Guest Editorial

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New Trends of Learning in Computational Intelligence

This special issue of the *IEEE Computational Intelligence Magazine* is dedicated to New Trends of Learning in Computational Intelligence.

Over the past few decades, conventional computational intelligence techniques faced severe bottlenecks in terms of algorithmic learning. Particularly, in the areas of big data computation, brain science, cognition and reasoning, it is almost inevitable that intensive human intervention and time consuming trial and error efforts are to be employed before any meaningful observations can be obtained. Recent development of emerging computational intelligence techniques such as extreme learning machines (ELM) and fast solutions shed some light upon how to effectively deal with these computational bottlenecks.

Based on the observations that increasing correlation can be found among apparently different theories from different fields, as well as the increasing evidence of convergence between computational intelligence techniques and biological learning mechanisms, this special issue seeks to promote novel research investigations in computational intelligence bridging among related areas. Topics of interest for this special issue include but are not limited to the following theories, algorithms and applications:

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Theoretical foundations and algorithms:

- ❏ Extreme learning machines (ELM), No-Prop algorithms and random kitchen sinks
- ❏ Real-time learning, reasoning and cognition
- ❏ Sequential / incremental learning
- ❏ Clustering and feature extraction/selection
- ❏ Closed form and non-closed form solutions
- ❏ Multiple hidden layers solutions and random networks
- ❏ Parallel and distributed computing/cloud computing
- ❏ Fast implementation of deep learning Applications:
- ❏ Biologically-inspired natural language processing
- ❏ Big data analytics
- ❏ Cognitive science/computation
- ❏ Autonomous systems

This special issue received 161 submissions. Due to a large number of submissions, in addition to guest editors, some experts as area editors have been invited to handle the review too. Especially, Editor-in-Chief handled the review of the guest editors' submissions directly. All manuscripts have gone through rigorous peer review process. We finally selected less than 4% of the submitted papers for this special issue which will be published in two parts: Part I in May 2015 issue of the magazine and Part II in August 2015 issue. Many high quality submissions cannot be published due to the page limitation of the magazine.

Part I of this special issue (May 2015 issue) includes two papers which propose efficient ELM solutions on big data applications:

The first paper by G.-B. Huang, Z. Bai, L.L.C. Kasun and C.M. Vong shows that from ELM theory point of view local receptive fields can be formed by randomly generated hidden nodes. They can be randomly generated based on different continuous probability distributions which may be denser around some input nodes while sparser further away. On the other hand, a hidden node in ELM can be a combinatorial node formed by several nodes (a network), which results in local feature learning. Interestingly, this paper builds a good relationship between ELM and popular convolution neural networks (CNN), and shows that CNN with random input weights actually has universal approximation capability. A combinatorial hidden node in ELM can be formed by several random convolution nodes plus pooling functions. ELM theories may shed a light on the research of different local receptive fields including true biological receptive fields of which the exact shapes and formula may be unknown to human beings. Experimental results on the NORB dataset, a benchmark for object recognition, show that compared with conventional deep learning solutions, the proposed local receptive fields based ELM (ELM-LRF) reduces the error rate

from 6.5% to 2.7% and increases the learning speed up to 200 times.

The second paper by A. Akusok, Y. Miche, J. Karhunen, K.-M. Björk, R. Nian, and A. Lendasse targets at a web content filtering problem as an integral part of an automated Internet security framework using machine learning techniques. Due to a large volume of information produced every day (both content and malicious software), machine learning based decision making and security monitoring are highly demanded. This work provides a comprehensive methodology for a tunable web content filtering system based on an ELM variant. The proposed approach was tested in a real-world dataset which has 600,000 images (50 GB of disk space originally, and the 200,000,000 extracted image features take 200 GB in a database) with 19 offensive classes and one benign class. The average accuracy is achieved up to 97%.

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Society Briefs

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strategy for adaptive synchronizing different chaotic systems, developed fuzzy guaranteed cost networked control of uncertain stochastic nonlinear systems, and near-optimal control of a class of nonlinear systems with control constraints using adaptive dynamic programming algorithm based on neural networks. He has also established a series of stability criteria for several kinds of recurrent neural networks with delays.

He was awarded the Outstanding Youth Science Foundation Award from the National Natural Science Foundation Committee of China in 2003. He was named the Cheung Kong Scholar by the Education Ministry of China in 2005. He is a recipient of the IEEE Trans. on Neural Networks 2012 Outstanding Paper Award.