrarian Technical University named after Zhanqir Khan, Uralsk, Republic of Kazakhstan, g_ainura_91@mail.ru, gokhakam@gmail.com

Enterprise information systems contain applications designed for complex analysis of data, their dynamics, trends, etc. To make any management decision, you must have the necessary information. To do this, you need to collect this data from all the information systems of the enterprise, bring it to a common format, and then analyze it.

The purpose of the work is to develop an information system using a multidimensional database to improve the efficiency of data processing and analysis by sharing existing information resources of the institution with new information systems.

This paper describes a solution to the problem of analyzing large amounts of data using OLAP technology. The purpose of data warehouses is to provide users with information for statistical analysis and management decision — making. Data warehouses provide high-speed data acquisition, the ability to obtain and compare so-called data slices, as well as consistency, completeness and reliability of data. OLAP is a key Component of building and applying data warehouses. This technology is based on the construction of multidimensional data sets — OLAP cubes, whose axes contain parameters, and cells-aggregate data that depends on them. Applications with OLAP functionality provide the user with analysis results in an acceptable time, performs logical and statistical analysis, supports multi-user access to data, performs a multidimensional conceptual representation of data, and has the ability to access any necessary information. It also discusses the basic principles of logical organization of OLAP cubes, their main terms and concepts used in multidimensional analysis. As a result, we determine what different types of hierarchies are in the dimensions of OLAP cubes.

The Regulatory Framework, as a Set of Documents, United by the Sign of The Processes Provision in the System

Eugenia Kuharenko and Gulmira Ospanova

M.Kozybayev North Kazakhstan University, Petropavlovsk, Kazakhstan, genylapteva@mail.ru,
ospanova.19@mail.ru

The regulatory framework is characterized by the depth and breadth of documents which regulate the processes in the system. The depth of the regulatory framework is measured by the variability of the documentation for the maintenance of distinguishable processes, the breadth - by the provision of all processes with regulatory and regulatory documents. Thus, the regulatory framework should be strategically focused on the formation and development of the management system and ensuring the successful course of processes in the system.

Based on this, we will consider the regulatory framework as a set of documents united by the sign of ensuring the processes in the system and giving the system the property of controllability. The level of complexity of the regulatory framework determines the number of documents in it, their hierarchical structure, interconnectedness and subordination.

The regulatory framework can be formed in full and enlarged versions - to group documents by types of processes, purpose, strategic management, direction on a specific group of subsystems. The formation of an enlarged version of the regulatory framework means its structuring, which increases the coefficient of controllability and systematization in order to detect errors.

The main indicators of the quality of the regulatory framework are its structure, completeness, depth, determinism and renewability. These indicators are considered in a comprehensive manner and represent an integral system of indicators used in the processes of making management decisions to control the quality of the regulatory framework.

By the structure of the regulatory framework we mean the proportion of certain sets of documents to their total number. Thus, documents grouped according to certain criteria represent a more structured regulatory framework in the case of their small share in the total number. For example, a group of documents with a fraction of 0.5 is a poorly structured regulatory framework due to their location in it according to the principle of relational algebra - the absence of hierarchy and grouping. As a result, a poorly structured regulatory framework is also a system with low levels of manageability.

The breadth of the regulatory framework will be expressed by the ratio of the number of document groups at the time of its determination in the total number of process groups. That is, the latitude sets the provision of regulatory documents for all processes of the system. A latitude value less than 1 means that there are no document groups for some of the processes defined by the process group.

The completeness of the regulatory framework is set by the compliance of the actual availability of documents with the developed list of regulatory documents. In order to determine the completeness, the ratio of the actual number of documents

to the number of documents provided to ensure all processes of the system is revealed.

The depth of the regulatory framework is considered as the number of varieties of documents by areas of activity in the system and processes in it. The ratio of the actual number of documents for a group of processes and the regulated number of documents for each group sets a numerical characteristic of the depth of the regulatory framework.

The parameter «determinism of the regulatory framework» can be characterized as the ability of the regulatory framework to support and regulate all processes of the system at any given time. Violations of the determinism property of the regulatory framework lead to the inability of the system to regulate the processes and, as a consequence, to the violation of the controllability of the system. The coefficient of determinism can be defined as the ratio of the total number of missing or not meeting the integrity requirement at the time of monitoring documents to the regulated number of documents.

