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PREFACE

Cognitive data science methods and models for engineering applications

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Cognitive computing has broad horizons, which cover different characteristics of cognition. The cognition field is highly transdisciplinary in nature, combining ideas, principles and methods of psychology, computer and Internet technologies, linguistics, philosophy, neuroscience, etc. Cognitive computing is the creation of self-learning systems that use data mining, pattern recognition and natural language processing (NLP) to solve complicated problems without constant human oversight. Moreover, cognitive computing will bring a high level of fluidity to analytics. This special issue explores domain knowledge and reasoning of data science technologies and cognitive methods over the engineering applications. The idea of embodying this concept would be to extend existing data technology approaches by incorporating knowledge from experts as well as a notion of artificial intelligence, and performing inference on the knowledge. The main focus is design of best cognitive embedded data technologies to process and analyze the large amount of data collected through various sources and help for good decision-making.

The new frontier research era and convergence of cognitive data science methods and models with reference to engineering has three main streams' needs to be addressed in the current scenario: bio-informatics, medical imaging and sustainable engineering and so on. This special issue editorial is integrating machine learning, cognitive neural computing, parallel computing paradigms, advanced data analytics and optimization opportunities to bring more compute to the real-world engineering problems and challenges. Further, it is important to make a note that convergence of cognitive computing and data science methods and its intelligence techniques has not been adequately investigated from the perspective of engineering research streams (bio-informatics, medical imaging, and sustainable engineering) and its related research issues.

Furthermore, there are many noteworthy issues (health informatics, bio-image informatics, energy efficiency, etc.) that need to be addressed in the context of cognitive computing and engineering. Obviously, these challenges also create immense opportunities for researchers. For the aforementioned reasons, these special issue submissions focused to address the comprehensive nature of cognitive computing, and to emphasize its character in human intelligence and learning systems, complex analysis tasks mimic human cognition and learning behavior, prediction and control of engineering systems. Finally, this special issue intends to give an overview of state-of-the-art of issues and solution guidelines in the new era of cognitive computing paradigm and its recent trends of techniques for real-world engineering applications.

A brief overview of the papers is presented and discussed as follows:

In the paper, *Optimality criteria for fuzzy-valued fractional multi-objective optimization problem*, Agarwal et al. (2018) presented the optimality criteria for fuzzy-valued fractional multi-objective optimization problem (FVFMOOP). First, the original problem is modified using

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the parametric approach of Dinkelbach into multi-objective, non-fractional optimization problem and then the optimality conditions are established for the modified problem using the Hukuhara derivative. The established optimality criteria are verified by two numerical examples illustrated in this paper.

In the paper, *A cognitive/intelligent resource provisioning for cloud computing services: opportunities and challenges*, Al-Asaly et al.(2019) study the possibility of using a cognitive/intelligent approach for cloud resource provisioning which is a combination of the autonomic computing concept, deep learning technique and fuzzy logic control.

In the paper, *K-means clustering and neural network for object detecting and identifying abnormality of brain tumor*, Arunkumar et al. (2018) investigated the automated brain tumor segmentation and identification approach using ANN from MR images. This paper illustrated that the approach without human mediation by applying the best attributes toward preparatory brain tumor case revelation has been improved. The result of this study shows ANN approach classifier recorded accuracy 94.07% when compare to brain tumor cases classification, sensitivity and specifcity result were 90.09% and 96.78% respectively.

In the paper, *Traffic flow guidance algorithm in intelligent transportation systems considering the effect of non-floating vehicle*, Chen et al. (2019) present the method of estimating non-floating vehicles' driving information according to floating vehicles' information. The authors presented the estimation method, a new traffic flow guidance algorithm, Estimated Weighted Vehicle Density Feedback Strategy (EWVDFS) based on Weighted Vehicle Density Feedback Strategy (WVDFS).

The paper *Improved Relevance Vector Machine (IRVM) classifier for Intrusion Detection System* by Devi and Suganthe (2018) used the relevance vector machine which can recognize extract intrusion activities involved in the intrusion detection system. The experimental result concludes that improved relevance vector machine algorithm provides greater performance than the existing approaches.

The paper *Bring your own hand: how a single sensor is bringing multiple biometrics together* by Jaswal et al. (2018) presents a single sensor-based multimodal biometric identification system by fusing major finger knuckle, minor finger knuckle, palm print and hand print features of the human hand for enhancing the security and privacy of any consumer device.

In the paper, *Data processing model and performance analysis of cognitive computing based on machine learning in Internet environment*, Jin (2019) proposed a cognitive computing model and the data processing technology that can use a task-scheduling algorithm under distributed background conditions that are explored.

In the paper, *A performance analysis of genome search by matching whole targeted reads on different environments*, Jung and Yi (2018) illustrated the genome search system that automatically identifies genes from assembled sequences and reference amino acids. This enables not only the identification of genes without redundant processes including changing of formats but also would improve the performance and shorten the execution time to identify genes.

