Student IT/EE Workshop 2024

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Warsaw University of Technology

Book of Abstracts

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Session B (Poster) / 1

Using Small Language Models For Local Email Categorization Into Variable Number Of User-Defined Labels

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This paper presents a novel approach, **Analyze-Select-Match (ASM)**, for local email categorization using small language models. The objective is to enable users to organize emails on their local machines by categorizing them into **user-defined labels with flexibility in both quantity and quality**. A dataset of email samples was curated, and five models, sized for widespread graphics card compatibility, were tested using various prompt engineering techniques. The highest achieved accuracy was 97\%, with a focus on maintaining efficiency measured by the accuracy-to-average time ratio for classifying a single message. The proposed ASM methodology, emphasizing Analyze, Select, and Match stages, proved efficient without the need for retraining, making it suitable for quick transitions between tasks. The models' performance and efficiency were visualized, with the openhermes mistral 2.5 7b model and cot_1 prompt combination achieving the highest accuracy. The developed model fulfills expectations of high accuracy, efficient processing time, effective performance, agent capability, compact model size, high availability, small contextual footprint, and full customization. This research contributes a valuable methodology and insights for practical and **customizable local email organization**.

Session B (Poster) / 2

Pathfinding algorithms in dynamic gaming enviroments

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Since the development of advanced gaming engines, pathfinding has evolved into a crucial role in enhancing the complexity and realism of non-player characters (NPCs). This article explores the implementation of the D* algorithm in Unity, a leading solution in game development. It features a comparison of various notable pathfinding algorithms, tested in a generated labyrinth with interactable objects, designed to evaluate the adaptability and efficiency in real-time.

The practical demonstration comprises a level in Unity consisting of five characters, each employing a different pathfinding algorithm to navigate the labyrinth. In this setup, not only the capabilities of the D* algorithm are shown in practice, but it also enables a visual comparison in real-time.

The study aims to provide valuable insights into the practical application and comparative strengths of these algorithms in dynamic gaming environments, potentially guiding future developments in pathfinding strategies.

Session C (Poster) / 3

Text2SQL with „small”Large Language Models

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This article conducts a comprehensive comparison of Mistral7B and SQLCoder 2.0, two „small”large language models, in the context of the Text2SQL task using the „Spider”dataset. Despite its modest scale, Mistral7B achieves a notable 33% accuracy without any query-answer examples in the prompt, showcasing promising prospects for compact large language models in the Text2SQL domain. The portability of Mistral7B, capable of running on mobile devices, suggests novel applications for natural language processing in portable services.
Challenges persist in handling complex queries and diverse SQL dialects. The article emphasizes the significance of under- standing nuanced insights into Mistral7B's effectiveness, espe- cially when varying the number of provided examples in the prompt.
The study explores models performance with different prompt configurations, revealing unexpected trends in its effectiveness. The findings prompt a detailed discussion on potential reasons, such as model confusion or interference from provided examples.
Despite the results show promise, it is noteworthy to ac- knowledge that the observed trends may pose limitations for practical production use cases. While the findings provide valu- able insights, further refinement and exploration of small large language models are imperative to fully unlock their potential across diverse applications in the Text2SQL domain.
Index Terms—Text2SQL, Large Language Models, LLM, Mis- tral7B, SQLCoder 2.0, Natural Language Processing, NLP, Fine- tuning, Database Schema, Query Generation, Spider Dataset, SQL

Session C (Poster) / **4**

The concept of a system for high-scale computing based on microservice architecture

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This study introduces a microservice-based architecture designed to compute a large amount of data, offering scalable and modular system components. Main system concepts are illustrated through the example of credit risk management in a fictional banking system. The architecture's design principles emphasize scalability, domain separation, and technological agnosticism, aiming to ensure functionality across various platforms and programming languages. The research acknowledges the complexity of integrating multiple technologies and the challenges in anticipating evolving business requirements. The inability to test in a real-life environment marks a limitation; however, the research contributes to the limited body of knowledge on microservices in scalable systems and remains optimistic about future practical deployments.

