

Book of Abstracts

2025 International Conference on Recent Advances in Information Systems (ICRAIS)

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Editors

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Preface

We are pleased to present the Book of Abstracts for the 2025 International Conference on Recent Advances in Information Systems (ICRAIS). The research compiled within this volume showcases the evolution of information systems, increasingly shaped by advancements in artificial intelligence. A central theme is the integration of AI and machine learning not as standalone technologies, but as core components that enhance the design, function, and impact of modern information systems.

This is reflected in a broad spectrum of research. Readers will find explorations of foundational architectures for distributed information systems, such as Federated Learning and Retrieval-Augmented Generation (RAG), alongside studies on how these technologies are embedded into systems for complex tasks like financial risk analysis, cyber threat intelligence, and internal auditing. The practical utility of computer vision is also a key focus, with papers demonstrating how it is integrated into systems for industrial inventory management, agricultural monitoring, and enhancing traffic safety. Beyond business applications, the papers investigate critical security and architectural issues, from mitigating modern phishing attacks to understanding the impact of quantum computing on the underlying security of information systems.

Furthermore, the scope of this work extends beyond technical implementation to address the role of information systems in tackling pressing societal challenges. Several contributions examine the function of technology in education, addressing both the potential of AI to create new learning paradigms and the persistent challenges of academic integrity. The theme of sustainability is also prominent, with research on AI-driven tools for climate change mitigation and the design of information systems for smart city initiatives. These abstracts reflect the global and collaborative nature of our field, bringing together perspectives on how information systems can support everything from supply chain resilience to responsible AI development in different economic contexts.

We hope this collection serves as a valuable reference for attendees and the wider research community, providing insight into current trends and acting as a catalyst for future discussions and collaborations. We are grateful to all authors, reviewers, and session chairs who have contributed to making this conference a success.

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Session 1

Session Chair: Hauke Precht

Decentralized Federated Learning using Transformer-based Language Models

Paper ID: P61

Gerrit Schumann, Carsten Montag, Lars Steffens, Michael Karl and Jorge Marx Gómez

Abstract. When simulating federated learning scenarios, most studies use a centralized learning architecture in which a global server performs the orchestration of the individual clients and the aggregation of the associated weights. Decentralized federated learning (DFL) clusters, on the other hand, are rarely investigated, although they can counteract disadvantages such as "single point of failure" or limited scaling options. Furthermore, Transformer-based language models have not yet been investigated in DFL clusters, although they are still the de facto standard in the field of natural language processing. In order to investigate how such model architectures can be trained in a decentralized federated manner and which influencing factors play a decisive role, this study presents the implementation of three peer-to-peer topologies (Ring, Wheel, Fully connected) for a DFL cluster and their evaluation using the well-known text classification problem "Contradiction Detection". The results of this case study show that the use of the "Fully connected" topology leads to faster and more stable convergence (model divergence of 0.38), while "Ring" and "Wheel" topologies initially exhibit greater fluctuations (model divergence of up to 0.53).

Keywords: Decentralized Federated Learning, Peer-to-Peer, Gossip Protocol, Transformer Model, Text Classification, Contradiction Detection

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Leveraging Large Language Models for supporting Cyber Threat Analysis

Paper ID: P72

Fabian Rybinski, Demian Frister, Gunther Schiefer and Marzieh Malekzadeh Mahani

Abstract. The efficient and accurate analysis of cyber threat data is crucial in the constantly evolving cybersecurity landscape. However, a major challenge lies in the vast amounts of unstructured, human-readable information that is often used for threat intelligence communication, such as threat reports and news articles. While structured formats like STIX (Structured Threat Information eXpression) enable effective machine-to-machine exchange of threat data, they often lack the contextual information needed by human analysts. This paper proposes a novel framework that leverages Large Language Models (LLMs) to bridge the gap between unstructured text and structured cyber threat intelligence. The key contributions of this work are twofold: (1) Automating the conversion of unstructured cyber threat data into the standardized STIX format, enabling the efficient incorporation of diverse threat intelligence sources into automated analysis and sharing systems. (2) Generating human-readable reports and insights from structured STIX data, tailored to the needs of different personas within an organization, such as CISOs, security analysts, executives, etc. By combining the power of LLMs with structured threat data formats, the proposed framework improves the efficiency, accessibility, and interpretability of cyber threat intelligence. The evaluation of a prototype implementation demonstrates the accuracy of unstructured-to-structured conversion, the quality of the generated reports, and the positive feedback from users across various roles. This research contributes to the field of cybersecurity by enhancing the flow of critical threat information, streamlining cross-platform communication, and ultimately supporting more effective and informed decision-making in cyber defense.

Keywords: Large Language Models, Cyber Security, Structured Threat Intelligence, STIX, Automated Conversion

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A Comprehensive Comparison of Federated Learning Frameworks

Paper ID: P32

Jonas Boekhoff, Jan-Philipp Awick, Lars Steffens, Michael Karl and Jorge Marx Gómez

Abstract. Federated Learning is a Machine Learning paradigm that allows institutions to train models on distributed data while preserving data privacy. The selection of a suitable framework is a crucial step in designing a Federated Learning System, as the choice can influence the capabilities and limitations of the system. While previous research has mainly focused on comparing Federated Learning functionalities, other important criteria, such as usability, technical performance, and legal aspects have often been addressed only partially or overlooked entirely. To address this gap and support informed framework selection, we conducted a comprehensive comparison of Federated Learning frameworks. Frameworks were identified through a literature review and an analysis of GitHub repositories. The comparison considers five relevant comparison criteria: (1) Federated Learning functionalities, (2) user-friendliness, (3) technical aspects, (4) legal aspects and (5) performance evaluation.

Keywords: Federated Learning, Framework Comparison, Benchmark

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Large Language Models for Qualitative Risk Analysis in Banking: A Systematic Review

Paper ID: P69

Jan-Hendrik Witte and Henry Eggers

Abstract. This systematic review examines the emerging role of Large Language Models in enhancing qualitative risk analysis within banking credit risk management. We identify five key application domains: credit scoring and default forecasting, comprehensive risk assessment, document analysis and report generation, fraud detection, and regulatory compliance. Various models, from general-purpose LLMs like GPT-4 to domain-specific models like Fin-BERT, demonstrate significant potential for improving predictive accuracy by integrating unstructured textual data with traditional financial metrics, while simultaneously increasing operational efficiency. Despite these advancements, critical challenges persist: data quality and privacy concerns, limited model explainability, computational resource requirements, and regulatory compliance complexities. For financial institutions, effective LLM implementation implies enhanced decision-making precision and operational efficiency, but necessitates strategic investments in technology infrastructure, talent development, and governance frameworks. Future research should prioritize developing explainable financial LLMs, privacy-preserving techniques for sensitive data, optimized architectures for resource efficiency, hybrid models combining LLMs with traditional analytics, and comprehensive regulatory frameworks balancing innovation with ethical considerations. These developments could transform qualitative risk analysis from a resource-intensive manual process to a scalable, consistent, and comprehensive assessment mechanism.

Keywords: Large Language Models, Credit Risk Management, AI in Finance

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Session 2

Session Chair: Jan-Hendrik Witte

Optimizing Inventory in Outdoor Warehouses: A Drone-Based Approach Using Photogrammetry and Computer Vision

Paper ID: P12

Steffen Meeuw

Abstract. Efficient inventory management is critical for modern supply chain operations, yet traditional manual inventory processes in warehouses remain labor-intensive, often prone to human error due to their repetitive nature, and costly. While drone-based inventory auditing has demonstrated effectiveness in indoor warehouses, its application to outdoor warehouses remains underexplored. Unique challenges such as the absence of fixed orientation points and the diverse nature of stored products hinder straightforward adoption. This paper addresses these challenges by introducing a novel drone-based inventory system specifically designed for outdoor storage environments, where products are stored on handling units such as pallets. To ensure broad applicability, an abstract spatial representation of outdoor warehouses is developed. The proposed system integrates photogrammetry and computer vision techniques to capture aerial and front-view images, enabling automated inventory recognition and digital warehouse modeling. A real-world field experiment compares the drone-based inventory approach with traditional manual counting, demonstrating substantial improvements in efficiency, accuracy, and workforce optimization. The results indicate reduced labor dependency, enhanced digital traceability, and improved operational cost efficiency. While technical challenges affecting detection accuracy persist, this study contributes to scalable, automated inventory solutions, advancing supply chain digitalization in outdoor warehouse management.

Keywords: Inventory Management, Computer Vision, Outdoor Warehouses, Drones, Photogrammetry

Network Structural Analysis of Digital Technology Adoption for Human-Centric Teaching and Learning Models

Paper ID: P37

Anass Bayaga and Liile Lekena

Abstract. This research examines the adoption of digital technologies in higher education utilizing network structural analysis and focusing on human-centric teaching and learning models. The research is anchored upon extant gaps including inconsistencies in global research output, limited interdisciplinary diffusion, and challenges in aligning technological advancements with ethical and pedagogical frameworks. The goals are to map collaborative networks, uncover interdisciplinary configuration, and evaluate the combination of AI-driven tools into teaching frameworks. The methodology utilized bibliometric data from Scopus and Web of Science (2015–2025) and employed visualization tools like Networkx to analyse citation pathways, and keyword co-occurrence networks. Results suggest robust regional partnerships but a lack of international inclusivity, with advanced regions dominating research groups. Ethical questions and faculty inclination surfaced as substantial barriers to incorporating AI-driven tools and immersive technologies into pedagogy. The thematic development revealed an increasing focus on adaptive learning, differentiated pedagogy, and ethical consequences. These conclusions emphasize organised pathways including Strong regional collaborations → Limited global inclusivity → Ethical and faculty readiness challenges → Evolving focus on adaptive learning and personalized pedagogy. These configurations exhibit how gaps in international impartiality, interdisciplinary incorporation, and ethical frameworks are unified, modeling the research environment.

