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Guest Editorial

Computational Intelligence for Internet of Things in the Big Data Era (Part I)

This special issue focuses on the research challenges of computational intelligence technologies toward trustworthy IoT in the Big Data Era.

Emerging Internet of Things (IoT) applications in various domains such as smart city, smart home, smart grid, e-health, smart transportation, and computer vision critically require trustworthy networking solutions that are resilient against disturbances and disruptions, including high mobility, high density, disasters, infrastructure failures, cyberattacks, etc. The networking framework should be capable of providing more secure, reliable and efficient communications in various network environments, especially for the performance-sensitive and mission-critical applications such as remote surgery and autonomous driving.

Two main challenges exist in enforcing trustworthy IoT. The first challenge comes from the spatial diversity of the entities involved in communications, such as the high mobility of the devices, and the limitations of propagation media and other resources. The second challenge is due to the varying temporal features of the environment. These challenges can be solved by using computational intelligence (CI) technologies such as fuzzy logic and evolutionary computation. On the other hand, Big Data-based approaches, including deep neural networks, could facilitate data-driven prediction and performance improvement by capturing time-dependent properties of network elements such as user traffic and behaviors. While CI technologies can achieve a flexible and self-evolving system design, Big Data can facilitate the use of deep neural networks through which learning the best strategy from complex data becomes possible.

This special issue focuses on the technical challenges and the synergistic effect of Big Data and CI for trustworthy IoT. We were successful in attracting 47 submissions. All of the submitted papers were reviewed by at least three competent independent referees and also by one editor. Following a rigorous peer review process, 7 papers have been accepted for publications, and four of them have been selected for the Part I of this special issue.

In the first paper entitled "QoE-driven Content-Centric Caching With Deep Reinforcement Learning in Edge-Enabled IoT", X. He et al. introduce a deep reinforcement learning (DRL) model for improving Quality-of-Experience (QoE) in edge-enabled IoT. Reinforcement learning is used to learn the best policy, and a novel DRL algorithm is proposed to seek out a balance between Q-value accuracy and accelerated stability. Extensive simulation results are provided to show the performance of the proposed algorithm.

In the paradigm of AI-based networking, H. Yao et al. propose a hybrid machine learning architecture for packet routing in their paper entitled "AI Router & Network Mind: A Hybrid Machine Learning Paradigm for Packet Routing", where a distributed intelligent approach based on AI routers is combined with a centralized platform. The authors present simulation results to demonstrate the feasibility and performance of the proposed architecture.

Understanding user behaviors becomes a key enabler in many applications such as sedentary-related healthcare, human-computer interaction (HCI) and affective computing. The third paper, "BeSense: Leveraging WiFi Channel Data and Computational Intelligence for Behavior Analysis" by Y. Gu et al., proposes BeSense, a CI-based device-free and real-time system to analyze common human behaviors (e.g., surfing, working and gaming) using WiFi signals. BeSense

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is prototyped on low-cost and ubiquitous WiFi devices and evaluated in extensive real-world experiments. Experimental results verify the effectiveness of BeSense in recognizing user behaviors.

The last paper, "ADMM Empowered Distributed Computational Intelligence for Internet of Energy" by W. Zhong et al., proposes an approach that employs Alternating Direction Method of Multipliers (ADMM) as the theoretical framework for the design of distributed computational intelligence in Internet of Energy (IoE). The authors discuss the challenges of ADMM implementation in IoE and propose a joint computing and networking resources management architecture to meet the challenges. Numerical results show that this architecture could reduce the computing and communication costs of ADMM implementation.

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