ML2019SPRING HW3

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(準確度皆為*public/private*)

1.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:

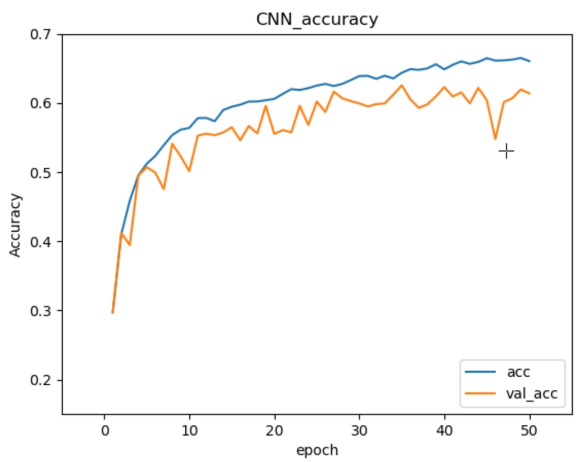
```
datagen = ImageDataGenerator(rotation_range = 10 * np.pi, horizontal_flip = True)

model = Sequential()
model.add(Conv2D(filters = 32, kernel_size = (5, 5), input_shape = (48, 48, 1),
activation = "relu", kernel_regularizer = regularizers.l1_l2(l1 = 3e-5, l2 = 5e-5),
padding = "same"))
model.add(BatchNormalization())
model.add(Conv2D(filters = 32, kernel_size = (4, 4), activation = "relu",
kernel_regularizer = regularizers.l1_l2(l1 = 3e-5, l2 = 5e-5), padding = "same"))
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size = 2 * 2, padding = "same"))
model.add(Conv2D(filters = 64, kernel_size = (5, 5), activation = "relu",
kernel_regularizer = regularizers.l1_l2(l1 = 3e-5, l2 = 5e-5), padding = "same"))
model.add(BatchNormalization())
model.add(Conv2D(filters = 64, kernel_size = (4, 4), activation = "relu",
kernel_regularizer = regularizers.l1_l2(l1 = 3e-5, l2 = 5e-5), padding = "same"))
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size = 2 * 2, padding = "same"))
model.add(Conv2D(filters = 128, kernel_size = (5, 5), activation = "relu",
kernel_regularizer = regularizers.l1_l2(l1 = 3e-5, l2 = 5e-5), padding = "same"))
model.add(BatchNormalization())
model.add(Conv2D(filters = 128, kernel_size = (4, 4), activation = "relu",
kernel_regularizer = regularizers.l1_l2(l1 = 3e-5, l2 = 5e-5), padding = "same"))
model.add(BatchNormalization())
model.add(MaxPooling2D(pool_size = 2 * 2, padding = "same"))
model.add(Flatten())
model.add(Dense(units = 2048, activation = "relu", kernel_regularizer =
regularizers.l1_l2(l1 = 3e-5, l2 = 5e-5)))
model.add(Dropout(0.5))
model.add(Dense(units = 512, activation = "relu", kernel_regularizer =
regularizers.l1_l2(l1 = 3e-5, l2 = 5e-5)))
model.add(Dense(units = 7, activation = "softmax", kernel_regularizer =
regularizers.l1_l2(l1 = 3e-5, l2 = 5e-5)))
model.compile(loss = "categorical_crossentropy", optimizer = "Adam", metrics =
['accuracy'])
```

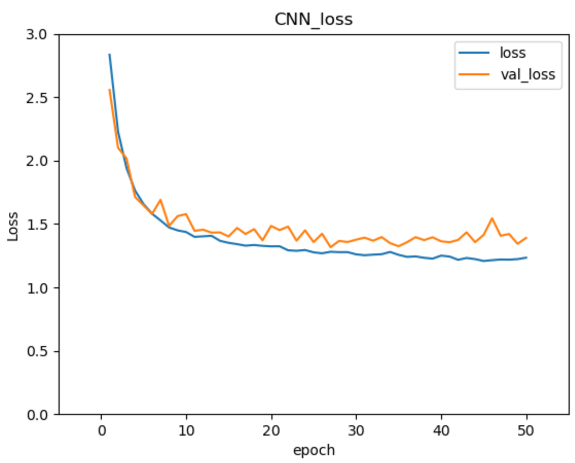
DNN:

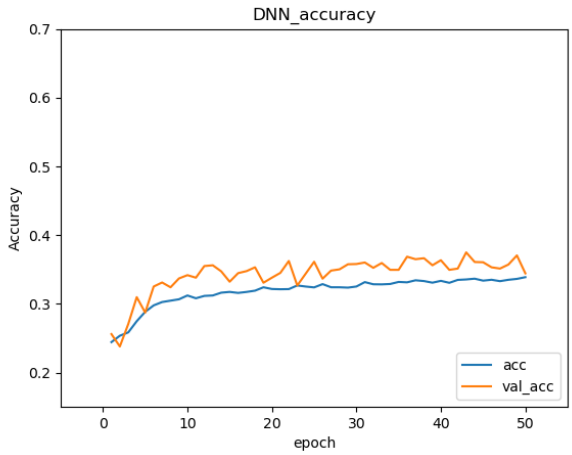
```
datagen = ImageDataGenerator(rotation_range = 10 * np.pi, horizontal_flip = True)

model = Sequential()
model.add(Dense(input_shape = (48, 48, 1), units = 30, activation = "relu",
kernel_regularizer = regularizers.l1_l2(l1 = 3e-5, l2 = 5e-5)))
model.add(Flatten())
model.add(Dense(units = 30, activation = "relu", kernel_regularizer =
regularizers.l1_l2(l1 = 3e-5, l2 = 5e-5)))
model.add(Dense(units = 30, activation = "relu", kernel_regularizer =
regularizers.l1_l2(l1 = 3e-5, l2 = 5e-5)))
model.add(Dense(units = 30, activation = "relu", kernel_regularizer =
regularizers.l1_l2(l1 = 3e-5, l2 = 5e-5)))
model.add(Dense(units = 30, activation = "relu", kernel_regularizer =
regularizers.l1_l2(l1 = 3e-5, l2 = 5e-5)))
model.add(Dense(units = 30, activation = "relu", kernel_regularizer =
regularizers.l1_l2(l1 = 3e-5, l2 = 5e-5)))
model.add(Dense(units = 7, activation = "softmax", kernel_regularizer =
regularizers.l1_l2(l1 = 3e-5, l2 = 5e-5)))
model.compile(loss = "categorical_crossentropy", optimizer = "Adam", metrics =
['accuracy'])
```

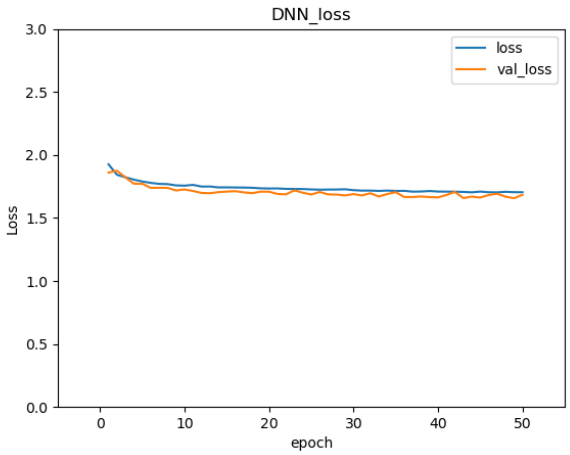
此CNN模型的準確率為0.62217/0.62217，相近參數量的DNN為0.36639/0.3728，$epoch$皆為50，兩者卻有非常大的差別。我是用的為小模型，參數量落在200萬左右，DNN神經元數量較CNN多，較容易產生過擬合。為了使參數接近，每層能使用的神經元也無法太多，我也沒有多用`batchnormalization()`來優化他，才造成如此低落的準確度。

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



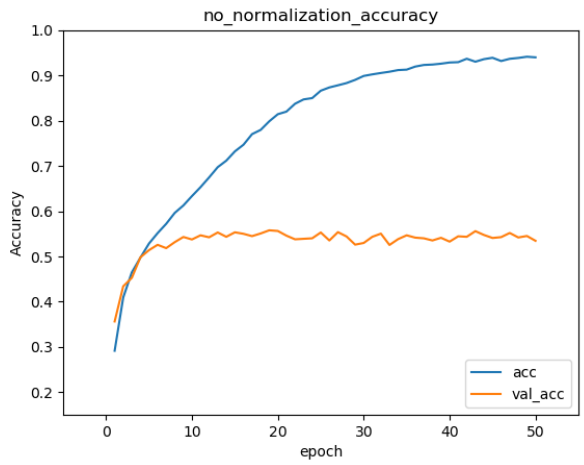


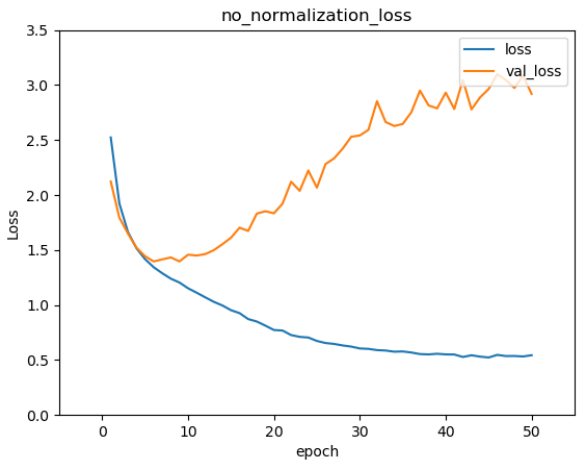


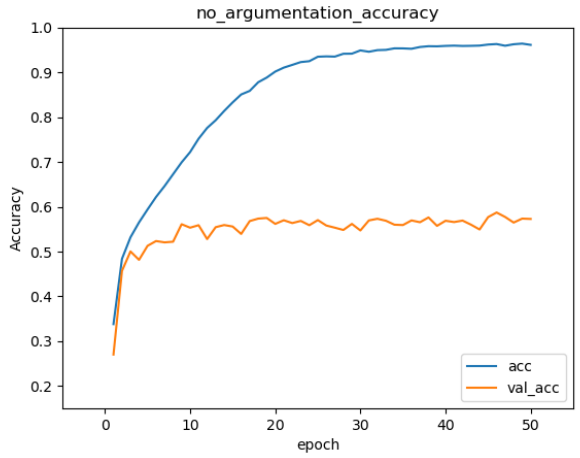


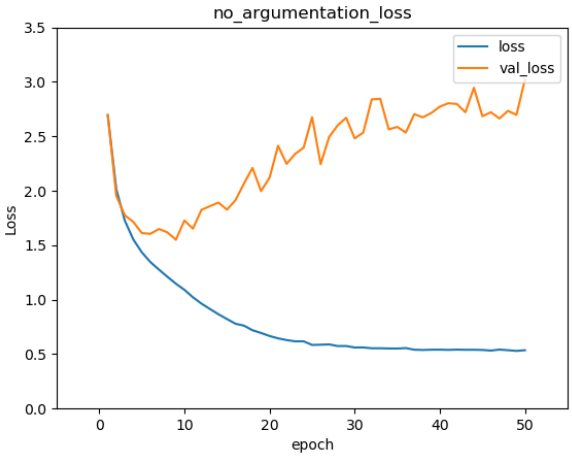
3.請嘗試 **data normalization, data augmentation,**說明實作方法並且說明實行前後對準確率有什麼樣的影響？

我使用的model與前兩題的$CNN\ model$ 相同，準確度為0.62217/0.62217。移除掉$data\ argumentation$後，準確度下降了一些，不過幅度不大，為0.59375/0.57954。再移除掉所有$normalization$後，下降幅度就比較多了，多數的training在沒有標準化的情況下，受數值影響太大，不容易有好的結果。另外一個發現，移除掉此兩種方法後，model本身的$Accuracy$會衝非常高，有些過擬合的現象，$validation\ loss$常在中後期又會升高，並非一個穩定且好的model。

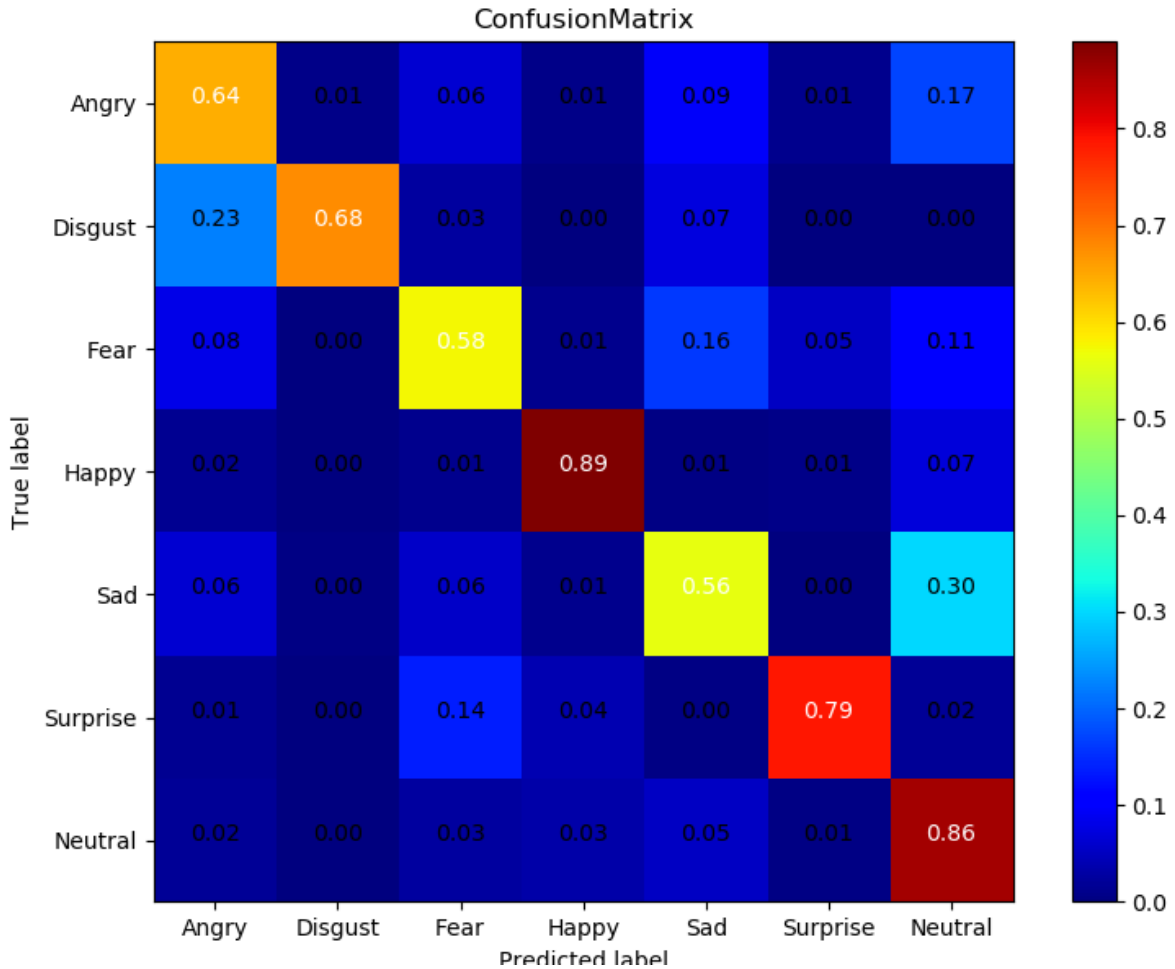








4.觀察答錯的圖片中，哪些 **class** 彼此間容易用混？**[**繪出 **confusion matrix** 分析**]**



此次我使用較好的模型，我們可發現難過滿容易判定成無情緒的，可能因為難過比較沒有像開心，生氣等大幅度的表情變化，但也因為如此，難過較不會跟其他種情緒搞混。其他的表情中，驚訝也常判定成驚嚇，畢竟都是遇到突發的情況。噁心通常帶有負面情緒，也有一定機會判定成生氣。