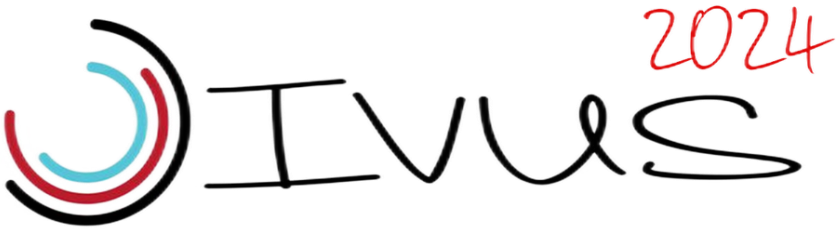


29TH INTERNATIONAL CONFERENCE INFORMATION SOCIETY AND UNIVERSITY STUDIES

Abstracts

Kaunas, Lithuania

Vilnius University, Kaunas Faculty

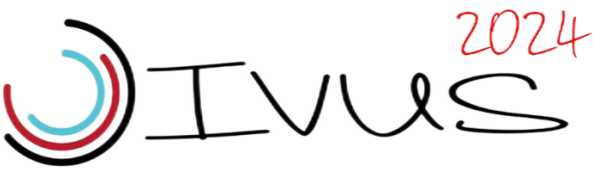
www.knf.vu.lt/ivus2024

May 17th, 2024

Vilnius University

Kaunas University of Technologies

Vytautas Magnus University



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Preface

29th International Conference “Information Society and University Studies” IVUS2024 is the continuation of the annual conference series organized in succession by three universities: Vilnius University Kaunas Faculty, Vytautas Magnus University and Kaunas University of Technology. The event was started in 1995. In 2017, the conference became an international event. For the reason of a long history of this conference, we left conference acronym according to it's Lithuanian title “Informacinė visuomenė ir universitetinės studijos” – IVUS.

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Building Heat Loss Evaluation using Artificial Intelligence Methods and Thermal Photogrammetry

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Thermal point-clouds are becoming increasingly relevant in times of climate change, and it is essential that efficient methods for calculating heat losses exist. Whilst heat losses can be calculated by means of simulations and / or on-site expertise, such methods can consume significant financial resources. With the rise of artificial intelligence methods and the availability of thermal imaging technologies, they can be utilized for the automation of such calculations. We propose a methodology for calculating heat losses based on thermal photogrammetry and imaging. By segmenting thermal point-clouds for buildings and removing noise from the result of the segmentation, the output is a point-cloud that is void of unnecessary data for heat loss calculations. This model is then converted to a mesh, and heat losses are calculated for each triangle of the mesh by mapping the area of each triangle to the surface temperature of it based on the closest RGB color from the thermal images, resulting in a direct map between triangle surface area and triangle surface temperature. Our results indicate that such a methodology can be used for more efficient heat loss calculations, as we have achieved a mean average error of 0.42 kW or 0.14 kW depending on whether the ground is considered during calculations or not, respectively. Further work could explore calculating heat losses for multiple buildings at a time, calculating heat losses during different seasons. Furthermore, different emissivity and thermal loss coefficients can be used, as using static values for these parameters limits the accuracy of the calculations.

Fine-Grained Visual Classification of Fish

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Fine-grained visual classification (FGVC) is a concept of classifying images belonging to the same metaclass. This problem is challenging due to the small differences between classes and also the small number of data. In this paper, a fine-grained classification model based on the attention mechanism is proposed. Attention allows the model to focus on small differences that determine class membership. The model used was tested on the Croatian Fish Dataset and achieved an accuracy of 94.375%.