The renewability of the regulatory framework is characterized by the share of new documents in the average number of documents in the regulatory framework. This indicator determines the share of newly introduced documents and is a parameter characterizing the stability of the entire system as a whole, since the introduction of new documents demonstrates the emergence of new processes in the system.

Algorithm and structural and functional organization of the decision support system in state youth policy based on the theory of clubs

Vladimir Kulikov and Elnar Utyubaev

M. Kozybayev North Kazakhstan State University, Petropavlovsk, Kazakhstan

The purpose of this study is the possibility of applying the theory of clubs in state youth policy and building a mathematical model that will allow studying it as an integral system. Young people are the most active and progressive part of society. In sufficient knowledge of this research topic allows us to declare the scientific novelty of the research, which consists in the following: 1) High mathematical culture in our country in the field of state youth policy is not represented. 2) Development of new methods for efficient allocation of resources and justification of decision-making in state youth policy based on the theory of clubs. Practical significance lies in the possibility of an objective justification of the decision made using an algorithm and a decision support system in state youth policy based on the theory of clubs. The proposed mathematical models can be used to determine the parameters of the state of the state youth policy, to determine the main parameters (factors) of the self-organization process.

Perspectives of robotics

Mukhamedyar Ulpan and Akerke Mukhamedyar

West Kazakhstan Agrarian Technical University named after Zhangirkhan, Uralsk, Republic of Kazakhstan, ulpan.muhamedyar@mail.ru

Kazakh national University mukhamedyar01@inbox.ru

Progress in robotics is a breakthrough innovation with significant promise and the ability to radically change the economic and social aspects of society. Research on the development of robotics is still scarce.

The article contains statistical data on the use of robots for various purposes, presents the leading companies in the field of robotics production. This information may help the reader understand the applications of robots and the prospects for robotics.

The general information on the principles of constructing manipulation robots and robotic systems is presented; the areas of their application in various types of machine-building production and other sectors of the national economy are indicated. The prospects for the development of robotics are highlighted, as well as its role in the creation of flexible, comprehensively automated production facilities with labor-saving technology. For engineers and technicians in all sectors of the national economy, dealing with automation and mechanization of production processes.

Waterproofing membranes reliability analysis by embedded and high-throughput deep-learning algorithm

Darya Filatova and Charles El Nouty

Université Sorbonne Paris Nord, daria_filatova@interia.pl, elnouty@math.univ-paris13.fr

The reliability analysis in civil engineering requires an understanding of the stability, durability, and rigidity principles over the planned period of exploitation. We develop a high-performance deep learning algorithm related to the water-repellent membranes' defects' classification with consequent reliability analysis. Based on CNN architecture and on the mixed technique which uses K-blocks cross-validation with artificial dataset augmentation, the proposed methodology consists of the sequent transformations of pixel-image intensities to find and to classify damaged fragments on the membrane's surface. The "domain of confidence" reliability metric is introduced to analyze the further behavior of membranes. The computational experiments showed that the methodology can be successfully applied in near-real time while improving throughput to get conclusive results by projecting AI-based, automated, and embedded devices on-site removing the human error factor.

Classifying socially significant news using topic modelling

Kirill Yakunin, Sanzhar Murzakhmetov, Yan Kuchin, Ravil Mukhamediev and
Rustam Musabayev

Institute of Information and Computational Technologies, Satbayev University, Almaty,
Kazakhstan, yakunin.k@mail.ru, sanzharmrz@gmail.com, ykuchin@mail.ru,
ravil.muhamedyev@gmail.com, rmusab@gmail.com

Mass media monitoring allows to analyze public opinion regarding different topics and entities, which is a task with very high demand in enterprise and governmental structures. One of the accompanying tasks is classifying which news publication and other social media posts are actually significant for society, and distinguish them from informational noise, entertainment content and other insignificant information. We propose a hybrid approach, which combines three different data sources: governmental development program documents, population survey results and activity (views, likes, comments) of different publications. For that purpose, a classifier based on topic modelling is proposed. Cross validation indicates high quality of classification (ROC AUC of 0.7+).