Keywords: Digital Education, Network Structural Analysis, Human-Centric Learning, AI and Ethics

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HERAG: A Holistic Approach for Evaluating Organizational RAG Applications

Paper ID: P58

Felix Kleinekathöfer, Felix Dick, Alina Ahrens, Tobias Oltmanns, Steffen Meeuw, René Kessler and Jorge Marx Gómez

Abstract. Retrieval-Augmented Generation (RAG) systems are becoming increasingly vital in enterprise environments due to their potential to streamline access to internal knowledge, support onboarding, and improve decision-making. As this technology gains traction, the need for effective evaluation methods becomes critical—yet current approaches remain fragmented and technically limited. This paper introduces HERAG, a holistic, tool-agnostic framework for systematically assessing RAG systems across all pipeline stages—from data ingestion and indexing to retrieval, generation, and metric analysis. Unlike existing approaches that focus narrowly on performance metrics, technical implementations, or QA-based black-box evaluations, HERAG offers a structured evaluation matrix that enables modular, transparent, and context-aware assessments. It supports a wide range of configurations and enterprise-specific scenarios, helping practitioners identify impactful parameters, document system design decisions, and optimize performance. We demonstrate HERAG’s practical applicability through a case study on retrieval quality within a corporate Q&A system, showing how different embedding models and top-k values significantly affect performance. HERAG empowers developers and researchers to conduct comprehensive, comparative evaluations and build more robust, effective AI-assisted information systems.

Keywords: Retrieval Augmented Generation, Large Language Models, Enterprise Information Retrieval, Evaluation Framework, RAG Evaluation

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Analyzing Student Gaze Behavior in Classroom Settings: A Computer Vision Approach for Multi-Person Attention Detection

Paper ID: P59

Florian Voßmann, Steffen Meeuw, Jan-Hendrik Witte, Ines Oldenburg and Jorge Marx Gómez

Abstract. This paper presents a novel computer vision pipeline for simultaneously tracking the gaze direction of multiple students in authentic classroom environments using a single blackboard-mounted camera. While student attention is widely recognized as critical for effective knowledge acquisition and has been extensively investigated in educational research, traditional methodologies for assessing attention have predominantly relied on structured behavioral observation protocols or self-report measures, with eye-tracking applications limited to capturing the teacher's perspective. These methodological constraints present a significant research gap, particularly for understanding attentional patterns among students with specialized learning needs. Our approach addresses this gap through a six-stage processing pipeline that transforms classroom video data into quantified gaze direction measurements for each detected individual. We demonstrate potential applications through a classroom setup experiment with 12 students and one teacher, enabling both continuous tracking of students' gaze behavior over time and target-specific attention analysis. The pipeline offers new possibilities for understanding classroom dynamics at scale while preserving ecological validity without requiring specialized per-student hardware. Future work should focus on comprehensive validation with ground truth data, enhancing environmental robustness, optimizing computational efficiency, and examining relationships between visual attention patterns and learning outcomes.

Keywords: Gaze tracking, Classroom attention, Computer vision, Multi-person analysis, Educational technology

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The Use of Artificial Intelligence Tools to Support Post-graduate Research

Paper ID: P41

Andre Calitz and Margaret Cullen

Abstract. Artificial Intelligence (AI) can transform traditional research practices. AI is not simply augmenting research with advanced tools, instead, it is starting to disrupt established methodologies, ethical paradigms and fundamental principles that have long guided scholarly work. This possible automation of research has caused concern because of ethical issues; however, AI has impacted the academic research process by allowing greater efficiency and productivity for researchers. Students have perceived the use of AI tools positively, however, this research aims to gain a better understanding and further contextualisation of AI-based tools to support scientific research in post-graduate studies. The qualitative study collected data from MBA students using an online survey. A thematic analysis of the open-ended questions was conducted using the AI tools Claude-AI and ChatGPT. The results indicate that the students' use of ChatGPT for research and that training for AI-assisted research is required. The respondents were aware of the ethical issues and indicated their intention to make use of other AI tools for research purposes.

Keywords: AI tools, Post-graduate students, Research

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Session 3

Session Chair: Jan-Philipp Awick

An Exploration of the impact of AI Capabilities on Supply chain Resilience in Mauritius

Paper ID: P115

Loovesh Sharma Ramwodin and Doorgesh Sookarah

Abstract. This study examines the role of Artificial Intelligence (AI) in enhancing supply chain resilience in Mauritius. The COVID-19 pandemic exposed vulnerabilities in global and local supply chains highlighting the need for technologies that mitigate disruptions and ensure continuity. As a technological enabler, AI offers transformative tools such as machine learning, predictive analytics, AI-driven bots, and big data all of which improve supply chain adaptability, responsiveness, and robustness. Using a qualitative, exploratory design, the study draws on a comprehensive literature review and focus group discussions with procurement managers from 20 large organizations across various sectors in Mauritius. Six key AI capabilities: automated compliance, predictive analytics, AI bots, algorithms, machine learning, and big data were assessed for their impact on supply chain resilience. Findings indicate these technologies significantly enhance visibility, forecasting accuracy, risk assessment, and agility. Focus group insights confirm AI's practical value in real-time decision-making, logistics optimization, warehouse automation, and inventory management. The study presents a conceptual framework linking AI capabilities to supply chain resilience. While global research has explored AI in supply chains, localized studies in small island developing states remain scarce. This paper addresses that gap by providing one of the first assessments of AI's contribution to supply chain resilience in Mauritius thus offering a basis for future empirical validation and informing strategic decisions in digital transformation.

Keywords: AI-Capabilities, Supply chain, Supply chain Resilience

Key Insights on the Use of Quantum Computing in Breaking Cryptographic Algorithms

Paper ID: P40

Khemant Nirvaan Degambur and Girish Bekaroo

Abstract. Quantum computing utilises the principles of superposition and entanglement to perform certain computations exponentially faster than classical systems and this poses significant threats to classic cryptographic frameworks. Recent studies focused principally on developing or reviewing security methods based on classical cryptography and quantum cryptography, but limited studies synthesised insights using a structured approach. Taking cognizance of the need to advance literature in this area, this study critically examines the growing influence of quantum computing in cybersecurity, both as a disruptive force capable of breaking classical encryption and as a foundation for next-generation security paradigms. Through a structured investigation of four key research questions, the study explores quantum supremacy, the vulnerability of existing cryptographic systems, and the evolution of post-quantum defences. A focused analysis of the quantum development timeline is also undertaken, offering insights into the pace of technological advancement and informing strategies for proactive preparedness against quantum-enabled threats. Findings highlight the critical vulnerabilities in public-key cryptosystems, which are especially susceptible to Shor's algorithm, while symmetric systems face a reduced but still significant, security margin due to Grover's algorithm. Among the proposed post-quantum cryptographic (PQC) alternatives, lattice-based, hash-based, and code-based schemes emerged as leading candidates, with lattice-based protocols like CRYSTALS-Kyber gaining traction through standardization efforts. A strategic transition toward quantum-resilient infrastructures, supported by forward-looking policies, global standardization efforts, is imperative to safeguard critical systems and ensure long-term cybersecurity in the quantum era.

Keywords: Quantum Computing, Cryptographic Algorithms, Post-Quantum Cryptography, Quantum Threats, Shor's Algorithm, Grover's Algorithm, Qubits

Evaluating AI as a Tool for Climate Change Risk Mitigation: A Systematic Literature Review

Paper ID: P76

Hannah Brown, Sonali Das and Marié Hattingh

Abstract. Artificial Intelligence (AI) is increasingly being used by various decision-makers to access information for the management of different risks associated with their businesses. Climate change is one such risk that is pervasive across almost all industries, with no exceptions to location, with some nations more equipped to survive than others. To evaluate literature on how AI is used to inform climate change risk mitigation and adaption strategies, in this paper we adopt a systematic literature review methodology following Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. We sourced literature from the Web of Science, EBSCOhost, Emerald Insights and ScienceDirect using keywords that are reflective of the interdisciplinary relationships between AI, climate change, climate services, and risk management. In total, 65 papers met the inclusion criteria of our search. Our findings revealed that while AI tools reap many benefits, including task simplification, its value as a research tool, and its decision-making capabilities, its shortcomings are not to be overlooked. These include AI's potential to generate biased and inaccurate content, its lack of an ability to cater to context, and its intense energy requirements. Further, findings established that the topic of AI-assisted climate change-induced risk management overlooks considerations of how indigenous communities fit within it. This presents a gap that calls for further research and contribution to the corpus, particularly from and of the Global South, including low-resourced language representation, which was found to be lacking at the time of the writing of this paper.

Keywords: artificial intelligence, climate change, climate services, systematic literature review

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Paradigm Shift in Education Using AI in Mauritius - A Global Perspective with Comparative Analysis

Paper ID: P74

Dineshen Chuckravanen, Abdallah Peerally and Nishtee Gopee

Abstract. The traditional education paradigm, centered on rote memorization and standardized assessments, is increasingly inadequate in preparing learners for a rapidly evolving digital society such as Mauritius. Artificial Intelligence (AI) has emerged as a transformative force, enabling personalized learning, adaptive assessments, and data-driven decision-making. This meta-review synthesizes research from Mauritius, Africa, and global contexts (UK, USA, Europe, China, India) over the past decade (2014 – 2024) to analyze AI's impact on education. themes include AI's role in catering to diverse learning styles, identifying student needs, providing tailored resources, facilitating decision-making, and adapting learning environments. A comparative analysis of recent studies highlights trends, gaps, and best practices. Challenges such as ethical concerns, digital divides, and teacher readiness are also examined. The paper concludes with policy recommendations to foster equitable AI integration in education in Mauritius as well as it can be adopted globally.

Keywords: AI in education, personalized learning, adaptive learning, intelligent tutoring systems, Mauritius

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Session 4

Session Chair: Gerrit Schuhmann

Preliminary results of the AI supported detection of cyclists and related overtaking situations

Paper ID: P102

Johannes Schering, Maximilian Bosse, Fatih Karahan, Jorge Marx Gómez, Daniel Mentrup and Johannes Wilbers

Abstract. Traffic safety is a key factor to make cycling more attractive. The detection of critical overtaking situations is a topic that is not well reflected by existing research. In this context, the research project BikeDetect tries to identify sensor and AI supported approaches to improve cyclist detection in real traffic scenarios. As part of this research, we present as a first step the results of a requirement analysis regarding type and functionalities of the required sensors (ultrasonic, LiDAR etc.) and potential AI models. Several existing AI models were identified that potentially may be applied to the data that is gathered as part of the project. As we will see, there are models with implementations for Faster R-CNN, SSD and YOLOv8 with a lot of potential for implementation available. It is also observed whether there could be technical approaches as an alternative to image based object detection. Based on the selected sensors, a first test study outside of the real traffic situation was conducted to gather initial data. A suitable data management including an ETL process was designed. First visualizations of the sensor data show that the distance measurements may be realized by the selected sensors. Based on the camera data we received, an image-based model was obtained by training a YOLO model on a pre-trained dataset. Preliminary results regarding the applicability of the existing model will be presented. In the end, a summary of the results and an outlook to future research will be presented.