An Overview of Patient Monitoring Systems Based on Machine Learning in the Internet of Things

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The Internet of Things (IoT) is widely used in many applications including patient monitoring systems. The purpose of healthcare systems is to monitor the patient in order to prevent risks, deal with critical cases quickly, and establish long-distance communication for remote treatments. The IoT has a longterm impact on patient monitoring, patient management, patient physiological information, and critical care. Sensor are connected to the patient to collect the data which are first sent to system controls and then autonomously to healthcare providers. There are a variety of biosensors that send the medical information to mobile applications or websites via wireless network. Healthcare providers are thus enabled to monitor the patient and control the treatment outside of hospital walls. Therefore, the IoT medical devices require accurate patient monitoring methods in order to predict patient condition more precisely, and increase the efficiency of the network. An overview of patient monitoring systems based on machine learning in the IoT is provided in this article.

Analysis of Datasets Created to Assess the Risk of Developing Gestational Diabetes Mellitus

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In recent years, the healthcare field has seen a rise in the use of artificial intelligence. There is growing interest in applying artificial intelligence technology to the field of healthcare. To effectively predict disease and deploy proper artificial intelligence and machine learning algorithms, there is a need for suitable datasets. Datasets are widely used to assess the risk of developing diabetes, one of the most common diseases. Given the preceding, this paper reviews datasets created to assess the risk of developing gestational diabetes mellitus (GDM) used worldwide.

Advancements in AI for Poultry Farming to Ensure Early Detection to Tackle Fallen Bird Incidents

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This study explores the application of deep learning architectures for image classification and segmentation in poultry farms with overlapping objects. Early detection of fallen birds is crucial for preventing disease outbreaks and maintaining animal welfare. We investigate the efficacy of various architectures, including U-Net, mU-Net, SegNet, and O-Net, for segmenting live and dead birds within poultry farm real time images. Our experiments, conducted on a dataset of 1805 images with varying lighting, distances, and object numbers, reveal that U-Net achieves the highest Dice coefficient (0.95128) for segmentation accuracy. We further demonstrate the potential of these models for classifying individual birds as alive or dead, with U-Net reaching a classification accuracy of 88.938%. The findings suggest that AI-powered image segmentation holds promise for enhancing poultry farm management by enabling early detection of deceased birds and fostering improved animal health and welfare.

Predicting Company Credit Rating Using Artificial Intelligence Techniques from Publicly Available Financial Data

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The study focuses on predicting credit rating using statistical methods (Linear and Huber Regressions) and machine learning techniques (Artificial Neural Network and Random Forest) while using publicly available financial data with additionally calculated features. The results show that machine learning techniques outperformed statistical methods significantly. The best results were obtained using the ANN model: MSE reached 0.063, MAE – 0.1858, R^2 - 0.9065, and RMSE – 0.251. The notable performance improvement across all models was noticed when incorporating additionally derived financial ratios, notwithstanding their derivation from metrics already included in the analysis.

Fast-Fourier Transform in 5G Network

Davit Begashvili[1], Giorgi Akhalaia[2], Avtandil Gagnidze[3] and Sergiy Gnatyuk[4]

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The advent of 5G technology has ushered in a new era of high-speed wireless communication, bringing unprecedented connectivity and capabilities. However, the inherent vulnerabilities of 5G networks pose significant cybersecurity challenges that demand innovative solutions. This research explores the utilization of Fast Fourier Transform (FFT) as a foundational element in addressing cybersecurity concerns within the 5G paradigm. The paper begins with an overview of 5G technology and its pivotal role in contemporary communication systems. Emphasis is placed on the evolving security landscape, highlighting the distinctive threats posed to 5G networks. Against this backdrop, the research establishes its primary objective: to investigate the application of FFT techniques in fortifying the security infrastructure of 5G networks. A comprehensive literature review examines existing research in both 5G security and signal processing, identifying gaps that underscore the need for advanced security mechanisms. The theoretical framework elucidates the role of FFT in the modulation/demodulation process, channel estimation, and signal processing within the 5G context. This theoretical foundation serves as the basis for proposing innovative FFT-based security mechanisms. The paper delves into specific cybersecurity threats faced by 5G networks, presenting FFT as a viable solution to mitigate these threats. Intrusion detection, anomaly detection, and enhanced encryption and decryption processes are explored as key applications of FFT in bolstering cybersecurity measures.

