[Image Segmentation]

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[Patterns Recognation]

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[Problem Statement]

We intend to perform image segmentation. Image segmentation means that we can group similar pixels together and give these grouped pixels the same label. The grouping problem is a clustering problem. We want to study the use of K-means on the Berkeley Segmentation Benchmark

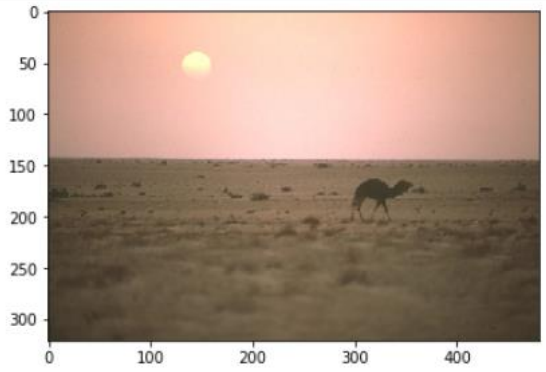
[Downloading and extracting the data]

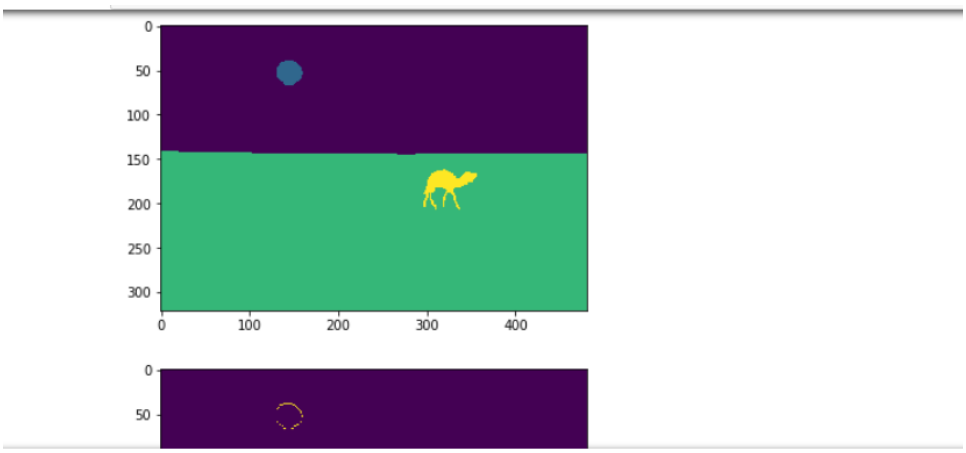
- I used the direct link to download the data.
- I did extract the data using tarfile.open function that is taken from the module tarfile.

[Visualize the image and the ground truth segmentation]

To use the images and visualize them I used a function that I created called ImageAndSegmentations that takes the image name and then changing the directory to the images file and uses imshow to display the image and then change the directory to whre the .mat files exist and saves the .mat file into a variable called mat from noticing the .mat file after printing it I noticed that the last index is used for gray or colored and the second index is used to display different ground truths .

```
In [1307]: img,mat = ImageAndSegmentations ("271031")
           hight = img.shape[0]
           width = img.shape[1]
```

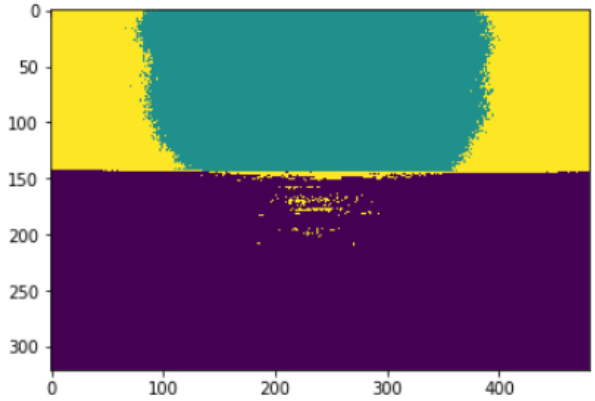




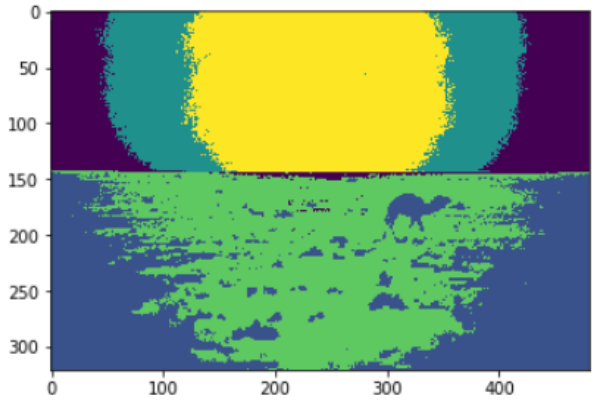
[Segmentation using K-means]

