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EDITORIAL

Deep learning: emerging trends, applications and research challenges

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Machine learning is to design and analyze algorithms that allow computers to "learn" automatically, and allows machines to establish rules from automatically analyzing data and using them to predict unknown data. Traditional machine learning approach is difficult to meet the needs of Internet of Things (IoT) only through its outdated process starting from problem definition, appropriate information collection, and ending with model development and results verification. But however, recent scenario has dramatically changed due to the development of artificial intelligence (AI) and high-speed computing performance. Therefore, deep learning is a good example that breaks the limits of machine learning through feature engineering and gives astonishingly superior performance. It makes a number of extremely complex applications possible.

Machine learning has been applied to solve complex problems in human society for years, and the success of machine learning is because of the support of computing capabilities as well as the sensing technology. An evolution of artificial intelligence and data-driven approaches will soon cause considerable impacts to the field. Search engines, image recognition, biometrics, speech and handwriting recognition, natural language processing, and even medical diagnostics and financial credit ratings are all common examples. It is clear that many challenges will be brought to publics as the artificial intelligence infiltrates into our world, and more specifically, our lives.

Thus, this special issue aims to bring together various research and development achievements in exploring techniques, applications, and challenges that face the evolution of artificial intelligence in the context deep learning. A brief overview of the papers is presented and discussed as follows:

The first theme in this special issue focuses on "Reduction of parameters in deep-learning models". Cao and Wang (2019) integrated the principal component analysis (PCA) and back propagation (BP) neural network algorithm to construct the stock price prediction model. The experimental results illustrated the significant improvement than the traditional investment strategies. Chen and Huang (2019) used the evolution matrix function to extract the important feature and then built the 3D art creation network. Gao et al. (2019) applied the genetic algorithm (GA) into the BPNN and the experimental results illustrated the model can obtain the high accuracy of the convertible bonds and closed funds benefits. Huang et al. (2019a, b, c) used the grey relational and multi-objective decision-making methods to extract the high risk factors for aboriginal elderly falls. The proposed model can be useful for the variables reduction in the neural network construction. Liu (2019a, b) developed the novel analytic hierarchy process (AHP) based on the grey relational analysis (GRA). The proposed method can be the efficient way to recede the unnecessary factors and parameters in deep-learning models. Ohno (2019) used the variational auto-encoders (VAEs) as generative models for data augmentation and can be an efficient method to build the multi-layer neural networks. Sangaiah et al. (2019a) used the biogeography-based optimization (BBO) to reduce the parameters, and experimental results illustrated the efficiency and feasibility of the proposed algorithm. Sangaiah et al. (2019b) developed the cuckoo optimization algorithm (COA) to construct the robust mixed-integer linear

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programming model with the deep learning approach. Shen et al. (2019) proposed the rough set-genetic-BP neural network to predict the safety problem of the construction industry. The proposed model has the advantages on the feasible, effective and accurate. Wang and Lu (2019) proposed the visualization analysis of big data for Web of Science and CNKI databases. After using the visualization analysis, this research can identify the key research and key documents in the field of big data research. Zhang and Huang (2019) proposed the novel deep learning approach based on particle swarm optimization (PSO) and Spark big data computing framework. This research is a good reference for big data parallel programming design based on cloud platform.

The second theme in this special issue focuses on "Enhanced interpretation and reasoning methods in deep-learning models". Cagcag Yolcu et al. (2019) proposed the intuitionistic fuzzy regression functions approach based on hesitation margin (I-FRF-HM) to construct the time-series prediction. The experimental results figured out the proposed algorithm can outperform than other prediction models and can be integrate with deep learning approach. The same as Kocak et al. (2019) and Xu et al. (2020), they developed the deep-learning model to deal with the time-series problems. Fan et al. (2019) designed and implemented a novel way to extract network information to overcome the poor performance at downstream tasks. Jing et al. (2019) evaluated the three kinds of deep learning algorithms into the China capital market. Lu (2019) proposed an object-region-enhanced deep learning network, including object area enhancement strategy and black-hole-filling strategy. This model can be the reference as future researches for the robust and practical application. Melnyk et al. (2019) modified the global weighted average pooling (GWAP) and global weighted output average pooling (GWOAP) to build the convolutional neural network (CNN) model for handwritten Chinese character recognition. Özyurt (2019) developed the extreme learning machine (ELM) classifier and built the CNN architecture for white blood cell (WBC) dataset. The experimental results indicated the proposed model obtain the high accuracy.

The third theme in this special issue focuses on "Self-adapting and evolving deep-learning models and applications". Chang et al. (2019), Ghazi Zahedi et al. (2019) and Wang et al. (2020) used the text mining technique to decide the most important factors from online electronic word-of-mouth (e-WoM) and crowdfunding projects. Then, these factors can be the input variables to construct the deep learning prediction model. Chen (2019), Tseng et al. (2019), and Zhang et al. (2020) integrated the deep learning framework and convolutional neural network (CNN) methods to build the Chinese ink style painting creation model and image semantic segmentation, separately. Chen et al. (2019) built a sentiment analysis framework based on different deep learning models. The experimental results showed the approach can improve the sentiment classification performance. Both Feng (2019) and Liang and Wang (2019) adopted the ant colony algorithm (ACO) to design the evolving deep-learning model for rural e-commerce and marine investigation path planning, separately. Fouad et al. (2019) implemented different natural language processing (NLP) techniques along with the aid of the various deep learning approaches and architectures for Arabic tweets. Gao and Zhou (2019) presented the privacy protection algorithm and also integrated with deep learning approach to construct the precise poverty alleviation platform. Huang et al. (2019a, b, c) integrated the sequential pattern mining (SPM) and association discovery (AD) to construct the financial time series neural network model. Ji and Xiao (2020) presented the Q-learning algorithm to help the agent make the effective decision in video games. Li (2020) used the back propagation neural network (BPNN) model to predict the football games. Liu (2019a, b) designed the high-resolution remote sensing image storage model in the cloud computing environment. The proposed system architecture can be the reference for the online learning for the neural network. Liu and Zhang (2019) developed the deep learning methods to deal with the feedback information on health courses. Meng et al. (2020) developed the backpressure routing control strategy based on K-means algorithm and the experimental results showed the significant improvement of traffic vehicles controlling and traffic smoothness. Suresh et al. (2019) developed the novel classifier based on decision tree algorithm and implemented the hybridized neural network for breast cancers prediction. Wang et al. (2019) adopted the fuzzy C-mean clustering algorithm to build the intelligent economic decision support system. Huang et al. (2019a, b, c) and Wu and Zhang (2019) integrated the association rule and FP-growth algorithms to build the chronic diseases and electronic evidence analysis model. Wu and Li (2019) integrated the cloud computing and Internet of Things (IoT) architecture to build the graffiti art classification model. Yang et al. (2019) adopted the Hadoop cluster, relational database (RDB), and not only Structured Query Language (NoSQL) techniques to build the air pollution monitoring system. This system framework can be as the reference for the big data in neural network researches.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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