Keywords: Artificial Intelligence, cycling, traffic safety, object detection, LiDAR, radar, ultrasonic, infrared

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A Systematic Literature Review of Reference Architectures in the Blockchain Domain

Paper ID: P57

Hauke Precht and André Calitz

Abstract. With the advent of blockchain technology, the domain of blockchain oriented software engineering emerged. While research focuses especially on the development, verification, and testing of smart contracts, the employed architectural methodology is scarcely researched. Especially the lack of insights into the adoption of reference architectures in the blockchain domain is noticeable despite the fact that reference architectures hold the potential to ease and standardize the development of similar systems. To investigate the current applications of reference architectures in the blockchain domain, we conducted a systematic literature review combined with a qualitative content analysis. Specifically, we examine the underlying methodologies, definitions, evaluation strategies, and thematic focus of the identified reference architectures. Our analysis reveals that most papers lack a solid theoretical foundation. Consequently, we advocate for greater scientific rigor in future research, including the integration of established methodologies for reference architecture development in the field of blockchain oriented software engineering. Our findings enrich the existing body of knowledge by offering a comprehensive overview of the current state of reference architectures in the blockchain domain and identifying key shortcomings to inform future research directions. Furthermore, this overview serves as a valuable resource for practitioners aiming to develop their own blockchain-based systems.

Keywords: Reference Architecture, Blockchain, Systematic Literature Review, Blockchain Oriented Software Engineering

AI-Powered Interactive Technologies and Cognitive Engagement in Mathematics: A Generational Cohort PLS-SEM and ANN Approach

Paper ID: P38

Anass Bayaga

Abstract. This study explores cognitive engagement in mathematical problem-solving across generational cohorts using artificial intelligence (AI)-enabled tools. Key hypotheses include: (H1) mathematical modeling and simulation (MMS) influences mathematical performance (MP), when mediated by maths computational algorithms (MCA) and moderated by generational cohort; and (H2) abstract-concrete principles (ACP) mediate the MMS and mathematical achievement (MAS) relationship, moderated by prior technological exposure. The research employs a cross-sectional survey with 71 participants analyzed via partial least squares structural equation modeling and artificial neural networks- multilayered perceptron (ANN-MLP). The results reveal significant paths from MCA to ACP ($\beta = 0.69, p < 0.001$) across cohorts, indicating MCA's strong influence on cognitive engagement. The MMS-MCA relationship ($\beta = 0.23, p = 0.05$) and MCA-MP ($\beta = 0.4, p < 0.01$) are similarly strong, affirming MCA's role as a key mediator for MMS's effect on MP. However, the ACP-MAS path is non-significant ($\beta = 0.09, p = 0.58$), indicating a weaker link between foundational principles and achievement. Findings advocate universal design learning (UDL) principles in educational technology to optimize engagement across diverse learner backgrounds. Future research should explore motivational and contextual factors influencing AI tool efficacy to refine educational practices that universally support cognitive engagement.

Keywords: Cognitive Engagement, AI-powered tools, Mathematical Problem-Solving, Generational Cohort Analysis, Multi-Group Analysis

A Review of Academic Integrity and Cheating at a Higher Education Institution

Paper ID: P43

Margaret Cullen and Andre Calitz

Abstract. Academic dishonesty or misconduct has a long-standing history in education. Academic integrity is a moral code of conduct that students can trust so that everyone's work is their own and was performed in an honest, truthful way. The Artificial Intelligence (IA) environment has created several new challenges and increased opportunities for academic misconduct, specifically cheating. Academics new to the use of AI tools and the modern assessment environment do not know how to manage the use of ChatGPT and cheating services offered to students. In this mixed methods study, academics, who have experienced cheating in the courses they presented, as well as students, share their observations regarding cheating. The academics and students associated with the large South African Higher Education Institution agreed that collusion and plagiarism are the most frequent types of cheating observed. The fact that no serious disciplinary consequences were enforced and published by the institution was highlighted as to why cheating occurs and has increased. The study highlights the major implications that cheating has on all academic stakeholders, including the institution, academics, students and industry. The prevalence of lack of academic integrity and the evidence of dishonest behaviour suggest that HEIs struggle with students' lack of integrity and the apparent lack of knowledge about how to apply the conventions of academic integrity and how important it is to do so.

Keywords: Academic integrity, Cheating methods, Student cheating

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Automated Detection and Tracking of Individual Piglets for Real-Time Behavioral Monitoring

Paper ID: P31

Jan-Hendrik Witte, Dante Nicolai Ahrens and Jorge Marx Gómez

Abstract. Automated monitoring of piglet behavior offers potential benefits for animal welfare assessment in modern pig production. This paper describes a system for individual piglet detection and tracking in farrowing environments using standard RGB cameras. We evaluated several deep learning architectures to address the specific challenges of farrowing pens, where piglets often cluster together, partially occlude one another, and move unpredictably. Comparative testing showed that a YOLOv5l detector combined with a SORT tracking algorithm achieved promising results (98.6% MOTA, 93.9% IDF1) at 38 frames per second under controlled test conditions. The system extracts basic behavioral metrics including total distance traveled, average speed, and idle time, with mean squared errors of approximately 0.01 when compared to manual annotations. These preliminary metrics may contribute to automated activity analysis related to piglet welfare status. Our results suggest that individual tracking in farrowing environments is feasible with conventional hardware, though performance may vary under different farm conditions. The current implementation focuses on fundamental movement parameters, with limitations in tracking stationary objects and distinguishing between tightly clustered piglets. This work represents an incremental step toward precision livestock farming applications, potentially supporting more targeted welfare monitoring in commercial settings when further developed and validated across diverse environments. The datasets used in this study are made publicly available.

Keywords: precision livestock farming, piglet tracking, computer vision

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Session 5

Session Chair: Steffen Meeuw

Enhancing User Experience in Smart City Tools: A Design Science Approach to Patent Dashboard Innovation

Paper ID: P53

Timothy Musharu and Jorge Marx Gomez

Abstract. Smart city initiatives increasingly rely on data-driven tools to advance urban sustainability. Yet, many solutions fail due to poor user experience (UX) design and misalignment with global sustainability frameworks like the United Nations Sustainable Development Goals (SDGs). This paper addresses this gap by applying Design Science Research (DSR) methodology to develop and evaluate a patent dashboard prototype geared for smart city applications. The study focuses on two interrelated challenges: (1) the lack of intuitive interfaces in existing patent analytics tools, which hinders adoption among non-technical stakeholders, and (2) the absence of explicit linkages between patent data and SDG targets, limiting their utility for sustainable urban innovation. Through iterative DSR cycles, a functional prototype was built using the MEAN stack (MongoDB, Express.js, Angular, Node.js), integrating features such as SDG-aligned patent filters and role-based dashboards for policymakers, analysts, and researchers. The dashboard's UX was rigorously evaluated via the User Experience Questionnaire (UEQ) with 15 participants representing business intelligence smart city roles. Results revealed strong scores in efficiency (Avg. 5.6/7) and practicality but highlighted opportunities to enhance stimulation (Avg. 4.1/7) and novelty (Avg. 3.9/7). Qualitative feedback further underscored the tool's potential to democratize access to green technology trends, directly supporting SDG 9 (Industry, Innovation), SDG 11 (Sustainable Cities) and contributing to SDG 17 (Revitalize the Global Partnerships). This work contributes to the fields of Human-Computer Interaction and Sustainable IT Practices by demonstrating how user-centered design principles can bridge technical functionality and societal impact. It also offers a replicable framework for cities seeking to align digital transformation strategies with global sustainability agendas.

Keywords: Smart Cities, User Experience (UX), Design Science Research (DSR), Sustainable Development Goals (SDGs), Patent Analytics

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Organizational Values and Practices for Hybrid Agile Teams

Paper ID: P84

Roelof Briers and Maureen Tanner

Abstract. This study explores the values and practices relevant to agile teams operating in a hybrid environment. It was conducted given the rise in hybrid work models after the Covid-19 pandemic. This rise further leads to the need to understand the values and practices that ensure a cohesive and supporting work environment in that work context. The Competing Values Framework (CVF) was employed as a lens to identify the organizational cultural traits that could be manifested in a hybrid work context. During a case study, semi-structured interviews were conducted, of participants across several teams demonstrating cultural traits from the CVF. In the Clan quadrant, trust, empathy and respect emerge as essential for maintaining team cohesion and building relationships. Team interaction and engagement, an ability to self-organize, and the promotion of psychological well-being are also identified as relevant practices. In the Adhocracy quadrant, flexibility is valued. There is also a need for innovative technologies to support day-to-day work. In the Hierarchy quadrant, accountability, consistency and transparency are valued, as well as practices related to planning and coordination and knowledge sharing. Lastly in the Market quadrant, hybrid agile teams value proactiveness and ensure that they maintain good stakeholder involvement. This research contributes to the growing body of literature on hybrid work models and provides additional insights into organizational culture and hybrid work practices during agile software development. It highlights the need for organizations to adapt cultural values and practices to support hybrid work, ensuring that teams build strong relationships while remaining productive

Keywords: Agile, Competing Values Framework, Organizational Culture, Hybrid Work.

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Deep learning for detection and quantification of *Bactrocera dorsalis* in intelligent electronic fruit fly traps

Paper ID: P80

Florence Lello, Elizabeth Mkoba and Mussa Dida

Abstract. This research aims to implement a state-of-the-art (SOTA) deep learning model for detecting and counting Oriental fruit flies in mango farms, facilitating efficient pest management through electronic traps. The study proposes designing and modifying You Only Look Once (YOLO) model to monitor the species in real-world environment settings using low-resource constrained devices. Images of the flies were collected in real-world environment (mango orchards), pre-processed, and annotated to create a dataset. From the conducted experiments, YOLOv8n (frozen) demonstrated good performance in terms of mean average precision at 50% Intersection over Union (mAP@50), F1-score, precision, and recall, outperforming other models and achieving the highest mAP@50 (98.72%), F1-score (97.20%), precision (97.54%), and recall (96.87%). The proposed method integrates a YOLO-based deep learning model into a Raspberry Pi4 for accurate detection of the flies. The use of a simple, well-designed electronic trap combined with a clear white background enhances the visibility of captured flies in the images, thereby improving detection and counting accuracy to above 97% while ensuring cost-effectiveness and ease of deployment.

