CSCI 631 Homework 2

1. This homework consists of two codes. The first one is a K means algorithm implemented from scratch. I have implemented K Means on a dataset containing 782 datapoints. The algorithm carried iterations till the point when difference between two consecutive set of centroids is at least greater than an epsilon value. The resultant coloured graph shows that the implementation is quite accurate.
   K Means algorithm is the simplest of all the clustering algorithms. Because, it just iteratively calculates distance between two datapoints. However, it is not an efficient one. Since it calculates distances with every other centroid, it progresses very slowly for a large datasets.

   The second part of this homework contains image segmentation using K Means algorithm. The code for this part is present in 'VaidyaHitesh_hw2_segmentation.ipynb'. I have used scikit-learn library for implementing K Means on images. There are two approaches in this subsection. The first one is to convolve images with 48 different filters which come from LM filter bank. I perform convolution using scipy python library. The feature map generated as a result of convolution of image with these filters, is flattened further. K Means is applied on this feature map. The result obtained is reshaped back to the resolution of original image. This reshaped image is the output of the K Means algorithm which contains clusters of pixels. The clusters that form the desired object from source image are taken out and superimposed on the target image. The results obtained from implementation of this technique show that the accuracy of this operation depends on various factors like the color scheme used, number of clusters passed and the combination of clusters used while superimposing object on target image. LAB color scheme give the most accurate result as compared to RGB and HSV. The result obtained is still not 100% accurate and could be improved if a more sophisticated machine learning model like neural network is used for this task.

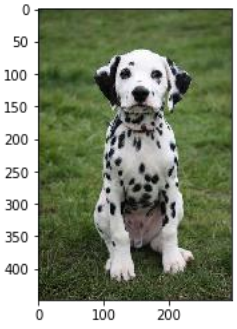
2. I have implemented my own version of K Means algorithm in this homework. The code for it is present in file, 'VaidyaHitesh_hw2_kmeans.ipynb'.

3. The source image and the transferred image are as followed,

   Source Animal: Dog

   Texture based segmentation:

   Source image

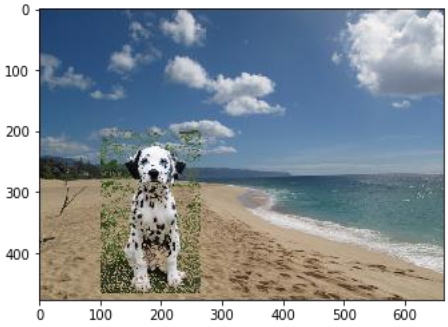
   

   Target image (Texture based)

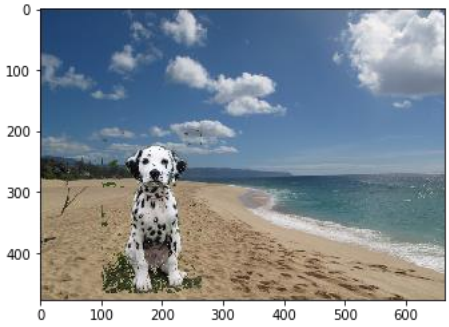
   

   Color based segmentation:

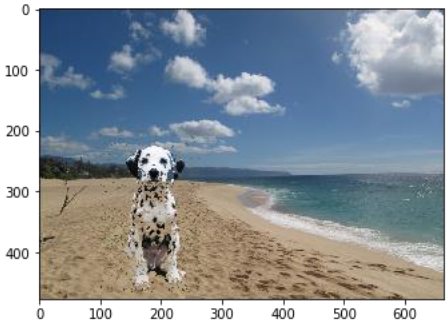
RGB colour scheme



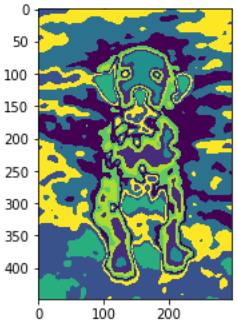
HSV colour scheme



LAB colour scheme



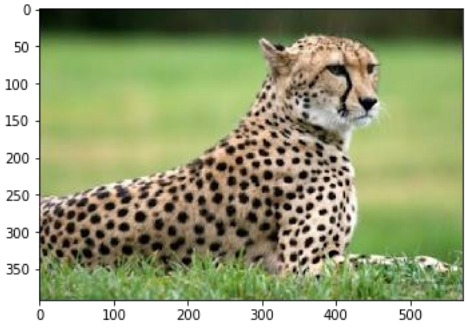
clustering output



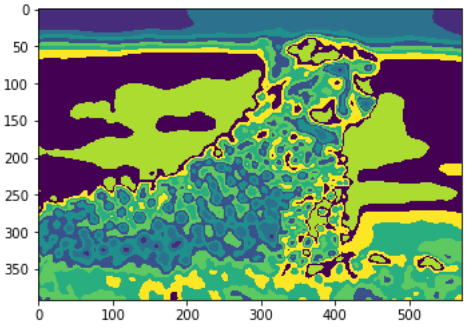
We can observe from the above images that texture based segmentation and RGB colour scheme based segmentation give somewhat similar results. In comparison, HSV gives better result and LAB colour scheme gives the best result out of all. Some more results are as follows,