To validate the effectiveness of the proposed FFT-based solutions, the research outlines an experimental setup, including simulations or case studies conducted in realistic scenarios. Results and analysis are presented, comparing the efficacy of FFT-based security mechanisms with existing

solutions, and interpreting findings in the context of the research objectives. In conclusion, this research contributes to the evolving field of 5G cybersecurity by showcasing the potential of FFT as a strategic tool for addressing vulnerabilities and fortifying network defences. The findings open avenues for further research, offering insights into the integration of signal processing techniques in the pursuit of resilient and secure 5G communication networks.

Self-Attention Generative Adversarial Network

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The possibilities of the generative approach are enormous because they enable the generation of data by using the knowledge used in the learning process. This allows you to create new images based on the given information. In this paper, we propose the architecture of a neural network based on a generative model with a generator and a discriminator, where an attention module is introduced. The attention module allows you to add a weighted matrix assigning importance to appropriate pixels, thus drawing attention to selected features. The proposed architecture was described and tested on a publicly available database using the ADAM algorithm.

Advancements in Dating Undated Manuscripts through Dual Methodologies

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Manuscript dating, particularly in the context of analyzing handwritten materials, poses a distinct challenge compared to author identification in anonymous holographs. The intricacy arises from the broader spectrum of differences in handwriting styles among various authors, overshadowing the subtler variations within the handwriting of a single author across different years. To address this complexity, our research explores diverse methodologies and technologies for accurately dating the undated holographs of Galaktion Tabidze, a prominent Georgian poet of the 20th century. This article delineates two distinct approaches employed in our study, presenting experiments conducted to assess the efficacy of the proposed dating method. By delving into these methodologies, we aim to contribute valuable insights and enhance the accuracy of dating historical manuscripts.

Comparison of Neural Network Models with GRU and LSTM Layer for Earthquake Prediction

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The prediction task is an important element of research as it allows for forecasting future events. In the case of earthquakes, it is possible to make such a prediction based on specific attributes of historical data. In this paper, we compare two solutions in the field of neural networks that allow for such an analysis. More specifically, we model two recurrent networks by using the LSTM and GRU layers. The comparison is based on sequences of one-element and two-element data to determine which model is more accurate. Also, such methodology allows us to pay attention to the amount of sequence data needed to train the recurrent classifier for earthquake prediction tasks.

Exploring Convolutional Architecture Capabilities for Image Classification Tasks with Insufficient Amount of Data

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Nowadays Convolutional Neural Networks are used everywhere from facial recognition to malware detection and flat evaluation and are considered to bring significant changes to computer vision. They introduce solutions of such problems as insufficient and low-quality dataset. However, they tend to possess same problems as other Machine Learning and Deep Learning techniques. The paper considers and analyses the most commons methods for image classification, involving usage of feed-forward convolutional architecture. The object of the study is self-collected dataset, consisting of 7 classes, that provide of low-, middle- and highlevel features. The subject of the study is to explore the capabilities of CNNs key architecture blocks and their combinations.

KATH: A No-Coding Data Processing Aid for Genetic Researchers

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In this paper, we present KATH - a No-Coding Data Processing system designed to assist genetic researchers at Harvard University in their work on mutations in the human genome related to eyesight pathologies. We aim to deploy a no-coding solution that can enable R&D researchers untrained in programming skills to process data from open-source gene databases with advanced DNA processing algorithms via the application of a Large Language Model (LLM) based instruction interpreter. The paper presents the overview of the design system and the current status of the project.

