Homework #1

October 13, 2020

Problem 1 (no collaborators) (1) (2)

1. Plot the clustering results by replacing all pixels' RGB value in each cluster with the that of the corresponding cluster center.

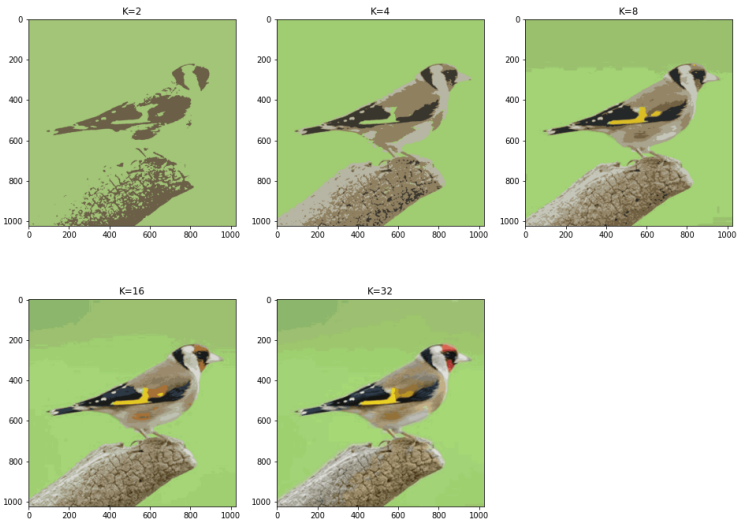
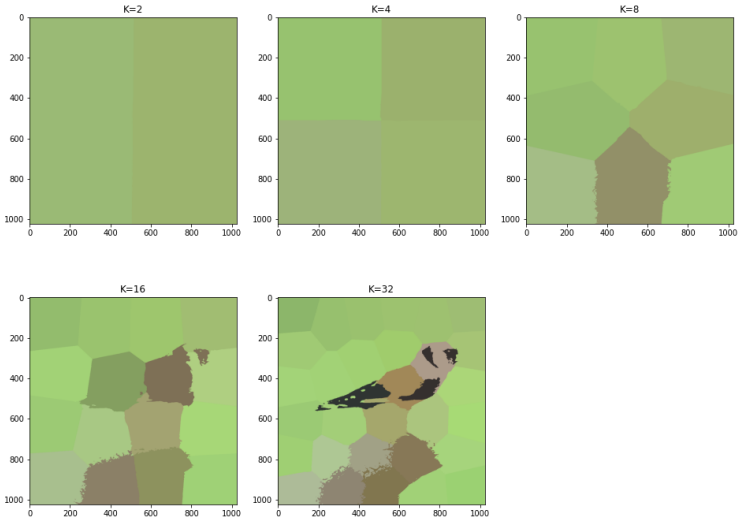
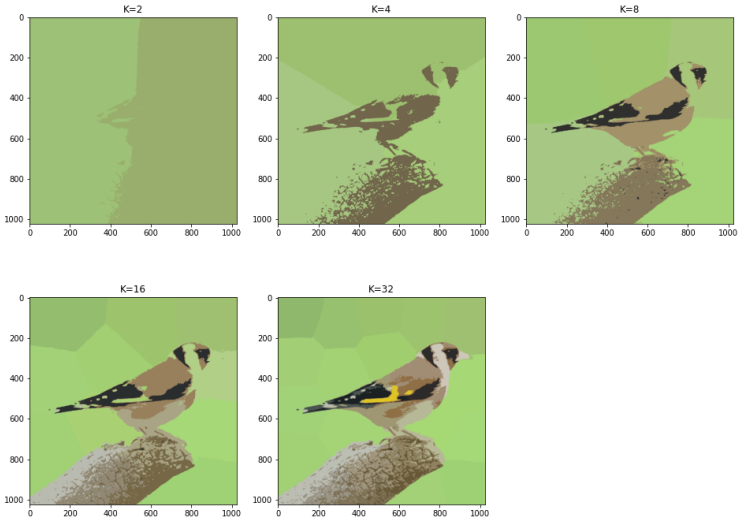


Figure 1: for 1.1

2. Take both RGB values and the location (x and y) as a five dimensional vector as the feature for describing each pixel and plot the clustering results.



(a) RGB values and the location as feature



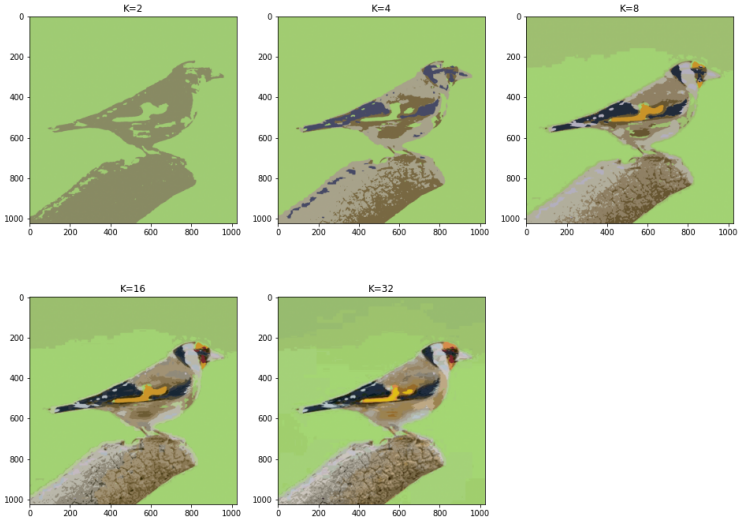
(b) normalize to (0, 1)

Figure 2: for 1.2

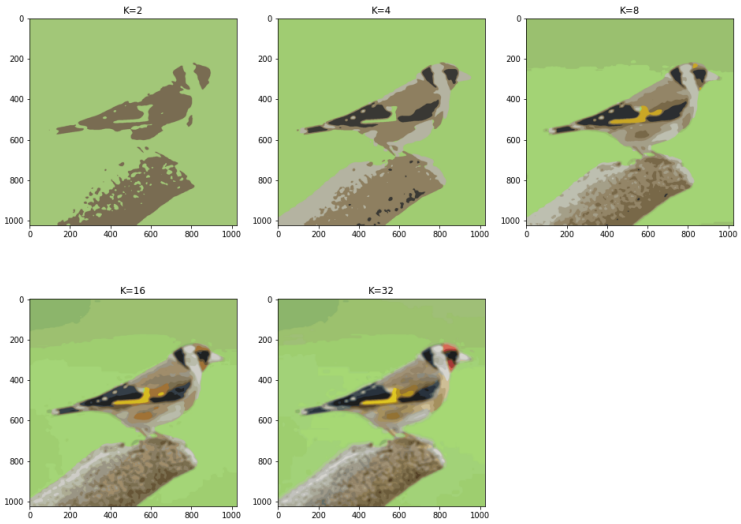
3. 分析：

如果沒有 normalize 到 [0, 1]，會考慮較多距離，因為距離最大為 1024，而 RGB 值最大為 255，造成只有分離出空間區塊；將其 normalize 後 (Figure 2(b)) 與原本的比較，可以看出在綠色背景的地方，分類的較整齊，但在分離出鳥的部分成果較差，可能是因為原本鳥頭就與綠色相近，且加上位置的元素，造成多用一種綠色描述背景導致。

Some trying



(a) convert RGB to HSV



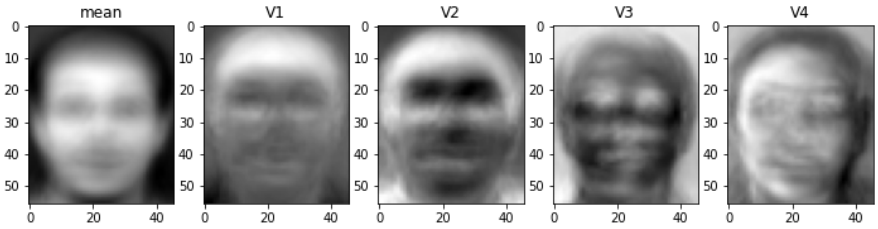
(b) average blur(kernel = (15,15))

Figure 3: for 1.3

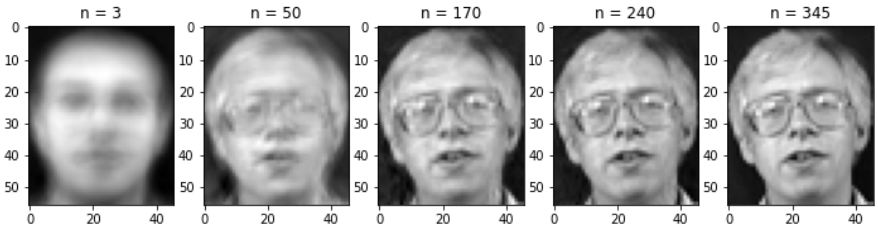
從 Figure 3(a) 可以看到 HSV 在邊緣部分比較容易分割開來，但在鳥的身體部分卻有點破碎的感覺；而從 Figure 3(b) 可以看到身體部分比較容易分割開來，邊緣也比原本的平滑。

Problem 2 (no collaborators) (3) (4) (5)

1. Plot the mean face and the first four eigenface



2. Plot the five reconstructed images.



3. The corresponding MSE values

```
n = 3.00, mse = 746.80
n = 50.00, mse = 236.55
n = 170.00, mse = 46.72
n = 240.00, mse = 13.37
n = 345.00, mse = 0.22
```

4. Use sklearn.model_selection.GridSearchCV(cv=KFold(n_splits=3, shuffle=True)) to determine the best k and n value. The cross validation results would be

```
k =       1          3          5
n = 3    [0.65555556 0.56666667 0.47222222]
n = 50   [0.94722222 0.87777778 0.80555556]
n = 170  [0.96111111 0.87777778 0.78333333]
```

we can choose k = 1, n = 170 because it got the best score on validation set.

5. The recognition rate of the testing set.

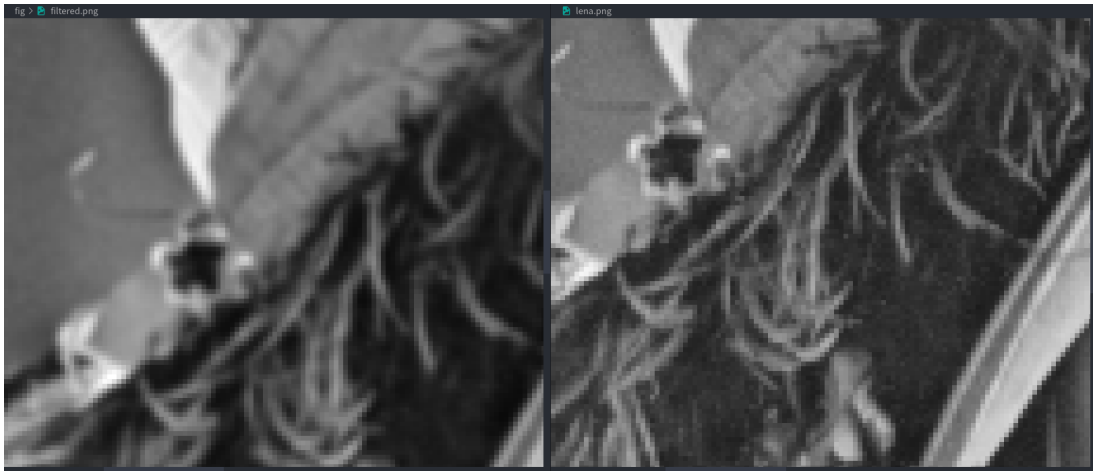
```
the recognition rate = 0.95
```

Problem 3 (no collaborators)

1. Plot 2D Gaussian filtered image.

(a) Gaussian filtered

(b) Original



(c) Scale up

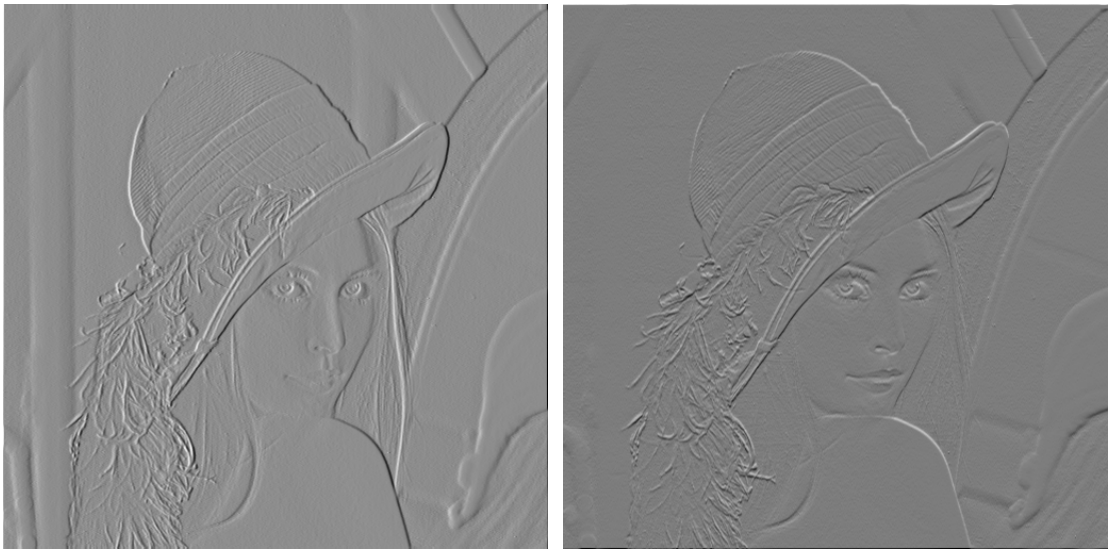
Figure 4: for 3.1

From (c), we can see that some noise will be filtered after guassion filtering, and the image will be smoothed.

2.

$k_x = \begin{bmatrix} \frac{1}{2} & 0 & -\frac{1}{2} \end{bmatrix}$ and $k_y = \begin{bmatrix} \frac{1}{2} \\ 0 \\ -\frac{1}{2} \end{bmatrix}$

plot the resulting images I_x and I_y



(a) I_x (b) I_y

Figure 5: for 3.2

3. Plot the two output gradient magnitude images

(a) Guassion filtered (b) Original

Figure 6: for 3.3

可以看到由於經過 Guassion filtered 後的圖片較平滑，因此在 magnitude 表現上較少粗糙的白點，尤其像是帽子、頭髮上較多粗糙平面的部分，原圖的結果白點較多。

Reference

(1) Comparing the Performance of L*A*B* and HSV Color Spaces with Respect to Color Image Segmentation [https://arxiv.org/ftp/arxiv/papers/1506/1506.01472.pdf]

(2) https://scikit-learn.org/stable/modules/generated/sklearn.cluster.KMeans.html

(3) https://scikit-learn.org/stable/modules/generated/sklearn.decomposition.PCA.html

(4) https://scikit-learn.org/stable/modules/generated/sklearn.model_selection.KFold.html

(5) https://scikit-learn.org/stable/modules/grid_search.html#grid-search