

# Homework3 Report

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EE5184 - Machine Learning

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1. (1%) 請說明你實作的 CNN model，其模型架構、訓練過程和準確率為何？

架構如右圖，基本上只是基本的CNN以及Flattern之後接上Dense，並且在每一層之間加上Norm\_Batch以及Dropout。

共四次 Cov2d Maxpool 之組合  
Flattern後兩層Dense  
最後接Softmax

訓練過程使用Adam訓練61個epoch  
並使用ImageDataGenerator增加更多影像訓練  
參數為 rotation\_range=15,  
width\_shift\_range=0.1,  
height\_shift\_range=0.1

準確率public score為0.68041

其實這模型由於有不少隨機的因素，所以訓練完準確率會在0.65~0.68之間，我是嘗試多次之後找一次最高的繳交。

2. (1%) 承上題，請用與上述 CNN 接近的參數量，實做簡單的 DNN model，其模型架構、訓練過程和準確率為何？試與上題結果做比較，並說明你觀察到了什麼？

DNN參數量：

Total params: 6,302,855

Trainable params: 6,292,103

模型架構跟上面模型基本一樣，只是把所有Cov2d Maxpool組合換成Dense  
訓練過程同樣使用Adam訓練61個epoch，準確率public score為0.37280，相對於CNN模型準確率只有一半以下。

原因可能是DNN模型並不會考慮2d空間點跟點之間的相關性，所以效果較差，而且更容易overfitting。

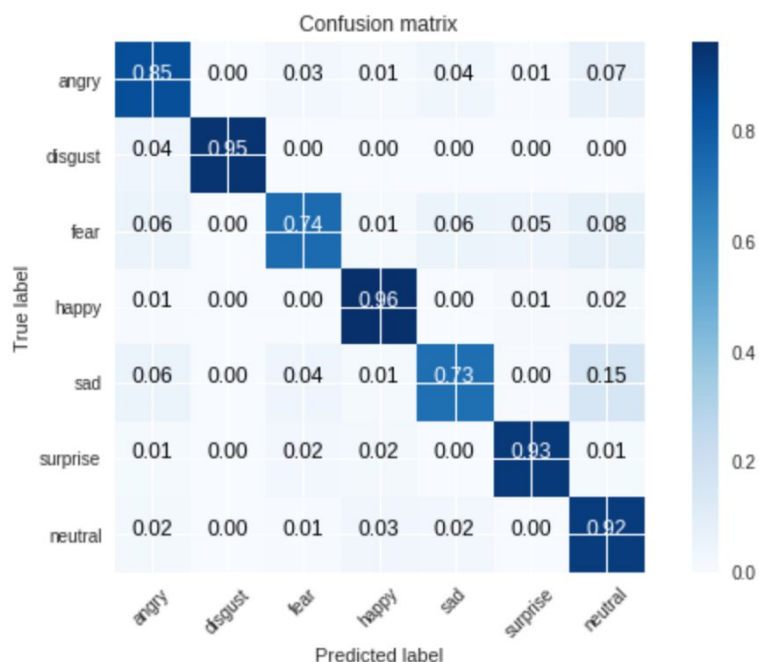
3. (1%) 觀察答錯的圖片中，哪些 class 彼此間容易用混？並說明你觀察到了什麼？ [繪出 confusion matrix 分析]

Layer (type)	Output Shape	Param #
conv2d_5 (Conv2D)	(None, 48, 48, 128)	1280
batch_normalization_11 (Batch Normalization)	(None, 48, 48, 128)	512
dropout_11 (Dropout)	(None, 48, 48, 128)	0
max_pooling2d_5 (MaxPooling2D)	(None, 24, 24, 128)	0
batch_normalization_12 (Batch Normalization)	(None, 24, 24, 128)	512
dropout_12 (Dropout)	(None, 24, 24, 128)	0
conv2d_6 (Conv2D)	(None, 24, 24, 256)	295168
batch_normalization_13 (Batch Normalization)	(None, 24, 24, 256)	1024
dropout_13 (Dropout)	(None, 24, 24, 256)	0
max_pooling2d_6 (MaxPooling2D)	(None, 12, 12, 256)	0
batch_normalization_14 (Batch Normalization)	(None, 12, 12, 256)	1024
dropout_14 (Dropout)	(None, 12, 12, 256)	0
conv2d_7 (Conv2D)	(None, 12, 12, 512)	1180160
batch_normalization_15 (Batch Normalization)	(None, 12, 12, 512)	2048
dropout_15 (Dropout)	(None, 12, 12, 512)	0
max_pooling2d_7 (MaxPooling2D)	(None, 6, 6, 512)	0
batch_normalization_16 (Batch Normalization)	(None, 6, 6, 512)	2048
dropout_16 (Dropout)	(None, 6, 6, 512)	0
conv2d_8 (Conv2D)	(None, 6, 6, 512)	2359808
batch_normalization_17 (Batch Normalization)	(None, 6, 6, 512)	2048
dropout_17 (Dropout)	(None, 6, 6, 512)	0
max_pooling2d_8 (MaxPooling2D)	(None, 3, 3, 512)	0
batch_normalization_18 (Batch Normalization)	(None, 3, 3, 512)	2048
dropout_18 (Dropout)	(None, 3, 3, 512)	0
flatten_2 (Flatten)	(None, 4608)	0
dense_3 (Dense)	(None, 512)	2359808
batch_normalization_19 (Batch Normalization)	(None, 512)	2048
dropout_19 (Dropout)	(None, 512)	0
dense_4 (Dense)	(None, 512)	262656
batch_normalization_20 (Batch Normalization)	(None, 512)	2048
dropout_20 (Dropout)	(None, 512)	0
dense_5 (Dense)	(None, 7)	3591
Total params: 6,477,831		
Trainable params: 6,470,151		