Development of IoT solution for collecting disposable plastic bottles in private Kazakhstani university

Bauyrzhan Berlikozha and Azamat Zhamanov

Suleyman Demirel University, Kaskelen, Kazakhstan, bauyrzhan.berlikozha@sdu.edu.kz

Today, conversion of plastic bottles is one of the most profitable segments of the conversion market. I, you and many of us know that plastic is a global environmental problem in modern civilization, especially in private University like SDU. No way is the production of plastic bottles not so expensive, plastic is a cheap raw material, so far no one is going to stop this production.

The aim of my project is to create a prototype plastic bottle collecting system on the Arduino platform. It works on 2 levels. When objects detected with specific sensors, three sensors implemented, if all sensor's outputs are equal to zero, that shows the bottles are passed correctly. Arduino's sensor counts only the passes bottles, according to how much were putted, the machine will give one refreshing candy with a fruit flavor for each bottle. At the end of the working day it will be something like this: a report for 1 working day will be displayed on the screen of the device. A report in the form of how many bottles this highly intelligent device has collected, it will also publish on social networks (instagram).

The goal of the thesis is not just the collecting bottles; I have worked on improving it as smart and clever system. Because, such kind of terminals can be located on crowded places, also in some European countries like Germany, Spain and Asian Japan, people can use this system for ticket payment in public transports or can buy food for homeless animals. It shows that they have qualified organizing service system. The important part of my job is starting from private university's place to collect some dates to analyze them.

Digital methods for processing images of noctilucent cloud fields to determine the structural and temporal parameters of the polar vortex

Alyoshin D.V, Solodovnik A.A. and Demianenko A.V.

M.Kozybayev North Kazakhstan University, Petropavlovsk, Kazakhstan, dmitriy_alyoshin@bk.ru, aasolodovnik@mail.ru, demianenkoav@mail.ru

The influence of a near-space phenomena complex on the geophysical processes, as well as the state and seasonal changes in the Earth's atmosphere, and, as a result, on the climate, and through this on the state of the biosphere, attracts the attention of astronomers and specialists in close scientific fields. This issue harmonically combines fundamental and purely practical significance. Those studies, that are related to the problem of climate and geophysical changes and that have been repeatedly noted in the history of the Earth and can be repeated in the near future, are especially important. One of the markers that allows us to objectively judge the general state of the atmosphere and climate and the direction of development (trends) of their characteristic processes is the upper layers of the Earth's atmosphere, in particular, the mesosphere. At the level of the mesosphere, there are processes that are the subject of astrophysics: the genesis and evolution of mesospheric noctilucent clouds (MNC) and a complex of meteor phenomena. Their study has points of contact not only from the point of view of their high-altitude localization or historical tradition, but also because of the real physical connection of these phenomena. The peculiarity of this research area is given by the fact that its objects are located at the intersection of interests of near-space astrophysics, meteorology and climatology, geophysics, physics of solar-terrestrial relations, as well as applied problems of cosmonautics.

One of the main problems of upper atmosphere physics is the lack of a physical concept that would link the largest movements in the troposphere (polar vortices) with their seasonal changes, the phenomena of the upper atmosphere, in the development of which there are constant patterns and climate trends. As a result, the development of specialized information systems will allow you to get close to solving this problem.

Most of the scientists, studying various atmospheric processes, use standard applications, which is not always convenient. It happens, they provide unreliable data because the embedded algorithms are focused to perform only common functions of a standard image.

Efficient algorithms are necessary to process, or possibly re-process large amounts of data. Methods based on reflection spectra of the upper atmosphere for single-pixel images without the use of external data or spatial context have the greatest potential for parallel data processing and high optimized bandwidth. Such algorithms can be considered as a basis for possible trade-offs in processing performance discussing the application of more sophisticated methods that are applicable to our research.

IT information system in management of teachers' in-service education in the aspect of reducing the gap between the best and the lagging school

Valentina Kulikova and Ainagul Kabdirova

M. Kozybayev North Kazakhstan State University, Petropavlovsk, Republic of Kazakhstan

The modern dynamic modernization of an education system of the Republic of Kazakhstan mainstreams the gap issue between the best and the lagging schools. This gap does not allow providing the equal access to quality education for each child. The main idea of the Project is to develop and implement IT information system that is directed on increasing learning quality in the lagging schools by means of stimulation, monitoring, resource and the environment management of teachers' professional development.

