Engineering 6 (2020) 205–206

Contents lists available at ScienceDirect

Engineering

journal homepage: www.elsevier.com/locate/eng

Editorial

Artificial Intelligence: Enabling Technology to Empower Society

Yue-Guang Lyu

Department of Information and Electronic Engineering, Chinese Academy of Engineering, Beijing 100088, China

Artificial intelligence (AI) can be used to tackle problems that are difficult or impractical to solve using traditional methods. In general, the fundamental goals of AI are to enable machines to possess sensing (e.g., speech recognition, natural language understanding, and/or computer vision), problem-solving/decision-making (e.g., searching and/or planning), and acting (e.g., robotics) capabilities that only humans or other intelligent creatures would naturally have.

AI has the potential to enhance every technology; in this sense, it resembles "enabling" technologies such as the combustion engine or electricity. Many people in this field believe that AI is general purpose, with a multitude of applications across many different fields [1–3]. Moreover, AI has been greatly advancing specific technological innovations in the fields of agriculture, manufacturing, transportation, and healthcare. In the coming years, AI will unpredictably impact every aspect of human life. AI can help and empower society to reach a new height. In fact, the impact of AI will be greatest when it is used to empower all of us to positively transform society.

This special issue reports on recent rethinking of AI from different aspects, such as theoretical research, algorithmic models, practical methodologies, and ethical issues. In the article titled "Multiple knowledge representation of artificial intelligence," Yunhe Pan proposes a multiple knowledge representation of AI that consists of the knowledge graph, visual knowledge, and the deep neural network. This representation is beneficial to the development of interpretable, evolutional, and transferable models for knowledge representation and inference. In "How to interpret machine knowledge," Fashen Li et al. analyze research methods in the fields of physics and AI, and propose principles and models for interpreting machine knowledge. Toward the long-term goal of keeping AI beneficial to human society, governments, research organizations, and companies in China have published their ethical guidelines and principles for AI. Wenjun Wu et al. present a survey of those efforts titled "Ethical principles and governance technology development of AI in China" and highlight the preliminary outcomes in China.

Although brain science has resulted in breakthroughs in AI such as deep learning, there is still an insurmountable gap between AI and human intelligence. In "From brain science to artificial intelligence," Jingtao Fan et al. examine how to bridge that gap and discusses the opportunities and challenges in adapting brain science to AI. In "A survey of accelerator architectures for deep neural networks," Yiran Chen et al. summarize the recent advances in accelerator designs for deep neural networks (DNNs)—namely, DNN accelerators—and discuss various architectures that support DNN executions. Na Lei et al. present "A geometric understanding of deep learning," and introduce an optimal transportation (OT) view of generative adversarial networks (GANs). OT theory can help to reveal the intrinsic collaborative—rather than competitive—relation between the generator and the discriminator in GANs, and the fundamental reason for mode collapse.

Natural language processing (NLP) is a subfield of AI that focuses on enabling computers to understand and process human languages. In "Progress in neural NLP: modeling, learning, and reasoning," Ming Zhou et al. review the latest progress in the neural network-based NLP (neural NLP) framework from three perspectives—modeling, learning, and reasoning—and briefly outline their thoughts on the future directions of neural NLP.

With the rapid development of AI and deep learning techniques, it is critical to ensure the security and robustness of the deployed algorithms. In "Adversarial attacks and defenses in deep learning," Kui Ren et al. introduce the theoretical foundations, algorithms, and applications of adversarial attack techniques, and describe a few research efforts on defense techniques. In "Artificial intelligence in healthcare: review and prediction case studies," Guoguang Rong et al. summarize the latest developments in the application of AI in biomedicine, including disease diagnostics, living assistance, biomedical information processing, and biomedical research.

Recent progress in deep learning is essentially based on a "big data for small tasks" paradigm. In "Dark, beyond deep: a paradigm shift to cognitive AI with humanlike common sense," Yixin Zhu et al. propose the "small data for big tasks" paradigm to solve a wide range of tasks with little training data. They illustrate the potential power of this new paradigm by reviewing models of common sense that synthesize recent breakthroughs in both machine and human vision. Cewu Lu and Shiquan Wang discuss "The general-purpose intelligent agent": a system that can adapt to different tasks like humans do, with an architecture inspired by a general-purpose computer. They propose a primitive flow

https://doi.org/10.1016/j.eng.2020.01.005

model and manipulation primitive to describe and model human manipulation skills and behaviors effectively. Finally, aiming to bring the knowledge of causal inference to the participators of machine learning and AI, Kun Kuang et al. provide a survey on causal inference from different aspects, titled "Causal inference."

The articles in this special issue outline underlying considerations for the launch of the next generation AI (AI 2.0) in China. Big-data intelligence [4,5], crowd intelligence [6], cross-media intelligence [7], hybrid-augmented intelligence [8], and unmanned autonomous systems [9] play an important role in AI 2.0. As mentioned in Ref. [5], the next breakthroughs of AI will be an interdisciplinary endeavors, since AI is an enabling technology. This special issue undoubtedly provides food for thought about the future advance of AI 2.0.

I would like to express appreciation to the reviewers of this special issue for their timely and professional comments. Most importantly, I extend our thanks to all the authors who submitted their manuscripts for consideration. Their support has made this special issue successful. The strong support from Professor Fei Wu, Professor Qiang Yang, Professor Ya-Hong Han, and Dr. Kun Kuang, as well as the editorial office, is also greatly appreciated. Furthermore, I thank the members of the disruptive information technology research group of the Department of Information and Electronic Engineering at the Chinese Academy of Engineering.

References

[1] Pan Y. Heading toward artificial intelligence 2.0. Engineering 2016;2(4):409–13.
[2] Pan Y. Special issue on artificial intelligence 2.0. Front Inform Technol Electron Eng 2017;18(1):1–2.
[3] Pan Y. 2018 special issue on artificial intelligence 2.0: theories and applications. Front Inform Technol Electron Eng 2018;19(1):1–2.
[4] Zhuang YT, Wu F, Chen C, Pan Y. Challenges and opportunities: from big data to knowledge in AI 2.0. Front Inform Technol Electron Eng 2017;18(1):3–14.
[5] Pan Y. On visual knowledge. Front Inform Technol Electron Eng 2019;20(8):1021–5.
[6] Li W, Wu W, Wang H, Cheng X, Chen H, Zhou Z, et al. Crowd intelligence in AI 2.0 era. Front Inform Technol Electron Eng 2017;18(1):15–43.
[7] Peng Y, Zhu W, Zhao Y, Xu C, Huang Q, Lu H, et al. Cross-media analysis and reasoning: advances and directions. Front Inform Technol Electron Eng 2017;18(1):44–57.
[8] Zheng N, Liu Z, Ren P, Ma Y, Chen S, Yu S, et al. Hybrid-augmented intelligence: collaboration and cognition. Front Inform Technol Electron Eng 2017;18(2):153–79.
[9] Zhang T, Li Q, Zhang C, Liang H, Li P, Wang T, et al. Current trends in the development of intelligent unmanned autonomous systems. Front Inform Technol Electron Eng 2017;18(1):68–85.