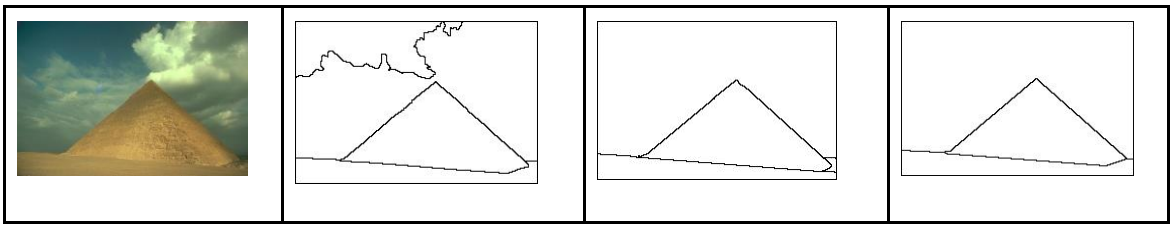
Assignment #2 Image Segmentation (Total 60 Points)

Problem Statement

We intend to perform image segmentation. Image segmentation means that we can group similar pixels together and give these grouped pixels the same label. The grouping problem is a clustering problem. We want to study the use of K-means on the Berkeley Segmentation Benchmark. Below we will show the needed steps to achieve the goal of the assignment.

1. Download the Dataset and Understand the Format (5 Points)
    a. We will use Berkeley Segmentation Benchmark
    b. The data is available at the following link. http://www.eecs.berkeley.edu/Research/Projects/CS/vision/grouping/BSR/BSR_bsds500.tgz.
    c. The dataset has 500 images. The test set is 200 images only. We will report our results on the first 50 images of the test set only.

2. Visualize the image and the ground truth segmentation (5 points)
    a. Write your own function that reads an image and display an image with its associated ground truth segmentation(s).



3. Segmentation using K-means (15 Points) (your implementation)

    Every image pixel is a feature vector of 3-dimension {R, G, B}. We will use this feature representation to do the segmentation.

    a. We will change the K of the K-means algorithm between {3,5,7,9,11} clusters. You will produce different segmentations and save them as colored images. Every color represents a certain group (cluster) of pixels.

b. We will evaluate the result segmentation using **F-measure**, **Conditional Entropy** for image I with M available ground-truth segmentations. For a clustering of K-clusters you will report your measures M times and the average of the M trials as well. Report average per dataset as well.
c. Display good results and bad results for every configuration in a, b. Discuss them.

4. Big Picture (10 Points)

a. Select a set of five images and display their corresponding ground truth against your segmentation results using K-means at K=5. Comment on the results.
b. Select the same five images and display their corresponding ground truth against your segmentation results using Normalized-cut for the 5-NN graph, at K=5. Comment on the results.
c. Select the same five images and contrast your segmentation results using Normalized-cut for the 5-NN graph, at K=5 versus using K-means at K=5. Comment on the results.

5. Extra (10 points)

a. In the previous parts, we used the color features RGB. We did not encode the layout of the pixels. We want to modify that for K-means clustering to encode the spatial layout of the pixels.
    i. Suggest a way to modify the feature vector to include spatial layout.
    ii. Contrast the results you obtained in 4.a to the results you obtained by considering the spatial layout.

6. Submission Notes

a. Work in groups of 3-4 students.
b. **[15 Points]** You are required to submit a clear and detailed report [in PDF format] illustrating every step in the assignment.

Good Luck

Prof. Dr. Marwan Torki

Eng. Abdelrahman Wael
Eng. Ismail El-Yamany