CSCE 2024 BOOK of ABSTRACTS

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Note that the titles of papers, the authors' names and the abstracts that appear in this book ("Book of Abstracts") were extracted from the papers that were submitted to the EVALUATION web portal (i.e., extracted from the first draft submissions). The official published proceedings/book will have any and all changes/revisions that authors may have done.

KEYNOTE ADDRESSES

(The Keynote lectures are open to all participants)

CONGRESS WELCOME REMARKS

Professor Emeritus Hamid R. Arabnia
(Chair, Steering Committee & Coordinator), School of Computing, University of Georgia, USA;
Editor-in-Chief, The Journal of Supercomputing (Springer Nature);
Editor, Transactions of Computational Science & Computational Intelligence (Springer Nature)
Fellow, Center of Excellence in Terrorism, Resilience, Intelligence & Organized Crime Research (CENTRIC)

KEYNOTE TITLE:
The Effect of Tech Savviness of the Design and Interaction of AI systems: The Exploration of Trust

Professor John C. Murray
Academic Dean of the Faculty of Technology at the University of Sunderland, UK, and
Professor of Robotics and Autonomous Systems, University of Sunderland, UK

Abstract - Examining how self-perceived tech savviness influences an individual's reliance on AI technologies in their daily lives, we look into AI perceptions, considering comfort, trust, usefulness, ease of use, and habit formation around such AI interactions. With the increase in pervasiveness and applications of AI systems, their use in everyday lives, it is more important than ever to understand the interplay between humans and AI systems. The findings from our work emphasises the interplay of tech savviness and self-confidence in shaping AI adoption. Designing inclusive AI interfaces and creating educational interventions tailored to diverse backgrounds are crucial for promoting AI use and unlocking its full potential for all users. Within this talk we also touch on latest developments in embodiment and how the presentation of AI through different modalities can impact the perception, trust and acceptance of AI systems by its users.

KEYNOTE TITLE:
The Dawn of Cognitive AI, Self-Aware Robotics, and the Industrial Metaverse

Prof. Dr. Diego Galar
Operation and Maintenance Engineering, Lulea University of Technology (LTU), Sweden

Abstract - As we embark on the next great industrial revolution, the fusion of Artificial Intelligence (AI), Robotics, and the Metaverse is poised to redefine the landscape of modern manufacturing. This keynote speech will transport you into the future, where cutting-edge advancements in Generative AI are transforming industrial robots into cognitive, autonomous entities, seamlessly integrated with Digital Twins and the Metaverse. Explore the latest trends and ground-breaking achievements that are pushing the boundaries of what's possible in industrial automation. Discover how AI is not only endowing robots with human-like cognition but also integrating them into a vast digital ecosystem. This ecosystem includes Digital Twins—virtual replicas of physical assets—that provide real-time data and analytics, and the Metaverse, an interconnected virtual world that offers immersive simulation and collaboration opportunities. Intelligent systems are revolutionizing sectors such as automotive, aerospace, and consumer electronics, driving efficiency, reducing downtime, and sparking unprecedented innovation. Generative AI enables robots to learn, adapt, and evolve autonomously, creating a new paradigm of smart factories and intelligent supply chains. The Metaverse facilitates remote monitoring, predictive maintenance, and virtual prototyping, making industrial operations more agile and resilient. Delve into how Generative AI, Robotics, Digital Twins, and the Metaverse converge to form a fully integrated digital framework. This framework drives unparalleled growth and innovation by blending the physical and digital worlds into a seamless, intelligent continuum. Witness the dawn of a new technological era that disrupts and redefines the landscape of modern industry.

TUTORIAL/KEYNOTE TITLE:
Explaining the Design of the Quantum Fourier Transform

Prof. Leon Deligiannidis
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Abstract - The Discrete Fourier Transform (DFT) is one of the most practical mathematical tools that has been developed and is used in engineering, sciences and beyond. It converts a finite sequence of samples from the time/space domain into the frequency domain, and vice versa. Many operations and analyses are simpler in the frequency domain where after the appropriate operation (or filtering), the signal is converted back to the spatial domain. The Quantum Fourier Transform (QFT) is the quantum equivalent of the classical DFT. Instead of operating on classical signals, it operates on quantum states. Many important quantum algorithms utilize the QFT, or the inverse QFT, at their last step to extract the periodicity from their input quantum states. Some of these algorithms are Shor's, Quantum Phase Estimation (QPE), Quantum Counting and numerous other algorithms. In this work, we attempt to present QFT in a way that undergraduate students can understand the design of the algorithm and the reasoning of the implementation.

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High-Precision Method to Reduce Overfitting in ANNs using Highly Uniform Chaotic Sequences

Samad Shirzadeh, Ken Ferens, Witold Kinsner
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Abstract - Overfitting is a common problem in various neural networks because of limited data, a complex model, or a lack of regularization. Chaos injection is one of the effective solutions to prevent overfitting for multilayer perceptron neural networks (MLPs). This paper presents an improved chaotic injection technique utilizing the enhanced multiparametric tent map (MTM). Using the heuristic technique, we choose a set of control parameters with the most uniformity according to the Kolmogorov-Smirnov method. When the MTM is used in training an ANN, the uniformity of each generated sequence is greatly reduced due to the random selection of the initial value of a sequence. To solve this problem, we generated all the sequences before training time using the MTM based on dataset size, number of neurons in each layer, batch size, and number of Kfolds. Next, we normalized the sequences through a novel chaotic-sequence normalization and PDF equalization procedure to ensure they were uniform, and, finally, we stored them in a table. During training, the uniform-sequences were read from the table and were injected into the learning fabric of the ANN. The experimental results demonstrated an accuracy superiority of our proposed scheme in comparison with the latest techniques in terms of using the following performance metrics: accuracy (ACC), F1-score (F1), negativepredictive value (NPV), positive-predictive value (PPV), sensitivity (SN), and specificity (SP).

Assessing Information Influence for Node Attribute Prediction

Tonni Das Jui, Erich Baker, Mary Lauren Benton
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Belmont University, Nashville, Tennessee, USA

Abstract - Methods for node attribute prediction tasks utilize graph embedding approaches for graph data processing. However, many of these embedding strategies are developed leveraging specifically graphs' structural information. However, the graph offers diverse information of various types, and in case of scarce input information, careful incorporation of available data types can help achieve the expected performance. Incorporating available network information types, such as node attributes, inherent properties, and structures, into the graph embedding strategy for node attribute prediction requires understanding their effectiveness. To this end, our study thoroughly analyzes the relationship between network information types and their impact on attribute prediction performance within graphs. We evaluate the performance of the attribute prediction method with diverse information types and explore the benefits of different data combinations. Our results prove the contribution of feature information alongside network topology for node attribute prediction.

Experimental Analysis of Contemporary Trends, Performance, and Limitations in Graph Embeddings: A Comprehensive Review

Tonni Das Jui, Erich Baker, Mary Lauren Benton
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Belmont University, Nashville, Tennessee, USA

Abstract - As graph embedding research evolves, contributing to this research requires understanding prevailing challenges that current state-of-the-art models may not fully address. Navigating this dynamic landscape, however, is challenging due to the abundance of literature and the complexity, especially for newcomers to the field. Although review articles aim to synthesize information to solve this challenge, they can be intricate and encompass numerous models, some of which may lack widespread recognition within the research community. Our investigation focuses on fundamental embedding techniques that have made significant contributions and serve as embedding strategies in this field. In addition to categorizing them, we reproduce these repositories to evaluate their performance in similar settings, analyze their limitations, and point to future research. This approach aims to provide a concise yet comprehensive overview, facilitating accessibility for researchers entering the domain.

In-vehicle Sensing Platform for the Inference of Older Drivers' Mild Cognitive Condition

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Christine E. Lynn College of Nursing, Florida Atlantic University, Boca Raton, Florida, USA;
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Abstract - Changes in the driving behavior of older drivers can be indicative of conditions of mild cognitive impairment (MCI), which affect their memory and recognition skills on the road. Traditional clinical evaluations cover only a limited subset of cognitively impaired drivers, prompting the need for innovative technologies to monitor the cognitive status of older drivers routinely. In this study, we developed in-vehicle sensing devices capable of capturing vehicular data streams that reveal older drivers' driving patterns. Using K-means clustering on preprocessed and scaled data, we identified four distinct driver profiles characterized by trip frequency, driving style, and demographic factors. These profiles ranged from active, frequent travelers to sedentary, cautious drivers, with significant differences in trip duration, distance, and vehicle operation metrics such as speed and engine load. A developed random forest model further identified peak hour trips, age, gender, and ambient temperature as significant predictors of MCI, highlighting the complex interplay between lifestyle, driving behaviors, and demographics.

From Static Graph Attention Generation to Dynamic Graph Attention Coefficient

Tonni Das Jui, Mary Lauren Benton, Erich Baker
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Abstract - Graph attention networks have demonstrated competitive performance in node classification tasks. Nonetheless, recent studies have highlighted their limitation in generating static attention scores. Static attention coefficients imply that attention scores for node pairs remain fixed regardless of variational query keys or structural information. Consequently, researchers have been exploring diverse strategies to devise a dynamic attention mechanism suitable for graph data. In this vein, we introduce a dynamic attention-based graph neural network (GNN) grounded in structural information learning and engaged in enhancing its efficacy.

Infusing Human Feedback into Intermediate Prompting Steps of Large Language Models

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Abstract - This paper explores the implications for the problem-solving performance of large language models (LLM) when utilizing augmented intelligence by infusing human reasoning into the generated intermediate steps before a model outputs a result. We propose a framework that includes steps for injecting human reasoning and feedback into the prompting steps of large language models, using three different categories of human feedback, namely Substitution, N-Shot Learning, and Conversational, aiming to improve the model's problem-solving ability. In order to test the framework, we conducted a user study with participants who edited the intermediate steps to align with their reasoning. The results of revised prompts are compared against their base performance on the ARC, DROP, and WinoGrande datasets. Our findings reveal that the injection of human reasoning steps can boost a large language model's problem-solving accuracy regarding the test benchmarks, particularly regarding the N-Shot Learning approach. We aim to shed light on the different applications of infusing human feedback into the output of pre-trained models.

An Integrated Approach for AI-Assisted Survey Systems Using Deterministic and Nondeterministic Models

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Abstract - Low response rates have always been a challenge in online surveys. Filling out a survey, especially those with openended questions, can become tedious for respondents. To address these issues, we propose a new approach that reduces the burden of typing responses by integrating traditional search algorithms and machine learning algorithms. A hybrid Trie-based search algorithm was introduced for word auto-completion, significantly reducing the number of keystrokes required for responses. Domain-specific survey data was input into the training model, demonstrating promising results in initial testing.

A Secure Self-Adaptive System in Applications of Cognitive Computing

Yong-Kyu Jung
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Abstract - In the realm of cognitive computing, integrating self-adaptive and self-organizing systems is pivotal for efficiency, autonomy, and security. Our paper, "A Secure Self-Adaptive System in Cognitive Computing," explores a robust system design tailored for dynamic environments. Leveraging natural language processing and machine learning, it adjusts to environmental changes and threats. Our approach enhances performance with feedback mechanisms and decentralized control, critical for healthcare, finance, and smart infrastructure. With adaptive security measures, the system maintains resilience against cyber threats without compromising functionality. Supported by empirical evidence, our findings demonstrate significant improvements in efficiency, resilience, and autonomy, marking a notable advancement in cognitive computing.

Revisiting the Nexus Between Handwriting and Personality: Graphology

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Abstract - Handwriting analysis offers a valuable tool for predicting personality traits, as individuals typically find it challenging to mask their personality in their handwriting. Despite awareness of handwriting analysis techniques, consistently altering one's writing to obscure personality traits is difficult. Continuous writing naturally reveals aspects of the writer's personality through pen movements and strokes. Furthermore, compared to other biometric features such as fingerprints, irises, or facial recognition, handwriting is easier to obtain and involves fewer privacy concerns, aside from personal signatures and private diaries. Our study leverages the integration of psychological questionnaires and the expertise of graphologists to enhance handwriting analysis. By employing deep learning methods from the field of computer vision, we aim to extract more complex features from handwriting samples, thereby improving prediction accuracy compared to traditional machine learning approaches. This innovative approach capitalizes on the strengths of deep learning to advance the field of personality prediction through handwriting analysis.

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Dihedral Angle Adherence: Evaluating Protein Structure Predictions in the Absence of Experimental Data

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Abstract - Determining the 3D structures of proteins is essential in understanding their behavior in the cellular environment. Computational methods of predicting protein structures have advanced, but assessing prediction accuracy remains a challenge. The traditional method, RMSD, relies on experimentally determined structures and lacks insight into improvement areas of predictions. We propose an alternative: analyzing dihedral angles, bypassing the need for the reference structure of an evaluated protein. Our method segments proteins into amino acid subsequences and searches for matches, comparing dihedral angles across numerous proteins to compute a metric using Mahalanobis distance. Evaluated on many predictions, our approach correlates with RMSD and identifies areas for prediction enhancement. This method offers a promising route for accurate protein structure prediction assessment and improvement.

Synthetic Generation of Escape Sequences for Escape-prediction of SARS-COV-2

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Abstract - The challenges of developing drugs and vaccines against SARS-CoV-2 is intensified by the constant evolution of the spike protein. This study focuses on using Artificial Intelligence, specifically Generative Adversarial Networks (GANs), to simulate escape sequences, and utilize these sequences to improve the escape prediction model. Our novel GAN model generates synthetic spike protein sequences with potentially higher infectivity and transmission. This approach showed a promising increase in prediction accuracy, with improvements noted across various datasets. Such advancements could revolutionize our ability to anticipate future mutations, aiding in the creation of more effective treatments and preventive measures against COVID19 and its variants. Our findings underscore the potential of AI in tackling challenges posed by fast-evolving pathogens.

Early Alzheimer's Detection: Bidirectional LSTM and Attention Mechanisms in Eye Tracking

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Abstract - This study presents an innovative deep-learning framework designed to enhance the early detection of Alzheimer's Disease (AD) through comprehensive analysis of eye movement patterns. We have developed a Bidirectional Long Short-Term Memory (Bi-LSTM) network augmented with an attention mechanism by leveraging a dataset comprising eye movement data from both early-stage AD patients and a control group. This advanced model captures the nuanced temporal dynamics and ocular characteristics that signal early cognitive decline. Our empirical results reveal that the Bi-LSTM network with attention mechanism markedly surpasses traditional models in essential performance metrics, including accuracy, precision, recall, F1 score, and the area under the Receiver Operating Characteristic (ROC) curve. When scrutinized through sophisticated deep learning techniques, these outcomes underscore the potential of eye movement data to serve as a potent, non-invasive diagnostic tool for early AD detection. The implications of this study advocate for a paradigm shift towards more accessible and prompt diagnostic methods, enhancing the potential for early intervention and improved patient outcomes.

HIBR: A Hybrid Intelligent Brainwave Recognition Model with Higher Accuracy

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Henry M. Gunn High School, Palo Alto, California, USA;
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Abstract - Deciphering electroencephalogram (EEG) signals accurately poses a formidable challenge due to their intrinsic high dimensionality, non-stationarity, and intricate spatiotemporal patterns. While convolutional neural networks (CNNs) have found widespread use in EEG signal processing, their limited receptive fields impede their capacity to capture long-range dependencies, which are pivotal for comprehensive EEG analysis. To overcome this constraint, this paper introduces a novel hybrid intelligent brainwave recognition model that amalgamates convolutional layers with a transformer-based self-attention mechanism for EEG signal interpretation. The proposed model harnesses the strengths of convolutional layers to grasp local spatiotemporal features, while utilizing self-attention to effectively discern global correlations in EEG signals. Evaluation The efficacy of the proposed approach was assessed on the Physionet EEG dataset, yielding an accuracy of 88.7% and a Kappa score of 86.3%, surpassing existing methods solely reliant on CNNs. These findings underscore the promise of hybrid architectures in robust EEG signal recognition and their potential utility in clinical settings and brain-computer interface applications.

Enhancing Diabetes Prediction with Advanced Machine Learning Techniques

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Abstract - Diabetes stands as one of the foremost causes of mortality in the United States. The imperative to predict diabetes in the country arises from its widespread prevalence, substantial healthcare expenses, potential severe complications, and the prospect of proactive prevention and early intervention. This study leverages data from the Framingham study to investigate the utilization of machine learning models in the realm of diabetes prediction. Consequently, the implementation of predictive models to combat diabetes holds the promise of yielding substantial positive outcomes for public health, optimizing healthcare resource allocation, and enhancing the overall health and welfare of individuals and communities.

Lung and Colon Cancer Classification Based on a Hybrid Deep Convolutional Neural Networks of Xception, VGG-16, and VGG-19 using Histopathological Images

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Abstract - Lung and colon cancer are considered as two of the leading causes of fatalities in human beings. The ability to detect this cancer is very necessary to determine the subsequent actions. In this paper, we perform lung and colon cancer detection using a framework of multiple state-of-the-art deep learning architectures. The feature maps of three models: Xception, VGG-16, and VGG-19 are combined which will result in a bigger feature map. Then, we train this hybrid model from scratch on a large dataset of Lung and Colon images called LC25000 which consists of five classes with 5000 images per class. Finally, Softmax layer of the combined model is used to classify images. Classification results show that our hybrid model achieves a high classification accuracy of 99.34% using fourfold cross-validation. Comparison has also been carried out on previous work experiments performed on the same dataset and results showed that our hybrid model outperforms state-of-theart methods. Thus, our model has the potential to become a valuable tool in clinics, helping doctors in cancer diagnosis.

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Rethinking Transfer Learning for Histopathology Cancer Detection: HistoNet

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Abstract - This study presents HistoNet, a refined convolutional neural network based on the EfficientNet B0 architecture optimized explicitly for histopathological image classification. Trained on a diverse array of cancer images, HistoNet showcases exceptional feature extraction capabilities, surpassing established models such as the VGG series, InceptionV3, and the EfficientNet variants, particularly on datasets not encountered during training. Our analysis demonstrates that HistoNet outperforms these conventional models in extracting nuanced features critical for accurate cancer detection. In a series of comparative tests, HistoNet consistently achieved higher validation accuracies, excelling with up to 99.47% in specific cancer subtype classifications, thereby illustrating its superiority over other recently proposed models. The efficacy of HistoNet's feature selection is further evident in its capacity to enhance classification performance across various cancer types, including those with subtle histological differences. We also present Topo-HistoNet, an advanced feature extraction methodology, integrating the HistoNet deep learning based approach with traditional image analysis techniques, and establishing a new standard for automated histopathological image analysis. The results of this research not only bolster the role of tailored deep learning models in biomedical imaging but also pave the way for their application in broad diagnostic contexts, potentially extending to unexplored tumor categories.

White Blood Cell Nuclei Detection and Segmentation on Ratio Channels G/B, B/G, and B/R for FPGA Implementation

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Health Sciences Department, UDLAP, San Andres Cholula, Mexico

Abstract - The study of white blood cells (WBC) is crucial in clinical practice due to their role in assessing immune system health. However, the manual evaluation of blood smears is often tedious and prone to errors, making it a prime candidate for automation. This paper proposes an alternative method for WBC nuclei segmentation using blue-to-green and green-to-blue ratio subtraction, followed by Otsu's thresholding. Additionally, a size filtering algorithm, designed for FPGA acceleration, is applied to obtain the final mask. Blue-to-red ratio computation corrects segmentation errors, improving results. The algorithm achieves a Dice similarity coefficient (DSC) of 0.8444 without correction and 0.8777 with correction. Testing on LISC and a private dataset yields Accuracy results of 0.9982 and 0.9600 respectively.

MobiVitalsConnect: A Comprehensive Mobile Healthcare System for Real-Time Patient Monitoring and Data Visualization

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Abstract - This paper introduces MobiVitalsConnect, a novel platform-agnostic mobile healthcare system designed for both bedside and remote monitoring of patients. Central to our system is its integration with the Vitaliti™ wearable, equipped with biosensors for real-time monitoring of vital signs such as heart rate, blood pressure, respiratory rate, body temperature, and oxygen saturation, along with physiological signals including ECG, PPG, Respiratory waveforms, and accelerometer data. MobiVitalsConnect provides advanced visualizations, including real-time data and 15-minute trend lines, facilitating rapid clinical decision-making. The system employs colour coding to enhance data interpretation and supports seamless data transfer to a backend server, making it a robust solution for personalized healthcare management and improved patient outcomes.

EEGNet-Vision Transformer Ensemble Model with Pseudo Labeling for Epilepsy Patients Seizure Prediction from EEG

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Abstract - Epilepsy is a common chronic neurological disorder marked by seizures of unknown origin. Electroencephalography (EEG) is crucial for diagnosing and managing epilepsy due to its cost-effectiveness and portability, compared to advanced neuroimaging methods like MEG, fMRI, MRS, and SPECT. This study proposes a novel method to categorize six types of EEG votes using deep learning techniques. We employed 1D convolutional neural networks (1D CNN) and vision transformers (ViT), enhancing model performance with pseudo-labeling (PL) and ensemble learning. The dataset, annotated by clinical experts and scientific collaborators, was divided into high-quality and low-quality categories based on expert participation. The EEGNet-ViT model with ensemble and pseudo-labeling achieved a Kullback-Leibler divergence (KLD) of 0.3362 and an accuracy of 74.22%. This approach leverages the strengths of both 1D CNN and ViT models, reducing variance and improving the accuracy of EEG signal analysis.

Internet-of-Things Chair and the 30 Second Chair Stand Test

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Walnut Valley Research Institute, Walnut, California, USA;
Yale University, New Haven, Connecticut, USA;
Brown University, Providence, Rhode Island, USA

Abstract - Falls are a leading cause of injuries and deaths for adults. Fall risk of falls can be evaluated by standardized tests, including the 30-Second Chair Stand Test (30CST). This test is done by visually observing the participant and manually counting. This study tested an Internet-of-Things (IoT) Chair and its performance on the 30CST. The IoT Chair was less labor-intensive and produced additional data not measured with the observer method, including calculating the weight placed on each chair leg, the rate of weight change placed on the chair, the sitting time, standing time, and time it took to complete each sit-stand-sit cycle. This additional information can help physicians better understand their patients' leg weakness and fall risks.

Off-line CNN based Finger Number Gesture Recognition System using Raspberry pi

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Abstract - In this study, we implemented off-line wearable CNN based finger number gesture recognition system on Raspberry pi. OpenBCI's bio-sensing board was used to collect sEMG training signals and sEMG test signals collected from the forearm of a subject when finger number gesture is performed. Using training data, CNN model is trained on Google Colaboratory platform and the resulting CNN model is deployed and run on Raspberry pi board. In experimental study, CNN model on Raspberry pi recognizes one to five finger number at an accuracy of 91.3%.

Classification of Heart Rate Variability (HRV) based on Attention Mechanism of Transformer Model

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Abstract - In this paper, a novel ECG classification method based on attention mechanism of transformer model and feature extraction was proposed to detect normal and abnormal ECG signals. RR intervals, half width of R peak as well as their distributions were taken as features of ECG signals. Then, the transformer-based neural network with feature extraction was trained to classify imbalanced ECG signals. This research shows how to detect heart rate variability and classify electrocardiogram (ECG) data from the PhysioNet using transformer-based neural network model. The experimental results demonstrate that the proposed method achieves a good classification performance. The proposed method can be applied to distinguish between different cardiovascular diseases or autonomic nervous system disorders and to aid in early detection and diagnosis of conditions such as arrhythmias, heart failure, or diabetic autonomic neuropathy.

Advancing Fall Detection and Prevention: Integrating Wearable Devices and a Camera-Based Analysis

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Sentinel Secondary School, West Vancouver, BC, Canada;
Burnaby North Secondary School, Burnaby, BC, Canada;
Department of Research and Development, Canada Youth Robotics Club, Vancouver, BC, Canada

Abstract - One of the most severe health risks to elderly populations is the risk of falling. Falls can lead to acute injuries, correlating with a decline in physical health. Recognizing the significance of this issue, the Fall Prevention Project aims to develop a method that can accurately predict and prevent falls in elderly demographics. Data collection is essential to understanding and predicting falls. This article addresses the data collection methods used in the Fall Prevention Project. For this project, two separate fall detection methods were proposed. The first method uses a gyroscope and accelerometer sensor embedded in a watch-like device to record data. The second uses a depth-camera-based device to record pose data. By collecting information to train a machine learning algorithm, patient stability can be modelled to reduce the likelihood of injuries and fatalities in at-risk patients. Recently, notable advancements have taken place in the development of prototypes for both the software and hardware components of the wearable and camera-based devices utilized in the Fall Prevention Project. The findings of this study contribute to the field of fall detection, offering insights into the advantages of camera-based analysis of human pose and gyroscopebased analysis of human pose, and improving the safety of individuals at risk of falls. Future work should include the integration of machine learning techniques to enhance system performance. The technology showcased in this study has implications for healthcare, monitoring, and elderly care, providing valuable insights to support various domains and improve quality of life.

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Notes on Symmetric Generalized Tent Map: Route to Chaos

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Abstract - Many known non-linear dynamic maps follow similar behavioral patterns such as periods of double cascading and islands of stability before reaching the fully developed chaotic regimes. The paper introduces a novel family of parametric generalized tent maps that do not follow the above route to chaos. Instead of forming well defined and observable cascading patterns, all cyclic structures become dynamically unstable with bifurcation branches scattered inside narrow subdomains that can overlap. The method of Lyapunov Exponent is applied to characterize transitions to chaotic regimes. The paper demonstrates the ergodic property of the dynamic process by computing invariant distributions of the map. A closed-form distribution for the developed chaos is derived. A zone of instability exists where ergodic property fails.

Scalable Service Model and Scheduler for Delay-Sensitive Services

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Faculty of Electrical Engineering and Informatics,
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Abstract - Efficient resource management is crucial in modern networks due to the stringent requirements of emerging services. As networks become more complex with technologies such as 5G, edge computing, service-defined networking, scalable packet scheduling becomes essential. In parallel, there is a growing revolution in latency-sensitive applications, with the different latency requirements of 5G and beyond services. To promote delay-sensitive traffic in a scalable manner, this paper presents a general delay-oriented analysis of multi-queue systems. Through this model, we present a scheduling rule and scheduler implementation for a proportional and fair service that can serve delay-sensitive traffic more efficiently and scalable than previously known.

Regret-minimization Heuristics for Identifying Monotone Boolean Functions

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Nova Southeastern University, Fort Lauderdale, Florida, USA

Abstract - In many applications that involve identification of an unknown monotone Boolean function (MBF), the cost of inferring the value of a vector using monotonicity is negligible compared to the cost of querying its value. Accordingly, heuristics to identify MBFs seek to minimize the number of vectors queried. The order in which queried vectors are selected determines the number of queries needed. This paper presents a method for MBF identification that iteratively selects vectors to be queried based on a regret-minimization criterion. We observe that the best extant heuristic may be considered a special case of our approach and present alternate regret functions that perform no worse than this heuristic.

Feasibility Study of Neutron Mammography Using MCNPX with a Breast Voxel Anthropomorphic Phantom

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Hamed A. Alshammari, D. A. Bradley
Department of Radiological Sciences, College of Applied Medical Science,
Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia;
School of Medicine, Royal College of Surgeons in Ireland-Bahrain, Adliya, Bahrain;
Department of Physics, College of Science, Imam Abdulrahman Bin Faisal University,
Dammam, Saudi Arabia;
School of Mathematics and Physics, University of Surrey, Guildford, UK

Abstract - Neutron radiography represents a nondestructive testing method using neutron beams instead of X-rays or gamma rays for imaging purposes. This approach offers distinct advantages, particularly in its enhanced interaction with light atoms and materials, facilitating the visualization of concealed structural intricacies. This study investigated the applicability of neutron radiography in mammography. Monte Carlo simulations, employing voxel phantoms, are pivotal in analyzing neutron interactions within objects or biological bodies. Specifically, this study uses MCNPX 2.5.0 alongside a high-resolution breast voxel phantom. Grayscale postprocessing methods were implemented to refine image contrast. The findings underscore the contrast enhancement achieved through influence of varied neutron energies. Notably, fast neutrons sourced from the fission spectrum manifest better overall contrast. However, further investigations are warranted to optimize possible in-beam collimation, conduct dose assessments, and juxtapose neutron radiography with conventional photon mammography. This study underscores the potential of neutron radiography in medical imaging and delineates pathways for future research and development endeavors.

Multi-class Classification of Satellite Orbits for Database Quality Control

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LinQuest Corporation, Beavercreek, Ohio, USA

Abstract - The Joint Spectrum Center (JSC) Equipment, Tactical, and Space (JETS) database contains 9,539 satellite records. When new data is ingested the satellite orbit type needs to be identified, which is currently a manual process. In order to save time, this work explores automating the process using machine learning. Several statistical machine learning models and neural network models were developed and compared using the weighted averages of precision, recall, and F1 score metrics. The number of records used in training and testing was 1,024 with a 60/20/20 train, validation, and testing split. Six orbital parameters were initially used to fit the models but three parameters (the mean motion, eccentricity, and inclination) were the most important in determining orbit type. There were seven target orbit classes. The best model was a decision tree model with the three most important orbital parameters as inputs. The weighted averages of the precision, recall, and F1 score on the test data were 0.991, 0.990, and 0.990 respectively. This compared favorably to the F1 metrics for a random classifier (0.106) and a model that always predicted the majority class (0.103).

Real-time Motion Planning for Autonomous Vehicles in Dynamic Environments

Mohammad Dehghani Tezerjani, Sudip Dhakal, Deyuan Qu, Dominic Carrillo, Amir Mirzaeinia, Qing Yang
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Abstract - Recent advancements in self-driving car technologies have enabled them to navigate autonomously through various environments. However, one of the critical challenges in autonomous vehicle operation is trajectory planning, especially in dynamic environments with moving obstacles. This research aims to tackle this challenge by proposing a robust algorithm tailored for autonomous cars operating in dynamic environments with moving obstacles. The algorithm introduces two main innovations. Firstly, it defines path density by adjusting the number of waypoints along the trajectory, optimizing their distribution for accuracy in curved areas and reducing computational complexity in straight sections. Secondly, it integrates hierarchical motion planning algorithms, combining global planning with an enhanced A $*$ graph-based method and local planning using the time elastic band algorithm with moving obstacle detection considering different motion models. The proposed algorithm is adaptable for different vehicle types and mobile robots, making it versatile for real-world applications. Simulation results demonstrate its effectiveness across various conditions, promising safer and more efficient navigation for autonomous vehicles in dynamic environments. These modifications significantly improve trajectory planning capabilities, addressing a crucial aspect of autonomous vehicle technology.

A Novel Deep Learning Method for Solving PDE's Applied to a Shallow Water Problem

Jose Palacios-Garcia, Julio Ibarra-Fiallo, Servando Espin-Torres
Colegio de Ciencias e Ingenierias Universidad San Francisco de Quito, Cumbaya, Ecuador

Abstract - In this work we explain and implement a method that uses an artificial neural network to solve differential equations numerically. The method was applied to a model of the flow of water in an open channel described by the Saint-Venant Equations (SVE). These equations constitute a system of partial differential equations. The method was implemented in Python using the libraries Numpy and Pytorch to manage matrix operations and the construction of the artificial neural network. The results of the method were compared with a common numerical method using RK1, where an average relative error of 4,05% was obtained. The results show that the proposed method has a promising performance in the resolution of partial differential equations, especially because of the versatility that it offers to define boundary conditions in complex geometries. The execution time was comparable to traditional methods, thanks to common performance enhancements developed for training artificial neural networks. Possible improvements for further research are mentioned.

A New Approach Toward Interface-aware Methods for Diffusion Equations

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Abstract - A numerical method is developed for two- and three-dimensional time-dependent diffusion equations in numerical simulations involving mixed cells. The focus of the development is on the formulation for large time steps, second order accuracy in time, the correct treatment of the discontinuity in diffusion coefficient, the handling of mixed cells, and its simplicity compared with previous interface-aware methods. The discontinuity in material diffusion coefficient is correctly treated based on governing physics principles. For mixed cells, material interface reconstruct is applied. Compared with existing interface-aware methods, the proposed method is simpler. The correctness and features of the method are demonstrated through numerical examples.

An Evaluation Tool for Cybersickness Mitigation Techniques in a Virtual Reality Environment

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Department of Electrical & Computer Engineering,
New York Institute of Technology, New York, USA

Abstract - This study presents a proposal of a ball-hunting game to evaluate cybersickness mitigation techniques in virtual reality (VR). As VR technology evolves, lower costs and smaller systems will demand that developers create high-quality content. Integrated cybersickness countermeasures are often required to ensure safety and comfort for all users. Our application aims to trigger cybersickness in some VR users and automates data collection to compare these techniques.

Exploring the Impact of Social Media on Mental Health and Well-being: A Multi-Dimensional Analysis

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School of Electronic Engineering, Dublin City University, Dublin, Ireland

Abstract - Lately, the popularity and adoption of social media have increased globally, leading to an inevitable part of daily communication and connection. However, the widespread use of social platforms introduces significant challenges to mental well-being. Ongoing state-of-the-art research demonstrates a robust correlation between extensive social media usage and the worsening of medical conditions such as depression and anxiety. These approaches often struggle because they fail to adequately model key health-related information and screen usage frequency in their analyses. Moreover, most of the existing methods do not fully leverage advanced data analytics and machine learning technologies to effectively model the influence of social media algorithms on different age groups. In this paper, we employ a multi-model analysis, utilizing techniques such as decision trees, random forests, support vector machines (SVMs), and convolutional neural networks (CNNs), to gain a deeper understanding of the intricate relationship between social media use and mental health. In particular, we present four case studies exploring demographic risk factors, broader health consequences and specific health behaviors, and depression predictors associated with the use of social media. These analyses provide a comprehensive view of social media's multi-dimensional impact on mental health and offer critical understandings for designing targeted interventions and policies.

The Strategic Optimization of a Tabletop Role-Playing Game

Zhi Zheng, Nicholas Porter, Toby Hilliard, Feng-Jen Yang
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Florida Polytechnic University, Lakeland, Florida, USA;
Computer Science Department,
Florida Polytechnic University, Lakeland, Florida, USA

Abstract - Globally, Warhammer 40k TRPG (Tabletop RolePlaying Game) enthusiasts often find that the most timeconsuming aspect of the game is setting up their loadout. In this project, we're taking an approach by employing genetic algorithms to streamline the optimization of a Space Marine Squad's weapon loadout, tailored to combat various adversaries. This endeavor is not just an exercise in game preparation, but a deep dive into the intricate interplay between strategy and probability. It's akin to significant AI research in game playing, reinforcing the notion that games serve as an excellent proving ground for AI research. Our ultimate goal is to forge a connection between genetic algorithms and practical tabletop warfare games, transforming the way players strategize and engage with the game. This project is more than a study; it's an exploration into the complex balance of strategy and chance.

Acquisition and Analysis of Mobile Data using Digital Forensics Tools and Techniques

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California State University Dominguez Hills, Carson, California, USA

Abstract - Mobile phones have become a key necessity in today's world. With the rapid advancement of technology, mobile phones are now ubiquitous and on par with supercomputers. From a conventional business to an e-business, all the work is being done on the tip of your fingers. As a result, more and more cybercrimes are occurring eventually. Therefore, mobile forensics is the need of the hour, and it is essential for forensic professionals to keep themselves updated and enrich one's investigation capabilities. Mobile forensics is the process of acquiring, analyzing, and investigating digital data that resides in a mobile phone. Since the use of mobile phones has increased significantly over the past decades, it can provide a wealth of information which can be served as digital evidence to solve cybercrimes in a forensically sound manner [1]. In this research, we have compared various mobile forensics tools and evaluated it based on the data acquisition and analysis capabilities. The aim of our research is to help forensic professionals, forensics researchers and law enforcement agencies choose an appropriate tool for better acquisition and analysis of mobile data. The paper focuses on logical acquisition of Android and iOS smart phones using various software based forensic tools with file system extraction capabilities along with the analysis of metadata, cryptographic hash values and data recovery.

