BIRZEIT UNIVERSITY
Electrical and Computer Engineering Department
First Semester, 2023/2024
Intelligent Systems Lab - ENCS5141
Assignment #3: Image Segmentation with Clustering Algorithms
Submission deadline: 12.01.2024

Background

Image segmentation is a crucial task in computer vision which involves partitioning an image into multiple parts or regions, often based on the characteristics of the pixels in the image. Image segmentation has many applications including background subtraction, object detection, and scene understanding.

Objective

This case study aims to explore and compare the effectiveness of the clustering algorithms we discussed in the lab - K-means, Gaussian Mixture Model (GMM), and DBSCAN - in the context of image segmentation on a set of diverse images.

Dataset

Evaluate the clustering algorithms using a collection of 4 to 8 RGB images depicting various scenes and objects.

Tasks

Compare the following clustering algorithms on image segmentation: K-means, Gaussian Mixture Model (GMM), and DBSCAN. Perform both qualitative assessment based on the quality of the clustered images, and quantitative evaluation using appropriate metrics. Note that, depending on the images experimented with, ground-truth clustering may not be available.

Experiment with different number of clusters for k-means and GMM. Tune hyperparameters for DBSCAN.

For the comparison study the impact of the following:

- Feature Space: in the lab, we conducted image segmentation in the RGB space. For this case study, you have to design two setups: one that uses the RGB space, whereas for the second, augment the RGB channels with two additional features that correspond to the x-y coordinates of the pixel.

- Data Preprocessing: study the impact of standardizing the features before clustering.

Report

Write a comprehensive report that summarizes the results of your comparison on the different setups. Make sure to visualize, comment on and interpret the results. Write a conclusion to summarize your findings. No need for a theoretical background about the tested algorithms.

To make things easier for you, you can prepare the report in a jupyter notebook format. But make sure to include well-commented code snippets alongside your explanations.