Session A (Presentation) / **5**

Procedural plot generation for Role Playing Games using Large Language Models

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Procedural plot generation is a topic widely researched in the context of video games. This paper discusses parts of the existing research using Role Playing Games as a target for plot generation. Analysis of table-, atom-, and Large Language Model-based approaches to plot generation for Role Playing Games indicates that more is needed. This paper proposes the solution to this problem using a Polish Role Playing Game named Wolsung as an example system not well known by the Large Language Model. Using tables, a skeleton is created and responsible for maintaining word information and keeping causality. The resulting skeleton is then transformed with the GPT model to convert the skeleton into an actual plot. Evaluation of results is performed based on language correctness and task completion. The solution provides a way of using the Large Language Model over a broad unknown domain without the need for additional training.

Session B (Poster) / **6**

Deepfake Detection: A Comprehensive Analysis of Convolutional Neural Networks

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In the era of rapidly advancing technology, the spread of deepfake content has become an escalating challenge, making detecting synthetically created materials crucial in softening the potential harms. This paper focuses on a comparative analysis of Convolutional Neural Networks (CNNs) designed explicitly for deepfake detection (MesoNet and MesoNet Inception) with a custom architecture proposed by the authors, demonstrating a high degree of precision in distinguishing between authentic and manipulated content. The tested models consisted of a few layers, which enabled focusing on mesoscopic features in the images. The networks were trained on a dataset generated using the CelebA dataset and FaceDancer, a face-swapping method. Additionally, the networks were tested on additional deepfakes to evaluate their generalization ability. This study critically evaluates the effectiveness of the solutions and the impact of dataset selection.

Session C (Poster) / **7**

Solutions of Maxwell equations for defining improvements of parallel computing with CUDA library

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Maxwell equations are fundamental laws of physics for understanding electromagnetic fields. Their usage is essential in applications related to propagation of electromagnetic waves. To provide a numerical implementation of these equations, a Finite-Difference Time-Domain method can be used. It is crucial to optimize such complex calculations in order to provide convenient, time-saving tools. For this reason, two solutions to an example FDTD problem are devised which comprise of CUDA library for parallel computing on the GPU, and Julia as a programming language designed with the aim of handling such tasks. In addition to these, a similar CPU implementation is provided for comparison purposes.

Session B (Poster) / **8**

Analysis of Application Handling System Process in the Internet Dean's Office Support System Using Process Mining

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This paper investigates the process discovery conducted using process mining on anonymized logs extracted from the university's departmental application handling system (ISOD) in CSV file format. The study focuses on analyzing the process occurring within the application handling system. Activities and analyses are based on logs from this system. The proper data processing was needed to allow gaining knowledge from event logs with the usage of process mining. Data preparation involved converting the data into an event log format (XES) with appropriate data types, highlighting Case_ID: Application_ID, activity_key: Application Status, and timestamp_key: Change Date. Date format modification was performed to standardize the Change Date of application status to a timestamp format. Process analysis was conducted on the event log file using process discovery algorithms, both in ProM and Pm4Py software. The results of process mining obtained from both programs were presented. The different types of algorithms and possible analyses utilized in both programs were presented. Among other algorithms, analysis was conducted using Alpha Miner and Heuristic Miner algorithms. Finally, the paper discusses the results of process discovery schemas that create new possibilities for improvements in universities' systems. This study contributes to understanding and improving the efficiency of processes in academic environments. This research shows a new perspective on using process mining tools in educational systems analysis that could result in a major quality improvement.

Session C (Poster) / **9**

Learning a foreign language through voice conversation with AI chat

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In this comprehensive exploration, the author delves
into a visionary initiative aimed at fundamentally transforming
language learning through the implementation of a groundbreaking Conversational AI system. The research underscores the
pivotal role of innovative features, particularly the successful
integration and testing of TextToSpeech and real-time translations, which have emerged as key contributors to the efficacy
of the system. The outcomes of these tests not only affirm the
immediate impact on language acquisition but also illuminate the
untapped potential that the Conversational AI system holds for
the broader landscape of language education.
As the article unfolds, it navigates through the intricacies of
the developed AI system, shedding light on the multifaceted
layers of its architecture and functionality. The author, as the
sole contributor to this ambitious project, narrates the journey
through the challenges and triumphs encountered in the realms of
programming, linguistics, and user interface design. The immersive and effective language acquisition tool that has emerged from
this endeavor represents a pioneering leap beyond conventional
language learning boundaries.
Motivated by a keen recognition of the hurdles faced by
language learners, such as the need for real-time feedback and
engaging learning materials, the author strategically harnessed
the power of Python, Bard AI, Speech Recognition modules, and
more. The fusion of these tools has resulted in a transformative
Conversational AI system designed to provide learners with an
unparalleled language acquisition experience.
While the focus of the article lies in the innovative elements

