# The 2018 IEEE World Congress on Computational Intelligence

2018 International Joint Conference on Neural Networks (IJCNN'2018)

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## Special Session on "**Extreme Learning Machines (ELM)**"

Over the past few decades, conventional computational intelligence techniques faced bottlenecks in learning (e.g., intensive human intervention and time consuming). With the ever increasing demand of computational power particularly in areas of big data computing, brain science, cognition and reasoning, emergent computational intelligence techniques such as extreme learning machines (ELM) offer significant benefits including fast learning speed, ease of implementation and minimal human intervention.

Extreme Learning Machines (ELM) aim to break the barriers between the conventional artificial learning techniques and biological learning mechanism. ELM represents a suite of machine learning techniques for hierarchical neural networks (including but not limited to single and multi- hidden layer feedforward neural networks) in which hidden neurons need not be tuned: inherited from their ancestors or randomly generated. From ELM theories point of view, the entire networks are structured and ordered, but they may be seemingly ''messy'' and ''unstructured'' in a particular layer or neuron slice. ''Hard wiring'' can be randomly built locally with full connection or partial connections. Coexistence of globally structured architectures and locally random hidden neurons happen to have fundamental learning capabilities of compression, sparse coding, feature learning, clustering, regression and classification. ELM theories also give theoretical support to local receptive fields in visual systems.

ELM learning theories show that hidden neurons (including biological neurons whose math modelling may be unknown) (with almost any nonlinear piecewise activation functions) can be randomly generated independent of training data and application environments, which has recently been confirmed with concrete biological evidences. ELM theories and algorithms argue that "random hidden neurons" capture the essence of some brain learning mechanism as well as the intuitive sense that the efficiency of brain learning need not rely on computing power of neurons. This may somehow hint at possible reasons why the brain is more intelligent and effective than computers. ELM offers significant advantages such as fast learning speed, ease of implementation, and minimal human intervention. ELM has good potential as a viable alternative technique for large-scale computing and artificial intelligence.

The need for efficient and fast computational techniques poses many research challenges. This special session seeks to promote novel research investigations in ELM and related areas.

**Topics of interest:**

All the original papers related to ELM technique are welcome. Topics of interest include but are not limited to:

*Theories*

- Universal approximation, classification and convergence, robustness and stability analysis

- Biological learning mechanism and neuroscience
- Machine learning science and data science

*Algorithms*

- Real-time learning, reasoning and cognition
- Sequential/incremental learning and kernel learning
- Clustering and feature extraction/selection/learning
- Random projection, dimensionality reduction, and matrix factorization
- Closed form and non-closed form solutions
- Hierarchical solutions, and combination of deep learning and ELM
- No-Prop, Random Kitchen Sink, FastFood, QuickNet, RVFL, Echo State Networks
- Parallel and distributed computing / cloud computing

*Applications*

- Time series prediction, smart grid and financial data analysis
- Social media and video applications
- Biometrics and bioinformatics, security and compression
- Human computer interface and brain computer interface
- Cognitive science/computation
- Sentic computing, natural language processing and speech processing
- Big data analytics

*Hardware*

- Lower power, low latency hardware / chips
- Artificial biological alike neurons / synapses

**Paper submission:**

Potential authors may submit their manuscripts for presentation consideration through WCCI2018 submission system. All the submissions will go through peer review. Details on manuscript submission can be found from http://www.ecomp.poli.br/~wcci2018/submissions/

**Important dates:**

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| Paper submission deadline: | January 15, 2018 |
| Notification of acceptance: | March 15, 2018 |
| Final paper submission and early registration deadline: | May 1, 2018 |

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