CS 6375.001
Machine Learning

By

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ASSIGNMENT – 5

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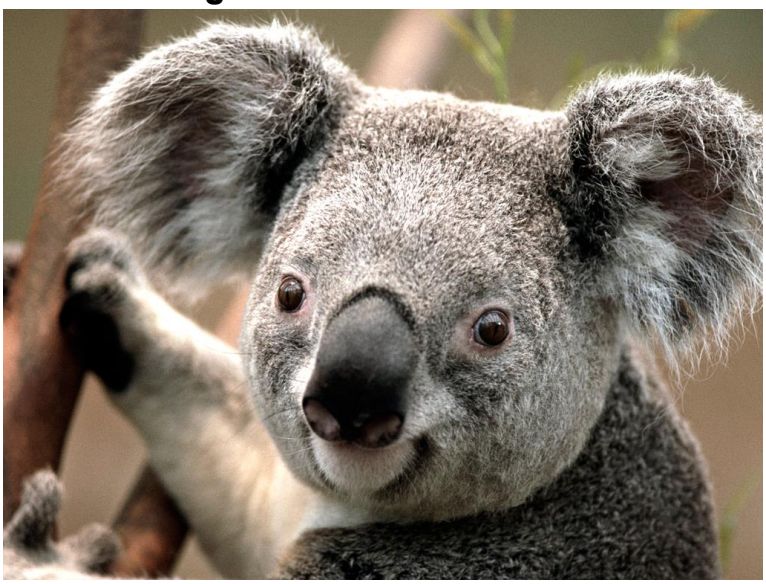
In this problem, you will use K-means clustering for image compression. Two image files provided in the elearning. The assignment task is to display the images after data compression using K-means clustering for different values of K (2, 5, 10, 15, 20). Is there a tradeoff between image quality and degree of compression? What would be a good value of K for each of the two images?



Koala.jpeg

Penguins.jpeg

Above given are the original images.

Answer:

First, we will create program where we will dynamically take input values like image name, K value and Iteration value. Using these values we will perform k-means algorithm.

First, we will covert the image into an array 3-Dimension. After Converting it we will perform k-means algorithm on it.

For the K-means algorithm we will first initialize the centroids K points defined from input, and then we will find closest centroids after that we will compute the mean of all these centroids. We will iterate these 2 functions number of times as defined in input. After that we will we find the K-means for centroids and return centroids and image array.

From this image Array we will remake the image which will be compressed.

Thus, we will be able to compress image with use of K-means function.

I have taken 5 different values of K = [2,5,10,15,20].

Also 3 different Iteration Values ITR = [5,10,20]

Using above values I have compressed Koala and Penguin Images.

For Koala.jpeg

For ITR = [5]

K-Values/Size	Size Before Compression	Size After Compression	Compression Ratio
K = 2	762.5302734375 KB	62.8310546875 KB	12.13
K = 5	762.5302734375 KB	162.3203125 KB	4.7
K = 10	762.5302734375 KB	269.6611328125 KB	2.83
K = 15	762.5302734375 KB	391.595703125 KB	1.94
K = 20	762.5302734375 KB	455.8056640625 KB	1.67

K = 2

K = 5

K = 10

K = 15

K =20

For ITR = [10]

K-Values/Size	Size Before Compression	Size After Compression	Compression Ratio
K = 2	762.5302734375 KB	63.1279296875 KB	12.07
K = 5	762.5302734375 KB	160.4599609375 KB	4.75
K = 10	762.5302734375 KB	285.650390625 KB	2.67
K = 15	762.5302734375 KB	375.6181640625 KB	2.03
K = 20	762.5302734375 KB	454.599609375 KB	1.67

K = 2

K = 5

K = 10

K = 15

K =20

For ITR = [20]

K-Values/Size	Size Before Compression	Size After Compression	Compression Ratio
K = 2	762.5302734375 KB	64.689453125 KB	11.78
K = 5	762.5302734375 KB	162.73828125 KB	4.68
K = 10	762.5302734375 KB	288.853515625 KB	2.63
K = 15	762.5302734375 KB	404.5224609375 KB	1.88
K = 20	762.5302734375 KB	456.5048828125 KB	1.67

K = 2

K = 5

K = 10

K = 15

K =20

For Penguins.jpeg

For ITR = [5]

K-Values/Size	Size Before Compression	Size After Compression	Compression Ratio
K = 2	759.6044921875 KB	34.6767578125 KB	21.9
K = 5	759.6044921875 KB	81.4951171875 KB	9.32
K = 10	759.6044921875 KB	143.9384765625 KB	5.27
K = 15	759.6044921875 KB	207.4697265625 KB	3.66
K = 20	759.6044921875 KB	284.859375 KB	2.66

K = 2

K = 5

K = 10

K = 15

K =20

For ITR = [10]

K-Values/Size	Size Before Compression	Size After Compression	Compression Ratio
K = 2	759.6044921875 KB	34.3603515625 KB	22.1
K = 5	759.6044921875 KB	73.3896484375 KB	10.35
K = 10	759.6044921875 KB	160.3349609375 KB	4.73
K = 15	759.6044921875 KB	235.1416015625 KB	3.23
K = 20	759.6044921875 KB	272.50390625 KB	2.78

K = 2

K = 5

K = 10

K = 15

K =20

For ITR = [20]

K-Values/Size	Size Before Compression	Size After Compression	Compression Ratio
K = 2	759.6044921875 KB	35.220703125 KB	21.56
K = 5	759.6044921875 KB	83.845703125 KB	9.05
K = 10	759.6044921875 KB	176.2490234375 KB	4.31
K = 15	759.6044921875 KB	210.2119140625 KB	3.61
K = 20	759.6044921875 KB	273.7529296875 KB	2.77

K = 2

K = 5

K = 10

K = 15

K =20

Observation:

Here we can observe that the colors in both images differ by a lot the Koala image has colors so its compression size not as less as the penguin's image. The penguin's more colors than the Koala image so its compression size of penguins is less than Koala image.

Also, as the K value increases the image quality increases as we can see more colors in the image. Also, as the value of iteration increases the better compression of the image is done.

Is there a tradeoff between image quality and degree of compression?

Yes. 'K' represents the degree of compression. Smaller value of K means fewer clusters, and hence fewer colors to represent the image. Therefore, for smaller 'K' values, a lot of details in the image are compromised, which produces a lower image quality. Higher 'K' values show more colors due to a larger number of clusters, and hence produces a better-quality image. However, higher values of K take longer to execute.

What would be a good value of K for each of the two images?

For the given images, Koala.jpg and Penguins.jpg, reasonably good images are seen when k lies between 15 and 20. The output file shows the reasonable compression ratio and most colors which are identifiable.

For Koala.jpg, K=10 gives an average compression ratio of 2.6, which is close to that for K=15 and K=20. Thus, K=10 would be a good choice for K.

For Penguins.jpg, K= 15 gives an average compression ratio of 3.6, which is close to that for K=20. Thus, K=15 would be a good choice for K.