that form the bedrock of the project, it also contemplates the
future trajectory of AI-driven language learning. The concluding sections meticulously outline future development prospects,
emphasizing the author's unwavering dedication to pushing the
boundaries of this evolving field. The visionary insights presented
in this article underscore not only the current state of AI in
language education but also the trajectory it is poised to take,
with the author's unique contribution at the forefront of this
transformative journey.

Session B (Poster) / **10**

Automated Identification of Malignant Breast Lesions: A Convolutional Neural Network Perspective

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Accurate diagnosis and prognosis are crucial for the effective treatment of breast cancer. To improve diagnostic accuracy and reduce human error, this study presents a novel approach using deep neural networks (DNNs) to detect cancerous lesions in microscopic specimens from the breast. In this paper, I examine the performance of convolutional neural network (CNN) model as well as CNN-based hybrid models in relation to traditional image classification methods such as SVC, Random Forest and KNN. The proposed model used a WSI dataset of 100 patients diagnosed with invasive ductal carcinoma (IDC), from which 80 slides were randomly selected for training and validation and 20 slides for testing. By harnessing the power of convolutional neural networks, I achieved a significant improvement in accuracy and F-score compared to traditional methods. While my study shows significant progress, it is important to acknowledge certain limitations. The representativeness of the dataset and potential biases may affect the generalizability of the model. Further research and clinical trials are needed to validate the model in real-world settings.

Keywords: machine learning, breast cancer, convolutional neural network, image classification

Session C (Poster) / **11**

Automated Liver Cancer Diagnosis: A Convolutional Neural Network Approach on CT Imaging

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In recent years, deep neural networks (DNNs) have shown remarkable potential in medical image analysis, particularly in the field of computed tomography (CT) imaging. The use of DNNs to analyze medical images, especially in the context of detecting cancer, is becoming a promising area of research. In this study a novel approach to detect liver cancer using deep neural networks (DNNs) based on computed tomography (CT) images was explored. Convolutional neural networks (CNNs), a specialized class of DNNs tailored for spatial data processing tasks, prove highly effective in image analysis. Methodology of this study involves the preprocessing of a diverse imaging dataset of CT scans of the liver created in collaboration with seven hospitals and research institutions and training of several different convolutional neural networks CNNs with various architectures. The whole dataset was divided into three sets. The training set consisted of 70% of the data. The validation set was created from 15% of the data and the remaining 15% was used for testing. In order to evaluate the

effectiveness of several convolutional neural networks, multiple measures such as accuracy, precision, recall, F1-score and confusion matrix were used. The results of this study showcase significant improvements in accuracy and efficiency compared to traditional methods, paving the way for early and accurate diagnosis without the help of specialists.

Keywords:
convolutional neural networks, computed tomography, liver cancer detection, CT image segmentation, deep learning

Session B (Poster) / **12**

Comparison of cardiovascular diseases' classification models based on ECG signal

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Deep neural networks (DNNs) are becoming a handy tool in the healthcare field. Research work in recent years has led to the creation of solutions that can effectively support the work of medical staff. This paper presents a comparison of deep learning architectures used for the classification of cardiovascular diseases. Models were trained and tested on the PTB-XL dataset, a large publicly available electrocardiography dataset containing electrocardiography (ECG) signals with disease labels assigned by qualified cardiologists. Some architectures achieved promising accuracy despite the poor computational capabilities of the machine used for training.
This study compares architectures, including LSTM, CNN, and GRU layers, inspired by the ones available in scientific publications and CinC challenge entries. However, all of them were modified so they could be trained on a local machine, which has more computational limits than the ones provided by the competition organizer. For this reason, the performance is lower than presented by the owners in their original descriptions. The task performed by the models is to classify correctly occurrence of five classes (four cardiovascular diseases such as: myocardial infarction, ST/T change, conduction disturbance, hypertrophy and one class for average outcome).

