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Editorial: AI-Enhanced Computing and Digital Transformation

Hairulnizam Mahdin[1]
[1]Faculty of Computer Science and Information Technology, Universiti Tun Hussein Onn Malaysia, Persiaran Tun Dr. Ismail, 86400 Parit Raja, Johor
**corresponding author: (hairuln@uthm.edu.my; ORCiD: 0000-0002-2275-0094)*

Abstract – Artificial intelligence (AI), machine learning (ML), and advanced computing techniques are now central to the digital transformation journey, reshaping industries, academia, and society. This special issue of the Journal of Informatics and Web Engineering on AI-Enhanced Computing and Digital Transformation brings together contributions that reflect both technical innovation and societal applications. The featured articles span optimization methods, software quality improvements, data augmentation techniques, intelligent mobile applications, blockchain-based governance systems, and disaster management platforms. Together, they illustrate how computational advances not only strengthen efficiency and accuracy but also enable resilience in the face of global challenges. From a technical standpoint, metaheuristic algorithms, hybrid learning models, and refactoring strategies are pushing the boundaries of optimization and software reliability. At the data level, challenges such as imbalance, redundancy, and scalability are being addressed through novel augmentation and hybridization techniques, ensuring more robust predictions. Beyond computation, AI-powered applications are transforming healthcare, education, agriculture, and financial governance, while blockchain-based systems enhance transparency and accountability. In addition, disaster management frameworks integrating big data, hydro-informatics, and real-time monitoring are redefining preparedness in flood-prone regions. Collectively, these works showcase the breadth of AI-enhanced computing as a catalyst for systemic digital transformation, shaping a smarter, more sustainable, and interconnected future.

Keywords—Artificial Intelligence, Machine Learning, Optimization, Blockchain, Digital Transformation, Flood Management.

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1. INTRODUCTION

AI and ML have become central to the rapid evolution of digital ecosystems, especially as organizations respond to the challenges of the Fourth Industrial Revolution and the disruptions accelerated by the COVID-19 pandemic [1], [2]. Companies across industries are now investing heavily in AI-driven strategies to accelerate digital transformation, leveraging cloud computing, IoT, big data, and automation to reshape their operations [3-5]. According to recent global market analyses, AI adoption is projected to yield an economic impact exceeding USD 22 trillion by 2030, as governments and corporations accelerate investments in infrastructure and innovation to build regional AI hubs [6].

At the strategic level, organizational readiness and leadership commitment have been shown to play a decisive role in digital transformation, with top management support often exerting greater influence on success than technical capabilities alone [7], [8].

In parallel, the technical foundations of digital transformation are advancing through the integration of optimization, software engineering practices, and data-centric innovations. Metaheuristic algorithms such as ant colony optimization, genetic algorithms, and particle swarm optimization have been increasingly applied to enhance regression testing and other software quality assurance processes [9], [10]. Refactoring methods are also gaining renewed attention for their role in improving code maintainability, scalability, and overall system effectiveness [11]. At the data level, imbalanced datasets remain a persistent challenge in ML, spurring the adoption of hybrid oversampling methods such as GANified-SMOTE to ensure more robust classification outcomes [12], [13]. Currently, many modifications have been made to the conjugate gradient (CG) method, particularly through hybridization strategies. Recent studies propose new hybrid CG formulations [14], some combining established methods under exact and inexact line searches [15]. These approaches consistently demonstrate improved convergence properties, reduced iterations, and lower computational costs compared to classical CG variants. These advances underscore the breadth of AI-enhanced computing, where innovations in algorithms and optimization are driving reliability, efficiency, and scalability.

Beyond technical advances, AI-enabled systems are also reshaping societal applications and public services. Blockchain-based models are increasingly deployed to ensure transparency, accountability, and immutability in financial transactions and organizational governance [16], [17]. AI-powered mobile applications, such as medical chatbots for healthcare, intelligent tutoring systems in education, and precision farming tools in agriculture, are transforming these critical sectors by enabling real-time analytics and predictive services [18]. Similarly, web-based disaster management systems increasingly integrate big data analytics, hydro-informatics, and real-time monitoring to strengthen preparedness and response capacities in flood-prone urban regions [19], [20]. Together, these developments illustrate how AI-enhanced computing is not only a tool for technical optimization but also a catalyst for systemic digital transformation, driving innovation across industries while shaping a smarter, more resilient, and interconnected world.

2. IN THIS THEMATIC ISSUE

2.1 Optimization and Software Quality

Two papers in this issue emphasize optimization strategies and code improvement as enablers of digital reliability.

- "Improving Code Effectiveness Through Refactoring: A Case Study" by Almogahed et al. explores five refactoring methods applied in the jHotDraw case study. Findings reveal that Extract Subclass, Extract Class, and Introduce Parameter Object improve code effectiveness significantly, offering insights for practitioners in software maintenance and continuous improvement.
- "Impact of Data Quality Types on Computational Time in Data Source Selection Using Ant Colony Optimization" by Sabri et al. investigates how high- and low-quality datasets affect computational efficiency. Results show that high-quality datasets reduce computational time by over 3%, underscoring the importance of data quality in AI-based optimization.

2.2 ML and Data Augmentation

Four articles present new techniques for addressing imbalanced data, duplicate detection, and numerical optimization in real-world applications.

- "Enhancing Imbalanced Data Augmentation: A Comparative Study of GANified-SMOTE and Latent Factor Integration" by Ruslan et al. introduces a hybrid oversampling approach that combines SMOTE, GANs, and latent factors. The method enhances diversity in minority class generation and improves classification accuracy for imbalanced datasets.
- "Lightweight String Similarity Approaches for Duplicate Detection in Academic Titles" by Wibowo et al. evaluates four similarity algorithms, demonstrating that character-based methods (e.g., Jaro-Winkler) excel in literal duplicates, while TF-IDF captures semantic similarity. A hybrid two-stage framework is proposed for academic title screening.

- "Implementation of Conjugate Gradient Method for Estimating Inflation Rate in Malaysia" by Wong et al. applies modified CG optimization techniques to predict inflation rates. Results show that linear least square estimators perform best, contributing to economic forecasting.
- "Conjugate Gradient Methods in Fitting Precipitation of Rainfall Data in Malaysia" by Tang et al. employs spectral CG methods to model rainfall precipitation. The study demonstrates that sHS-CG methods are reliable alternatives for regression analysis in environmental data fitting.

2.3 AI Applications and Reviews

- "A Scoping Review of Artificial Intelligence Research Trends in Mobile Applications" by Usman et al. synthesizes ten years of AI applications in mobile platforms, with healthcare, agriculture, and education emerging as leading domains. The review highlights convolutional neural networks as the most prevalent deep learning technique, reflecting the growing importance of mobile AI ecosystems.

2.4 Digital Transformation Systems

Two articles focus on systems that embody digital transformation principles, showcasing blockchain transparency and disaster preparedness.

- "Societies' Funds Management System Using Blockchain" by Lau and Harun introduces a blockchain-based system leveraging Ethereum for transparent, immutable financial record-keeping. The system enhances accountability and efficiency in managing societies' funds.
- "Real-time Read and Analysis of Air Pollution Produced from Private Electrical Generators in Mosul City using LoRaWAN" by Alfathe et al. deploys a low-power LoRaWAN sensor network (SCD30/MH-Z19 CO_2 nodes over TTN) with GIS-based spatial interpolation to map generator-driven emissions in Mosul in real time. The system identifies seasonal hotspots, validates long-range, low-cost connectivity under dense urban conditions (RSSI/latency/packet-loss analysis), and demonstrates a scalable smart-city blueprint for environmental monitoring in resource-constrained settings.

3. CONCLUSION

The contributions in this issue collectively illustrate how AI, optimization, and advanced computing are converging to transform digital ecosystems. From software testing and economic forecasting to blockchain governance and flood preparedness, these works highlight the multi-domain impact of AI-enhanced computing. The articles emphasize the critical importance of optimization and efficiency in scaling AI solutions, the role of data quality and augmentation in ensuring model reliability, and the value of domain-specific applications that demonstrate how context-driven innovations can deliver meaningful societal impact. As digital transformation deepens, future research must continue to address not only technical performance but also the scalability, ethics, and sustainability of AI-enhanced systems. Together, the studies presented in this thematic issue provide timely insights into how computing innovations are shaping a smarter, more resilient, and interconnected world.

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Hairulnizam Mahdin – Completed the entire article.

CONFLICT OF INTERESTS

No conflict of interest was disclosed.

ETHICS STATEMENTS

Our publication ethics follow The Committee of Publication Ethics (COPE) guideline. https://publicationethics.org/

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BIOGRAPHIES OF AUTHORS

Hairulnizam Mahdin is a Professor at the Faculty of Computer Science and Information Technology, Universiti Tun Hussein Onn Malaysia (UTHM). He has published more than 100 journal and conference papers indexed in Web of Science (WoS), Scopus, and Google Scholar. His research interests include data engineering, Internet of Things (IoT) and artificial intelligence (AI). With extensive experience in computer science, he has also played active roles in international conferences, serving as chair, co-chair, program committee member, and vice-chair. He can be contacted at email: hairuln@uthm.edu.my.