Structural Health Monitoring for Risk Assessment and Reliability of a Structure After Extreme Loads

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Civil and Environmental Engineering Department, California State University, Fullerton, California, USA

Abstract - The present paper focusses on the latest health monitoring techniques and system for continuous health assessment and reliability of a Civil Structure like bridge especially after an extreme force as earthquake. The Indian bridges are deteriorating due to harsh environmental condition, intense traffic and some natural disaster like earthquake. It is very essential to timely monitor the heath of a bridge structure in such aggressive environmental conditions in terms of retrofitting or rehabilitation of a bridge and also the reliability for the remaining useful life of a structure. All available Global and Local techniques for structural health monitoring were studied. Among these techniques the Electro-Mechanical Impedance technique is found to be very sensitive to incipient damage detection. The EMI technique is a relatively new technique of structural health monitoring in which a PZT patch is bonded to the surface of structure using high strength epoxy adhesive or embedded in structure whose health is to be monitored. The signature of the PZT patch is acquired over a high frequency range (30-400 kHz) with the help of LCR meter or impedance analyzer. The signature is complex in nature, Detection of incipient damage is quite critical and challenging task for health monitoring of structures with traditionally available techniques. In this study, through artificial damage created in the Bridge and it is found that the incipient level damage is very quickly detected by the EMI technique. The proposed EMI technique is considered as most reliable health monitoring technique for civil engineering structure. It can easily be used for the bridges also.

Scientific Constructing Adequate Statistical Decision Rules under Parametric Uncertainty of Applied Mathematical Models via the Smart Use of Pivotal Quantities and Ancillary Statistics

Nicholas Nechval, Gundars Berzins, Konstantin Nechval
BVEF Research Institute, University of Latvia, Riga, Latvia;
Mathematics Department, Riga Aeronautical Institute, Riga, Latvia

Abstract - In this paper, the novel technique of intelligent constructing adequate statistical decision rules under parametric uncertainty of applied mathematical models via the smart use of pivotal quantities and ancillary statistics is proposed. It is assumed that only the functional form of the underlying distributions is specified, but some or all of its parameters are unspecified. In such cases pivotal quantities and ancillary statistics, whose distribution does not depend on the unknown parameters, are used. Eliminating unknown (nuisance) parameters from a model is universally recognized as a major problem of statistics. A surprisingly large number of elimination methods have been proposed by various writers on the topic. The classical method of elimination of unknown (nuisance) parameters from the model, which is used repeatedly in the large sample theory of statistics, is to replace the unknown (nuisance) parameter by an estimated value. However, this method is not efficient when dealing with small data samples. The novel statistical technique of computational intelligence isolates and eliminates unknown parameters from the underlying model as efficiently as possible. Unlike the Bayesian approach, which is dependent of the choice of priors, the proposed method is independent of the choice of priors and represents a novelty in the theory of statistical decisions. It allows one to eliminate unknown parameters from the problem and to find the efficient statistical decision rules, which often have smaller risk than any of the well-known decision rules. It is conceptually simple and easy to use. To illustrate the proposed technique, numerical examples are given.

A High Order Scheme for Modelling Viscous Incompressible Fluid Flow in a Channel with a Step

Saeed M. Dubas
Engineering and Computer Science Division, University of Pittsburgh at Johnstown, PA, USA

Abstract - The viscous incompressible fluid flow in a channel with a step is studied under steady state conditions. An earlier work employed a fourth order scheme with second order boundary conditions to obtain very accurate results which were in close agreement with various other studies in channel flow problems. The present work employees a fifth order scheme using 13- point grid. Moreover, it uses fourth order boundary conditions to further improve the accuracy of results. Two well-known workshop problems are chosen for the comparison of results, the problems of contraction and expansion flows. The results compare favorably with the literature from experimental and numerical view-point.

A Smart Air Quality Analysis and Pollutant Diffusion Detection and Prediction System Based on Tree Canopy Shape Research Using Machine Learning and Artificial Intelligence

Mingyuan Liu, Ang Li
Montverde Academy Shanghai, Shanghai, China;
EECS Department, California State University, Long Beach, California, USA

Abstract - This project represents a significant foray into the intersection of computational fluid dynamics (CFD), machine learning, and environmental science. By integrating CFD results with the predictive capabilities of computer vision and AI, we have crafted a multifaceted approach that not only serves environmental sciences by forecasting air quality but also advances the field of machine learning with its interdisciplinary applications. The developed model stands as a testament to this synergy, exhibiting high levels of accuracy in its predictions, albeit with occasional outliers. Recognizing the model's substantial promise, we are committed to its ongoing refinement. Future efforts will be channeled into expanding its data foundation and exploring innovative algorithmic strategies, underscoring our long-term commitment to enhancing the project's contribution to both scientific domains. This sustained investment is poised to solidify and extend the practical and theoretical benefits of our interdisciplinary methodology.

SESSION: Military and Defense Modeling and Simulation

Co-Chairs: Prof. Douglas D. Hodson (Chair), Prof. Michael R. Grimaila**, Dr. Torrey J. Wagner****
**Computer Science and Engineering Department, US Air Force Institute of Technology (AFIT), USA*
***Head, Systems Engineering & Management Department, US Air Force Institute of Technology (AFIT), USA*
****Data Analytics, supporting the AFIT/EN Data Analytics graduate certificate program*

Performance Evaluation of Utilizing Rust for PCAP Analysis in Satellite Cybersecurity

Samual M. Asher, Douglas D. Hodson
The Air Force Institute of Technology, WPAFB, Ohio, USA

Abstract - TBA

Austere Runway Simulated Identification

Luke H. Boyd, Douglas D. Hodson
The Air Force Institute of Technology, WPAFB, Ohio, USA

Abstract - TBA

Using Rhai to Create & Benchmark Bevy Entities

John H. Hardy, Douglas D. Hodson
The Air Force Institute of Technology, WPAFB, Ohio, USA

Abstract - TBA

PyQ3: Building Python Extension Modules in Native Rust with Performance and Safety in Mind

Price D. Johnson, Douglas D. Hodson
The Air Force Institute of Technology, WPAFB, Ohio, USA

Abstract - TBA

Leveraging Python Interpreters for Concurrency in SeQUeNCe

Brett M. Martin, Michael R. Grimaila, Douglas D. Hodson
The Air Force Institute of Technology, WPAFB, Ohio, USA

Abstract - TBA

Benchmark Performance of a Rust-based Python Extension

Ethan J. Schofield, Douglas D. Hodson
The Air Force Institute of Technology, WPAFB, Ohio, USA

Abstract - TBA

Quantum Error Correction in Repetition Codes

James A. Williams, Douglas D. Hodson
The Air Force Institute of Technology, WPAFB, Ohio, USA

Abstract - TBA

Investigating Selective Reliability with the Laminar Networking Package

Ryan D. Winz, Douglas D. Hodson
The Air Force Institute of Technology, WPAFB, Ohio, USA

Abstract - TBA

A Bell State Measurement Throughput Analysis Using Linear Quantum Optics

Kurt T. Spranger, Michael R. Grimaila, Douglas D. Hodson
The Air Force Institute of Technology, WPAFB, Ohio, USA

Abstract - TBA

The 23rd International Conference on e-Learning, e-Business, Enterprise Information Systems, & e-Government (EEE'24: July 22-25, 2024; Las Vegas, USA)

https://american-cse.org/csce2024/conferences-EEE
https://www.american-cse.org/csce2024/

A Framework for Evaluating Organization Accelerator Success

David Keever
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Abstract - Given the pace of innovation, organizations are exploring a variety of models to discover and exploit innovations for organizational improvements or market advantage. One popular approach is the accelerator model in which a cadre of experts are assembled to focus on domain-specific topics to assess technology rapidly and advance promising technologies towards market introduction and affiliated uses. This poster presentation introduces a three-part framework to evaluate accelerator success in achieving market introduction of novel technology. A preliminary set of effectiveness measures are presented for consideration by organizational leaders.

Navigating Challenges in E-participation: A Comprehensive Meta-Analysis

Mayssa Bougherra, Abdul Khalique Shaikh, Saranjam Baig, Naresh Adhikari
Northumbria University, Newcastle upon Tyne, United Kingdom;
Department of Information Systems, Sultan Qaboos University, Muscat, Oman;
Department of Political Science, Sultan Qaboos University, Muscat, Oman;
Slippery Rock University of Pennsylvania, Pennsylvania, USA

Abstract - E-participation systems have emerged as valuable tools for enhancing democratic processes and citizen engagement in decision-making. These systems leverage information and communication technologies to facilitate interactions between citizens and government entities. While e-participation systems hold great potential, they also face numerous challenges that hinder their effectiveness and adoption. This paper aims to provide a comprehensive study of the challenges encountered by existing e-participation systems, focusing on key areas such as technological, social, legal, and organizational aspects. By understanding these challenges, policymakers, system developers, and stakeholders can devise strategies to overcome them and foster successful e-participation initiatives. This paper conducts a meta-analysis of past studies between 2017 and 2023 on the challenges faced by existing e-participation systems. Through this meta-analysis, the authors find that e-participation systems encounter multifaceted challenges spanning various dimensions, including technological, organizational, political, and social aspects.

The Shifting Landscape of Cybersecurity: The Impact of Remote Work and COVID-19 on Data Breach Trends

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School of Information Technology, University of Cincinnati, Cincinnati, Ohio, USA;
Friedrich-Alexander-Universitat, Cybercrime and Forensic Computing, Erlangen, Germany;
CJ and Criminology Department, University of Scranton, Scranton, PA, USA;
School of Criminal Justice, University of Cincinnati, Cincinnati, Ohio, USA

Abstract - This study examines the impact of the COVID-19 pandemic on cybersecurity and data breaches, with a specific focus on the shift toward remote work. The study identifies trends and offers insights into cybersecurity incidents by analyzing data breaches two years before and two years after the start of remote work. Data was collected from the Montana Department of Justice Data Breach database and consisted of data breaches that occurred between April 2018 and April 2022. The findings inform best practices for cybersecurity preparedness in remote work environments, aiding organizations to enhance their defenses. Although the study's data is limited to Montana, it offers valuable insights for cybersecurity professionals worldwide. As remote work continues to evolve, organizations must remain adaptable and vigilant in their cybersecurity strategies.

A Systems Approach to Improving e-Learning using Theory of Constraints

Nancy Oley, Murthy Cheruvu, Vikas Ashok, Ravi Mukkamala
Medgar Evers College, CUNY, Brooklyn, New York, USA;
Hopewell Junction, New York, USA;
Old Dominion University, Norfolk, Virginia, USA

Abstract - e-Learning has the potential to offer equitable, worldwide access to education in all disciplines. However, today's non-traditional students are increasingly disenchanted with the quality of online education, as suggested by disappointing retention and persistence rates. In this paper, we employ the Theory of Constraints (TOC) methodology to identify the one bottleneck or constraint in our online system that leads logically to all the negative concerns/undesirable effects (UDEs) openly expressed by stakeholders. We then show how removing this constraint and adding interventions at key points in the system can have positive ramifications for the whole system, thereby improving student success.

Farmchain: Empowering Smallholder Farmers through Blockchain and DAOs: Cryptournomic Approach

Sasan Bahrami, Kevin Aragon, Michael G. Wagner
Digital Media, Westphal College of Media Arts and Design, Drexel University, Philadelphia, USA;
MaCT01, Institute for Advanced Architecture of Catalonia, Barcelona, Spain

Abstract - This paper proposes a blockchain and Decentralized Autonomous Organization (DAO)-centered solution to improve the economic resilience and market integration of smallholder farmers, who manage around 475 million farming operations globally. Utulizing blockchain technology can reduce issues like intermediary exploitation and certification barriers, facilitating direct market access and fair profit distribution. The design incorporates smart contracts to streamline certifications and a DAO model for transparent resource and transaction management. This practical approach, aligning blockchain with urban agricultural development, aims to further sustainable food hubs and empower farmers with improved market access and sustainable practices.

A Self-Assessment Tool to Empower Police Officers' Online Protection

Petra Saskia Bayerl, Marcel Obst, Jack Spencer, Martin Snowden, Babak Akhgar
CENTRIC (Centre of Excellence in Terrorism, Resilience, Intelligence and Organised Crime Research),
Sheffield Hallam University, Sheffield, UK

Abstract - In this paper, we report on research that aims to co-design technological capabilities for better protecting police officers in public-facing roles. In a first step, we investigated police professionals' digital literacy, experiences of online harms, and requirements for a tool that would empower them in their handling of privacy whilst using digital platforms. These findings are translated into the design and development of a Self-Assessment Tool to increase officers' privacy awareness and literacy. We discuss the design challenges encountered designing a tool for police officers specific needs and present the resulting tool. The tool is part of a comprehensive approach to address online harms to police personnel as public-facing professionals.

Using Survey to Investigate the Integration of Artificial Intelligence in e-Learning

Yi Tao, Zijiang Yang, Ethan Boyi Zhang
School of Information Technology, York University, Toronto, Canada;
St. Robert Catholic High School, Thornhill, Canada

Abstract - This paper focuses on analyzing data obtained from a survey conducted among 312 management undergraduate students in China. The aim of the survey is to explore their perceptions, inclinations, and attitudes towards the use of AI in e-learning. In addition, feature importance analysis is conducted to identify the most influential factors in determining students' attitudes towards AI in e-learning. This analysis helps uncover the key factors that significantly impact students' perceptions and evaluations of AI usage in the daily learning process. Overall, this paper provides a comprehensive and empirical analysis of the survey data. The findings contribute to a better understanding of the key factors influencing attitudes and provide valuable insights for educational practitioners, creators of AI technology, and policymakers involved in the implementation of AI technologies in the educational industry.

Moore's Law: What Comes Next?

Aimee Hatfield, Abdel-Hameed A. Badawy
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New Mexico State University, Las Cruces, New Mexico, USA

Abstract - Moore's Law has proven itself solid and steady over the past half-century, but is the curve starting to flatten? Most would answer yes to this question. However, Intel predicts that the number of transistors on a chip will continue to double every two years, as has been the case over the years. Some have redefined Moore's Law to reference other correlating data, including shrinking critical dimension. Moore's Law has progressed as such due to human innovation regarding cooling methods, lithography methods, and researching other materials for semiconductors. This research and development are highly dependent on the economics behind the semiconductor industry and, therefore, can only go so far. Ultimately, the original definition of Moore's Law seems to be dead, but because the definition of Moore's Law is fluid and malleable, it is still very much alive and will continue to exist as long as a trend over time exists.

Students Satisfaction with the Distance Education During Covid-19 Pandemic

Omar Ahmad Masmali
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Abstract - The spread of the Covid-19 virus prevented human gatherings, disrupting the traditional study. The Ministry of Education in the Kingdom of Saudi Arabia decided to adopt the method of distance education in universities and educational institutions. As the best option imposed on her by the epidemic. Through this research, a survey on a sample of students from the Computer Department at the Technical College in Dammam to measure the extent of trainees' satisfaction with distance learning. The results were the trainees' satisfaction with the method of education provided in the pandemic.

Improving Student Success in Math Courses Using WeBWorK

Dhruba R. Adhikari, Larry Wang
Department of Mathematics, Kennesaw State University, Marietta, Georgia, USA

Abstract - WeBWorK has helped improve success rates in the Ordinary Differential Equations course that the authors have instructed at Kennesaw State University. WeBWorK provided by the Mathematical Association of America was adopted for homework management in the course. In the spring semester of 2024, the learning management system was implemented in two sections of the course. It is found that success rates in the sections with WeBWorK is well above other sections without WeBWorK (about 26% higher). This paper details how WeBWorK was utilized and further plans for utilizing it in more course and assessing student success data.

The Fast Food Review Online

Jack Taylor, Zizhong John Wang
Department of Computer Science,
Virginia Wesleyan University, Virginia Beach, Virginia, USA

Abstract - This paper presents an online fast food review platform that utilizes PHP and MySQL to create a website where reviews and be added and stored to an online database. These reviews can also be filtered to see different reviews based off their order, which are especially meaningful for college students.

Use of Emerging Technologies in Africa

Matthew N. O. Sadiku, Janet O. Sadiku, Uwakwe C. Chukwu
Department of Electrical & Computer Engineering, Prairie View A & M University, Prairie View, Texas, USA;
Juliana King University, Houston, Texas, USA;
Department of Engineering Technology, South Carolina State University, Orangeburg, South Carolina, USA

Abstract - Technologies are unlocking new pathways for rapid economic growth, innovation, job creation, and access to services in Africa. Emerging technologies promise to reduce the costs of undertaking research, offer endless opportunities for innovations and present opportunities to catch up with leading nations. These technologies can enable economic transformation in Africa and help create more jobs for its people. They are transforming all elements of the continent's economy . from education to healthcare, agriculture to telecommunications. This paper highlights the opportunities and challenges of implementing emerging technologies in Africa. It will unpack what some of the economies in Africa have achieved in terms of emerging technologies.

The 22nd International Conference on Embedded Systems, Cyber-physical Systems, & Applications (ESCS'24: July 22-25, 2024; Las Vegas, USA)

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https://www.american-cse.org/csce2024/

Container Performance in Space Systems

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Embedded and Specialized Computing Department,
The Aerospace Corporation, El Segundo, California, USA;
Embedded and Specialized Computing Department,
The Aerospace Corporation, Chantilly, Virginia, USA;
Software Architecture & Engineering Department,
The Aerospace Corporation, Chantilly, Virginia, USA

Abstract - Critical embedded software, such as spacecraft flight software, requires high reliability, efficiency, and real-time performance while being capable enough to meet application needs. The increasing prevalence of Linux, and in particular Linux containers, presents opportunities for space systems but also poses potential risks since Linux was not designed to be a realtime operating system. In this study, we conducted a variety of experiments to look at both the overhead imposed by containers and the latency experienced in Linux using various combinations of patched OS and containers running on a Raspberry Pi 4. We found that containers have little impact on CPU utilization but do incur penalties in RAM, disk storage, and startup time. We also found the unpatched Linux kernel performs well for real time; and that, while the real-time kernel patch reduces both overall and maximum latency, it can negatively impact performance, particularly on single-core systems running non-real-time tasks.

Using Heuristics and Byte Histograms to Detect Anomalies in OT Network Traffic

Philip Rahal, Jack Nunnelee, Alex Howe, Mauricio Papa
The University of Tulsa, Tulsa, Oklahoma, USA

Abstract - Anomaly detection is a significant problem in Operational Technology (OT) networks. Given a collection of network traffic, detecting anomalies is paramount due to safety and functionality concerns. This paper seeks to prove the effectiveness of anomaly-based Intrusion Detection Systems (IDS) to protect Industrial Control Systems (ICS) from cyberattacks. Our twostage anomaly detection strategy employs heuristics and the byte histogram data structure to detect malicious activity as packets enter the network. The novelty of our byte histogram data structure is the ability to detect anomalies in packets where the details of every protocol in the packet are unknown. This paper discusses the heuristics used in Stage One, the usage and effectiveness of byte histograms used in Stage Two, and the algorithms used to process packet information. Using a data set of raw OT network traffic, we evaluate our approach using multiple different attack examples achieving an average F-Beta Score of 99.81%.

Reliable I/F Circuit for Embedded Self-Timed Data-Driven Processors

Riku Uemoto, Makoto Iwata
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School of Informatics, Kochi University of Technology, Kami, Kochi, Japan

Abstract - A self-timed data-driven processor (DDP) is one of the promising embedded processor architectures realizing highperformance and low-power operations. The DDP is implemented by a self-timed pipeline (STP), i.e., asynchronous circuits. Therefore, if the DDP is used as an accelerator with a commodity application processor, an I/F circuit with buffers is required to synchronize operation timing, convert data transfer control protocols, and perform data input/output according to the DDP's processing capability. This paper proposes a reliable I/F circuit using asynchronous FIFOs for the DDP. The prototype circuit with a 50 MHz clock is implemented and evaluated on an FPGA chip. Results demonstrate that it achieves over 3.8 times higher input/output throughput while maintaining comparable reliability to synchronous FIFO-based I/F circuits.

Design Of an Autonomous Mower and Embedded Microcontroller

Bassam Shaer, Natalia Dejesus, Tyler Murray, Malcolm Jones
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Abstract – This paper presents the design and implementation of an intelligent embedded microcontroller in an autonomous mowing robot. The autonomous robot is able to maintain a residential lawn or commercial turf efficiently and within a set boundary. The robot will be designed with features that include: obstacle avoidance, self-containment to the area of operation, the ability to return to its docking station using its boundary wire direction sensors, and safety features for residential use. An emergency kill switch is included for emergency shutdown. The boundary wire system is designed to be connected to a standard household 120V outlet, resulting in easy integration into the residence. This paper will describe the design, implementation, and results of each of these objectives.

Analytical Study of Attacks and Defenses for IoT in Critical Infrastrucure

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Venkatesh Mannuru, Rohith Reddy Battula
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Abstract - Technological advancements in critical infrastructures have led to an increase in cyber-attacks. This paper studies a vulnerable aspect of these infrastructures - Internet of Things (IoT) which comprise Supervisory Control and Data Acquisition (SCADA) systems. Evaluating cyber-attacks and defenses in regard to: attack deployment, type, and impact scope; defensive algorithms, response, and efficiency. These attacks and defenses are then analyzed to provide insights on the most common and effective methods to deploy and combat IoT threats. Concluding that Denial of Service (DoS) attacks are the most common, and machine learning algorithms are currently the most effective defense.

SVM Enhanced Detection of Volume-Based Attacks in IoT Networks

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Abstract - In the rapidly evolving digital landscape, the proliferation of the Internet of Things (IoT) presents considerable efficiency and connectivity. However, this expansion also brings significant cybersecurity challenges, particularly through volume-based attacks (VBAs) that aim to overwhelm systems with sheer data volume. This paper studies the unique characteristics and impacts of VBAs within IoT networks, emphasizing the necessity for advanced detection strategies to protect interconnected devices. Utilizing a comparative analytical approach, we examine the efficacy of Support Vector Machines (SVM) and Naive Bayes classifiers in identifying and countering these threats. Our findings reveal that SVM, with an accuracy of 87.7%, significantly outperforms Naive Bayes, which achieves 74.3% accuracy.

Utilizing Logistic Regression to Detect Tautology Based SQL Injection Attacks

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Abstract - In an increasingly vulnerable cyber environment, this research paper introduces an AI-based Logistic Regression algorithm specifically developed to detect Tautology-Based SQL Injection attacks, underscoring the need for enhanced cybersecurity measures to protect digital infrastructures. This research employs logistic regression algorithms to predict SQL injection attacks on critical infrastructure login pages, targeting username and password inputs. Employing ML.NET for development and testing, the algorithm demonstrates a superior efficacy with an accuracy rate of 87%, notably higher than the 80% accuracy achieved by the Random Forest algorithm. These findings highlight the potential of sophisticated, machine learning-driven cybersecurity strategies to significantly strengthen defenses against complex cyber threats. The study advocates for a comprehensive, multi-faceted approach to securing critical infrastructure, leveraging advanced machine learning technologies.

Analytical Study on Advanced Persistent Threat Detecting, Defending and Mitigating

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Abstract - Advanced Persistent Threat (APT) are elusive and target well-defined, specialized targets. Detecting APT attacks remains challenging due to the lack of attention given to human behavioral factors contributing to APTs, This Analytical study describes a spectrum of approaches and techniques for detecting, defending and Mitigating against APT attacks. The analysis is primarily based on detection methodology accuracy, defending techniques and mitigating strategies. Recent specialized research papers were studied and categorized based on their characteristics, nature of algorithm, and framework. Emphasis is given to Machine Learning (ML) and Deep Learning(DL) algorithms as they acquired efficient results and an effective approach. This paper concluded that ML technique is the most commonly used and efficient detection mechanism to detect APT malware.

Time Series Analysis for Detecting Anomalous Behavior using a Mobile Device

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Abstract - Detecting anomalous behavior in real-time for an urban area from large data is a challenging problem. Efficient parking management in urban areas is crucial for optimizing space utilization, improving traffic flow, and enhancing the overall urban experience. This paper presents a comprehensive study on the application of time series analysis techniques for detecting anomalous behavior in urban parking lots. It proposes a mobile application that allows users to collect data on location, time, and license plate details. The collected data is then analyzed using advanced time series analysis methods to identify anomalous behavior, such as unauthorized parking, irregular occupancy patterns, and violations of parking regulations. Realworld experiments on diverse parking lot datasets demonstrate the high accuracy of the proposed approach in detecting anomalies. These insights are valuable for predicting future parking demands, enabling parking administrators to efficiently allocate resources during peak hours and optimize space utilization. Additionally, the analysis can detect irregularities in parking patterns, promptly identifying unauthorized or abnormal parking and violations, such as parking the wrong type of vehicle or parking in restricted or reserved areas. This research advances the state-of-the-art in time series analysis for parking lot management, providing valuable insights for practitioners and researchers in the field. It also contributes to more efficient, data-driven, and proactive parking management strategies, leading to improved urban mobility and enhanced user satisfaction.

Enhancing Cybersecurity in Industrial Internet of Things: Machine Learning-based Approaches for Cyber-attack Detection in a Real-world Testbed Environment

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Abstract - The expansion of the Internet of Things (IoT) over the past decade has significantly changed how we interact with everyday appliances and industrial systems, from smart homes to the Industrial Internet of Things (IIoT). However, as cyberattacks become more frequent, sophisticated, and dynamic, IIoT systems are presenting new security challenges. The need for timely availability of new efficient approaches and accessible/feasible testbeds to support new approach development and validation in real-world scenarios. In this paper, we present a novel securityoriented IIOT testbed that comprises a wide range of physical processes through diverse controllers and devices interacting with each other through various networking protocols. Additionally, we implement and test the performance of machine learning (ML) algorithms, including Random Forest, Decision Tree, Naive Bayes, KNN, Logistic Regression, MLP Classifier, RNN, and Transformer for cyber-attack detection. Finally, we collect a new dataset and compare it with another IIoT-based dataset, CICIoT2023, revealing machine learning models' effectiveness in detecting various cyber-attacks and the feasibility and future work of the proposed testbed.

A Low-Cost Automatic DEF Refueling Controller for Diesel Generators

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Abstract - This paper presents a design and implementation of a low-cost automatic controller for Diesel Exhaust Fluid (DEF) tanks. The controller monitors error codes from the generator's Engine Control Unit (ECU) and readings from a temperature and level sensors and refuels the generator's DEF tank when needed. The proposed controller presents a lowcost and easy to install solution for DEF refueling automation; eliminating cumbersome refueling process that requires constant user monitoring.

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https://american-cse.org/csce2024/conferences-FCS
https://www.american-cse.org/csce2024/

The Influence of Self-Perceived Tech Savviness on AI Reliance: The Role of Trust

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Abstract - The increasing pervasiveness of Artificial Intelligence (AI) within our daily lives necessitates a deeper understanding of how trust shapes our evolving relationship with technology. This mixed-methods study investigates how educational level, self-perceived 'tech-savviness', and emotional responses to tech absence, influences individual reliance on, and trust in, AI. Quantitative analysis reveals that individuals who have been in educational institutions for longer periods (e.g. obtained Master degrees) demonstrate greater trust in AI, leading to stronger reliance, particularly for recommendations scores. Qualitative analysis uncovers a complex interplay between trust, convenience, task-specific trust, and concerns about autonomy. A striking finding is the prevalence of negative emotions, including a sense of "incompleteness," during tech absence, especially among the tech-savvy group. This highlights how reliance can extend beyond functional utility and become psychologically intertwined with trust, potentially impacting self-perception. These findings challenge traditional models of technology adoption and emphasize the need for frameworks that consider the psychological dimensions of trust in understanding AI reliance. The interplay between education, trust-based reliance, and psychological factors will be crucial for individual adaptability and resilience in an increasingly AI-driven world.

Exploring Efficient but Intricate Delivery Truck Routing Heuristics in Supply Chain Management

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Abstract - Vehicle Routing Problem (VRP) is a well-known combinatorial optimization and integer programming problem. In the world of computing, modern vehicle routing is more focused but aligned with the GPS-based coordinate system, as the state-of-the-art vehicle, and trucking fleets are equipped with the most recent digital navigation, and coordination system. In this paper, a number of two dimensional coordinate-based algorithms for addressing the vehicle routing problem for a supply chain network covered through a delivery trucking fleet are proposed and analyzed, and the algorithms are compared with other available, and the most recent heuristics in the literature. For the algorithms discussed, which includes a proposed coordinate-based heuristic search as well, the advantages and the disadvantages associated with each heuristic is further elaborated. The proposed algorithms are navigated with specific application focus to a moderate sized supermarket chain delivery network that supplies to its stores in four different states around the East Coast area, and is trying to optimize its trucking delivery cost. Minimizing the delivery cost from the warehouse to the retail stores in the supply chain network of a supermarket distributor is important to ensure its business success, and also to thrive and survive in the competitive grocery and food chain supply industry.

Searching Real Numbers in Constant Time

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Abstract - This paper introduces a novel approach for efficient searching of real numbers by integrating Fredman, Komlos´ and Szemeredi's sparse table technique with correspondence between real numbers and the integers converted from them. We achieve constant time searching capabilities while maintaining an O(n) storage bound. Through an exploration of comparison based sorting algorithms and the conversion of real numbers into integers using Han's algorithm, we establish a comprehensive framework capable of seamlessly handling both integers and real numbers. This research not only enhances the efficiency of searching operations but also contributes to the broader landscape of algorithmic optimization, providing a robust solution for real number searching within computational constraints.

MultiMap Implementation in OpenJDK

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Abstract - The key-value data model allows efficient storage and retrieval of data but is limited to associating a single value against a given key. In this paper, we present the implementation of a Multimap data structure in OpenJDK that allows the association of multiple values with a single key. The implementation consists of three layers, an interface MultiMap, an abstract class AbstractMultiMap which provides common functionality, and three concrete implementations: ArrayListMultiMap, SetMultiMap, and TreeMultiMap. Each implementation provides unique properties for the keys and the associated values. Experiments compare the performance of inserting key-value pairs in OpenJDK multimap implementation, multimap in the Google Guava library, and multimap in C++.

A Novel Simple Data Structure for Selecting Inserting and Deleting in Square Root Time

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Abstract - This paper presents a novel index based data structure designed to strike a balance between the select, insert, and delete operations. It can achieve a square root of n time complexity for these operations by splitting a linked list into multiple increasingly longer lists. Compared to order statistical trees or other data structures that can reach O(logn) of time for the same operations, it is simpler and easier to implement, which provides an instructional data structure that can also be useful when engineering time is a constraint.

The Evolution of Computer Science Education

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Abstract - Online streaming platforms such as Twitch.tv, while originally created as a form of entertainment for viewers to watch people play video games, has expanded to more instructional applications, including the livestreaming of programming and game development while the streamer talks through their actions to their viewers. This paper seeks to identify the specific learning effects that instruction via livestream offers to learners as compared to more traditional classroom, lecture-based learning environments. We analyzed several research papers previously written on this subject which included qualitative data extracted from interviewers with streamers and viewers, and scraped data from two popular streamers, Adam13531 and georgehotz, for quantitative data related to the popularity of the two main livestreaming platforms: Twitch.tv and YouTube Live. Our research suggests that there are significant advantages to utilizing livestreaming as a method of instruction stemming from the nature of videobased instruction and the ability to provide real-time teacher/learner and learner/learner interaction.

Autosymmetry Using GF(2) Matrices

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Abstract – Autosymmetry is useful in minimizing certain Boolean functions. Autosymmetry is usually detected using closed functions. Here we show that singular GF(2) matrices can be used for the same purpose, and that this approach also permits the use of the universal symmetry detector to detect autosymmetric functions. Autosymmetric functions can generally be implemented more efficiently than ordinary Boolean functions, so detection of autosymmetry is useful in the efficient implementation of Boolean logic.

Triangle Packing in Graphs with Bounded Degree

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Abstract - We study the parameterized complexity of the Vertex-Disjoint Triangle Packing problem in graphs with bounded degree and tripartite graphs. We show that this problem admits a linear kernel of size 15k in graphs with maximum degree four, and a quadratic kernel of size 30k 2 in tripartite graphs.

TOIChain(TM) - A Proposal for High Performance Tamper Resistant Transactions without Scaling Limits

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Abstract - This paper proposes a blockchain-based high performance transaction processing system called TOIChain. A new programming paradigm and architecture using Active Content Addressible Networking protocol and Statistic Multiplexed Computing runtime is introduced to overcome the typical service infrastructure scalability challenges.

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https://www.american-cse.org/csce2024/

Navigating the Ethical Landscape of Big Data Collection and Analysis

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Abstract - The widespread adoption of big data collection and analysis across industries has yielded significant benefits in terms of valuable insights and improved decision-making processes. However, it is essential to acknowledge and address the ethical considerations associated with big data. This study delves into the ethical dilemmas arising from the utilization of big data, encompassing concerns such as privacy, consent, data ownership, algorithmic bias, impartiality, openness, responsibility, data protection, and bridging the digital divide. The paper offers recommendations aimed at tackling these challenges, emphasizing the importance of collaborative efforts between policymakers, organizations, and individuals to establish comprehensive guidelines and regulations that strike a balance between the advantages of big data and the potential risks it entails.

Developing a Machine Learning Model to Identify At-Risk Students

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Abstract - This research presents preliminary work to address the challenge of identifying at-risk students using supervised machine learning and three unique data categories: engagement, demographics, and performance data collected from Fall 2023 using Canvas and the California State University, Fullerton dashboard. We aim to tackle the persistent challenges of higher education retention and student dropout rates by screening for at risk students and building a high-risk identification system. By focusing on previously overlooked behavioral factors alongside traditional metrics, this work aims to address educational gaps, enhance student outcomes, and significantly boost student success rates across disciplines at the University. Pre-processing steps take place to establish a target variable, anonymize student information, manage missing data, and identify the most significant features. Given the mixed data types in the datasets and the binary classification nature of this study, this work considers several machine learning models, including Support Vector Machines (SVM), Naive Bayes, K-nearest neighbors (KNN), Decision Trees, Logistic Regression, and Random Forests. These models are employed to predict at-risk students and identify critical periods of the semester when student performance is most vulnerable. We will use validation techniques such as train test split and k-fold cross-validation to ensure the reliability of the models. Our analysis indicates that all algorithms generate an acceptable outcome for at-risk student predictions, while Naive Bayes performs best overall.

ECAF: Educational Cybersecurity Assessment Framework for Small Businesses

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Abstract - With a significant number of cybersecurity job openings remaining unfilled in the U.S., we are grappling with a critical shortage of cybersecurity experts who are essential for safeguarding businesses, national infrastructure, and networks against cyber threats. This shortage becomes particularly acute among local small business owners who form a vital part of the community. Many of these entrepreneurs lack technical expertise and operate on tight budgets, making their websites susceptible to cyber attacks. Simultaneously, many young individuals are eager to enter the field of cybersecurity but find a disconnect between their educational experiences and practical applications. This paper presents ECAF (Educational Cybersecurity Assessment Framework) for Small Businesses, a framework to bridge this gap and equip young learners with the necessary support to perform security checks to assist local small business owners in bolstering the security of their websites. We also describe a capstone project that showcases the effectiveness of the framework. The goal of this work is two-fold: firstly, to empower young people with the necessary cybersecurity literacy, skills, and experience, and secondly, to assist local small business owners who compose the essential fabric of the community. This dual approach not only mitigates potential financial risks for business owners but also fosters a generation of skilled cybersecurity practitioners who can contribute meaningfully to their communities.

A Personal Tutoring Bot With VR/AR Tools

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Abstract - Personalized learning refers to an educational approach that tailors instruction to meet the unique needs, interests, and abilities of each learner. This method of learning aims at providing students with a customized learning experience that is more engaging, interactive, and relevant to their personal lives. With generative pre-trained transformers technology, an AIbased learning environment PTB (Personal Tutoring Bot) has been built with support for personalized learning. The author used PTB in his EE 499 Microelectronics Metrology class in the fall semester of 2023 with positive feedback from students. This paper provides an overview of the PTB design and its experiment in classroom, followed by a discussion of integrating VR/AR capabilities into PTB for metrology education. Finally, the author briefly touches the potential applications of PTB and similar AIbased tools targeting academic advising and career mentoring for college students.