Session B (Poster) / **13**

Exploitation of prototyping network in shelf product recognition

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This paper uses a prototyping network to address the problem of recognizing products on store shelves. The problem of identifying store products is similar to the problem of facial recognition. The number of facings is practically unlimited, and new products are introduced every week, current labels are changed, and new product variants are added. Collecting appropriate training patterns is very time-consuming, and with such high product variability, it would require continuous collection of vast amounts of data and retraining classification models. To effectively solve this problem, we should try to reduce it to a few-shot and zero-shot learning problem in classification applications where the available data representing each class is limited. Prototype networks have been gaining popularity recently, partly due to their effectiveness in solving this class of problems.
This research presents the concept of utilizing a prototype network for recognizing store products, where training and test sets consist of real photos of store products. Prototypes are determined in a

latent space, and classification is based on the distance to the prototypes. The results are compared for three distances: cosine similarity, squared Euclidean distance and Chebyshev distance.

keywords: CNN, prototype network, few-shot learning, zero-shot learning

Session C (Poster) / **14**

Picture Captioning

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The research focused on classic image captioning based on a coder-decoder structure, where the coder encodes the image features. At the same time, the decoder produces a caption –a phrase describing the image content. We investigated the decoder part by testing multiple convolutional-neural-network-based backbones –feature extractors. This investigation aimed to find the optimal encoder, i.e., one that maximizes text generation metrics BLEU_1-Bleu_4, CIDEr, SPICE, and METEOR. Moreover, we worked on optimizing beam-search parameters used by the decoder to generate alternative phrases. Our research proves that an optimal choice of model's hyperparameters increases caption generation efficiency.

Session A (Presentation) / **15**

One-shot learning from prototype SKU images.

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The paper discusses the significance of one-shot learning from prototype SKU images for efficient product recognition in various retail and inventory management sectors. Traditional methods require large supervised datasets for training deep neural networks, which can be costly and impractical. One-shot learning techniques address this issue by enabling classification from a single prototype image per product class, reducing data annotation efforts. The variational prototyping-encoder (VPE) is introduced as a novel deep neural network tailored for one-shot classification. By utilizing a support set of prototype SKU images, VPE learns to classify query images while capturing image similarity and prototypical concepts. Unlike metric learning-based approaches, VPE pre-learns image translation from real-world object images to prototype images as a meta-task, facilitating efficient one-shot classification with minimal supervision. The result of the research indicated the potential for applicability of VPE in reducing the need for large datasets and accurately classifying query images into their respective categories, offering a practical solution for product classification tasks.
Index Terms: one-shot learning, autoencoders, VPE, prototyping.

Session C (Poster) / **16**

Comparative analysis of frontend layer design and implementation methods (Analiza porównawcza metod projektowania i implementacji warstwy frontend)

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Abstract:

In software development, clean code and clean architecture are crucial aspects that ensure separation between business logic, application logic, and framework-related code. However, in the dynamic world of web development, these approaches are not commonly utilized due to the lack of standardization among frontend frameworks and libraries. This often leads to complications in creating web applications. To address this issue, a study was conducted to compare two approaches to building React applications with calendar functionality. The study evaluated the time required to create the applications, code usage, and ease of modifications. The research was conducted in two stages: building and modifying. During the first stage, two researchers created two calendar apps with the same use cases. The first researcher utilized React with clean architecture, while the second one followed React's recommended approach. In the second stage, a third researcher made uniform modifications to both apps. Clean code architecture offers clear logic separation but requires significant development time. On the other hand, React's recommended approach enables quicker modifications, which may be influenced by app size and team expertise. The comparative analysis provides developers with valuable information to make informed decisions on architectural choices for scalability, maintainability, and modification ease. This study contributes to the ongoing discussions on modern software development best practices. Further analysis with more control groups and the development of larger apps would provide more comprehensive results.

