IMAGE COMPRESSION USING K-MEANS CLUSTERING

INTRODUCTION

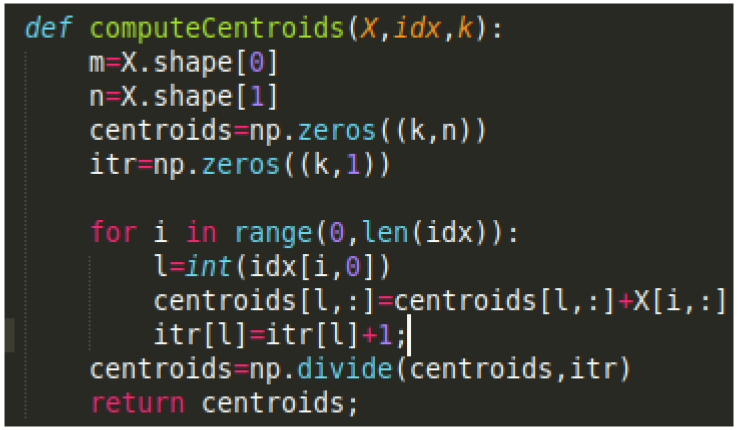
- K-means algorithm is used to cluster *n* objects based on attributes into k partitions where k<n.
- The grouping is done by minimising the sum of squares of distances between data and the corresponding cluster centroid.

PROBLEM STATEMENT

We are given a JPEG/png image. Our aim is to compress the image still retreiving majority of the attributes. We also try to prove our claim by running the compressed and the original images through an image classification program and observe the results. The image classification program is implemented using neural networks from the keras python library.

IMPLEMENTATION

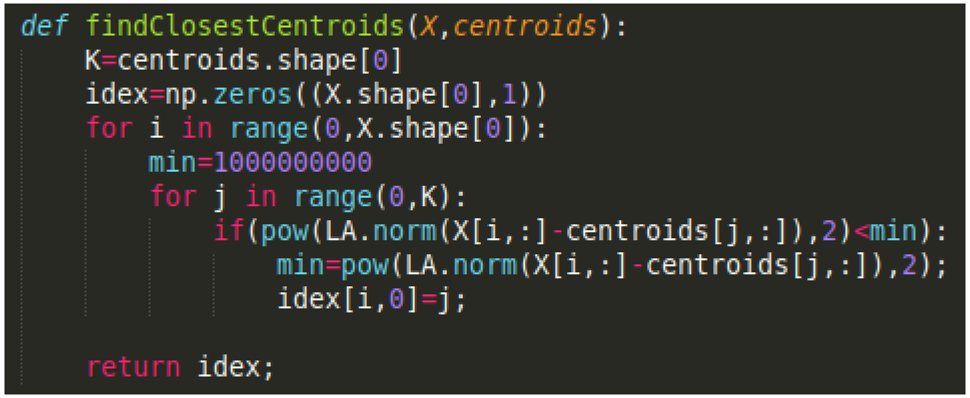
Compute centroids : Returns the new centroids by computing the means of the data points assigned to each centroid.



```python
def computeCentroids(X,idx,k):
    m=X.shape[0]
    n=X.shape[1]
    centroids=np.zeros((k,n))
    itr=np.zeros((k,1))

    for i in range(0,len(idx)):
        l=int(idx[i,0])
        centroids[l,:]=centroids[l,:]+X[i,:]
        itr[l]=itr[l]+1;
    centroids=np.divide(centroids,itr)
    return centroids;
```

Find closest centroid : Assigns the centroid memberships to each datapoint.