Keywords: Oriental fruit fly, Deep learning, YOLO, Object detection, Electronic trap

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AI Implementation in African Development: The Contextual Necessity Framework

Paper ID: P97

Errol Francke

Abstract. While artificial intelligence (AI) is reshaping global economies and societies, Africa faces the complex challenge of integrating AI meaningfully without exacerbating existing inequalities. Inspired by a presentation delivered at the "Smart Technology & Smart Research Seminar" at the University of Economics in Katowice, Poland, this paper critically engages with the African Union's Continental AI Strategy, the European AI Action Plan, findings from the SA Innovation Summit 2024, and insights from the African Institute for Entrepreneurship's 2024 study. Although the literature reveals promising innovations and a growing awareness of ethical and contextual challenges in African AI adoption, it lacks a unified framework for guiding decision-making. This study addresses that gap by introducing a new theoretical model to help determine where, when, and how AI can be ethically and effectively implemented across diverse African contexts. A key scientific contribution of this research is the introduction of the Contextual Necessity Framework (CNF), a novel theoretical model designed to guide context-sensitive AI implementation. Through qualitative document analysis, conceptual framing, African case studies, and targeted policy recommendations, the CNF emphasizes a human-centered, youth-driven approach to AI. This study argues for a distinctly African AI future rooted in ethical governance, youth empowerment, strategic infrastructure investment, and the promotion of decent, dignified work.

Keywords: Contextual Necessity Framework (CNF), Artificial Intelligence Implementation, African Development

Bridging the Gap Between Curricula and the Labor Market: The Role of Predictive Models in Shaping Educational Relevance

Paper ID: P91

Yolisa Luwaca, Boniface Kabaso and Waldon Hendricks

Abstract. This paper presents a systematic review of predictive models developed to align university curricula with evolving labour market demands, with the broader aim of addressing graduate unemployment and skills mismatches. Drawing from the analysis of 37 peer-reviewed studies, the review identifies key limitations in current approaches, including reliance on static datasets, limited regional specificity, algorithmic bias, and institutional barriers to adopting predictive analytics in higher education. The findings point to several emerging opportunities, such as the use of real-time labour market data through LinkedIn APIs and the application of fairness-aware machine learning techniques to improve transparency and accountability. Overall, the review underscores the need for future research to develop dynamic, context-sensitive, and ethically robust predictive frameworks that support curriculum adaptability and advance workforce readiness across diverse educational environments.

Keywords: Predictive analytics, curriculum design, labour market alignment, machine learning, higher education

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Session 6

Session Chair: Timothy Musharu

Wearables in the Workforce: The Perceived Value Experienced by South African Computing Professionals

Paper ID: P65

Carmen Bekker, Brenda Scholtz and Simone Beets

Abstract. Smartwatches are valuable Internet of Things (IoT) wearable devices that can assist in promoting physical activity (PA) and in reducing sedentary behaviour. A lack of PA can result in numerous health disorders and diseases, especially in the case of sedentary office workers. Computing professionals experience long periods of sedentary behaviour, which poses serious health risks. Furthermore, South Africans spend a significant portion of their day being sedentary. This paper aims to investigate the impact of PA levels on smartwatch value within the context of South African computing professionals. To achieve this research aim, hypotheses were developed, and a survey was conducted. The results were statistically analysed and the analysis revealed that most of the smartwatch users had a medium PA level despite the sedentary nature of South African computing professionals. It was also revealed that the PA levels of the smartwatch users had an impact on two of the attributes of value, namely Goal Pursuit Motivation (GPM) and social value.

Keywords: Smartwatches, Internet of Things (IoT), Physical activity (PA), Smartwatch value

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Security of Mobile Devices: A Taxonomy Study of Detection Methods of Pegasus Spyware and Countermeasures

Paper ID: P48

Davish Ramlochund and Girish Bekaroo

Abstract. Whilst privacy is recognised as a fundamental and universal human right in almost every country around the world, those rights are often overlooked or disregarded when it comes to surveillance or tracking by various entities. The demand for spyware continues to thrive globally as many consider information as a powerful weapon that can be leveraged. NSO Group's most prized surveillance technology called Pegasus has been around since 2011 and has been in the headlights since its public reveal in 2016. Since then, a number of high-profile cases and investigations on how the NSO Group and Pegasus exploited and infected thousands of devices for surveillance. Nevertheless, limited studies have been undertaken to present or analyse its detection methods. This study presents a taxonomy review of methods used to detect Pegasus and discusses countermeasures for mitigating the risk of getting infected by securing mobile devices.

Keywords: Pegasus Spyware, NSO Group, Taxonomy, Indicators of Compromise, Detection Methods, Countermeasures

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Heart Attack Risk Prediction Using Machine Learning and Deep Learning Techniques

Paper ID: P78

Doorgesh Sookarah, Loovesh Sharma Ramwodin, Manish Putteeraj and Vivasvansingh Dwarka

Abstract. Cardiovascular disease (CVD) is still one the main causes of mortality worldwide. This emphasizes the critical need for efficient and effective risk assessment approaches. In this study, machine learning (ML) and deep learning (DL) techniques have been used to forecast the likelihood of myocardial infarctions from publicly available clinical data. A rigorous methodology was followed and this included steps such as data pre-processing, class balancing using SMOTE, data augmentation by adding Gaussian noise, model training, hyperparameter optimization, and evaluation using simple performance metrics such as accuracy, recall, F1-score, and AUC-ROC. Among the various models that were investigated, Random Forest and an optimized Artificial Neural Network (ANN) both consistently outperformed others. The ANN performed with an F1-score of 0.894 and exhibited stability in generalizability through a 15-fold cross-validation process. The best-performing ANN model was developed as a web application in Flask and deployed in Heroku for enabling real-time assessment of the risk of heart disease. The deployment of this implementation illustrates the viability of converting predictive models into usable clinical tools. The findings confirm the utility of data-driven methodologies for the early detection of heart disease and set the stage for future integration with actual clinical systems and wearable device data.

Keywords: Machine Learning, Deep Learning, Artificial Neural Network, Cardiovascular Disease

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Privacy challenges with human imposed and AI based filters during virtual meetings

Paper ID: P85

Rooma Ramasamy

Abstract. Innovative technology has revolutionized the future of work and will continue to play a vital role in virtual working arrangements. Remote communication is today a norm, users adopt available features to protect their their privacy. This study explores challenges caused by AI(Artificial Intelligence) filters specific to noise reduction and virtual backgrounds and human-imposed filters with the mute button feature during video conference calls through the lenses of the privacy paradox theory. These filters have become essential for virtual communication with the growth of remote and hybrid work environments, however little their limitations remains a gap in the literature. Data triangulation shows that privacy filters' perceived efficacy frequently outweighs their real capabilities. Although users have faith in the tools, particularly those that are human-imposed, there are still behavioral and technical challenges. The privacy paradox, in which users' confidence in their privacy choices coexists with constant risks is best shown by the gap in practice. The contradiction is particularly noticeable in AI-based filters, which offer smooth, intelligent defense but frequently fails in dynamic, individual environments. According to the study's findings, while users are protecting their boundaries, these filters create additional challenges. Platform developers, users, and organizations are suggested to adopt best practices and more user-centric design.

Keywords: Privacy Paradox, virtual meetings, privacy challenges

Session 7

Session Chair: Corne van Staden

Comparing Vertical Federated Learning Frameworks in Manufacturing Supply Chains

Paper ID: P64

Jonas Kallisch, Jorge Marx Gómez and Christoph Wunck

Abstract. This paper investigates data analysis and predictive modelling within industrial production supply chains. Despite its potential, cross-company data analysis remains limited due to technical challenges, organizational barriers, and trust issues. A primary concern is the potential misuse of sensitive data. Federated Learning offers a promising solution by enabling decentralized analysis without direct data exchange. It supports horizontal and vertical models, with the latter particularly suitable for supply chains. This study presents a case study from an industrial supply chain to evaluate whether vertical Federated Learning can facilitate cross-company data analysis. A benchmark of various Federated Learning frameworks was conducted. Additionally, these frameworks are compared based on usability, integration into corporate structures, and other quality factors.

Keywords: Data Sharing, Federated Learning, Analytics, Supply Chain, Data Platforms

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Optimization And Stabilization Of Power Distribution Grids Through The Use Of Sensor Networks.

Paper ID: P49

Connor Cress and Jp van Deventer

Abstract. As global electricity demand continues to rise, ensuring stable and efficient power distribution is of increasing importance. The integration of renewable energy sources and fluctuating consumption patterns present challenges to grid stability. This systematic review explores the role of Sensor Networks (SNs), Artificial Intelligence (AI), and smart-grid technologies in optimizing and stabilizing modern power grids. Following the PRISMA methodology, 28 relevant studies were analyzed to evaluate current applications, future benefits, and existing challenges in grid management. Findings indicate that advanced monitoring, predictive analytics, and real-time data collection significantly enhance operational efficiency, fault detection, and energy management. By highlighting key trends and technological advancements, this review serves as a valuable resource for researchers and professionals interested in intelligent grid solutions, AI-driven optimization, and the transformative potential of SNs in power distribution.

Keywords: Sensor Networks, Optimization, Power Distribution, Grid Stability

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An Analysis of the Value of Robotic Process Automation for Healthcare Administration using the Task Technology Fit Theory

Paper ID: P82

Phillip Sibanda, Ifeoluwapo Fashoro and Brenda Scholtz

Abstract. Robotic Process Automation (RPA) technology incorporates easy-to-develop and deploy software bots that emulate human interactions with digital systems and software. This paper aims to analyse the value of RPA as a healthcare technology by evaluating to what extent it fits with the characteristics of administrative healthcare tasks. The Task Technology Fit (TTF) theory was used to analyse articles reporting cases of successful RPA implementation in healthcare. A qualitative thematic analysis process was employed to analyse the collected data. Administrative healthcare task characteristics were classified as routine or non-routine tasks. Patient registration and appointment booking are routine tasks, whilst data validation and analysis and exception handling are non-routine. The adopted RPA characteristics were attended bots, unattended bots, seamless integration, optical character recognition (OCR), and rule-based exception handling. The findings indicate that RPA provides value to the healthcare industry and is a strong fit for automating administrative healthcare tasks. Streamlining administrative healthcare tasks with RPA enhances operational efficiency, reduces errors, and frees time for healthcare professionals by relieving them from the burden of their administrative tasks. These benefits, therefore, enable healthcare workers to focus more on providing quality patient care.

Keywords: Robotic Process Automation, Healthcare, Task Technology Fit

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Machine Learning In Public Transport Management: Using Smartphone Tracking Data To Reduce Delays.

Paper ID: P55

Vassilis Drossopoulos and Jp van Deventer

Abstract. Public transportation plays a pivotal role in urban mobility, yet delays and disruptions remain a persistent challenge, affecting efficiency, passenger satisfaction, and economic sustainability. Advancements in machine learning (ML) and smartphone tracking data offer promising solutions to analyze, predict, and mitigate these disruptions. This systematic literature review (SLR) examines the effectiveness of ML-driven methodologies in addressing transport inefficiencies by considering and evaluating relevant studies across reputable databases. Through thematic analysis, insights are derived regarding ML algorithms, smartphone sensor applications, and predictive modeling techniques. Findings indicate that ML enhances transport management by identifying delay and disruption patterns. However, heterogeneity in methodologies and variations in algorithm performance present obstacles in standardizing predictive frameworks. Despite these challenges, the review underscores ML's potential as a valuable tool in reducing delays, fostering sustainable urban mobility, and innovations in transport systems. This study consolidates existing knowledge, identifies research gaps, and proposes future directions, advocating for data-driven approaches to strengthen public transport resilience through technology-integrated solutions.

Keywords: Machine Learning, Smartphone Tracking Data, Public Transport Delays, Traffic Prediction

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AI-Enhanced Monitoring and Failure Prevention in Distributed Systems: A Systematic Literature Review

Paper ID: P89

Mike Tyolani, Boniface Kabaso and Waldon Hendricks

Abstract. This systematic literature review synthesizes research on AI-enhanced frameworks for application failure prevention in distributed systems published between 2020 and 2025. Following PRISMA guidelines, the study analysed 40 high-quality studies to address four research questions concerning existing monitoring solutions, their comparative effectiveness, evidence strength supporting various approaches, and implications for creating resilient distributed systems. Results reveal significant capabilities in modern monitoring tools while machine learning techniques demonstrate promising anomaly detection capabilities with accuracy rates up to 97%. For cascading failure prediction, hybrid approaches combining graph analysis with machine learning show highest accuracy (81-94%) with meaningful lead times of 5-20 minutes before service impact. The field is advancing toward integrated platforms that combine monitoring, prediction, and remediation capabilities, emphasizing context awareness and business impact.

Keywords: Distributed Systems, Application Failure Prevention, Machine Learning

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Privacy-preserving synthetic network traffic generation for machine learning based-intrusion detection systems

Paper ID: P95

Kalala Gael Kapia, Boniface Kabaso and Waldon Hendricks

Abstract. Machine learning-based intrusion detection systems (IDS) rely on large-scale network traffic datasets to detect cyberattacks effectively. However, the collection and use of real-world network traffic raise privacy concerns. As a solution, researchers have explored synthetic data generation methods combined with privacy-preserving techniques. This systematic literature review examines existing approaches to generating privacy-preserving synthetic network traffic for training IDS models. A total of six studies were selected following a structured search process. The review highlights the diversity of methods used, ranging from Generative Adversarial Networks to diffusion models, and evaluates them based on methodology, privacy protection, data utility, and ease of implementation. Future research directions are proposed to guide the development of privacy-preserving frameworks for IDS applications.

Keywords: Intrusion Detection Systems, Synthetic Network Traffic, Differential Privacy, Machine Learning, Privacy-Preserving Data Generation.

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Session 8

Session Chair: Ali Akyol

Real-time recognition of Malagasy banknotes (Ariary)

Paper ID: P14

Miandrisoa Hoby Randriatsarafara, Volatiana Marielle Ratianantitra and Thomas Mahatody

Abstract. This research focuses on real-time recognition of Malagasy banknotes to introduce an innovative solution benefiting the financial sector. The main goal is to develop an automatic system for banknote recognition, applicable in Automated Teller Machines (ATMs) and mobile devices for visually impaired individuals. The study begins with an analysis of real-time object recognition models, such as Faster Region-based Convolutional Neural Network (Faster RCNN), Single Shot MultiBox Detector (SSD), and You Only Look Once (YOLO). Yolov8 is selected due to its superior accuracy, especially for small objects, leveraging transfer learning. Model performance is enhanced through hyperparameter tuning and improved data preprocessing, including padding for image standardization and instance normalization to reduce class biases. Evaluation is conducted on Android mobile phones, simulating real-world conditions. Results confirm that preprocessing improvements significantly enhance model accuracy and stability, ensuring reliable recognition of Malagasy banknotes. This research successfully develops a real-time recognition system using Yolov8, providing an effective solution for financial transactions and inclusive access for visually impaired individuals. Future work includes extending recognition to other currencies, counterfeit detection, and integration into diverse financial devices.

Keywords: Malagasy Banknotes, Real-time Recognition, Preprocessing enhancements, Transfert learning, YOLOv8

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Joint Modeling of Entities and Relations through Hierarchical Analysis of Span Sequences

Paper ID: P15

Jules Michel Andriafetiarison, Onja Kostka Michel Andriamihary and Volatiana Marielle Ratianantitra

Abstract. Relation extraction, a crucial aspect of information extraction, has greatly benefited from recent progress in deep neural networks and pretrained language models. Two dominant approaches emerge: the cascade method and the joint approach. The latter, though ambitious, faces challenges related to entity overlap. A promising alternative is the span-based approach, but it is hindered by limitations in span representation. To overcome these obstacles, we propose an innovative joint extraction model. It relies on multi-level feature analysis at the span representation level, detecting local patterns and sequential dependencies. This approach enables the identification of crucial information at a fine scale, thereby improving extraction accuracy. We trained our model using two datasets, NYT and WEBNLG, and evaluated its effectiveness on the latter. Our approach surpasses other models, achieving superior performance, especially in terms of the F1 score on WEBNLG, underscoring its potential for relation extraction.

Keywords: Deep Learning, Joint approach, Multi-level features, Relation extraction, Span representation

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Tax Defense Analytics: A Data-Driven Application for Identifying Cross-Border VAT Fraud and Tax Avoidance Schemes

Paper ID: P18

Kristof Mose, Keyvan Narimani, Maged Ahmad, André Klümpen and Jorge Marx Gómez

Abstract. In this work we present the current state of a work in progress multi-functional application for detecting cross-border value added tax (VAT) fraud and identifying tax avoidance schemes of multinational corporations. We outline the design and architecture of this data science and artificial intelligence (AI) driven application, which incorporates not only data analytics but additional functionalities, which in combination support and elevate the workflow of the auditors. These additional functionalities include a sophisticated data integration pipeline, a multipurpose AI tool suite, as well as a tax expert knowledge management system. Despite not being finished this approach already shows the potential to significantly enhance the efficiency and effectiveness of tax fraud detection and tax avoidance identification. This work aims to share insights from operationalizing AI in tax administration to facilitate broader digital transformation efforts.

Keywords: VAT Fraud, Tax Avoidance, Artificial Intelligence, Data Analytics, Tax Administration

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Integrating Differential Privacy Mechanisms within a Simulated Autonomous Vehicle Environment: A Critical Evaluation

Paper ID: P34

Thejmeela Seetamonee and Girish Bekaroo

Abstract. Autonomous vehicles and their supporting technologies, such as Vehicle-to-Everything (V2X) connectivity, are becoming more and more common with the advancements in intelligent mobility. The AV environment allows cars that are wirelessly connected to adjacent infrastructure and other cars to exchange location-related data. These sensor data, which amount to personal data under the definition of the EU GDPR ("identifiable"), are processed by AV manufacturers and related third parties. The processing of sensor data has privacy implications and requires adherence to data protection regulatory requirements. The aim of this study was to investigate the challenges posed by connected and automated vehicles from a data privacy perspective and evaluate the effectiveness of two existing differential privacy mechanisms, namely LaPlace and Gaussian, within a simulated autonomous vehicle environment. CARLA, the simulation AV environment, and the AV were configured to collect sensor data. The sensors in scope were collision intensity, collision location, lane invasion, obstacle detection, GNSS, IMU accelerometer and IMU gyroscope. The differential privacy mechanisms were applied to add noise to the original sensor data. The original and the noise sensor data were compared based on the absolute difference measurement and the calculation of MEA. Mathematically, it was concluded that Gaussian was more effective in adding noise to the sensor data. However, there is a trade-off between data privacy and data usability making LaPlace was more effective at keeping the data reliable for future analysis.

Keywords: Autonomous Vehicles, Differential Privacy, LaPlace, Gaussian, Epsilon

AI-Powered Digital Twins with Bio-Sensory Feedback for Enhanced Predictive Security in Cyber-Physical System

Paper ID: P47

Kwabena Addo, Katleho Moloi and Musasa Kabeya

Abstract. The integration of cyber-physical systems (CPS) in critical infrastructures demands adaptive security solutions capable of preempting evolving threats. This paper presents an AI-powered digital twin framework enhanced with bio-sensory feedback for predictive CPS cybersecurity. By fusing real-time physiological signals (such as EEG, HRV) with system telemetry and environmental data, the framework enables proactive threat detection and mitigation. A multimodal Transformer-based model processes these inputs, achieving 96.2% accuracy (AUC-ROC: 0.983) and outperforming traditional SVM (81.3%) and LSTM (87.4%) approaches. The system demonstrates low-latency responsiveness (<300 ms at scale) and robustness in simulated attack scenarios, validating its efficacy in dynamic CPS environments. Key contributions include a novel bio-sensory digital twin architecture, formalized threat detection with fused inputs, and empirical validation on a CPS testbed. Results highlight the critical role of human-centric feedback in enhancing cybersecurity resilience. This research advances intelligent, anticipatory security paradigms for next-generation CPS.

Keywords: Digital Twin, AI, Cybersecurity, Bio-Sensing, Cyber-Physical Systems

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Automated Screening of Chronic Sinusitis from Voice Recordings using Machine Learning

Paper ID: P67

Thabo Maibi and Eldon Burger

Abstract. Chronic sinusitis is a common illness affecting millions of individuals worldwide. Current sinusitis screening methods include symptoms evaluation, endoscopic examinations, and medical imaging. However, symptom-based diagnosis is often inaccurate, endoscopic procedures are invasive and limited by anatomical variability, and medical imaging is costly and exposes patients to ionizing radiation. Since chronic sinusitis symptoms affect voice quality and resonance, this study proposes to develop a machine learning model to automatically screen chronic sinusitis using voice recordings. To evaluate the proposed model, voice recordings of patients who underwent tonsillectomy, septoplasty, functional endoscopic sinus surgery and minor surgeries unrelated to the nasal cavity or vocal tract are used. A pre-emphasis filter was applied to denoise the voice recordings and short-term energy analysis was employed to filter out unvoiced speech segments. Several audio features including Mel-frequency cepstral coefficients, linear predictive coding coefficients, Mel-spectrogram, spectral contrast, spectral centroid, spectral flatness, spectral bandwidth, and spectral roll-off were extracted from voiced speech segments. These features were concatenated and reduced in dimensionality using principal component analysis and subsequently used to train various machine learning models which included logistic regression, k-nearest neighbors, decision tree, extreme gradient boosting, random forest, support vector machine and deep neural network. The deep neural network outperformed all other models with an accuracy of 63%, which is comparable with findings from several non-sinusitis voice-based diagnosis studies. The findings demonstrate that chronic sinusitis can be automatically screened using voice recordings.

Keywords: chronic sinusitis, machine learning, audio features, deep learning

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Session 9

Session Chair: Elsie Kaaya

Concept to Provide Environmental Information in a Multi Channel Way by Using Citizen Science

Paper ID: P81

Ali Akyol, Jorge Marx Gómez and Malte Schott

Abstract. Environmental data, such as air and water quality indicators, are critical for public health and environmental awareness. This study proposes an extension of existing environmental information portals through the integration of a Telegram bot utilizing open APIs and push notifications to directly reach citizens. By combining traditional web platforms with messenger-based communication, the approach aims to increase the number of users participating in citizen science initiatives. Key aspects such as data quality, user motivation, and platform integration are systematically analyzed. Preliminary findings indicate that messenger bots can substantially expand the user base for environmental information platforms. The proposed framework offers a foundation for future research on scalable dissemination strategies and the promotion of citizen-driven environmental monitoring.

Keywords: Citizen Science, Environmental Information, Telegram Bot, Air Quality, Open Data, Particulate Matter

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Examining The Prevalence Of Social Loafing In Agile Methodologies.

Paper ID: P50

Leon Combrink and Jp van Deventer

Abstract. In Agile environments, Social Loafing, a tendency for team members to reduce effort due to shared responsibility, can undermine even the most promising projects. If left unchecked, it often leads to failure. By understanding Social Loafing's causes and applying tailored mitigation strategies, teams can curb this behavior and improve outcomes. The success of these interventions depends on each team's unique dynamics, making it essential to identify the most relevant contributing factors. This review highlights key drivers of Social Loafing and offers practical strategies to address them, aiming to boost team performance in Agile settings. By conducting a Systematic Literature Review (SLR), key factors influencing Social Loafing, such as team size, cohesion, accountability, and task visibility, are identified and analyzed. The findings reveal that targeted interventions, including peer assessment, structured accountability systems, and enhanced communication, can significantly reduce the impact of Social Loafing and improve Agile team performance. By understanding these dynamics, organizations can refine their Agile practices to foster more engaged and productive teams, ensuring sustained project success. The paper concludes with recommendations for future research, which includes, but isn't limited to, testing Social Loafing mitigation strategies in a real-world environment.

Keywords: Agile Methodology, Social Loafing, Mitigation Strategies, Teamwork, Mutual Accountability

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Mitigating Phishing Attacks: Current Strategies Emerging Trends and Future Directions

Paper ID: P96

Tebogo Mashabane, Dr Boniface Kabaso and Dr Waldon Hendricks

Abstract. Abstract. This paper presents a systematic literature review of current research on phishing attack mitigation strategies. By examining peer-reviewed publications from 2020-2025, the analysis focuses on the effectiveness of technical and human-centered approaches to combating phishing threats. The review identified machine learning and artificial intelligence as dominant technological solutions, achieving detection accuracies between 85% and 98%. User training programs and multi-factor authentication were found to be essential complementary measures. Findings highlight the need for hybrid approaches that combine automated detection with user education and robust access controls. The also identifies significant research gaps, including standardization of evaluation metrics, mitigation strategies for emerging contexts like mobile environments, and post-attack response protocols. This review contributes to the cybersecurity discourse by providing a comprehensive analysis of the current state of phishing defenses and recommending directions for future research.

Keywords: Phishing Attacks, Social Engineering, Cybersecurity, Machine Learning, User Awareness

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Value Stream Analysis and Design with Large Multimodal Models: Evaluating the Impact of Complex Value Stream Graph Networks

Paper ID: P99

Mick Geisthardt, Lutz Engel and Jorge Marx Gómez

Abstract. Value stream analysis and design are core components of lean management, used to identify inefficiencies and enable resource-efficient value creation. With increasing complexity and the rise of artificial intelligence (AI), large multimodal models (LMMs) have gained relevance as decision-support tools in digital lean management. However, the accuracy and reliability of LMMs currently depend on the quality and structure of the input they receive. Traditional image-based representations of value streams often lack the semantic clarity required for effective computational analysis, limiting LMM accuracy. This paper investigates the impact of complex value stream graph networks (CVSGNs)—a structured, graph-based data model—on the accuracy of LMMs in value stream analysis and design. The paper follows a two-stage methodology utilizing the socio-technical simulation game "North Star – The Value Stream Game". In the first stage, a pre-test assesses the descriptive accuracy of LMMs, comparing image-based and CVSGN-based inputs, revealing an error rate reduction by over 70% points. In the second stage, 300 simulation game rounds are used to investigate the LMM-based evaluation accuracy of value stream design strategies for both input conditions. Results demonstrate a substantial improvement in expert alignment, with LMM-based evaluation accuracy increasing from 62.1% to 88.1%. A t-test confirmed the statistical significance of these findings ($p < 0.001$) with a large effect size (Cohen's $d = 2.01$). These results provide evidence that structured graph-based representations can significantly enhance both descriptive and evaluative LMM accuracy, supporting more reliable decision-making in the context of digital lean management.

Keywords: Value Stream Analysis and Design, Large Multimodal Models (LMMs), Complex Value Stream Graph Networks (CVSGNs), Simulation-Based Study, Digital Lean Management

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Development and Implementation of a Low-Cost IoT Network for Air Quality Monitoring in the Historic Downtown of San Salvador

Paper ID: P100

Omar Otoniel Flores Cortez, Alberto Oviedo, Fernando Arévalo, Carlos Pocasangre and Renata Barriere Garcia

Abstract. This paper presents the design, construction and real-world deployment of a low-cost Internet of Things (IoT)-based bare-bones system for urban air quality monitoring in San Salvador's historic downtown. The system comprises carbon dioxide (CO₂), total volatile organic compounds (TVOC) and air quality index (AQI-UBA) sensors, WiFi enabled microcontroller and open-source platforms. The main contribution of this study is the demonstration of an initial real-time monitoring solution that not only fills critical environmental data gaps, but also sets the foundation for future expansions, including predictive analytics, early warning systems, and integration into broader innovative city initiatives. The findings support the feasibility of implementing affordable IoT-based environmental networks in developing cities to bridge critical gaps in air quality data. Despite limitations such as the reliance on public WiFi and the absence of reference-grade calibration equipment, the system demonstrated strong reliability and significant potential for urban integration. These enhancements will also contribute to the transformation of the area into an innovative and health-conscious urban ecosystem.

Keywords: Internet of things, CO₂, air quality, El Salvador, low cost.

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Part-of-Speech Tagging To Sentence Structure Malagasy

Paper ID: P10

Vatosoa Razafindrazaka and Volatiana Marielle

Abstract. This paper explores the field of Malagasy language processing, focusing on morphosyntactic tagging and the identification of specific syntactic structures in Malagasy. We use recurrent neural network models, specifically BiLSTM (Bidirectional Long Short-Term Memory), enhanced with embedding techniques and dense layers for learning. Applying these advanced methods in our linguistic context presents a major challenge due to the specific characteristics of the Malagasy language, notably its complex syntactic structure and morphological richness. We developed and trained each module using the Fitsipika corpus, enriching it with advanced preprocessing techniques. The data was prepared and structured from CSV files to ensure consistency and result quality. Experimental results confirmed the robustness of our approach, achieving an overall accuracy of 97% for morphosyntactic tagging and scores of 85% and 69% for the two models analyzing the language's syntactic structure, demonstrating its effectiveness in linguistic analysis. We also explore the possibility of extracting FKI from long sentences. These findings outperform existing methods and open the door to numerous potential applications in Malagasy language processing, such as automatic text comprehension and the development of learning assistance tools.

Keywords: Part-Of-Speech Tagging, EFL Structure, FKI, Malagasy, Deep Learning

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Session 10

Session Chair: Sunet Eybers

Impact of Artificial Intelligence (AI) on Cyber Safety Awareness and Culture in Small and Medium Enterprises (SMEs)

Paper ID: P79

Betty Kekana, Elmarie Kritzinger and Dorothy Scholtz

Abstract. The research investigates the impact of artificial intelligence (AI) in promoting cyber awareness as well as setting in place a robust cybersecurity culture in small and medium enterprises (SMEs). As AI technologies are increasingly adopted by SMEs, the need for improved cyber resilience becomes more acute. The research discusses how AI can contribute to threat detection, risk management, and training of employees in awareness. Using the research on-ion model and Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) framework, a systematic literature review has been conducted, with data analysis being done through ATLAS.ti for key themes and insights identification. Presenting a literature matrix of 30 relevant articles, the data highlight trends and gaps in existent research. Findings were revealed concerning five primary themes, linking AI adoption with enhanced cyber safety practices. Having shown such themes, the work helps build a better understanding of how small and medium enterprises can take advantage of AI for cyber resilience. The results feature five primary themes that are seen to link AI uptake with improved cyber security behaviors of companies, providing more in-depth insight into how SMEs use AI resources for enhancing cyber resilience. The conclusion outlines the recommendations created at the end for SMEs on leveraging AI solutions effectively for a robustly built cyber awareness culture.

Keywords: Artificial Intelligence, Cybersecurity, SMEs, Cyber Safety, AI Adoption

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Hybrid Augmented Intelligence Applied to Technical Trading: Improvements through Compensatory Fuzzy Logic and WKD

Paper ID: P83

Norma Patricia Rodriguez Candido, Rafael Alejandro Espin Andrade and Jorge Marx-Gómez

Abstract. Technical trading, a cornerstone in financial markets, often relies on subjective interpretations of a limited set of strategies, leading to inconsistent applications. This paper proposes an enhanced approach for the improvement of an existing Technical Trading Model based on Compensatory Fuzzy Logic (CFL), using the strategy of Wide Knowledge Discovery (WKD) for Hybrid Augmented Intelligence (HAI). That approach allows meaningful improvement associated to the virtues of WKD for HAI, and the use of the natural language interpretability of CFL to build a new explainable model from the original oriented to that. Experimental evaluation across diverse asset classes and market scenarios demonstrates a significant improvement in predictive accuracy, decision consistency, and model interpretability, validating the effectiveness of the proposed approach.

Keywords: Compensatory Fuzzy Logic, Technical Analysis, Hybrid Augmented Intelligence, Wide Knowledge Discovery

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The Impact of the Prompt Language on Code Generation with LLMs: An Experimental Study

Paper ID: P87

Kai Meier, Christian Koot, Marc Fernandes and Andreas Theissler

Abstract. This study investigates the affect of using different languages in the prompt input for code generation with large language models (LLMs). Python code is generated from German and English prompt inputs using a zero-shot prompting strategy, targeting a comparison of the model performance between the languages and difficulties. Therefore a bilingual benchmark dataset containing 16 algorithmic tasks was developed, covering domains such as linear algebra, number theory, probability theory, and cryptography. The tasks were semantically aligned and categorized into three levels of difficulty. Six large language models were evaluated across the tasks. Standardized prompts were designed using prompt engineering principles, assigning the models the role of an expert in the topic of Python programming. Score metrics were implemented to assess the individual performance of the models and statistical analyses were conducted using Pearson's chi-squared and Fisher exact test to evaluate significant associations across language prompts and task difficulty. Each model completed 16 tasks in German and 16 in English, with two independent runs per task, resulting in 64 runs per model. This adds up to 192 test runs per language and 384 runs in total. Results show that most models perform better using English language prompts, with GPT-4o outperforming its competitors, reaching the highest scores in both languages and solving all tasks with the maximum score with English prompting. Association between the models across the difficulties showed significant differences using English prompting, while for German only the easiest difficulty showed significant differences. Association between the language performances only showed significant differences in medium difficulty with Pearson's chi-squared test ($p=0.05$) and Fisher exact test ($p=0.029$).

Keywords: Large Language Models, Program Synthesis, Multilingual Code Generation

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Energy-Efficient Cloud Computing for Artificial Intelligence Training: Challenges Techniques and Future Directions

Paper ID: P93

Fayez Salma and Jorge Marx Gómez

Abstract. The rapid growth of artificial intelligence (AI) has amplified the computational and energy needs for training models, especially in cloud environments. This study takes into account the primary challenges in realizing energy efficiency for AI training, which are the growth of model sizes, inefficient use of resources, and infrastructural inefficiencies. A comprehensive review of novel solutions is provided, ranging from specialized hardware, software enhancements, to the operation of sustainable cloud infrastructure. Moreover, we highlight emerging trends such as AI-driven resource optimization, federated learning, and carbon-aware scheduling. Through our discussion, we highlight that there is an urgent requirement for energy efficiency to be a top priority alongside performance in the development of AI systems. We conclude by highlighting the requirement for cross-disciplinary collaboration to achieve a sustainable artificial intelligence future.

Keywords: nergy-Efficient Cloud Computing, AI Training, Green AI, Cloud Infrastructure Optimization

Critical Smart City Drivers for Small and Rural Municipalities

Paper ID: P51

Nkhangweni Lawrence Mashau and Jan Hendrik Kroeze

Abstract. Small and rural municipalities continue to struggle to implement smart cities successfully due to issues with outdated infrastructure, lack of expertise and limited resources. There is a lack of scholarly studies exploring information systems (IS) drivers that are crucial for smart city implementation. The paper addresses this research gap, focusing on small and rural municipalities. A qualitative research approach was used. The data was collected from five small and rural municipalities in South Africa using semi-structured interviews. The results indicate that network infrastructure, innovation, data, modern software, modern infrastructure, digital infrastructure, suitable technologies, governance and the automation of processes are vital in smart city development. The study contributes to the body of knowledge on smart cities by revealing critical IS drivers that are key for smart city development. These drivers may guide policymakers, town and regional planners, and community stakeholders who are involved in smart city projects.

Keywords: Information systems (IS), Drivers, Smart city, Development, Implementation, Municipalities, Rural, Small

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Validating a Framework for Assessing Small and Rural Municipalities' Readiness for Smart City Implementation

Paper ID: P101

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Abstract. Small and rural municipalities have limited infrastructure and resources to deliver essential services to their citizens. There is a need for smart solutions to manage the limited resources at the disposal of these municipalities. This paper presents a validated framework tailored explicitly for assessing the readiness of small and rural municipalities for smart city implementation. The design science research (DSR) methodology was employed to conceptualize, create, and assess the framework. During the evaluation and validation DSR cycles, qualitative online surveys were used to facilitate participatory design and expert reviews. The validated framework addresses the unique needs of small and rural municipalities by amending existing models designed for larger urban areas.

Keywords: Smart city, Framework, Municipality, Small, Rural, Readiness, Assessment, Implementation, Evaluation, Validation, Design Science Research

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Session 11

Session Chair: Viktor Dmitriyev

Structured extraction and hierarchical parsing of addresses using Large Language Models

Paper ID: P117

Ashish Dhansukhbhai Desai, Keyvan Narimani, Prof. Dr. Ing. Jorge Marx Gómez and André Klümpen

Abstract. In the era of digitalization and cross-border trade, address inconsistencies present a critical challenge across sectors such as taxation, fraud prevention, law enforcement, and public service delivery. Unstructured and inconsistent address formats—characterized by spelling errors, missing postal codes, incorrect or absent city and street names, and improper punctuation—hinder the effectiveness of automated systems. These issues are particularly detrimental to efforts aimed at combating tax fraud in an European region or international context, where precise address data is essential for accurate entity verification, transaction tracking, and fraud detection. Despite initiatives by tax authorities, postal agencies, and government bodies to enforce standardized address formats, real-world data continues to exhibit substantial variability and noise. Traditional rule-based solutions fall short in addressing the complexity of such data, while existing AI-based methods are often not tailored to the nuances of European address formats. In this research, we propose an approach to transform unstructured address data into structured formats using pre-trained large language models (LLMs), with a focus on the European region. Our experimental results demonstrate that the LLM-based approach significantly outperforms conventional methods in generating structured addresses, and these structured outputs have shown strong performance when evaluated using our rule-based script. This hybrid solution offers a promising tool in the broader effort to ensure regulatory compliance and enforce tax authorities in the fulfillment of their legal mandate against illegal activities.

Keywords: Complexity of unstructured addresses, Large language models for structured addresses, Structural address model, Address analysis, Structured extraction of the data, Hierarchical parsing of the data, Combating fraud

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Secure Data Smarter Decisions: A Blockchain-enhanced Federated Learning Framework for the Pharmacogenomics of Depression

Paper ID: P62

Elsie Kaaya and Jorge Marx Gómez

Abstract. Depression continues to be a global health problem affecting approximately 280 million people worldwide. Unfortunately, its treatment selection depends on a trial-and-error approach, which leads to ineffective treatment selection. A personalized approach to treatment, such as pharmacogenomics, offers great promise in addressing this limitation. This study proposes a Blockchain-enhanced Federated Learning (BFL) framework for effective and secure personalized treatment selection for depression. By leveraging privacy-enhancing technologies such as blockchain, homomorphic encryption, and Secure Multiparty Computation (SMPC), the study aims to encourage collaborative model training across multiple health centers by enhancing data privacy and security in decentralized federated learning. Collaboration among health institutions will encourage the development of models trained on datasets representing diverse populations with varying genetic, clinical, and environmental characteristics, thereby improving model generalizability, which will improve overall treatment selection.

Keywords: Pharmacogenomics, Depression, Federated Learning.

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AI-Generated Visualizations for Sustainable Urban Planning: Enhancing Decision-Making and Public Engagement in the MobiLe Project Context

Paper ID: P66

Sreedhar Kokkarachedu and Jorge Marx Gómez

Abstract. This paper investigates the potential of AI-generated imagery to support sustainable urban planning, with a particular focus on the MobiLe project, led by VLBA Oldenburg in collaboration with the City of Norderstedt. A key contribution of this work is the integration of user input via the MobiLe web application, enabling policymakers and citizens to select proposed urban planning measures. These inputs are translated into structured prompts for generative AI tools such as Stable Diffusion and DALL·E 2, which are then used to produce realistic visualizations of potential future urban environments. The paper primarily examines the conceptual applicability of AI-generated visualizations and evaluates their role in participatory planning. Specifically, it explores whether visual feedback generated through AI can enhance decision-making processes and increase public engagement in urban development initiatives.

Keywords: AI-generated visualizations, sustainable urban planning, participatory planning, MobiLe project

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A Conceptual Scale For Attributing Financial Penalties to Privacy Breaches

Paper ID: P68

Kweku Arthur and Hein Venter

Abstract. Modern organisations leverage computing systems to fulfill business services. Such systems are therefore treasure-troves for threat actors, hence the prevalence of cybersecurity incidents and privacy breaches globally. Governments implement information privacy regulations and establish information privacy regulators to advocate that organisations implement appropriate information security measures to avoid cybersecurity and privacy breach incidents. The purpose of the Information Regulator is to oversee privacy regulations and to assign an appropriate penalty to the responsible organisation if the evaluations of the Regulator reveal a lack of security controls as the source of a cybersecurity or privacy incident. In this paper, the identified problem is that there is no structured method to attribute a financial penalty for investigated privacy breaches.

Keywords: privacy breach, cybersecurity incident, privacy breach penalties, information regulator, financial penalty scale

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Creating Robot Game Mission Strategies Using Machine Learning

Paper ID: P112

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Abstract. Evaluating mission strategies in competitive robot games like the FIRST® LEGO® League (FLL) is hard because physical testing takes a lot of time and costs a lot of money. This study explores the integration of machine learning (ML) techniques, particularly genetic algorithms, to optimize mission strategy evaluation. A genetic algorithm was created to create and evaluate mission strategies based on factors like completing missions, minimizing travel time, making the best use of attachments, and the strategy's ability to withstand changes. The FLL game field was modeled as a grid-based environment. The evaluation involved extensive simulations of different strategic approaches, including point-based, difficulty-based, and zone-based strategies, revealing that the zone-based approach yielded the highest efficiency. The results show that evolutionary algorithms could be used to automatically test mission strategies, cutting down on the need for physical tests while keeping the learning outcomes for problem-solving. We propose six key guidelines for designing ML-driven evaluation tools for robotics competitions, based on experimental insights. This research contributes to developing computational frameworks that support mission planning and optimization, enhancing strategic decision-making in competitive robot games.

Keywords: Machine Learning, Evolutionary Algorithms, Mission Strategy Optimization

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Towards Cybercrime Profiling: The Validity and Reliability of Criminal Profiling Methods

Paper ID: P35

Thulani Mashiane and Elmarie Kritzinger

Abstract. Cybercrime has a negative impact on online users, businesses and organisations. To apprehend criminals both online and offline, law enforcement officials make use of various tools and strategies. One such tool is criminal profiling. Criminal profiling is a tool used by law enforcement to aid in the identification of characteristics of an offender or group of offenders. While criminal profiling has made positive contributions in apprehending offenders, criminal profiling methods have been critiqued for having limited reliability and validity. Reliability and validity are measures of quality. High reliability and validity imply that one can have confidence in the results obtained from using a selected method. Empirical experiments are conducted to test validity and reliability. While limited, there are studies that have evaluated criminal profiling using empirical methods. This article presents a systematic literature review of empirically tested criminal profiling methods. This article is aimed at building a robust foundation for the development of a cybercriminal profiling method. The article concludes by presenting a discussion on the implications of the results from the systematic literature review on cybercriminal profiling. While the reliability and validity of criminal profiling are elements which need to be carefully studied for cybercriminal profiling, there is potential to make use of the identified criminal profiling methods for cybercriminal profiling.

Keywords: Criminal profiling, Cybersecurity Profiling, Reliability, Validity

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Exploring the Potential of Retrieval-Augmented Generation in Internal Audit Practice

Paper ID: P73

Maurice Saluschke and Jorge Marx Gómez

Abstract. Retrieval-Augmented Generation (RAG) enables answering questions in subject-specific domains using Large Language Models without additional training or fine-tuning. This study aims to determine if and how RAG can provide operational added value along the value streams of internal auditing processes. The research is based on Hevner's Design Science Research approach, comprising three cycles: Relevance, Rigor and Design. The Relevance Cycle analyzes audit-specific challenges, the Rigor Cycle derives requirements from existing knowledge, and the Design Cycle outlines a conceptual RAG system with domain-specific design principles. This conceptual and exploratory study does not present a technical implementation but instead lays the theoretical groundwork for future empirical research. The findings suggest that RAG can enhance access to relevant knowledge, improve the efficiency of processing large and heterogeneous data sets, and support deeper insights into business processes and compliance requirements. In particular, RAG shows potential to support key audit activities such as risk identification, compliance verification, audit planning, and reporting by enabling real-time, context-aware information retrieval and generation. At the same time, the study identifies ethical and organizational challenges, including data quality, transparency, and auditor competencies, that must be addressed for successful implementation. This work contributes to closing the research gap at the intersection of RAG and internal auditing and provides a foundation for future studies on its practical applicability and effectiveness.

Keywords: Retrieval Augmented Generation, Internal Auditing, Large Language Models, Design Science Research, Audit Automation

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Session 12

Session Chair: Timothy Musharu

Sustainability-First Microservice Design: Extending GranMicro for Efficient Microservice Extraction

Paper ID: P109

Ola Mustafa and Jorge Marx Gómez

Abstract. The increasing environmental footprint of software systems has become critical as digital infrastructures expand globally. While microservices architecture offers sustainability benefits through improved resource allocation, suboptimal service boundaries can lead to excessive resource consumption. This paper extends the GranMicro approach—a methodology for extracting microservices from monolithic applications—to incorporate sustainability metrics and support applications lacking traditional logging mechanisms. We introduce a modified framework that integrates resource efficiency considerations into service boundary decisions while adapting to alternative data sources such as event logs, API metrics, and service communication patterns. The approach is validated through a case study of a middleware application level gateway system, demonstrating that sustainability-optimized microservice boundaries can reduce energy consumption by 21% overall, with up to 32% reduction during peak loads. The approach achieves comparable quality to manual domain-driven design while requiring significantly less effort, contributing to more environmentally sustainable information systems.

Keywords: sustainable computing, microservices, GranMicro, software architecture, resource optimization, service extraction

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Investigating e-Learning in Marginalised Independent Secondary Schools: A Teacher's Perspective

Paper ID: P60

Sunet Eybers and Corne J. van Staden

Abstract. e-Learning refers to the utilization of technology to support learning across geographical boundaries. It is an important aspect of digital transformation, as it offers many benefits, such as accessibility, flexibility, scalability, self-paced learning, and democratizing education. It supports enabling quality education to all, an essential aspect of sustainable development, even in marginalized communities. Marginalized communities, defined as communities that are often excluded from traditional social, economic, educational, or cultural groups due to various reasons (for example, race or socio-economic conditions), are often excluded from access to learning, including e-learning opportunities. However, independent Section 29 schools, privately owned and funded to offer discounted school fees, provide learners in rural areas the opportunity to receive quality education as part of digital transformation efforts. This study aims to investigate the teachers' perspectives on e-learning implementations in marginalized independent Section 29 secondary schools in South Africa. Using the Community of Inquiry (CoI) framework as a theoretical foundation. Online questionnaires were distributed to teachers at marginalized independent secondary schools in a small mining town in South Africa. The results indicated that internet infrastructure, connectivity, and lack of device resources remain challenging, forcing teachers to use their own devices to conduct lessons. Both blended and virtual learning were the preferred methods for teaching. The Community of Inquiry (CoI) framework proved reliable (except for the triggering event construct) and suitable for use in online teaching communities, contributing to eLearning's success. The Social presence of the CoI was indicated to be the most important aspect in e-Learning, followed by the Cognitive and Teaching presence.

Keywords: e-learning, independent schools, marginalized schools, Section 29, secondary schools, Community of Inquiry (CoI), digital transformation

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MaaS-broker implementation for an intermodal journey planner combining public transit with carpooling using time expanded graph networks

Paper ID: P113

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Abstract. The mobility offer in rural areas nowadays is limited due to too few customers and the economic inefficiency for the public transport providers. A survey from the NEMo-project revealed that carpools offer great mobility potential for reoccurring journeys. A combination of both carpooling and public transportation can improve the overall mobility needs for residents in rural areas. This paper proposes implementation of a mobility as a service aggregator alongside heterogeneous mobility systems such as public transport and carpool matchers, which combines all mobility offers in a homogeneous time expanded graph model to query for the best intermodal route. The time expanded graph model reveals to perform well, however the quality depends on the existing offers from the mobility providers itself.

Keywords: intermodal route planning, time expanded networks graph, public transport, carpooling

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Integrating Entrepreneurial and Sustainability Competences for Responsible AI Engagement in Diverse Work Fields

Paper ID: P104

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Abstract. This paper explores how combining sustainability, and entrepreneurial competences can support responsible use of artificial intelligence (AI) in different professional roles. While existing AI competence models often focus on technical and managerial skills, they rarely address ethical, social, and ecological dimensions. Building on the competence framework by Halberstadt et al. (2019), originally developed for social entrepreneurship education, we adapt its structure to the context of responsible AI. We propose two core competence clusters—Responsible AI and Sustainable AI—and link them to role-specific tasks in software development, product management, and sustainability coordination. This approach highlights the need for interdisciplinary, normative, and future-oriented thinking in AI development and application. The paper aims to support the design of educational programs that prepare future professionals to use AI in ways that are both innovative and aligned with societal and environmental values.

Keywords: Responsible AI, Sustainability Competence, Workforce Competency Development

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Generative AI in OCR: A Case Study for License Plate Recognition

Paper ID: P108

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Abstract. Accurate character recognition is critical for Automatic License Plate Recognition systems. However, existing optical character recognition (OCR) models often suffer from substitution, addition, and deletion errors, especially under visual artifacts and ambiguous character forms. Single-modal OCR models have limited contextual understanding. In this study, we evaluate whether recent multimodal large language models (LLMs) with vision capabilities, such as GPT-4o and Gemini can reduce character-level recognition errors by leveraging semantic and spatial context. We compare these models against the Single-modal OCR systems PaddleOCR, TrOCR, EasyOCR, and Tesseract. Our results show that multimodal LLMs outperformed the single-modal OCR models in terms of overall accuracy (GPT-4o: 97.62%, Gemini: 83.12%). They also exhibit reduced character error rates (CER), notably in substitution, deletion, and insertion errors. We further show that introducing ensemble inputs to a fine-tuned T5, a generative language model with natural language processing capabilities, as a post-processing step in an OCR pipeline, enables single-modal models to almost match the performance level of Gemini. These findings suggest that the integration of generative models into OCR pipelines can enhance the robustness of license plate recognition systems, particularly under visually challenging conditions.

Keywords: Multimodal, Large Language Model (LLM), Optical Character Recognition (OCR), Natural Language Processing, License Plate Numbers

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A systematic literature review on multimodal abstractive text summarisation using a generative pre-trained transformer

A systematic literature review on multimodal abstractive text summarisation using transformer-based and attention models

Paper ID: P86

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Abstract. The easy access to technology and the COVID-19 outbreak has accelerated communication among users through various multimedia formats (text, image, audio, and video). This has resulted in the mass production of multimodal information and has created challenges among many users in selecting relevant content, which is deeply buried within vast multimodal data generated. To address this issue, multimodal summarisation has emerged, aiming to enhance user experience by generating representative visual and textual summaries. However, current methods often lack semantic coherence and grammatical accuracy due to the complexity of integrating multiple modalities. This paper conduct a systematic review of multimodal abstractive texts summarisation techniques using PRISMA framework, with a focus on transformed-based models including attention mechanisms. It analyses recent studies, theirs methods, datasets and performance based on ROUGE metrics. The findings indicate that approaches such as hierarchical attention and BERT-based models improve summarisation quality but still faced challenges including data alignment, computational cost and limited datasets diversity. ROUGE benchmarking reveal inconsistent results with How2 and Dailymail datasets frequently used. The study highlights the need better modality fusion, improve generalisation and dataset diversity in future research.

Keywords: Multimodal summarisation, abstractive text summarisation, transformer-based, DUC, ROUGE scores.

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