

EE5175: Image Signal Processing

Lab-11

k-means Clustering

In all the following questions, perform K -means clustering on the two input images (`car.png` and `flower.png`) for $K = 3$ clusters. Use only Euclidean distance as the distance measure for all iterations. Basic data units to be clustered are vectors containing pixel data, i.e., $[r \ g \ b]$. Perform 5 iterations of the algorithm. To visualize the output of k -means clustering, replace each pixels in the input image with the cluster center it belongs to and display the resulting image.

a. Perform K -means clustering with initial cluster means as follows:

- c_1^{init} - $[255 \ 0 \ 0]$
- c_2^{init} - $[0 \ 0 \ 0]$
- c_3^{init} - $[255 \ 255 \ 255]$

b. Perform K -means clustering on both images using random initialization of cluster means. Generate 3 random vectors of size 1×3 that are sampled from uniform distribution in $[0 \ 255]$ and use them as the cluster centers to begin the K-means with. Perform K-means clustering using N such initializations. The cost corresponding to the output of k -means clustering can be computed as

$$C = \sum_{i=1}^P dist(p_i, c_k)$$

where $dist$ measures the Euclidean distance between a pixel color value p_i and its cluster center c_k , and P refers to the total number of pixels in the image. Use $N = 30$ (which means that you will repeat K -means clustering with 30 different random initializations), and find the cost corresponding to the output in each case. Among the 30 values that you got after repeatedly running the K -means, find the output corresponding to the lowest and highest value of C . Comment on your observations.

Note:

- In this assignment, you will be working with color images `car.png` and `flower.png`.
- Each pixel in a color image has (R,G,B) components. The matrix containing color image data is a 3 dimensional matrix (e.g. - `height*width*3`). So `[img(m,n,1) img(m,n,2) img(m,n,3)]` will give the R,G,B components at `(m,n)` pixel respectively.
- At the end of K -means, if any cluster turned out to be empty, use only the non-empty clusters to display the image.