Source animal: Cheetah

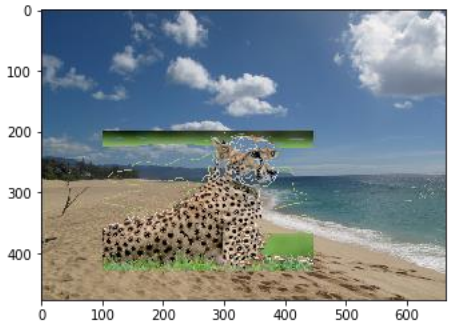
Source image



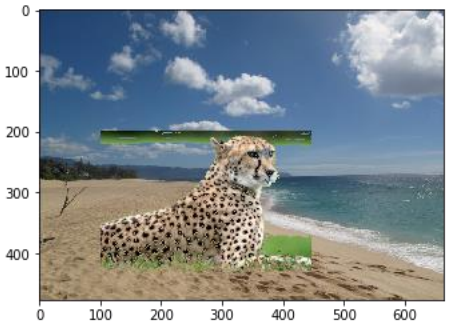
Clustering output



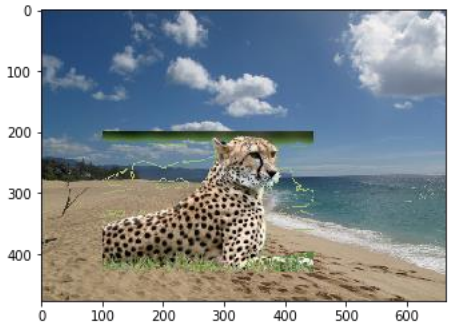
Texture based output



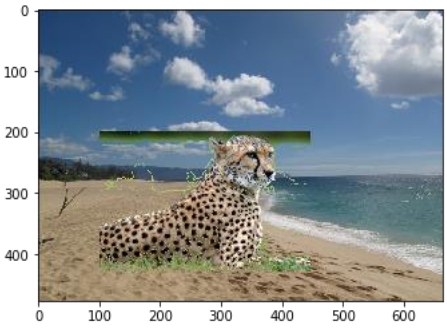
HSV colour scheme



RGB colour scheme

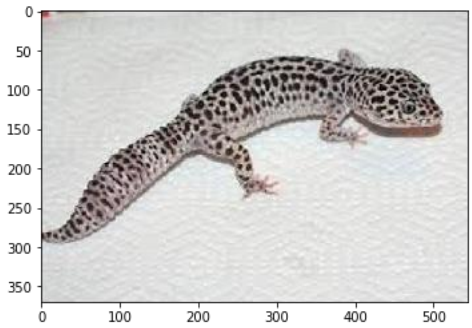


LAB colour scheme

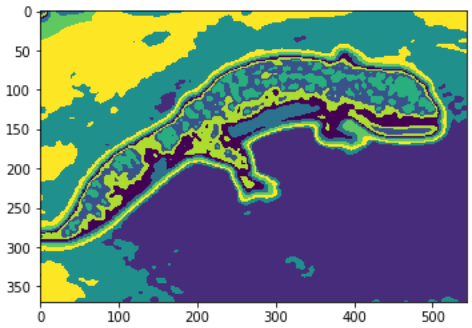


Source Animal: Gecko

Source image

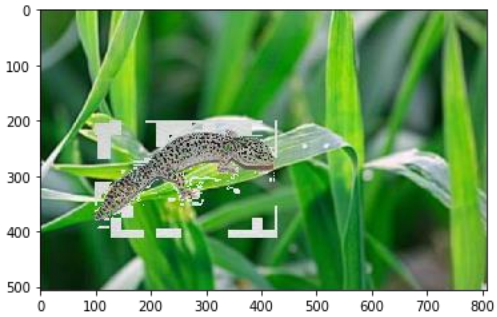


Clustering output

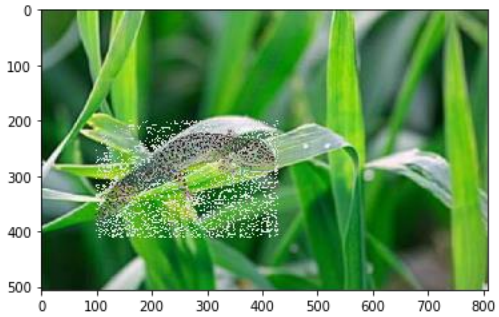


Texture based output

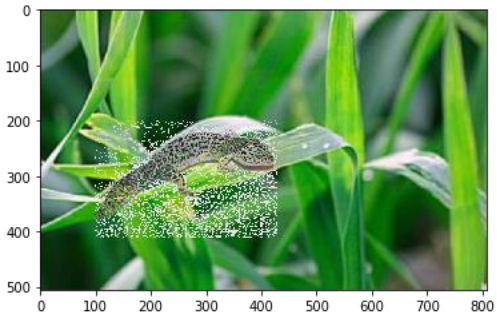
HSV colour scheme



RGB output



LAB colour scheme



4. The reason behind holes and artifacts from background being present in target image is, they get picked up by filters that capture texture in the image. The image of Gecko has lot of texture in the background, hence it gets captured as well by the LM filter bank. The image of Dog, had less texture in the background, therefore, not a lot of holes and artifacts were transferred to the target image. Also, the choice of number of clusters make a lot of difference. Depending on number of clusters, some pixels may get captured as noise in the segmented image. More the number of clusters, better is level of segmentation in the image. Hence, having more number of clusters helps to avoid background noise. The choice of clusters is one more reason behind which selection of pixels. With the right choice of clusters we could avoid transfer of noise in the target image.