Detecting Fair Play Violations in Chess Using Neural Networks

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This study addresses the challenge of distinguishing between human and computer-generated play in chess, crucial for ensuring the integrity and fairness of both online and tournament play. As unauthorized computer assistance becomes increasingly sophisticated, we utilize sequential neural networks to analyze a vast dataset of chess games, employing both traditional engines, such as Stockfish and Leela, and innovative neural networks like Maia and its individual sub-models. This analysis incorporates centipawn deviation metrics to gauge departures from typical computer strategies, Maia's insights into human and idiosyncratic playstyles, and an evaluation of time distribution for moves. Our method extends by considering the strategic implications of move sequences and the consistency of play under varying game conditions, enhancing our understanding of the nuanced differences between human and AI play. Remarkably, our algorithm achieves approximately 98% accuracy in identifying the use of chess engines, offering a significant advancement in efforts to maintain the game's integrity.

To further validate our findings, we conducted cross-validation with a separate dataset, confirming the robustness of our model. We also explored the algorithm's applicability to detecting AI assistance in other board games, suggesting its potential for broader use. The research highlights the critical role of machine learning in combating digital cheating, emphasizing the need for continuous adaptation of detection methods to keep pace with evolving technologies. Additionally, our findings point to the importance of developing ethical guidelines for the use of AI in games, ensuring a fair and level playing field for all participants. Lastly, by publishing our methodology and the criteria for AI detection, we aim to foster an open dialogue within the gaming community and among developers, promoting transparency and collaboration in the fight against cheating.

Expert System for Analyzing CT Images Using CNN With a Self-Attention Module

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Expert systems in medicine support doctors in analyzing medical data. Such a system is based on artificial intelligence methods, where expert data is used to train the model. In this paper, we present the architecture of an expert system for the classification of computed tomography (CT) images in the detection of COVID-19. The architecture of a convolutional neural network was proposed, including the self-attention module to focus on specific features in CT images. The proposed methodology has been described and tested on a publicly available database to demonstrate its effectiveness. The model reached 94% of accuracy according to the validation set.

Design of a Wheel Legged Robot

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The design and development of a robot capable of climbing stairs and moving on uneven terrains represents a significant advancement in the field of robotics, particularly in applications where adaptability in challenging environments is crucial. This type of robot becomes an invaluable tool in a variety of scenarios, from search and rescue operations in disaster-affected areas to exploration tasks in unknown or inaccessible terrains for humans. What sets this robot apart is its efficient rotational capacity across various surfaces. This capability not only allows it to navigate obstacles more effectively but also enhances its practical utility when faced with varied and difficult terrains. Its ability to adapt to different types of surfaces, whether smooth, rough, inclined, or irregular, makes it extremely versatile and suitable for a wide range of applications. Furthermore, the efficiency in the robot's rotational capacity not only enhances its mobility but can also have significant implications in terms of energy consumption and durability. An optimized rotation system can reduce the load on the robot's components and prolong its lifespan, making it a more sustainable and economically viable long-term solution.

Density Functional Theory Calculations in Designing Symmetric and Asymmetric TADF Emitters

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A pair of thermally activated delayed fluorescence (TADF) emitters with symmetric and asymmetric D-A-D structure are investigated. The introduction of density functional theory (DFT) has tremendously aided the application of computational material science in the design and development of organic materials. The use of DFT and other computational approaches avoids time-consuming empirical processes. Therefore, this review explored how the DFT computation may be utilized to explain some of the features of organic systems. First, we went through the key aspects of DFT and provided some context. Then we looked at the essential characteristics of an organic system that DFT simulations could predict. Gaussian software had been employed with the B3LYP functional and 6-31G(d, p) basic sets for organic systems.

Development of Websites Ranking Algorithm Based on SEO Metrics

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The paper deals with the development of websites ranking algorithm and its web application based on search optimization metrics data. The application provides web page search optimization analysis and website ranking based on it, which will allow both entities and companies to select the best websites to post information about their products or services. The algorithm is based on Entropy Weight and TOPSIS methods of multi-criteria decision analysis.

