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Abstracts

14 May
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PE111

Knowledge-Data Environment of Machine Learning

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Over the recent years, we have been witnessing truly remarkable progress in Machine Learning (ML) with highly visible accomplishments encountered, in particular, in natural language processing and computer vision impacting numerous areas of human endeavours. Driven inherently by the technologically advanced learning and architectural developments, ML constructs are highly impactful coming with far reaching consequences; just to mention autonomous vehicles, control, health care imaging, decision-making in critical areas, among others.

Data are central and of paramount relevance to the design methodology and algorithms of ML. While they are behind successes of ML, there are also far-reaching challenges that require urgent attention especially with the growing importance of requirements of interpretability, transparency, credibility, stability, and explainability. As a new direction, data-knowledge ML concerns a prudent and orchestrated involvement of data and domain knowledge used holistically to realize learning mechanisms and support the formation of the models.

The objective of this talk is to identify the challenges and develop a unique and comprehensive setting of data-knowledge environment in the realization of the development of ML models. We review some existing directions including concepts arising under the name of physics informed ML. We investigate the representative topologies of ML models identifying data and knowledge functional modules and interactions among them. We also elaborate on the central role of information granularity in this area.

Keywords
Granular Computing, Machine Learning, data-knowledge environment, information granularity

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15 May
1:00pm
PE111

Development of an algorithm for the formation of a brand of a higher educational institution

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The article addresses the challenges associated with establishing and nurturing the brand of higher education institutions, exploring the functions and components within the brand structure. The significance of this study arises from the heightened demand for educational services in the higher education market. Intense competition has compelled universities to increasingly employ marketing strategies to adapt to market conditions. It is important to note that those educational institutions that consider the creation of a brand as one of the main stages of the strategy for promoting their educational services on the market are faced with the problem of the lack of a methodological base, specific tools for solving the tasks set. Therefore, institutions of higher education often use separate elements of marketing communications, focusing consumers' attention on individual elements of the offered range of services, without reducing them into a common system, which leads to a mismatch of actions of all providing structures and a lack of understanding by the consumer of the advantages of receiving this educational service. Traditional tools are proving insufficient, emphasizing the pivotal role of creating and sustaining an appealing and memorable university brand.

Throughout the study, a model for forming the brand of a higher education institution was developed, highlighting distinctive features of branding and communications within the realm of educational services. Key factors influencing the establishment and growth of the university brand were identified. Leveraging these factors, the article proposes enhancements to the tools used in university brand formation, ensuring effective promotion and enhancing competitiveness. The advantages and challenges associated with the use of IT in the branding of educational institutions, as well as strategies aimed at maximizing their potential, are also discussed. In conclusion, recommendations are offered on the optimal use of information technology to strengthen the brand of a higher education institution and attract a target audience.

Keywords
brand, university brand formation, educational process, information technology in branding, brand organization of higher education

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Detection of air pollution in developed areas using neural networks

15 May
1:15pm
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This article includes the research that represents the main factors of air pollution in developed countries and the role played by neural networks and other deep learning models in this field. Due to the development of technology, air pollution is becoming an increasingly acute problem in the modern world, and its impact on human health and the environment cannot be overestimated.

In the context of developed countries, where technological capabilities are extensive and resources are more accessible, the use of neural networks and machine learning models comes to the fore as an effective tool for air quality analysis, forecasting and management and is considered the optimal solution. Neural networks have the ability to analyze complex datasets, identify patterns, and predict trends, making them a powerful tool for studying air pollution.

In this work, various photographs are used as input data, which are the main data for detecting air pollution, as well as information covering various aspects of the problem of air pollution, including monitoring air quality, identifying sources of pollution, as well as developing strategies to reduce it and analyzing the results of metrics. The object of the experimentation is the city of Almaty, which is considered a megalopolis and the center of various industries. The work is based on an analysis of modern methods and technologies used to collect and process air pollution data, as well as examples of successful applications of neural networks and machine learning models in this area. The deep neural network Inception V3 and the Convolution neural network were selected. They were chosen because neural networks of this architecture use blocks of perception, which make it possible to effectively capture information at different levels of image detail. CNN often shows good results in image classifications, object detection, image segmentation, and more. In the research work, all the data was processed and a model of this algorithm was built and a 90 % detection of pollution in developed countries was made.

Keywords
Neural networks, Inception V3, Convolutional neural network, air pollution, global problem, metrics

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15 May
1:30pm
PE111

Using artificial intelligence for environmental monitoring of pasture areas

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This article provides an overview of methods for comprehensively solving the problem of effective exploitation of pasture areas based on the implementation of environmental monitoring using artificial intelligence technologies. A qualitative study of the state of pasture areas is impossible without automated environmental monitoring systems using artificial intelligence technologies. The quality of research and monitoring primarily depends, of course, on the completeness of the input data entering the automated monitoring system and effective algorithms for data processing and analysis. A complex set of data that comes from heterogeneous information sources, including satellite imagery and geospatial data along with ground data, contains enormous potential for studying the state of pasture areas, identifying trends, analyzing and forecasting using artificial intelligence technologies that process large amounts of data at high speed and accuracy. Effective algorithms and machine learning models for analyzing and interpreting data make it possible to discover hidden connections and patterns that are invisible to humans.

Ultimately, the introduction and use of intelligent environmental monitoring systems can significantly contribute to more sustainable development and achievement of environmental safety of pasture areas, more efficient and rational use of pasture resources. The main goal of monitoring is, first of all, the timely identification of anthropogenic and technogenic changes, their assessment, in order to prevent and eliminate negative processes, determine the feeding potential of various types of pastures, develop methods for optimal pasture load, determine the dynamics of yield depending on weather conditions and solve a number of other important issues related to pasture use. Effective management of pasture resources is focused on improving the quality of pasture lands and grasses, preventing degradation and desertification of pastures and, in general, balanced pasture use.

Keywords
artificial intelligence, environmental monitoring, automated system, pasture areas, artificial intelligence technologies, machine learning

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A new approach to coin classification using artificial intelligence

15 May
4:45pm
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Identification and recognition of coins usually occur through organoleptic methods. Unfortunately, counterfeit coins with a high degree of similarity to original ones are appearing on global markets. This creates significant confusion in numismatic markets and undermines the credibility of institutions dealing with coins made of precious metals. Similar problems occur in the field of numismatics. Authenticating coins is a task for expert numismatists who possess extensive historical knowledge. The problem is becoming increasingly widespread, as evidenced by statements from mint employees and collectors. "We are entering an era of counterfeiting collector coins and numismatics, where counterfeits are made almost perfectly," warns Dr. Dariusz Pączkowski, an expert from the Warsaw branch of the Polish Numismatic Society, during the lecture "Counterfeiting of Polish coins". A key element of this field is the ability to distinguish authentic coins from counterfeits, which can be extremely difficult to do with the naked eye. Therefore, tools are needed to support the process of detecting counterfeit coins in numismatic collections. The authors of the study suggest conducting an analysis of the potential use of artificial intelligence models for coin image recognition. Machine learning-based artificial intelligence models demonstrate the ability to accurately recognize and classify images, as documented in numerous scientific articles. The use of artificial intelligence for coin classification is relatively new and promising. The authors conducted initial training and testing processes of the YOLO ver.3 model. Preliminary research results were obtained on PLN coins.

