# Assignment 3[*]

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***Abstract*** -使用LeNet對資料集分50個類別。

***Index Terms – Deep Learning、LeNet5***

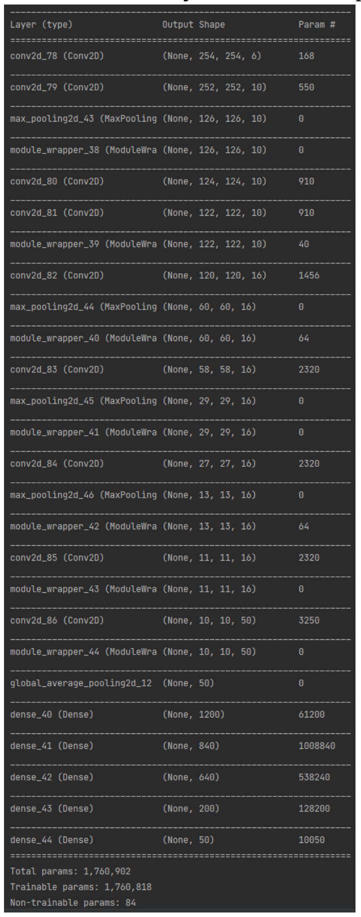
## I. Introduction

本次作業目標為使用Tensorflow or pytorch實現LeNet，所有code都放在https://github.com/Jason890102/Deep-Learning/tree/main/Assignment_3。

## II. Method

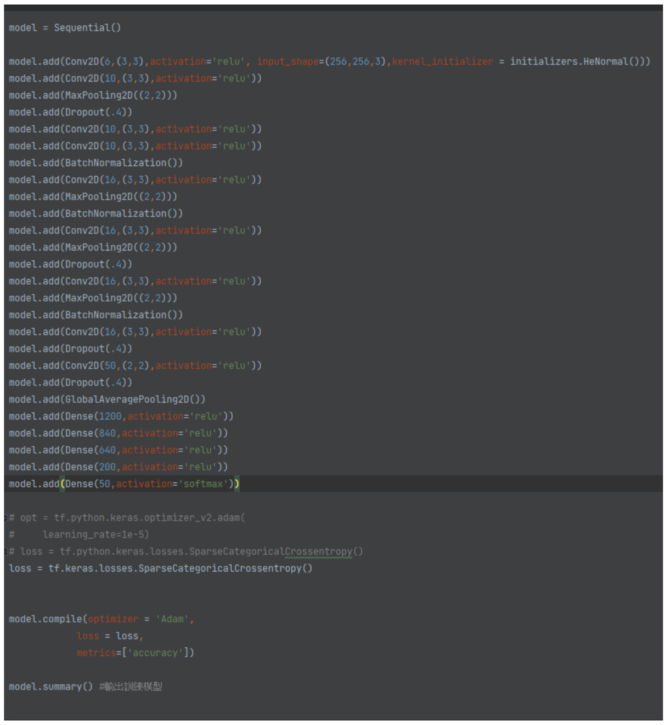
### A. *LeNet Architecture*

Two Layer Net架構圖如Fig. 1.。Fig. 2.為trianing的Loss curve，以及trian&Test的accury，訓練300個epochs。



```
----------------------------------------------------------------
Layer (type)                 Output Shape              Param #
================================================================
conv2d_78 (Conv2D)           (None, 254, 254, 6)       168
----------------------------------------------------------------
conv2d_79 (Conv2D)           (None, 252, 252, 10)      550
----------------------------------------------------------------
max_pooling2d_43 (MaxPooling (None, 126, 126, 10)      0
----------------------------------------------------------------
module_wrapper_38 (ModuleWra (None, 126, 126, 10)      0
----------------------------------------------------------------
conv2d_80 (Conv2D)           (None, 124, 124, 10)      910
----------------------------------------------------------------
conv2d_81 (Conv2D)           (None, 122, 122, 10)      910
----------------------------------------------------------------
module_wrapper_39 (ModuleWra (None, 122, 122, 10)      40
----------------------------------------------------------------
conv2d_82 (Conv2D)           (None, 120, 120, 16)      1456
----------------------------------------------------------------
max_pooling2d_44 (MaxPooling (None, 60, 60, 16)        0
----------------------------------------------------------------
module_wrapper_40 (ModuleWra (None, 60, 60, 16)        64
----------------------------------------------------------------
conv2d_83 (Conv2D)           (None, 58, 58, 16)        2320
----------------------------------------------------------------
max_pooling2d_45 (MaxPooling (None, 29, 29, 16)        0
----------------------------------------------------------------
module_wrapper_41 (ModuleWra (None, 29, 29, 16)        0
----------------------------------------------------------------
conv2d_84 (Conv2D)           (None, 27, 27, 16)        2320
----------------------------------------------------------------
max_pooling2d_46 (MaxPooling (None, 13, 13, 16)        0
----------------------------------------------------------------
module_wrapper_42 (ModuleWra (None, 13, 13, 16)        64
----------------------------------------------------------------
conv2d_85 (Conv2D)           (None, 11, 11, 16)        2320
----------------------------------------------------------------
module_wrapper_43 (ModuleWra (None, 11, 11, 16)        0
----------------------------------------------------------------
conv2d_86 (Conv2D)           (None, 10, 10, 50)        3250
----------------------------------------------------------------
module_wrapper_44 (ModuleWra (None, 10, 10, 50)        0
----------------------------------------------------------------
global_average_pooling2d_12  (None, 50)                0
----------------------------------------------------------------
dense_40 (Dense)             (None, 1200)              61200
----------------------------------------------------------------
dense_41 (Dense)             (None, 840)               1008840
----------------------------------------------------------------
dense_42 (Dense)             (None, 640)               538240
----------------------------------------------------------------
dense_43 (Dense)             (None, 200)               128200
----------------------------------------------------------------
dense_44 (Dense)             (None, 50)                10050
================================================================
Total params: 1,760,902
Trainable params: 1,760,818
Non-trainable params: 84
```