Assessing ABET Outcomes Through a Software Engineering Capstone Course

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Abstract - This paper presents a case study of implementing General Criterion 3 and Program Criterion 3 as specified by the ABET Computing Accreditation Commission (CAC) for accrediting computing programs. Both criteria deal with student outcomes. A step-by-step approach using performance indicators and proposed data sources to assess the attainment of student outcomes using a software engineering capstone course is demonstrated. This paper also proposes how the student outcome 6 recently defined by CAC for the Information Technology program can be assessed. It also points out an issue with the outcome 6 statement. It is expected that the schools applying for ABET accreditation find this paper very helpful in simplifying their assessment activities for a successful implementation of criteria 3.

Learning from the Arts: Incorporating Classroom Critiques in a Computer Science Course

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Abstract - In most computer science courses, students do not see other students' code (if they have followed their course's academic honesty polices), nor do they typically know their instructor's assessment of work other than their own. This contrasts with instruction in the visual arts where students are regularly exposed to the work of other students, both finished and in progress, and often hear their instructor's evaluation of other students' work. Critical evaluation of one's own work and that of others, and the development of that skill, is a significant component of most arts courses; however, computer science students typically do not receive such formal instruction or see examples that are not from the textbook or instructor in the context of the classroom. This work describes experiences in incorporating a commonly used teaching tool in the visual arts, the classroom or group critique, into an intermediate, university level computer science classroom. The primary goals of this approach are to develop students' ability to critically evaluate code, both their own and code they may encounter, and to boost achievement on challenging programming assignments. Both successes and challenges encountered with this method are addressed.

ES4AL: A Website for Effectiveness Study for Algorithm Learning in Computer Science

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Abstract - In this study, a website was implemented called ES4AL (Effectiveness Study for Algorithm Learning) to help educators evaluate the effectiveness of different teaching methods for students learning about sorting algorithms. Students explore four different sorting algorithms through three video-based learning methods: KLA dance, visual animation, and recorded traditional lecture. First, the website assigns a sorting algorithm for the student to learn using one of the three learning methods. After taking a pre-test and watching an educational video, a posttest assesses how much their knowledge about the algorithm has improved. This data is then collected and displayed in a userfriendly interactive chart, serving as a valuable tool for teachers seeking the most effective teaching method for their students.

Using Logical Fallacies to Educate Computer Science Students

Peter M. Maurer
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Abstract - To show students how to think clearly and logically, we demonstrate many forms of incorrect reasoning in the form of well-known logical fallacies. We use these fallacies to redirect the student's thinking away from incorrect paths and into correct, logical paths. We show several examples of different kinds of logical fallacies, describe what is wrong with them, and show them the correct reasoning.

Tertiary Mathematics Students in Different Learning Environments for the Same Subject: Perceptions and Achievement

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Abstract - The study investigated the experience of students enrolled in the same first-year mathematics subject at an Australian university, whose learning environment had naturally occurring differences. One group was very much smaller than the other, and taught by a smaller team, so that organisational coordination of teaching was simpler for the small group, and access to staff support easier. In addition, the small group had additional formative teaching material designed to clarify the requirements of subject assessments, and to foster students' getting started on relevant problem solving There were also initial differences between groups, because the men in the small group contained a high proportion of students repeating the subject after failure. Scales adapted from the SLEI were used to give information about students' perceptions of their leaning environment. Perceived learning environment factors were linked to achievement, again with some interaction with gender and background. The highest scale scores were for men in the small group, and a comparison of final examination results showed no significant differences associated with class or gender. The conclusion was that the initially disadvantage group of men in the small class had benefitted from their learning environment. Correlations between scale scores and test achievement indicated that women in each group had wider needs from the learning environment than the men in the group.

Capstone Projects as Ventures to New Knowledge

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Abstract - The capstone project serves as a culmination of a computer science student's academic journey, encapsulating their learning across the curriculum and culminating in the creation of robust software systems relevant to real-world applications. Throughout the project's development, students not only refine their technical abilities but also cultivate essential project management and teamwork skills. This paper presents an innovative pedagogical approach to teaching the capstone course, emphasizing the integration of new techniques, and fostering a culture of lifelong learning. Through various illustrative examples, it demonstrates how students acquire proficiency in new databases systems, programming languages, and AI technologies through their engagement in capstone project development.

INDRA: A Drone Penetration Testing Platform for Cybersecurity Education

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Justin Scott, Grant Thompson, Logan Yokum, Peter Zekonis
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Abstract - Closing the cybersecurity skills gap requires handson education that puts students in realistic scenarios to prepare them for the many challenges faced by cybersecurity professionals. As the modern world expands to more technologically focused industries, drones and small Unmanned Aerial Vehicles (sUAV) have become easily accessible and capable. Thise uptick in drone usage makes them an increasingly tempting target for cyber attacks. This paper details an ongoing experiment in hands-on cybersecurity education at the undergraduate level to test the cybersecurity of sUAVs. To gain hands-on experience in ethical radio frequency (RF) hacking, we created INDRA: Sky Commander, a cloud-deployable penetration testing platform for sUAVs. INDRA is a project built, maintained, and evolved by undergraduate students as their capstone senior design.

Unravelling Dropout Intentions: Multifaceted Factors Influencing Student Retention in Computer Science Education

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Abstract - This paper investigates the multifaceted factors influencing student intentions to drop out of Computer Science (CS) programs. A comprehensive analysis of various studies highlights the significant role of expected GPA, which negatively impacts student retention, whereas variables such as "Year of studies left" and "Effort" exhibit positive effects. The analysis further identifies specific challenges faced by CS minor students, including time constraints and motivational deficits. Early academic performance emerges as a critical indicator of future success or failure within the discipline. Gender-specific challenges are particularly pronounced, with female students experiencing higher rates of dropout linked to "belonging uncertainty" and lower academic achievements in initial courses. Additionally, this study explores the impact of poor teaching quality, excessive workload, and lack of supportive academic environments on dropout rates, noting that these factors disproportionately affect female students. The research also examines dropout factors among doctoral CS students, emphasizing the importance of advisor support and the perceived meaningfulness of work tasks. Lastly, the underrepresentation of women in CS is scrutinized through the lens of societal stereotypes, personal values, and initial preparedness for college-level CS studies. By integrating these diverse factors, this paper aims to provide a holistic understanding of the dropout phenomenon in CS education, offering insights for developing more inclusive and supportive educational practices.

To Hack or Not to Hack? Connecting Cybersecurity, the IoT, and Smart Environments to K12 Learning Experiences

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Abstract - The Internet of Things (IoT) refers to the interconnectedness of devices within a network, while smart environments denote the interface between users and IoT through network capabilities. The widespread adoption of connected smart devices is projected to continue growing exponentially, benefiting businesses, households, and educational institutions. However, this growth also brings increased risks of security threats and privacy breaches associated with IoT. Users of smart environments may overlook, lack awareness of, or have insufficient resources to address these potential security risks effectively. Security challenges in the IoT encompass various threats such as data leakage, hacking, software vulnerabilities, device security, IoT exploitation, and denial of service attacks. Currently, security protocols in smart environments and IoT are fragmented, posing challenges for consistent protection against these threats. As security risks persist, there is a growing need for innovative cybersecurity education, especially in K-12 settings. This study conducted training sessions for high school teachers to educate them about IoT device security vulnerabilities through an NSFRET grant. The aim was to impart this knowledge to students through their teachers. The curriculum and project designs resulting from the training generated significant interest among students. Moreover, feedback from student surveys indicated enhanced knowledge and increased practical understanding of IoT security concepts.

Metrology Training for EE/CE Students

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Abstract - This paper proposes a microelectronics metrology certificate program for undergraduate electrical and computer engineering students at Northern Arizona University, and a metrology training for non-traditional students and medical device manufacturers. The paper argues that metrology is crucial for the semiconductor industry, especially as the feature sizes shrink and the quality standards become more stringent. Solving the seven grand challenges proposed by NIST in metrology research and development requires a skilled workforce and academic innovation. The paper outlines the curriculum plan and implementation strategy for the proposed metrology certificate program, which consists of seven courses covering various metrology topics and techniques. The paper discusses how to build a metrology workforce pipeline through micro-credentials for high school CTE students and community college students, and upskilling training for medical device manufacturers. The paper concludes by highlighting the benefits of metrology training for both university students and medical device professionals, and addressing the challenges and opportunities in delivering such training.

Leveraging Chat-GPT to Generate Educational Assessment Materials for Software Engineering

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Abstract - This paper presents an educational use-case for creating assessment materials with Chat-GPT 3.5 turbo in the domain of software engineering. We attempt to (a) alter specific aspects of a generic domain model (UML class diagramm) and (b) generate requirement texts (problem scenarios) that creatively describe the previously altered model. The challenge that comes with these two approaches is (1) to change only the variables contained in the generic domain model in such a way, that the resulting domain model makes sense and (2) to generate natural language requirement texts (scenarios) that creatively and correctly describe the underlying domain model. Results: The first approach (a) yielded satisfactory results. After providing Chat-GPT with examples, it was able to alter all variables in a coherent way according to the topic that was specified in the prompt. This result indicates potential for other educational use cases and ongoing software engineering research with LLMs. Chat-GPT's generated requirements texts were useful but require caution from the lecturers before handing them out to students. We reflected the contribution of this paper (and papers similar to this) and argue, that the provided value lies not only in the quality of the yielded results but much rather in describing educational use cases that are worth following up on with future versions of large language models.

A Longitudinal Study to Investigate the Impact of a Service-Learning Course on Its Participants

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Abstract - The Technology Ambassador's Program (TAP) was established in 2012 as an extra-curricular program and has been offered as a service learning course since spring 2016. To investigate the impact on program participants, we launched a longitudinal study in fall 2022 and surveyed the students who completed the course from spring 2016 to spring 2021. Analysis of the survey results discovered that students strongly agree that this program has provided them opportunities to conduct research, to network with other professionals in the field, and apply technical skills. Further analysis also revealed a strong correlation of these opportunities with improving soft skills and career readiness among participants. Overall, this program increased the confidence of the students and prepared them to learn new skills on their own. This paper describes the overall structure of the service learning program and presents the details of this study including the process and survey results.

Industry Sabbaticals in Computing: Motivation and Preparation

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Abstract - There is a notable disparity in the field of Computing between undergraduate majors, who are gearing up for careers in industry, and tenure-track faculty, who are primarily academics and lack firsthand experience in such roles. As a result, computing graduates may not receive the optimal preparation they need, as their instructors may lack personal familiarity with the types of jobs the students aspire to secure post-graduation. One effective avenue for faculty members to gain industry experience is through sabbaticals. This paper explores the benefits of professional experience for educators and gives advice on how professors can find industry positions for sabbaticals.

Traffic Analysis of Online Video Games

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Abstract - Over the past few decades, the world of online gaming has exploded in popularity. Games such as Counter Strike: Global Offensive, League of Legends, Quake Champions, PlayerUnknown's Battlegrounds, etc. have attracted millions of players especially young populations. These games use various network architectures and communication models, including dedicated servers, peer-to-peer networking, with either remote connection or local area networking. With strong student interests, online games can serve as an ideal platform for students to study and understand computer networks. Using tools such as Wireshark, students can analyze how packets are sent from player to player and see how various protocols work and function.

An Edge AI Course Template

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Abstract - Edge AI, also known as AI at the edge, refers to the implementation of artificial intelligence in an edge computing environment. It combines Edge Computing and AI to run ML tasks directly at the edge without relying on centralized cloud servers. Edge AI is used in various domains: healthcare (wearable devices), manufacturing (predictive maintenance), smart cities (traffic management), and more. This paper proposes an Edge AI course to prepare students for careers in the coming market. The proposed course takes TopDown and Bottom-Up approaches concurrently. The lecture component uses the Top-Down approach. It starts from the market end and walks learners through career opportunities, required skill sets, and Deep Learning knowledge (YOLOv8, LLaMA-2). The activity component uses the Bottom-Up approach and starts from an inexpensive AI inference board (RK3588-based) that executes YOLOv8 and small LLM (lama 7.4 B) pre-trained modes to implement real-world applications.

Assessing ChatGPT for Algorithm Time Complexity Education

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Abstract - We present the results of experiments performed using ChatGPT versions 3.5 and 4o to explore the possibilities of generating and solving exam questions related to the time complexity analysis of algorithms in programming courses. Both well-known and artificial code segments for educational purposes were observed. We have concluded that ChatGPT 4o is more descriptive and in some cases more successful in generating and solving test problems correctly.

Optimizing Fuzzy Comprehensive Evaluation of Teaching Quality Using Elastic Proximity

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Abstract - Evaluating course teaching quality and building effective teaching teams pose significant challenges in university education assessment. Traditional evaluation methods often suffer from inaccuracies, low precision, and high spatiotemporal complexity. Moreover, assessments of teaching team effectiveness have not sufficiently enhanced course system development or improved teaching quality. This paper presents an enhanced fuzzy comprehensive evaluation method for course teaching quality by integrating numerical and level representation techniques and employing elastic proximity. This approach increases evaluation accuracy and precision while reducing algorithmic spatiotemporal complexity. Additionally, it incorporates teaching team evaluations into the assessment of course teaching quality, fostering collaborative development of course systems by teaching teams and collectively enhancing overall teaching quality.

Exploring the Potential of Generative AI in Education: Opportunities, Challenges, and Best Practices for Classroom Integration

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Abstract - Generative Artificial Intelligence (GenAI) is making significant contributions across various sectors, and education is no exception. This study explores the potential of GenAI in the educational domain, offering opportunities to integrate AI tools into university settings. Specifically, it analyzes the opportunities, challenges, and best practices for integrating GenAI into the classroom, based on the experience of a series of courses conducted for university professors. The primary objective is to examine how generative AI can enhance teaching and learning while promoting ethical and responsible use. Grounded in the growing importance of AI in education, this study investigates how large language models (LLMs) such as ChatGPT, Copilot, Gemini, Claude, and others can improve teachers' professional skills and teaching and learning experiences. Through a literature review and experimentation with university professors, the research examines the effectiveness of AI-generated resources, as well as the impact of prompts and assistance provided by these tools in educational settings. Additionally, the study evaluated discussion forum outcomes and collected university professors' experiences through observations, interviews, surveys, collaborative activities, and practical exercises conducted in the courses. Collaboration among university educators is crucial for advancing the understanding and effective use of GenAI for the benefit of education. The results highlight several opportunities to leverage LLMs for creating educational resources, assisting in lesson planning, supporting teaching activities, and enhancing teacher productivity. However, challenges are also identified regarding the ethical and responsible use of AI and the need to establish appropriate strategies to detect AI-generated text. Finally, this study provides a summary guide on how to responsibly integrate GenAI into the classroom, addressing aspects such as teacher training, fostering critical thinking in students, and establishing institutional policies. Best practices are proposed for effectively integrating AI tools, including the development of prompts for various activities and strategies to guide the ethical use of AI. These practices aim to maximize the benefits of AI while mitigating risks and promoting ethical, balanced, and responsible use in education.

Coding Process Visualizations for Improved Learning and Academic Integrity in CS1

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Abstract - While novice programmers often find it challenging to learn coding in CS1 courses, teachers also face the daunting task of fostering an environment that encourages students to become original thinkers and develop meta-thinking skills. A significant reason for these teaching and learning challenges is the focus on outcomes rather than processes. Merely reviewing and assessing a student's submitted code is often insufficient to provide insightful and personalized feedback to students. This work suggests a potential solution: quantitative summaries and data visualizations of a student's coding process can serve as powerful tools for unveiling the students' coding habits. By presenting process data—such as breaks taken, code execution history, AI usage, copy-paste events, and code evolution process playback—in easy-to-understand and interactive visualizations, students can reflect on and learn from their own process. An added benefit of this process-focused approach to teaching and learning is the automatic promotion of academic integrity. This paper elaborates on these process visualizations and discusses strategies for their effective implementation in CS1 courses.

OBDev: Wireless on Board Development Environment for Raspberry Pi Pico W

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Abstract - An on-board standalone Micropython based development environment is implemented for the Raspberry Pi Pico W SBC integrating several existing open-source technologies into a comprehensive, wirelessly accessible, development system. This facilitates embedded systems/IoT development using a variety of student devices using only system integrated applications on their devices.

Adapting to the AI Disruption: Reshaping the IT Landscape and Educational Paradigms

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Abstract - Artificial intelligence (AI) signals the beginning of a revolutionary period where technological advancement and social change interact to completely reshape economies, work paradigms, and industries worldwide. This essay addresses the opportunities and problems brought about by the AI-driven economy as it examines the effects of AI disruption on the IT sector and information technology education. By comparing the current AI revolution to previous industrial revolutions, we investigate the significant effects of AI technologies on workforce dynamics, employment, and organizational procedures. Human-centered design principles and ethical considerations become crucial requirements for the responsible development and implementation of AI systems in the face of the field's rapid advancements. IT education programs must change to meet the changing demands of the AI era and give students the skills and competencies they need to succeed in a digital world that is changing quickly. In light of AI-driven automation, we also examine the possible advantages and difficulties of moving to a shorter workweek, emphasizing chances to improve worker productivity, well-being, and work-life balance. We can build a more incslusive and sustainable future for the IT industry and beyond, enhancing human capabilities, advancing collective wellbeing, and fostering a society where AI serves as a force for good by embracing the opportunities presented by AI while proactively addressing its challenges.

Digital Badging as a Motivator in an Undergraduate Course

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Math and Learning Technology, DeVry University, San Jose, California, USA;
Business, DeVry University, San Diego, California, USA;
Business, DeVry University, Phoenix, Arizona, USA

Abstract - Digital badges have become popular in education and business. These badges can be easily added to resumes, social media, or portfolios to increase a candidate's employability. Thus, students see value in obtaining badges. This study explores badging and motivation in business and educational settings, and reviews adding badging to an online introductory programming class to reward students who participate in an optional programming competition. Student participation and comments are solicited and evaluated, then compared with a course that does not use badging. In addition, badging is explored as a motivating factor for informal learning in an adult education environment.

Leveraging Chatbots for Academic Advising to Help Overcome Advising Challenges

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Abstract - Using AI-driven chatbots for academic advising can enhance student access to educational support and streamline the advising processes. A prototype self-advising website and a GPT-based chatbot were developed to simulate course selection and handle routine inquiries, which are discussed in this paper. Initial interactions indicate that while the chatbot facilitated efficient course advice and reduced advising wait times, it still will require human oversight for complex issues and accuracy assurance. Initial usage suggests that integrating AI into academic advising can significantly aid in managing student needs, although continuous improvements and rigorous validation are necessary to optimize reliability and effectiveness. This paper highlights our initial efforts to use chatbots for academic advising as we continue to develop more robust systems.

Mentoring STEM Students by Faculty: A Literature and Expert Panel Review

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Abstract - In this study, we conducted a thorough review literature on the importance and effectiveness of mentoring STEM students by faculty, including those aspects of mentoring that promote mentoring failures versus mentoring successes, and reported on insights generated by a panel of experts who develop mentoring programs and train STEM faculty in mentoring.

Integrating Technical Problem-Solving Skills Into Data Structures and Algorithms Course

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Abstract - For software engineering jobs, one of the interviews is the technical interview where the candidate must solve problems on a whiteboard or explain how they would approach solving the problem. Some technical interviews can involve take-home problems or problems that must be solved using on online assessment service. Companies, such as Leetcode.com, have been collecting the technical interview problems and providing an Online Self Learning Environment for candidates to study. Students have found that to be successful in technical interviews they have to 'grind' Leetcode problems. Even for students that have done well in Data Structures and Algorithms (DS&A) courses, these Leetcode problems can be very challenging. While the DS&A courses provide the foundation, they typically fall short of preparing students for technical interviews. We leave aside the question of whether the technical interview process employed by companies is the correct process for choosing among candidates and focus on how to better prepare and support students in gaining these skills.

Curriculum for a New Academic Program with Bachelor's Degrees in Intelligent Systems Engineering and Computer Engineering

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Abstract - This research paper proposes a curriculum for a six-year academic program with a bachelor's degree (honors) in intelligent systems engineering and a bachelor's degree (honors) in computer engineering. This program includes courses in digital electronics, analog electronics, computer organization, computer architecture, computer communication networks, data structures, compiler design, operating system design, firmware design, database systems, computer graphics and virtual reality design, static and dynamic website design, development of chatbots and voice assistants, software engineering methodology, knowledgebased systems, fuzzy logic, neural networks, evolutionary computation, evolutionary multiojective optimization, machine learning, image processing, computer vision, pattern recognition, voice recognition, natural language processing, data science, control systems, intelligent control systems, robotics, digital signal processing, signals and systems, mathematics, engineering physics, biology, etc. These degrees will allow graduates to have a good understanding of all of the main branches of intelligent systems engineering and software engineering as well as other relevant subjects in electrical and computer engineering.

The 20th International Conference on Grid, Cloud, & Cluster Computing (GCC'24: July 22-25, 2024; Las Vegas, USA)

https://american-cse.org/csce2024/conferences-GCC
https://www.american-cse.org/csce2024/

Accelerating Cloud Database Recovery for Providing Real-time Service After a Cyberattack

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Abstract - Given the many advantages offered by cloud computing, organizations are increasingly moving their databases to cloud. Some of these databases contain critical infrastructure data requiring real-time service. Unfortunately, data in critical infrastructure systems has become one of the major targets of attackers. Since such data are highly connected and interdependent, the initial damage done by an attacker spreads quickly through the system when valid transactions make any updates based on the value of a damaged object. As a result, it adversely affects the real-time service the system is designed to offer. In this work, we provide a model to perform fast damage assessment and recovery. Our approach allows all unaffected data objects to be available to users and makes the affected system recover swiftly. This work uses a modified log mechanism and a graph-based approach to perform fast damage assessment and recovery. Through simulation, we proved that the model expedites the process significantly.

Scientific Workflow Provenance Management: System Requirements and a Reference Architecture

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Abstract - Scientific workflows have emerged as a new paradigm to facilitate and automate scientific processes. During workflow execution, the need often arises to capture and store the data derivation history, known as provenance, which describes the steps that yielded workflow output results. Workflow tools available today address this need by employing systems that capture provenance, store it in a database, and provide an interface for scientists to explore the stored data. However, these systems differ both in their functional and non-functional characteristics. This fact indicates that there is no agreement yet in the community about the essential capabilities that a provenance system has to provide. It is therefore important to develop a set of requirements for a scientific workflow provenance system. Furthermore, due to the lack of understanding of what these standard requirements should be, it is only natural that a standard system architecture for provenance management is missing. To address these shortcomings, in this paper, we 1) identify a set of functional and non-functional requirements for scientific workflow provenance management systems that cover key aspects of provenance storage, exploration, and reasoning, and 2) propose a reference system architecture for scientific workflow provenance management.

Enhancing Data Security with Decentralized Cloud Storage: An IPFS Approach

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Abstract - As digital ecosystems evolve and data breaches become more frequent, traditional centralized data storage systems are increasingly proving to be vulnerable to a variety of cyber threats, including data leaks and Distributed Denial of Service (DDoS) attacks. The InterPlanetary File System (IPFS), a peer-to-peer hypermedia protocol, offers a paradigm shift from traditional centralized cloud storage by decentralizing the storage and management of digital content. This paper explores the unique security advantages of IPFS, including its use of content-addressable storage for enhanced data integrity, cryptographic hash linking for immutability, and a distributed architecture to eliminate single points of failure. By dissecting the core functionalities and security mechanisms of IPFS, this study illustrates how decentralized storage systems can significantly mitigate common security vulnerabilities inherent in centralized models, thereby providing a more resilient infrastructure for secure data storage and retrieval. Through theoretical analysis and empirical case studies, this research not only underscores the robustness of decentralized systems but also delineates the practical implications of adopting IPFS in securing sensitive data across various industries.

The 10th International Conference on Health Informatics & Medical Systems (HIMS'24: July 22-25, 2024; Las Vegas, USA)

https://www.himscsce.org/hims24/
https://www.american-cse.org/csce2024/

Advancing Health Literacy through Generative AI: The Utilization of Open-source LLMs for Text Simplification and Readability

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Abstract - TBA

Predictive Modelling for Length of Stay with the MIMIC-III Critical Care Database

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Abstract - TBA

Challenges and Opportunities in a Big Data Pipeline for Resilience and Wellness Development: A Case Study for Police Training

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Abstract - TBA

Comparing Models for Sentiment Analysis of Tweets in Response to Public Health Announcements during the Pandemic

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Abstract - Social media is a popular source of information for the public and therefore it is critical that health officials are able to engage with the public in an effective way on these platforms. We were interested in the sentiment reflected in tweets from the public responding to messaging from these agencies. This paper reports on a comparison of different machine learning models for use in the multi-classification of the sentiment of such tweets. Tweets were first collected and manually labeled into seven different sentiment classes. The labelled tweets were then processed to form a core dataset. Several machine learning models were compared using this dataset and augmentation of the dataset, including using up-scaling and the use of "artificial" tweets constructed from the core dataset. The paper reports on the techniques used during preprocessing, augmentation of the dataset, the machine learning models, and the results obtained.

Enhancing Diabetes Mellitus Prediction: A Comparative Study of Random Forest and Stacking Ensemble Methods

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Abstract - The electronic Diabetes Mellitus represents a significant global health challenge, characterized by pervasive prevalence and the potential for severe long-term complications. The advent of predictive modeling in the medical field holds promise for early detection and classification of this condition, providing a pivotal advantage for timely and effective intervention. Among various analytical methodologies, ensemble learning techniques stand out for their robustness and accuracy, particularly the Random Forest algorithm, renowned for its proficiency with complex datasets. This paper delves into an empirical comparison between an optimized Random Forest model and an innovative stacking ensemble method, aiming to unravel their efficacies in the context of diabetes prediction. The study leverages a comprehensive diabetes dataset, emphasizing meticulous preprocessing and normalization to ensure data quality. Within this framework, we contrast the performance of a fine-tuned Random Forest classifier against a stacking ensemble model, which amalgamates predictions from diverse algorithms to enhance decision accuracy. Our results underline the nuanced advantages of each approach, with the stacking ensemble demonstrating superior precision and accuracy, albeit with nuanced trade-offs in recall metrics. Through this comparative analysis, we aim to enrich the dialogue within medical informatics, offering insights that could steer future predictive modeling endeavors. By articulating the strengths and synergies of these advanced ensemble methods, the research aspires to contribute substantially to the early detection and management strategies of Diabetes Mellitus, fostering improved patient prognoses and healthcare outcomes.

Duration and Measurements of Dementia Progression: A Systematic Review

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Abstract - The literature review aims to identify the duration of different dementia stages and the ways in which the progression of dementia can be measured. There are three main stages of dementia, namely mild, moderate and severe which can further be classified into 7 stages: normal behavior, forgetfulness, mild decline, moderate decline, moderately severe decline, severe and very severe decline. However the question arises, how do we measure the rate of progression from one stage to the next? For this survey, we thoroughly searched articles published on Google Scholar and PubMed and reviewed them. This survey paper is a consolidation of our search conducted. This paper follows the PRISMA formatting and checklist.

Ethical Perspectives into the Utilization of Health Informatics for Cancer Care

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Abstract - Health informatics (HI) plays a pivotal role in revolutionizing cancer treatment by improving patient care, healthcare outcomes, and system efficiency. This report examines the integration of health informatics in oncology, focusing on its implementation and implications. Advanced technologies like electronic health records (EHRs) and predictive analytics are utilized to optimize care coordination and treatment precision, leading to more effective patient management. However, privacy and ethical considerations are brought up using health informatics in cancer treatment. Ethical conundrums relating to patient permission and data privacy must be carefully considered while gathering and using patient data. Ensuring the confidentiality of patient information and addressing these issues need the implementation of strong safeguards. Strict data security protocols are necessary to protect against online dangers and preserve privacy. Moreover, leveraging the advantages of health informatics while maintaining ethical standards depends on efficient information management procedures. Making well-informed decisions about cancer care is made easier when patient data is managed properly, which guarantees its accessibility, correctness, and integrity. Healthcare practitioners can maximize the benefits of health informatics to improve cancer treatment outcomes while protecting patient interests by following ethical guidelines and putting strong information management policies in place.

Integrative Stress Assessment: A Triangulated Approach Using Psychological, Biochemical, and Physiological Measures

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Abstract - This paper examines the efficacy of stress triangulation, a comprehensive method that integrates psychological, biochemical, and physiological measures, in assessing human stress responses. By utilizing a combination of salivary cortisol, interleukin-6 (IL-6), skin conductance level (SCL), electrodermal activity (EDA), heart rate variability (HRV), blood pulse wave (BPw), and the Perceived Stress Scale (PSS), this approach offers a nuanced perspective on individual stress levels. The synergy among these measures not only enhances the accuracy of stress assessments but also allows for the dynamic monitoring of stress responses through advancements in wearable sensor technology. This integrated approach promises significant implications for personalized stress management and intervention strategies, aiming to optimize individual health outcomes.

Emotional Landscapes: Family and Staff Perceptions of Robotic Assistants in Caregiving Settings

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School of Nursing Foundation, University of Minnesota, USA;
Department of Family Medicine and Community Health, University of Minnesota, USA

Abstract - This study examines the perceptions and emotional responses of family members and staff in hospitals and home environments towards robotic assistants. By exploring the nuanced sentiments associated with the deployment of robots in caregiving settings, this research aims to delineate the intricate emotional landscape shaped by the introduction of these technologies. This paper delves into the array of hopes, concerns, and expectations that characterize human-robot interactions within these caregiving contexts, offering insights into the challenges and opportunities presented by robotic integration. The findings contribute to a deeper understanding of how robots are woven into the fabric of modern caregiving practices, potentially transforming the dynamics of care provision.

Gender Differences in Working Memory - A Holistic Review

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Abstract - This paper reviews and synthesizes findings from 21 studies on gender differences in working memory (WM) and associated neural activation patterns using EEG and fMRI technologies. The studies explore hemispheric lateralization, the effects of negative emotional stimuli on cognitive performance, and gender-specific neural and cognitive responses during WM tasks. Distinct patterns of right-sided dominance in males and left hemisphere activation in females were commonly observed, alongside gender-specific performance in verbal and visuospatial WM tasks. This review also discusses the implications of these findings on the understanding of cognitive neuropsychological dimorphism, offering insights into the complex interplay of gender, cognition, and neural architecture.

Integrating HRV and Activity Data for ADHD Classification Using Machine Learning Methodologies

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Abstract - This study explores reliable approaches to identifying Attention-Deficit/Hyperactivity Disorder (ADHD), a neurodevelopmental condition impacting various aspects of life. While traditionally diagnosed through subjective clinical evaluation, this work examines the integration of sensory data and machine learning techniques for more objective ADHD detection. Investigating diverse machine learning algorithms, including Logistic Regression (LR), Random Forest (RF), XGBoost (XGB), LightGBM (LGBM), Neural Network (NN), and Support Vector Machine (SVM), the research analyzes both activity and heart rate variability (HRV) data from a dataset of 103 participants. Results indicate comparable performance between activity and HRV data individually, with notable improvement seen in a combined dataset. The SVM model emerges as the top performer, achieving an F1-Score of 0.87 and a Matthews Correlation Coefficient of 0.77. This study underscores the great potential of interdisciplinary collaboration and diverse data resources in advancing ADHD detection through innovative machine learning techniques.

Modeling the Dynamics of Infectious Diseases in a College Campus: A Case Study of the 2016 Harvard Mumps Outbreak

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Abstract - Infectious diseases posed a persistent threat in the United States between 2014 and 2017. Several cases were reported between 2016 and 2017, despite high vaccination rates. Infectious diseases created even worse threats for residents in proximity to each other, such as college campuses. This study analyzes and models the dynamics of infectious diseases within a college setting, employing the notorious Harvard mumps outbreak of 2016 as a case study. It draws data from the Harvard University outbreak to offer a valuable framework for managing infectious disease outbreaks in educational environments. This paper provides insights into how college-level socialization, dormitories, classrooms, and social networks affect transmission rates, disease spread, quarantining, and vaccination campaigns. These factors are unique to educational institutions as they contribute a new perspective to public health strategies for colleges on infectious diseases and develop proactive intervention planning.

A Respite Work Exchange Service Mechanism based on Blockchain Technology

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Department of Media Arts, University of Kang Ning, Taipei, Taiwan;
Department of Information Management, Aletheia University, New Taipei, Taiwan

Abstract - The process of mutual respite generates a large flow of information. Existing mutual respite service information platforms are centrally managed. However, relying on a single point for data maintenance presents risks such as single point of failure, data loss, and security vulnerabilities. Additionally, since time point transactions are involved, the service content and time contributed by the service providers must be verified and recorded. This study integrates blockchain technology to achieve secure data storage, and the data and records stored on the chain are traceable.

Predicting Efficacy of Cancer Drug Combinations Using Machine Learning

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Michigan Institute for Data Science (MIDAS),
Center for Data-Driven Drug Development and Treatment Assessment (DATA),
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Abstract - Drug combinations have demonstrated considerable potential in enhancing cancer chemotherapy efficiency, reducing adverse side effects, and overcoming multidrug resistance. Over the past few years, AI-based computational models have been developed to screen the huge search space of all potential drug combinations and accurately detect those with synergistic anticancer effects. These methods can efficiently bypass the laborious and time-consuming experimental steps involved in in-vitro drug combination testing. Here we used the NCI-ALMANAC dataset to develop cell line-specific machine learning models capable of predicting synergistic growth inhibition of 108 cancer medications, tested at multiple dosages. The average performance of these models, as indicated by an AUC of 0.75 underscores the promise of leveraging neural networks for predicting drug combination outcomes.

Cardiac Valvular Diseases Classification Using Statistical Features and Machine Learning

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Abstract - Timely and accurate classification of cardiac valvular diseases is imperative for effective therapeutic interventions and improved health care applications. This research introduces a hand-crafted feature based solution for classifying cardiac valvular diseases using phonocardiogram (PCG) signals, achieving an accuracy of 99.5%. Instead of relying on computationally intensive deep learning paradigms, our approach emphasizes statistical feature extraction from raw sound wave data. By studying the impact of factors like segment lengths, model selection, and the nature of feature extraction, we have proposed an efficient alternative for cardiovascular diseases diagnostics. Our methodology, when positioned against benchmark deep learning solutions, performs remarkably. This holds significant advantages for real-world applications where computational efficiency and model lightweightness are crucial.

Automatic Wound Detection System for Multi-Ethnic Populations using YOLO

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Amrita School of Computing, Bangalore, Amrita Vishwa Vidyapeetham, India;
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Abstract - TBA

Evaluating Vaccine Effectiveness During the COVID-19 Pandemic: Insights from Advanced Statistical and Machine Learning Methods

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Abstract - The study provides valuable insights into the complex relationship between SARS-CoV-2 vaccination and work absences. The higher attack rate among vaccinated individuals highlights the need for further research to understand the underlying factors and inform evidence-based decision-making in the workplace and public health settings. The findings have implications for workplace policies and public health strategies related to SARS-CoV-2 vaccination and infection control.

Explainable Machine Learning-Based Alzheimer's Disease Prediction

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Abstract - Alzheimer's disease is a global health concern, underscoring the need for early detection to enable timely intervention. By exploring handwriting data from individuals with and without AD across various tasks, we aim to identify predictive features that influence the models. The analysis encompasses data from dictation, copy, graphic, and memory tasks, providing insights into the complexity of handwriting behavior in AD. Notably, copying tasks exhibit higher predictive accuracy. Key features like mean jerk and pressure variance emerge as significant predictors. These findings underscore handwriting as a promising marker for early AD detection, informing personalized screening and intervention strategies. Future research avenues include refining machine learning models, expanding datasets, and exploring additional handwriting features to enhance predictive precision.

Transformer-Based Encoder Method for Classification of Heart Rate Variability (HRV)

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Abstract - Transformer model can be used to process a sequence-to-sequence information and effectively capture dependencies among words or tokens in the sequence. ECG signals are the time sequence data. Transformer model is well suited for classification of ECG signals. In this paper, we use the encoder architecture of the transformer model to detect heart rate variability and classify electrocardiogram (ECG) data from the PhysioNet. The results show that our model can achieve 91% accuracy, 95% recall, 91% precision and 89% Specificity. The experimental results demonstrate that the proposed method achieves a good classification performance.

