APNNS Advanced Forum Series: Deep Learning and Artificial Intelligence Winter School 2018

1st – 4th February 2018, Bangkok, Thailand

ABSTRACT

Professor Irwin King

Associate Dean (Education), Engineering Faculty
Director, Rich Media Big Data Analytics and Application Key Laboratory, Shenzhen Research Institute (SZRI), The Chinese University of Hong Kong
Principal Investigator, The Knowledge and Education Exchange Platform (KEEP) Project, SMIEEE (CIS), MACM, SMINNS (VP, BoG), APNNA (VP, BoG), FHKIE, IrwinKing.com

Topic: **Online Learning for Big Data Application**s

ABSTRACT. Online learning investigates sequential decisions with uncertainty, in which learning models generally are updated without reusing training samples. As data generated from sciences, business, governments, etc. are reaching petabyte or even Exabyte, and perform other characteristics (such as non-stationarity and imbalance), theories, models, and applications in online learning are becoming important in machine learning to process a large amount of streaming data effectively and efficiently. Recently, a number of online learning algorithms have been proposed to tackle sequential decisions with uncertainty, especially for cases of big data volume, non-stationary and/or highly imbalanced data. In this talk, we focus on some new developments of online learning technologies in both theory and applications. Relevant topics including Multi-Armed Bandits (MAB), online learning in stochastic settings, online learning with contextual information, and unsupervised online hashing, will be discussed. Moreover, some of our recent works such as combinatorial exploration of MAB, locality-sensitive linear bandits, online learning with imbalanced data, and faster online hashing, will also be presented to demonstrate how online learning approaches can be effectively applied to big data.

Topic: **Randomized Algorithms for Efficient Learning**

ABSTRACT. As data routinely collected from social science, business, education, biology, etc. are reaching petabyte or even exabyte at an alarming rate, developing approaches for enabling learning with big data have been critically important. Recently, randomized algorithms stemming from numerical linear algebra have attracted much attention, and these randomized approaches may produce approximate solutions to certain large problems very efficiently. In this talk, we offer a high-level introduction to randomized algorithms and a set of associated applications including kernel learning, regression, clustering, deep learning, etc. Moreover, some of our recent work such as randomized algorithms for covariance matrix estimation and unsupervised online hashing, will also be presented to demonstrate how randomized algorithms can effectively handle large-scale machine learning with big data.

Professor Nikola Kasabov

FIEEE, FRSNZ, DVF RAE UK**,** Director, Knowledge Engineering and Discovery Research Institute, Auckland University of Technology, Auckland, New Zealand

Topic: **Brain-Inspired Artificial Intelligence and Deep Learning with Spiking Neural Networks: Methods, Systems, Applications**

ABSTRACT. Brain-inspired AI (BI-AI) is the contemporary phase in the AI development that is concerned with the design and implementation of highly intelligent machines that utilise information processing principles from the human brain, along with their applications. Spiking neural networks (SNN) and deep learning algorithms make it possible for the BI-AI to gain a fast progress nowadays. This presentation has two parts. The first part covers generic methodological aspects, including: Learning and understanding evolving processes in space and time. Data, Information and Knowledge; The human brain as a deep learning, evolving system; A Brief history of AI; Methods of Spiking Neural Networks (SNN); Brain-inspired SNN architectures; Evolutionary and quantum-inspired optimisation of SNN.

The second part presents specific methods, systems and applications based on deep learning in SNN and BI-AI for various applications, including: Deep learning of audio/visual data; Deep learning of brain EEG data; Deep learning of fMRI data; Brain-Computer Interfaces (BCI) and human-machine symbiosis; Computational Neurogenetic Modelling in Bio/Neuroinformatics; Personalised modelling in Bio/Neuroinformatics; Multisensory predictive modelling of ecological and environmental data; Neuromorphic computer systems. It concludes with discussions and future directions.

A brain –inspired SNN architecture NeuCube is used as illustration. Development software and application systems based on NeuCube can be found on: http://www.kedri.aut.ac.nz/neucube/

Professor Simon Fong

Associate Professor at Department of Computer and Information Science and Data Analytics and Collaborative Computing Laboratory, University of Macau, Taipa, Macau SAR

Topic: **Optimizing Hyper-parameters for Deep Learning Using Meta-Heuristic Algorithms**

ABSTRACT. Deep learning (DL) is one of the most emerging types of contemporary machine learning techniques that mimic the cognitive patterns of animal visual cortex to learn the new abstract features automatically by deep and hierarchical layers. Hyper-parameter optimization is a model selection problem that attempts to find the best solution among a combination set of parameters with an aim to attain high accuracy. However, the trial and error methods to optimize the hyper-parameters take a very long time to test the accuracy given that there are many variables and some of their numerical data types are continuous. In this talk, we discuss an architecture that can be used for optimizing the hyper-parameters of neural network using metaheuristics. The comparison results of using meta-heuristic methods and traditional exhaustive search method would be presented. The novelty of applying the swarm search methods for finding the best hyper-parameters would be demonstrated. The pros and cons of swarm search methods for hyper-parameter optimization would be discussed, as well as pointing out some future directions of the hyper-parameters optimization.