Session B (Poster) / **17**

Deciphering AI Black Boxes: A Comparative Review of Python XAI Packages

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As artificial intelligence (AI) systems increasingly penetrate various domains, the need to understand their decision-making processes becomes paramount. This study presents a comprehensive review of Python-based eXplainable AI (XAI) packages aimed at deciphering the black box nature of AI models. By analyzing and comparing prominent XAI techniques and tools, this review sheds light on their functionalities, strengths, and limitations. Through a structured evaluation, we highlight the diverse methods employed by these packages to elucidate AI model behaviors, ranging from feature importance analysis to model-agnostic interpretability methods. Furthermore, we discuss the practical implications of these XAI techniques in enhancing model transparency, fairness, and trustworthiness in real-world applications. By synthesizing key insights from various XAI approaches, this review provides researchers, practitioners, and developers with valuable guidance in selecting appropriate XAI tools for their specific needs, thereby fostering greater transparency and interpretability in AI systems.

Session C (Poster) / **18**

Energy trading optimization: A Comparative Analysis of Reinforcement Learning Techniques

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This paper embarks on a comparative study of three diverse reinforcement learning techniques applied to forecasting and optimizing energy trading in day-ahead markets for medium-sized prosumers. Given renewable energy sources' inherent volatility and unpredictability, this study leverages these diverse approaches, each known for its unique advantages in navigating complex optimi-

sation landscapes. The primary objective is to develop robust energy trading strategies that guide the challenges posed by fluctuating energy demands, prices, and the limitations of battery storage capabilities. Through this comparative analysis, the authors aim not to prescribe definitive solutions but to illuminate the strengths and limitations of each methodology in the context of energy management. The insights garnered are intended to serve as a valuable resource for researchers, offering a foundational understanding that could spur further investigations into adaptive, cost-effective, and efficient energy trading mechanisms. While the direct applicability to the energy sector remains entirely determined, the methodological comparisons and discussions presented herein contribute significantly to the ongoing discourse on optimising renewable energy utilisation and trading strategies.

Session B (Poster) / **19**

Eye disease multiclassification based on fundus images

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Sense of sight is fundamental in one's life and one can hardly imagine living without it yet in modern times eye diseases can develop relatively early and without timely reaction can lead to severe eyesight degradation or even loss. A means widely used in ophthalmology is fundus photography which can be obtained with relativaly low effort. Their analysis can reveal symptoms of various diseases, however it is a tedious and nontrivial process that must be performed by a specialist which increases method's cost, complexity and becomes a major hurdle in developing countries. Various works have proposed the usage of convolutional neural networks (CNNs) as a way of automatic detection of eye diseases and while one-class classification approaches bring in satisfying results the multi-class problems are much more challenging. Subject paper explores transfer learning with various CNN architectures with goal of creating an effective model for multi-class classification of ophthalmic diseases. Due to the nature of medical data, where ceratin diseases are much rarer than other, much effort was put into data augmentation .

Session C (Poster) / **20**

Convolutional Neural Network for Diabetic Retinopathy Detection

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This scientific article describes a project focused on creating a convolutional neural network designed to assist physicians in diagnosing diabetic retinopathy based on Optical Coherence Tomography (OCT) images. The project involves an in-depth analysis of existing research on the classification of this disease using fundus images. Leveraging a diverse dataset of OCT images, encompassing both eyes affected by diabetic retinopathy and healthy eyes, we developed an effective neural network model. The proposed model demonstrates promising potential in supporting medical professionals in the diagnostic process for diabetic retinopathy. This research contributes to the advancement of medical imaging technologies and holds promise for improved healthcare outcomes in the realm of diabetic eye complications.

Session B (Poster) / **21**

Application of machine learning in epileptic seizure detection

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The presented work utilizes machine learning methods to solve the problem of detecting epileptic seizures using EEG signals. Epilepsy is one of the most common neurological diseases, affecting millions of people worldwide. This disease has always been of great importance in the field of biomedicine due to the health risks it poses. It is characterized by recurring, unprovoked epileptic seizures and can be recognized using an electroencephalogram. These signals are complex, noisy, nonlinear, non-stationary, and generate a large amount of data. Additionally, the problem may turn out to be class imbalance - a small sample of data indicating an epileptic seizure compared to the normal state.