Inference Acceleration for Large Language Models Using "Stairs" Assisted Greedy Generation

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Large Language Models (LLMs) with billions of trained parameters are known for their impressive predicting capabilities but suffer from slow inference speeds due to their size. On the other hand, smaller models offer faster execution but may sacrifice accuracy. In this paper, we are proposing an implementation of “stairs” assisted greedy generation. It is a modified assisted generation methodology that makes use of a smaller model’s fast generation, large model’s batch prediction, and “stairs” validation in order to achieve a speed up in prediction generation. Results show between 9.58 and 17.24 percent inference time improvement compared to a stand alone large LLM prediction in a text generation task without a loss in accuracy.

Financial Anomalies Detection Method Example

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The aim of this paper is to provide continuous results on research in financial data analysis. Financial processes involve complex procedures concerning the recording and analysis of financial data. Many companies encounter difficulties when handling large amounts of financial data for assessing the current state of the company, planning future strategies, and other purposes. This paper proceeds with the analysis and usage of financial data space dimensions using General Ledger information from specific companies in the Netherlands, also introduces a method for identifying financial anomalies.

Providing Brands Visibility Data in Live Sports Videos Using Deep Learning Algorithms

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In the dynamic landscape of marketing and advertising, assessing brand visibility in live sports events plays a pivotal role in understanding brand exposure and impact. Traditional methods of manual annotation and analysis are timeconsuming and subjective, necessitating automated solutions for efficient and objective evaluation. In this study proposed a novel approach leveraging deep learning algorithms to evaluate brand visibility in live sports videos. This research employs state-of-the-art object detection models, such as YOLO (You Only Look Once) and Faster R-CNN, to detect and localize brand logos within video frames. By training these models on annotated open-source logo datasets, we can extract valuable insights about the brands. The experimental results demonstrate the effectiveness of the proposed methodology in detecting logos and providing a valuable data about the positions for brand owners.

Anomaly Detection for System Logs Literature Overview

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This paper describes analysis results of system log Anomaly Detection literature from time period of 2018 to 2023. The literature was found using keywords “log anomaly”, “machine learning”, “neural network”. A total of 80 different scientific papers have been analyzed. It has been determined that most popular neural networks are LSTM/BiLSTM; most common datasets are HDFS, BGL and Thunderbird; Most popular evaluation metrics include F1, precision and accuracy. Most of research sought to address issues of improving model detection accuracy, lowering system resource use and making model more suitable real time detection.

Design and Manufacturing of a 3D-Printed Underwater Robot Through Parameters CAD/CFD and Stress Analysis for Optimization and Performance

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This project focuses on the design and development of an open-structure ROV (Remotely Operated Vehicle) using 3D printing technology. The implementation of this technology as a cost-effective and pioneering alternative in submarine construction was explored, contrasting with traditional methods that often use conventional metals or plastics. CAD/CFD analyses were conducted to optimize the design, eliminating vortices and turbulent flow, and stress tests were performed to ensure proper distribution of the structure. Additive manufacturing allowed for the creation of 25 PLA parts for the ROV assembly, facilitating an intuitive and practical process. The resulting ROV demonstrated three degrees of freedom and successfully passed submersion and buoyancy tests, showing navigational capability both at the bottom of the pool and on the water surface. This project not only expands knowledge about open-structure submarines but also opens new possibilities for the application of 3D printing technologies in underwater engineering.

Data Processing Method for Gini Coefficient Application in Assessing the Centralization Within the BTC Lightning Network

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The Bitcoin Lightning Network (BLN) is a second layer blockchain solution, which emerged to address scalability issues. However, potential centralization concerns have surfaced as current distribution might indicate a trend toward centralization. The Gini coefficient, a measure of inequality, can be applied to BLN to assess its centralization by analyzing the distribution of channel capacity among nodes. This research proposes a data processing method specifically designed to utilize the Gini coefficient for evaluating centralization within the BLN. Main challenge in applying the Gini coefficient to assess BLN centralization is limitations of existing research. The lack of description on how to process data makes it difficult to replicate these studies and verify the conclusions made by other researchers. The proposed data processing method addresses the challenges associated with collecting data from both Bitcoin blockchain and Lightning Network, including data linking, storage, and variable selection. Results of the experimental research of the proposed method show that Gini coefficient increased from 0.829 to 0.930. The results are confirmed by existing research and can be used for future research to explore the BLN centralization.