Professor Soo-Young Lee

Institute for Artificial Intelligence & Brain Science Research Center
Korea Advanced Institute of Science and Technology

Topic: **Deep Learning and Human Audio-Visual Pathways**

ABSTRACT. Recently deep learning had attracted a lot of attention from both academic and industrial communities for image and speech recognition tasks. However, the basic models are not new and have strong connection to the audio and visual processing models in our brain. This Lecture will bring the connection between deep neural networks and cognitive computational models for audio-visual information processing. We will first discuss the cognitive scientific facts on information processing mechanism in human audio and visual pathways, and then move to the computational models in the form of deep learning for the hierarchical feature extraction, stereo/binaural spatial information processing, selective attention, and audio-visual integration.

Topic: **Deep Learning for Emotion and Top-down Attention**

ABSTRACT. Human emotion is an internal state of human brain which makes different decision and behavior from same sensory inputs. Therefore, for efficient interactions between human and machine, i.e. chatbot, it is important for the machine to estimate human emotions. Due to the internal nature, the classification accuracy of the emotion from a single modality is not high. For example, our result was ranked as Top-1 with only 61.6% accuracy for the emotion recognition task from facial images at EmotiW2015 challenge. In this tutorial we will first present a hierarchical Committee machine to win EmotiW2015 challenge, and further extend the ideas to multi-modal classification with top-down attention and identification of brain signals for the two-other brain internal states.

Topic: **Understanding Brain Internal States**

ABSTRACT. At the third Lecture we will introduce cognitive neuroscience of brain internal states, aka Mind, which may consist of emotion, personality, intention, etc. The emotion is relatively better studied in cognitive neuroscience and probably the only one with engineering applications at this moment. We will introduce two cognitive neuroscientific findings on the other brain internal states. Especially, we made hypothesis on 2 axes of the internal state space, i.e., agreement/disagreement and trust/distrust to conversational counterparts during conversation and identified fMRI and/or EEG signal components related to those internal states. Then, we will propose a method to utilize these brain signals for generating near-ground-truth labels of brain internal states, which will be used to train classifiers from audio-visual signals.

Professor Sung-Bae Cho

Professor at Department of Computer Science, Yonsei University

Topic: **Hybrid Deep Learning for Anomaly Detection**

ABSTRACT. In the field of deep learning, a generative model via an adversarial process gets a great attention due to the amazing demonstration of performance. It can simultaneously train a generative model to capture the data distribution, and discriminative model to estimate the probability that a sample came from the training data. In this talk, I will present a new method of transfer-generative adversarial network (tGAN) with auto-encoders to detect anomaly in malicious software (malware) for computer security. The proposed method of malware detection treats zero-day attacks by generating fake malware and learning to distinguish it from real malware. The data generated from a random distribution are similar but not identical to the real data: it includes modified features compared with real data. The detector learns various malware features using real data and modified data generated by the tGAN based on a deep auto-encoder (DAE), which stabilizes the GAN training. Before training the GAN, the DAE learns malware characteristics, produces general data, and transfers this capacity for stable training of the GAN generator. The trained discriminator passes down the ability to capture malware features to the detector, using transfer learning.

Topic: **Prospects and Challenges of Deep Learning**

ABSTRACT. Recently, deep learning opens another renaissance of artificial intelligence that is a long dream of human-beings. There are four representative models for deep learning, and two of them can be convolutional neural networks and recurrent neural networks. In this talk, I will give the general idea of both methods, and discuss about the prospects and challenges. Especially, to work out realistic problems, we need a hybrid architecture of several deep learning models. I will also present a generative model via an adversarial process gets a great attention due to the amazing demonstration of performance. It can simultaneously train a generative model to capture the data distribution, and discriminative model to estimate the probability that a sample came from the training data. Experiments with the malware dataset from the Kaggle Microsoft malware classification challenge (https://www.kaggle.com/c/malware-classification) show that the tGAN achieves 95.74% average classification accuracy which is higher than accuracy of other state-of-the-art methods and increases the learning stability.

Professor Weng-Kin Lai

Associate Professor at Department of Electrical & Electronic Engineering, Tunku Abdul Rahman University College

Topic: **A machine intelligence Approach to Identify the Quality of Natural Rubber Latex**

ABSTRACT. Natural rubber latex is readily obtained from many parts of South East Asia and as a renewable resource. It is widely used to make many common household and industrial products. Unfortunately, as its quality is not consistent due to a variety of reasons there is a need to be able to measure its quality. A common measure of its quality is the mechanical stability, which is defined as the time at the first onset of flocculation when the latex is subjected to physical stress. Currently, the assessment is performed manually by trained personnel, closely adhering to the specifications defined by the ISO35 standard mechanical stability test that is widely adopted by the rubber industry. Nevertheless, there is some level of subjectivity involved as the test heavily depends on the human eyesight as well as the technician's experience. In this presentation we will share some of the results from a machine intelligence approach to determine the quality of natural rubber latex. Experimental results demonstrated that the proposed approach was able to provide good accuracies in identifying the quality of natural rubber latex.