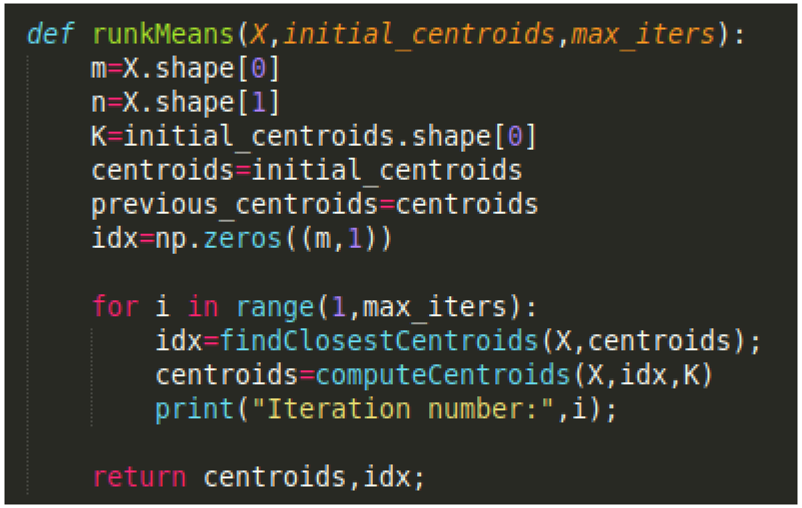


```python
def findClosestCentroids(X,centroids):
    K=centroids.shape[0]
    idex=np.zeros((X.shape[0],1))
    for i in range(0,X.shape[0]):
        min=1000000000
        for j in range(0,K):
            if(pow(LA.norm(X[i,:]-centroids[j,:]),2)<min):
                min=pow(LA.norm(X[i,:]-centroids[j,:]),2);
                idex[i,0]=j;

    return idex;
```

IMPLEMENTATION(cont.)

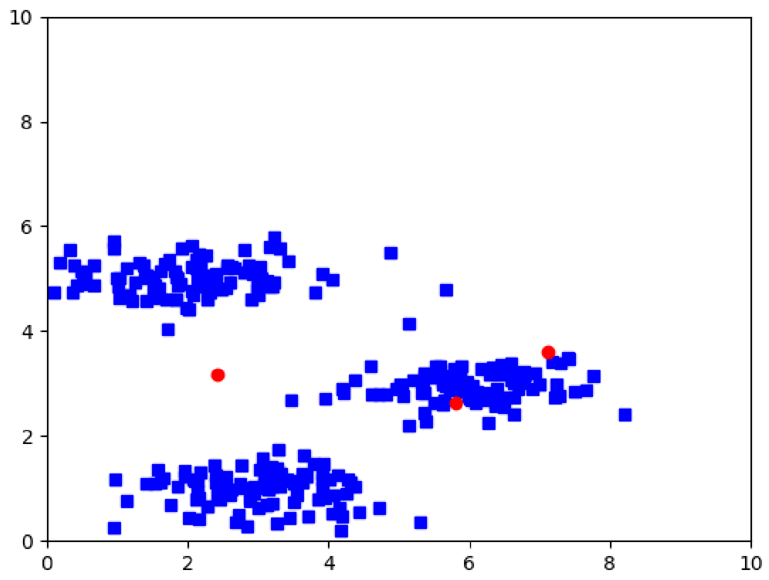
Run K-means : Implements the previous two functions for a fixed number of iterations to find the final centroids.



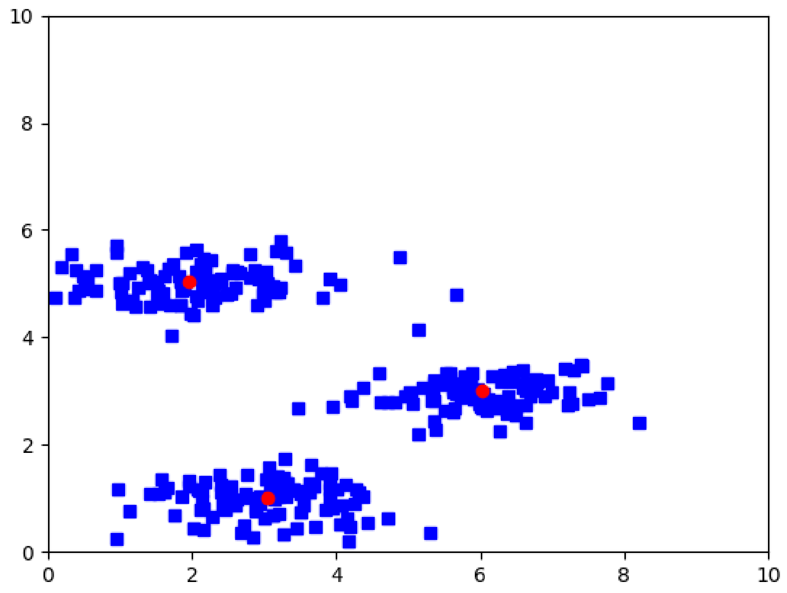
```
def runkMeans(X,initial_centroids,max_iters):
    m=X.shape[0]
    n=X.shape[1]
    K=initial_centroids.shape[0]
    centroids=initial_centroids
    previous_centroids=centroids
    idx=np.zeros((m,1))

    for i in range(1,max_iters):
        idx=findClosestCentroids(X,centroids);
        centroids=computeCentroids(X,idx,K)
        print("Iteration number:",i);

    return centroids,idx;
```