In the paper, A *robust lane detection method based on hyperbolic model*, Li et al. (2018) investigated a robust lane detection method under structured roads. The method contains two parts: straight line detection in near field and curve matching in the far field. The results of the experiment indicate that the proposed method has a robust performance in complex environments.

In the paper, *Nucleosome positioning based on generalized relative entropy*, Lu and Liu (2018) proposed a novel method of nucleosome positioning for predicting nucleosome positioning in human, worm, fly and yeast genomes, respectively.

In the paper, *An efficient hybrid metaheuristic approach for cell formation problem*, Nalluri et al. (2019) addressed a novel clonal selection algorithm (CSA) that uses a new affinity function and part assignment heuristic for solving a multi-objective cell formation problem (CFP). The proposed CSA has been hybridized with genetic algorithm (GA) for generating feasible cell sequences that fulfill both mutually exhaustive as well as exclusive properties of machine cells prior to the initial population generation.

The paper *Biomechanics of artificial intervertebral disc with different materials using finite element method* by Omran et al. (2018) aims to help the orthopedic in selecting the most suitable artificial intervertebral disk material that can be used in intervertebral disk replacement surgery based on the finite element method.

In the paper, *A framework combining DNN and level-set method to segment brain tumor in multi-modalities MR image* by Qin et al. (2019), the authors proposed a framework for brain tumor MR image segmentation combining deep learning and level set method. Experiments show that the proposed method has effectively overcome discontinuity in segmentation result and obtain a satisfied segmentation result.

In the paper, *Performance analysis of efficient data distribution in P2P environment using hybrid clustering techniques*, Raju and Chandrasekaran (2019) applied *K*-Means algorithm for distributed large data using hybrid clustering techniques. The proposed approach in this paper considered the system for the distribution of data in peer to peer environment using mining techniques.

The paper *New level set approach based on Parzen estimation for stroke segmentation in skull CT images* by

Rebouças et al. (2018) focused on the hemorrhagic type of stroke and proposes a new approach to automatically start the level set method within the CVA region and to use a nonparametric estimation approach based on the Parzen Window to segment the CVA. The experimental results showed that the proposed method presented a superior performance compared to the other commonly used methods.

The paper *Gait identification using fractal analysis and support vector machine* by Si et al. (2018) presents the development of wearable sensing system that can be used to study the gait dynamics of human.

The paper *Road network-based region of interest mining and social relationship recommendation* by Tan and Zhang (2019) proposed road context-based active region extraction algorithm (RAREA) which explores the method to extract the specific regions within the road network.

The paper *Wearable devices for health-related quality of life evaluation* by Tramontano et al. (2019) describes a novel architecture and an example of algorithm to reduce the complexity of the non-structured data like a single-channel ECG.

In the paper, *A high-performance parallel coral reef optimization for data clustering* by Tsai et al. (2019), proposed algorithm is based on a new kind of metaheuristic algorithm, coral reef optimization with substrate layers (CRO-SL), to get a better cluster result; it has also been applied to a cloud computing platform to reduce the response time of a data analytics system.

The paper *A bearing vibration data analysis based on spectral kurtosis and ConvNet* by Udmale et al. (2018) proposes a novel efficient method for the fault classification of rotating machines. The experimental results demonstrate that the proposed method effectively classifies the bearing faults under different operating conditions in comparison with other methods.

The paper *A comprehensive review on iris image-based biometric system* by Winston and Hemanth (2018) introduces the reader with different segments of an iris recognition system and reviews the techniques involved with each segment.

The paper *Multifocus image fusion using random forest and hidden Markov model* by Wu et al. (2019) studies about image fusion methods which can be used to integrate these multifocus images into a fused image. The authors used the patches instead of the pixels as the processing unit and process each patch in the spatial domain.

The paper *An improved two-lane cellular automaton traffic model based on BL-STCA model considering the dynamic lane-changing probability* by Xiang et al. (2019) introduces the dynamic lane-changing probability and proposed an improved BL-STCA model with modification of lane-changing rules.

In the paper, *Learning to rank with relational graph and pointwise constraint for cross-modal retrieval* by Xu et al. (2018), the authors consider the cross-modal retrieval task, from the perspective of optimizing ranking model, as a list-wise ranking problem and propose a novel method called learning to rank with relational graph and pointwise constraint.

The paper Strength prediction of similar materials to ionic rare earth ores based on orthogonal test and back propagation neural network by Zhong et al.(2019) aims to predict the strength of materials similar to the ionic rare earth (IRE) ores [hereinafter referred as similar materials(SM)]. A $4 \times Y \times 2$ back propagation neural network (BPNN) prediction model, based on 18 groups of samples of the SM with different mix proportions, was used to describe their strength.

The paper Virtual *machine migration method based on load cognition* by Zhu et al. (2018) focused on the communication costs of VMs migration in the data center. In this paper, a double auction-based VM migration algorithm is proposed, which takes the cost of communication between VMs into account under normal operation situation. The simulation result shows that the proposed VM migration algorithm-based heuristic is efficient.

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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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