Electronic Health Record Summarization via LLM-constructed Knowledge Graph

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Abstract - With the introduction of electronic health records (EHR) in the medical field, doctors and nurses can examine patients faster and more efficiently than paper records. Despite the advancement in patient documentation technology, one of the main drawbacks for EHRs is the inconsistent format of documents among the different medical specialties, specifically psychiatry and behavioral health EHRs, as well as those used by a range of behavioral healthcare professionals, tending to be more anecdotal and text-based. With the recent advancement of large language models (LLM), this technology has a considerable potential to become a viable solution, as medical professionals could use them to summarize and inquire about patients at record speeds. While LLMs have the potential to revolutionize the medical industry, their issues include their inconsistently formatted responses and their limited knowledge domain. Consequently, they are currently not applicable in highstakes medical situations, as a single incorrect diagnosis could result in the patient's injury. We propose using LLM-augmented knowledge graphs to aid in the LLM's ability to perform QnA tasks and mitigate the possibility of data hallucination. Through prompt engineering, the LLM is able to generate formatted knowledge graphs based on a set of rules that focus on extracting as many relationships involving the patient, including afflictions and previous addictions. Using these graphs, we are provided with better visualizations of the patient's current and prior issues and reduce the complexity of future inquiries regarding their health via knowledge graph queries.

Prediction of the Outcomes of SSRI Therapy for Depressed Patients using Tuned Q-factor Wavelet Transform and EEG Signals

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Abstract - Depression is a mental disorder that might cause self-harm or suicide. Selective serotonin reuptake inhibitors (SSRI) therapy is the most prescribed medication to treat depression. This paper proposes a novel classification model to predict the outcomes of SSRI therapy for depressed patients based on recorded electroencephalogram (EEG) signals. Our proposed method is developed using a tunable Q-factor wavelet transform (TQWT) as a robust signals processing technique. The EEG signals are decomposed using TQWT into six sub-bands, and the log energy entropy is computed as feature for each sub-band. The statistically significant features are selected by Kruskal-Wallis test. The selected features are used as inputs for k-nearest neighbors (KNN) classifier. Mumtaz database is used to evaluate the performance of our proposed method. Mumtaz database has pretreatment EEG signals of 30 major depressive disorder patients who were selected to start SSRI therapy. The results show that the proposed method achieves a promising classification accuracy level 99.17% using 10-fold cross-validation strategy. The results show that our method outperforms other methods in the literature. The results show the importance and suitability of the higher frequency spectrum of EEG signals to predict the outcomes of SSRI therapy. The proposed method can be used in clinics and hospitals as a computer-assisted prediction system.

Prediction of the Outcomes of Repetitive Transcranial Magnetic Stimulation for Depressed Patients using Neural Networks and EEG Signals

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Abstract - Depression is a mental disorder that causes self-mutilation or suicide. Repetitive transcranial magnetic stimulation (rTMS) is a technique for the treatment of major depressive disorder (MDD) patients. This paper proposes a new method to predict the outcomes of rTMS for depressed patients based on electroencephalogram (EEG) signals. In this paper, linear and nonlinear features of multi-dimentional EEG signals are extracted and fed into several neural network (NN) architectures and machine learning (ML) techniques. The results show the cascade forward neural network (CFNN) has better performance than others. The designed CFNN has 11 layers with 10 neurons in each layer and achieves a perfect classification accuracy of 97.10%. The reported results for the CFNN architecture are reliable and robust because we used a 10-fold cross-validation strategy in the training and testing phases to avoid bias. The designed CFNN with a simpler structure than the previous pretrained architectures can achieve a performance as perfect as predefined architectures. The CFNN architecture can be used in clinics and hospitals as a computer-assisted prediction system for predicting the outcome of rTMS for MDD patients.

Surgical Tool Detection: A Comparative Study of Supervised and Semi-Supervised Learning Approaches

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Abstract - Surgical tool detection and classification are of great importance in enhancing the efficacy, safety of surgical procedures, and providing advanced surgical assistance, especially applicable to robotic/automatic surgery. Current methodologies predominantly rely on supervised techniques necessitating extensive annotated datasets. However, the availability of labeled datasets remains a persistent challenge. In this research, the objective is to detect and classify surgical instruments while evaluating the performance of supervised machine learning and deep learning models against a semi-supervised approach in image classification. Also, we investigate and contrast the significance of preprocessing, transfer learning, and semi-supervised learning techniques. Our findings demonstrate that while thorough preprocessing mechanisms can significantly impact the performance of machine learning models, employing transfer learning with deep learning models yields superior results. Additionally, training data on semi-labeled datasets exhibits comparable, or in some cases better performance than supervised deep learning methods, particularly in scenarios where labeled data is scarce.

Enhancing Cancer Cell Detection in H&E Images through AI

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Abstract - The paper outlines a roadmap for enhancing healthcare quality by introducing AI technology to diagnose patients with cancer using H&E images. Advances in machine learning offer significant potential for achieving non-destructive treatments for cancer patients in the near future. The current synergy of advancements in AI holds promise for addressing this fatal disease. The paper details the creation and implementation of an object detection system utilizing TensorFlow's MobileNetV2 model. Despite the training using a limited set of low-resolution images, the model demonstrated effective performance in identifying healthy and cancerous cells. Upon detecting cancer, there is anticipation that future research involving liposomes and carbon nanotubes will progress. Eventually, a nano-device could be employed to administer antibodies and targeted drugs directly to specific body regions where the treatment is needed.

Gender Differences in Robot Acceptance

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Abstract - As robots become increasingly integrated into our daily lives, it is imperative to examine how gender influences their acceptance. This research explores the gender disparities in robot acceptance, analyzing the various factors that shape human attitudes toward these technologies. By investigating the intersection of gender dynamics and technological advancements, this study seeks to uncover the underlying reasons why certain individuals are more receptive to robots than others. It will explore the diverse elements, including cultural norms and personal experiences, that contribute to the formation of perceptions regarding robots in both professional and personal contexts. This study aims to shed light on the critical yet often neglected aspect of gender within the field of robotics.

Gender-Specific Risk Factors for Dementia: Exploring the Unique Vulnerabilities in Women

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Abstract - This review synthesizes recent research published since 2015, addressing the gender disparities in dementia risk, focusing primarily on the unique risk factors for women. These include reproductive factors, hypertensive pregnancy disorders, other modifiable risk factors, hormonal changes, and cardiovascular conditions. The evidence suggests that women's increased vulnerability to dementia may be influenced by a complex interplay of hormonal, reproductive, and cardiovascular dynamics, which differ significantly from those affecting men. Key findings indicate that earlier age at first childbirth and hypertension in midlife increase women's risk, while an older age at menopause decreases it. This review highlights the critical need for gender-specific approaches in both research and clinical practices to better understand and potentially mitigate the risks of dementia in women.

Effects of Breathing Exercises on Cognition: A PRISMA Guided Systematic Review

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Abstract - Background: Different types of breathing exercises are known to have positive effects on cognition and memory. Aim: To analyze the effects of breathing exercises on cognition and memory. Design: Systematic Review. Methods: Research articles were searched on PubMed and Google Scholar. Results: Ten studies were included for the analysis. Several breathing exercises showed improvements in cognition and memory-recall. Conclusions: Breathing exercises improve the cognitive functioning of individuals. Combining these breathing exercises with other physical activities has proven to have a positive impact on the overall cognitive well-being and memory. More studies should be conducted to understand the effects of breathing exercises on cognition and memory on a deeper level.

Modernizing Medicine Through a Proof of Concept That Studies the Intersection of Robotic Exoskeletons, Computational Capacities and Dementia Care

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Abstract - This article explores the potential applications of robotic exoskeletons in managing mobility challenges associated with dementia. These conditions impose significant hurdles to mobility and independence, and strongly impact the overall quality of life for individuals afflicted by them. Conventional rehabilitative methods often prove inadequate in addressing the multifaceted motor impairments characteristic of these conditions. By highlighting the intricate interplay between cognitive function and gait control, we meticulously examine the current landscape of robotic exoskeleton technology and the incorporation of artificial intelligence in dementia care, the hurdles encountered in implementation, and future trajectories. Robotic exoskeletons have exhibited promising therapeutic benefits in case of many ailments which affect the neuromuscular system and hamper nerve-muscle coordination, including Parkinson's disease, Guillain-Barre Syndrome, stroke, and injuries which cause partial or complete paralysis of the body. Since patients with dementia encounter neural weakness which negatively influences their muscles which control their voluntary actions, we hypothesize that exoskeletons, in combination with intelligent sensing and analysis, can be useful in dementia, helping prolong the lives of patients with dementia, an incurable, irreversible disease. However, despite their potential, obstacles such as cost, user acceptance, and long-term efficacy necessitate further scrutiny. In summary, robotic exoskeletons present potentially innovative avenues for ameliorating mobility constraints, bolstering independence, and enriching the quality of life for individuals grappling with dementia.

Experimental Study on Assistive System using Statistical Signal Processing Technology for Visually Impaired People

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Abstract - In this study, we will investigate a new image signal processing method in order to develop a highly useful walking support device for visually impaired people. Visually impaired people walk independently using assistive devices. Currently, there are many support devices that use object detection and object recognition using deep learning, but there are still no highly useful devices. The smallest unit constituting an image signal is a pixel. Adjacent pixels are correlated with each other. The positional relationship of pixels expresses the features of objects, and scenery in the image. Autoregressive (AR) model is a regression analysis method used to analyze time-series signals. AR models are one of the basic methods for signal processing for speech recognition and control. Furthermore, in image signal processing, it can be used as a signal processing method when data has some kind of order, such as texture feature extraction, contour processing, and video processing. In this experiment, we converted the pixel array of the image signal into a one-dimensional time-series signal and process the signal. We tried to identify objects or regions within images. The method proposed in this study may be used to extract "Point of Interest" (POI) and "Point of Reference" (POR), which are important information for visually impaired people.

Experimental Study on Evaluation Method of Orientation and Mobility Skills for Visually Impaired People based on Brain Activity

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Abstract - Orientation and Mobility (O&M) skills are essential for visually impaired people to live an independent life. O&M skills are generally evaluated subjectively by instructors, a quantitative evaluation method is required. Accidents in which visually impaired people become victims at intersections and station platforms have become a social problem. The final purpose of this research is to establish a method to quantitatively evaluate the walking skill proficiency of visually impaired people. We investigated the effectiveness of biological signals using NearInfrared Spectroscopy (NIRS) for quantitative evaluation of walking skills. In a previous study, we measured brain activity in sighted subjects who wore eye masks. The experimental results showed that brain activity in the prefrontal cortex changed significantly, especially when walking alone through narrow passages. We considered to be due to anxiety and caution caused by being aware of contact with the wall. In this experiment, we added subjects to verify the results of past experiments. In addition, we focused on the distance between the subject and the wall. We considered brain regions involved in cognition and intention, which are important for visually impaired people when walking.

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An Analysis of Different Information Granularity Distribution Protocols to Improve Consistency in Intuitionistic Reciprocal Preference Relations

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Abstract - Recently, an optimization of information granularity distribution has been proposed as a way in which the consistency of an intuitionistic reciprocal preference relation can be increased. Specifically, a symmetric and uniform distribution of information granularity has been taken into account for intuitionistic reciprocal preference relations. However, there are other information granularity distribution protocols that could also be used. The objective of this paper is to analyze all the information granularity distribution protocols and determine their effectiveness in improving consistency of an intuitionistic reciprocal preference relation. The performance of the different protocols is discussed by conducting some numerical studies that help provide insights into the effectiveness of the protocols to increase the consistency.

A Voxel-representation-based Data Generator of Adversarial Objects for Robotic Manipulators

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Abstract - In order to develop robust grasping AI algorithms, it is important to generate objects that become progressively more adversarial and complex with each iteration, as in curriculum learning, in a manner agnostic to the particular visual processing method used by the robot. We present a data generator of voxel-based 3D adversarial object geometries for training grasping algorithms, which operates independently of any particular visual encoding/decoding pipeline. Our novel approach uses genetic algorithms and can generate arbitrarily many samples, bounded only by the user-specified voxel resolution. The success of our approach is demonstrated in terms of the number of adversarial objects generated, how difficult they are to grasp, and how similar they are to more easily graspable objects.

Federated Learning with Frequency Estimation for Smart Meter Systems

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Abstract - Federated learning (FL) is a powerful framework that allows multiple distributed clients to collaborate, without moving their data to the central server. However, this setting by default does not provide the privacy preservation the clients are hoping for. We reviewed the recent studies that implemented privacy in FL and found that frequency estimation (FE) techniques have not been explored enough in this space. We developed FE techniques and integrated them on the client side, we also explored the impact of having an adaptive range and shuffled model. Additionally, we investigated the impact of range of hyper-parameters on the privacy preservation. Results show clear direction on which algorithms and settings perform well for FL with long short-term memory architecture.

Towards the Generation of Learning Objects with Generative Artificial Intelligence

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Abstract - This paper describes an on-going research on the use of generative artificial intelligence (GAI) in generating learning objects. Learning Objects are digital or non-digital artifacts, which can be used, reused, or referenced to augment or enhance the learning process. Examples of these are presentation slides, images, text, surveys, quizzes, and hands-on exercises. The unprecedented availability and capability of GAI tools in recent years brings us to consider how their technical capacities and abilities can bring about effective and useful learning objects. We first explore the published literature to survey the work that has been done in the field of applied GAI to generate learning objects. Next, we provide a review of their technical features and closely look at the distinctive features of the tools used in various GAI models. The focus of this research is to develop a method of utilizing freely available GAI tools to expedite the generation of learning objects and to evaluate their effectiveness. Specifically, we seek to optimize the utilization of these AI-generated learning objects for active-learning applications and learning best practices.

3D Artistic Images Generation from 2D Images Using Improved Wasserstein Generative Adversarial Networks

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Abstract - Excellent artistic work frequently showcases the individual inventiveness of the creator, and many artists place a high value on producing images of superior quality. A remarkable success has been achieved by GANs in producing photorealistic 2-D images. Because traditional GANs generate 3D images directly from 2D, their images frequently lack the perfect quality and consistency of multiple views from a single image. With varied degrees of success, numerous attempts have been made to address these issues. With the use of a 3D Variational Autoencoder (VAE) that integrated Improved Wasserstein Generative Adversarial Networks (3D VAEIWGAN), this research aims to produce high-quality and consistent multi-view three-dimensional (3D) artistic images. The experiments were conducted using the COCO Africa Mask dataset, and the proposed method produced high-quality images that were more closely aligned with the aesthetic qualities of authentic works of art than other complex methods. In comparison to other methods, the proposed method has a high Inception Score(IS) score of 26.37, a low fréchet inception distance (FID) score of 12.09, a peak signal-to-noise ratio (PSNR) of 31.35, a mean squared error (MSE) of 65.32, a chamfer distance (CD) of 0.243, Learned Perceptual Image Patch Similarity (LPIPS) score of 0.134 and a structural similarity index measure (SSIM) of 0.772. These results are better than those obtained with other methods on the COCO Africa Mask dataset. The proposed approach can help artists showcase, develop, and improve the originality of their work, which will increase their financial gains.

Evaluating Artificial Intelligence Robustness Against FGSM and PGD Adversarial Attacks with L-norms Perturbations

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Abstract - This research evaluates the robustness of DenseNet161 neural network architecture using the Stanford Dogs dataset for fine-grained image classification. Specifically, it examines the model's performance against adversarial examples developed with the Fast Gradient Sign Method and Projected Gradient Descent attack techniques. These attacks created inputs that appear normal to humans but induce errors in machine learning models. In this process, adversarial perturbations were regulated with L1, L2, and L∞ norms to ensure subtle modification. Although the DenseNet-161 model successfully provided a high accuracy of 83.75% on clean (without attack) Stanford Dogs data, it was severely impacted by adversarial attacks, which detrimentally affected confidence scores and predictions. Hence, the model was highly sensitive to uniform pixel-wise perturbations from L∞ norm attacks. The results reveal vulnerabilities in current artificial intelligence models and emphasize the importance of adversarial robustness, especially in security-sensitive applications. This analysis provides insights into developing broader defenses across perturbation norms rather than solely relying on L∞ robustness, bridging gaps in understanding model limitations and advancing toward more reliable systems.

Automating Automation: Using LLMs to Generate BPMN Workflows for Robotic Process Automation

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Abstract - This paper explores the potential of using Large Language Models (LLMs) to generate Business Process Model and Notation (BPMN) files as input for Robotic Process Automation (RPA) tools. The combination of AI-driven workflow generation with RPA aims to improve the automation of complex processes in both scientific and business domains. The proposed approach leverages the ability of LLMs to interpret natural language instructions and convert them into structured BPMN files, which can then be graphically edited using software like Camunda and executed by RPA tools. The feasibility of this approach is demonstrated through zero-shot prompt experiments using Anthropic Claude 3 Opus and GPT-4o. This solution has the potential to streamline the automation of workflows, reduce human error, and increase productivity across various industries.

High Level Design of Photorealistic VTON System based on Generative A.I. Technologies

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Abstract - In this paper, we propose the overall architecture design and discuss the feasibility of implementing a Virtual TryOn (VTON) system using Generative A.I. (artificial intelligent) technologies. The proposed scenario involves using a smartphone to capture the user's body, generating a three-dimensional avatar model based on the captured image, and then virtually dressing this 3D avatar model with selected clothing in online shopping mall. The objective of this system is to achieve photorealistic image results by utilizing Generative AI-based Virtual Try-On (VTON) technology. By employing this technology, we anticipate that the satisfaction of users when purchasing clothing online will increase, consequently reducing the return rate of clothing items.

Enhancing Cultural Algorithm Guided Policy Gradient with Parameter Exploration through Topographic Knowledge and Adaptive Weighting

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Abstract - Building upon our previous work on integrating Cultural Algorithms (CA) with the Policy Gradients with Parameter-Based Exploration (PGPE) algorithm, this study presents an enhanced version of the CA-PGPE algorithm for the MNIST hand-written digit classification task. The improved CA-PGPE incorporates Topographic knowledge source (KS) and refined knowledge source weighting to efficiently navigate the search space and improve convergence speed. By leveraging the belief space consisting of Domain, Situational, History, Topographic, and Normative knowledge sources, the enhanced CAPGPE algorithm demonstrates improved performance compared to the original PGPE algorithm. The results showcase the potential of integrating cultural knowledge into evolutionary optimization algorithms for tackling complex machine learning tasks. Future research directions include exploring the application of CA-PGPE to evolve the parameters of Kolmogorov-Arnold Networks (KAN) and investigating the implementation of a social learning mechanism within the population space.

Enhancing Clinical Documentation Through NLP-driven Disease Categorization and Visualization: A Case Study Utilizing the Llama2 AI Model

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Abstract - Clinical documentation is integral to healthcare, providing essential information for patient care, billing and research purposes. However, the documentation process often encounters challenges such as inaccuracies, inconsistencies and inefficiencies. Leveraging advancements in Natural Language Processing (NLP) presents a promising solution to enhance clinical documentation practices. In this paper, we propose a novel approach utilizing an advanced AI model, specifically Llama2, to address these challenges and improve clinical documentation. Our methodology involves leveraging NLP techniques, including text categorization, data cleaning and visualization, to streamline the clinical documentation process. We present a case study utilizing a custom dataset of patient records to demonstrate the effectiveness of our approach. The results highlight significant improvements in categorization accuracy, data cleanliness and visualization of trends, underscoring the potential of NLP in driving clinical documentation improvement and enhancing healthcare delivery.

Demand Forecasting in Planned Production Orders Using a Dual-Path Time Series Decomposition and Fusion Multi-Level Ensemble Model

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Abstract - Our study proposes a Dual-Path Time Series Decomposition and Fusion Multi-Level Ensemble Model (DP-TDFM) architecture, which is divided into two paths. Path one is dedicated to handling non-stationary time series and uses STL decomposition to divide the sequence data into three aspects: trend, seasonality, and residual, which are then fed into our designed Multi-Level Ensemble Model (MLEM). The MLEM is based on algorithms such as Random Forest, SVR, and Decision Tree, and utilizes a neural network in the hidden layer as the final prediction model. Path two is based on the GatedTabTransformer, introducing both trend and seasonality features, and includes external environmental factors as our augmented features (AF). Experimental results show that, even when individual models are overfitted, our DP-TDFM architecture still maintains stable overall performance, and it has the highest prediction accuracy among all models at five-time points, demonstrating more stable and smoother prediction results. This model effectively solves several challenges in prediction tasks, including overfitting, sparse data, and long-distance dependencies.

Automatic Modulation Recognition: A Hybrid Approach using Deep Learning and K-Means Clustering

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Abstract - This paper introduces a hybrid model for Automatic Modulation Recognition (AMR) that enhances classification accuracy of digital communication signals across various signalto-noise ratios (SNR). The proposed model integrates a Deep Learning (DL) layer featuring a Convolutional Neural Network (CNN) for initial classification with a subsequent refinement layer using the K-Means Clustering algorithm. The process begins with the continuous wavelet transform (CWT) of the received signal to generate a magnitude spectrogram, which is used as an input image to the DL Layer. Due to the inherent loss of phase information in generating the magnitude spectrogram, the system activates the K-means layer when the initial classification of the signal is a higher-order Phase Shift Keying (PSK) modulation scheme. This subsequent layer refines the classification by evaluating the Inphase and Quadrature (IQ) data and determines the modulation order of the PSK signal by use of the K-means algorithm. The MATLAB simulations showed that incorporating the K-means layer resulted in a 15% improvement in recognition accuracy, ultimately achieving over 95% accuracy for SNR levels of 15 dB and higher.

XAI-based Assessment of Software Vulnerability Contributing Factors in Transformer Models

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Abstract - This paper studies the feature contribution values of software code tokens in the learning task of vulnerability multi-classification in terms of Common Weakness Enumeration (CWE) types. The nuance of sibling CWEs under the same parent CWE category has the challenges of learning the correct types. Such an issue of the semantic meanings in relation to feature attention values and feature contribution values requires a systematic assessment. We device an assessment framework that integrates the eXplainable AI (XAI) techniques and measurements to examine the importance of factors, including token length, separators, tokens attention values, abstract syntax tree meta constructs and their effects to learning performance. We apply three open source datasets in both Java and C++ languages, three transformer learning models, two XAI algorithms. The results highlight three clues that (1) higher attention values have more feature contribution values as the impact; (2) the attention values alone may not distinguish the subtle difference among close CWE types; and (3) increasing input token length should has more impact on type of tokens with most contribution values.

An ISR Asset Planning Application

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Abstract - In many reconnaissance and surveillance tasks, the challenge is to deploy a considerable set of assets in the best manner for satisfying a set of given information requirements. The paper at hand presents an approach for an optimal plan-ning of ISR asset deployment in order to satisfy the information needs of a commander. Based on the processes of information requirements management (IRM) and collection management (CM), a two-step approach has been developed.

Causal Discovery with Interactive Human Inputs

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Abstract - Integrating expert knowledge into causal structure learning from observational data has proven beneficial. Unlike prior approaches where human knowledge operates independently of structure discovery, we propose a framework for causal discovery with interactive human input. Within our framework, human experts offer edge relations within a local context defined by a machine learning algorithm, iteratively refining the causal graph estimate. Results on simulated and real networks demonstrate superior accuracy with human input. We also analyze the effects of various human inputs and node selection strategies on algorithm performance.

Leveraging JSBSim and Gymnasium: A Reinforcement Learning Approach for Air Combat Simulation

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Abstract - This paper explores the application of reinforcement learning in air combat simulations, emphasizing the use of JSBSim and Gymnasium to create realistic combat scenarios. The objective is to leverage artificial intelligence to validate military designs and enhance tactics in the field. The ongoing efforts involve testing and surveying several prominent frameworks for their suitability for cross-domain application towards designing and developing an open-source testbed for RL techniques to execute and visualize the simulations. We share insights gained from experimenting with these tools and highlight the creation of customized scenarios for specific needs. The focus is on collaborative multi-aircraft air combat, aiming to improve mission success and reduce casualties. Referencing DARPA's ACE project, the paper showcases real-world AI applications in air combat intelligence. This contribution adds to the discourse on air combat, flight simulation, and reinforcement learning, emphasizing practical implications for military advancements.

Orthogonal Activation Functions in Neural Networks: Utilizing Chebyshev, Legendre, and Hermite Polynomials

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Abstract - In this study, we explore the potential of orthogonal polynomial functions as activation functions within the SWAG neural network architecture. By employing Chebyshev, Legendre, Hermite polynomials and and sinusoidal functions, we conduct a rigorous comparative analysis to evaluate the performance enhancements across a range of benchmark datasets. Furthermore, this paper investigates the influence of factorial coefficients on the performance of these models, providing a nuanced understanding of how these mathematical modifications affect learning dynamics and model efficacy. Our results offer insights into optimizing neural network architectures through advanced mathematical functions.

Enhancing Differential Evolution for Neural Network Optimization through Boundary Individual Consideration

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Abstract - This paper presents a novel approach to Differential Evolution (DE) for optimizing neural networks by incorporating boundary individual consideration during the mutation process. Standard DE often encounters exploration challenges at the search space boundaries, potentially hindering the discovery of optimal solutions. To address this, our enhanced DE algorithm strategically includes boundary individuals to ensure a thorough exploration of the boundary regions. We applied the improved algorithm to obesity level, stroke, and fetal health prediction datasets and conducted a series of experiments comparing the enhanced DE against traditional DE technique. The results demonstrated that the enhanced DE achieved superior performance, with more consistent and higher fitness scores across generations, as well as improved precision and recall in several classification categories. These findings support the hypothesis that boundary exploration can significantly benefit the hyperparameter optimization of neural networks.

Predictive Modeling of Shading Effects on Photovoltaic Panels Using Regression Analysis

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Abstract - Drones have become indispensable assets during human-made and natural disasters, offering damage assessment, aid delivery, and communication restoration capabilities. However, most drones rely on batteries that require frequent recharging, limiting their effectiveness in continuous missions. Photovoltaic (PV) powered drones are an ideal alternative. However, their performance degrades in variable lighting conditions. Hence, machine learning (ML) controlled PV cells present a promising solution for extending the endurance of a drone. This work evaluates five regression models, linear regression, lasso regression, ridge regression, random forest regression, and XGBoost regression, to predict shading percentages on PV panels. Accurate prediction of shading is crucial for improving the performance and efficiency of ML-controlled PV panels in varying conditions. By achieving a lower MSE and higher R2 Scores, XGBoost and random forest methods were the best-performing regression models. Notably, XGBoost showed superior performance with an R2 Score of 0.926. These findings highlight the possibility of utilizing the regression model to enhance PV-powered drones' efficiency, prolong flight time, reduce maintenance costs, and improve disaster response capabilities.

Lookahead Secured AI/ML Platforms

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Abstract - In an era where machine learning permeates critical domains such as finance and healthcare, safeguarding these systems against vulnerabilities is paramount. This paper explores the imperative of securing machine learning systems and advocates for a holistic strategy merging hardware and software co-design. Our proposed framework integrates hardware-level security mechanisms with software-based techniques, presenting a robust approach to fortifying machine learning algorithms and models against potential threats.

Exploring Poverty Factors through Predictive Modeling

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Abstract - This paper presents a case study on the IPUMS USA database that contains microdata samples sourced from censuses and surveys, encompassing a wide array of socio-economic variables such as demographics, household composition, education, employment, income, including poverty. Addressing gaps in previous studies, we propose a machine learning approach to develop a number of predictive models aimed at identifying and quantifying factors influencing poverty. Our experiments focus on three groups of factors: pre-disposing, socio-demographic, and socio-economic. By analysing the sensitivity of model-training variables and employing Variable Effect Characteristics (VEC) analysis to assess variable values, we evaluate the significance of various poverty-related factors.

Analysis of the Integration of Artificial Intelligence and Blockchain Technology in a Legal Process in Ecuador

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Abstract - The challenges for integrating Artificial Intelligence (AI) and blockchain technology into a legal process are persistent, primarily due to the legal definitions of each country that must mitigate the risks, vulnerabilities, and threats of using these technologies in legal processes. The objective is to define a generic prototype to achieve the integration of Artificial Intelligence, blockchain, and a legal process. A deductive method and exploratory research were employed to analyze information related to the research topic from various official websites and indexed documents. The outcomes of this research include the identification of problems arising from the application of legal processes, indicators for integrating Artificial Intelligence (AI) with legal processes, indicators for integrating Artificial Intelligence (AI) with blockchain technology, and a generic prototype for integrating Artificial Intelligence, blockchain, and a legal process. It was concluded that it is currently crucial to consider Artificial Intelligence for security processes with a holistic view for integration with new technologies such as blockchain, to ensure confidentiality, integrity, and availability (CIA) in legal processes, and to manage information with Identity, Authorization, Authentication, and Audit (IAAA) effectively and efficiently.

The Evolutional Treasury Hybrid Optimization System (ETHOS)

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Abstract - TBA

The Evolutional Portfolio Optimization System (EPOS)

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Abstract - TBA

Identifying and Displaying EdTech Implementation Context Profiles

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Abstract - Education technology (edtech) is increasingly prevalent in classrooms, yet 85% of the technologies currently implemented are a bad fit for the school or are poorly implemented. This is especially problematic for poorly funded schools typically seen in minority communities. To address this limitation, the EdTech Evidence Exchange has collected survey responses to characterize the contexts in which technologies are being implemented. Variable selection via penalized regression and unsupervised machine learning methods extracts a subset of the factors that are the most informative in characterizing schools. contexts. This subset is then used to fit a Gaussian Mixture Model to create soft clusters of schools with similar contexts. A new feature, "Schools Like Mine," combines soft classification and Euclidean distance to identify and rank schools by similarity. This research will hopefully reduce the likelihood of failed software investments.

Smart Farming: Leveraging a Deep Learning Model for Plant Leaf Classification

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Abstract - The intelligent systems specialized in monitoring plant growth have entered into precision agriculture, and integrated systems have been built that contain built-in cameras within these systems. This monitoring takes place over varying periods and results in many captured images. The monitored plants may be unhealthy and infected with bacteria. However, some are healthy, leading to significant damage as these bacteria move around and spread to healthy plants. From this perspective, a proposed system based on deep learning is developed to classify plant images into healthy and unhealthy categories. The images from the observation are usually random and need to be more organized. Hence, using classification algorithms helps extract organized and arranged image data for easier access according to labels. This process enables us to save time and effort by monitoring a plant's leaves. The proposed model achieved 87% accuracy on the plantvillage tomato leaf dataset, consisting of one healthy class and nine different unhealthy classes.

Harnessing Pre-Trained Language Models for Efficient Move Recognition in Biomedical Abstracts

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Abstract - Over the years, the literature in the field of biomedical science has increased exponentially. Structured literature helps readers to grasp the content efficiently. Segmenting abstract sentences into categories like background, objective, method, results, and conclusions will benefit readers and will aid information extraction and information retrieval in complex biomedical literature. This paper focuses on randomized clinical trials (RCTs) and presents a comparative study of fine-tuned BERT-based variants for move recognition on the RCMR RCT dataset, a subset of RCMR 280k. Among the models used in the experiment, BioBERT has outperformed BERT, SciBERT, PubMedBERT, BioMedBERT, BART, and RoBERTa. Utilizing the RCMR RCT dataset instead of the PubMed 20k RCT dataset using BERT, BioBERT, SciBERT, and PubMedBERTmodel demonstrates an improvement of 4.95%, 5.71%, 3.95%, and 4.32% in the F1 score metric. This paper contributes to advancing the biomedical literature analysis by developing methods for move recognition.

Comparative Analysis of Statistical Machine Learning and Deep Learning Approaches for Forecasting News Popularity on Social Media Platforms

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Abstract - Forecasting news popularity on social media platforms is a challenging task that requires accurate prediction. The news popularity progression needs to be monitored at an interval of specified time steps. The research was carried out using experiments on a real-world dataset of news articles. This problem was modeled as Multivariate Time Series prediction. The Popularity Index is monitored from three social media sources, Google+, LinkedIn and Facebook at an interval of 2hrs. Statistical and Deep Machine Learning Models were used to predict the News Popularity Index after 48 hrs. based on the progression of News every 2hrs. For Statistical Regression Linear Regression Model was used. For Deep Learning Long Short-Term Memory based LSTM and BiLSTM models were used. The models were compared using the metric of root-mean-square error (RMSE) for the accurate prediction of News Popularity. LSTM and BiLSTM outperform regression techniques in terms of prediction accuracy. Additionally, the performance of LSTM and Bi-LSTM were compared. Bi-LSTM slightly outperforms LSTM. Our findings suggest that deep learning models, specifically LSTM and Bi-LSTM, are well-suited for forecasting news popularity on social media platforms. Our research provides insights into the strengths and weaknesses of these models and offers practical implications for media outlets and social media platforms in their efforts to increase the reach and impact of news content.

Integrating Retrieval-Augmented Generation with Large Language Models for Supply Chain and Finance Optimization

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Abstract - This paper presents the integration of Retrieval-Augmented Generation (RAG) with Large Language Models (LLMs) to support supply chain management and financial decision-making. RAG combines effective retrieval process with Generative neural-based language models to improve data privacy and expand knowledge. The proposed dual-module system consists of a retrieval module and a generation module that retrieves generation as the process of generating contextual response. Contextual analysis and contextual generation achieved via iterative chunk retrieval and optimization. Contextualized visual analytics, predictive analytics supported by chunk retrieval and optimization help achieve data-driven forecasting and inventory planning supply chain as well as data-driven insights for financial reporting. An analysis set including balance sheet analysis evaluates the effectiveness of the RAG system through recursive retrieval and multi-hop questioning and generative and retrieval module integration. The results show that RAG can contribute to disrupting the supply chain and finance process for increased agility, resilience, and added data privacy. The implication includes data-driven forecasting, inventory, supplier risk assessment, and financials. However, RAG should consider counter exploitation and ethical evaluation. The next steps should include scalable and advanced metrics evaluation and interdisciplinary research between machine learning, retrieval systems, supply chain, and finance.

Analyzing Gender Polarity in Short Social Media Texts with BERT: The Role of Emojis and Emoticons

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Abstract - In this effort we fine tuned different models based on BERT to detect the gender polarity of twitter accounts. We specially focused on analysing the effect of using emojis and emoticons in performance of our model in classifying task. We were able to demonstrate that the use of these none word inputs alongside the mention of other accounts in a short text format like tweet has an impact in detecting the account holder's gender.

Restating the Prowess of Logic Programming

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Abstract - Logic programming stands as a cornerstone among programming paradigms, presenting an unparalleled methodology for addressing a spectrum of quintessential AI challenges. This paradigm harnesses the power of predicate logic to enhance the inference mechanism, thereby demonstrating exceptional proficiency in complex problem-solving domains, including graph traversal and constraint satisfaction dilemmas. This paper explores the potent application of logic programming in devising innovative solutions for the classic conundrum of the farmer-wolfchicken-grain riddle, showcasing its robustness and versatility in computational reasoning.

Enhancing Irrigation Efficiency with a Unified Stochastic Decision Tree Model: Predictive Analysis of Stem Water Potential in Almond and Pistachio Orchards

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Abstract - Stem Water Potential (SWP) is the standard method for assessing water stress and irrigation scheduling in tree crops. This method is time-consuming and labor-intensive, limiting data collection to only a few trees in the orchard. To find an alternative approach that predicts water stress in every tree in the orchard, we implemented a novel Stochastic Decision Tree (SDT) method, utilizing remote sensing and weather data to predict SWP in almond and pistachio orchards. The input data for our model included various vegetative indices such as NDVI, GNDVI, OSAVI, LCI, and NDRE, as well as local weather parameters, such as temperature (Ta), relative humidity (RH), air pressure (P), Vapour Pressure Deficit (VPD), and the Water Stress Index (WSI). Our results indicate that the SDT model achieves a prediction accuracy of nearly 94%, Outperforming Random Forest (RF), support vector machine (SVM), and the k-nearest neighbor (KNN) algorithms. We investigated various combinations of collected data under different scenarios to improve the impact of sensor-derived data from pistachio and almond orchards and enhance the accuracy of SWP predictions using an SDT model. Our findings suggest that a data-driven model utilizing cost-effectively collected data can predict water stress. The successful development of a universal model enhances the accuracy of SWP predictions. Moreover, its adaptability and effectiveness allow it to be utilized for different orchards, making it highly applicable to real-world agricultural scenarios.