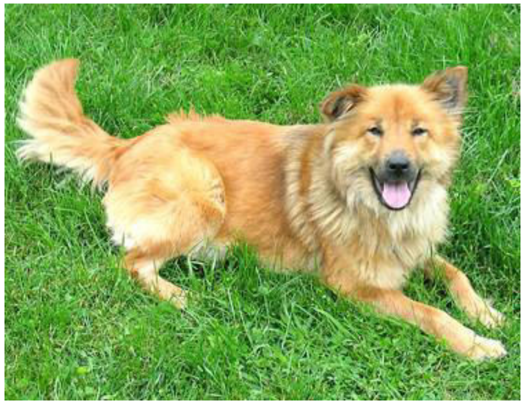
Initial Centroids

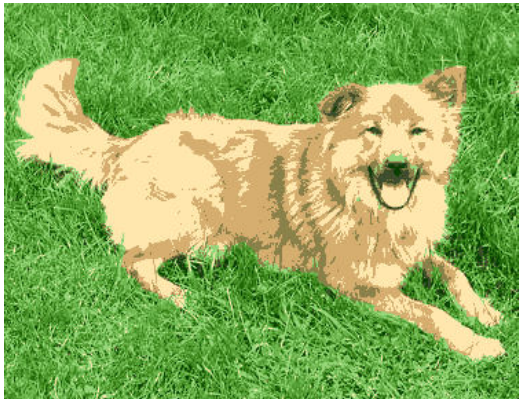


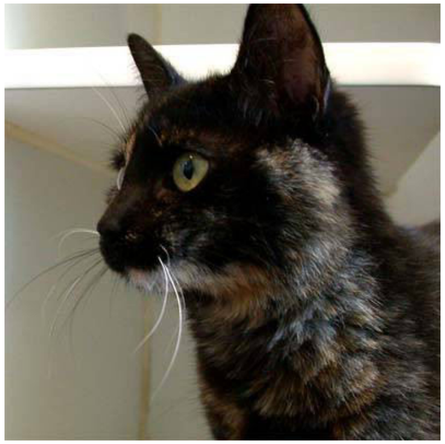
Final centroids

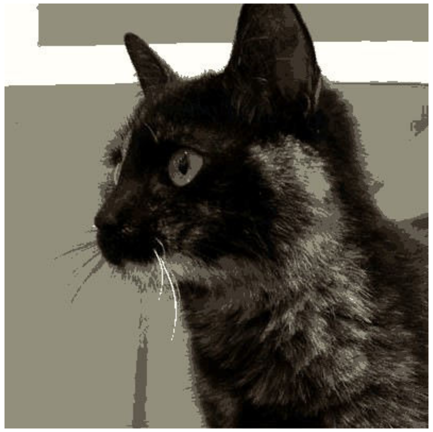
*plotted using matplotlib library

RESULTS

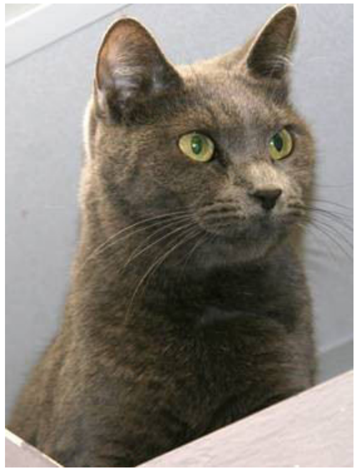

Original Image(250.1Kb)

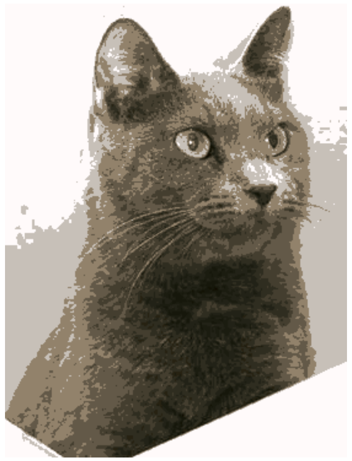

Compressed Image(73.6Kb)

