CMPT 412
Assignment 6 Report (4 Late Days Used)

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Introduction

This assignment mainly focuses on the technique studied in lectures, including basics about ConvNet, standardization, dropout, and deep learning etc. The programming language used is python, which copes with TensorFlow and TensorPack for easier neuron network training and validation.

Part 3: Training

3.1 TensorFlow Installation

Installation

The environment is set up on my personal Windows 10 (64bits) laptop. The following commands are my installation procedures:

1. Download and install python 3.6.3, then add python and pip to %PATH
2. Install TensorFlow and TensorPack
    a. PS > pip install --upgrade pip
    b. PS > pip install tensorflow
    c. PS > pip install --upgrade tensorflow==1.15.0
    d. pip install --pre "tensorflow==1.15.0" [(1)]
    e. PS > pip install --upgrade tensorpack==0.8.9
3. Install required packages
    a. PS > pip install opencv-python

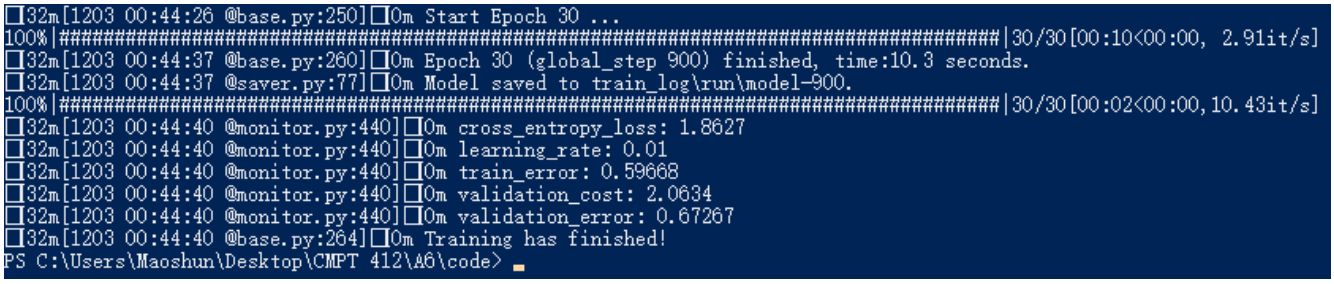
[(1)] According to the TensorFlow document, for 1.15 release, CPU and GPU support are included in a single package

Run

The following command is for running the code

```
PS > python run.py --task 1 --gpu 1
```

The followings are the output (partial) for the command above:



It achieves an accuracy at around 33.8%.

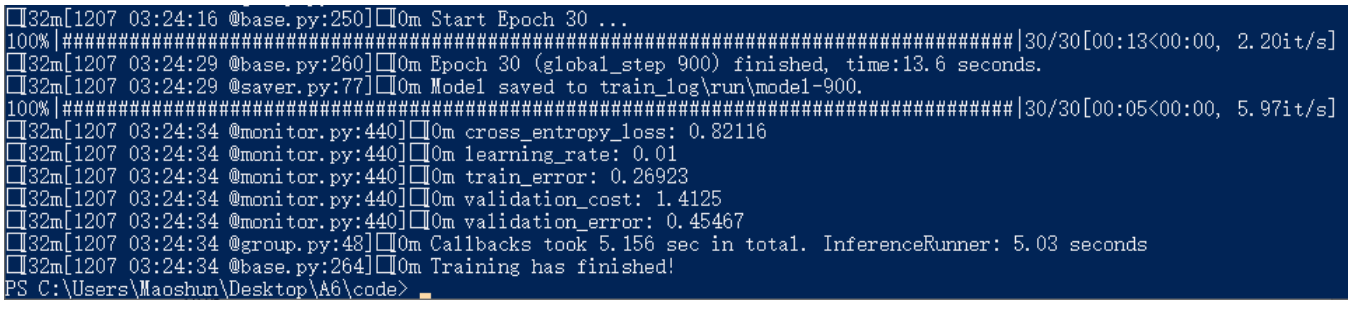
3.2 Training from Scratch

3.2.1 Add Improvements

The following features are added into the code

- run.py
  - Standardization
    - Subtracting the mean of images intensities then divide by standard deviation
  - Augmentation (imgaug package added)
    - Resize
    - Random crop
    - Flip (horizontal)
    - Transpose
- your_model.py
  - Dropout regularization
    - Added at the end of the original network architecture
  - More layers
    - Added three more layers, including dropout and dense layers, between the initial max pooling layer and the initial fully connected layer. (see your_model.py for detail)