One area where artificial intelligence could find additional application is the identification of archaeological coins. These coins are often in poor condition, worn out, or damaged, making traditional identification methods challenging. AI models can analyze their features more accurately and compare them with reference images, facilitating the identification of original coins and their copies. The application of coin classification algorithms can bring many benefits, such as faster detection of counterfeits and better identification of archaeological coins. However, despite promising preliminary research, further study and development of technology are necessary to ensure high accuracy in coin classification using artificial intelligence.

Keywords
numismatic, coin classification, image recognition, archaeological coins, coin counterfeiting

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The use of vertical and horizontal scaling in the in-depth similarity search using editing distances

15 May
3:00pm
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Modern computational problems related to data processing and pattern searching are often characterized by high computational complexity due to factors like combinatorial optimization. Solving such issues requires significant computational resources and can be time-consuming. This study examines the possibility of accelerating the process of finding element matches using vertical and horizontal scaling techniques of IT processes. Vertical scaling is the process of adding more CPUs, threads, or RAM to a single machine. Two techniques for vertical scaling were tested: •Multithreading — This technique involves running multiple computational threads simultaneously on one processor. This work uses the default .NET System.Threading.Tasks.Parallel library to implement multithreading. •Running applications in non-GUI mode — Running applications in non-GUI mode can reduce system resource consumption, which can lead to faster computation times. In this work, the application was launched using command line mode, and was compiled for Windows and Linux. Horizontal scaling involves adding more machines to spread out computations. This work investigates the possibility of distributing computations across multiple machines to accelerate the process of finding element matches. The research has shown that the use of vertical and horizontal scaling significantly reduces the time necessary to determine solutions in all tested test scenarios. The vertical scaling of multithreaded computing allowed the computation time to be reduced by an average of four times. The horizontal scaling, performed by distributing calculations to 11 PCs and two server machines, allowed the time to check research scenarios to be reduced by approximately eleven times. The overall experiment time was shortened from approximately 12,000 to 240 hours. The presented conclusions may be applicable to other cases susceptible to the formation of a combinatorial explosion, such as searching for patterns in a data set. The presented research is part of the author's work carried out as part of his dissertation— a method of finding matches in images of 2D objects based on contour analysis using linguistic measures.

Keywords
vertical scaling, horizontal scaling, multithreading, pattern searching, data processing, combinatorial optimization

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Automated system for analyzing the operation of public transport

15 May
3:15pm
PE111

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The key problem today is the colossal density of automobile traffic, which in turn causes significant damage to the environment. Residents of the capital who can afford to keep a personal car prefer to use it instead of public transport for two main reasons: congestion of public transport and traffic jams. Moreover, the second problem is a consequence of the first, as residents of the capital who can afford to travel by personal transportation put their comfort above. Given the huge growth in the number of personal vehicles over the past 3 years in the capital of the Kyrgyz Republic, the issue requires an immediate solution.

This article considers options for solving the problem of traffic jams in developed countries, which faced a similar situation in the early 2000s. Scientific novelty of the study lies in the proposal of methods to solve the problem. Consideration of the automated system as a method of analyzing the work of public transport will allow to identify the weaknesses of the current work performed by the transport organization. Also, this article considers the potential of using artificial intelligence to optimize the schedule of public transport.

The field of urban public transport management requires the analysis of large amounts of data. Passenger flow identification by physical counting method becomes insufficient. In order to continuously collect data on various aspects of public transportation in real time, innovative methods have been considered and comparative analysis of the results obtained in advanced countries that have long been using modern devices for this purpose has been carried out. Integrating artificial intelligence into public transport management will open up a wide range of opportunities to optimize schedules and improve service reliability. AI will help analyze data such as passenger flow and suggest the optimal frequency of traffic that will meet the needs of passengers.

The article is devoted to a detailed analysis of the problem of congestion in urban public transport and aims to consider automated systems for analyzing the performance of transport infrastructure as a solution method. The options considered will create sustainable transportation ecosystems that meet the needs of residents, promote environmental sustainability and economic prosperity.

Keywords
Public transport, automated systems, traffic density, transportation infrastructure, AI optimization

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Intonation model for simple sentences of the Kazakh language for a Kazakh language synthesizer

15 May
3:30pm
PE111

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The aim of this research is to develop an intonation model tailored to Kazakh short sentences, aiming to enhance the performance of Kazakh language synthesizers. Intonation plays a crucial role in conveying meaning and emotion in speech, and accurate expression is essential for achieving natural-sounding synthesized speech. However, existing models often fail to adequately capture the complexity of Kazakh intonation due to its distinct phonological characteristics. Therefore, this study proposes an innovative intonation model specifically customized for Kazakh.

This process involves analyzing a corpus of Kazakh speech to identify characteristic intonation patterns and features. The analysis encompasses pitch contours, stress patterns, and rhythmic structures in Kazakh speech. A computational model of Kazakh intonation is then developed by integrating statistical methods and machine learning algorithms.

Additionally, this research includes PyTorch Tacotron, a deep learning-based text-to-speech fusion method, to develop a prototype for deployment. The Tacotron's proficiency in producing high-quality, natural-sounding speech and its ability to adapt to other languages were the reason for this decision. Additionally, we use online scraping techniques to obtain short sentences for model training data from sources such as TengriNews and Wikipedia. This strategy ensures that a comprehensive data set representing a variety of linguistic forms and spellings is available.

This study includes both objective and subjective measurements. The model's ability to reproduce natural Kazakh vowels is evaluated using objective measures such as pitch accuracy, stress fixation, and prosodic duration. Furthermore, the perceived naturalness and meaning of the integrated language are evaluated through empirical research with native speakers of Kazakh.

This study is of great importance for the further development of Kazakh speech synthesis technology. The goal of creating accurate phonetic models is to create a more realistic hybrid language that faithfully reflects the nuances of Kazakh. This presentation will disseminate assistive technology, language learning tools, and a multimedia content generation series with many applications to assist native speakers and learners of Kazakh.

Keywords
Intonational modeling, Kazakh language, speech synthesis, prosodic analysis, neural network-based synthesis

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Review and analysis of methods for optimizing and modeling base station positioning

15 May
3:45pm
PE111

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When planning cellular networks, an important task is the optimal location of base stations (BS). At the same time, it is necessary to ensure reliable joint operation of the BS and technical equipment operating in this area.

The article analyzes existing technical solutions for the optimal location of base stations. Brief descriptions of the standards that allow providing subscribers with a wide range of services are also given: video calls, video conferencing, high-quality voice calls, high-speed file downloading, mobile commerce, etc. Well-known models and methods for calculating the main losses during signal propagation under various conditions are given.

The choice of the most appropriate model in difficult terrain is substantiated to determine the service area in which communications with the specified quality and reliability will be ensured.

Propagation models that estimate the average signal power for various distances between the receiver and transmitter, over a range of several hundred or thousands of meters, are called large-scale propagation models. Large-scale models are quite simple and do not take into account very small changes, such as attenuation caused by multipath propagation. These models are useful in predicting the coverage of a radio communication system.

In mobile networks, communication is carried out between a stationary BS and a mobile subscriber terminal, while the parameters of the communication line change. In this regard, statistical methods are used to describe the behavior of signals in the studied area. There are several mathematical models and methods that allow you to calculate the main losses during signal propagation under various propagation conditions for macrocells and microcells. A comparative analysis of existing technologies for solving the problem allowed us to formalize the objective function and restrictions. The usefulness of the results obtained lies in the possibility of their application (after implementing algorithms for solving the problem) for optimizing and modeling the placement of cellular base stations.