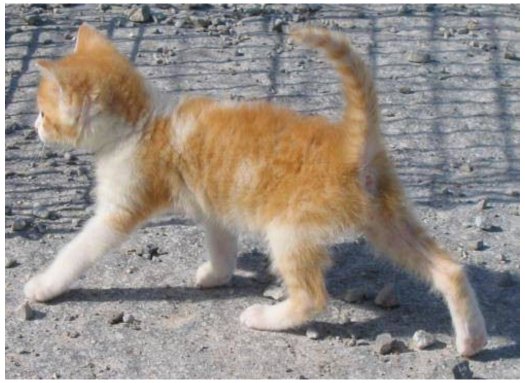

Original Image(173Kb)


Compressed Image(53.1Kb)

RESULTS(cont.)


Original Image(117.7Kb)


Compressed Image(23.8Kb)


Original Image(299.2Kb)

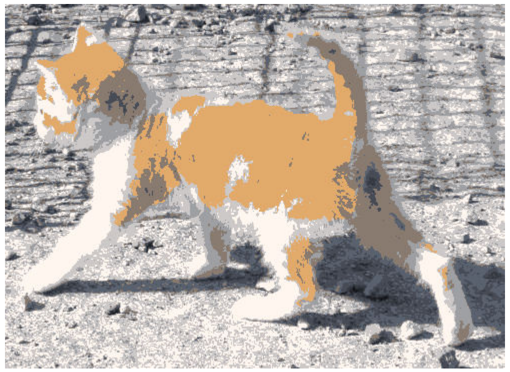
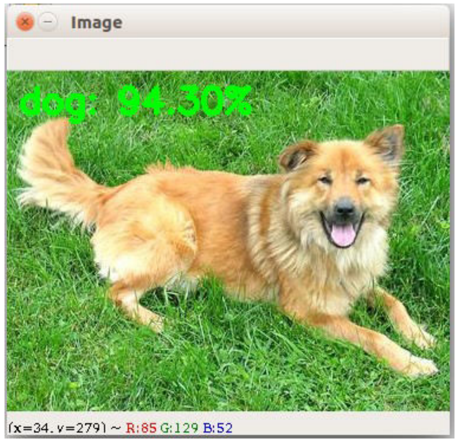
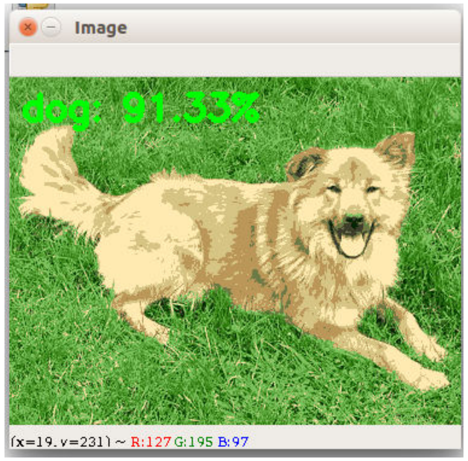

Compressed Image(62.8Kb)

IMAGE CLASSIFICATION RESULTS



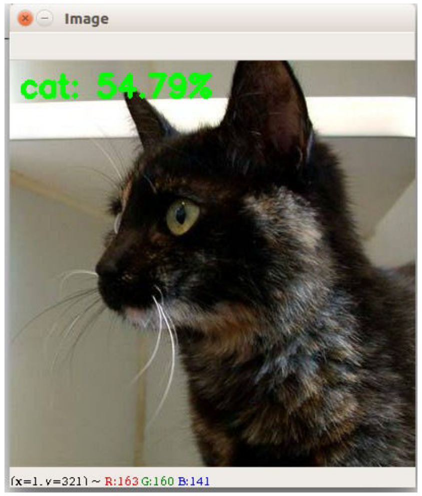
```
dog: 94.30%
(x=34, y=279) ~ R:85 G:129 B:52
```

Original Image



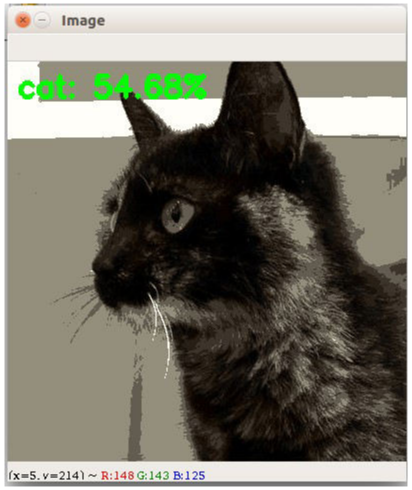
```
dog: 91.33%
(x=19, y=231) ~ R:127 G:195 B:97
```