The IT information system development and implementation that is allow reducing the gap between the best and lagging schools through the effective management of teachers' professional development. It includes the following:

- objective estimate of school and teachers' professional development efficiency by means implementing of Value-Added Models in Education;
- determination of teachers' competences that are necessary for increasing the students' progress in the conditions of a real social and economic context of the school work and with the help of applied Software and web development;
- creation and implementation of the personalized pedagogical staff development strategy. It is based on the principles of Digital Ed.

Objectives:

1) to reveal the factors defining low students' educational achievements by means of the data mathematical analysis for studying of teaching quality features in the regional schools and definition of extent of impact on students' educational achievements of objective and subjective factors;

2) to adapt and apply Value-Added Models in Education in the aspect of the Kazakhstan education system features for objective assessment of teaching quality taking into the social and economic context of a school and the level of teacher's professional development;

3) to develop and implement the automated system of teachers' professional development prognostics taking into account the features of the certain educational organization for creation of the personalized educational profiles;

4) to develop and implement technology of information and scientific and methodical maintenance of teachers' professional growth of the lagging schools for expansion of scalability opportunities of the project outcomes.

Objectives of the Project will be realized taking into account modern achievements in the field of science and technologies.

The Objective 1 will be realized by means of the mathematical analysis of an extensive range of the quantitative and qualitative data that will be collected at the first stage of Project implementation. The processing data issue will be solved with the help of Statistical Package for the Social Science (a statistical package for social

sciences). SPSS is a widespread mean of the computer data analysis which gives the chance to organize data input, to change its structure, to apply modern processing methods, to receive results in a convenient and evident form.

The Objective 2 is directed to adaptation and the subsequent approbation of Value-Added Models in Education taking into account the features of the Kazakhstan education system. This task will be realized by means of studying of the existing models criteria (Great Britain, Canada) and development of criteria taking into account the features of the national education system (including, prevalence of ungraded school) and also the revealed factors of low educational achievements (following the results of the previous task realization) and experience of REL Southwest.

The Objective 3 includes creation of the automated system "SMART development" for teachers' professional development prognostics. The received during approbation of Value-Added Models in Education statistically significant regularities of teachers' professional development influence on the educational achievements in different conditions of a social and economic context of school will be considered.

The Objective 4 will be realized by means of Project consulting group creation from number of heads and school teachers according two main criteria: 1) high level of students' educational achievements; 2) educational organization type compliance will be given support within implementation the technology of information and scientific and methodical maintenance of teachers' professional growth.

Implementation of the Objectives will promote considerable positive changes of all education system of the Republic of Kazakhstan: (a) educational institutions of professional education are to improve the pedagogical education programs; (b) the system of teachers' professional development is to update the scientific and methodical basis of teachers' professional development within in-service training; (c) state education management authorities are to increase the effectiveness of quality management in education on the basis of efficiency of schools cluster analysis results; (d) the organizations of secondary education are to improve the quality of the school management system, management of pedagogical staff professional development; (e) teachers are to the relevant professional development focused on increase the level of students' educational achievements.

The scientific novelty is a search of support contents forms and mechanisms for certain teachers of the "weak" schools including directed for overcoming a barrier in the form of low students' SES.

The implementation outcomes will

- enrich the theory and practice of teachers professional development support;
- make a contribution in the informational support of education and communication technologies' theory and practice;
- encourage researches directed on tracking teachers' professional development effectiveness, change the competences and improve the students' educational achievements.

Information entropy in the system for identifying patterns of multilingual texts

Vladimir Kulikov, Valentina Kulikova and Gulnur Yerkebulan

M. Kozybayev North Kazakhstan State University, Petropavlovsk, Kazakhstan, qwertyra@mail.ru, v4lentina@mail.ru, erkgulnur@mail.ru

Information entropy is directly related to the unexpected occurrence of an event. The more predictable an event is, the less informative it is. This means that its entropy will be lower. The entropy of connected processes converges when their connection is strengthened. EEG entropy is used to search for the stages of anaesthesia, sleep, Alzheimer's and Parkinson's diseases, the effectiveness of treatment for epilepsy, etc.