Keywords
base station, signal propagation, model, service area, method

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Methods of organization of network topology based on SD-WAN technology

15 May
4:00pm
PE111

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Software Defined World Area Network (SD-WAN) leverages Software Defined Networking (SDN) technology to efficiently identify the most optimal path for directing traffic between Wide Area Networks (WAN) and Data Centers (DCs) in an automated manner. This is achieved through the use of programmable networking devices that utilize SDN protocols to steer traffic based on the parameters of application-defined policies. By facilitating programmable configurations, SD-WAN solutions enhance the operational and capital efficiencies of telecommunication companies, service providers, enterprise network owners, and data center operators, enabling them to improve connectivity, streamline network management, and scale network deployments more effectively.

In accordance with SDN principles, all intelligence is delegated to the central control plane in SD-WAN technology. The SD-WAN controller is responsible for managing Customer Premises Equipment (CPE) devices. On one side, the controller interacts with orchestrators and APIs designed for high-level network management and service provisioning, while on the other side, it collaborates with CPE devices that form the data forwarding plane. One of the key advantages of SD-WAN is its ability to dynamically allocate additional resources to the most efficient WAN connections at any given time, thereby enhancing overall user satisfaction with IT services. Additionally, SD-WAN facilitates the support of additional features beyond packet routing, such as WAN resource pooling, precise allocation to specific business obligations, which ultimately makes the network efficient and adaptable to evolving needs.

This topic reveals the principle of operation of the global network of technologies (WAN), in particular, new promising Wan technologies that are determined by software. Previous and existing WAN technologies are discussed to show their weaknesses and strengths, and then compared with SD-WAN. The technological principles of SD-WAN and its impact on the WAN market are carefully analyzed to show the reader what the scenarios for the development of this market will be.

Keywords
Software Defined - World Area Network, software, distributed networks, analysis, prospects, technologies, virtual machine, data

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Web Accessibility of Open Access Journals in Sub-Saharan Africa

15 May
4:15pm
PE111

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Open access journals (OAJs) play an important role in disseminating scientific knowledge to the world. Access to OAJs is primarily via the Internet, which reduces distance barriers and provides an opportunity for people with disabilities to access digital resources using assistive technologies such as screen readers. Currently, 16% of the world's population lives with some form of disability and cannot enjoy equal access to the web. Although equal access to the web is a human right under the Convention on the Rights of Persons with Disabilities (CRPD) and a key aspect of achieving the Sustainable Development Goals, people with disabilities still face barriers to accessing the web. The African population with access to the internet is growing, but approximately 80 million people with disabilities face barriers to equal access to the web. Some countries and supranational organizations like European Union have promulgated laws to enforce web accessibility, although many websites still present barriers to persons with disabilities. which has resulted in slight improvement in web accessibility. Legislation related to web accessibility in Africa is an ongoing challenge and there is decline in web accessibility in higher educations after COVID-19 pandemic ended. Despite the potential benefits of the adoption of open access journals in developing countries, there are not a lot of studies on their accessibility by persons with disabilities. The purpose of this study is to assess the web accessibility of OAJs in sub-Saharan Africa using the Web Content Accessibility Guideline (WCAG). A selection of OAJs, from the Directory of Open Access Journals (DOAJ), is evaluated against WCAG 2.1 using an automated web accessibility evaluation tool (AWAET), Mauve++. The results show that sub-Saharan African OAJ websites are not compliant to WCAG 2.1, and that further improvements are needed to ensure equal access for everybody.

Keywords
web accessibility, open access journals, person with disabilities, digital inclusion, sub-Saharan Africa

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Classification of Brain Tumor MRI Images Using Convolutional Neural Networks

15 May
4:30pm
PE111

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necessitating reliance solely on magnetic resonance imaging (MRI) analysis for diagnosis. Manually scrutinizing MRI data to identify tumour specifics is, however, laborious and inefficient. Currently, Convolutional Neural Networks (CNNs) are pivotal in biomedical imaging and analysis, offering automated feature extraction capabilities for high-dimensional datasets. CNNs have emerged as valuable tools in pathology classification and malignancy detection in medical imaging. Additionally, computer-aided diagnostic methods offer insights into disease mechanisms. Such methods, albeit, face ongoing challenges, with various CNN models continually evolving to enhance image classification accuracy. Our study aimed to evaluate current pre-trained CNNs for their efficacy in identifying brain tumour types. We thus assessed several convolutional network models, including VGG16, VGG19, Xception, ResNet152 V2, ResNet50 V2, MobileNet V2, Inception V3, InceptionResNetV2, DenseNet 201 and DenseNet 121. The objective was to determine the most suitable model for recognizing brain cancers. Utilizing a dataset encompassing 1426 images of glioma, 708 of meningioma and 930 of pituitary tumours, our research achieved commendable results (validation of 90the implementation of an ensemble model, combining the strengths of the above-mentioned networks, might impact accuracy. Three models will be carefully chosen for further investigation, with each demonstrating exceptional proficiency in identifying a specific class. Following this selection, they will undergo a process of integration using ensemble methods aimed at bolstering the overall accuracy of the system. Automatically and accurately segmenting brain tumour areas from multimodal MRI scans can provide crucial information about tumours, including shape, volume and localization. It should be emphasized that the preliminary results of the research reveal that convolutional networks can achieve high performance in the diagnosis of brain tumours, and that this performance might be raised in the future by applying specialized methods.

Keywords
artificial intelligence, pre-trained networks, ensemble-method, brain tumors, convolutional neural network, machine learning

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The impact of noise on deepfake audio detection

15 May
1:45pm
PE111

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Nowadays, in digital world, it is increasingly difficult to discern a work made by a human from one generated by a computer. The development of methods used to support creation is rapid and forceful. An example is machine learning (ML). Deep learning is a technique used to solve many modern problems with very high efficiency i.e. pattern recognition, natural language processing (NLP), recommendation systems. However, it can also be used to create fake media (commonly known as deepfakes), which is undesirable. Deepfake involves generating artificial media, i.e.audio, image, or video, using advanced machine learning algorithms. The term deepfake also refers to the modification of existing media by using the existing one in a very sophisticated, even unrecognizable to the human eye and ear. Deepfake media has become very popular recently due to inauthenticity becoming increasingly difficult to detect. Spreading this type of content on the Internet may involve many risks. The basic problem may be using the image of a famous person for malicious purposes, phishing, data theft and the most insidious manipulation of society, e.g. before elections. Currently research suggests that the presence of noise may make it even more difficult to detect a fake recording. Properly prepared noise present in a real recording may cause the recording to be incorrectly classified. The basic measure of noise in a recording is Signal to Noise Ratio (SNR), which can be imprecisely increased or decreased in prepared recordings - e.g. the lack of naturally occurring background noise in the case of sound generation. Another case may be an inadequate noise level in relation to the signal. Current techniques for creating fake recordings are becoming more and more advanced and the signals generated in this way have an SNR level similar to real audio. The paper presents research of the influence of recording noise on the possibility of detection and correct classification as authentic or faked. The level of recording recognition for various types of noise was tested, both in real and prepared recordings.

