IN THIS ISSUE

Deep Learning Applications

Longbing Cao, *Editor in Chief*

This issue highlights the technical theme on "Deep Learning Applications," one of the most active areas in this new age of AI and machine learning. Eight articles demonstrate new progress made in deep representation learning, deep neural network architectures, and their multidomain applications. Three column articles debate on decentralized AI, autonomous racing, and big AI.

This issue presents three contributions to the columns: Editor's Perspective, AI Focus, and AI Future, respectively. The theme on "Deep Learning Applications" selects eight feature articles, which highlight various advanced applications of deep neural networks for approximating Goldbach's function, maximizing performance fairness, enabling cross-modal retrieval, classifying COVID-19 lesions and chest CT scans, diagnosing robot fault, optimizing recommendation, extracting open information, and estimating travel time.

COLUMN ARTICLES

The Editor's Perspective column "Decentralized AI: Edge Intelligence and Smart Blockchain, Metaverse, Web3 and DeSci," carries forward the discussion on decentralization made in the article "The DAO to DeSci: AI for Free, Fair, and Responsibility Sensitive Sciences," published in the March/April issue. I focus on the technical perspectives by reviewing and delineating the conceptual map, research issues, and technical opportunities of decentralized AI (DeAI) and edge intelligence. I then discuss new perspectives and opportunities of DeAI and edge intelligence in enabling smart blockchain, Web3, metaverse, and decentralized science (DeSci) for making them intelligent, widely applicable, and actionable.

AI Focus presents the first article "Challenges and Opportunities of Applying Reinforcement Learning to Autonomous Racing" by Peter R. Wurman, *et al.* They discuss their lessons learned and open research challenges in applying deep reinforcement learning for simulated motor racing, which beats the best drivers at the racing game *Gran Turismo*.

1541-1672 © 2022 IEEE
Digital Object Identifier 10.1109/MIS.2022.3184260
Date of current version 22 July 2022.

AI Future shares the expert opinion by the editor Michael Wooldridge in "Welcome to Big AI." He describes the necessity for, emergence of, as well as the opportunities and challenges inherent to Big AI as a new AI territory. He reviews the development of new Big AI systems and brings our attention to potential dangers including bias, toxic content, and ethics.

DEEP LEARNING AND FEATURE ARTICLES

This May/June issue highlights the theme on deep learning. Deep learning has demonstrated the state-of-the-art performance and achievements across a wide spectrum of AI tasks, in particular, in supervised learning for computer vision, image processing, pattern recognition, neural language processing, imitation learning, recommender systems, and multimedia applications.

However, deep learning still faces various theoretical and practical challenges, such as in 1) addressing reality-like complexities in the real world, such as non-IIDness with complex nonstationarity, heterogeneities, couplings, interactions, and entanglement between high dimensional, stylistic, uncertain, and small data; 2) enabling human-like learning theories and capabilities going beyond large data fitting and reliance on super computational power; 3) supporting effective learning from unsupervised or few-shot small data; 4) enabling the resilience of network architectures and learning mechanisms over evolving sampling, time, source, space, domain, modality, or task; and 5) supporting large-scale decentralized, energy-efficient, privacy-preserving, and on-device learning for individuals and low-performing and low-capacity devices.

Eight articles are presented in this issue, which address different aspects of deep learning research and application issues. In the article "Deep Learning Architectures for Approximating Goldbach's Function in New Regions," the authors apply deep neural networks to address the mathematical question of Goldbach's conjecture and Goldbach's function. They propose two novel deep learning

WELCOME NEW EDITORS

It is my great pleasure to welcome several new editorial board members and to sincerely thank those who have served *IS* for many years but are recently retired from the editorial board.

COLUMN AND DEPARTMENT CHANGES

A thorough review of the existing *IS* departments has inspired strategic restructuring of the departments for better engagement, readership, and impact, and to establish several new columns for targeted activities.

In addition to the four columns, Editor's Perspective, AI Expert, *AI* Focus, and AI Future—announced in the previous issues, *IS* has recently created the AI Insight column, which aims to share expert opinions and visionary insights on AI and intelligent systems with our readers. Professor Usama Fayyad, who is a world leader in data science and experiential AI research and applications, and the Executive Director of the Institute for Experiential AI at Northeastern University, USA, will edit this column. I look forward to his thoughts and insights on AI, and will enjoy reading contributions from other key leaders whom he will invite.