Utilizing Federated Learning and SHAP for Predictive Analysis in Smart Grid Security

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Abstract - In the context of smart grid security, this paper explores the integration of Federated Learning (FL) with eXplainable Artificial Intelligence (XAI) techniques to address the dual challenges of data privacy and model interpretability. We employ a federated learning framework with a 3-hidden-layer neural network, trained on diverse smart grid datasets. Our approach includes comprehensive data preprocessing strategies, such as the removal of duplicates and handling of missing values, as well as the application of mutual information for rigorous feature selection. To tackle the opacity of complex machine learning models, we incorporate SHapley Additive exPlanations (SHAP) to elucidate the decision-making processes, enhancing transparency and trust. The model's effectiveness is validated through improved performance metrics, including accuracy, precision, recall, and F1 scores, across different data distributions. Our results underscore the potential of combining FL with SHAP to enhance the interpretability and reliability of AI applications in energy systems, highlighting significant implications for real-world deployments where both security and privacy are paramount.

Subject Matter Expert versus ChatGPT

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Abstract - The current capabilities of ChatGPT allow experienced practitioners to learn new techniques and to better organize and document their work, but raise issues of fair use, false attribution, and academic misconduct by some users and students. This paper analyzes the responses to three questions and its use to recognize fraudulent social media posts. ChatGPT gave an insightful and useful answer to an interpersonal relationship question. Its response to a technical question suggests that a nonexpert can, with effort, produce a publication quality paper with little or no domain knowledge, and it would be difficult for a domain expert to detect the fraud. The response to the factual question illustrates an error also observed in some human work.

Compararitive Analysis of AI-Powered Image Recognition for Dermatological Diagnosis

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Abstract - With the increasing incidence of skin cancers such as Basal Cell Carcinoma (BCC), Malignant Melanoma (MM), and Squamous Cell Carcinoma (SCC), the field of dermatology struggles to meet the demand in early diagnosis. Creating a necessity for a portable solution that is both easy to use and cost effective. This study investigates robust Artificial Intelligence (AI)-powered image recognition methods to diagnose skin diseases. Directly comparing different forms of AI such as Convolutional Neural Networks (CNN), and Deep Learning networks (DL). With a special focus on accuracy, sensitivity, and specificity. Aiming to indicate a recognition algorithm that can be implemented reliably. Finding that a DL (IMLT-DL) method would be both effective and easy to implement in an application.

Explainable Machine Learning based Intrusion Detection Systems for IoT

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Abstract - The Internet of Things (IoT) can be described as the entire network of interconnected devices as well as the technology that enables communication between the devices themselves and with the cloud. With IoT becoming very extensive over the last decade with huge improvements in network systems, technology, and the Internet, there has been a need for security alongside the rapid growth. In this research work, our goal is to address that issue and enhance the IoT security measures. This is done by analyzing the effectiveness of various machine-learning models and techniques. Oversampling and undersampling methods were used to address the imbalance issues in the two IoT network datasets, NF-ToN-IoT-V2 and NFBoT-IoT, used. The models used included White Box Models: Decision Tree, Logistic Regression, Naive Baye, and Black Box Models: Neural Networks, Support Vector Machines, Random Forest, and K-Nearest-Neighbors. They achieved high accuracy in both oversampling and undersampling scenarios, where Decision Tree and Random Forest models outperformed other models. We utilized the explainable AI technique, SHAP, to enhance interpretability by quantifying feature contributions to individual predictions. SHAP discovered the features that had the most impact on the model's decision-making. The top feature for the NF-ToN-IoT-V2 dataset was the TCP WIN MAX IN and TCP FLAGS for the NF-BoT-IoT dataset with both techniques, oversampling and undersampling.

Deep Reinforcement Learning Strategies in Finance: Insights into Asset Holding, Trading Behavior, and Purchase Diversity

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Abstract - Recent deep reinforcement learning (DRL) methods in finance show promising outcomes. However, there is limited research examining the behavior of these DRL algorithms. This paper aims to investigate their tendencies towards holding or trading financial assets as well as purchase diversity. By analyzing their trading behaviors, we provide insights into the decision-making processes of DRL models in finance applications. Our findings reveal that each DRL algorithm exhibits unique trading patterns and strategies, with A2C emerging as the top performer in terms of cumulative rewards. While PPO and SAC engage in significant trades with a limited number of stocks, DDPG and TD3 adopt a more balanced approach. Furthermore, SAC and PPO tend to hold positions for shorter durations, whereas DDPG, A2C, and TD3 display a propensity to remain stationary for extended periods

Classifying Network Traffic using Images and Deep Convolutional Neural Networks

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Abstract - Network traffic classification is the process of categorizing the network traffic into several traffic classes. It is an important problem that has various applications from identifying different types of network applications to malware traffic detection. In recent years, machine learning methods have been applied in network traffic classification. Most research uses structured statistical features extracted from network packet capture (PCAP) files, which were trained and tested with classic machine learning algorithms. These engineered features are useful, but they ignore some of the important details of individual packets. In this paper, we propose a method to encode the packets into images and use deep convolutional neural networks (CNN) to extract features automatically and identify the network traffic. Specifically, we encode the IP header information and duration between the packets of a sequence of packets in a traffic session into a single labeled image. We then use CNN to train and test millions of images generated using this approach. A lot of research train and test the machine learning model on the same dataset which may not be able to work well on a different dataset. To test the effectiveness of our approach, we use datasets that come from multiple different sources. The accuracy and F1 scores show the proposed method provides accurate network traffic classification.

Gradient Reduction Convolutional Neural Network Policy for Financial Deep Reinforcement Learning

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Abstract - Building on our prior explorations of convolutional neural networks (CNNs) for financial data processing, this paper introduces two significant enhancements to refine our CNN model's predictive performance and robustness for financial tabular data. Firstly, we integrate a normalization layer at the input stage to ensure consistent feature scaling, addressing the issue of disparate feature magnitudes that can skew the learning process. This modification is hypothesized to aid in stabilizing the training dynamics and improving the model's generalization across diverse financial datasets. Secondly, we employ a Gradient Reduction Architecture, where earlier layers are wider and subsequent layers are progressively narrower. This enhancement is designed to enable the model to capture more complex and subtle patterns within the data, a crucial factor in accurately predicting financial outcomes. These advancements directly respond to the limitations identified in previous studies, where simpler models struggled with the complexity and variability inherent in financial applications. Initial tests confirm that these changes improve accuracy and model stability, suggesting that deeper and more nuanced network architectures can significantly benefit financial predictive tasks. This paper details the implementation of these enhancements and evaluates their impact on the model's performance in a controlled experimental setting.

Automatic Detection of Errors in LLM Large Benchmarks Using Frontier Model Consensus

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Abstract - The rapid advancement of Large Language Models (LLMs) has led to their widespread adoption in various academic and business applications. However, the reliability of these models remains a concern, particularly in situations where their outputs cannot be fully trusted. This paper presents a novel approach to identify potential errors in large LLM benchmarks through leveraging the consensus of frontier models. Our study focuses on the Massive Multitask Language Understanding (MMLU) benchmark, a popular dataset used to evaluate the performance of LLMs across a wide range of subjects.

Explainable AI for SQL Grading: A Practical Approach with Multi-Task CNNs

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Abstract - This study focuses on enhancing an automated SQL statement grading model by expanding the dataset and integrating Local Interpretable Model-agnostic Explanations (LIME) to improve explainability. By incorporating a significantly larger dataset, the model's ability to generalize across a variety of SQL queries has been enhanced, as demonstrated by improved performance metrics such as precision, recall, and F1 scores. The integration of LIME provides insights into the inference processes of the model, highlighting the influence of specific SQL components on assessment outcomes. These enhancements have practical implications, including more accessibility for users to understand the rationale behind model decisions, potentially leading to more effective learning experiences.

Driving Planner for Freight Trains Using Reinforcement Learning

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Abstract - The railway industry is crucial for a country's infrastructure, enabling the efficient transport of products over long distances at a lower cost. One of the main objectives of modern railway engineering is developing automatic train control systems to enhance operational efficiency and safety, save energy, and reduce costs. This paper proposes a planner capable of creating driving models for heavy haul trains on a real railway section, respecting speed limits without compromising travel time and fuel consumption. The planner was trained using a reinforcement learning algorithm called Deep Q-Network (DQN) and an analytical train driving simulator also developed in this work, which models the dynamic of a railway composition. Results show acceptable travel times but difficulty in respecting speed limits when the train stops at the end of the journey. Fuel consumption slightly increased compared to current standards, indicating the need to improve the DQN algorithm's reward function.

Fraud Detection Using Machine Learning Models and Encryption Techniques

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Abstract - In the era of increasing digital transactions and data exchange, safeguarding financial assets and data from fraudulent activities is a critical concern. Although existing algorithms, such as deep isolation forests, cryptoTree, XGBoost, and Convolutional Neural Networks, have shown success, they face challenges in achieving a commendable level of precision for encrypted data. This paper investigates the integration of Fully Homomorphic Encryption (FHE) into Logistic Regression and XGBoost models for credit card fraud detection, addressing a gap in existing literature. The results indicate that FHE does not significantly compromise model accuracy, with Logistic Regression and XGBoost achieving comparable accuracy on encrypted and unencrypted data. Real-world applicability is demonstrated using ULB and Vesta datasets. The findings contribute to the discourse on privacy-preserving machine learning, offering insights for secure credit card fraud detection.

Pruning and Optimizing Large Language Models in an Era of GPU Scarcity

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Abstract - The increasing computational and environmental costs associated with AI models, especially large language models (LLMs), highlight the urgent need for network optimization. These models consume vast amounts of energy and resources, requiring more efficient training strategies to balance performance with ecological responsibility. Our focus is on enhancing the efficiency of deep neural networks on embedded devices through novel pruning techniques: ”evolution of weights” and ”smart pruning.” These methods, compared to traditional pruning approaches using benchmark datasets, involve evaluating parameter importance during training to better preserve accuracy during compression. Our approach results in faster computations and higher compression rates with minimal accuracy loss. We have successfully applied these techniques to LLMs consisting of around 10 million parameters. The LLM experiment is publicly available on Github to facilitate replication testing.

Detecting Hallucinations in Large Language Model Generation: A Token Probability Approach

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Abstract - Concerns regarding the propensity of Large Language Models (LLMs) to produce inaccurate outputs, also known as hallucinations, have escalated. Detecting them is vital for ensuring the reliability of applications relying on LLM-generated content. Current methods often demand substantial resources and rely on extensive LLMs or employ supervised learning with multidimensional features or intricate linguistic and semantic analyses difficult to reproduce and largely depend on using the same LLM that hallucinated. This paper introduces a supervised learning approach employing two simple classifiers utilizing only four numerical features derived from tokens and vocabulary probabilities obtained from other LLM evaluators, which are not necessarily the same. The method yields promising results, surpassing state-of-the-art outcomes in multiple tasks across three different benchmarks. Additionally, we provide a comprehensive examination of the strengths and weaknesses of our approach, highlighting the significance of the features utilized and the LLM employed as an evaluator. We have released our code publicly at https://github.com/Baylor-AI/HalluDetect.

An Investigation of Methods for Improving Spatial Invariance of Convolutional Neural Networks for Image Classification

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Abstract - Convolutional Neural Networks are widely used for image recognition tasks. Data augmentation is a technique used to improve spatial invariance and reduce overfitting in Convolutional Networks. This article provides an empirical comparison of two common data augmentation techniques: RandAugment, (a stochastic technique that applies geometric transforms to images) and Conditional Generative Adversarial Networks (models that generate synthetic samples from the same distribution as the training set). Combinations of these data augmentation techniques are also investigated. Three models - a base model developed for this study, and finetuned pre-trained versions of ResNet50 and InceptionV3 - are evaluated on benchmark datasets. Results indicate that RandAugment is more effective.

Artificial Intelligence based Automatic Product Recognition for Toys Retail Stores

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Abstract - Automatic product recognition via product image scan has a positive impact for both economic and social progress is it faster than human based product identification and more reliable. Object recognition via images has become popular in the field of computer vision due to the great application prospect, such as automatic product checkout, goods management and stock tracking. As retail is evolving, companies are increasingly focusing on the integration of AI technology in the day-to-day activities of a retail store. The research study presented in this paper aims to investigate the use of deep learning models such as Convolutional Neural Network (CNN), ResNet50, and VGG16 to classify a large set of toy images representing items from a toys retail store. The performance of the three models investigated was analysed in terms of training accuracy, training validation, training loss, average runtime per epoch and test accuracy. The dataset contains over 21,000 toy images. The study consisted of two testing scenarios that used a 70:30 data split ratio and 80:20 ratio respectively, for training and testing. Both VGG16 model and ResNet50 module provided very similar accuracy results for both scenarios and outperformed the CNN model. However, a 9.3 % and 14.2% increase in the average runtime per epoch was observed in the 80:20 scenario for the VGG16 model and ResNet50 model respectively. Hence, it was concluded that the best runtime per epoch and accuracy was achieved when the data is split into 70:30 train test ratio and ResNet50 model produced the best results.

Exploring Data Augmentation and Stochastic Weight Averaging as an Alternative to Adversarial Training of Deep Neural Networks

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Abstract - Deep neural networks used for image classification are highly susceptible to adversarial attacks. The de facto method to increase adversarial robustness is to train neural networks with a mixture of adversarial images and unperturbed images, a method also known as adversarial training. However, this method leads to robust overfitting, where the network primarily learns to recognize one specific type of attack used to generate the images while remaining vulnerable to others after training. This study investigates whether combinations of state of the art data augmentation methods with Stochastic Weight Averaging improve adversarial robustness and diminish adversarial overfitting.

Bridging the Gap: The Sentiment of User Reviews and 5-Star Ratings

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Abstract - Customer reviews, encompassing both textual descriptions and star ratings, offer valuable insights into customer satisfaction with products and services. While sentiment analysis tools determine whether text is positive, negative, or neutral, their output often differs from the nuanced evaluations conveyed by user-provided star ratings. This mismatch poses a challenge when attempting to correlate sentiment analysis results with traditional star rating systems. This study aims to investigate the correlation between the sentiment in text reviews and their corresponding numeric star ratings. By examining the alignment between these two, we assess whether the sentiment of text reviews accurately resembles the corresponding user-assigned star ratings. Additionally, this research focuses on developing machine learning models to predict star ratings from textual reviews, offering a valuable tool for products or businesses on platforms that lack native rating systems.

Leveraging Data Augmentation and Large Language Models for Enhanced COVID-19 Tweet Classification

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Abstract - This study assesses the integration of Large Language Models (LLMs) with traditional machine learning techniques to classify COVID-19 related tweets, utilizing the lightweight Mistral model developed by AI21 Labs. Enhanced with word2vec-based data augmentation, class-defining attributes are generated dynamically, enabling the production of high-quality, contextually relevant text. This dual-model approach combines Mistral's preprocessing strengths with BERT and a Random Forest classifier to address themes such as vaccine, masks, quarantine, and social distancing effectively. The exploratory case study demonstrates that LLM labeling and strategic data augmentation can significantly improve accuracy on small datasets and offers a scalable solution for social media content analysis. The BERT model achieved a 94% accuracy with simple augmentation and 91% accuracy with advanced augmentation, while the Random Forest model showed lower performance, correctly classifying fewer examples. The study highlights the effectiveness of LLM-generated labels and advanced data augmentation, particularly with the BERT model, in enhancing classification accuracy, semantic relevance, and reducing uncertainty. Future research will focus on expanding data classification range, improving dynamically generated class attribute quality to improve model performance and capture of semantic complexity more comprehensively.

Taming Large Language Models for Healthcare - A Multi-Layered Guardrail System

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Abstract - This paper presents ongoing research on a novel framework for implementing robust safety guardrails in conversational AI systems powered by large language models (LLMs) for healthcare applications. We propose a multi-layered approach combining LLM-based classifiers, vector store matching, and dynamic prompt engineering to ensure safe and ethical interactions. Our system, designed to support patients with chronic conditions, demonstrates how LLMs can be effectively constrained to provide helpful information while avoiding potential risks. We describe the system architecture and guardrail implementation methodology. Preliminary results from our evaluation suggest the efficacy of this approach in maintaining safety without significantly compromising conversation naturalness. The research contributes to the ongoing discourse on responsible AI deployment in sensitive domains like healthcare.

Unleashing the Lifesaving Potential: A Deep Dive into Responsible AI Use

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Abstract - The integration of Artificial Intelligence (AI) technologies into firefighting supervision has emerged as a pivotal advancement, offering unparalleled opportunities for innovation and safety enhancement. This paper focuses on the application of AI in detecting the presence of firefighters in thermal imagery or realtime thermal camera footage. By leveraging AI-driven solutions for object detection, particularly in hazardous environments, the aim is to augment traditional firefighting practices with advanced technologies to optimize response efforts and ensure the safety of both responders and communities. Through a combination of real-time monitoring, predictive analytics, and decision support systems, AI holds the potential to revolutionize firefighting operations. This paper explores the challenges, opportunities, and implications of employing AI in firefighter detection, with a focus on enhancing operational efficiency and safety protocols.

A Review of Uncertainty Quantification in Convolutional Neural Networks

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Abstract - Convolutional Neural Networks (CNNs) are a fundamental architecture in deep learning, especially in computer vision. They excel in tasks like image classification and object detection. Still, despite their success, CNNs typically provide point estimates without quantifying uncertainty, which poses critical issues for safety-centric applications and model interpretability. This paper reviews various methods developed to quantify uncertainty in CNNs, including Bayesian Neural Networks, Monte Carlo Dropout, Deep Ensembles, Evidential Learning, Deterministic Uncertainty Quantification, Stochastic Weight Averaging-Gaussian, Spectral-normalized Neural Gaussian Processes, and Uncertainty-Aware CNNs. We discuss each method's principles, advantages, and limitations and highlight their applicability in real-world scenarios.

Induction of Association Rules Using Mapping and Sorting

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Abstract - Mining association rules in large transaction databases has been a very important, classic data mining research problem for more than three decades. The famous original Apriori algorithm uses the complicated hash-trees to compute the frequencies of the item list, which slows down the performance. In this paper we proposed a novel, faster mapping and sorting based approach to inducting association rules. By mapping the items to integer ID's and sorting each of the transactions by item ID's, the testing of whether a transaction contains an itemlist is greatly improved. Our simulations on real and synthetic datasets validated the efficiency of the new algorithm.

Automatic Labeling of Computer Vision Data Using Self-Supervised Learning

Abdulghani M. Abdulghani, Wilbur L. Walters, Khalid H. Abed
Jackson State University, Jackson, Mississippi, USA

Abstract - Data labeling is an essential setup preparing data for computer vision applications, especially for object detection and segmentation due to several reasons: time-consuming, mislabeling, large-scale data, imbalances between classes, and expertise with object categories. Addressing these challenges and finding efficient labeling strategies is crucial for advancing object detection and computer vision research. The aim of this work is to use a self-supervised learning model, the Grounding DistillationBased Image Navigation and Orientation (DINO) that belongs to Meta company to auto-annotate our data. The DINO model uses the knowledge of self-supervised learning to automatically generate labels for our objects in the dataset for object detection tasks. This self-supervised model reduced the time and complexity of labeling big-scale datasets and that will help to create a dataset for object detection and other computer vision tasks faster and easier. In the results section of this paper, we present how the DINO model could generate auto-labeling data for [Cars, Buses, Motorcycles, and Persons].

Object Detection and Counting Using Voice Recognition for Real-Time Human-Machine Teaming Tasks

Mokhles M. Abdulghani, Wilbur L. Walters, Khalid H. Abed
Jackson State University, Jackson, Mississippi, USA

Abstract - Computer vision technology has notably been an attractive area of research, and in this research, we have integrated voice recognition technology with its application in real-time. Object detection and classification is the most popular computer vision task that involves the identification and localization of objects within images or videos. It has a crucial contribution in various sectors, such the industry, healthcare, transportation, and military. Our objective is to implement YOLOv7, a popular object detection framework, to count specific object categories including Car, Bus, Motorcycle, and Person using human voice as input. Predesigned voice recognition algorithm was employed to convert the human voice to text. By capitalizing on the high accuracy and processing capabilities of YOLOv7, we have developed an efficient counting system that can analyze images and provide object counts for each category of interest. We have evaluated the performance of the system on diverse images taken from various angles, considering challenging scenarios such as occlusions and varying scales. The outcomes demonstrate the effectiveness and reliability of YOLOv7 in precisely counting instances of the specified object classes, even during nighttime and in crowded roads and highways from far distances. This methodology has the potential to be equipped for a drone to provide detecting and counting in an aerial photography view.

Object Detection and Counting Using YOLOV7 for Human-Machine Interaction Tasks

Abdulghani M. Abdulghani, Wilbur L. Walters, Khalid H. Abed
Jackson State University, Jackson, Mississippi, USA

Abstract - In the growth of the Human-Machine Interaction (HMI) discipline, it is essential to assess the human's experience to intervene with the given task for the autonomously navigated machine such as the unmanned aerial vehicles (UAVs). Object detection is a fundamental computer vision task that involves the identification and localization of objects within images or videos. It plays a critical role in various fields, such as object detection, tracking, and counting. Our objective is to implement the YOLOv7, a popular object detection framework, to count specific object categories, including Car, Bus, Motorcycle, and Person. By capitalizing on the high accuracy and processing capabilities of YOLOv7, we have developed an efficient counting system that can analyze images and provide object counts for each category of interest. We have evaluated the performance of the system on diverse images taken from various angles, considering challenging scenarios such as occlusions and varying scales. The outcomes demonstrate the effectiveness and reliability of YOLOv7 in precisely counting instances of the specified object classes, even during nighttime and in crowded roads and highways from high distances. This methodology has the potential to be equipped for a drone to provide detecting and counting in an aerial photography view.

Voice-Based Object Detection and Counting with Speaker Identity Verification for Human-Machine Interactions Tasks

Mokhles M. Abdulghani, Wilbur L. Walters, Khalid H. Abed
Jackson State University, Jackson, Mississippi, USA

Abstract - Computer vision technology has notably been an important area of research. In this research project, we have integrated voice recognition technology with its application in real-time. Object detection and classification is a popular computer vision task that involves the identification and localization of objects within images or videos. It has a crucial contribution in various sectors, such the industry, healthcare, transportation, and military. Our objective is to implement YOLOv7, a popular object detection framework, to count specific object categories including Car, Bus, Motorcycle, and Person using a human voice as input. Pre-designed voice recognition and voice signature recognition algorithms were employed to convert the human voice to a text command to be sent to the object detection and counting model while utilizing a speaker's identity verification before sending the text command. We have evaluated the performance of the system on diverse images taken from various angles, considering challenging scenarios such as occlusions and varying scales. The results demonstrate the effectiveness and reliability of YOLOv7 in precisely counting instances of the specified object classes, even during nighttime and in crowded roads and highways from far distances. This methodology has the potential to be used on drones to provide detecting and counting in an aerial photography view.

Performance Evaluation of Human-Machine Interaction for Safely Navigating Agent in Unity Environment

Abdulghani M. Abdulghani, Wilbur L. Walters, Khalid H. Abed
Jackson State University, Jackson, Mississippi, USA

Abstract - Advanced hardware and software systems can be employed to equip autonomous agents with the ability to explore their surroundings while minimizing the risk of collisions. Ensuring artificial intelligence (AI) safety is crucial to providing reliable service to consumers in various sectors, such as the military, education, healthcare, and automotive sectors. One way to increase the accuracy and performance of an AI agent is by guiding it in a specific environment through human intervention. This study presents the design of a system that can be controlled by two methods. The first method uses an AI controller with the proximal policy optimizer (PPO) algorithm to guide the agent automatically. The second method requires human interaction to guide the agent using keyboard inputs (manual controller). The Machine Learning Agents Toolkit (ML-Agents) was used to train the agent with a PPO algorithm with an intrinsic curiosity module (PPO+ICM). The objective of this study is to demonstrate the advantages and disadvantages of the two presented methods. We conducted both methods for ten minutes and measured the Goal (G), Collision (C), and GC-ratio or Goal (G) Collision (C) Ratio. The GC-ratio is a key metric for measuring the frequency of collisions between the agent and obstacles. The results show that the AI controlled method achieved 45 goals and 27 collisions, resulting in a GC-ratio of 0.66. On the other hand, the manually controlled method provided 30 goals and 6 collisions, resulting in a GC-ratio of 0.83. Each method has its own merits and limitations, and the decision to choose one over the other ultimately depends on the specific needs of the application.

Enhancing Smart Home Security: A Robust Voice Authentication Framework Using K-Nearest Neighbors on IoT Devices

Ajinkya Prabhu Jadhav, Sushanth S. Manakhari
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Abstract - In recent years, smart home technology has seen a significant surge in popularity, with smart speakers at the forefront of this technological revolution. These devices enhance everyday convenience by enabling users to control various home aspects, manage personal tasks, and access information through voice-activated interactions. Common functionalities include adjusting lighting, scheduling flights, and selecting music via voice commands. Despite their benefits, the widespread adoption of smart speakers has raised substantial privacy and security concerns. A primary issue is the lack of robust user authentication mechanisms, leaving these devices vulnerable to unauthorized access and control. To address these challenges, this project proposes a novel voice authentication system specifically designed for securing smart speakers. The system employs distinct wake-up words to activate and authenticate user interactions, thereby ensuring that only authorized users can access the functionalities of these devices. We conducted extensive testing of our prototype on standard hardware platforms such as laptops and Raspberry Pi, achieving an impressive 98% accuracy rate in recognizing and authenticating legitimate users. This paper discusses the development process, the technology underpinning our voice authentication model, and its potential for integration into existing smart speaker systems. Our results confirm the system's viability for real-world application, effectively mitigating critical privacy and security risks associated with current smart speaker technologies.

UAV-Assisted Car Accident Examination

Joud Faisal Al-Twaim, Adeem Turki Alotaibi, Lamyaa Nasser Alrayes,
Noura Ali Alhenaki, Lamees Alhazzaa
College of Computer Science and Information,
Al Imam Mohammad Ibn Saud Islamic University, Riyadh, Saudi arabia

Abstract - This review paper investigates the integration of (UAVs) in assisting car accident examination through the utilization of image processing techniques and the encryption of data stored in UAVs. Main reason we attempt to write this review paper is that we couldn't find any paper addressed these fields together, it is the first scholarly study specifically devoted to these topics. The paper addresses key questions including the proposed UAV-based solutions for car accident examination, the main advantages, and challenges of UAV adoption in this context, the current UAV applications in car accident examination, and the use of image processing techniques for examining car accidents. By integrating existing literature and research findings, this review aims to provide insights into the potential benefits and limitations of UAV-assisted car accident examination, as well as the role of image processing in enhancing data analysis and security within this domain.

Multimodal Insights: ImageBind Embedding Space Analysis in Auto Parts Online Marketplace Data Exploration

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Abstract - This study investigates ImageBind's ability to generate meaningful embeddings for marketplace data analysis, focusing on auto parts listings. We aim to capture the multimodal nature of these listings by fusing image and text data into a unified embedding. Principal Component Analysis (PCA) is used to reduce the embeddings' dimensionality, followed by k-means clustering and Uniform Manifold Approximation and Projection (UMAP) for visualization. The clusters, validated by analyzing posts nearest to each centroid, confirm ImageBind's effectiveness in discerning distinct characteristics of auto parts listings. Additionally, our initial findings with ImageBind's emergent zero-shot cross-modal classification suggest that pure audio embeddings can correlate with semantically similar marketplace listings, indicating potential avenues for future research.

Room Generation System on VR Space by Selecting Furniture According to User's Sensitivity

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Department of Intelligent Information Engineering and Science,
Doshisha University, Kyoto, Japan

Abstract - This research aims to create a room generation system on the VR space according to the user's sensibility. User sensitivity is expressed by adjectives such as “flashy” and “bright,” for example. Based on the user's sensitivity, we aim to generate a room in a VR space by selecting and placing furniture data that matches the user's sensitivity.

Leveraging Openflamingo for Multimodal Embedding Analysis of C2C Car Parts Data

Maisha Binte Rashid, Pablo Rivas
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Baylor University, Waco, Texas, USA

Abstract - In this paper, we aim to investigate the capabilities of multimodal machine learning models, particularly the OpenFlamingo model, in processing a large-scale dataset of consumer-to-consumer (C2C) online posts related to car parts. We have collected data from two platforms, OfferUp and Craigslist, resulting in a dataset of over 1.2 million posts with their corresponding images. The OpenFlamingo model was used to extract embeddings for the text and image of each post. We used k-means clustering on the joint embeddings to identify underlying patterns and commonalities among the posts. We have found that most clusters contain a pattern, but some clusters showed no internal patterns. The results provide insight into the fact that OpenFlamingo can be used for finding patterns in large datasets but needs some modification in the architecture according to the dataset.

Large Language Models Prompt Engineering: Principles and Techniques

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Abstract - As the field of Large Language Models has evolved radically in recent times, with the introduction of Transformers based LLMs, it has been realized that creating effective Prompts, also called Prompt Engineering, is the key to leveraging the full power of Language Models like GPT, Gemini, Llama, Mistral, etc. This paper explores core principles of Prompt design, the operations that Prompt Engineering provides, and various methods and techniques in Prompt creation, including Clarity, Specificity, Context Provision, Constraint Definition, Iterative Refinement, etc. We give an overview of each method or technique, its uses, and practical applications, and potential challenges in implementing them. It also discusses promising future developments and areas of further research.

Leveraging Deep Learning for Predictive Maintenance in Manufacturing

Tebasu Lisangi, Floribert Monga
LSG Consulting Group Inc., Toronto, Ontario, Canada

Abstract - We employ a deep convolutional neural network (CNN) architecture tailored to the unique characteristics of sensor data collected from manufacturing equipment. The model takes input from various sensors monitoring equipment conditions and uses multiple layers of convolution and pooling to automatically learn feature representations. Long Short-Term Memory (LSTM) networks are incorporated to capture temporal dependencies in the data, allowing us to make accurate predictions about equipment failures.

Articifial Intelligence in Africa

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Prairie View A & M University, Prairie View, Texas, USA;
Juliana King University, Houston, Texas, USA;
Department of Engineering Technology,
South Carolina State University, Orangeburg, South Carolina, USA

Abstract - Artificial Intelligence, a fast-evolving technology that taps the intelligence of machines, is transforming all social spheres globally. AI for Africa presents opportunities to put the continent at the forefront of the Fourth Industrial Revolution. Adopting and implementing AI in Africa could be significant if the focus becomes Africa-centered, nurturing local solutions to local challenges. It is essential that AI is adapted to the continent's interests, values, and cultures. Africa needs supportive policies and robust infrastructure to tap the limitless opportunities of AI. Africa can jump on the bandwagon of AI if they further unleash the potential of its young population in terms of innovation, creativity, and discovery. This paper examines the adoption of AI in African nations.

SESSION: XXIV Technical Session on Applications of Advanced AI Techniques to Information Management for Solving Company-Related Problems

Co-Chairs: Dr. David de la Fuente and Dr. Jose A. Olivas
University of Oviedo, Spain
University of Castilla - La Mancha, Spain

Enhancing Supply Chain Operations with Machine Learning Forecasts

P. Rodriguez, P. Gonzalez, M. Luna, B. Ponte
Escuela Politecnica de Ingenieria de Gijon, Campus de Viesques s/n, Gijon (Asturias), Spain

Abstract - TBA

Sovereign Road Funds: Leveraging Financing for Sustainable Infrastructure in Emerging Markets

J. Martinez, S. Fernandez-Vazquez, R. Rosillo, D. de la Fuente
Escuela Politecnica de Ingenieria de Gijon, Campus de Viesques s/n, Gijon (Asturias), Spain

Abstract – TBA

Some Examples of the Use of knowledge Engineering for a Better Exploitation of Massive Company Data

C. Vegega, F. Pollo-Cataneo, J. A. Olivas
GEMIS Research Team, National Techological University,
Regional Faculty Buenos Aires, Buenos Aires, Argentina

Abstract - TBA

Human-Centered Industry 5.0: Enhancing Supply Chain Resilience and Sustainable Practices

O. Leon, B. Kanat, J. Puente, I. Fernandez
Escuela Politecnica de Ingenieria de Gijon, Campus de Viesques s/n, Gijon (Asturias), Spain

Abstract - TBA

Train AI Architects Skills - Integrating the Talent of People and Machines to go Further in Applying JIDOKA and YOKOTEN in Operations

J. Costas, R. Pastor, C. Garcia, R. Pino
Escuela Politecnica de Ingenieria de Gijon, Campus de Viesques s/n, Gijon (Asturias), Spain

Abstract - TBA

The 20th International Conference on Data Science (ICDATA'24: July 22-25, 2024; Las Vegas, USA)

https://icdatascience.org/
https://www.american-cse.org/csce2024/

Predictive Analysis of Defense Language Proficiency Test Outcomes: A Comparative Study Using Neural Networks and Logistic Regression

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Air Force Institute of Technology, Wright-Patterson AFB, Ohio, USA

Abstract - Proficiency in foreign languages is crucial for effective global operations, and proficiency can be gained from training courses. In this work, we study the influence of various training courses by analyzing a 9,436-row dataset, including factors such as language, test timing, and their effect on an individual's language test performance. Both logistic regression algorithms and neural networks were employed to analyze the factors influencing language test scores. The key findings reveal that while the neural network model slightly outperformed the logistic regression model in terms of positive class recall (0.61 vs. 0.69), the logistic regression model is preferred due to its greater interpretability and generalizability. Notably, the logistic regression model identified higher initial reading scores and frequent testing as significant predictors of score improvement. Importantly, the logistic regression model achieved an accuracy of 78%, which significantly surpasses the trivial model's accuracy of 0.51. This study contributes to the field of predictive analytics in language proficiency and provides actionable insights for future research and policy-making in defense language programs. The interpretable logistic regression model can help inform the design of more effective language training courses and testing strategies to enhance global operations.

Artificial Intelligence Data Reduction Algorithm for Streaming Readout in High Energy Physics Experiment

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University of Genoa (Italy)

Abstract - New era of High Energy Physics experiments employing Streaming Readout techniques have to deal with very large amounts of data. This new approach is very challenging from the engineering point of view. Large detectors can easily eat up all the available bandwidth of the communication channel and key data could be lost. In this paper a Machine Learning approach for Data Reduction, an Autoencoder, is described and a low-cost hardware is built to implement it as a proof of concept. Different configurations of the autoencoder are implemented to study the tradeoff between model dimension, loss and inference time. In addition, a comparison with a standard lossless compression is made to highlight the benefit of the Artificial Intelligence supported algorithm.

User Behavior based Implicit Personality Detection in Recommendation Systems

Uzma Zubair Shaikh, Robert Chun
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Abstract - Recommendation systems are an integral part of any business, and a crucial factor in determining their success as these systems help businesses in marketing their products to the right kind of audience. Conventional methods of building recommendation systems such as collaborative filtering and content-based recommendation, although effective, suffer from limitations such as cold start and the data sparsity problems. Moreover, these methods aim at finding similar products as user's past interactions rather than personalizing the recommendations. The upsurge in use of social media, over-the-top content (OTT), and e-commerce platforms has made the task of personalizing recommendations imperative, leading to the advancement of an area of research called psychology aware recommendation systems. This paper first surveys the various ways in which these new types of systems incorporate concepts of psychology while making recommendations. We then propose a new way of incorporating personality information that centres around user behavior on a particular platform. People's personality traits are known to influence their behavior, hence a user's behavior on social media can be a good indicator of their personality. Users showing similar behavior can be deemed to prefer similar content. Our experimental results show that by identifying the right behavioral information to include in recommendations gives 21% performance gain over existing baseline systems.