Keywords
deepfake recognition, audio synthesis, noise detection, artificial neural networks

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15 May
5:00pm
PE111

Lightweight CNN for stress classification

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Work pressure, fast pace of life, conflicts, and everyday life problems – these are examples of sources of stress. Lack of control or elimination of it can lead to chronic stress, which contributes to the development of so-called stress-related diseases. Often, due to the variety of symptoms, assistance from several doctors is required, such as a psychologist or a cardiologist. Certainly, preventing illnesses is less costly than later treatment. However, despite intensified health campaigns and preventive offers, an increase in stress is noticeable in every age group. Therefore, the detection and recognition of stress are crucial for taking actions to reduce stress or develop coping strategies. In the research literature, many studies related to stress detection using popular techniques can be found, including EEG, EKG, GSR, EMG, and wearable sensors. Unfortunately, these are expensive solutions and also unavailable for the average person. Therefore, it is important to seek low-cost solutions that would also fit the specifics of mhealth. An example of such a solution could be the use of smartphone thermal imaging and a lightweight convolutional network for stress detection and classification. The smartphone thermal camera provides high-quality thermal images, while also being cost-effective It works in conjunction with a smartphone, ensuring ease of use and mobility Meanwhile, lightweight convolutional networks do not require massive computational resources, ensuring efficiency and time savings. At the same time, lightweight CNN characterized by speed of operation and efficiency. Taking everything into consideration, a test study of stress detection and classification was conducted using thermography and lightweight CNN networks. Using a smartphone thermal camera, the research participants exposed to stress were recorded. The obtained images served as research data. A simple lightweight convolutional neural network was used for stress classification. The model employed batch normalization and L2 regularization, among other techniques. Ultimately, for multiclass classification (four classes), an accuracy of 87% was achieved. The study confirmed the effectiveness of the lightweight CNN and the potential of detection technique.

Keywords
convolutional neural network, stress detection, thermovision, lightweight CNN, machine learning

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15 May
5:15pm
PE111

Application of mel-spectrograms in Polish national music recognition – case study

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Folk dances and music are invaluable cultural treasures that identify the history and traditions of communities. Their protection is necessary due to the effects of globalization. They serve as a vital conduit for intergenerational knowledge transfer, allowing for the preservation of unique artistic languages, steps, and rhythms that might otherwise vanish with the passing of elder practitioners. Preserving these art forms is crucial not only for maintaining cultural diversity but also for fostering global understanding and respect among different peoples through the appreciation of their distinct heritage. This study aimed to elucidate the case study of Polish national dance music recognition which is a significant part of preserving intangible cultural heritage. It was decided to focus on five Polish national dances due to the decreasing interest of young musicians, which may threaten to forget this part of art. Using online resources, the dataset of 137 audio files was created consisting of the following national dances: the Polonez, the Oberek, the Mazur, the Krakowiak, and the Kujawiak. The files were converted from mp3 into WAV format. Each of them was cut into a 10-second piece both to enlarge the dataset and to facilitate music recognition. From each recording, that demonstrates the unique features of each dance, the mel-spectrum coefficients were extracted and mel-spectrograms were generated. Due to the application of the mel scale, it became possible to evaluate the subjective sound level perceived by the human ear within the sound frequency measurement scale. The database consisting of over two thousand files was divided into training and testing datasets 80% and 20%, respectively. The most popular classification models such as VGG, and ResNet were applied. They were compared using the following metrics: accuracy, precision, recall, and F1 score. A proposed case study could have several applications in multiple fields, for example, song auto-tagging or music-driven dance generation.

Keywords
mel-spectrum coefficients, music recognition, Polish national dances, VGG, ResNet

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15 May
5:30pm
PE111

Registering vehicle movements using motion capture data – methodology and further implementations

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The implementation of scientific achievements in the entertainment industry allows for intensifying the recipient's feelings due to the use of sophisticated technology such as Virtual Reality. 3D modeling for creating graphics has reached a great interest, recently. The use of modern technology allows one to transform the actual movement of objects into digital data. As a result, interactivity, realism and automation are obtained, making the applications more attractive for the user. Creating animations is currently supported by various computer methods. The most frequently applied is Motion Capture, which allows one to map movement and its trajectory into 3D space. The precise and realistic reproduction is possible by utilizing an optical system. This study aims to elucidate the methodology that can be applied to analyse the movement of remotely controlled cars.

The proposed methodology consists of the following stages: 1) developing a mock-up containing three types of roads, 2) preparing remote controlled cars for recording by attaching markers in precisely defined places in such a way as to reproduce their shape, 3) recording four various types of movements: straight line forward and backward, along the curve in the left and right, 4) verifying the correctness of the recordings by reviewing marker tracks, and 5) post-processing the obtained data. In order to record movement, the 8-camera VICON system was used, which is an example of a passive motion capture system. The study was performed at the Motion Capture Laboratory at the Lublin University of Technology. A database of vehicles movement on the mock-up was collected in the form of C3D files. The preliminary analysis highlighted the need for algorithms to fill in gaps in the beginning and at the end of the movement. The development of the method will obtain the realistic trajectory of the vehicle's movement along the entire route.

The proposed methodology has potential applications in animations, video productions as well as gaming.

Keywords
motion capture, realistic animation, vehicle movement, methodology

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Poster Session

15 May
12:00pm-1:00pm

Social media application supporting dog care

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The work titled "Social media application supporting dog care" focuses on describing the software development process for a wide range of users. The primary target audience for the developed system are dog owners who, after a thorough analysis, cannot find alternative solutions tailored to their needs and are forced to use monopolized solutions which have big impact on users everyday life (both positive and negative). Globalization in solutions such as Facebook, YouTube, and Instagram is often overused for financial gains as well as market domination. They exploit the global society's dependence on these solutions, compelling users not only to consume marketing content but also to create substantial revenue sources from so-called premium plans that provide access to basic service features based on monthly subscriptions.

The goal of the work was to create an application that could become an alternative to social media market leaders, providing a familiar interface but addressing the needs of a smaller target group. The target group was narrowed down to dog owners due to the social characteristics of the group and the positive effects of social interaction.

Due to the nature of the developed platform and its implementation ,both the client-side and server-side parts were implemented using JavaScript. The choice of this language was made to speed up the development process and facilitate integration with the selected database technology. The programming frameworks used include Node/Express on the server-side because of its performance, as studied in "JCSI Journal of Computer Sciences Institute Vol. 19/2021". React.js was selected on the client-side based on good industry practices. Due to the dynamic nature of data within social media, a NoSQL approach was employed, allowing for a simpler data model compared to a SQL database approach. The chosen database system was MongoDB, which is highly popular according to the db-engineers ranking.

Keywords
social media, node, express, mongodb, react.js

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15 May
12:00pm-1:00pm

Comparative analysis of selected tools used in the speedcubing community

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Speedcubing is the solving of Rubik's cubes as well as logic puzzles on time and it is closely monitored by the World Cube Association to keep a watchful eye over the correct course of the competition regulations. Speedcubers use a variety of IT tools to improve their solving techniques, often integrating them into their daily practice or learning routines. These tools cater to different skill levels and preferences, reflecting the diverse needs of the speedcubing community. A survey is proposed to comprehensively review and compare the most commonly used tools in speedcubing from multiple perspectives. This research aims to provide insight into the preferred tools and their usability for different skill levels. Preliminary results have highlighted CS Timer and Twisty Timer as the two most prominent tools. Although CS Timer is the more popular choice among respondents, a detailed analysis is required to determine if CS Timer is ultimately a better tool for speedcubing. It is important to consider various factors that can influence the choice of the best timing tool when solving a Rubik's cube, despite the majority preference for CS Timer in the speedcubing community. Only after a thorough examination of these aspects can we unequivocally conclude which tool better meets the needs of the speedcubing community and is more effective in the practice of solving Rubik's Cube. Speedcubing timers and algorithm databases are an integral part of a speedcuber's toolkit, providing functionalities such as event selection, scramble generation and performance tracking. Algorithm databases aid in method training by presenting different sub-cases and solution possibilities. However, not all tools are equally effective or widely used. During the preliminary survey, respondents also gave other tools such as algdb.net, qqtimer.net and jperm.net. The final study concludes that CS Timer is the best tool for speedcubing, validated by intensive data analysis and user feedback. Of all the possible tools, this tool initially received the most votes, and compared to the second most popular tool, it proved to be a more universal tool for everyone and CS Timer proved to have far more features that are useful for the speedcubers. The whole comparative analysis made it possible to find the best speedcubing tool, but also showed how many tools there are in this community and what others need to be considered in order to reach the CS Timer application.