The paper describes the data preparation process and the chosen approach to the problem of epilepsy seizure detection. The used data set and methods of filtering and cleaning data are described. Then, the chosen methods of feature extraction and selection, as well as the applied machine learning models: Support Vector Machine (SVM) and decision trees are discussed. The results were compared using appropriate classifier evaluation measures based on the confusion matrix: accuracy, sensitivity, specificity.

Session A (Presentation) / **22**

Analysis of different approaches to video game bots based on bot bowl competition

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The paper explores different solutions for implementing self-learning artificial intelligence (AI) competitive bots for the game Blood Bowl. The winners of the most of the previous competitions were scripted bots but in recent years bots based on machine learning started to outspace their competition. Blood Bowl is a two-player, turn-based, asymmetric board game that combines elements of American football with the Warhammer board game. Teams consist of eleven to sixteen players, each of them having varying configurations of five main statistics: move allowance, strength, agility, armor value, and passing. The main goal is to score a higher takedown number than the opponent. This paper's primary objective is to develop a sophisticated AI agent capable of participating in the Bot Bowl Tournament and competing against other state-of-the-art bots. The research focuses on exploring behavioral cloning solutions created by using an in-depth analysis of games played in previous tournaments to vastly improve both the win ratio and complexity of moves employed by the bot. Using wrappers and scripted actions enhances the efficiency and effectiveness of the AI's learning mechanisms. By leveraging insights acquired from past gameplay data and employing advanced machine learning techniques, this research seeks to contribute to the advancement of AI in competitive gaming environments.

Session C (Poster) / **23**

Comparison of the NLU and NLG transformers in the context of classifying fake news

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This research presents a comparative analysis of
Natural Language Understanding (NLU) and Natural Language

Generation (NLG) models for the task of fake news detection. A concise literature review was conducted to understand the state-of-the-art techniques in the field. The study focused on comparing the performance of two language models, BERT (Bidirectional Encoder Representations from Transformers) and GPT-2 (Generative Pre-trained Transformer 2). The evaluation involved the application of various metrics to assess the effectiveness of each model. Additionally, the research utilized data visualization techniques to gain insights into the models'decision-making processes. The findings of this comparative study contribute to our understanding of the strengths and limitations of NLU and NLG approaches in the context of fake news detection, providing valuable insights for the development of robust and reliable misinformation detection systems.

Session B (Poster) / **24**

Prediction of photovoltaic energy generation using Recurrent and Transformer Neural Networks

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Precise prediction of photovoltaic (PV) energy generation is essential for optimal, profitable and ecological management of electric energy resources all over the world. As a result, one attempts to develop more accurate prediction algorithms. This paper compares the application of Long Short-Term Memory (LSTM), a subtype of Recurrent Neural Networks, with Transformer Neural Network for estimating PV energy production. The results indicate that both analysed methods have comparable prediction accuracy. The experiments were conducted on data from PV sites deployed across campuses at Australian La Trobe University. However, future studies could verify this approach using different datasets. Algorithms and results presented in this study may especially contribute to the development of Transformer Neural Networks as a prediction method of PV energy production.

Session C (Poster) / **25**

Study of various applications of the A* algorithm in the context of overhead line routing.

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The paper presents research on the usefulness of the A*algorithm in the context of setting a route for an overhead power line. The algorithm was implemented in Python using the pyautocad library. The final result of the program is the marked route in a dwg file. The research examined how different ways of implementing the A* algorithm and different heuristics affects its performance. The article also includes procedures to speed up the program's operation.

