Session 1.2 Deep Learning Algorithms

Time & Location: 16:00-17:30, Nov. 30, L009

Chair: Chao-Neng Wang (王昭能)

(1) Comparison of Loss Functions for Training of Deep Neural Networks in Shogi

Hanhua Zhu (University of Tokyo) and Tomoyuki Kaneko (University of Tokyo)

Evaluation functions are crucial for building strong computer players in two-player games, such as chess, Go, and shogi. Although a linear combination of a large number of features has been popular representation of an evaluation function in shogi, deep neural networks (DNNs) are recently considered to be more promising by the success of AlphaZero in multiple domains, chess, Go, and shogi. This paper shows that three loss functions, loss in comparison training, temporal difference (TD) errors and cross entropy loss in win prediction, are effective for the training of evaluation functions in shogi, presented in deep neural networks. For the training of DNNs in AlphaZero, the main loss function only consists of win prediction, though it is augmented with move prediction for regularization. On the other hand, for training in traditional shogi programs, various losses including loss in comparison training, TD errors, and cross entropy loss in win prediction, have contributed to yield accurate evaluation functions which are the linear combination of a large number of features. Therefore, it is promising to combine these loss functions and to apply them to the training of modern DNNs. In our experiments, we show that training with combinations of loss functions improved the accuracy of evaluation functions represented by DNNs. The performance of trained evaluation functions are tested through top-1 accuracy, 1-1 accuracy, and self-play.

(2) A Vector Mosquitoes Classification System Based on Edge Computing and Deep Learning

Li-Pang Huang (Academia Sinica), Ming-Hong Hong (National Taiwan Normal University), Cyuan-Heng Luo (Academia Sinica), Sachit Mahajan (Academia Sinica), and Ling-Jyh Chen (Academia Sinica)

In recent years, we have witnessed a sudden increase in mosquito-borne diseases and related casualties. This makes it important to have an efficient mosquito classification system. In this paper, we implement a mosquito classification system which is capable of identifying Aedes and Culex (types of mosquitoes) automatically. To facilitate the implementation of such Internet of Things (IoT) based system, we first create a trap device with a stable area for taking mosquito pictures. Then, we analyze the mosquito's photos in order to reduce the video size for transmission. Also, we build a model to identify different types of mosquitoes using deep learning. Later, we fine-tune the edge computing on the trap device to optimize the system efficiency. Finally, we integrate the device and the model into a mosquito classification system and test the system in wild fields in Taiwan. The tests show significant results when the experiments are conducted in rural area. We are able to achieve an accuracy of 98% for validation data and 90.5% for testing data.

(3) Application of Deep Reinforcement Learning in Werewolf Game Agents

Tianhe Wang (University of Tokyo) and Tomoyuki Kaneko (University of Tokyo & JST, PREST)

Werewolf, also known as Mafia, is a kind of game with imperfect information. Werewolf game agents must cope with two kinds of problems, "decision on who to trust or to kill", and "decision on information exchange". In this paper, we focus on the first problem. In the first problem, players decide to select a target to trust or to kill. We consider werewolf game as a Markov decision process and apply techniques in Deep Q Network in building werewolf agents. We also improve representation of states and actions based on existing agents trained by Q learning method. Our proposed agents were compared with existing agents trained by Q learning method and with existing agents submitted to the AIWolf Contest, the most famous werewolf game agents contest in Japan.

Experimental results showed that, when agents learned and played with same group of players, our proposed agents have better player performances than existing agents trained by Q learning method and a part of agents submitted to the AIWolf Contest. We obtained promising results by using reinforcement learning method to solve "decision on who to trust or to kill" problem without using heuristic methods.

(4) Deep Recurrent Q-Network with Truncated History

Hyunwoo Oh (University of Tokyo) and Tomoyuki Kaneko (University of Tokyo)

Reinforcement Learning is a kind of machine learn- ing method which learns through agents' interaction with the environment. Deep Q-Network (DQN), which is a model of reinforcement learning based on deep neural networks, succeeded in learning human-level control policies on various kinds of Atari 2600 games with image pixel inputs. Because an input of DQN is the game frames of the last four steps, DQN had difficulty on mastering such games that need to remember events earlier than four steps in the past. To alleviate the problem, Deep Recurrent Q-Network (DRQN) and Deep Attention Recurrent Q-Network (DARQN) were proposed. In DRQN, the first fully-connected layer just after convolutional layers is replaced with an LSTM to incorporate past information. DARQN is a model with visual attention mechanisms on top of DRQN. We propose two new reinforcement learning models: Deep Recurrent Q-Network with Truncated History (T-DRQN) and Deep Attention Recurrent Q- Network with Truncated History (T-DARQN). T-DRQN uses a truncated history so that we can control the length of history to be considered. T-DARQN is a model with visual attention mechanism on top of T-DRQN. Experiments of our models on six games of Atari 2600 shows a level of performance between DQN and D(A)RQN. Furthermore, results show the necessity of using past information with a truncated length, rather than using only the current information or all of the past information.

(5) Multi-label Classification with Feature-aware Cost-sensitive Label Embedding

Hsien-Chun Chiu (National Taiwan University) and Hsuan-Tien Lin (National Taiwan University)

Multi-label classification (MLC) is an important learning problem where each instance is annotated with multiple labels. Label embedding (LE) is an important family of methods for MLC that extracts and utilizes the latent structure of labels towards better performance. Within the family, feature-aware LE methods, which jointly consider the feature and label information during extraction, have been shown to reach better performance than feature-unaware ones. Nevertheless, current feature-aware LE methods are not designed to flexibly adapt to different evaluation criteria. In this work, we propose a novel feature-aware LE method that takes the desired evaluation criterion (cost) into account during training. The method, named Feature-aware Cost-sensitive Label Embedding (FaCLE), encodes the criterion into the distance between embedded vectors with a deep Siamese network. The feature-aware characteristic of FaCLE is achieved with a loss function that jointly considers the embedding error and the feature-to-embedding error. Moreover, FaCLE is coupled with an additional-bit trick to deal with the possibly asymmetric criteria. Experiment results across different datasets and evaluation criteria demonstrate that FaCLE is superior to other state-of-the-art feature-aware LE methods and competitive to cost-sensitive LE methods.