I did implement a kmeans algorithm by myself from scratches but I did use the sklearn built kmeans k means since its more optimized and faster and since our data is in shape of m x n x 3 we had to make just in 2 dimentions to be able to pass it to the k means . Fit so I made a function that reshapes to m*n x 3 that presents every pixel as an instance and did pass it to kmeasn I did apply for k – 3,5,7,9,11 and my results where as the following for the above picture

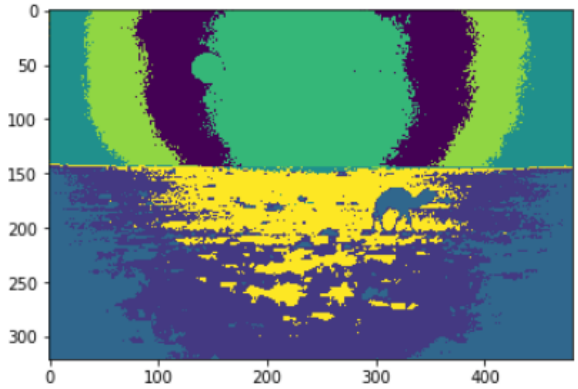
```
Number Of Clusters =  3
```



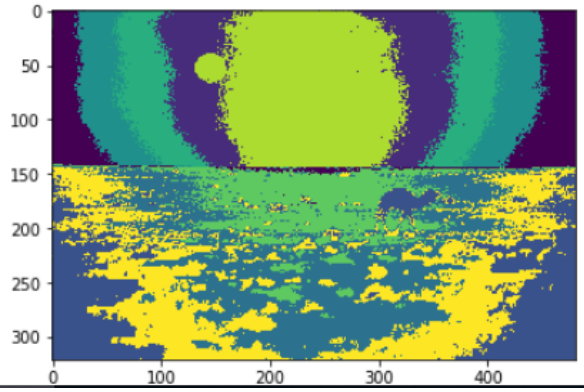

```
Number Of Clusters =  5
```



```
Number Of Clusters =  7
```




```
Number Of Clusters =  9
```



I also created functions to show the pixels in every cluster to use it later

And for the evaluations I used to built in function I did as well implemented the conditional entropy and I aslo did use the measure Homogeneity score and my results where as the following :

For f1 score :

```
0.2731718058820863
0.5447762644024327
0.8169895272699012
1.0888854346798271
1.3619989507839974
5
For K =  3 The F1 score is : 0.2723997901567995
0.1311196171009255
0.2620449349421312
0.39319045861101937
0.5241092998102344
0.6551771037752345
5
For K =  5 The F1 score is : 0.1310354207550469
0.21818511538137705
0.4342588454737987
0.616556887584925
0.8342886380269559
1.0523118373585665
5
For K =  7 The F1 score is : 0.2104623674717133
0.24569141391571298
0.4904048548908362
0.6200477976178911
0.8652469867423138
1.1109772605099708
5
For K =  9 The F1 score is : 0.22219545210199415
0.09262245710843843
0.18365166028717433
0.2850175840830047
0.37692761057247043
0.46945291805104894
5
For K =  11 The F1 score is : 0.09389058361020979
```

And for the homogeneous score :

```
0.8733079955292294
1.725557738507888
2.319846582455155
3.1809449286202613
4.0541528489512615
5
For K =  3 The Condetional Homogeneity Score is : 0.8108305697902523
0.8923307409902045
1.7603798555952412
2.3790651424419065
3.2577133143378254
4.150463354538529
5
For K =  5 The Condetional Homogeneity Score is : 0.8300926709077059
0.9022178086262579
1.77921349978615
2.4295563597280827
3.317822762519173
4.220653785852435
5
For K =  7 The Condetional Homogeneity Score is : 0.844130757170487
0.9056684059755549
1.7856557058504934
2.444157563537268
3.3360417698476765
4.242331714191624
5
For K =  9 The Condetional Homogeneity Score is : 0.8484663428383248
0.9068654571398073
1.7879629022604162
2.450000212954252
3.3428787777436497
4.250535751972663
5
For K =  11 The Condetional Homogeneity Score is : 0.8501071503945326
```

And for the condetional Entropy :

```
0.8733079955292294
1.725557738507888
2.319846582455155
3.1809449286202613
4.0541528489512615
5
For K =  3 The Condetional Homogeneity Score is : 0.8108305697902523
0.8923307409902045
1.7603798555952412
2.3790651424419065
3.2577133143378254
4.150463354538529
5
For K =  5 The Condetional Homogeneity Score is : 0.8300926709077059
0.9022178086262579
1.77921349978615
2.4295563597280827
3.317822762519173
4.220653785852435
5
For K =  7 The Condetional Homogeneity Score is : 0.844130757170487
0.9056684059755549
1.7856557058504934
2.444157563537268
3.3360417698476765
4.242331714191624
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For K =  9 The Condetional Homogeneity Score is : 0.8484663428383248
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1.7879629022604162
2.450000212954252
3.3428787777436497
4.250535751972663
5
For K =  11 The Condetional Homogeneity Score is : 0.8501071503945326
```