Task 1: Starting off by uploading image coins form skimage library that is a greyscale image. The image has several coins placed in the background. I have applied Otsu’s threshold method that finds an optimal global threshold by maximizing inter-class variance. Then, I have plotted the results. The threshold value T=107.

We can see the distinction between coins and the background. We can also notice the shades and textured areas of the coins in purple. And even though the background appears as uniform we can see the contrast in colors which by Otsu’s method is plotted by the change of color from yellow to purple. But that is also a limitation of the method because for coins that are poorly lit the texture may not be defined well or not at all.

Task 2: For the unsupervised method I have tried K-Means (commented out) and GMM.

The image chosen is lily by the same library and is an RGB image. We reshape it into a 2D array where each row is a pixel and each column is a color channel. We have applied GMM clustering with 3 components based on pixels colors. The result is reshaped back into an image that shows cluster labels for each pixel. GMM considers probability distributions of pixel values, making it more flexible than K-Means (which uses hard assignments). It works well when the image has distinct color regions. This method may converge to a local optimum. Results may not correspond exactly to objects, the clusters are based on color similarity, not semantic meaning.

Task 3: For this task we had to choose between annotated labels or classifier for the supervised segmentation method.

The solution is based on annotated labels. The image used is coins. We have created two labels (squares) to distinguish the background from the coins. We’ve then used LDA classification method that works with labeled data. This method separates the classes based on pixel features. Features include intensity and edge filters, more contextual/structural information than raw pixel values. It would be more accurate for semantic segmentation if we had provided the ground truth and used the classifier.

Task 4: For the same image (coins) I have applied GMM so we call tell the difference between an unsupervised and a supervised method (LDA). GMM as I’ve mentioned above fits a probabilistic model and is about discovering clusters in raw pixel intensity. It has no prior knowledge of what the clusters mean, it just groups similar pixels, so it is based on data distribution. It is good for discovering natural groupings in the data. LDA on the other hand uses multiple features such as intensity and edge. In this case we have applied manual annotations (may be considered as the limitation) and only labeled regions are used to distinguish the background from the coins. At GMM all pixels are used. GMM automatically finds clusters but in general they may not correspond to meaningful classes, LDA can learn specific background classes based on our input. GMM may be faster to set up, but at LDA even though we have to deal with annotations it is more flexible because of the features used. We mostly use unsupervised to explore structure and supervised for precise segmentation.