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1. (2%) 請說明你實作的 CNN model，其模型架構、訓練參數和準確率為何？並請用與上述 CNN 接近的參數量，實做簡單的 DNN model，同時也說明其模型架構、訓練參數和準確率為何？並說明你觀察到了什麼？

   CNN model:

   (1) 模型架構與訓練參數

Layer (type)	Output Shape	Param #
conv2d_1 (Conv2D)	(None, 48, 48, 128)	1280
conv2d_2 (Conv2D)	(None, 48, 48, 128)	147584
batch_normalization_1 (Batch	(None, 48, 48, 128)	512
max_pooling2d_1 (MaxPooling2	(None, 24, 24, 128)	0
dropout_1 (Dropout)	(None, 24, 24, 128)	0
conv2d_3 (Conv2D)	(None, 24, 24, 256)	295168
conv2d_4 (Conv2D)	(None, 24, 24, 256)	590080
batch_normalization_2 (Batch	(None, 24, 24, 256)	1024
max_pooling2d_2 (MaxPooling2	(None, 12, 12, 256)	0
dropout_2 (Dropout)	(None, 12, 12, 256)	0
conv2d_5 (Conv2D)	(None, 12, 12, 512)	1180160
conv2d_6 (Conv2D)	(None, 12, 12, 512)	2359808
batch_normalization_3 (Batch	(None, 12, 12, 512)	2048
max_pooling2d_3 (MaxPooling2	(None, 6, 6, 512)	0
dropout_3 (Dropout)	(None, 6, 6, 512)	0
conv2d_7 (Conv2D)	(None, 6, 6, 768)	3539712
conv2d_8 (Conv2D)	(None, 6, 6, 768)	5309184
batch_normalization_4 (Batch	(None, 6, 6, 768)	3072

max_pooling2d_4 (MaxPooling2	(None, 3, 3, 768)	0
dropout_4 (Dropout)	(None, 3, 3, 768)	0
flatten_1 (Flatten)	(None, 6912)	0
dense_1 (Dense)	(None, 1024)	7078912
dropout_5 (Dropout)	(None, 1024)	0
dense_2 (Dense)	(None, 1024)	1049600
dropout_6 (Dropout)	(None, 1024)	0
dense_3 (Dense)	(None, 1024)	1049600
dropout_7 (Dropout)	(None, 1024)	0
dense_4 (Dense)	(None, 7)	7175

Total params: 22,614,919
Trainable params: 22,611,591
Non-trainable params: 3,328

(2) 準確率

Public: 0.68208

Private: 0.68487

DNN model:

(1) 模型架構與訓練參數

Layer (type)	Output Shape	Param #
reshape_1 (Reshape)	(None, 2304)	0
dense_1 (Dense)	(None, 2048)	4720640
dense_2 (Dense)	(None, 2048)	4196352
dense_3 (Dense)	(None, 2048)	4196352
dense_4 (Dense)	(None, 2048)	4196352
dense_5 (Dense)	(None, 2048)	4196352
dense_6 (Dense)	(None, 7)	14343

Total params: 21,520,391
Trainable params: 21,520,391
Non-trainable params: 0

(2) 準確率

Public: 0.37642

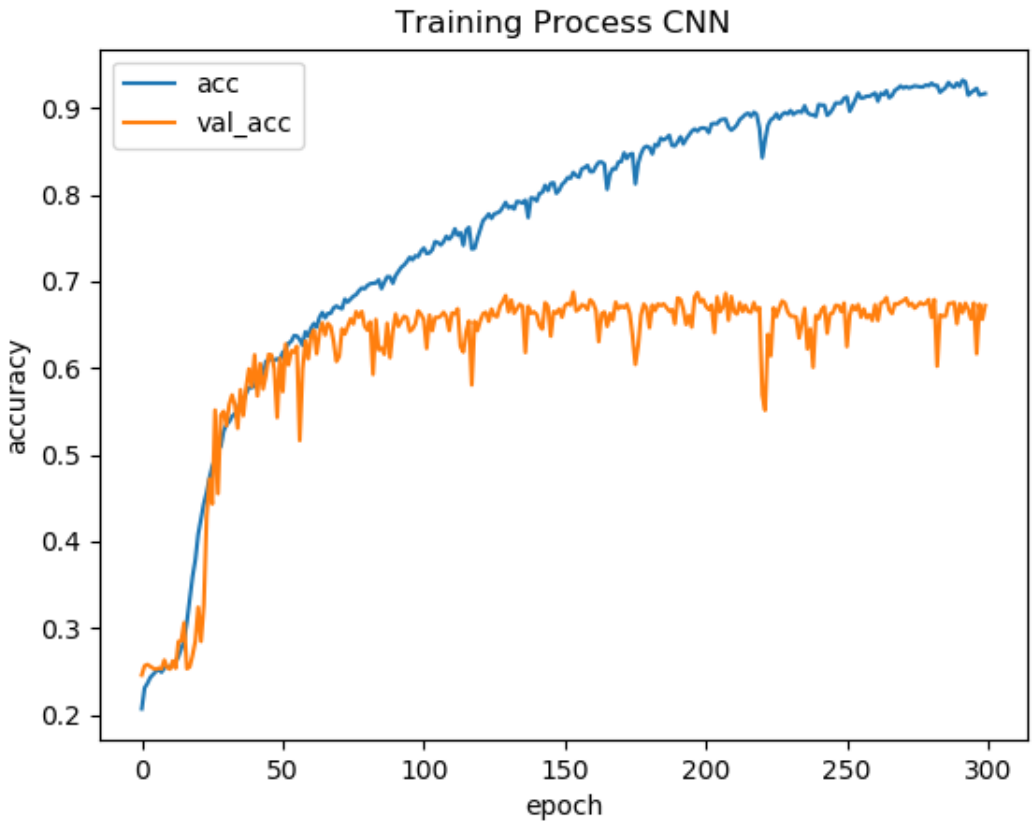
Private: 0.37698

觀察：

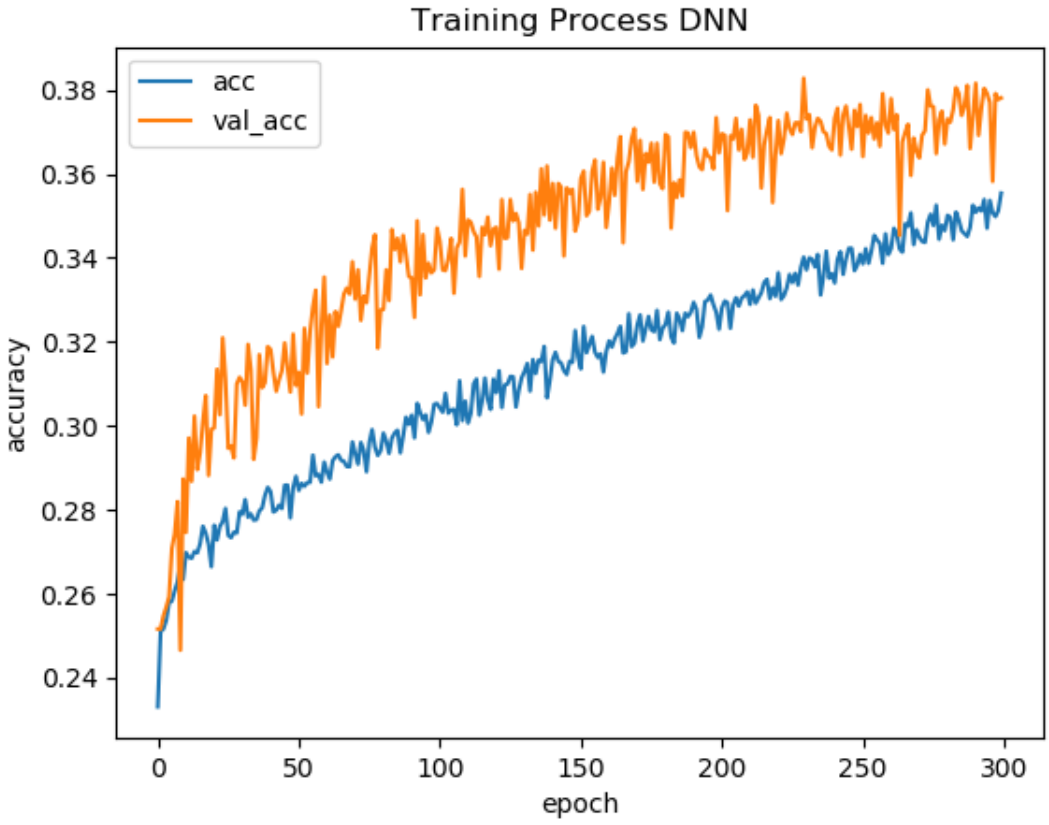
CNN model的準確率比單純的DNN model好上很多，我認為是因為此task很符合CNN的使用條件，包括了不同的feature可能出現在不同位置且可能出現多次，還有這是影像辨識，刪除奇數列偶數行後對影像沒有太大的改變，因此CNN model能在此task做得較好。

2. (1%) 承上題，請分別畫出這兩個model的訓練過程 (i.e., loss/accuracy v.s. epoch)

   CNN model:


Training Process CNN
acc
val_acc
accuracy
epoch
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
0
50
100
150
200
250
300

DNN model:


Training Process DNN
acc
val_acc
accuracy
epoch
0.24
0.26
0.28
0.30
0.32
0.34
0.36
0.38
0
50
100
150
200
250
300

3. (1%) 請嘗試 data normalization, data augmentation,說明實作方法並且說明實行前後對準確率有什麼樣的影響？

   without normalization and augmentation：Public: 0.63053 Private: 0.60406

   with normalization and without augmentation：Public: 0.65115 Private: 0.64641

   with normalization and with augmentation：Public: 0.68208 Private: 0.68487

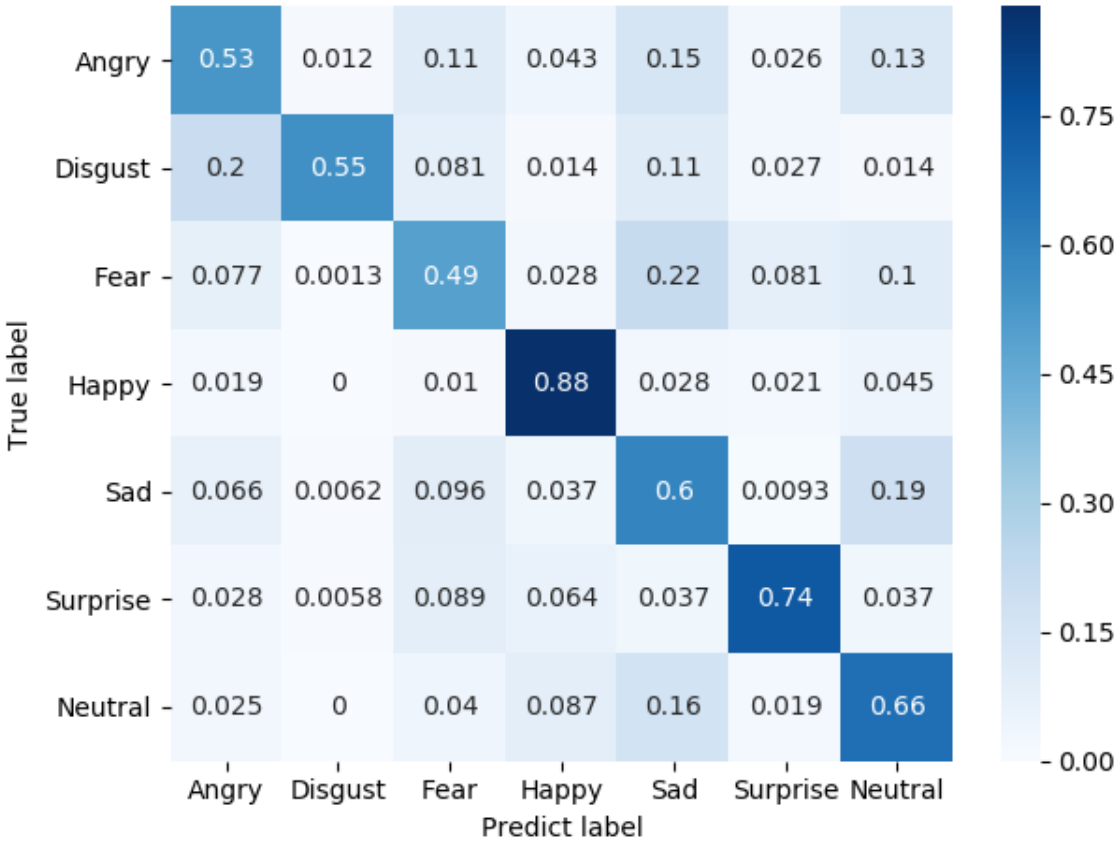
   nornalization實作方法：

   將每個pixel的值除以255，使得pixel的值都落在0~1之間。實作後使得準確率上升。

   augmentation實作方法：

   將圖片進行些微旋轉、放大縮小以及水平翻轉，使得資料量變大。實作後使得準確率上升。

4. (1%) 觀察答錯的圖片中，哪些 class 彼此間容易用混？[繪出 confusion matrix 分析]



此model容易把以下pair搞混

(Disgust, Angry)

(Fear,Sad)

(Sad,Neutral)

(Neutral,Sad)