Segmentation using KMeans Clustering

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1 K-Means Segmentation of Color Image

Given an input color image I with dimensions $H \times W \times C$, where H is the height, W is the width, and C is the number of color channels (usually 3 for RGB).

K-Means Clustering Algorithm

Initialization:

- Choose the number of clusters K.
- Initialize K cluster centroids $\mathbf{c}_1, \mathbf{c}_2, \ldots, \mathbf{c}_K$ randomly or using some other method.

Repeat until convergence:

1. Assign each pixel (i, j) to the nearest centroid:

$$\text{cluster}(i, j) = \arg\min_k \|\mathbf{I}(i, j) - \mathbf{c}_k\|^2$$

2. Recalculate centroids for each cluster k:

$$\mathbf{c}_k = \frac{1}{N_k} \sum_{(i,j) \in \text{cluster}_k} \mathbf{I}(i, j)$$

   where N_k is the number of pixels in cluster k.

3. Check for convergence. If the centroids have not significantly changed, stop.

Segmented Image

The segmented image is created by assigning each pixel to the cluster with the nearest centroid. The pixel values are replaced with the centroid values of their respective clusters.

Results

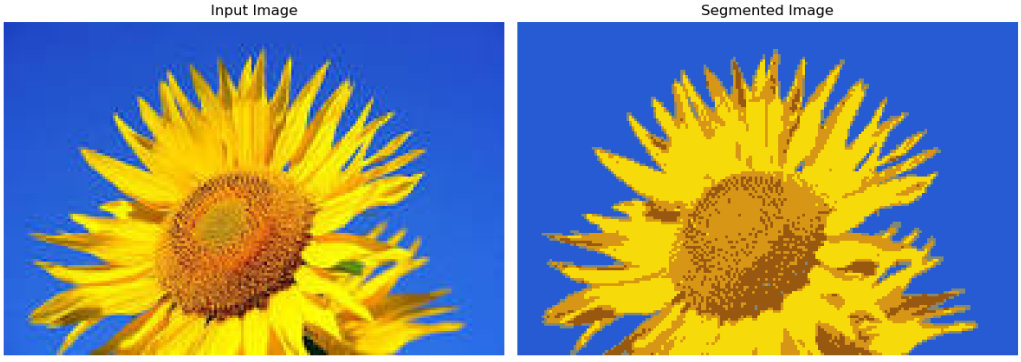

Figure 1: KMeans Segmentation