To refresh the *IS* lineup, some inactive departments were retired, including AI and Education, which was edited by Professor Judy Kay from the University of Sydney, Australia; AI and Game Theory, edited by Professor Michael Wooldridge from the University of Oxford, U.K.; AI and Sustainability, by Associate Professor Douglas Fisher from Vanderbilt University, USA; Human-Centered Computing, by Professor Jennifer Golbeck from the University of Maryland, College Park, USA; Intelligent Transportation Systems, by Professor Rosaldo J.F. Rosetti from the University of Porto, Portugal; and Web Science, by Professor Elena Simperl from King's College London, U.K. I thank everyone for their service and contributions to *IS*.

I am delighted to announce a new department: AI and Finance. Professor Tony Xuezhong He, from Xi'an Jiaotong-Liverpool University in China, and a global expert in finance, will edit this department. With his strong interest in applying AI and machine learning to this exciting field, Tony will continue to inspire increased cross-disciplinary development between the worlds of finance and AI.

ASSOCIATE EDITORS

IS is very grateful to Professor Lorenzo Cavallaro from University College London, U.K., who has retired from the editorial board after many years of service.

Meanwhile, *IS* welcomes Associate Professor Fabio Stella from the University of Milan-Bicocca, Italy, and Professor Jiuyong Li from the University of South Australia, who join the board as new associate editors. Fabio is an expert in Bayesian networks and general areas of AI, data science, and machine learning. Jiuyong specializes in data mining, causal discovery, biomedical informatics, fairness, and privacy. Their expertise will further expand the *IS*'s capacity and readership.

architectures with multiplication layers, which outperform the classic multilayer perceptron in handling large numbers (4–10 millions) for the Goldbach's function.

The article "Maximizing Fairness in Deep Neural Networks via Mode Connectivity" addresses the challenge of ensuring the fairness of deep neural networks. It aims to maximally reduce the performance disparity between individual samples while maintaining their overall modeling performance. Fairness maximization is made by mode connectivity combined with multiobjective optimization. Their strategies maximize the fairness over individual samples during selecting the best model for the overall performance.

The article "VGAN: Generalizing MSE GAN and WGAN-GP for Robot Fault Diagnosis" addresses the issues of oscillating training processes and mode collapse in generative neural networks (GANs). It introduces a generalization of mean square error (MSE) GAN and Wasserstein GAN (WGAN) with gradient penalty. Their GNA network takes the framework of conditional WGAN with gradient penalty and resorts to the Vapnik V-matrix-based criterion to generalize MSE.

The article "An Orthogonal Subspace Decomposition Method for Cross-Modal Retrieval" addresses a multimodal representation learning problem in deep learning. It differentiates modality-shared and modality-specific features for learning better common representations. An orthogonal subspace decomposition method is introduced for cross-modal retrieval by optimizing the intramodal discrimination loss and intermodal invariance loss to learn semantically discriminating features.

The article "One Shot Model for COVID-19 Classification and Lesions Segmentation in Chest CT Scans Using LSTM With Attention Mechanism" combines ResNet, long short-term memory network, and attention

mechanism to segment lesions and classify CT scan slices of COVID-19 patient's images.

In the article "A Stable Deep Reinforcement Learning Framework for Recommendation," the authors refine the Markov decision process for reinforcement learning-based recommendation. They model user feedback behaviors to optimize recommendation strategy and enhance the stability of user preference.

The article "Adding an Inception Network to Neural Network Open Information Extraction" applies inception networks to open information extraction. Their method applies the inception network to derive relation tuples from plain text and further learns the dependence path embedding.

The article "Deep Fusion for Travel Time Estimation Based on Road Network Topology" applies deep learning to intelligent transportation systems. A deep fusion framework estimates travel time in road networks with complex road network topology and dynamic traffic fluctuation. A relational fusion network learns the relationship between road link segments and an attention mechanism captures the correlations between spatial and temporal features.

2022 AI'S 10 TO WATCH

The call for 2022 AI's 10 to Watch award has been formally launched. We have substantially lifted the selection criteria of this award for more competitive and prestigious recognition of this well-regarded AI award in the broad-reaching new age of AI. *IS* is keen to continuously inspire next-generation AI scientists and engineers worldwide and celebrate their exemplary achievements and impact of AI.

I hope you enjoy this issue.