Session A (Presentation) / **26**

Research on the generation of user interface models into code

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This paper proposes a solution to the problem of automatically generating an efficient front-end layer code based on a provided UI design. With the increasing complexity and scalability requirements of systems, companies, as well as individual developers, are inclined to seek a sufficient and maintainable way to automate some internal processes. One such automation may involve focusing on creating a visual prototype of a graphical user interface, rather than programming skills necessary to implement it. This approach makes full automation achievable in cases where the front-end layer is a secondary concern.
The research described in the paper utilizes Node.js scripts paired with React utilities to transform a hierarchical JSON description of UI design into a basic React application. It then injects it into JSX templates while maintaining the same hierarchy in the generated virtual DOM as provided. The aspect of efficiency is addressed by providing a way to group similar components and reuse them. The resulting application is compared with referential solutions in terms of TypeScript rules compliance, code complexity, and memory allocation during the execution of a simple use case scenario.

keywords: front-end, code generation, UI design, React

Session B (Poster) / **27**

Virtualisation of the JetRacer ROS AI KIT platform using a simulation environment

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Simulation environments perform an important function in modern technical processes. Skillful utilization of such environments reduces testing costs and time associated with implementing solutions, thereby expediting development efforts. This paper focuses on reviewing the application of selected simulation environments for integration with the JetRacer ROS AI KIT mobile platform. This study is motivated by the need to enhance the movement and navigation quality of autonomous mobile robots by exposing them to a greater variety of scenarios generated within simulation environments. Data exchange between the robot's sensors, camera, and the computer environment is facilitated through the Robot Operating System. The study confirmed the feasibility of accurately virtualizing the robot's environment using simulation software. Employing this method has enabled the utilization of a greater array of learning scenarios and has opened prospects for further improving the navigation quality of autonomous robots in complex environments.
Keywords: simulation environment, autonomous robot, ROS

Session C (Poster) / **28**

Examination the combination of A2C Learning with Behavioral Cloning on a bot for the Blood Bowl board game

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This paper aims to improve existing solutions of machine-learned bots for the Blood Bowl game. Blood Bowl is a stochastic, fully-observable, turn-based, two-player board game. Players, referred

to as coaches, lead an 11-player team, where each individual has statistics and abilities. A wide grid-based board, various moves, possible interruption of the game sequence, and randomness create a complex and challenging environment. For such, most of the state-of-the-art solutions are scripted bots.
To accomplish our goal, we used Open Source and predefined code. Our solution was based on the first successful, deep-learning-based bot for Blood Bowl –MimicBot, the BotBowl III winner. It used a hybrid Reinforced Learning (RL) and Imitation Learning model. We used Behavioral Cloning and A2C models to train it, which offer a balance between simplicity and efficiency. We evaluated MimicBot, testing different settings and observing the reactions. Based on that, adding modifications to increase the bot's capabilities was possible.

Session C (Poster) / **29**

Detection of cancerous changes in microscopic specimens from the colon

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Contemporary medical diagnostics increasingly utilise advanced information technologies to analyse microscopic specimens, crucial in detecting and diagnosing cancerous changes. In our work, we focused on the analysis of microscopic specimens from the colon, which is extremely important in detecting early stages of cancer. We used Python to process and analyse these images, offering extensive image processing and machine-learning capabilities. Our approach did not use direct image segmentation but decided to divide the Whole Slide Images (WSI) into smaller sections of 256x256 pixels. This process allowed for effective management and analysis of large datasets characterised by high resolution and significant size, enabling focus on more detailed analysis of specific tissue areas and efficient model training. Subsequently, we developed a Support Vector Machine (SVM) –constructed and trained in Python to categorise image slices exhibiting cancerous changes or healthy tissue. Thanks to its ability to efficiently handle high-dimensional data spaces and generalisation capability, this model proved to be exceptionally effective in distinguishing areas of interest. Using machine learning techniques, including the SVM model, combined with an innovative approach to processing Whole Slide Images, opens new perspectives in precise oncological diagnostics, allowing for faster and more accurate identification of cancerous changes, which is crucial for treatment effectiveness and improving patient prognosis.