如右圖，可以發現幾個比較容易混淆的  
 實際為生氣、預測為中立 (0.07)  
 實際為恐懼、預測為生氣 (0.06)  
 實際為恐懼、預測為難過 (0.06)  
 實際為恐懼、預測為中立 (0.08)  
 實際為難過、預測為生氣 (0.06)  
 實際為難過、預測為中立 (0.15)

看起來恐懼、難過、生氣等負面情緒都  
 比較容易與其他負面情緒或中立混淆

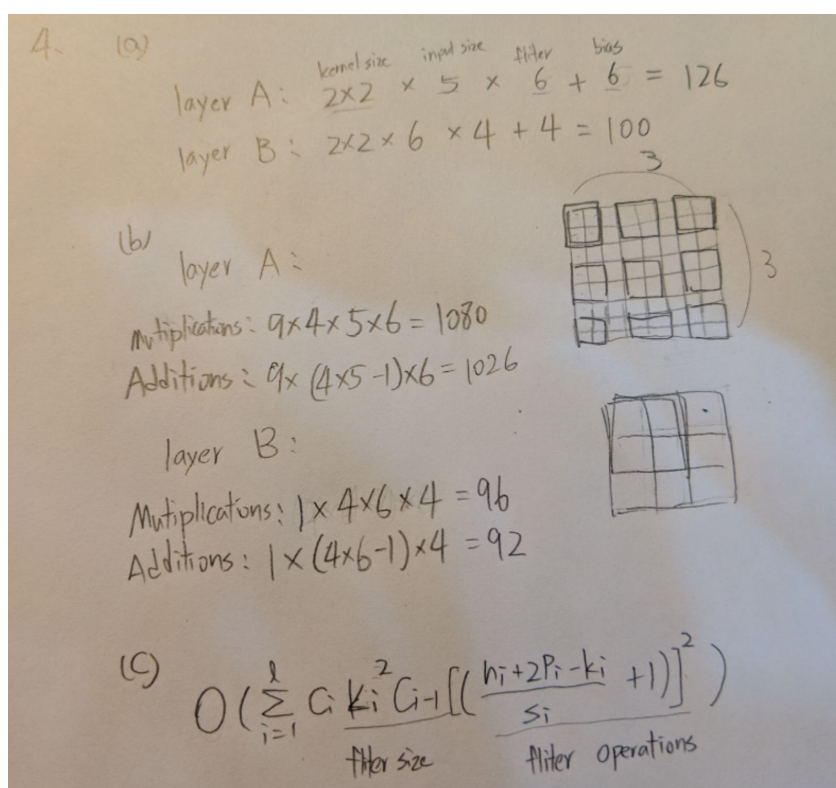
尤其是難過，容易被判斷為中立



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collaborator : d07946003 王嘉澤

4.



5.

5. let  $x = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$ ,  $\text{cov} = (x - \bar{x})^T (x - \bar{x})$

(a)

i	$x_i$	$V_i$
1	15.2974	$[-0.6165, -0.5888, -0.5225]$
2	11.6305	$[0.6781, -0.7343, 0.0272]$
3	5.4720	$[-0.3998, -0.3375, 0.8521]$

(b)  $p = x \cdot [V_1, V_2, V_3]^T =$

-3.36	-0.70	+1.48
-9.78	-3.02	-0.03
-13.61	-6.53	2.41
-17.94	-5.06	1.16
-12.37	-6.83	-5.02
-7.19	1.86	-3.29
-14.96	0.47	1.36
-7.08	-3.81	-3.04
-12.86	3.95	-0.97
-16.30	-1.10	-1.74

(c)  $[1.48, 0.04, 2.41, 1.16, 5.02, 3.29, 1.37, 3.05, 0.97, 1.75]^T$