The followings are the best test error:



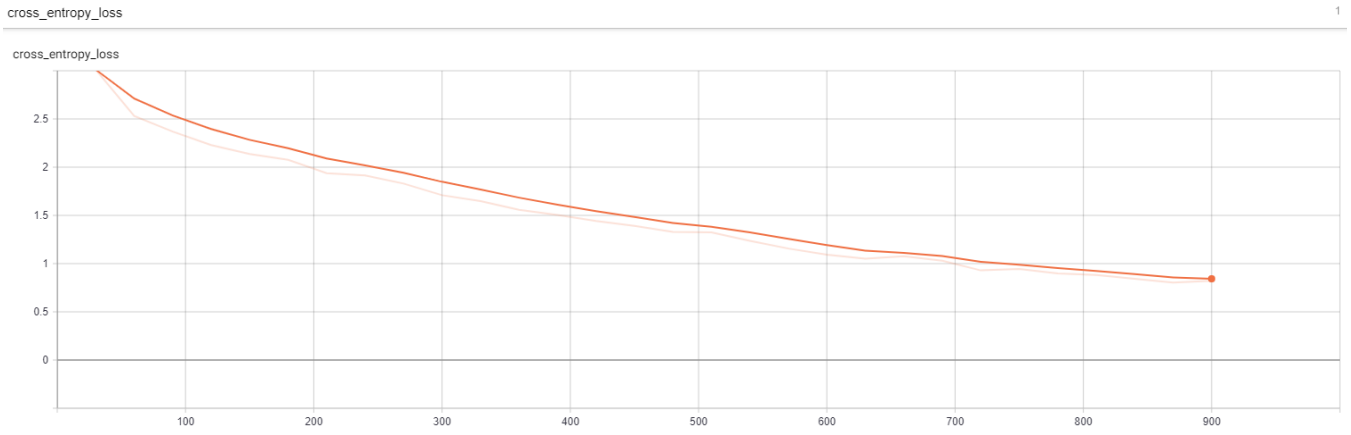
It achieved test accuracy at around 54.6%

3.2.2 Visualize by TensorBoard

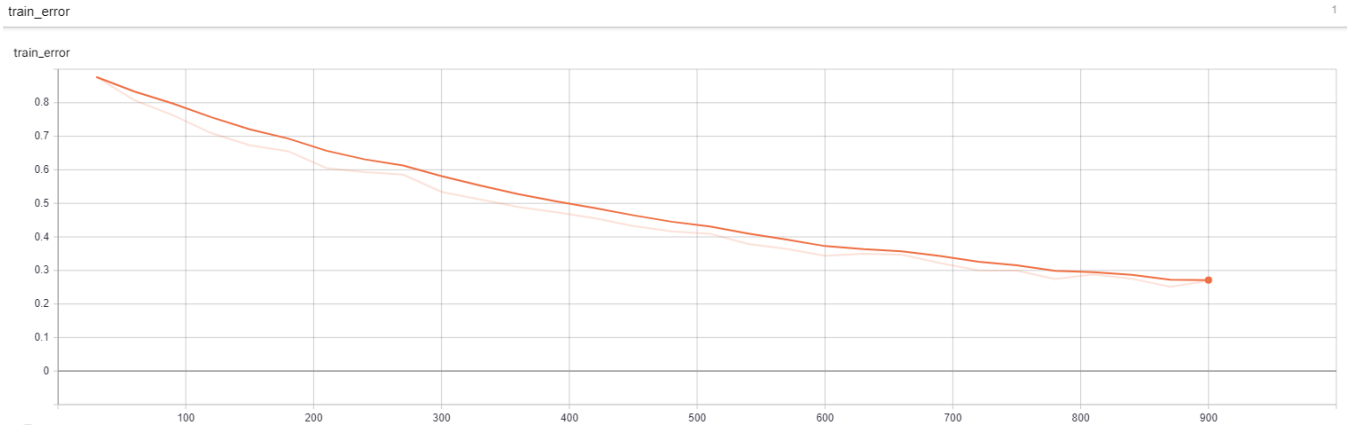
Running the following command

```
PS > tensorboard --logdir=train_log/run
```