Fig. 1. LeNet Architecture



```python
model = Sequential()

model.add(Conv2D(6,(3,3),activation='relu', input_shape=(256,256,3),kernel_initializer = initializers.HeNormal()))
model.add(Conv2D(10,(3,3),activation='relu'))
model.add(MaxPooling2D((2,2)))
model.add(Dropout(.4))
model.add(Conv2D(10,(3,3),activation='relu'))
model.add(Conv2D(10,(3,3),activation='relu'))
model.add(BatchNormalization())
model.add(Conv2D(16,(3,3),activation='relu'))
model.add(MaxPooling2D((2,2)))
model.add(BatchNormalization())
model.add(Conv2D(16,(3,3),activation='relu'))
model.add(MaxPooling2D((2,2)))
model.add(Dropout(.4))
model.add(Conv2D(16,(3,3),activation='relu'))
model.add(MaxPooling2D((2,2)))
model.add(BatchNormalization())
model.add(Conv2D(16,(3,3),activation='relu'))
model.add(Dropout(.4))
model.add(Conv2D(50,(2,2),activation='relu'))
model.add(Dropout(.4))
model.add(GlobalAveragePooling2D())
model.add(Dense(1200,activation='relu'))
model.add(Dense(840,activation='relu'))
model.add(Dense(640,activation='relu'))
model.add(Dense(200,activation='relu'))
model.add(Dense(50,activation='softmax'))

# opt = tf.python.keras.optimizer_v2.adam(
#     learning_rate=1e-5)
# loss = tf.python.keras.losses.SparseCategoricalCrossentropy()
loss = tf.keras.losses.SparseCategoricalCrossentropy()


model.compile(optimizer = 'Adam',
          loss = loss,
          metrics=['accuracy'])

model.summary() #輸出訓練模型
```

Fig. 2. LeNet hyprpapramter

### B. *Train&validation accuracy*

Fig. 3.為Train&Validation accuracy curve，從結果來看最高的準確度為32%，並且有點overfitting，Fig. 4.為手刻的LeNet5的Loss Curve、train&test accury，最高為3%。

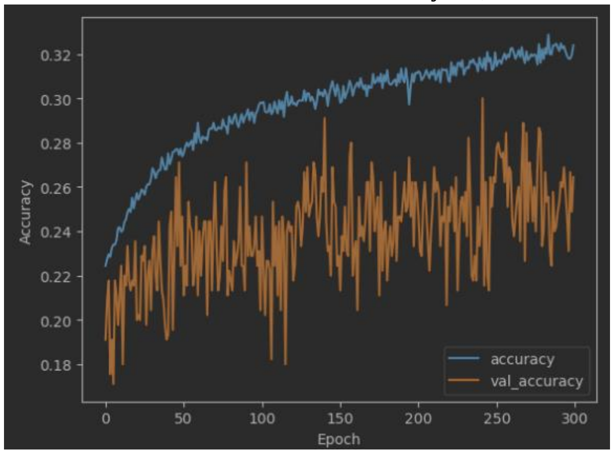
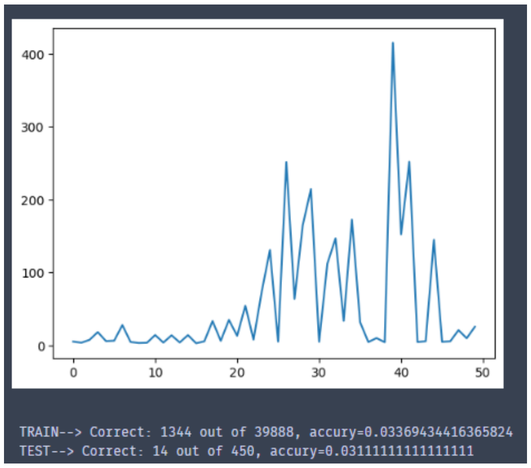


Fig. 3. Train&validation accury

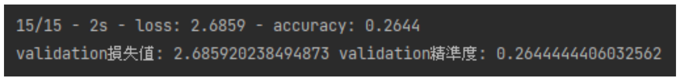


```
TRAIN--> Correct: 1344 out of 39888, accury=0.03369434416365824
TEST--> Correct: 14 out of 450, accury=0.03111111111111111
```

Fig. 4. LeNet5 Loss Curve、train&test accury

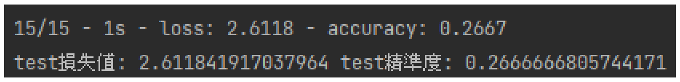
## *C. The predicted result on the validation set*

Validation的accuracy如Fig. 5.，分為50個類別，Fig. 6. 為Test set的accuracy，可以看出Test set的accuracy稍微好一點，。



```
15/15 - 2s - loss: 2.6859 - accuracy: 0.2644
validation損失值: 2.685920238494873 validation精準度: 0.2644444406032562
```

Fig. 5. Validation predict accuracy



```
15/15 - 1s - loss: 2.6118 - accuracy: 0.2667
test損失值: 2.611841917037964 test精準度: 0.2666666805744171
```

Fig. 6. Test predict accuracy

## III. CONCLUSION

在寫作業的過程中對於資料的前處理還是不太會導致正確率一直提升不上去，有試著增加層數及降低Learning rate，卻還是沒有超過40%。