DataDock: An Open Source Data Hub for Research

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University of South Carolina, Columbia, USA

Abstract - Every research project necessitates data, often requiring sharing and collaborative review within a team. However, there is a dearth of good open-source data sharing and reviewing services. Existing file-sharing services generally mandate paid subscriptions for increased storage or additional members, diverting research funds from addressing the core research problem that a lab is attempting to work on. Moreover, these services often lack direct features for reviewing or commenting on data quality, a vital part of ensuring high quality data generation. In response to these challenges, we present DataDock, a specialized file transfer service crafted for specifically for researchers. DataDock operates as an application hosted on a research lab server. This design ensures that, with access to a machine and an internet connection, teams can facilitate file storage, transfer, and review without incurring extra costs. Being an open-source project, DataDock can be customized to suit the unique requirements of any research team, and is able to evolve to meet the needs of the research community. We also note that there are no limitations with respect to what data can be shared, downloaded, or commented on. As DataDock is agnostic to the file type, it can be used in any field from bioinformatics to particle physics; as long as it can be stored in a file, it can be shared. We open source the code here: https://github.com/lxaw/DataDock.

An Application of Convolutional Neural Networks to Chaotic Systems

Jamal Rorie, Dean Lee, Andrew Sabater, Josh Duclos
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Abstract - We propose a novel method of analyzing dynamic systems for chaotic behavior using machine learning techniques. The study of chaos in dynamic systems often involves analyzing visual representations of data points generated by the systems. One method includes embedding one-dimensional time-series data into a two-dimensional space (a "pq diagram") as an interim step in the test for chaotic behavior. We study the application of a machine learning visual recognition model—a Convolutional Neural Network—on the pq diagrams generated in various systems and determine that they can be used to reliably differentiate chaotic and periodic systems from one another, and possibly to differentiate between different types of chaotic systems themselves.

Big Data Techniques in Mobile Cloud Networks for Healthcare: A Survey of Challenges, Opportunities, and Future Directions

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Abstract - The use of big data techniques in mobile cloud networks has the potential to revolutionize healthcare, but it also presents numerous challenges. This survey explores the current state of the field, including opportunities, limitations, and future directions. It analyzes various mobile cloud-computing technologies and their potential for healthcare applications. The survey also considers the challenges associated with collecting, storing, and analyzing large amounts of healthcare data, including security and privacy concerns. In addition, it discusses the potential benefits of big data techniques for personalized medicine, disease prediction, and prevention. Overall, the survey provides insights into the challenges and opportunities of implementing big data techniques in mobile cloud networks for healthcare and offers recommendations for future research directions.

Subgraph2vec: A Random Walk-Based Algorithm for Embedding Knowledge Graphs

Elika Bozorgi, Saber Soleimani, Sakher Khalil Alqaiidi,
Hamid Reza Arabnia, Krzysztof Kochut
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Abstract - Graph is an important data representation which occurs naturally in the real world applications. Therefore, analyzing graphs provides users with better insights in different areas such as anomaly detection, decision making, clustering, classification and etc. However, most of these methods require high levels of computational time and space. We can use other ways like embedding to reduce these costs. Knowledge graph (KG) embedding is a technique that aims to achieve the vector representation of a KG. It represents entities and relations of a KG in a low-dimensional space while maintaining the semantic meanings of them. There are different methods for embedding graphs including random walk-based methods such as node2vec, metapath2vec and regpattern2vec. However, most of these methods bias the walks based on a rigid pattern usually hard-coded in the algorithm. In this work, we introduce subgraph2vec for embedding KGs where walks are run inside a user-defined subgraph. We use this embedding for link prediction and prove our method has better performance in most cases in comparison with the previous ones.

Trust as a Classification Tool: Analyzing Collaboration in Senate Floor Speeches on Gun Legislation Post-Uvalde and Sandy Hook

William Ledbetter
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Purdue University, West Lafayette, Indiana, USA

Abstract - Valence measurement may be used to gauge feedback, yet a thorough understanding remains an ongoing pursuit, particularly when viewed through the emotional lens of trust. This research advances this perspective by showcasing its efficacy in classifying arguments about gun legislation, specifically in its successful alignment with legislative outcomes. The study conducts a comparative analysis of floor speeches by Senate members concerning gun legislation in the aftermath of the Sandy Hook and the Uvalde school shootings from 2013, 2014, and 2022. The examination reveals that terms associated with valence may serve as collaboration indicators. Notably, the valence showed a significant difference between the two means. This exploratory study is limited by a small sample size in the Uvalde and Sandy Hook debates (n=82 and n=62, respectively). Also, unbalanced representation in the speeches may restrict the broad generalization of the analysis. However, it does suggest further study utilizing resources such as those in the C-SPAN Video Archives.

Mobile Application for Conducting Time Series Analysis on Location-Based Spatial Data

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Department of Information Science,
University of North Texas, Denton, Texas, USA;
Wakeland High School, Frisco, Texas, USA

Abstract - Time series analysis and spatial data analysis allow us to analyze and understand how events and attributes of a place change over time. This paper presents the design and development of an innovative mobile application aimed at capturing, organizing, and analyzing location-based spatial data for performing time series analysis. The proposed mobile application is developed using the Unity framework and seamlessly integrates image capture, note-taking, GPS tracking, and a robust SQLite database, offering users a comprehensive memory management system. This work focuses on performing time series analysis techniques for detecting anomalous behavior in urban parking lots. The mobile application includes two modules: 1) Data Collection Module, and 2) Data Visualization Module. The data collection module allows users to add pins in the parking lot and collect data in text, audio, and video format for time series analysis. The data visualization module incorporates the time series analysis for data captured in the data collection module to provide meaningful insights, into the identification of recurring patterns in the parking lot.

Proactive Management of Delays in the French Railway Network: A Seasonal Machine Learning Based Approach

Prachi Mahajan, Paul Stynes, Cristina Hava Muntean
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Abstract - Transportation planning is a critical component of effective urban growth, but traditional methods which are relying on manual procedures such as set schedules, fixed travel routes, and on paper ticketing infrastructure have difficulty keeping up with real-time data and changing passenger demands. In contrast, by examining train delays, their causes and utilising machine learning models such as Support Vector Regressor (SVR), Artificial Neural Network (ANN), Random Forest (RF), Decision Tree (DT), this research paper aims to improve the effectiveness of the system. The study makes use of hyperparameter tuning, exploratory data analysis and model evaluation metrics like MSE, RMSE, R2. Using a dataset with transit records from the French transportation network, the investigated models predict delays caused by various factors with very good accuracy. A Power BI dashboard was created to allow meaningful data exploration and it acted as a useful decision support tool for optimising delay. The results show that ANN was the most effective model with R-squared value 0.95 which is a great performance in anticipating delays. This research outcome demonstrates ANN's strength and applicability for optimising proactive delay strategy in the challenging context of France railway system.

Real-Time AI Voice Clone Detection: A Deep Learning Approach to Safeguard Authenticity

Thaier Hayajneh, Cody Chen
Fordham University, USA

Abstract - TBA

Application of Transformer Models for Demand Forecasting in FMCG Industry

Vineeth Pydi, Liana Simopoulos, Nicholas Zimmerman,
Pratiksha Gupta, Nikolai Saporoschetz
Purdue University, USA

Abstract - TBA

Enhancing Financial Analysis with Generative AI: Utilizing Large Language Models for Efficient Data Extraction

Durga Madhab Dash, Matthew Lanham, Soham Agarwal,
Anto Fredric Henry Mohan Dass, Sai Bheeshma Ramaraju Pagilla,
Chaitanya Varma Sanaboina, Ashwin Mishra
Purdue University, USA

Abstract - TBA

LLM-Powered OLAP: Tackling High level Business Questions

Ainesh Panda, Fatemeh Sarayloo, Pragya Arora, Nithin Gowda,
Chun Hung Lin, Ayushi Gaur
University of Illinois at Chicago, USA

Abstract – TBA

Scalable Image Search Engine

Fatemeh Sarayloo, Adharsh Madhusudan Madhusudan, Kushal Adity,
Ming-Jen Chang, Siji Adisa, Vinay Khandelwal
University of Illinois at Chicago, USA

Abstract – TBA

CNN to BiLSTM: Enhancing Setswana Named Entity Recognition

Shumile Chabalala, Pius Owolawi, Sunday Ojo
Tshwane University of Technology, South Africa

Abstract – TBA

SynthFair: Ensuring Subgroup Fairness in Classification via Synthetic Data Generation

Begum Hattatoglu, Abdulhakim A. Qahtan, Heysem Kaya, Yannis Velegrakis
Utrecht University, Netherlands

Abstract – TBA

Enhancing Security with Automated Boom Gate Access through License Plate Recognition utilising YOLOv8 Model

Christine Asaju, Pius Owolawi, Chunling Du, Etienne Van Wyk
Tshwane University of Technology, South Africa

Abstract – TBA

Dual-Approach Interpretations of Bailout Strategies in the Eisenberg-Noe Model

Jiashan Wu, Zhiqian Chen
Mississippi State University, USA

Abstract – TBA

Assessing the Impact of Homelessness on COVID-19 Hospitalization Rates in Patients with Underlying Medical Conditions through Explainable AI

J. M. Imtinan Uddin, Yingfeng Wang, Hong Qin, Hayden Hall, Jessica Long, Connor Kimbrell, Isabel Obrien, Sudave Mendiratta, Patrick Koo
University of Tennessee at Chattanooga, Tennessee, USA

Abstract – TBA

FIONA: Detecting Syntactical Outliers in Attributes with Categorical Values

Abdulhakim A. Qahtan, Thanos Tsiamis
Utrecht University, Netherlands

Abstract – TBA

Leveraging Ensemble Learning Paradigms for B2B E-Commerce Fraud Detection

Sai Kiran Reddy Malikireddy, Subhayan Roy, Shivani Fnu, Tanvi Bagwe, Rewati Ovalekar
Walmart, USA

Abstract – TBA

Protecting the Whisper: A Security Assessment of Amazon CodeWhisperer's Generated Code

Thaier Hayajneh, Gabriel Araujo
Fordham University, USA

Abstract – TBA

TGAIN: Missing Data Imputation for Mixed-Type Relational Datasets using Generative Adversarial Networks

Ouassim Bannany, Abdulhakim A. Qahtan
Utrecht University, Netherlands

Abstract – TBA

Generative AI Techniques for the Simulation of Groundwater Well Data at Hanford Site

Fabiola Rivera Noriega
Florida International University, Florida, USA

Abstract – TBA

Comprehensive Analysis and Detection of Fraud Schemes on the Ethereum Blockchain Using Machine Learning

Thaier Hayajneh, Kayla Ramdass, Maria Chano, Mohamed Rahouti
Fordham University, USA

Abstract – TBA

Predicting NVIDIA's Next-Day Stock Price: A Comparative Analysis of LSTM, MLP, ARIMA, and ARIMA-GARCH Models

Yiluan Xing, Chao Yan, Cathy Chang Xie
Indiana University Bloomington, Indiana, USA

Abstract – TBA

Generative AI use in One Health, One System as Healthcare is Global

Muhammad Abdul Basit Ur Rahim, Atif Farid Mohammad
California State University Long Beach, California, USA

Abstract – TBA

Generating Culturally Appropriate Avatars

Zeeshan Gilani
Purdue University, USA

Abstract – TBA

Exploring Equity: Integrating Knowledge Graphs in Fairness Testing Methodologies

Jonathan Dabu, Muhammad Abdul Basit Ur Rahim, Muhammad Abid, Shahid Hussain
California State University Long Beach, California, USA

Abstract – TBA

Application of Data Science Techniques to Performing Arts

Toshiyuki Maeda, Masumi Yajima, Akiyoshi Wakatani
Hannan University, Japan

Abstract – TBA

NLP-Guided Synthesis: Transitioning from Sequential Programs to Distributed Programs

Arun Sanjel, Greg Speegle, Bikram Khanal, Pablo Rivas
Baylor University, Waco, Texas, USA

Abstract – TBA

Explainable Machine Learning Approach for Intelligent Edits of Medicaid Home Healthcare Services Claims

Ephina Thendral Surendranath
Conduent Inc., USA

Abstract – TBA

Leveraging NLP and Large Language Models for Clinical Documentation Improvement: A Medical AI Chatbot Approach

Bhavraaj Singh, Atif Farid Mohammad, Muhammad Abdul Basit Ur Rahim
California State University Long Beach, USA

Abstract – TBA

SESSION: Real-World Data Mining Applications, Challenges, and Perspectives

Chair: Dr. Mahmoud Abou-Nasr (Adjunct Faculty: Computer & Information Systems Department, University of Michigan Dearborn, USA)

Transforming Hurricane Intensity Prediction: Leveraging Transformers for Enhanced Forecasting Accuracy

Rose Atuah, Michael McGuire, Khalil Ibrahim Almakrami, Qianlong Wang
Towson University, USA

Abstract – TBA

SSSDAD: Structured State Space Diffusion Anomaly Detection in Industrial Time Series Data

Manuel Hirth, Daniel Meier, Nasser Jazdi, Johann-Friedrich Luy, Enkelejda Kasneci
Technical University of Munich, Germany;
Daimler Truck, Germany

Abstract – TBA

AuthAttLyzer-V2: Unveiling Code Authorship Attribution using Enhanced Ensemble Learning Models and Generating Benchmark Dataset

Arash Habibi Lashkari, Sepideh Hajihosseinkhani
York University, Canada

Abstract – TBA

Harnessing LLMs to Build an Autonomous Marketing Agent

Abithaa Shree Venkatesh, Ann Mathew, Monika Madugula, Nagraj Deshmukh,
Pratik Mahesh Merchant, Matthew Lanham
Purdue University, USA

Abstract – TBA

Government Contracts in Pandemic Era: A Comprehensive Impact Analysis Using Predictive Analytics

Fatemeh Sarayloo, Nabila Fakhruddin, Sunaina Tarimela, Vojtech Mensik,
Aarsh Vyas, Jahnavi Gulabani
University of Illinois at Chicago, USA

Abstract – TBA

The 3rd International Conference on Emergent Quantum Technologies (ICEQT'24: July 22-25, 2024; Las Vegas, USA)

https://baylor.ai/iceqt/
https://www.american-cse.org/csce2024/

Learning Robust Observable to Address Noise in Quantum Machine Learning

Bikram Khanal, Pablo Rivas
Department of Computer Science, Baylor University, Waco, Texas, USA

Abstract - Quantum Machine Learning (QML) has emerged as a promising field that combines the power of quantum computing with the principles of machine learning. One of the major challenges in QML is dealing with the presence of noise in quantum systems, especially in the Noisy Intermediate-Scale Quantum (NISQ) era. Noise in quantum systems can introduce errors in quantum computations and degrade the performance of quantum algorithms. In this paper, we propose a framework for learning observables that are robust against noisy channels in quantum systems. We demonstrate that it is possible to learn observables that remain invariant under the effects of noise, and we show that this can be achieved through a machine-learning approach. We present a toy example to illustrate the concept of robust observables and then describe a machine-learning framework for learning such observables. Our results show that it is possible to learn observables that are more robust to noise than conventional observables, and we discuss the implications of this finding for quantum machine learning. By developing techniques for learning robust observables, we can enhance the performance and reliability of quantum machine learning models in the presence of noise.

Methodology to Accelerate Defense and Federal Agency Adoption of Quantum Technologies

James Hornage
Capitol Technology University, Maryland, USA

Abstract - Current federal approaches to accelerating quantum adoption were designed prior to the broad implementation of modern technologies such as cloud computing and machine learning. The impact of increased expenditures in quantum computing research may be negated by slow adoption. A research-based approach that incorporates lessons learned from recent technology adoption challenges has the potential to dramatically improve quantum adoption rates.

Federal Cloud Computing Adoption Case Study: A Retrospective Analysis as a Precursor to Optimized Quantum Adoption Methodologies

James Hornage
Capitol Technology University, Maryland, USA

Abstract - Slowed federal adoption of cloud computing was due to a combination of major changes in information technology (IT) ecosystem and the lack of a new model to address adoption challenges in the evolving environment. Since cloud computing adoption is still ongoing, the federal government continues to focus on the steps necessary to move the government forward from a state of partial adoption. This paper analyzes the government approach to cloud computing adoption to identify changes that can be implemented to optimize quantum computing adoption. The research found that evolving cloud definitions, required governance changes, cloud workforce competition, competing enterprise requirements, and contracting approach issues were the primary adoption impediments.

Integrating Secure Quantum Digital Signature into Quantum Communications

Ahmad O. Hijaz, Ibrahim Yakubu, Jinsuk Baek
Department of Computer Science,
University of North Carolina Greensboro, North Carolina, USA;
Department of Computer Science, Winston-Salem State University,
North Carolina, USA

Abstract - We propose a quantum digital signature scheme to enhance security and ensure non-repudiation within quantum communications. Our scheme is designed to integrate seamlessly with the key protocols for efficient data transmission in quantum systems including quantum teleportation and superdense coding. By coupling the inherent security features of quantum communication with our scheme, we present an innovative approach that significantly bolsters the reliability and trustworthiness of quantum information exchange, marking a step forward in the quest for invulnerable quantum communication networks.

Evaluating Cost-Effective Reconfigurable Hardware for Quantum Simulation

Ishraq Islam, Vinayak Jha, Alvir Nobel, David Levy,
Manu Chaudhary, Dylan Kneidel, Esam El-Araby
University of Kansas, USA

Abstract - TBA

An Efficient Quantum Solver for Multidimensional Partial Differential Equations

Manu Chaudhary, Ishraq Islam, David Levy, Alvir Nobel,
Dylan Kneidel, Vinayak Jha, Esam El-Araby
University of Kansas, USA

Abstract - TBA

Optimizing Depth of Quantum Circuits for Generating GHZ States

Nishitha Reddy venkannagari, Varun teja Puram, Johnson Thomas
Oklahoma State University, Oklahoma, USA;
Northeastern State University, USA

Abstract – TBA

A Comparative Analysis of Hybrid-Quantum Classical Neural Networks

Kamila Zaman, Tasnim Ahmed, Muhammad Abdullah Hanif,
Alberto Marchisio, Muhammad Shafique
New York University Abu Dhabi, United Arab Emirates (UAE)

Abstract - TBA

NRQNN: The Role of Observable Selection in Noise-Resilient Quantum Neural Networks

Muhammad Kashif, Muhammad Shafique
New York University Abu Dhabi, United Arab Emirates (UAE)

Abstract - TBA

Studying the Impact of Quantum-Specific Hyperparameters on Hybrid Quantum-Classical Neural Networks

Kamila Zaman, Tasnim Ahmed, Muhammad Kashif, Muhammad Abdullah,
Alberto Marchisio, Muhammad Shafique
New York University Abu Dhabi, United Arab Emirates (UAE)

Abstract - TBA

Eclipse Qrisp QAOA: Description and Preliminary Comparison with Qiskit Counterparts

Eneko Osaba, Matic Petric, Izaskun Oregi, Raphael Seidel,
Alejandra Ruiz, Michail-Alexandros Kourtis
Tecnalia, Spain;
Fraunhofer Institute for Open Communication Systems (FOKUS), Germany;
National Centre for Scientific Research Demokritos, Greece

Abstract - TBA

The 25th International Conference on Internet Computing & IoT (ICOMP'24: July 22-25, 2024; Las Vegas, USA)

https://american-cse.org/csce2024/conferences-ICOMP
https://www.american-cse.org/csce2024/

Towards Objective Comparison of Security Algorithms for Resource-Constrained IoT Devices

Marten Fischer, Ralf Tonjes
Hochschule Osnabruck, Osnabruck, Germany;
University of Applied Sciences Osnabruck, Osnabruck, Germany

Abstract - Networked sensors are strategically deployed to gather real-world data, thereby facilitating the implementation of cutting-edge technologies like the Internet of Things (IoT) and Cyber Physical Systems (CPS). These devices, tailored to specific use-cases, often operate under strict resource constraints and must function optimally for extended periods. Concurrently, the sensitive data they collect must be safeguarded against unauthorized access, necessitating robust security measures. A range of security mechanisms is available to IoT system designers, with cryptographic algorithms, such as symmetric and asymmetric encryption, and hash functions being the cornerstone. They can select from multiple algorithm implementations and adjust configuration parameters to suit the device's capabilities. However, determining the ideal configuration is a complex task, requiring a balance between security effectiveness and efficient resource utilization. While the security aspect is continually assessed by experts, the impact of these choices on resource consumption, particularly across diverse platforms, often receives less attention. This paper introduces an objective evaluation method that assesses not only the effect of different security algorithms, but also various implementations and configuration adjustments on the resource consumption across different platforms. To facilitate this, a composite performance indicator is computed, enabling the systematic ranking of candidate configurations. The approach bridges the gap in understanding the interplay between security measures and resource management in the realm of IoT devices.

Malware Detection in the IoT Home Network

Haydar Teymourlouei, Daryl Stone
Department of Technology & Security,
Bowie State University, Bowie, Maryland, USA

Abstract - The recent development of Internet of Things (IoT)-based networks, devices, and applications has led to concerns regarding the security of such technology. In particular, IoT networks set up in a home (smart homes) can be vulnerable to cyber threats due to a lack of security measures, such as secure passwords. This research proposes to secure IoT home networks from cyber threats by identifying irregularities in network protocols, a common indicator of malicious activity. Three methods are used for this task. The first is real-time monitoring of network protocols using time series analysis. The second uses network protocol data as inputs to machine learning algorithms, which are tasked with detection of malicious activity. The third approach uses an IoT-custom firewall to block access to IoT devices from irregular network traffic. The approaches are each demonstrated on network traffic datasets, including CICIoT2023. The results show the machine learning algorithms can detect malicious activity with over 95% accuracy. The custom firewall is shown to block HTTP requests. In the future it is possible to expand the real-time monitoring with more sophisticated outlier detection methods, such as autoencoders.

Understanding User Interactions with IoT Process Models: A Demographic Perspective

Michael Winter, Yusuf Kirikkayis, Rudiger Pryss, Manfred Reichert
Institute of Clinical Epidemiology and Biometry, University of Wurzburg, Germany;
Institute of Medical Data Science, University Hospital of Wurzburg, Germany;
Institute of Databases and Information Systems, Ulm University, Ulm, Germany

Abstract - The rapid integration of the Internet of Things (IoT) into business processes has underscored the necessity of developing IoT process models that are both functional and user-friendly. This survey investigated how users from varied demographic backgrounds perceive and interact with IoT process models, focusing on visual clarity, distinguishability, and cognitive challenges. Utilizing a sample size of n = 249 individuals, the research analyzed interactions with two distinct IoT process models, each embodying unique IoT integration features such as sensors, actuators, and IoT-specific tasks. The findings highlight the importance of design in enhancing user experience and suggest to consider the interplay between demographic factors and model design. The insights offer guidance for the creation of future IoT process models, emphasizing the importance of inclusivity and the ability to adapt to the changing requirements of users within the IoT environment.

Re/Imagining Smart Home Automation Framework in the era of 6G-Enabled Smart Cities

Byungkwan Jung, Suman Kumar, Adityasinh Manthansinh Chauhan
Department of Computer Science, Troy University, Troy, Alabama, USA

Abstract - Smart home automation systems represent a seamless integration of Internet of Things technologies, facilitating the monitoring, management, and regulation of various aspects of our daily life. By leveraging advancements in communication, computing, sensing, and actuator technologies, they hold promises for enhancing the living experience. However, they face challenges such as the need for timely updates, efficient data management, real-time Big data processing, robust security measures, and advanced analytics. In this paper, we propose a novel framework that capitalizes on the capabilities of 6G networks and 6Genabled cloud computing to address these challenges and improve the overall landscape of smart cities. This framework features enhanced security, data pre-processing, big data intelligence, and security service virtualization in the cloud. Through various application scenarios and a case study—focusing on safe routing during disasters, we demonstrate the utility of this framework and the critical role 6G networks and 6G-enabled cloud computing play in smart home automation.

Advancing IoT Process Modeling: A Comparative Evaluation of BPMNE4IoT and Traditional BPMN on User-Friendliness, Effectiveness, and Workload

Michael Winter, Yusuf Kirikkayis, Rudiger Pryss, Manfred Reichert
Institute of Clinical Epidemiology and Biometry, University of Wurzburg, Germany;
Institute of Medical Data Science, University Hospital of Wurzburg, Germany

Abstract - In the evolving Internet of Things (IoT) landscape, integrating advanced technologies into business processes has become crucial for enhancing efficiency and automation. Accurate representation of IoT within business processes is a prerequisite for leveraging automation and monitoring benefits, underscoring the limitations of Business Process Model and Notation (BPMN) 2.0 in effectively capturing IoT-specific behaviors. For this reason, this study investigated the enhancement of IoT business process modeling through BPMNE4IoT, an extension of the standard BPMN 2.0, focusing on its user-friendliness, effectiveness, and workload compared to traditional BPMN. The comparative user study with 30 participants demonstrated that BPMNE4IoT significantly improves the modeling experience, reducing mental and physical strain and increasing satisfaction. These findings support the importance of user-centered design in IoT modeling tools to enhance productivity and foster adoption, highlighting the need for further investigation into the impact of features and scalability within complex IoT environments.

IoT-based Analysis of Environmental and Motion Data for Comfort and Energy Conservation in Optimizing HVAC Systems

Badmus Abdulwaheed, Ken McGarry, David Baglee, Neil Eliot
School of Engineering, Faculty of Technology, University of Sunderland, UK;
School of Computer Science, Faculty of Technology,
University of Sunderland, UK

Abstract - Growing energy consumption from campus infrastructure including lecture halls that run heating, ventilation and air conditioning (HVAC) systems motivates data-driven optimization. This research demonstrates an integrated application of Internet of Things (IoT) sensors and cloud-hosted predictive data analytics to enable smart lecture room policies improving efficiency and sustainability. A Raspberry Pi Pico W IoT device was interfaced with BME680 sensor for temperature, humidity and air quality data. The device also incorporated a PIR sensor for occupancy detection and Wi-Fi connectivity to transmit multivariate time series data. The prototype was installed in a university lecture room for real-time data capture. Data was directed to a cloud analytics pipeline including MySQL storage and Node-RED for preprocessing. Time series forecasting was conducted by training autoregressive integrated moving average (ARIMA), Prophet and machine learning models on historical data to predict temperature, occupancy levels, and usage patterns 24 hours into the future. An interactive dashboard visualized both real-time streams and model forecasts using Grafana for analytical insights.

Collaborative Federated Learning Cloud Based System

Partha Pratim Saha, Naresh K. Sehgal, Miad Faezipour
Wipro Technologies Limited, Pune, Maharashtra, India;
Deeply Human AI, Inc., Santa Clara, California, USA;
Purdue University, School of Engineering Technology,
Electrical & Computer Engineering Technology, West Lafayette, Indiana, USA

Abstract - Machine learning is deployed in various clinical and healthcare informatics applications, with centralized and decentralized learning schemes, each offering performance and security advantages and disadvantages. In centralized machine learning, all the data travel through a central location where the machine learning training code runs on it. A central server potentially represents a single point of failure - which is one of the issues of centralized learning. Another issue is the need for all participants to trust the central authority with their datasets. In a decentralized machine learning solution, data stays at the participating local sites, while the machine learning training code travels to each site. It needs parties to run a common binary code on each of their datasets and trust the incoming program, thus avoiding a single point of failure, but potentially creating a security hazard with malicious code. This can be addressed by using a mutually agreed upon signed binary code. Another issue is the training run time in decentralized learning due to multiple hops between different dataset locations. System designers often face tradeoffs between the higher performance of centralized machine learning vs. the better security of decentralized machine learning. In this work, we propose a novel Collaborative Federated Learning (CFL) solution that combines the advantages of centralized and decentralized machine learning schemes, without compromising security. We executed our simulation using synthetic data for 30 iterations to observe the behavior of code and dataset sizes with various incremental data sharing options. Interestingly, we observed that when more data is shared centrally, data security issues become more pervasive, however, machine learning training performance improves proportionally. The challenge is to balance between performance and security considerations by partitioning appropriate amount of data to be shared centrally.

DRIVE: A Mobile Application for Directed, Remote, Interactive Viewing and Exploring

Sonya Cates, Rudolph Desanti, Roderick Ramirez, Kyle Witham
School of Engineering Computing and Construction Management,
Roger Williams University, Bristol, Rhode Island, USA

Abstract - Technologies to support remote interaction hold great potential to expand opportunities for engagement and interaction. In this work, we present a mobile application to allow remote exploration of an environment by those who cannot be physically present due to geographic or mobility limitations. Our system is designed to place control of the experience with the audience or viewer to encourage greater engagement with the remote environment. After presenting the application, we discuss how the application will be used and tested in realistic contexts and present future extensions to create a more immersive experience.

An Edge Computing Architecture for Autonomous Vehicles

Hassan Rajaei, Sai Anusha Kodali, Niharika Mulinti
Department of Computer Science,
Bowling Green State University, Bowling Green, Ohio, USA

Abstract - The development of autonomous vehicles has been a hot topic in recent years, and the integration of 5G technology and edge computing with powerful processors like the Intel Xeon 4th Gen is expected to elevate the performance of smart car systems to the next level. This paper proposes a Vehicle Edge Computing architecture for integrating Intel Xeon 4th Gen processors into autonomous cars and explores the potential benefits of using these cutting-edge technologies in smart cars. The proposed architecture aims to enable fully autonomous vehicles through the integration of advanced Information and Communication Technologies. One of the key challenges in developing autonomous vehicles is ensuring real-time communication with other vehicles and infrastructure. This is addressed by leveraging 5G networks and edge computing, allowing autonomous vehicles to make high-speed decisions based on real-time information. To meet the demand for quick processing, fast processors like the recently launched Intel Xeon 4th Generation are essential. Such high-speed processing power is crucial for the advancement of self-driving cars, as these processors are designed to handle large amounts of data and perform complex calculations quickly and efficiently. This is particularly important for autonomous vehicles, which rely on processing vast amounts of data from sensors and cameras in real-time to navigate the road.

Harnessing Social Robotics and the Internet Of Things to Reduce the Risk of Older Adults Developing Hypothermia and Dehydration

Hani Sindi, Rachel McCrindle
Biomedical Engineering, University of Reading, Reading, UK

Abstract - Many older adults are at risk of developing hypothermia or becoming dehydrated, both of which can be dangerous conditions requiring hospitalization. This paper describes the development and evaluation of a novel support system, Hypothermia and Dehydration Advising Companion (HyDeAdCo), that integrates a social robot with off-the-shelf technologies within an IoT infrastructure, to help reduce the risk of older adults becoming hypothermic or dehydrated.

Smart Roadway Monitoring: Pothole Detection and Mapping via Google Streetview

Shazab Ali, Meng Xu, Daehan Kwak
Department of Computer Science and Technology,
Kean University, Union, New Jersey, USA

Abstract - Potholes pose significant financial and safety hazards to motorists worldwide, emphasizing the demand for innovative solutions for detection and repair. Conventional methods, reliant on manual inspection and patching, prove to be inefficient and unsustainable, prompting the need for automated detection systems. However, merely expediting the patching process does not address the underlying issues that cause the potholes in the first place. This paper introduces a pothole detection and mapping system over Google Streetview, utilizing highly effective learning models and Google Map's APIs. Our system extracts images along specified routes from the Google Streetview API, processes them using a detection model, and plots the results on an interactive map. Additionally, it compiles these findings into a video that simulates a drive along the route. By leveraging deep learning techniques, we provide users with valuable insights into road conditions, facilitating proactive maintenance strategies. The evaluation demonstrates a high classification accuracy and sensitivity in pothole detection. Additionally, the system's capacity to analyze data over time enables municipalities to identify and pinpoint persistent pothole-prone areas, paving the way for targeted interventions to prevent future hazards. Future work includes expanding the dataset and developing a user-friendly interface to enhance the system's capabilities and usability. Our system offers a promising solution for long-term pothole repair and maintenance, contributing to safer and more sustainable transportation infrastructure for communities around the world.

Towards Implementation of Privacy-preserving Federated Learning Aggregation using Multi-key Homomorphic Encryption

Svetlana Boudko
DART, Norwegian Computing Center, Oslo, Norway

Abstract - Federated Learning is a machine learning approach where a model is trained across multiple decentralized edge devices. Since the data are not uploaded to a server, this approach is particularly useful for data protection and efficient computation. Further, it can be combined with privacy-preserving technologies, e.g., homomorphic encryption for enhanced data protection. Considering all these elements, a practical solution will require an efficient multikey homomorphic encryption as well as an effective integration of federated model aggregation and multikey generation processes. The paper studies the related work for homomorphic encryption in the context of federated learning and outlines the rationale behind practical design of secure federated learning.

Advancing Nursing Education through Virtual Reality Training: A Revolutionary Approach to Ensuring Patient Safety

Sai Lokesh Reddy Gayam, Jiaofei Zhong
Department of Computer Science,
California State University East Bay, Hayward, California, USA

Abstract - Ensuring patient safety is a primary concern in the healthcare industry, and nursing education plays a vital role in providing future professionals with the necessary skills to identify potential risks. Traditional training methods often lack the immersive and interactive experience that students need. In this paper, we proposed and implemented a Virtual Reality (VR) application as an educational tool to help students learn the best clinical practices they should follow in a hospital setting. This application created a 360-degree VR environment for the simulation lab, where the user needs to identify unsafe clinical practices in this virtual environment. By leveraging cutting-edge VR technology, students can engage with virtual hospital scenes in a controlled and risk-free setting, allowing them to develop a deeper understanding of potential hazards and unsafe practices through the VR training application.

Energy-Efficiency Modeling for AI Applications on Edge Computing

Vamsi Krishna Bhagavathula, Xian Gao, Yi Zhou, Rania Hodhod, Lixin Wang
TSYS School of Computer Science,
Columbus State University, Columbus, Georgia, USA

Abstract - As artificial intelligence (AI) applications become more common on the edge of networks, such as Raspberry Pi servers, optimizing their energy use is crucial. This research project investigates how AI algorithms affect the energy efficiency and resource usage of Raspberry Pi servers. Two models were created: one predicts resource usage, and the other predicts the power consumption of AI algorithms on Raspberry Pi. Several factors are considered, including CPU and memory use, algorithm speed, dataset size, and types of algorithms and datasets. Using regression-based methods, we model how these factors affect energy use. By converting categorical factors into numerical ones, we develop models that describe the relationship between these factors and energy use on Raspberry Pi. This research contributes practical tools that enable developers to assess the energy impact of AI deployments on edge servers, offering unique insights not readily available through solely profiling-based approaches. Our work facilitates the scheduling of AI applications on edge servers for energy efficiency without compromising performance.

Optimizing Wireless Sensor Network Node Placement Using Bacterial Foraging Optimization

Piyush Rawat, Naga Raghuram Chinnapurapu, Tiansheng Yang, Rajkumar Singh Rathore
Faculty of Engineering and Technology ITER, Siksha "O" Anusandhan
(Deemed to Be University), Bhubaneswar, India;
School of Computer Science, UPES, Dehradun, Uttarakhand, India;
Department of Electronics and Communication Engineering,
Velagapudi Ramakrishna Siddhartha Engineering College,
Vijayawada, Andhra Pradesh, India;
University of South Wales, Pontypridd, UK;
Cardiff School of Technologies, Cardiff Metropolitan University,
Llandaff Campus, Cardiff, UK

Abstract - This paper investigates the application of Bacterial Foraging Optimization (BFO) for optimizing node placement in Wireless Sensor Networks (WSNs). Efficient node placement is crucial for enhancing network coverage, connectivity, and energy efficiency. BFO, inspired by bacterial foraging behavior, is particularly suited for this task due to its ability to adaptively explore and exploit search spaces. The study compares BFO against traditional optimization methods like Genetic Algorithms (GA) and Particle Swarm Optimization (PSO), highlighting its superior performance in achieving optimal node configurations. Experimental results demonstrate significant improvements in coverage, connectivity, and energy consumption metrics, validating BFO as an effective tool for optimizing WSN deployments. This research contributes insights into leveraging BFO for enhancing WSN performance and identifies avenues for further exploration in dynamic and large-scale deployment scenarios.