Keywords
speedcubing, Rubik's Cube, logic puzzles, IT tools for speedcubing, tool proficiency levels, comparative analysis, optimal tool selection

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15 May
12:00pm-1:00pm

RPG game with elements of resource management

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Designing a game that integrates the RPG genre with elements of resource management is a significant contribution to the field of computer game science. This process was carefully documented, starting from the identification of actors, through the specification of functional and non-functional requirements, to the development of use cases, activity diagrams, sequence diagrams and interface prototypes. The use of the Unity Engine and the Inky library emphasizes the importance of technological innovation in the context of creating interactive narratives and graphics. It is worth noting that most of the game's elements, including scripts and graphics, were created from scratch, which proves the care and commitment of the design team. The gameplay itself offers the player a variety of opportunities for interaction and choice, which makes this project a rich source of data for analyzing player behavior and gameplay dynamics. The work encourages the exploration of various aspects of game design and the possibilities of implementing new functions or gameplay mechanics, as well as to expand knowledge about computer game design and the interaction between the player and the game. Analysis of data collected during gameplay can also provide valuable information about users' preferences and behavior, which can be used in further research on the perception and reception of computer games. It is worth noting the potential of this project as a research tool in the field of human-computer interaction. Analyzing the interaction between the player and the game can provide a deeper understanding of the cognitive and emotional processes occurring during gameplay. Additionally, the ability to further develop the game, both in terms of content and mechanics, provides a unique opportunity to experiment with different concepts and explore their impact on the player's experience and the effectiveness of the narrative message. Continued research work on this project may lead to the discovery of new trends and patterns in player behavior and the creation of more advanced data analysis models in the context of computer games. As a result, this project may contribute to the further development of theories and practices related to game design and generate new perspectives on human interaction with entertainment technology.

Keywords
role-playing game, resource management, 2D game, interactive narration, unity, open world

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15 May
12:00pm-1:00pm

A Novel Method for 3D Models Fingerprinting

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In recent years, the development of new technologies has raised the importance of 3D techniques in various fields, including modelling, industrial production, animation and 3D printing. Given their widespread use and presence in the free media space, the integrity and authentication of 3D models have become indispensable, especially in scenarios where protection against unauthorised modification or forgery is crucial. Providing adequate protection is possible through the use of cryptographic techniques, but this will result in restricted access to the model data. Steganographic techniques, in particular fingerprinting, which allows a watermark to be attached to data confirming its originality, do not suffer from these disadvantages. The fingerprint is destroyed or corrupted if the data is modified.

Several methods produce fingerprints based on geometric features, such as vector norms or a triangle strip peeling sequence. Some solutions use technologies used in image steganography or video watermarking.

This paper presents an innovative, universal approach that works in the geometric domain. This novel approach addresses the drawbacks of previous methods, such as the introduction of significant noise due to excessive modifications and computational inefficiency.

In this research paper, the impact of appending additional data to the model by modifying the vertex coordinates of the 3D model grid and its effect on the level of interference was analysed. The results obtained confirm the applicability of the method for tagging 3D models of different sizes, highlighting its potential as a robust solution in the field of steganography. In addition, the relationship between data embedding ability, visual model distortion and various quality indicators was investigated. For fingerprinting, a discrete wavelet transform was used for signal decomposition and HMAC for data originality verification. The size of the fingerprint data depends on the cryptographic hash calculation algorithm used - for the SHA-512 algorithm, it is 64 bytes and is generated from the vertex coordinates and textures of the model. The originality of the model can be confirmed by extracting the attached HMAC and comparing it with the HMAC value calculated for the tagged model. The proposed method offers a high level of transparency of the attached data and allows the detection of arbitrary modifications to the model.

Keywords
fingerprinting, fragile watermarking, 3D model, discrete wavelet transform, steganography, Hash-based message authentication cod

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15 May
12:00pm-1:00pm

Comparative analysis of the functionality and interface quality of KeePass and 1Password password managers

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The most common way to secure access to online accounts is to use passwords. However, over time, the number of accounts used, and therefore the number of passwords that the user must remember, increases significantly. An additional difficulty in remembering them is that they must be long and complicated. However, this has the opposite effect. Users create simple passwords that are easy to remember and guess, and use them many times across different accounts. Password mangers offer a solution to this problem. They make it possible to generate long and complex passwords and allow them to be stored safely in one place. There are many such programs available on the market, both paid and open source. There is therefore a choice problem for future users.

The paper presents a comparison of two password managers. One of them represents commercial software: "1Password" and the other is open source software: "Keepass". Both are the most popular in the category they represent. Two aspects were taken into account in the comparison: the functionality and the quality of its interfaces. The quality of the interfaces was assessed using users. The research used the scenario method, the A/B technique and the System Usability Scale (SUS) method. The A/B technique was chosen because of its use in comparative user research, and the SUS method was chosen as an industry standard. The size of both research groups was 8. The groups were homogeneous in terms of age and education background. Users were to complete the developed scenarios with the programs and, immediately afterwards, complete the SUS survey. The quality of the interface was assessed based on surveys and time of scenario execution. Both programs offer a basic set of functionalities. The manager “1Password” offers several additional functionalities compared to “Keepass”. "Keepass", due to its open source nature, allows you to independently expand the software.

The average value of SUS points for the "1Password" password manager interface was 61.9, and for "Keepass" - 66.9. This places both programs below the industry average (i.e. 68 SUS points). Measuring the execution times of all four scenarios showed that users performed them slower using the "1Password" password manager. In the case of this program, the average time to complete the scenarios was 503 seconds, compared to 468 seconds for “Keepass”. The speed of scenario implementation is correlated with the quality of the interface assessed by users.

Keywords
password, password manager, Keepass, 1Password, security, software comparison

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15 May
12:00pm-1:00pm

Comparative analysis of the performance of serverless services offered in selected computer public clouds

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With the evolution of the containerization idea and technology, a micro-container approach has emerged, creating a new branch of cloud-delivered services known as "Function-as-a-Service". The main idea is to create a runtime environment for each user request, an approach that was previously impossible due to the excessive initialization time of the environment.

The objective of this research is to evaluate the performance of serverless solutions through the examination of selected implementations of typical applications. Based on the findings, the aim is to identify the most effective solution in different usage scenarios. The results of the study helped verify the hypothesis that compiled language is more efficient than interpreted language in serverless environments.