Compressed Image



```
cat: 54.79%
(x=1, y=321) ~ R:163 G:160 B:141
```

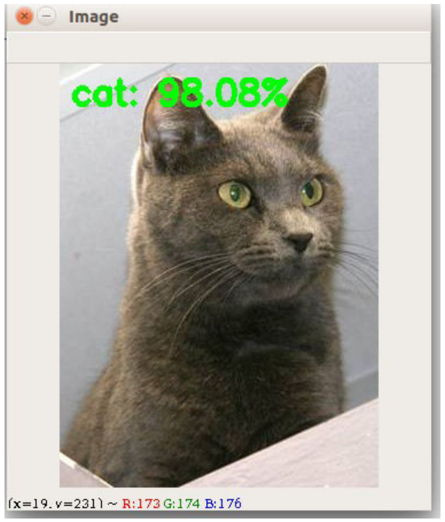
Original Image



```
cat: 54.68%
(x=5, y=214) ~ R:148 G:143 B:125
```

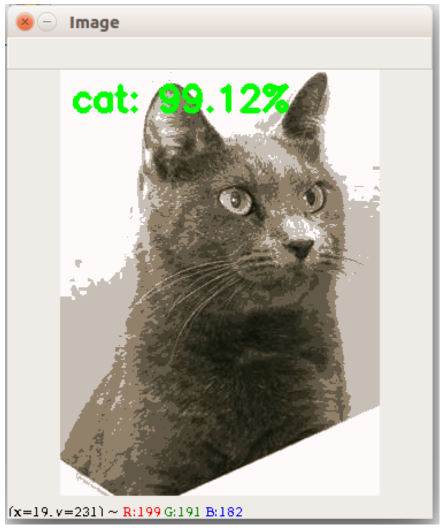
Compressed Image

IMAGE CLASSIFICATION RESULTS(cont.)



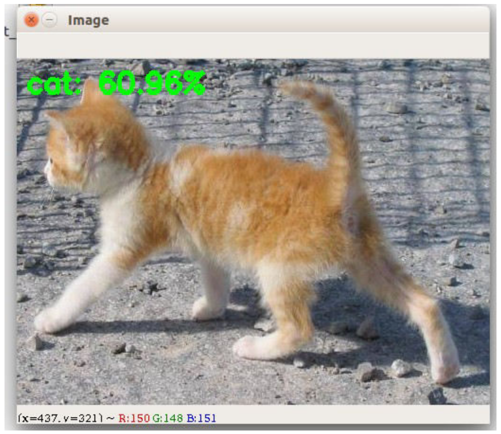
(x=19, y=231) ~ R:173 G:174 B:176

Original Image



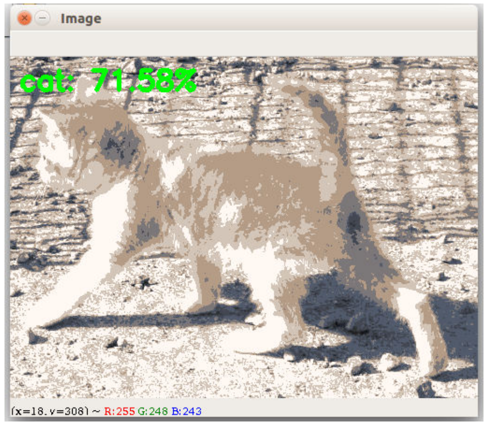
(x=19, y=231) ~ R:199 G:191 B:182

Compressed Image



(x=437, y=321) ~ R:150 G:148 B:151

Original Image



(x=18, y=308) ~ R:255 G:248 B:243

Compressed Image

Conclusions

- The sizes of the images have decreased significantly. For some images the decrease is upto 5 times.
- When passed through the image classifier, we observe that there isn’t significant difference between the classifying accuracy of the original and compressed images.
- This proves that the compression has retreived majority of the attributes or properties of the image, while also significantly reducing the image size.

References

- https://www.pyimagesearch.com/2016/09/26/a-simple-neural-network-with-python-and-keras/
- https://www.geeksforgeeks.org/python-numpy/
- https://matplotlib.org/users/pyplot_tutorial.html
- https://www.guru99.com/scipy-tutorial.html

THANK YOU!