Session B (Poster) / **30**

Pulmonary Hypertension Diagnosis: A Comprehensive Review of AI and Machine Learning Approaches

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Pulmonary hypertension (PH) refers to a group of diseases characterized by elevated blood pressure in the pulmonary arteries supplying the lungs. Accurate diagnosis of PH and determining its underlying causes is crucial but often challenging for physicians. The development of artificial intelligence (AI) techniques may help address this challenge by enhancing the diagnostic process. This paper aims to systematically review the existing literature on applications of AI, especially machine learning, in PH diagnosis and aetiology prediction. A comprehensive literature search will be conducted in major bibliographic databases without date or language restrictions. Studies applying AI methods to analyze clinical, imaging and biomarker data for PH diagnosis or cause classification will be included. Essential information on study design, AI algorithm employed, diagnostic or predictive performance, dataset characteristics and limitations will be extracted. A preliminary search has identified several studies developing AI models for automated classification of PH subgroups from various diagnostic modalities. However, investigations directly comparing AI-based

approaches against clinical practice are still scarce. This review seeks to provide a systematic assessment of the potential utility and current limitations of AI in modernizing PH diagnosis. It intends to outline promising research directions and highlight gaps needing further studies to realize the full benefits of AI for improving patient management and outcomes in PH.

Session B (Poster) / **31**

Optimization and parallelization of an electromagnetic field FDTD-based solver on asymmetrical 2D grid

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Finite-Difference Time-Domain method of electromagnetic field computation often requires significant amount of time and memory resources, which emphasizes the necessity for the development of high-performance programs. In this paper, we present enhancements to the performance of an electromagnetic field solver using the FDTD method on an asymmetric grid. The improvement in efficiency was achieved by exploring potential optimizations related to the specific features and capabilities of the Julia language, as well as employing multithreading and CUDA. To evaluate the effectiveness of computations, we compared the performance of the optimized solver with its previous version and a commercial solution –COMSOL Multiphysics.

Session A (Presentation) / **32**

The influence of dataset bias on the efficiency of the Intrusion Detection Systems

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Internet intrusion detection systems (IDS) use machine learning models, which one needs to train using public datasets. The training process requires a training set, which is a majority part of such a dataset, while validation is performed on its second part - the validation set. Finally, to evaluate the quality of the output model, one utilizes the test set, which is the third part. The measure (accuracy, precision, recall, or F1) obtained on the latter determines the quality of the model. In our paper, we investigate how the model prepared in the above classic way performs on other data, i.e., to what extent the model is biased to the public dataset used in the IDS model preparation. Our investigation uses cross-validation of models based on four internet traffic datasets: UNSW-NB15, BoT-IoT, ToN-IoT, and CIC-CSE-IDS2018. The results obtained show that quality measures of a model trained on one public dataset are only partially repeatable on others. It confirms the necessity of careful selection of data used in the machine learning models in IDS that guarantee high data diversity.

Session C (Poster) / **33**

Comparing UNET architectures in blood vessel segmentation task

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Advancements in UNet architectures have been pivotal in medical image segmentation, particularly for blood vessel segmentation, which is crucial for medical diagnosis and treatment. This article presents a comprehensive comparative study of various UNet models, examining their effectiveness in blood vessel identification within medical imaging. We explore the evolution of these models from the original UNet to advanced architectures like Swin UNetR, emphasizing their application in segmenting complex structures. Methodologically, we integrate different encoder architectures within the UNet++ framework with a decoder attention mechanism to evaluate their segmentation performance. Through both qualitative and quantitative analyses, we reveal significant performance differences across models and discuss the implications of these findings for clinical practice. The study underscores the importance of precision, recall, accuracy, and other metrics in determining model efficiency and highlights the potential of hybrid models that combine convolutional and transformer-based approaches. As we move forward, the goal is to refine these models for broader and more effective use in medical diagnostics, thereby enhancing patient care.

Session B (Poster) / **34**

Quantum Enhancement of Cryptography

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Quantum computers promise to revolutionize several fields, including cryptography. In recent years, researchers have made significant progress in developing quantum algorithms that can solve computational problems much faster than classical computers. These advances have led to concerns about the security of traditional cryptography algorithms, as they may be vulnerable to quantum attacks. In this article, we provide a comprehensive overview of the quantum enhancement of cryptography algorithms and examine the impact of quantum computing on various encryption and decryption schemes, including RSA, AES and Elliptic Curve Cryptography (ECC). We also discuss efforts to develop post-quantum cryptography and provide an outlook on the future of the field. The article concludes with an insight into the importance of preparing for the advent of quantum computing in cryptography and the need for continued research and development in this area.