

Homework 10, due March 27th, 11:59pm

March 21, 2024

Again, you are required to attach to your report the code that you implemented for each problem, as text, not as picture. If you use some code from the web, also mention in your report where you obtained the code from.

1. Load the image `scene2.jpg` from Canvas as a $82 \times 128 \times 3$ array. Normalize the image by dividing it by 255. We will cluster the $82 * 128 = 10496$ pixels using spectral clustering.

Construct an affinity matrix A between the pixels, with

$$A(i, j) = \exp(-||I(i) - I(j)||^2 / \sigma^2)$$

if pixels i and j are neighbors (left, right, top or down), otherwise zero. Here $I(i) = (R(i), G(i), B(i))$ is the RGB triplet of values of pixel i of the image I and a value of $\sigma = 0.1$ works fine.

Implement the spectral clustering algorithm discussed in the Clustering section using the affinity matrix A .

Use sparse matrices and sparse SVD (e.g. `scipy.sparse.linalg.svds`) for speed.

- a) Display the obtained clustering with 10 clusters as a 82×128 label image. (4 points)
- b) Construct a 82×128 color image where for each cluster you compute the means of the R, G, and B values of the pixels of that cluster and place that mean at all locations of the pixels from this cluster. (2 points)
- c) Repeat points a) and b) with 20 clusters. (3 points)