Machine Learning HW7 Report

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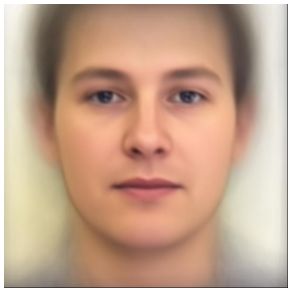
1. PCA of color faces:

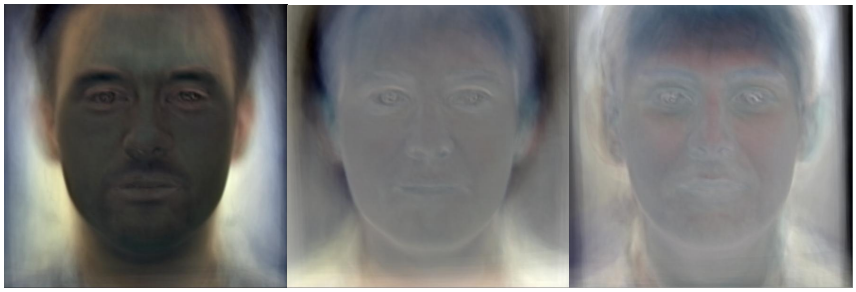
a. 請畫出所有臉的平均。

Ans:



b. 請畫出前五個 Eigenfaces，也就是對應到前五大 Eigenvalues 的 Eigenvectors。

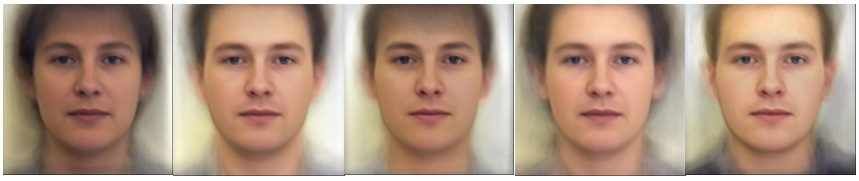
Ans: 由左至右依序為：



c. 請從數據集中挑出任意五張圖片，並用前五大 Eigenfaces 進行 reconstruction，並畫出結果。

原圖：

Reconstruct:



d. 請寫出前五大 Eigenfaces 各自所佔的比重，請用百分比表示並四捨五入
到小數點後一位。
Ans: 4.15%, 2.95%, 2.39%, 2.21%, 2.07%

2. Image clustering:

a. 請實作兩種不同的方法，並比較其結果(reconstruction loss, accuracy)。(不同的降維方法或不同的 cluster 方法都可以算是不同的方法)

方法一：

Layer (type)	Output Shape	Param #
input_2 (InputLayer)	(None, 32, 32, 3)	0
conv2d_10 (Conv2D)	(None, 32, 32, 160)	4480
max_pooling2d_4 (MaxPooling2	(None, 16, 16, 160)	0
conv2d_11 (Conv2D)	(None, 16, 16, 80)	115280
conv2d_12 (Conv2D)	(None, 16, 16, 40)	28840
max_pooling2d_5 (MaxPooling2	(None, 8, 8, 40)	0
conv2d_13 (Conv2D)	(None, 8, 8, 20)	7220
max_pooling2d_6 (MaxPooling2	(None, 4, 4, 20)	0
conv2d_14 (Conv2D)	(None, 4, 4, 20)	3620
up_sampling2d_4 (UpSampling2	(None, 8, 8, 20)	0
conv2d_15 (Conv2D)	(None, 8, 8, 40)	7240
conv2d_16 (Conv2D)	(None, 8, 8, 80)	28880
up_sampling2d_5 (UpSampling2	(None, 16, 16, 80)	0
conv2d_17 (Conv2D)	(None, 16, 16, 160)	115360
up_sampling2d_6 (UpSampling2	(None, 32, 32, 160)	0
conv2d_18 (Conv2D)	(None, 32, 32, 3)	4323

Encoding: Conv2D →pooling→Conv2D→

Conv2D→pooling→Conv2D→pooling→

Conv2D →upsampling→Conv2D→Conv2D→

upsampling→Conv2D→upsampling→Conv2D

PCA: 260 component

Loss Function: Mean Square Error

Loss, Accuracy = 0.0088, 0.96463+0.96468

方法二：

Layer (type)	Output Shape	Param #
input_1 (InputLayer)	(None, 32, 32, 3)	0
conv2d_1 (Conv2D)	(None, 32, 32, 120)	3360
max_pooling2d_1 (MaxPooling2	(None, 16, 16, 120)	0
conv2d_2 (Conv2D)	(None, 16, 16, 80)	86480
max_pooling2d_2 (MaxPooling2	(None, 8, 8, 80)	0
conv2d_3 (Conv2D)	(None, 8, 8, 50)	36050
max_pooling2d_3 (MaxPooling2	(None, 4, 4, 50)	0
conv2d_4 (Conv2D)	(None, 4, 4, 50)	22550
up_sampling2d_1 (UpSampling2	(None, 8, 8, 50)	0
conv2d_5 (Conv2D)	(None, 8, 8, 80)	36080
up_sampling2d_2 (UpSampling2	(None, 16, 16, 80)	0
conv2d_6 (Conv2D)	(None, 16, 16, 120)	86520
up_sampling2d_3 (UpSampling2	(None, 32, 32, 120)	0
conv2d_7 (Conv2D)	(None, 32, 32, 3)	3243

Encoding: Conv2D →pooling→Conv2D→

pooling→Conv2D→pooling→Conv2D

→upsampling→Conv2D→upsampling

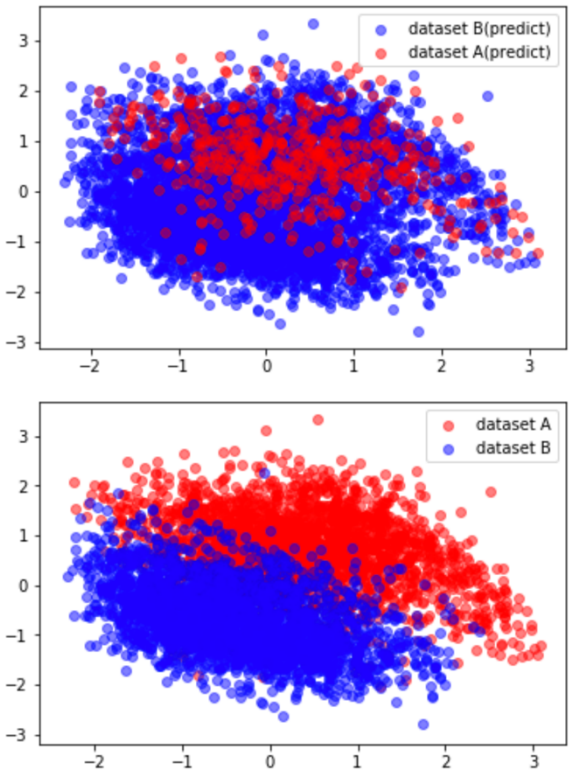
→Conv2D→upsampling→Conv2D

PCA: 720 component

Loss Function: Mean Square Error

Loss, Accuracy = 0.0079, 0.97392+0.97372

b. 預測 visualization.npy 中的 label，在二維平面上視覺化 label 的分佈。(用 PCA, t-SNE 等工具把你抽出來的 feature 投影到二維，或簡單的取前兩維 2 的 feature)
其中 visualization.npy 中前 2500 個 images 來自 dataset A，後 2500 個 images 來自 dataset B，比較和自己預測的 label 之間有何不同。

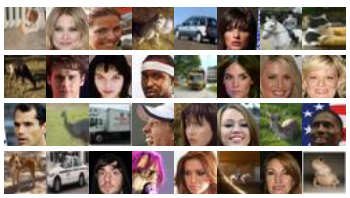


很難過的差很多，基本上多數在 Dataset B 的還是會被 predict 到 Dataset B，但有很多 Dataset A 被誤判成為 Dataset B，其中可能是因為在 training 的時候是只注意 training data set 的 loss，並沒有管 validation。也有可能是這些資料不在 training data 內，所以 model 對這些陌生的圖片 encoding 的結果可能不符合 training 的結果，以至於結果會不可觀。

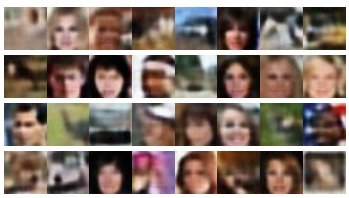
c. 請介紹你的 model 架構(encoder, decoder, loss function...)，並選出任意 32 張圖片，比較原圖片以及用 decoder reconstruct 的結果。

Ans:
encoder: Conv2D → pooling → Conv2D → pooling → Conv2D → pooling
decoder: Conv2D → upsampling → Conv2D → upsampling → Conv2D → upsampling
loss function: mean square error

原圖：



Decoded:



Decoder reconstruct 後的圖片較為模糊，但人臉的輪廓多數依舊能看出。