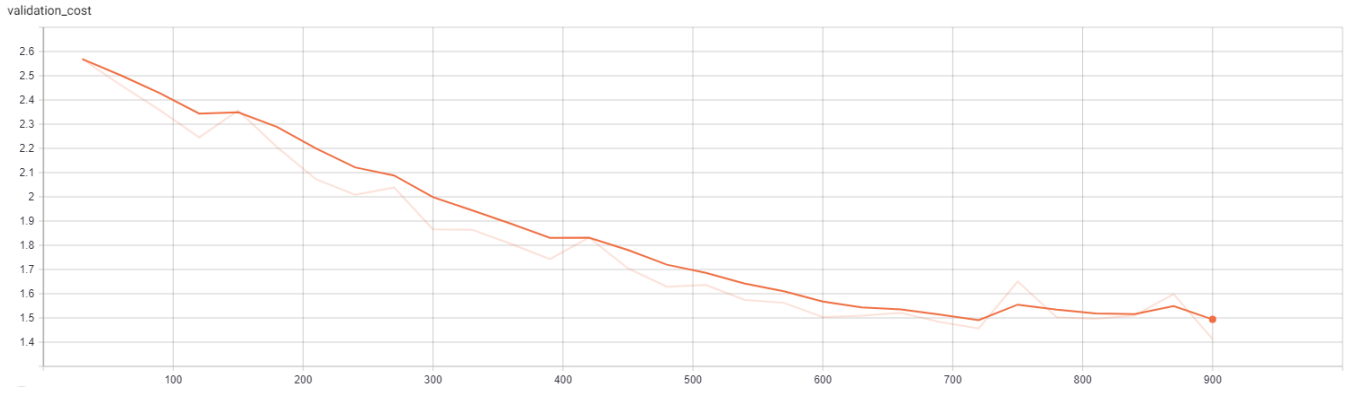
By navigating to http://localhost:6006/, we see the following graphs



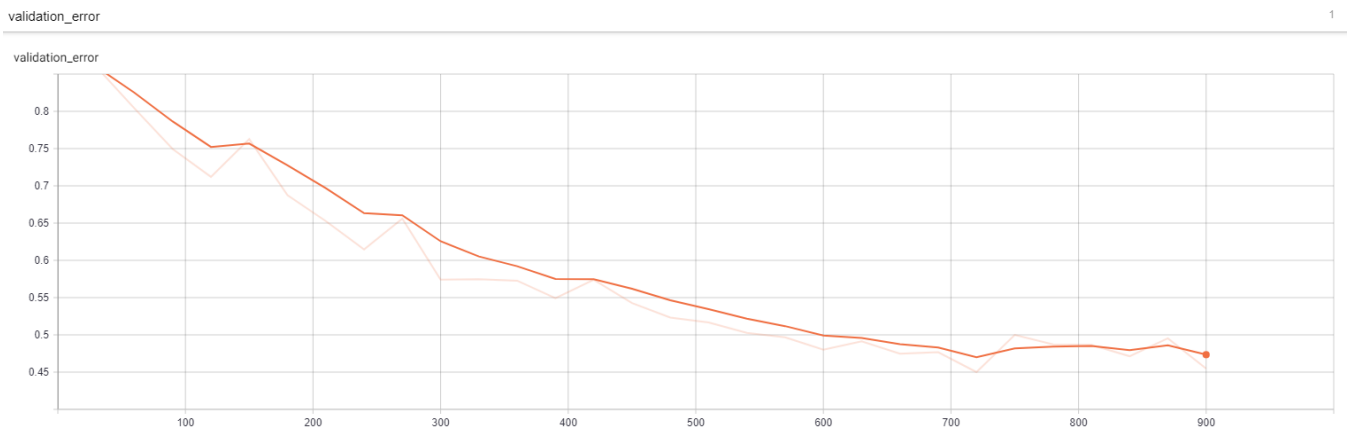
Cross Entropy Loss



Train Error



Validation Cost



Validation Error

The training error is monotonically decreasing while the validation error is not as low as training error. In addition, it shows a few fluctuations. All the phenomenon above might indicate an overfitting.

3.3 Fine-tuning VGG

Adjustments:

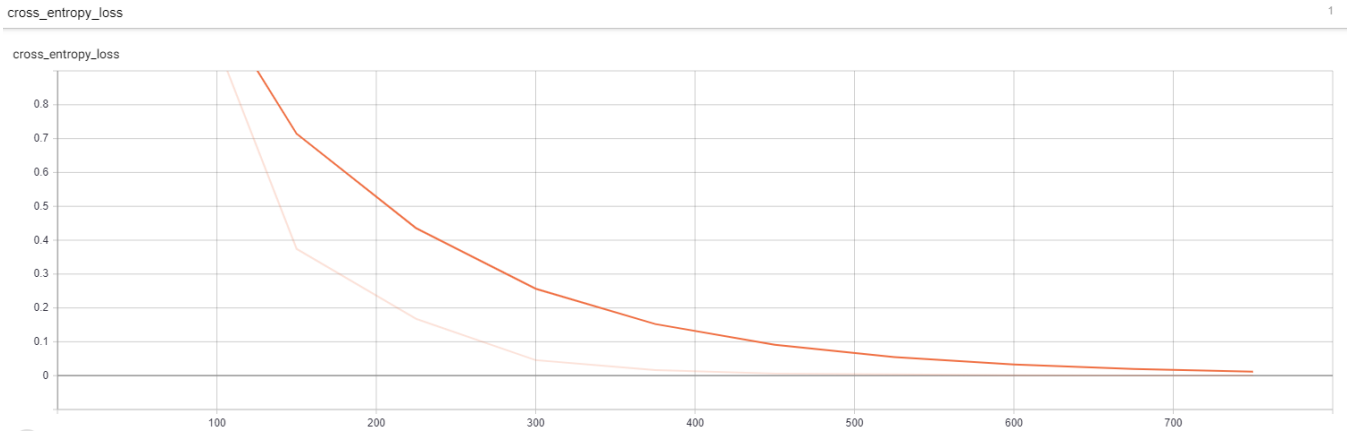
	Original	Adjusted
num_epochs	30	10
batch_size	50	20
learning_rate	0.01	0.00001

The result of hyperparameter turning is shown below:

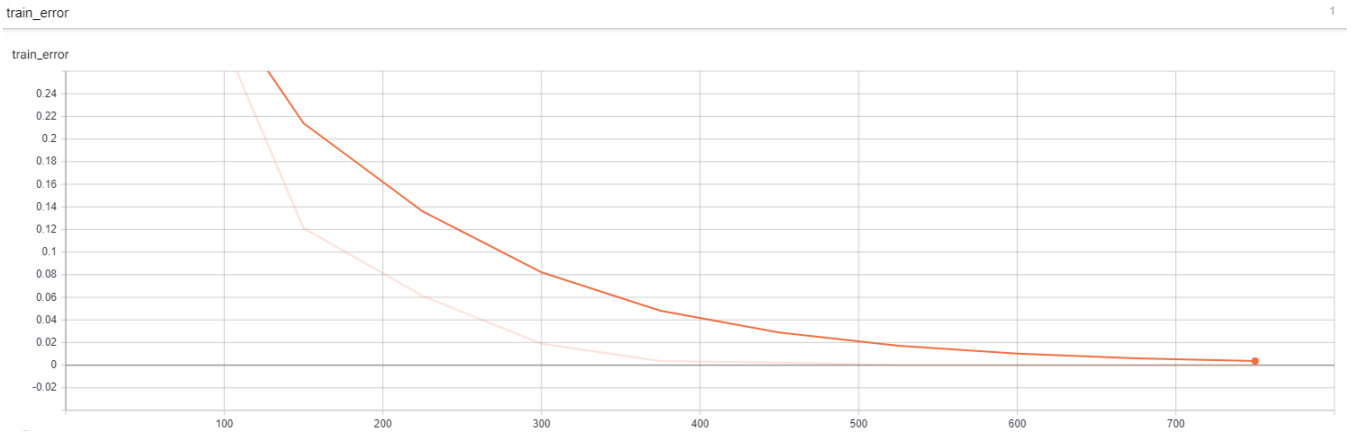
```
[32m[1205 07:35:36 @base.py:250][0m Start Epoch 10 ...
100%|#########################################################################################|75/75[36:05<00:00, 0.03it/s]
[32m[1205 08:11:42 @base.py:260][0m Epoch 10 (global_step 750) finished, time:36 minutes 5 seconds.
[32m[1205 08:12:23 @saver.py:77][0m Model saved to train_log\run\model-750.
100%|#########################################################################################|75/75[12:54<00:00, 0.10it/s]
[32m[1205 08:25:17 @monitor.py:440][0m cross_entropy_loss: 0.00036068
[32m[1205 08:25:17 @monitor.py:440][0m learning_rate: 1e-05
[32m[1205 08:25:17 @monitor.py:440][0m train_error: 1.2274e-09
[32m[1205 08:25:17 @monitor.py:440][0m validation_cost: 0.41256
[32m[1205 08:25:17 @monitor.py:440][0m validation_error: 0.11067
[32m[1205 08:25:17 @group.py:48][0m Callbacks took 815.372 sec in total. InferenceRunner: 12 minutes 54 seconds
[32m[1205 08:25:17 @base.py:264][0m Training has finished!
```

The test accuracy is at around 89%.