The research prepared 3 scenarios: a performance study based on CPU-intensive operations (recursive Fibonacci string computation), a performance study when interacting with a database, and a cold-start study for the previous two scenarios. For each scenario, 3 programming languages were tested: Golang (compiled language) and Node.js and Python (interpreted languages). Each function was also run for two RAM settings, 128 MB and 256 MB.

The first scenario was run for two N parameters (where N is the number for which the Fibonacci sequence is computed), where in the first case it was N=5, which allowed to confirm that for already initialized environments the client-side response time is the same for all tests, thus each function works in a similar environment and any deviations in the following scenarios are due to configuration. The second case, where N=27, allowed to confirm the thesis that compiled languages are more efficient in this scenario, where the difference in average response time from the fastest time ranged from 19% to 1960%. The second scenario, based on communication with the DynamoDB database, also confirms the above thesis, but the differences are much smaller. For the values in the 90th percentile, it can be seen that the results are similar when comparing Golang and Python, but Node.js has a time 24% longer for the same memory configuration. The last of the scenarios does not completely disprove the hypothesis, as the results for the first of the cases are comparable, but in the second case the time has deteriorated significantly for the compiled language.

Keywords
function-as-a-service, serverless, aws, cloud computing, performance

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15 May
12:00pm-1:00pm

Analysis of the graphical interface of logistic companies' websites, taking into account the principles of universal design

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Universal design (UD) refers to an inclusive approach for designing products, environments, or systems that ensures accessibility and usability for a diverse range of users, regardless of their age, gender, race, or disabilities. The set of principles of UD was defined to eliminate barriers and enhance the user experience for individuals with varying needs, ultimately promoting inclusivity and diversity. Thus, the significance of UD extends to the realm of software development. The aim of the study was to assess how the graphical user interface (GUI) of an established logistics company's websites influences webservices accessibility, taking into consideration UD principles. In the study, two webservices from the same industry branch were analyzed, one website fully compliant with the UD principles, which was created solely for the purpose of this study, and the other, Prime Parcel Service, that did not take into account these rules. Investigating the central question of this research topic within the context of usability and accessibility, this study examines three distinct hypotheses: 1) Websites compliant with the principles of UD outperformed those not following these guidelines in terms of effectiveness and efficiency; 2) Services compliant with UD principles exhibited higher user interface quality; 3) User satisfaction with the interface interaction was superior for websites conforming to UD principles. Three methods were used to determine the websites' accessibility: the LUT (Lublin University of Technology) survey, an evaluation based on WCAG 2.0 (Web Content Accessibility Guidelines) standards using the WAVE evaluation tool (Web Accessibility Evaluation Tool), and eye-tracking technology for observing user behavior on websites. The findings of the study conclusively supported all proposed hypotheses, demonstrating that websites and services designed in accordance with UD principles significantly outperformed those that did not, in terms of effectiveness, efficiency, user interface quality, and user satisfaction. The obtained results indicated that websites adhering to the UD guidelines were more user-friendly and intuitive. The concluded analysis proved that the topic of this study is of great importance and worth exploring in greater detail in the future.

Keywords
universal design, graphical interface, accessibility, usability, eye-tracking, WCAG

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15 May
12:00pm-1:00pm

Performance analysis of containerization solutions

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In today's dynamic software development landscape, where flexible and efficient tools are imperative, containerization emerges as an indispensable technology. Containerization constitutes a pivotal element of contemporary IT solutions, facilitating application isolation from the environment, thereby enhancing reliability, scalability, and portability.

The discussed poster focuses on evaluating the performance of three popular containerization solutions: Docker, Lxc, and Podman. The authors aimed to identify the most efficient containerization technology through performance tests conducted on the Linux platform. The poster commences with a brief analysis of existing research on the aforementioned containerization technologies, followed by an exposition of Podman, Lxc, and Docker technologies along with the utilization of the sysbench tool used for conducting tests. Next, the authors present the results obtained from the conducted benchmarking tests. Then, a discussion of the results is conducted.

The benchmarking results indicated that Podman emerged as the most efficient solution compared to Docker and Lxc. In terms of CPU performance tests, Docker exhibited lower efficiency compared to Podman by 3%, and Lxc by 2.6%, with Podman being the most effective. Similarly, concerning memory write tests, Docker displayed lower efficiency compared to Podman by 48.3%, and Lxc by 47.5%, while Podman showcased the highest effectiveness. Moreover, in memory read tests, Docker demonstrated lower efficiency compared to Podman by 10.8%, and Lxc by 11.4%, with Podman once again achieving superior results. In the category of disk write tests, Docker exhibited marginally lower efficiency compared to Podman by 0.2%, and Lxc by 1.5%, whereas Podman continued to demonstrate the most effective performance. Only in disk read tests, Podman showed lower efficiency compared to Docker by 0.5%, and Lxc by 0.4%, albeit Docker remained the most efficient solution. The research findings highlight the superiority of Podman over competing solutions Docker and Lxc, demonstrating its greater effectiveness across the majority of tested performance categories. The repetition of tests ten times, along with a meticulous analysis of results, ensured the reliability and credibility of the conducted research. Additionally, it is noteworthy that Podman, as the most efficient technology, may be a favorable choice for organizations seeking to optimize the performance of their containerized applications.

Keywords
containerization, Docker, Podman, Lxc, performance

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15 May
12:00pm-1:00pm

Performance analysis of data encryption methods

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Due to numerous cyberattacks taking place in recent days, data security is quickly becoming an increasingly significant issue. More and more sensitive data is stored in a digital form. A leakage of such data can have a devastating impact on both individuals and businesses.

The above concern is the reason for utilizing data-at-rest encryption mechanisms. Such mechanisms are becoming more widely used in enterprise information systems and on personal computers.

All encryption methods, however, rely on sophisticated arithmetic and logic operations, which need to be performed by the central processing unit during each input and output operation. This raises questions regarding the impact of data-at-rest encryption on the overall system performance and responsiveness.

This paper tries to answer the question of how significantly specific encryption methods impact the disk read and write operations speed, as well as processor utilization during such operations. Two software platforms (Linux and Windows), as well as various hardware platforms are also taken into consideration. Firstly, the authors perform a brief overview of existing research done in this area. Secondly, a description of all the analyzed encryption mechanisms and algorithms is provided, along with a specification of tools and research methods used to carry out the analysis. Flexible I/O tester (fio) tool was used to run the performance benchmarks for each encryption method and algorithm, including Advanced Encryption Standard (AES), Serpent and Twofish. After that, a comparison of the benchmark results for each encryption mechanism and algorithm is provided, with a specification of the software and hardware platform. Then, a discussion of the results is conducted.

The overall conclusion that can be drawn is that on hardware platforms with built-in native support for encryption instructions (specifically Intel AES New Instructions – AES-NI), the impact of using data-at-rest encryption mechanisms is insignificant and does not affect the performance in any meaningful way if the mechanism utilizes a hardware-accelerated encryption algorithm (AES). However, when encryption is applied on a device without the support for AES-NI, or if a different algorithm is used, the read and write speeds are reduced by 50-70% and the processor load rises up to 20 times. Finally, the authors draw overall conclusions from the research results and decide how to prevent data-at-rest encryption from impacting the performance.

