

Dynamic Neural Network for Incremental Learning

Liang Ma, Jianwen Wu, Qiaoyong Zhong, Di Xie, Shiliang Pu
Hikvision Research Institute

Hangzhou, China

{maliang6, wujianwen, zhongqiaoyong, xiedi, pushiliang}@hikvision.com

Abstract

Recently, artificial neural networks (ANNs) have been widely apply to machine learning application. However, it suffers from Catastrophic forgetting when learning incrementally over tasks. Incremental learning can be divided into data-incremental, class-incremental, and the combination of both. The goal of incremental learning is to maintain the performance of previous tasks while learning new tasks.

We present our solution for data-incremental problem in openLORIS [1][2] competition. In this competition, we develop a combined method with knowledge distillation and network expansion. Without using previous data, our method still achieves good performance and low time latency.

1. DNN

Our approach: dynamic neural network (DNN for short) adopts dynamic network expansion for data across dissimilar domain, and knowledge distillation for data in similar domain.

1.1. Network Expansion

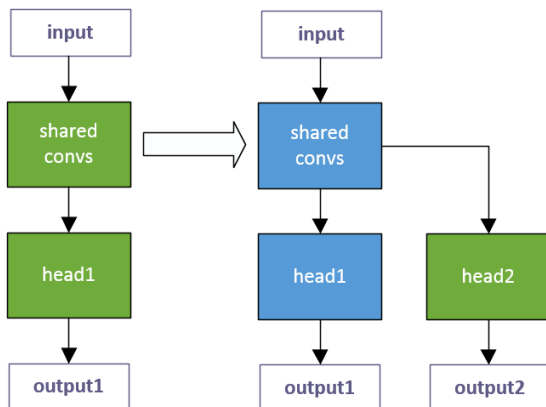


Figure 1 network expansion

As shown in Fig.1, we freeze the shared conv layers and train new heads for new tasks. We determine the domain gap by measuring the accuracy using previous model before training on current task.

In order to increase the generalization ability of trained model, we use imagenet pre-trained model for shared convs layers, and use more data augmentation and more batches to train head1 for base model.

1.2. Knowledge distillation

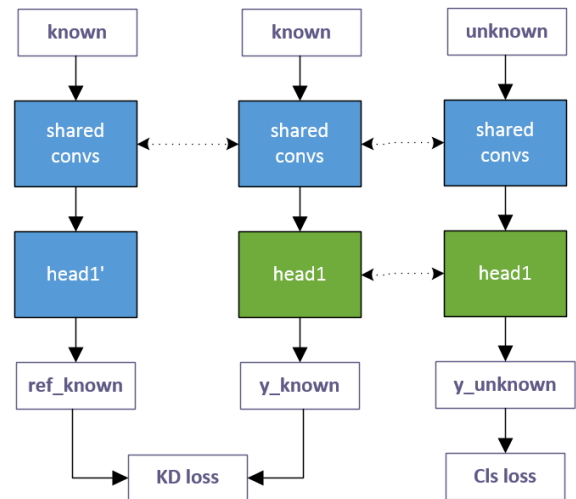


Figure 2 knowledge distillation

Without using previous data, we discover known instances in current task by a single forward pass via previous model. Those correctly classified are known samples. We use these samples for knowledge distillation.

To perform knowledge distillation over multiple heads, we must choose a suitable head first. Here, using best head for distillation is reasonable and more stable verified by experiment results.

Reference

- [1] Feng, F., Chan, R. H., Shi, X., Zhang, Y., & She, Q. (2019). Challenges in Task Incremental Learning for Assistive Robotics. IEEE Access.
- [2] She, Q., Feng, F., Hao, X., Yang, Q., Lan, C., Lomonaco, V., ... & Qiao, F. (2019). OpenLORIS-Object: A Robotic Vision Dataset and Benchmark for Lifelong Deep Learning. arXiv preprint arXiv:1911.06487.