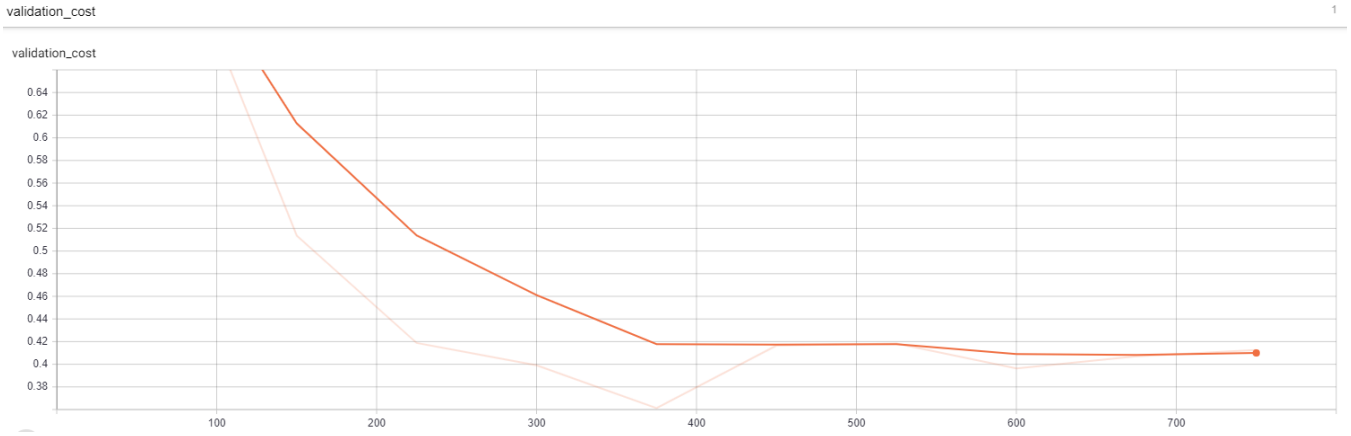
The below are the screenshots from TensorBoard:



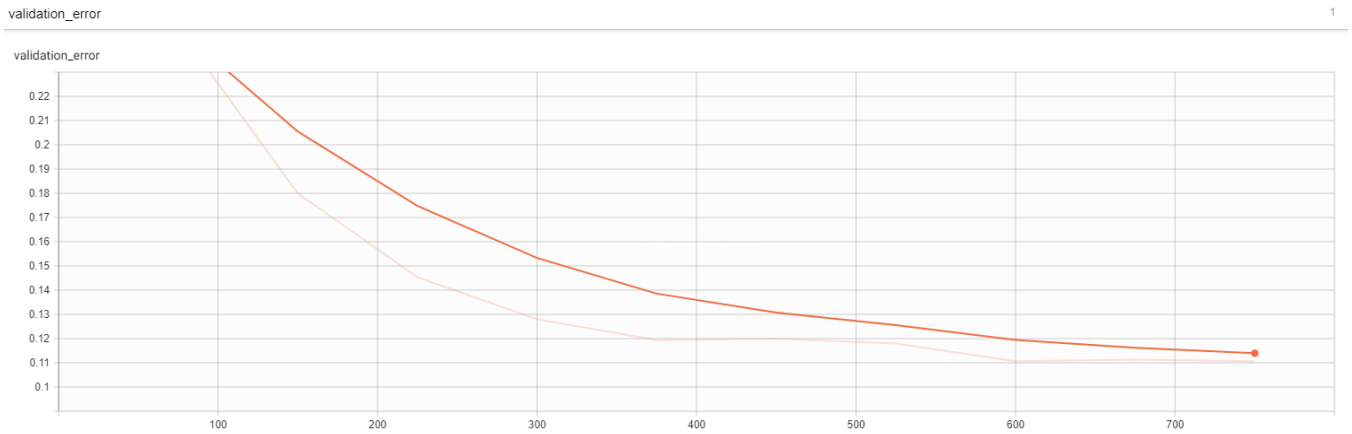
Cross Entropy Loss



Train Error



Validation Cost



Validation Error

VGG16 model is significantly different from the previous model. Both training and validation error shows a satisfying trend, which decreases until a very low level.

Note:

run “pip install numpy==1.16.2” if the system prompts exception of ValueError.

Reduce the batch_size if the system prompts “TensorFlow allocation memory” exception.