Keywords
kryptography, data security, encryption, performance, AES, Serpent, Twofish, LUKS

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A Comparative Analysis of Message Brokers Applied in an Asynchronous Java-Based Application Server

15 May
12:00pm-1:00pm

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The work aims to analyze three popular systems: Apache Kafka, Apache Pulsar and RabbitMQ, in terms of their functionality and architecture. The tests were realized for different message sizes, using the open source OpenMessaging Benchmark project. Each test was run in triplicate, and the final results represent the average of the obtained results. Due to the specific architecture of the RabbitMQ broker, the test configuration was adjusted accordingly by manipulating the available resources to replicate the behavior of the Apache Kafka and Apache Pulsar brokers.

The test results showed that Apache Kafka outperformed the other brokers in terms of possible throughput, regardless of the message size. For a message size of 100B, Kafka reached 347 MB/s, Apache Pulsar - 293.02 MB/s, while RabbitMQ only 3.21 MB/s. For other message sizes, Kafka achieved a maximum throughput of 620 MB/s constrained by hardware limits. Due to the different architecture of the RabbitMQ's throughput was markedly lower, barely reaching 1% of Kafka's and Pulsar's at 100B and over 90% lower at 1 kB due to bandwidth caps at about 25,000 messages per second. The advantages of the RabbitMq broker, on the other hand, are evident in the case of latency tests. For a message size of 100B, the average latencies for Apache Kafka, Apache Pulsar and RabbitMQ were respectively: 13.16 ms; 3.53 ms; 1.71 ms. The results for message sizes of 1 kB also showed an advantage for RabbitMQ, obtaining average delays of 1.71 ms, where for Apache Kafka and Apache Pulsar the average delays were 2.56 ms and 3.15 ms. In the case assuming message sizes of 64 kB, the average latencies for Apache Kafka, Apache Pulsar and RabbitMQ brokers were 2.58 ms; 2.88 ms and 3.65 ms, respectively.

The study suggests that for expected system throughput, where the lowest possible latency is not necessary, Apache Kafka or Apache Pulsar are good choices. On the other hand, when immediate data transfer is more important, RabbitMQ becomes a good match. If the system is to operate in a distributed global environment, it is possible to use the geo-replication offered by Apache Pulsar, speeding up the operation if different parts of the system are located in different parts of the world. On the other hand, when complex message distribution is more important, RabbitMQ and Apache Pulsar will find their place, offering the ability to configure special rules that determine the target queue to which a message will go.

Keywords
message brokers, Apache Kafka, RabbitMQ, Apache Pulsar, performance, throughput, latency

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15 May
12:00pm-1:00pm

Possibilities and effectiveness of Stable Diffusion AI generative model

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In the era of artificial intelligence's burgeoning complexity and efficiency, the advent of text-to-image models was only matter of time . These models, capable of generating images from textual prompts, have proliferated in both commercial and open-source version in recent years. This technological advancement empowers individuals devoid of artistic skills to materialize their ideas into visual form, thereby enriching the internet with a plethora of diverse and captivating images.

The thesis examines the "Stable Diffusion" model, which employs an algorithmic approach to progressively refine images by reducing noise from random input until a desired effect, prompted by specific cues or concepts, is achieved. Utilizing a diffusion technique, it iteratively enhances image quality throughout the generation process. The research evaluates commercially available open source algorithms built upon the Stable Diffusion model, analyzing the quality, generation time, and efficiency of its components.

During the study, various algorithmic variations were explored, including control models, samplers, generation step counts, and the influence of "LORA" models. Additionally, the study investigated differences between single-image and simultaneous multi-image generation. Factors like the "Clip Skip" technique, the "ControlNet Image" network, and VAE models were examined for their impact on image quality, particularly in enhancing sharpness and features like hands and faces. Furthermore, the study examined the influence of keywords, such as celebrity names, on the generated images. Lastly, ongoing research delved into the analysis of "Inference Steps," crucial for image quality and generation timing.

The research conducted is important because it can contribute to the further development of algorithms based on the Stable Diffusion model and improve the understanding of which factors and how they affect the quality and efficiency of these algorithms.

The experimental results confirmed the relationship between the parameters and the final effect of the generated image, especially visible when changing the checkpoint models and the power of the LoRA models. Additionally, control over the generated image using appropriate keywords and tools such as ControlNet has demonstrated the ability to tailor the image for intended purposes, although these changes impact generation time and hardware resource consumption.

Keywords
Stable Diffusion, LoRA, VAE, Automatic1111, EasyDiffusion, artificial intelligence, ControlNet, Clip Skip

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15 May
12:00pm-1:00pm

Analysis of emotions in social media: Comparison of NLP models in detecting emotions triggered by posts from the X platform

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Global digital development has led to an increase in the popularity of social media. These portals generate huge amount of data every day in the form of posts, photos and videos. They have become a place where Internet users share their emotions, preferences and experiences. Interpreting and understanding this content is a key tool for anticipating, analyzing and responding to any social changes. Therefore, research related to automatic emotion detection is constantly gaining popularity.

In this research, approximately 8,000 English-language entries from the X platform, previously known as Twitter, were analyzed. Each entry was assigned a maximum of two of the eight basic emotions of the Plutchik model.

Many previous studies have shown the significant impact of emoticons on the emotional tone of the entries they contain. Therefore, 10 emoticons were selected that were most frequently used by users of the X portal. These emoticons were matched to individual emotions based on the survey results. 200 respondents representing various social groups took part in the survey.

The results of the data labeling process largely coincided with the assumptions of Plutchik's model. Emotions that, in this model, appeared simultaneously in given texts many times are recognized as related emotions in Plutchik's model.

One of the main assumptions of the research was to select a natural language processing model that is the most effective in tasks related to automatic detection of emotions in text. Three models were selected for testing: BERT, ELECTRA and XLNet. Each of these models uses the Transformer tool, but each in a different way. These models were trained on 90% of the data obtained from website X. The accuracy of these models was in a wide range of 35-80%. Some of the models showed significant learning progress. Others, however, were distinguished by low interference times. The choice of one best model could not be clear. Model quality can be determined based on various factors resulting from specific hardware and design requirements and constraints.

Keywords
emotion detection, natural language processing, X platform, affective computing, emojis, emotion analysis, emotion model

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15 May
12:00pm-1:00pm

Comparative analysis of the performance of cryptographic algorithms in multiplatform programming using MAUI and Flutter platforms

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This work presents the results of comparative analysis of cryptographic libraries on the MAUI and Flutter platforms. The development of technology has led people these days to use all sorts of platforms using a variety of operating systems. In order to adapt to the modern market, developers must ensure that their applications are supported on a variety of devices. This is made possible by using for example the Dart language with the Flutter programming framework, or .NET in cooperation with MAUI. Both of these solutions are popular tools for programming multiplatform applications, which also have all kinds of implementation of encryption algorithms. The work includes the selection of several cryptography algorithms such as: AES, RSA, DES, 3DES and ChaCha20Poly1305. The research was carried out on two identical proprietary applications and included comparative analysis of the execution speed of cryptography operations and their impact on CPU and RAM usage. The tests were conducted on two computers with AMD and Intel processors as well as on Android mobile device. The results of the algorithm execution times were collected using internal functions inside the application code. The application's impact on CPU and RAM was collected using built-in system performance monitors. The results suggest that the application created using MAUI technology achieves significantly shorter execution times for encryption and decryption than the one created using Flutter technology. On the AMD processor platform, the application written in Flutter used about 17% less CPU resources, while on the Intel processor computer there was no significant difference in CPU usage between the two applications. In the case of RAM, for the AMD CPU computer there was no significant difference in RAM usage, regardless of the technology used, while for the Intel CPU computer the application written in Flutter used about 6% more RAM. When tested on a mobile device, no significant differences were noticed in CPU or RAM usage between the tested applications. Analysis showed that if the most important aspect of the application is the execution time of the cryptography operations, then the best solution is MAUI technology. When performance is a major factor for an application, Flutter provides better optimization of available system resources.