The Dark Side of Radio Technology

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Due to the fact that most modern technologies of the 21st century are based on radio signals, their safety is of utmost importance. The article presents common types of radio hacking, describes, and demonstrates some of them, and explains in detail how to spoof a GPS signal, as well as the associated dangers and ways to protect against them. Along with this, the purpose of ADS-B (a system installed on an aircraft that periodically broadcasts its location, altitude and other important details) and the importance of the safety of this system are discussed. The paper provides a comprehensive overview of GPS and ADS-B spoofing techniques, highlighting potential threats to navigation and airspace security. provides case studies and case studies of the changing landscape of navigation and aviation cyber threats.

Development of a Lecture Attendance Registration System Based on Facial Recognition

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The paper deals with the development of a registration system based on facial recognition to be used in the educational process, using which it will be possible to register and record the attendance of both students and professors at lectures. Based on the data recorded by the system, it will be possible to conduct lectures and monitor student attendance, which is one of the important tasks of an educational institution.

Basketball Board Detection Using YOLO Algorithms

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This research aims to detect basketball board, rim, net, and shooting box using different versions of the YOLO algorithm: YOLOv5, YOLOv7, and YOLOv9. The study found that the YOLOv9-C model provided the best performance with a precision of 0.996, recall of 1, mAP_0.5 of 0.995, and mAP_0.5-0.95 of 0.899. The YOLOv9 models also demonstrated fast training times with a low number of epochs. Meanwhile, YOLOv5 showed the fastest inference time for the detection task, and YOLOv7 was the smallest model in terms of size.

Sentiment Analysis of Lithuanian Online Reviews Using Large Language Models

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Sentiment analysis is a widely researched area within Natural Language Processing, attracting significant interest from various companies and resellers online due to the advent of automated solutions. Despite this, the task remains challenging because of the inherent complexity of languages and the subjective nature of sentiments. In this paper, we strive to evaluate texts as objectively as possible, focusing on Lithuanian online reviews from multiple domains. We discuss the outcomes of a sentiment analysis performed with a relatively small dataset in this less commonly studied language. Our review of existing Lithuanian NLP research reveals that traditional machine-learning methods and classification algorithms have limited effectiveness in analyzing and detecting sentiments under resource constraints. Additionally, this work explores the capabilities of pre-trained multilingual Large Language Models, specifically detailing our experiences with fine-tuning BERT and T5 models for sentiment analysis on a multitopic Lithuanian review dataset.

Ball and Player Detection in Futsal Videos using YOLOv8 Model

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There has been a significant increase in people's interest and enthusiasm for sports in recent years. This has resulted in an increased emphasis on high-quality video recording of various sports to capture even the smallest details. Recording and analysis have become extremely crucial in sports such as futsal, which involve several complex and fast events. Ball detection and tracking, along with player analysis, have emerged as areas of interest among many analysts and researchers. Coaches rely on video analysis to assess their team's performance and make informed decisions to achieve better results. Furthermore, coaches and sports scouts can use this tool to scout for talented players by reviewing their past games. Ball detection is vital in aiding referees to make correct decisions during critical moments of a game. However, due to the continuous movement of the ball, its shape and appearance change over time, and it often gets blocked by players, making it challenging to track its position throughout the game. This paper proposes a deep learning-based YOLOv8 model for detecting balls and players in broadcast futsal videos.

