Evolutionary/Automated Deep Learning and Applications

Professor Mengjie Zhang
Victoria University of Wellington, New Zealand
https://homepages.ecs.vuw.ac.nz/~mengjie/

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Venue: 12.08.02 (Building 12, Level 8, Room 2), RMIT City Campus

Abstract:

In recent years particularly since 2016 with success of AlphaGo, deep learning has been applied to many application areas especially image classification, speech recognition, and text classification and natural language processing. Among those algorithms, convolutional neural networks and autoencoders have received very good success and attracted great attentions to many industry people and researchers in AI and machine learning. However, there are at least three major issues in developing these deep (convolutional) neural networks: (1) the architectures including the number of layers, the number of feature maps in each layer and the number of nodes in each feature map are still very much determined manually via "trial and error", which requires a large amount of hand-crafting/trial time and good problem domain knowledge as well as good knowledge in convolutional neural networks. However, such experts are hard to find in many cases, or using such expertise is too expensive. In addition, the manually tuned network architectures are not transferable to even a very similar problem, where the experts will have to manually re-tune the architecture and hyper-parameters. (2) Almost all the current deep learning algorithms need a large number of examples/instances (e.g. AlphaGo used over 30 million instances) that many problems do not have. (3) Those algorithms require a huge computational cost that most universities and research institutions cannot cope, and even big companies such as Google, Huawei, Amazon, Baidu, and Microsoft have to put a large amount of human and financial resources.

To address these limitations, evolutionary learning and optimisation techniques start playing a significant role for automatically determining deep structures, transfer functions and parameters to tackle hard image classification, speech recognition and text mining/NLP tasks, and have great potential to advance the developments by automated design of deep structures and algorithms. This talk will first provide an extended view of deep learning, overview the state-of-the-art work (including our own recent work) in automated/evolutionary deep learning using Genetic Algorithms (GAs), Particle Swarm Optimisation (PSO) and Differential Evolution (DE). We will then discuss some recent developments using Genetic Programming (GP) to automatically evolving deep structures and feature construction for image recognition with a highlight of the interpretation capability and visualisation of constructed features. If time allows, we will provide an overview of the main work in AI, machine learning and big data with the main strengths at Victoria University of Wellington.

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Speaker bio:

Mengjie Zhang is a Fellow of Royal Society of New Zealand, a Fellow of IEEE, currently Professor of Computer Science at Victoria University of Wellington, where he heads the interdisciplinary Evolutionary Computation Research Group. He is a member of the University Academic Board, a member of the University Postgraduate Scholarships Committee, a member of the Faculty of Graduate Research Board at the University, Associate Dean (Research and Innovation) in the Faculty of Engineering, and Chair of the Research Committee of the Faculty of Engineering and School of Engineering and Computer Science.

His research is mainly focused on artificial intelligence (AI), machine learning and big data, particularly in evolutionary computation and learning (using genetic programming, particle swarm optimisation and learning classifier systems), feature selection/construction and big dimensionality reduction, computer vision and image processing, job shop scheduling and resource allocation, multi-objective optimisation, classification with unbalanced data and missing data, and evolutionary deep learning and transfer learning. Prof Zhang has published over 500 research papers in refereed international journals and conferences in these areas. He has been serving as an associated editor or editorial board member for over ten international journals including IEEE Transactions on Evolutionary Computation, IEEE Transactions on Cybernetics, IEEE Transactions on Emergent Topics in Computational Intelligence, ACM Transactions on Evolutionary Learning and Optimisation, the Evolutionary Computation Journal (MIT Press), Genetic Programming and Evolvable Machines (Springer), Applied Soft Computing, Natural Computing, and Engineering Applications of Artificial Intelligence, and as a reviewer of over 30 international journals. He has been involving major AI and EC conferences such as GECCO, IEEE CEC, EvoStar, AAAI, PRICAI, PAKDD, AusAI, IEEE SSCI and SEAL as a Chair. He has also been serving as a steering committee member and a program committee member for over 100 international conferences. Since 2007, he has been listed as one of the top ten (currently No. 4) world genetic programming researchers by the GP bibliography (http://www.cs.bham.ac.uk/~wbl/biblio/gp-html/index.html).
Prof Zhang is the (immediate) past Chair of the IEEE CIS Intelligent Systems Applications, the IEEE CIS Emergent Technologies Technical Committee and the IEEE CIS Evolutionary Computation Technical Committee, a vice-chair of the IEEE CIS Task Force on Evolutionary Feature Selection and Construction, a vice-chair of the IEEE CIS Task Force on Evolutionary Computer Vision and Image Processing, and the founding chair of the IEEE Computational Intelligence Chapter in New Zealand.

More information can be seen from our personal website:
https://www.victoria.ac.nz/engineering/about/staff/mengjie-zhang
http://homepages.ecs.vuw.ac.nz/~mengjie/

Further information: Professor Xiaodong Li (email: xiaodong.li@rmit.edu.au; or phone: 99259585).