

**Question 1:** Segmentation using K-means based clustering **[50 marks]**

For the images of apples shared in .\Q1-images\, implement K-means clustering based segmentation when:

- A. 3-dimensional color space is used for clustering
- B. 5-dimensional space is used for clustering, where first 3 dimensions are color space and extra two dimensions correspond to X and Y dimension of the image.

Draw a 3D scatter plot for part (A), illustrating the grouping (show only for 2or4objects.jpg). Also, compare and contrast the results of part (A) and part (B). Set value of K appropriately based on number of objects in the shared images.

**Question 2:** Mean-shift clustering **[30 marks]**

For the images of ice creams shared in .\Q2-images\., perform mean-shift clustering to segment the objects. Perform segmentation in such a way that the ice cream scoop in the shared image is grouped in the least number of segments. You may use in-built functions/toolboxes. Explain the choice of parameters.

**Question 3:** Face Detection (implement any 2; **bonus:** implement all 3) **[40 marks]**

For the face images in .\Q3-faces\., implement any 2 of the following methods for face detection. If you require more face images for training, you may use images from [\[link\]](#).

- A. **Skin color thresholding:** Choose an appropriate pixel value range for skin (use your "googling" skills). Threshold the pixels values based on this range to obtain skin regions. (*Hint:* To perform this operation, is RGB a good color space?).
- B. **Adaboost face detector:** Detect faces using any 15 rectangular features.
- C. **Seeded segmentation:** For this, manually select one pixel from the face region. Recursively analyze the neighborhood pixels average using average running intensity of skin by setting an appropriate tolerance.

**Question 4:** Bag of Visual Words **[40 marks]**

Using bag of words model, find the classification accuracy on CIFAR-10 dataset (using predefined train-test splits) with:

- 1) HOG Features
- 2) LBP Features

Explain your results along with a brief explanation of the above feature extraction algorithms. You should also show the difference by plotting the features for some sample images. Note: Implement LBP and HOG from scratch!

**[VIVA+Report: 20+20]**

**Submission Policy and Requirements**

- 1. Programming languages: python+opencv.
- 2. Show the outputs of segmentation in reports where possible.
- 3. Apart from question 2, all questions and their parts should be done from scratch. Calling basic numpy and mathematical functions are allowed.
- 4. Do not share the AR database. The database is provided to you only for assignment purposes.