EE5175: Image Signal Processing

Lab-9

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.