Keywords
cryptography; encryption; decryption; MAUI; Flutter

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Comprehensive analysis of selected kidney stone segmentation methods

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Kidney stones are affecting an increasing number of the population and thus contributing to a rise in patients seeking treatment at hospitals and requiring hospitalization (Fwu et al., 2013). The increased number of patients with kidney stones is leading to a heavier workload for radiologists, thereby prolonging the queue for diagnosis and the initiation of appropriate treatment. Due to this it is crucial to come up with a suitable solution that would support the work of radiologists. As the most efficient solution can be considered neural network models, particularly deep neural network segmentors (Çiçek et al., 2016). They are designed and trained specifically to search for renal calculi on 3D volumetric medical images, which greatly outperforms classical 2D approaches. Such models are capable of detecting and pointing out localization and size of searched objects on medical images. These methods utilize clustering objects on a basis of their specific features like color or texture. This study covers the topic of comparing the performance of various segmentation architectures. Furthermore, a new convolutional neural network model for kidney stone segmentation on computer tomography (CT) images has been proposed. This model is based on the V-Net architecture (Milletarì et al., 2016), with its hyperparameters adjusted to achieve high performance in kidney stone segmentation. According to the authors knowledge this study also describes the first use of the V-Net architecture for kidney stone segmentation of 3D volumetric images. To compare the results obtained from the proposed model with other kidney stone segmentation models, several popular and high-performing models were selected such as 3D U-Net or UNETR (Li et al., 2022). The comparative models were trained on the same dataset as the proposed model. The metrics used to compare performance of models were accuracy, sensitivity, F1 score and precision. The proposed model may be considered as an alternative to widely used models for kidney stone segmentation and could help alleviate the workload of radiologists.

Keywords
V-Net; segmentation; convolutional neural networks; kidney stone; 3D medical images; image processing

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Artificial Intelligence Use for Classifying Measurement Data

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In today's data-driven world, the need for effective classification of measurement data is of great importance in various fields. The main goal of this study is to deepen the understanding of machine learning concepts, demonstrate the possibilities in using the R language, and contribute to the continuous improvement of classification techniques for analyzing measurement data. Using datasets covering different domains such as phone prices, wine quality assessment, diabetes diagnosis and others, this study provides a thorough evaluation of the proposed methodologies in different contexts, contributing to a comprehensive assessment of their effectiveness.

The study employs a machine learning approach implemented in R to classify measurement data. Various classification algorithms such as decision trees, random forests, support vector machines, and neural networks are trained and evaluated on a datasets comprising diverse measurement data and then analyzed.

The results indicate promising performance of machine learning models in classifying measurement data. It was observed that certain algorithms outperformed others in terms of accuracy and computational efficiency. Notably, the random forest algorithm consistently emerged as the one of the best performers in accuracy across various experimental setups, demonstrating its reliability in handling complex and high-dimensional measurement datasets. In contrast, the k-nearest neighbors (KNN) algorithm often exhibited lower accuracy and struggled to match the performance of random forest and other decent models.

Furthermore, the study explores the impact of feature selection and dimensionality reduction techniques on classification performance. Feature selection methods such as principal component analysis were found to enhance model performance by eliminating irrelevant or redundant features and reducing computational complexity.

The findings of this study underscore the potential of artificial intelligence, particularly machine learning algorithms implemented in R, for effectively classifying measurement data. By leveraging these techniques, corporations and researchers can streamline data analysis processes, improve decision-making, and unlock valuable insights from their measurement datasets. Overall, this study contributes to advance the understanding of artificial intelligence for classification tasks in measurement data analysis.

Keywords
Artificial Intelligence, Machine Learning, R, Classification, Big Data, Analysis, Prediction

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Comparison of web application frameworks in terms of their communication with database management systems

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The main purpose of this research was to determine the best combination of a DBMS (database management system) and a web application framework for creating RESTful API-based backend for a web application. The chosen DBMS systems for this research were: MySQL, representing a system for managing relational databases, and MongoDB as the most popular system for document databases. The frameworks chosen were: Laravel, a PHP-based framework and Express, which uses NodeJS. An example database and web application were designed for the purpose of this experiment, which allows to view and manage basic information about movies and their creators – actors, writers and directors. People are connected to movies in this application via a many-to many relationship. The relationship also holds information about the role of the person, which is stored as a role entity in the database. The database model was reproduced in each DBMS and application combination in such a way that all of them work as similarly as possible, considering the recommended practices for both frameworks. The experiment tested the efficiency of each combination of a framework and a database management system, measuring the time it took them to answer requests using Apache JMeter for a varying number of users and requests. The applications apply all DML (Data Manipulation Language) queries for their respective databases to fully cover a basic CRUD system (Create, Read, Update, Delete). All the endpoints in the applications were designed to verify the incoming data to match the database model and validate its compliance with specified constraints using technologies available for the frameworks chosen. Each endpoint creates queries to the database for the relevant information. In the case of endpoints handling GET requests, they also returned a mapped data with data read from the database. Each of the endpoints was configured in Apache JMeter to be tested by virtual users, whose number was increasing over specified time to a set maximum value for the selected measurement. The original thesis of the research was that the Express framework with MongoDB database management system would be the most efficient in returning correct responses. The data from the load tests of the application with the JMeter software were analyzed with ignoring the outlying results and then calculated on the basis of the relevance of each query type in usual usage.

Keywords
database management system, web framework, Laravel, ExpressJS, MySQL, MongoDB

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Usability analysis of web service utilizing animations

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The usability of web services has recently been a major area of interest . Nowadays, websites often possess animations that improve communication if they are properly applied. Few studies have investigated the influence of animation on usability. The purpose of this study was to investigate how animations used in design of websites influence their usability. In order to examine the subject matter the following hypotheses have been established:
•Using too many animations distracts users, keeps their attention off important elements and negatively influences usability of website
•Websites that use animations to direct user attention to the most important parts of website have better usability then those that not
•Presence of animations on website have positive influence on usability

To validate the hypotheses, three versions of the same website were created, one containing hypothetically good animations, other containing bad examples of animations and the last one containing no animations at all. The participants of the study performed a set of tasks on a randomly assigned version of the website. The time required to finish each task, along with the number of clicks and the distance the mouse covered, were measured. The users were also asked to participate in a survey assessing user experience, perceived usability and satisfaction.

According to the survey, users' overall satisfaction, ease of use and opinion of website aesthetics has been the worst for the website with excessive use of animations, and the best for the version with moderate animation usage. On average the users of website with good examples of animations noted that animations had a positive influence on easiness of performed tasks, and did not distract their attention, and users of website with bad examples noted little influence of animations on these aspects. All of the above conclusions support the proposed hypotheses.

However, contrary to the survey results, performing tasks on website with good animation examples required 14% more time, 40% more clicks and 75% more mouse movement than on the website with bad animation examples. Users required the least average amount of time, clicks and mouse movement to perform tasks on website with no animations.

In conclusion the study showed that users' perceived usability may vary from what could be concluded based on objective measurements like time, number of clicks or mouse distance covered, necessary to perform tasks.

Keywords
animations, website usability, user interface, usability evaluation, website design

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