

# Overview

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In order to perform K-Means clustering, I separated out the index positions for each pixel using np.indices, as well as separating each R, G, B value at any given X, Y position. The index positions need to be a predictor in the clustering algorithm in order to add weight to pixels which are closer together by Euclidian distance. I also included R, G, B values after applying an image filter using cv2.filter2D in order to smooth out the image. This helped minimize some of the noise in the image when determining the clusters. Results below:



Original Image



K-Means with 2 Clusters



K-Means with 4 Clusters



K-Means with 2 Clusters (and smoothing predictor)



K-Means with 4 Clusters (and smoothing predictor)

Here we can see that the smoothing allowed the clustering to better identify the change from the trees in the background and the grass on the field. Overall the results were good, however, the roof of the house as well as portions of the trees were considered to be in the same cluster as grass. The roof cluster is likely the result of the color being closer in similarity to the trees above than the house below which is white.



Original Image



K-Means with 2 Clusters



K-Means with 4 Clusters



K-Means with 2 Clusters (and smoothing predictor)



K-Means with 4 Clusters (and smoothing predictor)

Here we can see that all tests performed fairly well. By adding an additional two clusters, the leaves were able to be clustered separately from the grass. Furthermore, the smoothing allowed better clustering on what is and isn't a leaf. This is due to the noise within the grass being smoothed out leading to better defined regions of grass vs leaves.



Original Image



K-Means with 2 Clusters



K-Means with 4 Clusters



K-Means with 2 Clusters (and smoothing predictor)



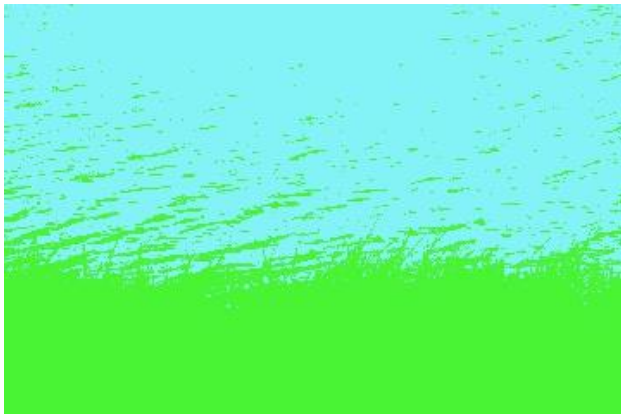
K-Means with 4 Clusters (and smoothing predictor)

Here we can see that the best performance was with 4 clusters and no smoothing. The reason smoothing was problematic was that the leaves on the left are very similar to the grass around it. By smoothing it out, it becomes harder to distinguish it from the grass below. However, most tests performed fairly well with some slight difficulty distinguishing the trees from the background vs. grass that has shade on it (due to color similarity).

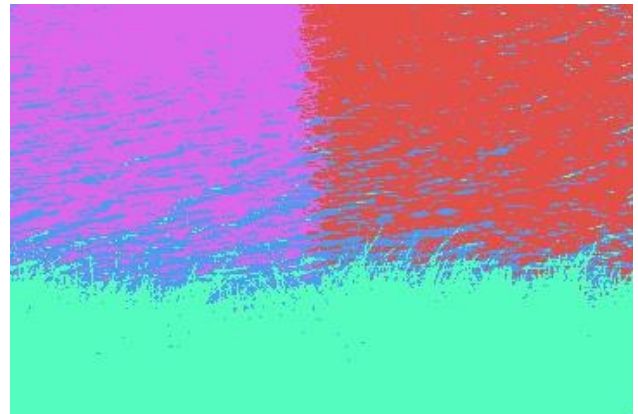




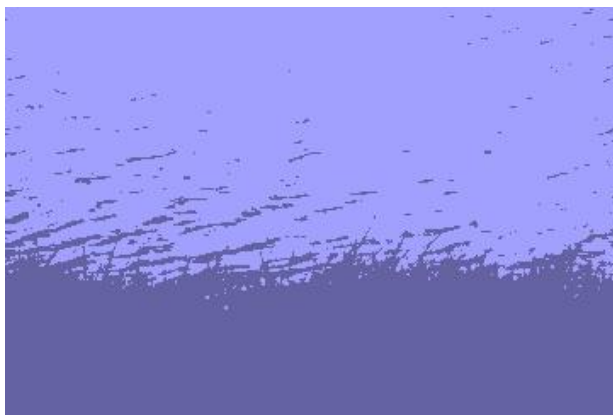
Original Image



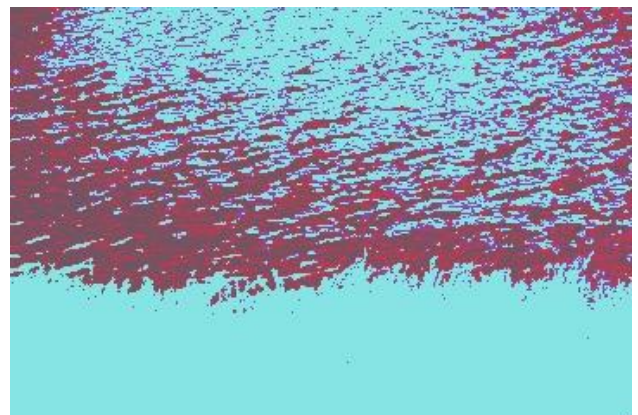
K-Means with 2 Clusters



K-Means with 4 Clusters



K-Means with 2 Clusters (and smoothing predictor)



K-Means with 4 Clusters (and smoothing predictor)

This image proved to be difficult in that the waves produce darker colors which can be placed in the grass cluster. Smoothing in this case improved the results for 2 clusters, but made it significantly worse for 4 clusters. While this result was unexpected, one possibility is that there was a stronger difference between portions of the waves than the grass and middle part of the water. Fortunately, the results with 4 clusters and no smoothing were very good.



Original Image



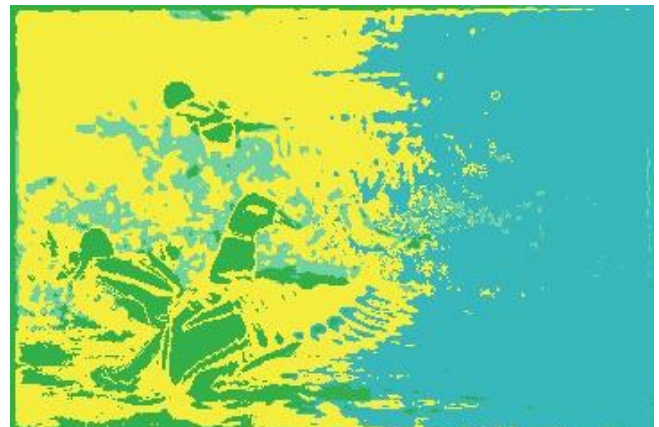
K-Means with 2 Clusters



K-Means with 4 Clusters



K-Means with 2 Clusters (and smoothing predictor)



K-Means with 4 Clusters (and smoothing predictor)

This is the worst performing result, which seemed to prefer clustering other objects such as portions of the duck and water before defining a cluster best fit for grass. By increasing the cluster count to 8 we can see better results: