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Editorial

Editorial for the Special Issue Applied and Innovative Computational Intelligence Systems (3rd Edition)

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1. Introduction

We are pleased to present the third edition of the Special Issue "Applied and Innovative Computational Intelligence Systems" in Applied Sciences, a journal with an Impact Factor of 2.7 and a CiteScore of 4.5 (2022). This Special Issue offers a unique opportunity for computational intelligence (CI) researchers and practitioners to share their latest theoretical and experimental outcomes with the international community. Supported by a wide range of approaches—including machine learning, deep learning, fuzzy systems, and evolutionary computation—CI aims to develop intelligent systems characterized by adaptability, fault tolerance, and high performance, enabling or facilitating intelligent behavior in complex and dynamic environments. The ultimate goal is to create technology that allows machines to think, behave, or act in ways that are increasingly human-like.

In this context, the Special Issue explores both the foundational and applied aspects of CI, welcoming contributions in artificial intelligence, machine learning, deep learning, computer vision, data analysis and science, fault detection, affective computing, natural language processing, privacy and ethics, and robotics. By embracing this broad scope, we aim to capture the diversity and dynamism of contemporary research on CI and its complementary fields.

The papers included in this issue represent a comprehensive collection of the research and development trends in applied and innovative computational intelligence systems. These works serve as a valuable reference for established CI experts and as an accessible introduction for newcomers to the field. In line with the journal's commitment to open science and reproducibility, there are no restrictions on the length of the manuscripts, and the authors are encouraged to provide the full experimental details, datasets, and software as supplementary material. This approach not only ensures transparency and reproducibility but also increases the visibility and impact of the authors' contributions.

We thank all of the contributors for their high-quality submissions and look forward to the continued growth and impact of the computational intelligence community. We hope that this Special Issue will inspire further research, foster collaboration, and serve as a catalyst for innovation in both theory and practice.

Section 2 provides a brief overview of the field of computational intelligence, highlighting its foundations, recent developments, and future directions. Section 3 presents an

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overview of the articles published in this Special Issue. Section 4 concludes this editorial and provides some thoughts on the future of computational intelligence.

2. Applied and Innovative Computational Intelligence Systems

Computational intelligence has evolved into a multidisciplinary field that encompasses a wide array of methodologies and technologies aiming to create systems capable of intelligent behavior in complex, dynamic, and often uncertain environments. The foundations of CI are rooted in the development of algorithms and models that mimic aspects of human cognition, learning, and adaptation, drawing inspiration from biological systems and natural processes [1–3].

Historically, the field of artificial intelligence (AI) laid the groundwork for CI by exploring symbolic reasoning, problem-solving, and knowledge representation. However, the limitations of early AI systems in handling ambiguity, noise, and incomplete information led to the emergence of alternative paradigms such as neural networks, fuzzy logic, and evolutionary computation. These approaches, collectively known as computational intelligence, emphasize adaptability, robustness, and the ability to learn from data [4–8].

The resurgence of neural networks, particularly deep learning, has been a driving force behind recent breakthroughs in CI. Deep learning architectures, such as convolutional neural networks (CNNs) and recurrent neural networks (RNNs), have demonstrated a remarkable performance in tasks ranging from image and speech recognition to natural language processing and game playing [9,10]. The success of deep reinforcement learning, exemplified by Mnih et al.'s work on human-level control in Atari games, has expanded the horizons of CI further, enabling agents to learn complex behaviors through interaction with their environments [11].

One of the defining characteristics of modern CI systems is their ability to operate in real-world settings, where the data is often high-dimensional, heterogeneous, and subject to change. This has led to the development of innovative techniques for data preprocessing, feature extraction, and model selection, as well as the integration of multiple modalities, such as vision, language, and sensor data [12–15]. The fusion of symbolic and sub-symbolic methods, including hybrid neuro-symbolic systems, is an emerging trend that seeks to combine the strengths of logical reasoning and deep learning [16,17].

The applications of CI span a vast spectrum of domains. In healthcare, CI systems are used for medical image analyses, disease prediction, and personalized treatment planning [18,19]. In industry, they enable predictive maintenance, process optimization, and intelligent automation [20–22]. Smart cities leverage CI for traffic management, energy optimization, and public safety, while the Internet of Things (IoT) benefits from adaptive algorithms for sensor fusion and anomaly detection [23,24]. In education, CI supports adaptive learning platforms and intelligent tutoring systems, enhancing student engagement and outcomes [25–27]. Innovative computational intelligence also addresses challenges related to privacy, ethics, and transparency. The growing demand for explainable AI (XAI) has spurred research into models that provide interpretable decisions, fostering trust and accountability in critical applications [28,29].

The future of CI is marked by ongoing advances in transfer learning, meta-learning, and continual learning, which aim to create systems that can generalize knowledge across tasks and adapt to new situations with minimal supervision [30–33]. As the field continues to mature, interdisciplinary collaboration and open science practices will be essential for driving innovation and ensuring the responsible deployment of CI technologies.

In summary, applied and innovative computational intelligence systems are at the forefront of technological progress, offering transformative solutions to some of the most pressing challenges in science, engineering, and society. The synergy between founda-

tional research and practical applications is propelling CI to new frontiers, making it an indispensable pillar of the digital age.

3. An Overview of the Published Articles

This Special Issue presents a rich and diverse collection of articles that exemplify the breadth, depth, and impact of contemporary research on computational intelligence. The selected works address both foundational challenges and real-world applications, spanning a wide range of fields. The topics covered include medical artificial intelligence and healthcare analytics, such as the use of generative models for rare disease diagnostics, advanced neural network architectures for cancer classification, and machine learning frameworks for analyses of physiological signals. This issue also features research into sentiment analyses applied to tourism competitiveness, energy-aware optimization in automated manufacturing, noise filtering and data preprocessing, and the development of explainable recommendation systems. Further contributions explore multimodal data integration and language technologies for low-resource languages, as well as applications in robotics and affective computing.

A notable contribution is the systematic review by Machado et al. [34], which explores the use of generative models and data augmentation to overcome the scarcity of data on inherited retinal diseases. This work highlights the transformative potential of synthetic data in medical diagnostics, demonstrating how computational intelligence can address critical bottlenecks in healthcare and enable more robust, generalizable AI models for rare diseases.

In the tourism sector, Ramos and Pinto [35] apply a sentiment analysis and machine learning to assessing the influence of gastronomic image on the competitiveness of tourism destinations. Their study exemplifies the value of computational intelligence in extracting actionable insights from large-scale, unstructured data, and illustrates how these methods can inform strategic decision-making in service industries and regional development.

Significant advances in neural network architectures and their application to medical image analysis are also featured, as exemplified by Lauande et al. [36]. By integrating DenseNet, Transformer, and MBConv blocks for cancer classification, this work demonstrates the ongoing evolution of deep learning techniques and their adaptability to complex, high-stakes domains such as digital pathology. The interplay between architectural innovation and domain-specific challenges is a recurring theme throughout this issue.

The integration of multimodal data and language technologies is addressed by Jiang et al. [37], who propose a framework for seed data augmentation for low-resource languages. Their contribution not only advances the state of the art in natural language processing but also supports the preservation and processing of linguistic diversity, highlighting the societal relevance of computational intelligence beyond mainstream applications.

Additionally, Zhu et al. [38] present a multi-task learning approach for explainable recommendation systems, reflecting the growing importance of transparency and interpretability in AI-driven decision support. Their work bridges the gap between technical innovation and user trust, a crucial consideration as computational intelligence systems become increasingly embedded into everyday life.

Collectively, these articles illustrate the interdisciplinary and transformative nature of computational intelligence. The methodologies presented not only advance the state of the art but also offer practical solutions to pressing challenges in science, engineering, and society. The interplay between foundational research and practical applications, as well as attention to ethical and societal dimensions, underscores the central role of computational intelligence in shaping the future of technology and its impact on the world.

4. Conclusions

The contributions in this Special Issue underscore the transformative potential of computational intelligence to address complex, real-world problems. By bridging theory and application, the published works highlight the importance of interdisciplinary collaboration and the continuous evolution of methodologies in AI, machine learning, and data science. We believe that the insights and innovations presented here will inspire further research, foster new collaborations, and contribute to the ongoing advancement of the field. We thank all of the authors and reviewers and the editorial team for their dedication and support in making this Special Issue a success.

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