A Fuzzy Restricted Boltzmann Machine: An Approach to Enhance Deep Learning

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In recent years, deep learning caves out a research wave in machine learning. With outstanding performance, more and more applications of deep learning in pattern recognition, image recognition, speech recognition, and video processing have been developed. Restricted Boltzmann machine (RBM) plays an important role in current deep learning techniques, as most of existing deep networks are based on or related to it. In particular, deep belief networks and deep Boltzmann machines are formed by stacking RBMs layer by layer and optionally fine-tuning the resulted deep networks with a backpropagation algorithm. RBMs have been widely applied in diverse fields, such as image recognition and classification, dimensionality reduction, feature learning, and collaborative filtering, etc. This talk will introduce a Fuzzy Restricted Boltzmann Machine (FRBM) that is established by replacing real-valued weights and bias terms with symmetric triangular fuzzy numbers (STFNs) or Gaussian fuzzy numbers and corresponding learning algorithms. A theorem is concluded that all FRBMs with **symmetric fuzzy numbers** will have identical learning algorithm to that of FRBMs with STFNs. Experiments results in MNIST handwriting recognition and other benchmarks indicate that the proposed FRBMs significantly outperform RBMs in learning accuracy and generalization ability, especially when encountering unlearned samples and recovering incomplete images.

Short bio of C. L. Philip Chen

Dr. Chen is currently the Dean of the Faculty of Science and Technology, University of Macau, Macau, China and a Chair Professor of the Department of Computer and Information Science. He worked at U.S. for 23 years as a tenured professor, a department head and associate dean in two different universities.

Dr. Chen's research areas are systems, cybernetics and computational intelligence. He is a Fellow of the IEEE and AAAS. He was the President of IEEE Systems, Man, and Cybernetics Society (SMCS) (2012-2013). Currently, he is the Editor-in-Chief of IEEE Transactions on Systems, Man, and Cybernetics: Systems (2014-). He has been an Associate Editor of many IEEE Transactions, and currently he is an Associate Editor of IEEE Trans on Fuzzy Systems, IEEE Trans on Cybernetics, IEEE/CAA Automatica Sinica, and several IEEE Transactions. He is the Chair of TC 9.1 Economic and Business Systems of IFAC. He is also a Fellow of CAA and Fellow of HKIE and an Academician of International Academy of Systems and Cybernetics Science (IASCYS). In addition, he is an ABET (Accreditation Board of Engineering and Technology Education, USA) Program Evaluator for Computer Engineering, Electrical Engineering, and Software Engineering programs.