The Vital Role of Small and Marginal Farmer in Future of our Climate: Democratization of Machine Learning, Artificial Intelligence, and Dairy Cow Necklace Sensors in Achieving the UN Climate Change Goals (COP21) and the Paris Agreement

Chandrasekar Vuppalapati, Anitha Ilapakurti, Sandhya Vissapragada,
Vanaja Mamidi, Sriya Vuppalapati, Akshay Vuppalapati, Sharat Kedari,
Santosh Kedari, Jaya Vuppalapati, Karthik Kallakur, Koduru Rajasri, Narendra Lella
Computer Engineering (CMPE Department),
San Jose State University, San Jose, California, USA;
Hanumayamma Innovations and Technologies, Inc., Fremont, California, USA;
Hanumayamma Innovations and Technologiesa PVT Limited, Hyderbad, India

Abstract - The study demonstrated that improving dairy cattle health by reducing methane emissions is economically and sustainably advantageous to small farmers, rural economies, and the global climate overall.

Soft Actor Critic based End-to-End QoS Path Selection in Multi-Domain SDN Environments

Gyumin Lee, Junghyun Lim, Byeong-hee Roh
AI Development Team, Webzen Inc., Seongnam, South Korea;
Department of AI Convergence Network, Ajou University, Suwon, South Korea

Abstract - Software Defined Networking (SDN) uses an architecture that is vertically separated into a control plane, a data plane, and an application plane. Though research has been conducted to apply reinforcement learning methods for path selections in SDN environments, they have still problems with limited and unstable features in variable network conditions. In this paper, we propose a Soft Actor Critic (SAC)-based learning methods that can be applied to dynamic, to solve the problems in DDPG-based methods with the problem that do not converge quickly in continuously changed networking environments.

Autonomous Driving Prototype with Raspberry Pi by Using Image Processing Technology

Mert Kaval, Jerry Yinran Huang, Jinhui Shen, Yanxiao Wang,
Haowei Ni, Lang Qin, Chris Zhang
Department of Research and Development,
Cansight Technology Corp., Vancouver, BC, Canada;
Nanjing Foreign Language School, Nanjing, Jiangsu, China;
School of Broadcasting and Hosting Arts, Communication University of China,
Nanjing, Jiangsu, China;
Saint Patrick Regional Secondary School, Vancouver, BC, Canada;
High School Affiliated to Nanjing Normal University, Jiangning Campus,
Nanjing, Jiangsu, China

Abstract - With the development of the internet, the concept of self-driving cars is no longer unfamiliar with us. From military use to commercial use, autopilot technology is playing a bigger and bigger role in society nowadays. In order to make this kind of invention easier for us to use in daily life, a self-driving car prototype is designed. It comes with basic functions like detecting and moving ability which can help people do a few household necessities. This kind of robot may be connected to the household WIFI in the future to realize more complex functions.

MultiDrone Simulator - An Open Source Multi-Plataform Tool to Use in Tests of Optimized Flight of Group of Drones

Robison Cris Brito, Huilson Jose Lorenzi, Alfredo Weitzenfeld, Eduardo Todt
Federal University of Technology, UTFPR, Brazil;
Univeristy of South Florida, USF, Florida, USA

Abstract - This article presents an open source multiplatform tool for simulating flight of Drones group. From this tool, the user can perform an offline execution, loading the flight plan from a JSON file, or even allows a dynamic online execution, since the simulator accepts the connection via socket from other client, that can be developed in any language, and it only need to allow a connection via socket with the simulator to be able to sending / receiving JSON messages. This simulator displays the result of the flight execution, as well as presenting the task allocation in a Gantt chart. During the simulation, this tool allows execution step by step, thus changes in the environment data, such as wind speed / direction, inclusion and exclusion of Drones, request for immediate Drone return of the base , among other resources. The tool was tested for different scenarios, using different optimization algorithms, and for all tests, the simulator behaved well, presenting the expected results.

Improving Critical Controls Using IoT and Computer Vision

Michael Kainola, Larbi Esmahi, Ali Dewan
School of Computing & Information Systems, Athabasca University, Canada

Abstract - In risk management, critical controls are processes that are put in place to prevent or mitigate the effects of material unwanted events (MUEs). One of the least effective categories of critical controls is administrative controls. This category of critical control encompasses manual, policy-based, and procedural controls. These manual inspections are ineffective as they are subjective and only provide point-in-time assurance. The application of computer vision, IoT, and predictive AI can help automate this type of controls and significantly reduce safety risks. In this research, two applied experiments are performed in an industrial nickel refining plant to validate the effectiveness of this technology. For the first experiment, a system is developed to monitor the flow of molted material during granulation and detect any buildup that could potentially cause a risk-event. For the second experiment, a system was developed to continuously monitor the ambient brightness of the reduction processing area and use the collected data to predict potential risk-events before they happen.

A Data-Driven Driving Under the Influence (DUI) Detection, Notification and Prevention System using Artificial Intelligence and Internet-Of-Things (IoT)

Aaron Li, Yu Sun
Computer Science Department,
California State Polytechnic University, Pomona, California, USA;
Francis Parker School, San Diego, California, USA

Abstract - Drunk driving represents a significant public health crisis not only in the United States but also globally. Sober Guardian is developed to mitigate this issue by leveraging advanced technologies including Machine Learning, Computer Vision, and potentially chemical sensors in the future. This system employs facial recognition and machine learning algorithms to swiftly determine if a driver is impaired, with the aim to prevent them from starting the vehicle. We used an IoT System to control the blocker and successfully prevent vehicle start with 100% rate. Additionally, Sober Guardian plans to incorporate hardware solutions such as sensors that can detect alcohol levels directly from the driver's breath or skin, enhancing the accuracy and reliability of impairment detection. Throughout its development, the project has faced challenges such as image clarity, limited datasets, and ensuring user-friendliness. Preliminary experiments with both image and video inputs have demonstrated the system's ability to predict sobriety with an accuracy between 86% and 87.5%. However, video analysis for impaired individuals was hindered by the scarcity of appropriate datasets. Despite these challenges, Sober Guardian, in its nascent stages, has proven to be

a promising solution for detecting driver impairment and preventing drunk driving, with ongoing enhancements expected to improve its functionality and deployment readiness.

Federated Threat Detection within Intelligence Sharing Organizations While Maintaining Privacy

Genea Taylor, David Johnson, Kaushik Roy
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Abstract - This paper explores the application of federated learning in the context of Internet of Things (IoT) data analysis, focusing on its benefits in terms of privacy, scalability, and performance. Federated learning facilitates the training of machine learning models on decentralized devices, enabling efficient data analysis without the need to share sensitive information with a central entity. By leveraging federated learning, organizations can localize data and ensure strong authentication with edge devices, thus enhancing security and privacy measures. While machine learning has proven effective in detecting network attacks within the same organization, challenges arise when dealing with heterogeneous data and multiple organizational structures while maintaining privacy and integrity. The paper addresses these limitations and proposes the use of a binary classifier, utilizing a key dataset in NetFlow format (NF-ToN-IoT), as an effective approach for decision-making based on IoT data. The implementation of PyTorch and binary classification simplifies the process of model development, training, and evaluation. Furthermore, the paper discusses how federated learning methods can facilitate collaboration among different organizations, allowing for threat detection and mitigation without compromising sensitive data. Various mechanisms for enhancing threat intelligence sharing within the IoT environment are explored, highlighting the importance of privacy-preserving techniques and effective data utilization strategies.

Revolutionizing Multiplayer Gaming: A Deep Dive into VisionXO, a 3D Multiplayer Tic-Tac-Toe Game

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Abstract - This research paper provides an in-depth exploration of VisionXO, a groundbreaking 3D multiplayer TicTac-Toe game that we designed exclusively for the Apple Vision Pro and iOS platforms. Leveraging a combination of SwiftUI for immersive user experience with the RealityKit alongside RealityKitContent for seamless 3D model integration, VisionXO delivers an unparalleled gaming experience where multiple players can compete in real-time matches using unique room code. Through a detailed analysis of its technical complexity, challenges encountered during development, and future prospects, this paper highlights the far-reaching impact of VisionXO on mobile gaming field.

The 23rd International Conference on Wireless Networks (ICWN'24: July 22-25, 2024; Las Vegas, USA)

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Minimum Dominating Set and Minimum Connected Dominating Set Construction in Wireless Sensor Networks under the Sleeping Model

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Abstract - In this paper, we study the problem of constructing a minimum dominating set (MDS) and a minimum connected dominating set (MCDS) in WSNs under the sleeping model. The sleeping model and the notion of awake complexity, which are recently introduced in the distributed computing literature, can model energy consumption of algorithms for wireless sensor networks (WSNs) in a more suited way. To the best of our knowledge, this paper is the first to study these problems under the sleeping model. Our MDS algorithm achieves a constant factor approximation for MDS in growth-bounded graphs in O(1) average and sublogarithmic worst-case awake complexity, whereas our MCDS algorithm is a 8.399 approximation algorithm for MCDS in Unit Disk Graphs (UDG) in O(log n) worst-case awake complexity and O(n log n) round complexity.

Classification of Radio Signal Modulations using Convolutional Neural Network

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Abstract - Complex-valued temporal radio signals are used as input with minimal pre-processing to a neural network. Expert feature extraction is avoided, but instead, truncated frames consisting of in-phase and quadrature (I/Q) data samples are supplemented with their Discrete Fourier Transforms of equal length and the continuous finite phase difference to produce inputs to the neural network. Based on the experiment, It is demonstrated that a convolutional neural network can accurately classify many common modulation types without the use of phase-locked loops or the need to calculate additional statistical quantities or higherorder moments. The classification accuracy of some modulation schemes, notability frequency shift keyed types, was shown to be over 95% at SNR greater than 10 dB. Conversely, PSK and QAMtype modulations that incorporate the instantaneous phase as a symbol component are demonstrated more challenging for this model to classify above 85% accuracy.

Hybrid Differential Evolution Algorithm for Optimal WSN Node Deployment

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University of South Wales, Pontypridd, UK;
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Llandaff Campus, Cardiff, UK

Abstract - This paper introduces the Hybrid Differential Evolution (HDE) algorithm as a novel approach for optimizing Wireless Sensor Network (WSN) node deployment, surpassing conventional Genetic Algorithm (GA) and Particle Swarm Optimization (PSO) methods. By amalgamating Differential Evolution (DE) with local search strategies, HDE achieves superior coverage, enhanced connectivity, and heightened energy efficiency. This hybrid methodology not only addresses the limitations of individual optimization techniques but also exhibits robustness and adaptability in managing intricate and large-scale WSN deployment scenarios. Consequently, HDE emerges as a potent optimization tool capable of efficiently optimizing sensor node placements to meet the diverse requirements of contemporary WSN applications.

Wireless Sensor Networks Using Biorobotic Sensors: Frameworks and Applications

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Abstract - Wireless Sensor Networks (WSNs) have emerged as a transformative technology with applications spanning environmental monitoring, healthcare, agriculture, and beyond. The integration of biorobotic sensors into WSNs presents a novel paradigm, capitalizing on the synergy between biologically inspired sensing mechanisms and wireless communication. This paper explores the conceptual framework, technological foundations, applications, and challenges of leveraging biorobotic sensors in WSNs. The paper discusses the potential benefits, including enhanced adaptability, energy efficiency, and robustness, while addressing concerns such as sensor reliability, privacy, and ethical considerations. Through a comprehensive review of existing literature and case studies, we elucidate the opportunities and limitations of this paradigm, paving the way for future research and development in the field of bioroboticenhanced WSNs.

Implementation and Performance Evaluation of a Wireless Covert Channel

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Abstract - Covert communication channels in computers have been a continual area of research and provide a potential avenue through which just-in-time data transfer may occur to bootstrap a secure communication when an existing dedicated secure channel is compromised. The ubiquity of WiFi networks today makes covert channels in network communications a particular hot spot of research and can provide many flexible and difficult to detect options. In this paper, we provide a systems implementation and performance evaluation of a RTS/CTS based covert channel dubbed “Opportunistic Secure Communication (OpSeCom)” proposed by Husain et.al. which shows the promising application of the proposed channel in real-time communication.

Wireless Multihop Transmissions with Concurrent Forwarding without Collisions by Capture Effect

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Abstract - In wireless multihop transmissions of data messages, concurrent data message forwarding by 2-hop neighbor intermediate wireless nodes are prohibited due to collision avoidance between these data messages. However, depending on the distances between neighbor intermediate wireless nodes, no collision concurrent data message forwarding by 2-hop neighbor intermediate wireless nodes is realized due to the capture effects. Therefore, with more partial sequences of intermediate wireless nodes allowing the concurrent data message forwarding, shorter end-to-end transmission delay and higher throughput of data messages are expected. This paper proposes a more concurrent data message transmission method with collision avoidance in consideration of the capture effects and a routing protocol detecting a wireless multihop forwarding route allowing the concurrent data message transmissions. Results of simulation experiments suggest the improvement of end-to-end throughput of data messages due to the concurrent data message.

A Prototype for Fire Detection based on Social Internet of Things

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Abstract - The increasing attention to environmental risks, particularly wildfires, impacting our planet annually underscores the urgent need for effective mitigation and extinguishing strategies. Over time, various solutions have been proposed, yet none have fully resolved the issue. In response, we propose an innovative approach leveraging electronic noses, LoRa network, neural networks, and cloud computing within a cutting-edge Social Internet of Things (SIoT) platform called Lysis. This method aims to significantly reduce response times for fire containment and suppression efforts.

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An Online Bookstore Design and Implementation

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Abstract - This paper presents a top-notch online Amazon-like bookstore that weighs more on customers' experiences and providing a straight way to buy and rate books. The website will have a user-friendly layout and a substantial and varied book library. Users will be able to sign up, establish profiles, browse books with ease, add them to carts, and make purchases directly from their Amazon carts. The website will also offer readers a special chance to post comments, express their ideas, and rate the books they have read. The system ensures high responsiveness, security, and scalability through the use of cutting-edge web technologies, leading to an effective and secure online buying experience for book enthusiasts. The system is implemented with the use of HTML, CSS, PHP, and MYSQL.

Using Linkage Context for Automated Correction in Unsupervised Entity Resolution

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Abstract - Many modern Entity Resolution (ER) systems leverage metadata about the reference data to facilitate processing and making equivalence decisions. This historically has required that each source of input data be pre-processed individually to conform to a common metadata alignment, have data cleansing applied, and the data condensed into a singular dataset to be submitted to an ER process. These are costly processes and require additional passes of the input data prior to ER decisioning. This paper expands on the concept of context within ER to replace the need for metadata alignment and preprocessing that was introduced in previous literature. Leveraging the four (4) points within ER processes for which context can be extracted, and introducing a new n-gram similarity method allows for better more intelligent corrections to be performed to the data in flight during processing without the need for preprocessing or metadata. This paper defines tested methods to enhance the initial context extraction to reduce erroneous automated corrections that thusly impact the final clustering results of the ER system and provides empirical results to support the effectiveness of these methods.

The Application of Blockchain Technology in the Transmission of Semiconductor Process Recipes

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Abstract - In contemporary society, semiconductors have become an indispensable part of daily life. From traffic lights, electric vehicles, computers, and smartphones to aerospace and military applications, most instruments requiring precise control feature semiconductors. However, the semiconductor manufacturing process is extremely complex and challenging, leading to the development of various semiconductor-related management systems, such as automated transport systems and production scheduling systems. Among these, the recipe management system, which controls production parameters, is particularly important.Against this backdrop, the main objective of this thesis is to address the semiconductor production process by utilizing blockchain technology to design a secure and immutable recipe transmission process. This ensures that the recipe remains consistent with the experimental results after being verified and uploaded by process engineers, thereby reducing errors due to manual modifications that could lead to production mistakes. This thesis proposes integrating a secure hashing algorithm with blockchain into the recipe management system. When recipes are uploaded, the blockchain data is simultaneously updated, and computations are performed during the download process. By comparing the current recipe with the records in the blockchain using a binary tree algorithm, a list of differing files is obtained. This allows for differential downloads, thereby reducing file transmission time and accelerating the production process.

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Improving Accuracy of Image Clustering using Convolutional Neural Network and Learning from Confusion

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Abstract - Image clustering is a very useful but difficult task in machine learning and computer vision. Recently, convolutional neural network (CNN) is taking a major role in image clustering in which it is used to extract features to be used for an objective function of similarity or dissimilarity measures. There are two problems in the image clustering methods using CNN. First, it is still challenging to estimate a correct number of clusters initially, which decides the quality of the clustering result mostly. Second, a clustering algorithm frequently clusters some semantically different images into a same cluster (due to their similar color distributions) and generates incorrect clustering result. In this paper we propose a framework for image clustering with CNN and learning from confusion, which addresses these problems. The experiments show that the proposed framework increases image clustering effectiveness significantly.

Implications for Designing Hawks Detection with Data Augmentation and Network Optimizations

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Abstract - In the agricultural environment, hawks and other birds of prey that are hunting livestock (e.g., chickens) are critical issues. To address the problems with pasture-raised livestock, the detection mechanism of predators is essential. We focus on hawks as major predators, but the availability of hawks dataset is very limited. In this paper, We attempt to generate more datasets using data augmentation techniques with several parameters. We also design deep-learning networks that can effectively detect airborne predators to protect livestock. The network has been optimized to improve its performance. We analyze the experimental results and provide implications. The detection scheme can be utilized in the chicken industry to allow corporations to increase animal welfare by raising chickens in an outdoor pasture environment.

Analysis of Driver Attention to Objects While Driving

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Abstract - A driver's gaze has often been used to estimate driver attentiveness or focus during driving. These works often rely on simple definitions of what it means to "see," namely, a driver's gaze falling on an object for a single frame. In this work, we consider a definition of "seen" which requires an object to be gazed upon for a set length of time, or frames, before it can be considered as seen by the driver. This is done by examining consecutive frames to find those where the driver's gaze remains uninterrupted within a bounding box of a given tracked object over a series of frames. Reliance on multiple frames allows enough time for a driver to process the object gazed upon. We analyze driver gaze on traffic-related objects identified in frames from actual driving sequences and consider the impact of different lengths of frames and bounding box overlap across frames on objects "seen".

Mobility Anomaly Detection with Video Surveillance

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Abstract - This paper outlines a study aimed at enhancing elderly care through an intelligent video surveillance system that leverages deep learning for detecting mobility anomalies, specifically near-falls. Identifying near-falls is essential because people who have fallen in the past usually report experiencing frequent near-falls while carrying out their daily activities. We successfully developed an autoencoder to detect these anomalies, particularly near-falls, by identifying high reconstruction errors throughout five consecutive frames. To extract a person's skeleton, we utilized MoveNet and narrowed it down to only seven keypoints. We then used a set of 20 features, encompassing joint positions, velocities, accelerations, angles, and angular accelerations, to train the model. Our model was tested on 100 videos of simulated daily activities recorded in an apartment laboratory, where 50 of them contained a nearfall. Results show that our model can successfully detect nearfalls with 90% sensitivity, specificity, and accuracy, highlighting its potential to enhance elderly care in their living environments.

Computer-Aided Industrial Inspection for Manual Tools using Computer Vision Technologies

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Abstract - This study takes the assembly process of the wrench, an essential component of manual tools, as an example to explore the automated detection of manual tool assembly defects in the industrial precision assembly process. A wrench is assembled from multiple parts, and the parts' design, manufacturing, and assembly are very important. No matter how well-designed the components are, they will not work properly if they are not assembled correctly. Therefore, this study samples the work-inprocess from three assembly stations in the ratchet wrench assembly process, investigates 26 common types of assembly defects in the assembly operation, and uses CCD to capture sample images of various types of assembly defects for experiments. First, the captured images are filtered to eliminate surface reflection noise from the workpiece; Second, a circular mask is given at the assembly position to extract the ROI area; Third, the filtered ROI images are used to create a defect type label set using manual annotation; Four, the R-CNN network models are used for object feature extraction and classification; Finally, it is compared with other object detection network models to select the better network model. The experimental results show that if each station uses the proposed model for defect inspection, it can effectively detect and classify defects. The average defect detection rate (1-β) of each station is above 90%, the average good product misjudgment rate (α) is lower than 7%, and the average correct classification rate (CR) is above 85%.

Image-Based Leopard Seal Recognition: Approaches and Challenges in Current Automated Systems

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College of Arts & Sciences, Department of Biology,
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Abstract - This paper examines the challenges and advancements in recognizing seals within their natural habitats using conventional photography, underscored by the emergence of machine learning technologies. We used the leopard seal, Hydrurga leptonyx, a key species within Antarctic ecosystems, to review the different available methods found. As apex predators, Leopard seals are characterized by their significant ecological role and elusive nature so studying them is crucial to understand the health of their ecosystem. Traditional methods of monitoring seal species are often constrained by the labor-intensive and time-consuming processes required for collecting data, compounded by the limited insights these methods provide. The advent of machine learning, particularly through the application of vision transformers, heralds a new era of efficiency and precision in species monitoring. By leveraging state-of-the-art approaches in detection, segmentation, and recognition within digital imaging, this paper presents a synthesis of the current landscape, highlighting both the cuttingedge methodologies and the predominant challenges faced in accurately identifying seals through photographic data.

Deep Learning Techniques for Lunar Impact Crater Identification Based on CCD and DEM Data

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Abstract - In recent years, the subject of detection of Lunar impact craters based on deep learning methods has been widely studied with the aim of providing efficient and effective methods for the automatic detection of Lunar impact craters. In this paper, we used the latest version in the YOLO series models, YOLO v9, to apply them to the detection of Lunar impact craters based on the CCD and DEM data provided by NASA to obtain accurate detection results. The performance results indicate that YOLOv9-c achieves a precision of 73.42% on CCD data, while YOLOv9-e records a slightly higher precision of 75.27%. On DEM data, their precision is 69.43% and 70.31% respectively. Additionally, the newly developed lightweight networks, GELAN-c and GELAN-e, were tested on the same CCD and DEM datasets. GELAN-c reached a precision of 74.84% on CCD data and 70.82% on DEM data. GELAN-e showed a precision of 75.81% on CCD data and 70.87% on DEM data. The results have proved that the latest version of YOLO, YOLO v9, performed effectively in the task of the Lunar impact crater.

Dishari: A Novel Gesture-Based Educational Application for Specially Challenged People

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Abstract - This research explores the integration of advanced technologies, particularly hand gesture detection, and Generative AI, to create an inclusive educational tool called "Dishari" tailored for individuals with hearing and speech impairments. Traditional search engines often fail to address the specific needs of this speech and visually impaired demographics, leading to a gap in accessibility and inclusivity. Leveraging machine learning algorithms and computer vision technologies, Dishari interprets hand gestures captured via web cameras, translating them into sign language expressions and helping the users search for a particular keyword through the search engine. Furthermore, the incorporation of Generative AI enhances the search functionality, enabling users to input queries through both text and hand gestures. Through a comprehensive literature survey, we highlight the advancements in hand gesture recognition systems and the transformative potential of Generative AI in image and text-based search. Dishari marks a significant milestone in bridging the communication gap and fostering inclusivity by empowering individuals with hearing and speech impairments to navigate the digital landscape effectively.

Silicon Wafer Map Defect Classification Using Artificial Intelligence Models

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Abstract - This paper presents a comprehensive evaluation of three modified advanced neural network architectures, ResNet, EfficientNetB0, and SqueezeNet, for their efficacy in detecting and classifying defects in silicon wafer maps. The research used the WM-811K dataset, consisting of various defect types, to train and test each model under binary and multi-class classification scenarios. A customized image processing algorithm was developed to process the wafer map images and subsequently the images were used as inputs to the neural network models. The performance of these models was assessed using three metrics: sensitivity, specificity, and accuracy. These evaluations aimed to determine the effectiveness of the models in classifying wafer maps into their respective categories. In binary classification tasks, the EfficientNet-B0 model demonstrated the highest accuracy at 95.12%, while in multi-class classification scenarios, the ResNet model achieved highest accuracy of 90.44%. The paper further elaborates on the performance metrics of the models. It also discusses the current research and suggests areas for future work.

Weakly-supervised Video Anomaly Detection Using Modified Anomaly Score Module and Modified BERT

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Abstract - In this study, a weakly-supervised video anomaly detection approach using modified anomaly score module and modified BERT is proposed. The proposed approach consists of four main steps. (1) A video sequence is divided into nonoverlapping video clips and each video clip consists of sixteen adjacent video frames. (2) The video clips are fed into I3D to extract video clip feature vectors, which are fed into the proposed modified anomaly score module and the proposed modified BERT module to obtain the video clip feature vector anomaly scores and the video sequence classification anomaly score, respectively. (3) The video clip feature vector anomaly scores are multiplied by the video sequence classification score to obtain the video clip anomaly scores, which are fed into frame anomaly score production operation to obtain the video frame anomaly scores. (4) Based on the specified threshold, the video frames are determined as abnormal or normal. Based on the experimental results obtained in this study, the performance of the proposed approach is better than those of comparison approaches.

Low Light Image Enhancement Using Autoencoder-based Deep Neural Networks

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Abstract - In this study, a low light image enhancement approach using autoencoder-baesd deep neural networks is proposed. The proposed approach consists of two subnets, namely, feature extraction (FE) subnet and color enhancement (CE) subnet. FE subnet extracts image features from the low light image and enhances detailed textures, while CE subnet recovers the color information of the low light image and performs image denoising. A pre-processing technique, namely, relative global histogram stretching (RGHS) is employed in CE subnet. Finally, the processing results of FE and CE subnets are fused to generate the final enhanced image. Based on the experimental results obtained in this study, in terms of two objective performance metrics (PSNR (dB) and SSIM) and subjective evaluation, the performance of the proposed approach is better than those of five comparison approaches.

Towards Elephants Intelligent Monitoring in Zakouma National Park, Chad

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Abstract - This paper proposes an approach based on artificial intelligence to open up new prospects for the protection of endangered species in Zakouma National Park, Chad. This paper analyzes a few major algorithm models used in the detection or segmentation process to determine their accuracy when applied to wildlife. An assessment and a benchmarking were carried out on detection and segmentation algorithms such as Faster RCNN, Mask R-CNN, YOLO V7, YOLO V8 and YOLO NAS. The process of tracking wild animals is handled by the ByteTrack library. A unique ID is assigned to each animal, enabling it to be identified individually after the detection and recognition process. The counting approach derives from the individual animal identification mechanism: when an animal, recognized by YOLO 8, is first detected during the counting process, then the species-specific counter, initialized at 0, is incremented by one unit. The YOLO 8 algorithm yields the most reliable precision rates, and is therefore chosen for animal detection and identification.

A Review of Multi-Modal and Multi-View Applications in Hand-Drawn Sketch Images

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Abstract - Hand-drawn sketches have played a significant role throughout human history, from the ancient world to the present, influencing everything from early childhood education to human psychology. While humans can effortlessly recognize and understand varying abstractions in these sketches, machines find these tasks challenging. Recent advancements in multimodal models have opened new possibilities for computer vision to interpret hand-drawn sketches more effectively. This survey provides a comprehensive review of the application of multimodal approaches in the domain of hand-drawn sketches, with a particular focus on generation and recognition tasks.

Contour Detection of Seeds Based on Traditional and Convolutional Neural Network (CNN) Based Algorithms

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Abstract - Computer vision is gaining increasing significance, particularly in image processing, image recognition, image analysis, and more. Among these applications, edge detection holds a significant role. While it has found extensive use in domains like autonomous driving and facial recognition, it has yet to receive adequate attention in some agricultural sectors. This paper delves into the potential of edge detection, specifically contour detection, in the domain of seed phenotyping. Contour detection is significantly influenced by image quality, with color saturation due to ambient light and background color playing important roles. This paper expands traditional contour detection algorithms to address their limitations and improve their accuracy. Images are captured using different physical characteristics and image backgrounds. A consistent background color allows for more contrast with the seeds being analyzed. This paper compares various traditional detection methods with convolutional neural network (CNN) detection methods. The analysis aims to highlight the strengths and weaknesses of each technique, offering valuable insights for seed researchers because contour detection is essential in supporting non-destructive measuring of the volume, and subsequently the density, of irregularly-shaped seeds.

Early Detection of Lameness in Dairy Cattle Using Activity Data, Image Analysis, AI and ML - An Approach for Improved Animal Welfare and Economic Impact

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Abstract - The economic burden of lameness in dairy cattle is a significant challenge facing the worldwide dairy industry. Studies suggest that it can cost the industry billions of dollars annually, with the exact cost varying by region. In the United States, the cost of lameness is estimated to be approximately $2 billion per year, while in the United Kingdom, it is around £200 million per year. These costs include lost milk production, decreased fertility, and treatment expenses. The impact of lameness on dairy cattle is farreaching, posing a significant economic burden on farmers and countries and affecting animal welfare, milk production, and farm profitability. It is particularly concerning for small and marginal farmers, who are vulnerable to economic and financial sustainability concerns. Early detection and prevention of lameness are crucial to reducing these costs and improving the overall health and productivity of dairy herds. Prevalence rates vary globally, ranging from 17% to 35% in dairy herds, underscoring the urgent need for innovative solutions. Our proposed paper offers a novel approach to addressing this challenge. By combining activity data captured by Cow Necklace IoT Sensor and image analysis with Computer Vision, alongside expert veterinarian input, we provide a comprehensive and datadriven solution for early lameness detection in dairy cattle. This approach has the potential to significantly improve animal welfare, farm management practices, and overall herd productivity, leading to substantial economic benefits for farmers and the agricultural sector as a whole.

Residential Real Estate Image Classification for Property Valuation

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Abstract - Residential real estate price is one of the key components of our economic developments and has also been a major concern of the public, bank industry, government, and investors. The accurate estimation of the sale price and its changes have an important role in the decision-making of related departments and organizations. In Australia, one of the biggest investments for people is in residential real estate. Therefore, many studies and research works have been carried out to build an automated valuation model to predict sale prices of residential properties accurately as much as possible. Automatic and accurate image classification of residential real estate plays an important role in property valuation and decision making of both sellers and buyers. It can be used in real estate online websites to organize the images for each property or used as a component in a visual decision support system for predicting the property sale prices based on property images. As convolutional image classification models show valuable performance in comparison with traditional models, a convolutional classification model is developed in this paper which creates a highly reliable classification component to be used in the corresponding research areas. The performance of the proposed model is investigated through a real dataset of New Sales Wales, Australia.

Lalitha: A Hand Gesture-Based Computer Control System

Tathagata Bhattacharya, Vinay Alsa, Akil Kumar Vujjini
Auburn University at Montgomery, Alabama, USA

Abstract - This novel research is dedicated to creating an application called Lalitha that helps disabled people control an entire workstation only with their hand gestures. Lalitha has proved to be a great tool for providing brilliant user interaction and user satisfaction in terms of controlling the computer only with hand gestures. Especially, for people with disability, Lalitha would be an extremely useful tool. We incorporated Arduino, ultrasonic sensors, and software to create Lalitha. We tested our system with almost 300 people and we have gotten positive feedback about our application Lalitha. In one word, we can claim that Lalitha is simple to set up, easy to use and its performance is brilliant. We have provided all the details of this entire application in this paper.

Novel Method to Investigate Decay in Rotting Bananas Using RGB Color Images

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Texas A&M University - Kingsville, Texas, USA

Abstract - Hyperspectral imaging has been used for years in tandem with image processing to collect data about objects and processes over time based on the reflection of different wavelengths of visible light inherent in different objects. However, hyperspectral imaging requires a hyperspectral camera, which can cost upwards of $50,000 and is unavailable to researchers without university, private, or federal funding. This work serves as a case study to see if an alternative, albeit less advanced method, may be used to study similar objects based on images taken from an average civilian camera, i.e., a phone camera such as that from an Android phone. Such a method would prove both more affordable and time efficient. This method relies on programming software in MATLAB to differentiate between red, green, and blue image frames and associated values in temporal images to check for changes in processes over time. In this work, the method is tested via the process of decomposition of bananas, where color change is simple and obvious; images may be taken over time to measure for color change during decomposition.

Detecting and Quantification of Cracks using CNN and Image Processing Techniques: A Review

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Shatha Khalid Alhazzani, Lamees Alhazzaa
Computer Science, Imam Mohammad Ibn Saud Islamic University,
Riyadh, Saudi Arabia

Abstract - Crack detection plays a crucial role in ensuring the safety and integrity of various structures, including buildings, bridges, and roadways. Convolutional Neural Networks (CNNs) have emerged as powerful tools for automated crack detection, offering the potential for accurate and efficient analysis. In this review paper, we conduct a brief analysis of CNN architectures employed for crack detection, focusing on their comparative performance, application domains, and future research directions. By examining a collection of 20 relevant studies, we identify and evaluate the utilization frequency of popular CNN architectures, namely AlexNet, GoogleNet, ResNet, VGG-16, YOLO v3, and YOLO v4, in the context of crack detection. This review offers valuable insights into the prevalence, usage patterns, and performance of CNN architectures in crack detection. It serves as a guide for researchers and practitioners in developing effective CNNbased crack detection systems.

The 21st International Conference on Modeling, Simulation & Visualization Methods (MSV'24: July 22-25, 2024; Las Vegas, USA)

https://american-cse.org/csce2024/conferences-MSV
https://www.american-cse.org/csce2024/

Data Clustering and Visualization with Recursive Max k-Cut Algorithm

An Ly, Raj Sawhney, Marina Chugunova
Institute of Mathematical Sciences,
Claremont Graduate University, Claremont, California, USA

Abstract - In this article, we continue our analysis for a novel recursive modification to the Max k-Cut algorithm using semidefinite programming as its basis, offering an improved performance in vectorized data clustering tasks. Using a dimension relaxation method, we use a recursion method to enhance density of clustering results. Our methods provide advantages in both computational efficiency and clustering accuracy for grouping datasets into three clusters, substantiated through comprehensive experiments.

Uncertainty Quantification for Ride Quality Mobility Tests using CREATE-GV Mercury

Jeremy Mange, Sara Boyle
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Abstract - In this paper, we perform Uncertainty Quantification (UQ) for the ride quality mobility test as implemented by the CREATE-GV Mercury modeling and simulation (M&S) software. We briefly explain the software itself, define the ride quality mobility test and associated metrics, discuss the uncertainty that arises as part of this test simulation procedure, and quantify that uncertainty through a large number of simulations performed on High-Performance Computing (HPC) resources, using parameterized terrain randomization. We present and discuss the results of these experiments, which reveal a higher level of uncertainty associated with this mobility test than initially expected.

Prediction of 1st Year Registration Renewal of General-use JP Domain Names Using Machine Learning

Takaharu Ui, Shota Ikehara, Kentaro Mori, Takeshi Ozaki, Hiroo Hirose
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Abstract - The management of domain names and the operation of the DNS are critical components within the foundational areas of the operation of the Internet. For domain name registries to operate stably and continuously, it is important to develop a long-term investment plan is essential. Since revenues depend on the number of registered domain names, forecasting future registration volumes is a crucial managerial task. This study aims to develop a model that predicts 1st year registration renewal of individual domain names, focusing on the General-use JP domain names, which account for about 70% of all JP domain registrations. Using decision trees and their advanced forms of machine learning algorithms, the model incrementally adds and verifies features, achieving an accuracy of 80.6%.

Understanding Public Policy Effects on Alcohol-related Behaviors and Outcomes Using System Dynamics

Damilare Ogungbesan, Ashiat Ashake Adeogun, Aanuoluwapo Adekoya, Misagh Faezipour
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Murfreesboro, Tennessee, USA;
Department of Engineering Technology,
Middle Tennessee State University, Murfreesboro, Tennessee, USA

Abstract - Public policies, such as alcohol taxation policy, age restriction policy, production and sales regulation policy, advertising restriction, and rehabilitation, significantly impact alcohol consumption—a complex social issue with wide-ranging implications for public health and safety. This study employs system dynamics methodology to explore the intricate relationships among crucial factors, policies, and their effects on behaviors and outcomes resulting from alcohol consumption. The research identifies various influential factors, including socioeconomic conditions, cultural norms, rehabilitation policies, alcohol pricing, healthcare costs, and societal consequences. These elements are integrated into a dynamic model that captures feedback loops and causal links guiding changes in alcohol consumption, accidents, and long-term effects. Through causal loop analysis, diverse policy scenarios are evaluated for their potential impacts, revealing the intricate influences surrounding alcohol use and the multifaceted repercussions of policy interventions. This research offers a comprehensive perspective on public policy's role in shaping alcohol-related behaviors and outcomes.