In our work to detect patterns of multilingual texts, we suggested that it is possible to construct a similar graph, in which the entropy lines of the original text and translated borrowing will be close to each other in comparison with the entropy lines similar to the original text (but not plagiarism).

To determine the dependence of the entropy of the text, 50 songs of The Beatles were considered. To investigate the relationship and differences between plagiarism and similar texts, we assumed that a line – by – line literal translation in Russian is the original text, a text in English is plagiarism from the original text, and free translations are texts similar to the original. After calculating the amount of entropy from the probability table using the Shannon formula, ignoring spaces and case, we built a graph of entropies. Experimentally, we realized that this graph is not very informative, since the lines run side by side and it is impossible to identify a certain pattern in their intersection. The conducted experiments corrected the direction of our research towards the study of Renyi entropy with the introduction of an additional parameter for detecting patterns of multilingual texts.

Development of a Complex of Practical Works on Programming Technology in the Android Studio Environment

Irina Pugacheva and Oksana Nass

West Kazakhstan Agrarian Technical University named after Zhangirkhan, Uralsk, Republic of Kazakhstan, irkadyf@mail.ru

Currently, mobile devices are widely used in many areas of human life. Thus, mobile applications have found application in such industries as robotics, logistics, navigation, cartography, etc. Therefore, training students in this area is of great importance. In this regard, the relevance of the topic is determined by the need for a theoretical and methodological substantiation of the peculiarities of studying the basics of programming mobile devices, as well as developing a set of practical works on programming technology in the Android Studio environment.

The aim of the study is to develop a theory and methodology, as well as a set of works for practical training of students in the field of developing programs for mobile devices using the Android Studio environment.

It is supposed to use the following research methods: theoretical analysis of scientific and technical literature on the research topic, as well as national and international standards in the field of programming mobile applications; programming in the Android Studio environment; processing, analysis, generalization and approbation of research results.

The research process uses an integrated software development environment and Android Studio 4.0. Practical work is aimed at mastering by students the skills of using programming technologies, which are significant for increasing the efficiency of mastering the basics of programming mobile applications and their further free use.

Expected results: Theoretical and methodological materials for studying the basics of programming mobile devices, as well as a set of practical works on programming technology in the Android Studio environment.

Modeling and Control of Plant Growth Productivity Based on Experimental Data Under Conditions of Hydroponic Systems

Kim G.A. and Demianenko A.V.

M.Kozybayev North Kazakhstan University, Petropavlovsk, Kazakhstan, demianenkoav@mail.ru

The accelerated development of information technology, computer technology and advances in mathematical disciplines provide new opportunities for physiologists to develop a method for controlling the productive processes of plants.

Currently, the development of a productivity management method for crop production in greenhouses, artificial climate installations and in hydroponics is relevant. The main objective of greenhouse crop production improvement is to produce plants regardless of the season. The most promising in terms of rationally used territory, reducing labor costs is the method of growing in low-volume hydroponics. Low-volume technology for growing plants in greenhouses provides for the creation of optimal water-air, nutrient, temperature parameters in the root zone of plants. The productivity management method should be based on mathematical models of production processes, which include photosynthetic activity of plants, growth and accumulation of biomass. Analytical techniques for describing growth processes cannot be applied independently, therefore, it is mandatory to supplement with graphical and tabular information.

In this regard, the goal is to model and evaluate the quality according to a pre-selected criterion and substantiate the methods and algorithms for determining the parameters of dynamic growth models from experimental data. The achievement of this goal will be carried out by theoretical and experimental research. The theoretical study is devoted to obtaining dependencies that make it possible to establish the optimal design and technological parameters of devices included in the supply and distribution system of nutrient solutions in low-volume hydroponic greenhouses. Experimental studies are planned to be carried out on specially made model installations using standard and private techniques using the method of planning an experiment.

Analysis of the effectiveness of using the space of cognitive modelling in historiography

Sayagul Zhakezhan

M. Kozybayev North Kazakhstan State University, Petropavlovsk, Kazakhstan

The study analyzes mathematical and statistical methods for analyzing mass historical sources. The article reveals the essence of mathematization of knowledge in modern science (in this aspect, the applied component is the use of specific mathematical methods for measuring historical information). The fact that history, along with the exact and natural Sciences, belongs to mathematics, indicates a high level of its development and the urgent need for quantitative clarification.

Different methodological systems of historiography do not allow us to develop a consistent opinion even on the basic concepts of "Historiographic fact and historiographic source".

The method of discussive analysis as establishing a correlation between the content of a historiographic source, the results of scientific research, and the socio-cultural context of the development of historical events and processes.

Objective: To develop methods and models for evaluating and interpreting historical sources in their interaction and interaction. Research problem: 1) to Form the conceptual basis of the research. 2) Analysis of the process of improving the methods of studying historical sources. 3) To reveal the essence of the concepts of cognitive modeling in historiography. 4) Research on the development of historical research issues. 5) Develop a set of models of the system for analyzing the effectiveness of using the space of cognitive modeling in historiography. Scientific novelty: application of cognitive principles in the historiography of Kazakhstan. Practical significance: the system of quantitative methods is aimed at increasing objectivity in its development.

Expected results: Development of the methodological apparatus of a professional coriographer in accordance with new requirements, a perfect level of information technology, and a system paradigm.

Research Topics in eCommerce Fraud Detection

Akylbek Zhumabayev

Satbayev University, Almaty, Kazakhstan, akylbekz@gmail.com

The article examines the problem of bank card fraudulent transactions in electronic payment systems (eCommerce). The main approaches and requirements for detecting and preventing unauthorized financial operations are analyzed.

Overall, the global level of fraud in e-Commerce systems was 3.80% in 2016 and 4.09% in 2017, according to Signified Global Fraud Index. Despite the significant achievements in the protection of financial transactions and the availability of advanced systems for detecting unauthorized actions, the increase in fraud is

explained by the following factors: the development of new types of services in the financial technologies industry and the constant improvement of fraud instruments by attackers.

The methods of fraud monitoring systems can be divided into two major groups. The first group includes systems that rely on clear rules for verifying transaction characteristics (rule-based systems). The second group includes systems that analyze customer behavior (deep learning systems).

The topics of the study are: (a) Algorithms ensembling from both groups. (b) Dataset preparation to train algorithms. (c) The interpretability problem of algorithms.

Geospatial Intelligence (GeoAI) and Explainable Machine Learning (EML) for Healthcare decision-making support

Ravil Mukhamedyev and Marina Yelis

Institute of Information and Computational Technologies, Satbayev University, Almaty, Kazakhstan, ravil.muhamedyev@gmail.com, k.marina92@gmail.com

The quality of the healthcare system may be manifested in three "dimensions": medical, economic, and social. In many cases, however, this evaluation is done separately. Attempting to achieve maximum cost efficiency can lead to insecurity in medical tasks and social dissatisfaction, up to social instability, which was particularly evident during the COVID-19 pandemic. At the same time, however, society cannot always afford high costs in this area. There is a need for comprehensive analysis and a comprehensive approach to improving the performance of healthcare organizations. Traditionally, such tasks, with their vaguely defined limitations, fall within the scope of multi-criteria analysis and decision support (MCDA) and are often carried out using different methods of expert judgment ranking and aggregation. However, the vast amount of data sets accumulated in the health sector, the mass media and social networks initiate the use of machine learning (ML) and natural language processing (NLP) techniques in decision support tasks. The methods of such applications have not yet been fully developed. In particular, algorithms and methods of explainable machine learning (EML) have been partially developed, which in practice is used from time to time. Spatial effects (place of residence, environment, a region where the health care organization located, etc.) are considered in the existing geographic information systems (GIS) of health care, but the regularities of such effects in the existing GIS are only statistically analyzed. The social impact of health care is still only qualitatively assessed. The mentioned problems and ways to overcome them using a set of methods NLP, EML, MCDA, and GIS.