Class-Focused Evaluation of Deep Learning Techniques for Network Intrusion Detection

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In an increasingly interconnected world, safeguarding digital systems and networks against cyber threats is of utmost importance. Traditional intrusion detection approaches, relying on rule-based systems or simplistic machine learning models, often struggle to adapt to the evolving threat landscape. Deep Neural Networks (DNNs) offer promising avenues for enhancing Intrusion Detection Systems (IDS) effectiveness, leveraging their hierarchical structure to process complex network traffic data and extract discriminatory features indicative of malicious activity. However, the temporal dynamics inherent in network traffic data pose a unique challenge, prompting exploration into Long Short-Term Memory (LSTM) networks, for their sequential data processing capabilities. This paper investigates the application of deep learning models, including dense neural networks and LSTMs, for classifying network traffic into 28 distinct attack types. By analyzing the architectural design and presenting experimental results on standard benchmark datasets, we demonstrate the practical applicability of our hybrid approach in real-world cybersecurity scenarios, contributing to the advancement of intrusion detection systems through deep learning techniques. Additionally, we explore the challenges posed by class imbalances and dataset characteristics, providing insights into model performance and limitations for various attack types.

Computational Analysis of the Influence of the Model Boundary Conditions on the Bacterial Self-Organization

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This paper deals with the effects of the type of boundary conditions on the spatiotemporal pattern formation in the computational modelling the bacterial pattern formation in a onedimensional-in-space domain. The computational model was derived from a mathematical model used in another research. By running tests with different boundary conditions, the output results were analyzed with a special emphasis on the edges of formed patterns. The numerical simulation, based on the governing equations of the reaction-diffusion-chemotaxis type, was carried out using the finite difference technique. The developed numerical simulator was validated by using published experimental data and known numerical solutions.

Assigning Different Activation Functions in Artificial Neural Networks with the Goal of Achieving Higher Prediction Accuracy

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The research paper explores the concept of using multiple activation functions in artificial neural networks and investigates their impact on model performance. The experiments conducted on various models such as AlexNet, ResNet50, TuNet, and SimpleNN reveal insights into the effectiveness of different activation function combinations. The results indicate that using multiple activation functions can lead to modest improvements in model performance, particularly in image segmentation tasks where modifications to the UNet architecture show significant enhancements. However, for time series regression/forecasting tasks, the experiments demonstrate that using multiple activation functions does not significantly improve prediction accuracy. Therefore, the paper concludes that while there are some benefits to using multiple activation functions in certain scenarios, the choice of activation function should be based on the specific task and dataset.

Efficient Dijkstra-Based Greedy Algorithm for Cycle-Route Planning

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Planning routes based on actual data is not an easy task, especially when faced with challenging conditions. Finding cycles of fixed-length in directed, weighted graphs is an NP-hard problem. In the field, not enough research has been done on many alterations of this problem, especially in regard to real-world applications. In this paper, we propose a greedy algorithm for generating cyclic routes of the desired length and characteristics to match specific types of bicycles, using real-world data. The proposal is based on a greedy search of sub-routes to find the best-fit bicycle route. The results indicate, that the algorithm performs very well and can be easily adjusted for other similar tasks. The mean absolute percentage error for the total distance of the routes was below the acceptable 5% error, reaching 3.24 MAPE for shorter and 2.74 MAPE for longer routes.

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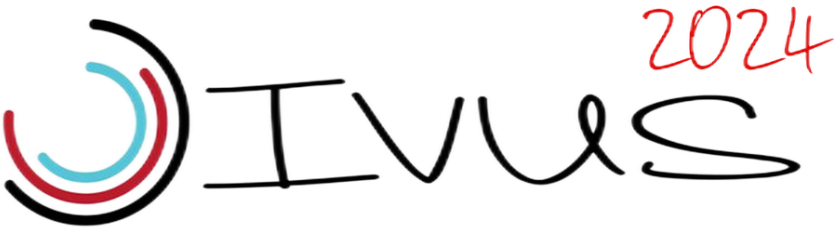

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