**AIN432 Project Report:**

**K-Means Clustering for Image Segmentation**

**Overview**

In this project, we applied K-Means clustering to perform image segmentation using pixel-level and superpixel-level features. The goal was to explore the effectiveness of k-means clustering in partitioning images into distinct segments, based on different feature representations.

**Approach**

1. **Data Preprocessing:**

The raw images were resized to a standard size (1024x1024) to ensure consistency. Pixel-level and superpixel-level features were extracted from the resized images.

1. **Feature Extraction:**

For pixel-level features, the RGB color and spatial location features were extracted. Superpixel-level features included the mean RGB color values, RGB color histograms, and mean Gabor filter responses.

A graph of a number of colored lines

Description automatically generated with medium confidenceA graph of a graph

Description automatically generated with medium confidence

A close-up of a basket of food

Description automatically generated

**A chart of a graph

Description automatically generated with medium confidenceA chart of a graph

Description automatically generated with medium confidenceA close-up of a screen

Description automatically generated**

*Others can be found in GitHub and Google Drive*

1. **K-Means Clustering:**

A custom k-means clustering algorithm is implemented to cluster the extracted features. The elbow method was used to determine the optimal number of clusters.

1. **Visualization:**

Clusters were visualized on the original images, providing insights into the effectiveness of segmentation.

**Results**

1. **Elbow Method Analysis:**

The elbow method was used to determine the optimal number of clusters for both pixel- and superpixel-level features.

A graph with a line

Description automatically generatedA graph with blue dots

Description automatically generated

A graph with a line

Description automatically generatedA graph with a line

Description automatically generated

*Others can be found in GitHub and Google Drive*

1. **Pixel-Level Clustering:**

Pixel-level features were clustered using a custom k-means algorithm. The results were visualized for different cluster numbers, and the impact of the number of clusters on segmentation quality was analyzed.

A close up of a cake

Description automatically generatedA hand holding a cake

Description automatically generatedA close-up of a cupcake

Description automatically generatedA close-up of a cupcake

Description automatically generated

*Others can be found in GitHub and Google Drive*

1. **Superpixel-Level Clustering:**

Superpixel-level features were clustered using a custom K-means algorithm. Visualizations show the segmentation results for varying cluster numbers.

**A hand holding a chocolate cake

Description automatically generatedA hand holding a cake

Description automatically generatedA cupcake with a red and white frosting

Description automatically generatedA cupcakes in a wrapper

Description automatically generated**

*Others can be found in GitHub and Google Drive*

**Conclusion**

In conclusion, the application of k-means clustering to image segmentation demonstrated promising results. The project provided insights into the impact of different feature representations and cluster numbers on segmentation quality. The custom K-means implementation, coupled with visualization techniques, offered a comprehensive understanding of the segmentation outcomes.