Methodology for teaching students programming by creating computer games

Nurlan Kulmurzaev and Abylaikhan Tobashev

Korkyt Ata Kyzylorda University, Kazakhstan

We all know that the Fourth Industrial Revolution is directly related to digital technology. In this regard, the first President of the Republic of Kazakhstan Nursultan Nazarbayev in his address to the nation outlined 10 tasks that need to be implemented. In particular, he noted that digital technologies will allow us to take into account the needs of citizens as much as possible, and the introduction of smart city technologies as well. And the basis of all these technologies is programming. In order to increase students' interest in learning programming, develop the ability to analyze in the course of learning, and achieve their goals, it is necessary to consider students' interest in the process of using computers as the main goal. What tasks may these needs meet? This question can be answered by the results of a survey conducted with a group of people of different ages. Children like to play, and the internal structure of the games arises great interest in them.

The main idea of the proposed methodology is to link all stages of learning programming in the school course with practical tasks. Each student gradually creates their own dynamic computer games. With the help of games, we increase students' interest not only in programming, but also in science in general. The main feature of this methodology is that it is not aimed at creating specific computer games. It is only necessary to determine the result. The main goal is to visually study the basic software structures. The game is considered only a stimulating tool.

Let's look at the main stages and developmental properties of creating games.

1. Reconstruction and analysis of games commissioned by the teacher – at this stage, students' analytical thinking skills are formed;
2. Creating a plot of your own game – at this stage, the ability to think abstractly, creativity, and realize it through imagination development;
3. Develop the ability to create or edit objects using image editors for your own games – the ability to convey your own thoughts;
4. Creating scenarios for the movement of objects –the ability to use mathematical apparatus is formed;
5. Develop the ability to analyze the scenario of movement of objects and their movement in sync with each other- the ability to analyze the given task;
6. Build game events – develop the ability to use mathematical apparatus;

The creative element is the main component of ensuring motivation for students to implement this concept. Therefore, the main requirement is for each student to create his own game. The teacher offers only general types of games. Here it is important to ensure that the teacher does not recreate the games created by him, that each student recreates the games himself. Students of the XXI century, who grow up in the world of high-level digital technologies, may learn and respond in a completely different way in the learning process compared to students who are not familiar with technology. This is also due to the fact that computer games attack the

lives of students at a very early age, which forces them to get used to many of the functions of the computer. In addition, students face difficulties in computer courses, such as computer programming, but their familiarity with the computer suggests that they are currently simplifying their curriculum. Extensive research over the past two decades suggests that these difficulties still exist, and that students are not even interested in programming. It is very important to avoid these difficulties, because successful training and training of computer programs can be very useful for students of the XXI century. This allows students to develop various competencies, such as critical thinking, develop their own programs, as well as conceptual analysis and problem solving, because they usually need to solve this scenario and interpret the code as a line. In addition, students learn to work in groups and interact with each other in efforts to develop programs that are implemented, while simultaneously participating in the exchange of experience and ideas.

Thus, general computer programming gives students the opportunity to gain knowledge throughout their lives, which is a very important advantage of knowledge for a continuously developing world, as they have the opportunity to combine and apply their skills with their future work (for example, Engineering, Computer Science, etc.). An interesting suggestion for solving new emerging problems is the introduction of training or important games in computer programming courses. The terms educational games are often used to describe computer games used as educational tools, and to describe interactive and interesting activities that encourage students to learn (Gunter et al., 2008). These games strengthen students' internal motivation through a sense of challenge; they stimulate their curiosity, increase their sense of security, and stimulate their imagination (Ho et al., 2006). In addition, students will be able to achieve certain goals and see the result of success only after completing the game, as well as when passing the game stages, they will gain confidence in their self-confidence and decision-making skills. Consequently, there is a need to reorganize modern teaching methods in accordance with modern technological trends, which can easily and effectively involve a new generation in computer programming.

Each stage of creating a game requires the organization of specific properties of the software design. For example, organizing the simplest movements of each character is a linear algorithm, unique movements of similar characters are arrays, and so on.

Another important issue is the presence of a high level of ability to master and implement the principles of Object-Oriented Programming in the game, as well as the traditional structure of structural programming.

