Real-time Model Adaptation for WiFi Gesture Recognition

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Abstract: Deep learning model is often used to classify Channel State Information (CSI) to recognize different sign gestures. However, the strong learning ability of a deep learning model is often accompanied by its weak generalization ability. In addition, deep learning model adaptation may involve intensive computation. In this project, we investigate how to accurately adapt deep learning models to diverse application scenarios in real-time. We proposed a few strategies, including parallel computing-based model training on GPU, redesigning a simpler model, and sample selection for model adaptation. Based on the above strategies, we obtained the accuracy of 96.1% while reducing the time cost from 121.1 seconds to 40.6 seconds.

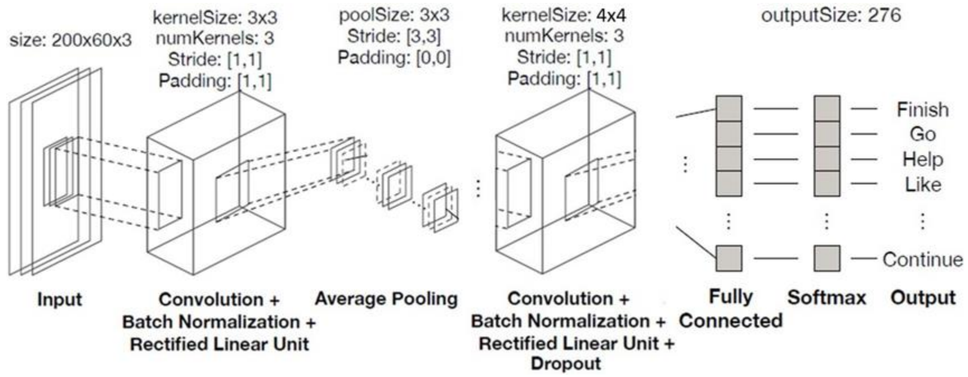
Strategy 1: Parallel computing-based model training on GPU

NVIDIA GeForce GTX 1050 Ti, Cores: 768, Memory Bandwith : 112 GB/sec

GPU

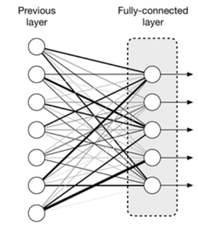
Compared with using CPU, using GPU can decrease the model training time 41.3%

Strategy 2: Redesigning a simpler model



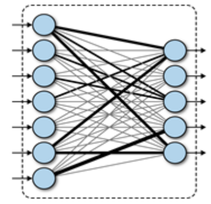
12-layer CNN new model

9-layer CNN



M x N x 3 x 276

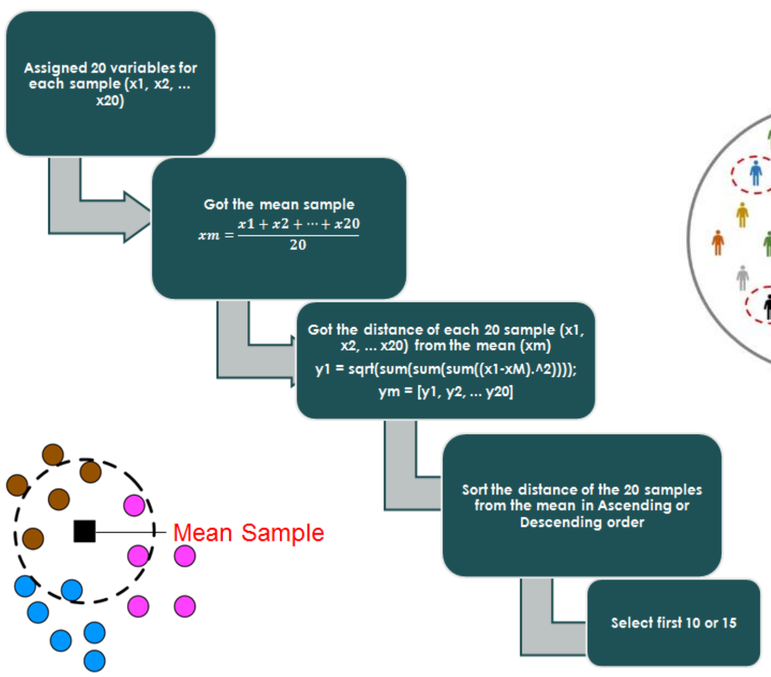
12-layer CNN



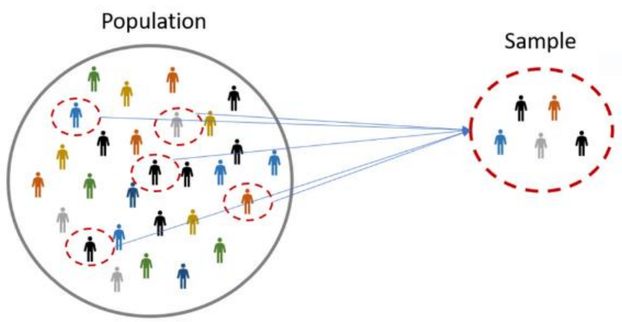
(M – 1) x (N – 1) x 3 x 276

Network complexity comparison

Strategy 3: Sample selection for model adaptation



(1) SDM based sample selection



(2) Random Sample Selection

Experimental results

	One layer (filter = 3*3) epoch = 15 Dataset = 5520 (Baseline)	New model (filter1 = 3*3, filter2 = 4*4) Dataset = 4140 epoch = 10	New model (filter1 = 3*3, filter2 = 4*4) Dataset = 4140 epoch = 15
Accuracy	96.2% (CPU)	96.1% (GPU)	98.5% (GPU)
Time Cost	121.1 sec (CPU)	40.6 sec (GPU)	52.8 sec (GPU)

This is the best result we got, we reduced 66.5% time cost compared with the baseline while preserving the accuracy.

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