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**{Topic 1}**

**Title:**

Automatic Music Composition and Generation

**Supervisors:**

Feng Zheng (SUSTech) and Ling Chen (UTS)

**Abstract:**

Generative adversarial network (GAN) is the most promising technology proposed in recent years and it is feasible to artificially generate some images that look very realistic. For example, we can directly generate an image of Picasso-style form a natural image captured by a camera. However, currently, there is no any research or related application focuses on automatic music composition and generation. To solve the problem, this project will thoroughly conduct the research from the perspectives of theory and algorithm to artificially make music by a GAN model. In this project, we will collect the first music dataset in the world, consisting of multiple music sequences from different modalities (sensors, instruments and voices). Furthermore, we will implement and explore some novel algorithms with the help of GAN, cross-model translation models and long short-term memory techniques. Finally, our aim is to develop models for automatically composing songs only from human voices and directly translating the guitar music into that produced by violin without any human participation. This research would be very interesting. While, more importantly, the techniques developed in this project are really potential to make big news both in research and industrial communities.

**{Topic 2}**

**Title:**

Automatically Generating Compact and Powerful Deep Neural Networks

**Supervisors:**

Feng Zheng (SUSTech) and Ling Chen (UTS)

**Abstract:**

Due to the advanced non-linearity and memorability to capture the intrinsic properties of data, deep neural networks (DNN) can often lead to promising recognition results. However, the unbearable problem of extensive memory consumption and computational requirements in inference phase is inevitable to greatly limit the scope of its applications on resource-constrained devices such as mobiles. Recent proposed model compression algorithms lie in hand-crafted heuristics and rule-based policies in which the domain experts are required to explore the large design space trading off among model size, speed, and accuracy. These empirical-based methods are usually sub-optimal and time-consuming. In contrast, this project will choose to automatically build the compact and powerful deep neural networks for diverse recognition tasks. To this end, we will first carry out the research on resource-efficient DNN models. Then, we will improve and optimize these models under a fixed budget of resources. Moreover, we will propose some novel automatic machine learning frameworks to optimize not only the weights of networks but also the topology of architectures, by leveraging the techniques and strategies from reinforcement learning and evolutionary neural networks. Finally, the compact and powerful DNN models can be implemented on the resource-constrained devices.

**{Topic 3}**

**Title:**

Integrating Augmented, Synthesized and Adversarial Crafted Samples for Robust Training

**Supervisors:**

Feng Zheng (SUSTech) and Ling Chen (UTS)

**Abstract:**

Incomplete data often lead to poor performance of predictive models on unseen samples. In addition, recent studies have clearly demonstrated that deep neural networks (DNN) are also vulnerable to adversarial samples. To improve the robustness, this project will integrate multi-source samples to complete the training dataset by exploring the differences between samples. To this end, we will first investigate, by using a generative adversarial network, how to generate fake images to improve the performance of DNN models on computer vision tasks, such as person re-identification and pose estimation. Then, with the help of the synthesis software, we will integrate these simulated samples to improve the training as well. Moreover, some local sample generation models will be built on all these fake samples to explore the local structure in certain directions and mitigate some of the uncertainty of the training dataset. All the models learned on the enlarged dataset will be significantly more powerful than those trained on the natural dataset alone. The final goal of this project is to develop a complete system, including all kinds of techniques: augmentation, synthesis and adversarial crafting, which enables automatically robust training.