Performance Investigation of small UAV Attitude Control Based on Optimized Nonlinear Dynamic Inversion

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Electronics and Communications Department,
Arab Academy for Science and Technology, Cairo, Egypt;
Guidance Department, Military Technical College, Cairo, Egypt

Abstract - Small Unmanned Aerial Vehicles (UAVs) are widely used in a broad range of civilian and military applications. UAV models exhibit intricate nonlinear characteristics, significant coupling between longitudinal and lateral motions, and a susceptibility to model disturbances. In light of these complexities, it is essential to devise a flight control scheme that is robust and optimized, addressing the unique challenges posed by UAVs' diverse missions and nonlinear dynamics. Nonlinear Dynamic Inversion (NDI) is one of the control solutions for UAV's flight control system as it can efficiently decouples the model and successfully handle the system's nonlinearity. Besides, the incremental approach of NDI (INDI) improves the system robustness by decreasing the control law's dependence on UAV's model. Nevertheless, one of the most difficulties associated with INDI in order to have the best tracking performance is the controller gain selection. In this work, an Incremental NDI control strategy for fixed wing UAV is presented. The optimal set of controller gains is expressed as an optimization problem; the controller gains are subsequently determined through Incremental NDI using the Particle Swarm Optimization technique. This approach has a number of benefits, including a very effective global search algorithm, a straightforward implementation, and minimal algorithm parameters. The optimized controller is assessed through different simulation scenarios which include ideal case, with 10% uncertainty and with 30% uncertainty. The simulation affirms the PSO-INDI controller's superiority, effectiveness, and reliability. It demonstrates a 25% improvement in rise time, a 52% reduction in overshoot, and consistently low steady-state error even with increased model uncertainty, unmodeled dynamics and wind disturbances.

The 30th International Conference on Parallel & Distributed Processing Techniques & Applications (PDPTA'24: July 22-25, 2024; Las Vegas, USA)

https://american-cse.org/csce2024/conferences-PDPTA
https://www.american-cse.org/csce2024/

Is Manual Code Optimization Still Required to Mitigate GPU Thread Divergence? Applying a Flattening Technique to Observe Performance

Lucas Vespa
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Abstract - We examine the impact of manual elimination of thread divergence in GPU code through removal of all branches using a flattening technique. The goal is to investigate the necessity of manual mitigation of thread divergence on GPU, compared with automated, modern compiler optimization and architectural improvements. We apply our previously presented flattening technique called Algorithm Flattening (AF), which eliminates all branches, producing divergence-free code with increased ILP at the expense of minor to moderate increased instruction overhead. We observe the effect of said optimization on kernel performance across historical architectures and compilers, up to recent offerings. We theorize that modern GPU improvements will eventually eliminate the need for programmer intervention of thread divergence coding issues for GPU, although further study is necessary.

A Methodical Approach to Parallel I/O Analysis in Distributed Deep Learning Applications

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Remo Suppi, Emilio Luque
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Universitat Autonoma de Barcelona (UAB), Spain;
Computer Sciences Department,
Barcelona Supercomputing Center (BSC), Barcelona, Spain

Abstract - Deep learning applications have become crucially important for the analysis and prediction of massive volumes of data. However, these applications impose substantial input/output (I/O) loads on computing systems. Specifically, when running on distributed memory systems, they manage large amounts of data that must be accessed from parallel file systems during the training stage using the available I/O software stack. These accesses are inherently intensive and highly concurrent, which can saturate systems and adversely impact application performance. Consequently, the challenge lies in efficiently utilizing the I/O system to allow these applications to scale. When the volume of data increases, access can generate high training latency and add overhead significantly when data exceeds the main memory capacity. Therefore, it is essential to analyze the behavior of the I/O patterns generated during the training stage by reading the data set to analyze the behavior when the application scales and what amount of resources it will need. The paper presents a methodology to analyze parallel I/O patterns in Deep Learning applications in this context. Our methodological approach mainly aims at providing users with complete and accurate information. This involves a thorough understanding of how the application, the dataset, and the system parameters can significantly influence the parallel I/O of their deep learning application. We seek to empower users to make informed decisions through a structured methodology that allows them to identify and modify configurable elements effectively.

Analyzing the Influence of File Formats on I/O Patterns in Deep Learning

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Remo Suppi, Emilio Luque
Computer Architecture and Operating Systems Department,
Universitat Autonoma de Barcelona (UAB), Bellaterra, Barcelona, Spain;
Computer Sciences Department,
Barcelona Supercomputing Center (BSC), Barcelona, Spain

Abstract - Deep Learning applications have become a very important solution in recent years for analyzing and making predictions with massive amounts of data. However, this type of application introduces significant input/output (I/O) loads on computer systems. Moreover, when executed on distributed systems or parallel distributed memory systems, they handle much information that must be read during training. This persistent and continuous access to files can overwhelm file systems and negatively impact application performance. A file format defines how information is stored, and the choice of a format depends on the use case. Therefore, it is important to analyze how the file format influences the training stage when loading and reading the dataset, as opening and reading a large number of small files could affect application performance. Thus, this article will analyze the I/O pattern of different file formats used in deep learning applications to characterize their behavior.

Parallel N-Body Performance Comparison: Julia, Rust, and More

Mark C. Lewis, Clarissa Garcia, Audrey Tollett, Seven Aguirre,
Henry Hafner, John Mcmahon, Amanda Sickafoose
Computer Science, Trinity University, San Antonio, Texas, USA;
Planetary Science Institute, Tuscon, Arizona, USA

Abstract - This paper explores parallelism performance for C, C++, Go, Java, Julia, and Rust on N-body simulations. We begin with a basic O(N 2) simulation for each language based on the n-body benchmark in the Benchmark Game. The original benchmark is adjusted to include a larger number of particles and run in parallel. We also add parallelism to the force calculations using a kD-tree. This work builds on previous work by including parallelism and adding the Julia programming language to our survey. We find that for straight numbercrunching, all of these languages provide similar performance, and all have sufficient support for parallelism that runtimes scale well with thread counts. On the other hand, when a spatial data structure, such as the kD-tree, is introduced, the runtimes vary dramatically between languages. In that situation, Julia's performance looks more like Python, taking over 100 times as long as Rust/C/C++ to finish. Rust comes out on top with an impressive 50% lead over C and C++.

REFT: Resource-Efficient Federated Training Framework for Heterogeneous and Resource-Constrained Environments

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Virginia Tech, Blacksburg, Virginia, USA;
Tennessee Tech University, Tennessee, USA

Abstract - Federated Learning (FL) is vital in distributed systems, especially for ensuring data privacy, particularly in IoT and edge-based setups. However, existing research mainly focuses on data heterogeneity, leaving gaps in addressing varying device capabilities and communication efficiency. To bridge this, we propose the "Resource-Efficient Federated Training Framework for Heterogeneous and ResourceConstrained Environments (REFT)". REFT leverages Variable Pruning to adapt pruning strategies to client computational capabilities, enhancing resource utilization. Additionally, our approach employs knowledge distillation to reduce bidirectional client-server communication, reducing bandwidth usage. Experimentation in image classification tasks demonstrates the effectiveness of REFT in resource-limited environments. Our method preserves data privacy and performance standards while accommodating diverse client devices, offering a minimal bandwidth solution for FL-based systems.

An Efficient Data Provenance Collection Framework for HPC I/O Workloads

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University of Alabama, Tuscaloosa, Alabama, USA

Abstract - Scientific data is essential for research and development in many fields, and its provenance and lineage are crucial for ensuring the validity of these findings. However, traditional data management methods fall short of transparency and accountability which can lead to data manipulation and falsification of research findings. By offering a transparent and impermeable mechanism for logging and verifying data integrity, tracking the provenance, and viewing the lineage of scientific data, blockchain technology provides a promising solution to address these issues. Metadata, verifiable research data, and configuration changes can be stored transparently and reliably using private blockchain technology. This paper proposes a framework to support secure scientific data provenance with minimum overhead on application performance while requiring minimal user intervention.

Using Minicasts for Efficient Asynchronous Causal Unicast and Byzantine Tolerance

Laine Rumreich, Paolo A.G. Sivilotti
Department of Computer Science and Engineering,
The Ohio State University, Columbus, Ohio, USA

Abstract - We present an implementation of asynchronous causally ordered unicast that requires linear space for message size, which is a significant improvement compared to the best existing algorithms which require quadratic space in the worst case. This algorithm is a modification of the Raynal-Shiper-Toueg algorithm and broadcasts a small control message, defined here as a minicast, to augment the unicast message to preserve causal ordering. The smaller message size is at the cost of additional traffic on the network. With the addition of cryptography in the form of digital signatures, this algorithm can be made tolerant to byzantine failures. For existing versions of causal unicast, byzantine tolerance has previously only been possible with the addition of bounded latency.

Towards Automatic, Predictable and High-Performance Parallel Code Generation

Lenore Mullin, Gaetan Hains
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LACL, Universite Paris-Est, Creteil, France

Abstract - High-performance architectures have complex features so that the reliable production of parallel software remains beyond the reach of most Computer Science graduates. Compilers alone cannot guarantee the highest performance and multiple APIs with complex performance features are difficult to master. As a first step towards more comprehensive solutions we are building key elements of a pre-compiler system that will automatically produce predictable, scalable and high-performance code from declarative tensor expressions. In this paper we summarize and analyze a large set of timing experiments of matrix multiplication variants that are mapped to vectorized and multithread code. The analysis covers two high-end target architectures and exhaust a whole space of code, compiler, pragma and parallelism parameters. Our analysis shows how the best choice of parameters is produced from a small set of tests that can converge in a matter of seconds and then predict performance of larger instances to within 25% or much less. Inefficient choices of parameters is also shown to be reliably predicted from small tests, so that our design for a precompiler is guaranteed to be a realistic and portable tool. The generality of our Mathematics of Arrays tensor algebra, and very broad applicability of tensor operations (signal processing, scientific computing, AI, etc) supports our claim that these experiments and design can be generalized to a general purpose parallel programming tool.

A Comparative Study of Two Matrix Multiplication Algorithms Under Current Hardware Architectures

Samuel Olatunde, Eduardo Colmenares
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Midwestern State University, Wichita Falls, Texas, USA

Abstract - A widely used computational intensive scientific kernel, the matrix multiplication algorithm is at the heart of many scientific routines, e.g. resurging fields, such as artificial intelligence (AI) strongly benefit from fast and accurate processing of large matrices. Through the years multiple efforts have been made to derive new algorithms capable of achieving better performance than the na¨ıve (traditional) dot product matrix multiplication approach Θ(n 3), one of those is Strassen variant Θ(n 2.81). This research compares the benefits and differences of using an optimal version of Strassen's algorithm versus a na¨ıve algorithm. The performance analysis makes use of the two most dominant high-performance computing (HPC) architectures available within the Lonestar6 at Texas Advance Computing Center (TACC), the multi-core (CPU) and many-core (GPU) architectures.

SESSION: International Workshop on Mathematical Modeling and Problem Solving (MPS)

Co-Chairs: Prof. Masahito Ohue, Prof. Nobuaki Yasuo**, Prof. Masami Takata****
** Tokyo Institute of Technology, Japan*
*** Tokyo Institute of Technology, Japan*
**** Nara Women's University, Japan*

Inference of Cell-Cell Interactions through Spatial Transcriptomics Data Using Graph Convolutional Neural Networks

Takahiro Hiura, Shigeto Seno, Hideo Matsuda
Graduate School of Information Science and Technology,
Osaka University, Osaka, Japan

Abstract - TBA

Natural Product-like Compound Generation with Chemical Language Models

Koh Sakano, Kairi Furui, Masahito Ohue
Department of Computer Science, Tokyo Institute of Technology, Yokohama, Japan

Abstract - TBA

Improved Early-modern Japanese Printed Character Recognition Rate with Generated Characters

Norie Koiso, Yuki Takemoto, Yu Ishikawa, Masami Takata
Graduate School of Humanities and Sciences, Nara Women's University, Nara, Japan

Abstract - TBA

Improved Method for Similar Music Recommendation using Spotify API

Miho Chiyonobu, Masami Takata
Research Group of Information and Communication Technology for Life,
Nara Women's University, Nara, Japan

Abstract - TBA

Reconfigurable Virtual Accelerator (ReVA) for Large-Scale Acceleration Circuits

Yaguchi Kazuki, Eriko Maeda, Syunya Kawai, Daichi Teruya,
Yasunori Osana, Takefumi Miyoshi, Hironori Nakajo
Graduate School of Engineering, Tokyo University of Agriculture and Technology,
Tokyo, Japan

Abstract – TBA

Building Simulation Environment of (Reconfigurable Virtual Accelerator) ReVA

Shunya Kawai, Eriko Maeda, Kazuki Yaguchi, Yasunori Osana,
Takefumi Miyoshi, Hironori Nakajo
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Tokyo University of Agriculture and Technology, Tokyo, Japan

Abstract - TBA

Vector Register Sharing Mechanism for High Performance Hardware Acceleration

Tomoaki Tanaka, Michiya Kato, Yasunori Osana, Takefumi Miyoshi,
Jubee Tada, Kiyofumi Tanaka, Hironori Nakajo
Graduate School of Engineering, Tokyo University of Agriculture and Technology,
Tokyo, Japan

Abstract - TBA

Efficient Compute Resource Sharing of RISC-V Packed-SIMD using Simultaneous Multi-Threading

Shogo Takata, Hironori Nakajo
Graduate School of Engineering, Tokyo University of Agriculture and Technology,
Tokyo, Japan

Abstract - TBA

Introducing Competitive Mechanism to Differential Evolution for Numerical Optimization

Rui Zhong, Enzhi Zhang, Masaharu Munetomo
Graduate School of Information Science and Technology,
Hokkaido University, Sapporo, Japan

Abstract - TBA

Hyper-heuristic Differential Evolution with Novel Boundary Repair for Numerical Optimization

Rui Zhong, Jun Yu, Masaharu Munetomo
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Abstract - TBA

Jump Like a Frog: Optimization of Renewable Energy Prediction in Smart Gird Based on Ultra Long Term Network

Xingbang Du, Enzhi Zhang
Graduate School of Information Science and Technology,
Hokkaido University, Sapporo, Japan

Abstract - TBA

Vision Transformer-based Meta Loss Landscape Exploration with Actor-Critic Method

Enzhi Zhang, Rui Zhong, Du Xingbang, Mohamed Wahib, Masaharu Munetomo
Graduate School of Information Science and Technology,
Hokkaido University, Sapporo, Japan

Abstract - TBA

Fast Computation Method for Stopping Condition of Range Restricted GMRES Method

Miho Chiyonobu, Masami Takata, Kinji Kimura, Yoshimasa Nakamura
Research Group of Information and Communication Technology for Life,
Nara Women's University, Nara, Japan

Abstract - TBA

Implementation of the OQDS Method for Principal Component Analysis

Miho Chiyonobu, Masami Takata, Kinji Kimura, Yoshimasa Nakamura
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Nara Women's University, Nara, Japan

Abstract - TBA

Explore Effective Attack Graph Generation on HPC Clusters

Ming Li
Tandy School of Computer Science,
The University of Tulsa, Tulsa, Oklahoma, USA

Abstract - TBA

The 23rd International Conference on Security & Management (SAM'24: July 22-25, 2024; Las Vegas, USA)

http://sam.udmercy.edu/sam24/
https://www.american-cse.org/csce2024/

Regarding the Exponential Growth of Security Vulnerabilities

Joline Wochnik, Olivia Sina Grauupner, Michael Spranger, Christian Hummert
Agentur fur Innovation in der Cybersicherheit GmbH, Halle (Saale), Germany;
Hochschule Mittweida, University of Applied Sciences, Mittweida, Germany

Abstract - TBA

Detecting Sybil Attacks in Decentralized Marketplaces

Meshari Aljohani, Ravi Mukkamala, Stephan Olariu, Mohan Sunkara
Department of Computer Science,
Old Dominion University, Norfolk, Virginia, USA

Abstract - TBA

Detecting Malware Traffic with Graph Neural Networks

Matthew Straughn, Armon Barton, Bruce Allen
Computer Science Department,
Naval Postgraduate School Monterey, California, USA

Abstract - TBA

Achieving Cyber Resilience in 5G-Enabled Microgrids Using Supervised Learning

Kim K. Trabandt, Bryan Eidson, Preetha Thulasiraman
University of Armed Forces, Munich, Germany;
Naval Postgraduate School, Monterey, California, USA

Abstract - TBA

Russian Cyber Disinformation Campaigns and Possible Countermeasures

LT Michael R. Williams, Neil C. Rowe
U.S. Naval Postgraduate School Monterey, California, USA

Abstract - TBA

Detection of Network Anomalies Using Unsupervised and Reinforcement Learning Models

Willie L. Waters, Mohamed Chouikha, Annamalai Annamalai
Department of Electrical Engineering, A&M University College of Engineering,
Prairie View A&M University, Texas, USA

Abstract - There has been much research on supervised ML for Network Intrusion Detection. With supervised learning, the ground truth (in the form of labels for each sample), are known. In unsupervised approaches, the labels are not known, such that training involves finding similarities and differences to the extinct that the samples can be clustered (or grouped). Clustering algo- rithms provide statistical techniques to accomplish classification of data into distinctive clusters. There are several methods of clustering and this research chose to demonstrate and compare the algorithms of Kmeans, Kmeans++, DBScan, Latent-Class Gaussian Mixture, and Learning Automata Clustering (LAC). We show that Learning Automata Clustering, a Reinforcement Learning algorithm, provides the highest accuracy (99.65%) of classifying the benign and malicious data samples. To our knowledge, this is the first evaluation of LAC for clustering network anomaly traffic.

An Optimized Key Schedule Algorithm of PRESENT-128 using Elliptic Curve Cryptosystem

Saleh Al-Sharaeh, Waleed Hisham Al-Fakiat
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The University of Jordan, Amman, Jordan

Abstract - Lightweight block cipher algorithms are essential to their throughput and high level of security, there are many applications that need this type of encryption, such as RFID, Credit Card, transfer data securely and integrity, etc. The PRESENT-128 is one of these algorithms based on the Substitution-Permutation Network (SPN) and Key Schedule Algorithm (KSA). In this research, in an attempt to increase key security and minimize key size, we propose an Optimized Key Schedule Algorithm based on Elliptic Curve Cryptosystem. The method analyzes and enhances the current key schedule to enhance the confusion test and key security. While ensuring high safety, it significantly reduces key size.

A Hybrid Risk Assessment Technique for Data Centers

Lorna Kangethe, Lei Chen
Department of Information Technology,
Georgia Southern University, Stateboro, Georgia, USA

Abstract - TBA

Determining the Secret Key in Hotel Card Lock Key Communication

Cheryl Hinds, Jonathan Graham, Thalia Guadalupe
Department of Computer Science,
Norfolk State University, Norfolk, Virginia, USA

Abstract - In this research, we investigate an example of the Learning Parity with noise (LPN) problem, the hotel key lock problem, discussed by Dr. Robert Kubler [4]. He proposed a solution using the decision tree classification problem. Our research indicated that this approach did not provide solutions for secret key values larger than n = 24. A tweaking of the Decision Tree parameters did not yield further success, neither did the Naïve Bayes approach. We tried a novel approach where we attempted to solve the problem by finding a vector c where Ac ≈ B + e, by finding vector c where the difference between Ac and B + e were minimal. This approach showed promise and should be further pursued.

Social Engineering: Financial and Psychological Effect

Francis Onodueze, Andre Kiah
Bowie State University, Maryland, USA

Abstract - This research explores the financial and psychological stress that a social engineering attack can have on a person or an entity. By researching the financial and psychological effects of social engineering, it will bring awareness to why it is important to know how to avoid the attack and what to do if anyone becomes a victim. Further, the research reflects how social engineering attacks have increased over the years and how they pose a high and critical threat to the world of cybersecurity. This research aims to distinguish the cause and effect of social engineering attacks, their techniques, and the financial and psychological measures that reflect on cybersecurity. In reference to the psychological and financial threats to humans, attackers can impose social engineering tactics which can leave the person with great stress and financial turmoil. By recognizing the threat of social engineering attacks, it will create more substantial methods and security measures to combat the ongoing threats. This research serves as an in-depth understanding of social engineering attacks and the impact it has on the world of cybersecurity and its psychological and financial risk amongst humans.

Adaptive Leadership in Public-Private Partnerships for Security Ehancement

Satpreet Singh
National University, Manteca, California, USA

Abstract - Public-private partnerships (PPPs) have emerged as crucial mechanisms for addressing contemporary security challenges by leveraging the complementary strengths of governmental and nongovernmental entities. Within this collaborative framework, effective leadership plays a pivotal role in navigating complex environments and fostering synergistic relationships between diverse stakeholders. This paper examines the concept of adaptive leadership within the context of PPPs for security enhancement. Drawing upon theoretical frameworks and empirical evidence, it explores the characteristics of adaptive leadership and its significance in facilitating successful partnerships between the public and private sectors. Through the analysis of case studies and examples from various security domains, this paper identifies key adaptive leadership strategies employed in successful PPPs, including building trust, fostering collaboration, and leveraging innovation. Furthermore, it addresses the challenges and limitations inherent in such partnerships, offering recommendations for strengthening adaptive leadership capacities and overcoming barriers to collaboration.

Network Intrusion Detection Based on Transformer Model

Shijun Tang
Department of Computer Science, Schreiner University, Kerrville, Texas, USA

Abstract - In this paper, we present a new technique based on the attention mechanism of transformer model; The proposed solution is a modified version of the transformer model which has been proposed and used in the language translation domain. We conduct experiments on a dataset containing several kinds of network attack. We have evaluated our performance results and demonstrated that the proposed model significantly has good precision, recall, and false positive rates. The experimental results indicate that the proposed approach is an efficient and effective in dealing with various attacks in networks.

Applying Hyperledger Fabric to a Credit Transfer Process - A Case Study

Wilson Rojas Reales, Santiago Acevedo Rodriguez, Fabian Gomez Cespedes
Universidad El Bosque, Colombia

Abstract - In recent years, blockchain technology has evolved by leaps and bounds, and its applicability across various sectors has increased. Since its inception, the financial sector has been the preferred field of application. However, blockchain technology can be applied to other sectors as well, and in the field of education, its applicability has primarily focused on issuing study certifications and diplomas. In the educational sector, the volume of information is continually growing, encompassing both academic and personal data. Therefore, it is necessary to employ security mechanisms to control access to information, ensure traceability, and maintain data integrity. The features offered by blockchain technology could be leveraged to explore other scenarios within the field of education beyond certificate issuance. Information theft and data manipulation are significant threats to the academic credit transfer process. The use of blockchain technology could mitigate these issues.

A Static Over-approximate Detection Tool for At-risk DLLs

Jack Berkowitz, Weihao Qu
Department of Computer Science and Software Engineering,
Monmouth University, West Long Branch, New Jersey, USA

Abstract - Dynamic Link Libraries (DLLs) are important components in the Windows operating system, which allows code modularity, rescue, and efficient resource management across different applications. This dynamic nature of DLLs also introduces security vulnerabilities, most known as injections. DLL injections can cause huge damage to the target Windows devices, for instance, the insertion of malicious code in the DLL address space allows attackers to manipulate or even compromise system behaviors. One way to prevent DLL injections is to detect potentially risky DLLs used in the Windows system early and frequently so more security checks can be performed to those risky DLLs when adversaries attempt to inject any malicious code into these DLLs. To this end, we design a static detection tool for risky DLLs that performs file integrity checks on DLLS of user-specified applications on Windows devices. Our tool maintains a list of DLLs in the past of those apps for reference and provides a list of "potentially risky" DLLs by comparing the referenced DLL list with the current DLL list of the specified app using our detection algorithm. We define the semantic of "potentially risky" by the fact that DLLs are usually stored in the expected directory and one DLL found in the expected directory in a new version of an application while not found in the expected directory in its older version can be regarded as potential tampering or injection introduced along with the update of this application. Based on this, our tool can be extended as part of antivirus software to frequently give a warning of those "potentially risky" DLLs introduced by auto-updating applications on Windows systems.

Enhancing User Active Authentication Through Keystroke Dynamics: Analysis of Individual Letter Characteristics and Classifier Performance

Alaa Darabseh, Xian Liu
Department of Mathematics, Engineering and Computer Science,
LaGuardia Community College, CUNY, New York, USA

Abstract - Our research addresses a critical issue in user authentication: the accuracy and reliability of keystroke dynamics-based systems. Specifically, we focus on the distinctive characteristics of individual letters and their influence on authentication accuracy, particularly in relation to the hold time feature. Utilizing the SelectFromModel feature selection technique alongside classifiers such as Random Forest, Support Vector Machine, Gradient Boosting, and Decision Tree Regressor, we conducted comprehensive experiments with real-world datasets. Our results identified letters like "W," "S," "U," "T," and "A" as particularly effective in capturing unique typing behaviors. These letters consistently showed high selection frequencies across classifiers, enhancing authentication accuracy. Although accuracy slightly declines with fewer features, the top-selected features maintain high accuracy levels, demonstrating the efficiency of our feature selection method in simplifying models without significant performance loss. Furthermore, our study highlights the robust performance of Random Forest and Support Vector Machine across different feature sets, underscoring their efficacy in authentication tasks.

An Analysis of Cyber Threats and the Protective Role of Cyber Insurance in the US Market

Zia Muhammad, Jeremy Straub
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North Dakota State University, Fargo, North Dakota, USA;
Institute for Cyber Security Education and Research,
North Dakota State University, Fargo, North Dakota, USA

Abstract - The emerging landscape of cyber threats is growing in complexity and impact. Cybersecurity continues to grow as a critical issue for small and medium-sized businesses, as cyber threats become more sophisticated. To build resilience against cyber threats, businesses need to implement both technical and financial measures. One such measure is risk transfer through cyber insurance. This article provides an analysis of the current state of cyber threats, discussing trends in cyber-attacks, based on a review of existing literature, publicly available datasets, and Federal Bureau of Investigation reports. It explores the sectors and industries most frequently targeted by cybercriminals and examines the role of cyber insurance in the protection and recovery of businesses in these sectors, with a particular focus on small and medium-sized businesses. Finally, the article discusses and assesses key policy reforms needed to ensure that businesses are able to get cyber coverage and insurers are able to continue to offer it.

The Role of Cyber Incident Response Plans in Securing Higher Education Institutions

Tanya Graham, D'Andra Bennett, Jameilia Jones, Shantae Coote, Jada Lawerence
University of Technology, Jamaica

Abstract - TBA

Subject Matter Experts' Feedback on Cybersecurity Footprint Index Measures to Assess Organizational Cyber Posture of Manufacturing Companies

John Del Vecchio, Yair Levy, Ling Wang, Ajoy Kumar
Nova Southeastern University, Florida, USA

Abstract - TBA

Federated Deep Learning-Based Framework for Intrusion Detection in Modbus Sensor Networks

Abir EL Azzaoui, Jimin Ha, Jungho Kang, Ji Su Park, Jong Hyuk Park
Department of Computer Science and Engineering,
Seoul National University of Science and Technology, Seoul, South Korea;
Department of Software Engineering, Baewha Women's University, Seoul, South Korea;
Department of Computer Science and Engineering, Jeonju University, Jeonju-si, South Korea

Abstract – TBA

Blockchain Technology Readiness in Engineering Project Management: Industry Experts. Perspectives

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Selina Amoah, Daniel O.T. Ihenacho
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Abstract – TBA

Value Embedding Approach for Access Control

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Abstract – TBA

Analysis and Improvement of MixColumn Operations in the Advanced Encryption Standard Algorithm

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Abstract – TBA

An Efficient Generation of Prime Numbers for RSA Encryption Scheme

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Abstract – TBA

An Adversarial Training Approach for Defending Against Object Misclassification in Smart Vehicles

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Abstract – TBA

Comparative Analysis of Black Box Attacks in Information Security

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Abstract – TBA

Analysis of Zero Day Attack Detection Using MLP and XAI

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Abstract – TBA

Unlocking the Power of Machine Learning in Cybersecurity Forensics: Identifying Malicious Files

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Abstract – TBA

Blockchain based Auditing for Enhanced Cloud Security: A Systematic Review

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Abstract - Although of the exponential growth in utilizing cloud computing services, still there are notable integrity concerns related to data storage over the cloud. Hence, a third-party auditor (TPA) is hired to confirm the accuracy of data that is stored externally on the cloud. While TPA offers advantages like impartiality and effectiveness, it does not fully mitigate the risk of deceitful auditors. Also, TPA can become a potential bottleneck to the system because it requires engagement with every cloud user and service provider. In this concern, Blockchain technology emerges as a promising solution, offering immutability, transparency, and improved trust in cloud security auditing. This research paper conducts a systematic literature review focusing on the application of various blockchain-based auditing techniques, to ensure data integrity in cloud storage. By thoroughly investigating and analyzing recent reported research methodologies, results and limitations, this paper aims to provide valuable insights and recommendations for future research and practical implementation in the field of cloud auditing.

Easy: Encryption-less Anonymity System

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Abstract – TBA

Robotics Process Automation in Cybersecurity Using Moveit Attack as a Case Study

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Abstract – TBA

Detecting Fake Accounts and Identifying Malicious URLs on Social Networks using Deep Learning

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Abstract – TBA

Adaptive Network Recovery: A Feedback-Driven Approach to Enhancing Resilience Against DDoS Attack

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Abstract – TBA

Nature-inspired Optimization Algorithms for Enhancing Phishing Intrusion Detection in Cloud-Based Systems

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Abstract – TBA

Intelligent Methods for Android Malware Detection: A Survey

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Abstract – TBA

Reverse Engineering the CAN Bus: Vulnerability Analysis in the Tesla Model

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Abstract – TBA

Unmasking ZetaXE: A Tool to Successfully Implement Social Engineering Attacks

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Abstract – TBA

Green Cybersecurity: An Evaluation of Antivirus Energy Consumption and Implications for Sustainable Software Engineering

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Abstract – TBA

Challenges in Blockchain Securities: Key Management & Decentralized Identity System

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Abstract – TBA

Managing Human Factors Vulnerabilities in the Risk Assessment Process

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Abstract - Risk assessment, a crucial component of an organization's information security risk management program, is heavily influenced by human decisionmaking. Human factor elements can affect decisionmaking, introduce vulnerabilities in the risk assessment process, and impact the deliverables. We aim to create awareness for organizations to focus attention and resources on reducing and capturing human error at the early stages of risk management programs. This paper delves into these human factors, exploring their impact on decision-making and risk assessment. We provide recommendations to address these vulnerabilities at all levels of the risk assessment approach, aiming to enhance organizations' overall information technology security.

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https://american-cse.org/csce2024/conferences-SERP
https://www.american-cse.org/csce2024/

Machine Learning Operations: A Mapping Study

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Abstract - Machine learning and AI have been recently embraced by many companies. Machine Learning Operations, (MLOps), refers to the use of continuous software engineering processes, such as DevOps, in the deployment of machine learning models to production. Nevertheless, not all machine learning initiatives successfully transition to the production stage owing to the multitude of intricate factors involved. This article discusses the issues that exist in several components of the MLOps pipeline, namely the data manipulation pipeline, model building pipeline, and deployment pipeline. A systematic mapping study is performed to identify the challenges that arise in the MLOps system categorized by different focus areas. Using this data, realistic and applicable recommendations are offered for tools or solutions that can be used for their implementation. The main value of this work is it maps distinctive challenges in MLOps along with the recommended solutions outlined in our study. These guidelines are not specific to any particular tool and are applicable to both research and industrial settings.

Shifting Gears: A Systematic Literature Review of Process Model Transitioning in Software Engineering

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Abstract - Process models are essential in guiding teams through the software development process. Initial process models, such as the waterfall model, offered clear and defined stages that must be completed sequentially before the next. However, they need to be more flexible and adaptable to the needs of businesses and their consumers. Newer process models are designed with versatility in mind, reflecting the ever-changing requirements of the software development industry to improve product speed and quality. The transition between process models can be complex and time-consuming, requiring careful coordination and training for many teams. Despite challenges, many groups recognize the benefits of newer process models that can help them respond to changing market demands. In this research, we conducted a systematic literature review (SLR) to find the current state of the process model transition. The Key concepts, challenges, and limitations are extracted from an SLR, and an empirical study is administered at Amazon and Experian. In the SLR, several factors for software process improvement are identified and further classified into seven categories. The responses are analyzed and compared with the current research literature to determine if the research literature properly covers real-world problems and challenges. Our findings show a disconnect between the current literature and realities experienced by process model practitioners and suggest areas for further research.

A Novel Architecture that Examines Network Activity in a Docker-based Multitenant to Verify Zero Trust Container Architecture (ZTCA) Compliance

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Abstract - The Zero Trust Container Architecture (ZTCA) security model ensures secure access control to applications within containers while trusting and verifying every access to each request. This research paper presents a multitenant architecture and a testing environment for analyzing and collecting Event ID data performance. This project will reveal if the testing environment demonstrates ZTCA compliance by designing and implementing a program to enhance visibility and secure multitenant environments using Docker containers to store and access data through Zero Trust Container Architecture's principle. In addition, the infrastructure and architectural framework for managing and deploying applications at scale that Microservices and Docker provide in a multitenant environment. Results show that Docker containers could verify ZTCA compliance using network activity recorded with the Event IDs.

VENUS: Designing a Validation Engine for User Stories

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Abstract - An incremental, agile approach to software development has become common with a lightweight approach to expressing requirements using user stories and frequent deployment using Continuous Integration and Continuous Deployment (CI/CD) pipelines. However, there is a gap between the lightweight requirements expressed so that non-technical stakeholders are able to understand the scope of the projects, and the information provided during incremental deployment. The latter should be useful and valuable in steering development efforts to desired outcomes earlier in the process. To bridge this gap, we propose a framework for adding information during deployment that relates to user stories. The framework can handle both functional and quality requirements expressed as user stories. We demonstrate VENUS, a prototype implementation of the framework using Buildkite and its CI/CD offering called Buildkite Pipelines. We illustrate the use of VENUS with a brief case study derived from a student project.

A Framework for Requirements Modeling of Safety Critical Systems: A Continuous Glucose Monitoring System Case Study

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Abstract - Developing safe and reliable systems goes beyond simply specifying what they should do but also to understand how they might fail. This paper proposes a framework for capturing both the desired functional requirements and the critical safety requirements of safety-critical systems. Our framework uses Extended Finite State Machines (EFSMs) to formally model both types of requirements. We introduce the concept of a "failing state," which is integrated into the normal behavior model, providing a comprehensive view of component operations. To demonstrate the practicality of our framework, we apply it to a safety critical healthcare device: the Continuous Glucose Monitoring System. This case study will show how our approach can enhance the design and analysis of safety-critical systems and ensuring their operation reliability.

Development of a Desktop Agent System Using GPT

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Abstract - In this study, we developed a desktop agent system that automatically operates a GUI as desired by the user through natural language interaction between the user and the agent. In this system, the user can interact with the agent using speech recognition. The agent interprets the user's input using GPT-3.5 and executes tasks. The agent interprets the user's input using GPT-3.5 and using image analysis of the desktop screen, and executes tasks properly. Tasks are performed automatically and in the same way that users normally use GUI, e.g. by moving the mouse cursor, clicking icons, typing from the keyboard.

Plan-based and Agile Companies: A Comparison of Project Management Approaches

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Abstract - Background Agile Methods have been around for nearly 25 years, yet there is still ongoing debate about their effectiveness in improving software development. Project management remains one of the most critical aspects of Agile Methods. Objective This paper examines how Agile companies implement project management compared to those using plan-based approaches extending the works performed in 2005 and 2016-2019 by some of the authors. Methodology The research problem is defined using the Goal Question Metric approach. A questionnaire was developed and administered to senior staff members of 152 companies over five years (2018-2023). Results The results of the research highlight that even if some important differences exist, all the companies approach project management in similar ways: many approaches that are considered Agile are used in Plan-Based companies as well. Comparison with the previous studies Compared to the previous studies of the authors, there is a stronger alignment in the usage of the approaches making the two groups nearly indistinguishable. Moreover, compared to the study of the 2005, Agile is now mainstream and widely adopted and understood in many application domains.