In order to meet the requirements of the time, it is necessary to start getting acquainted with information concepts from the lower classes. For this purpose, special programming languages are created that are very convenient for getting acquainted with the initial aspects of programming. There are many of them, and their content and structure of creation are different:

- *Drape programming language*. Drape programs are built on a visual basis, and this is very important, because students of this age better understand the material

with game elements presented in visual form. The Drape programming language was published on November 29, 1997 by Mark Overmars. Its goal is to teach a lower-grade student the basic elements of programming that will be needed in the future. The Drape program consists of many sets of commands that can perform various functions, such as: (a) drawing simple geometric shapes; (b) setting paint colors; and (c) call procedures, etc. For convenient work, each team is depicted as a sign-drawing.

- *Scratch*. Scratch is a relatively recent programming environment that allows junior and high school students to create games, movies, animated stories, and more. The Scratch program is “created” from a block of color commands in an object-oriented environment, just as in the Lego constructor, different objects are created from colored bricks. In Scratch, the creation of a program occurs from the intersection paths of graphic blocks on stacks. In addition, blocks intersect only with syntactically correct constructs, which prevents errors. Stocks of different types contain different forms of blocks, which, in turn, indicate the compatibility / incompatibility of objects with each other. Even when the program is launched, you can make changes to it, this feature allows you to experiment with new thoughts in the process of solving the problem. As a result of executing simple commands, a complex model is created, in which many objects with different properties interact. After the project was created in Scratch, it was <http://scratch.mit.edu/> / there is an opportunity to publish on the site.

One of the main features of this environment is that it is a free distributed software product, so that any educational institution can download the program from the internet and start working in a new programming environment. The interface of the program is designed and designed for children, so it is as intuitive as possible.

- There are also portals that teach programming languages in the process of developing the actions of objects encountered in the game. One of them is Code Combat.

The main purpose of this article is to review existing educational games aimed at teaching computer programming and, accordingly, to analyze the effectiveness of teachers in achieving educational goals in each specific case. In conclusion, we note that in the school curriculum, teaching programming languages and increasing students' interest are effectively and accurately implemented through the creation of games.

Development of Structured Arguments for Assurance Case

Vladimir Sklyar and Vyacheslav Kharchenko

National Aerospace University n. a. N. E. Zhukovsky "KhAI", Kharkiv, Ukraine,
v.sklyar@csn.khai.ed, u v.kharchenko@csn.khai.edu

The analysis of existing approaches to the development of the Assurance Case is conducted. Existing works have some drawbacks due to the lack of satisfactory practical argumentation techniques. In this paper, we use and develop the approach structured arguments based on modified Goal Structuring Notation (GSN) and structured text.

A mathematical and methodological apparatus for structuring the argumentation was selected and improved. We obtained the structured argumentation method including the following: the overall algorithm of the Assurance Case development; the proposed structure of the Assurance Case graph, which is based on the typical structure of the arguments and is developed in connection with the structured text of the description of these arguments; improved structured text templates for arguments description. The obtained method can be used as the basis of the appropriated argumentation framework supported with a set of formal operations performed with the Assurance Case graph and supported structural text.

As the result, we get the template with the Assurance Case graph and structural text related with typical reasoning and evidential steps.

"Smart City" technology: conception, security issues and cases

Heorhii Zemlianko and Kyrylo Leichenko

National Aerospace University n. a. N. E. Zhukovsky "KhAI", Kharkiv, Ukraine,
g.zemlynko@csn.khai.edu, k.leychenko@csn.khai.edu

Before all "smart" technologies were considered as tools to make the city and its objects more effective for work of inhabitants, the plants, factories and other infrastructure and housing estates and more ecological. Phones, lap-tops, tablets and other techniques have become key to the city, putting in millions of hands instant information about transit, traffic congestion, health services, community safety and news alerts, catch and search for bouts, currency analyses and quality of life improvements. However, the rough side of intensive industrialization and population growth in urban areas have become a big problem for administrators, security administrators, architects and urban planners. This article will discuss the concepts of "smart city" and will show for what the introduction of technologies is and what consequences are expected and cases of realizes of "Smart City". Also in this paper is proposed smart watering technology, which allows to minimize the consumption of fresh water for watering green spaces, which will increase the environmental friendliness of smart cities. The proposed technology is easily implemented in the existing management systems of smart cities.