**Lab 1 Report**

**68/100**

Part one:

Question 1(a):

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First round:

, , => in Group 1

, , => in Group 1

, , => in Group 1

, , => in Group 2

**,**

Second round:

**,**

, , => in Group 1

, , => in Group 1

, , => in Group 1

, , => in Group 2

No more change in and

MSE = = 0.5

Question 1(b):

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First round:

, , => in Group 1

, , => in Group 2

, , => in Group 2

, , => in Group 2

**,**

Second round:

**,**

, , => in Group 1

, , => in Group 1

, , => in Group 2

, , => in Group 2

**,**

Third round:

**,**

, , => in Group 1

, , => in Group 1

, , => in Group 2

, , => in Group 2

No more change in and

MSE = = 0.75

Question 1(c):

For the result in part(a), the MSE is 0.5 and it just need two iteration for K-mean algorithm. While the result in part(b), the MSE is 0.75 which is larger than the result in part(a) and also it requires 3 iteration for the K-mean algorithm.

To conclude, the result in part(a) is more accurate and better as the MSE is smaller than the MSE in part(b).

Question 2:

As we decompose an 512x512 image into a number of non-overlapping 4x4 block and each block is represented by a 16-vector, then:

= 16384

16384 data vectors

Question 3:

As we decompose an 256x256 image into a number of non-overlapping 4x4 block and each block is represented by a 16-vector, then:

= 4096

4096 data vectors

Question 4:

It is because computer using floating point format to store data and carry out different arithmetic operations which are represented in binary with a finite precision which usually 64-bit binary fraction for the floating point number. Also, the total storage requirement for data compression is bits, Therefore, if we set k = for compression, we can avoid the error that the number cannot represent accurately in the binary system and we can get the number in integer. If we k then the number of bits may not an integer or not accurate enough.

Question 5:

It is not a good choice to increase the value of k to 2048. It is because 2048 is much larger than 512, and it may take a quite long time for image compression and still in a quite large file size even after compression

Part two:

Original image:

一張含有 文字, 個人 的圖片

自動產生的描述一張含有 文字, 鳥, 室外, 直立的 的圖片

自動產生的描述

一張含有 文字 的圖片

自動產生的描述

K=16:

一張含有 文字 的圖片

自動產生的描述一張含有 文字, 鳥, 水鳥 的圖片

自動產生的描述

一張含有 文字 的圖片

自動產生的描述

K=32:

一張含有 文字, 個人 的圖片

自動產生的描述一張含有 文字, 鳥, 室外, 直立的 的圖片

自動產生的描述

一張含有 文字 的圖片

自動產生的描述

K=64:

一張含有 文字, 個人 的圖片

自動產生的描述一張含有 文字, 鳥, 室外, 水鳥 的圖片

自動產生的描述

一張含有 文字 的圖片

自動產生的描述

K=128:

一張含有 文字, 個人 的圖片

自動產生的描述一張含有 文字, 鳥, 室外, 直立的 的圖片

自動產生的描述一張含有 文字 的圖片

自動產生的描述

K=256:

一張含有 文字, 鳥, 室外, 水鳥 的圖片

自動產生的描述一張含有 文字, 個人 的圖片

自動產生的描述

一張含有 文字 的圖片

自動產生的描述

K=512:

一張含有 文字, 個人 的圖片

自動產生的描述一張含有 文字, 鳥, 室外, 水鳥 的圖片

自動產生的描述

一張含有 文字 的圖片

自動產生的描述

|  | K=16 | K=32 | K=64 | K=128 | K=256 | K=512 |
| --- | --- | --- | --- | --- | --- | --- |
| MSE  (Woman) | 0.004596194653197 | 0.003619252351838 | 0.002853062148135 | 0.002203940095629 | 0.001690755470065 | 0.001274034907125 |
| MSE  (Bird) | 0.001557193733203 | 0.001121028796214 | 8.451351028028297e-04 | 6.580169378051447e-04 | 5.072071094771502e-04 | 3.741179836278663e-04 |
| MSE  (House) | 0.002175346563031 | 0.0016592269275593 | 0.001336235909149 | 0.001107684314683 | 8.932483358293410e-04 | 7.318496503638759e-04 |

MSE of three images for different value of k to perform k-means:

MSE of three images for different value of k to perform k-means:

(Correct nearest to 3sig. fig.)

|  | K=16 | K=32 | K=64 | K=128 | K=256 | K=512 |
| --- | --- | --- | --- | --- | --- | --- |
| MSE  (Woman) | 0.00460 | 0.00362 | 0.00285 | 0.00220 | 0.00169 | 0.00127 |
| MSE  (Bird) | 0.00156 | 0.00112 | 8.45x10-4 | 6.58x10-4 | 5.07x10-4 | 3.74x10-4 |
| MSE  (House) | 0.00218 | 0.00166 | 0.00134 | 0.00111 | 8.93x10-4 | 7.32x10-4 |

According to the above picture and the MSE from the table, we can conclude that when the value of k is smaller, then the MSE will become larger.

When the k is smaller, the compressed image will have a lower quality which means higher MSE, and smaller k will have lower visual quality.

Thus, it means that a higher value of k will have better visual quality after compression. Therefore, the value of k will affect the size of MSE, and the size of MSE will also affect the visual quality for image compression.

File size of the image:

|  | Original | K=16 | K=32 | K=64 | K=128 | K=256 | K=512 |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Woman | 55KB | 51KB | 53KB | 54KB | 54KB | 54KB | 54KB |
| Bird | 36KB | 34KB | 34KB | 34KB | 34KB | 35KB | 35KB |
| House | 49KB | 45KB | 45KB | 46KB | 46KB | 46KB | 46KB |

From the above table, we can know that the size of the compressed image will be affected by the value of k, which means when the value of k is smaller, then the file size of the compressed image is smaller.

Conclusion:

To sum up, the value of k can be affecting the file size and the visual quality of the compressed image. For examples, a smaller value of k, smaller file size and worser visual quality, and vice versa.

Advantages of using clustering for compression:

1. It is quite simple to understand and implement
2. It is efficient and fast
3. It is suitable for large data sets

Disadvantages of using clustering for compression:

1. It may difficult to define the number of clusters by our own
2. It may difficult to define the initial cluster for lower MSE as different initial cluster will have different MSE.