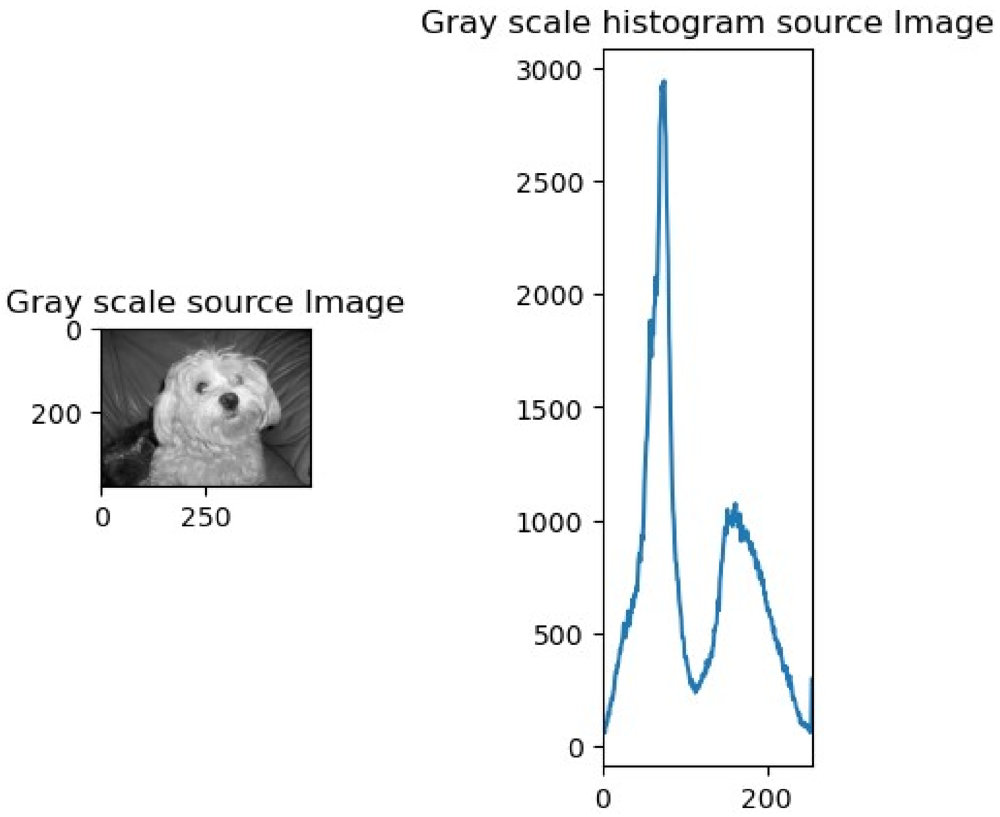
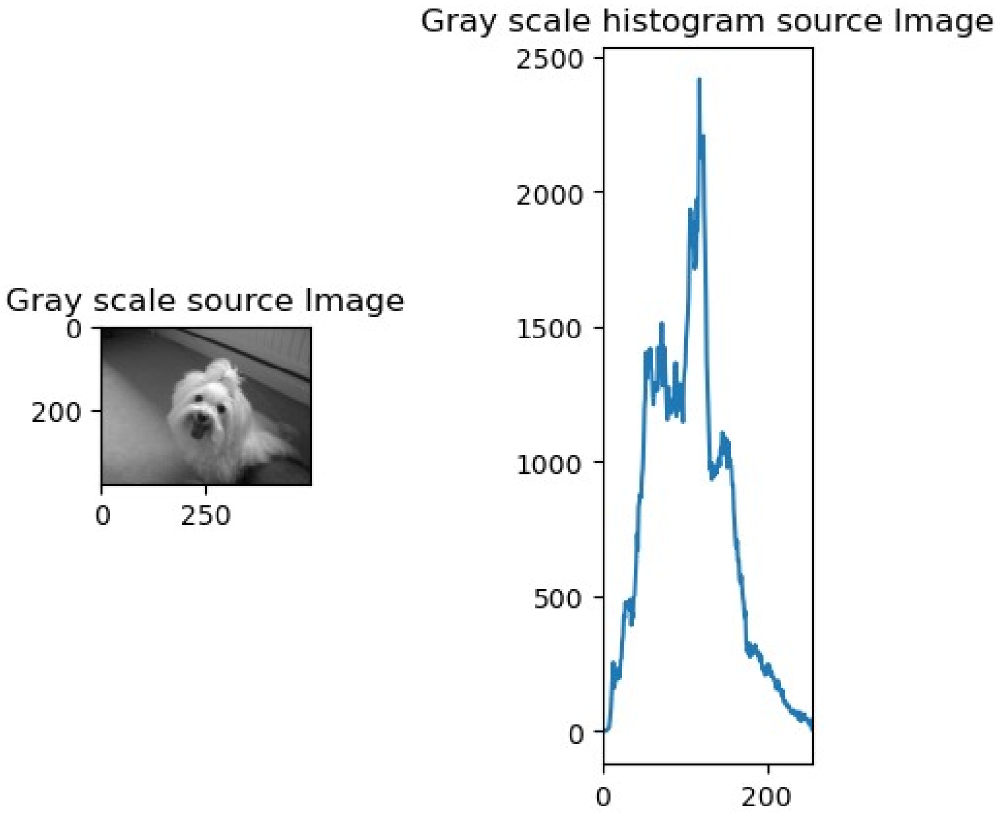
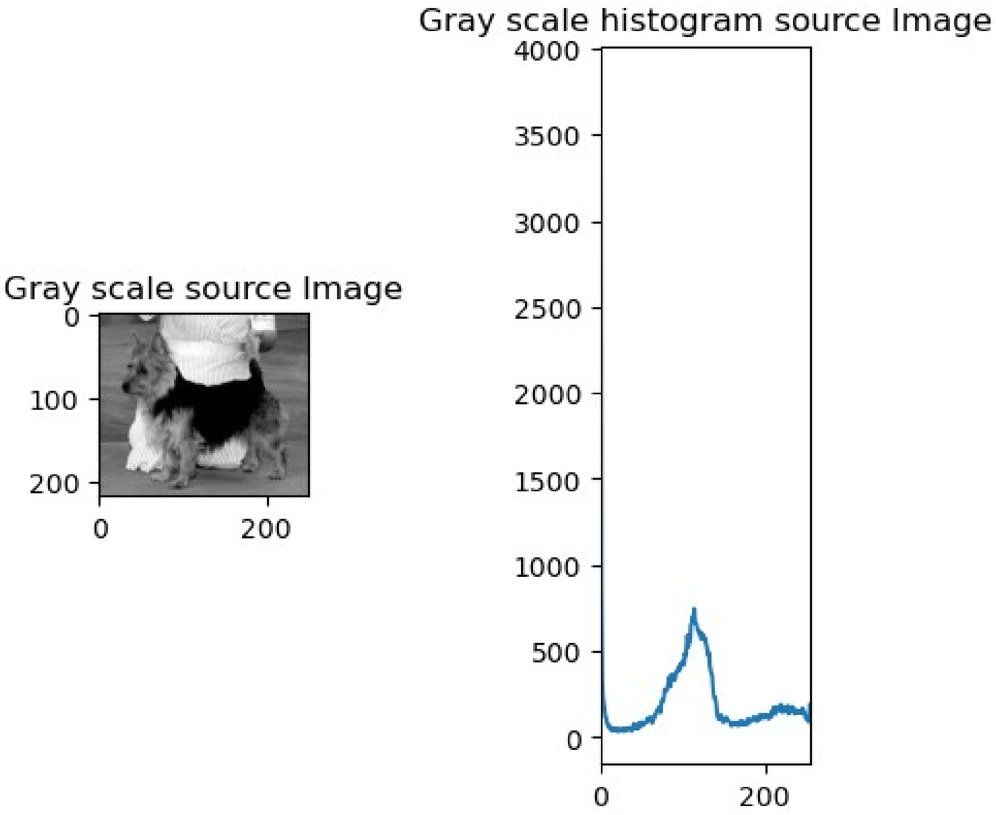
```
import cv2 as cv
import pandas as pd
import numpy as np
import glob
import sys
import random
import xml.etree.ElementTree as ET
from pathlib import Path
from PIL import Image
import matplotlib.pyplot as plt
from sklearn.decomposition import PCA
from sklearn.preprocessing import StandardScaler

#config dictionary
config_dictionary ={"Image_set":"C:\\Users\\sande\\OneDrive\\Desktop\\
Data_mining\\Images\\",
                    "bread_info":["n02085936-Maltese_dog","n02096294-
Australian_terrier",\
                                  "n02106550-Rottweiler","n02092339-
Weimaraner"]
                 }


#file lister
files_dict={}
for bread in config_dictionary['bread_info']:
    files_dict[bread]=glob.glob(config_dictionary['Image_set']
+bread+"/*.jpg")
    #removing un-wanted files in image folders
    if '.DS_Store' in files_dict[bread]:
            files_dict[bread].remove('.DS_Store')

# image modification
modify_dict ={}
for bread in list(files_dict.keys()):
    for file in files_dict[bread]:
        annotation_path = file.replace("Images","Annotation")
        annotation_path=annotation_path.split(".")[0]
        tree = ET.parse(annotation_path)
        root = tree.getroot()
        objects = root.findall('object')
        bbox = []
        for o in objects:
            bndbox = o.find('bndbox')
            xmin = int(bndbox.find('xmin').text)
            ymin = int(bndbox.find('ymin').text)
            xmax = int(bndbox.find('xmax').text)
            ymax = int(bndbox.find('ymax').text)
            bbox.append((xmin,ymin,xmax,ymax))
        image = Image.open(file)
        for value in range(len(bbox)):
            cropped_image = image.crop(bbox[value])
            modified_image = 
cropped_image.resize((100,100),Image.ANTIALIAS)
            modified_image = modified_image.convert('RGB')
            temp = "\\".join(file.split("\\")[:-1])
            temp+="\\cropped_images\\"
            Path(temp).mkdir(parents=True, exist_ok=True)
            modified_image.save(temp+file.split("\\")[-1])
```

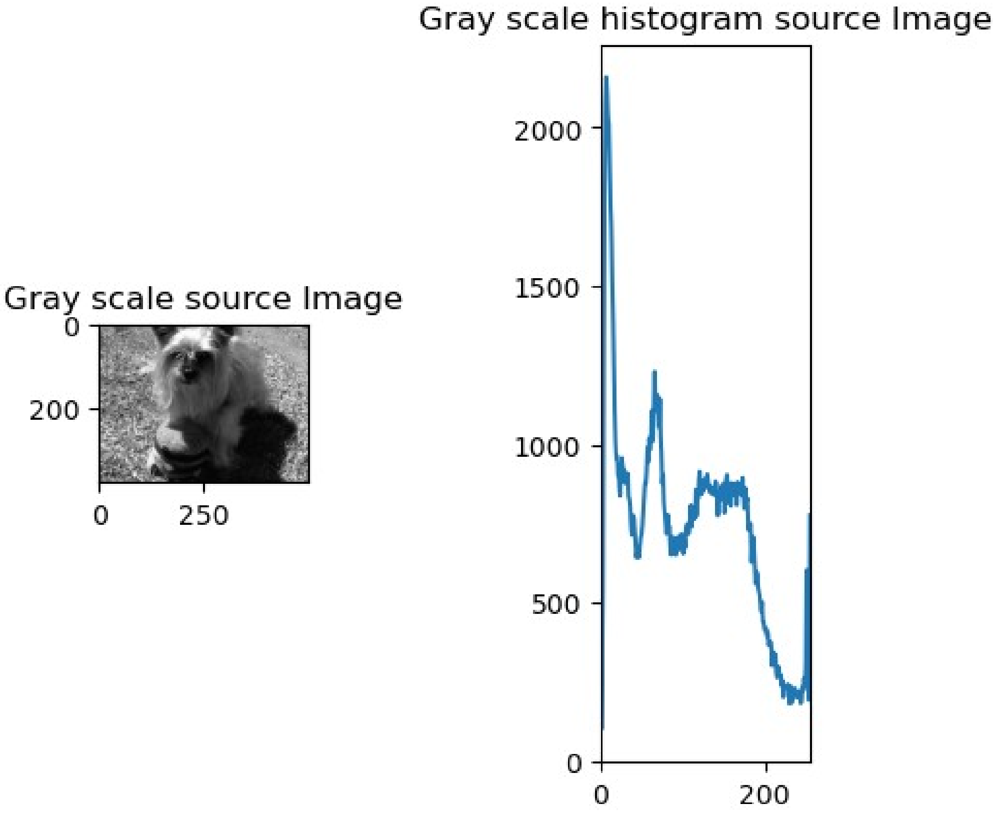
```
C:\Users\sande\AppData\Local\Temp\ipykernel_15244\3919825018.py:21: 
DeprecationWarning: ANTIALIAS is deprecated and will be removed in 
Pillow 10 (2023-07-01). Use LANCZOS or Resampling.LANCZOS instead.
  modified_image = cropped_image.resize((100,100),Image.ANTIALIAS)
```

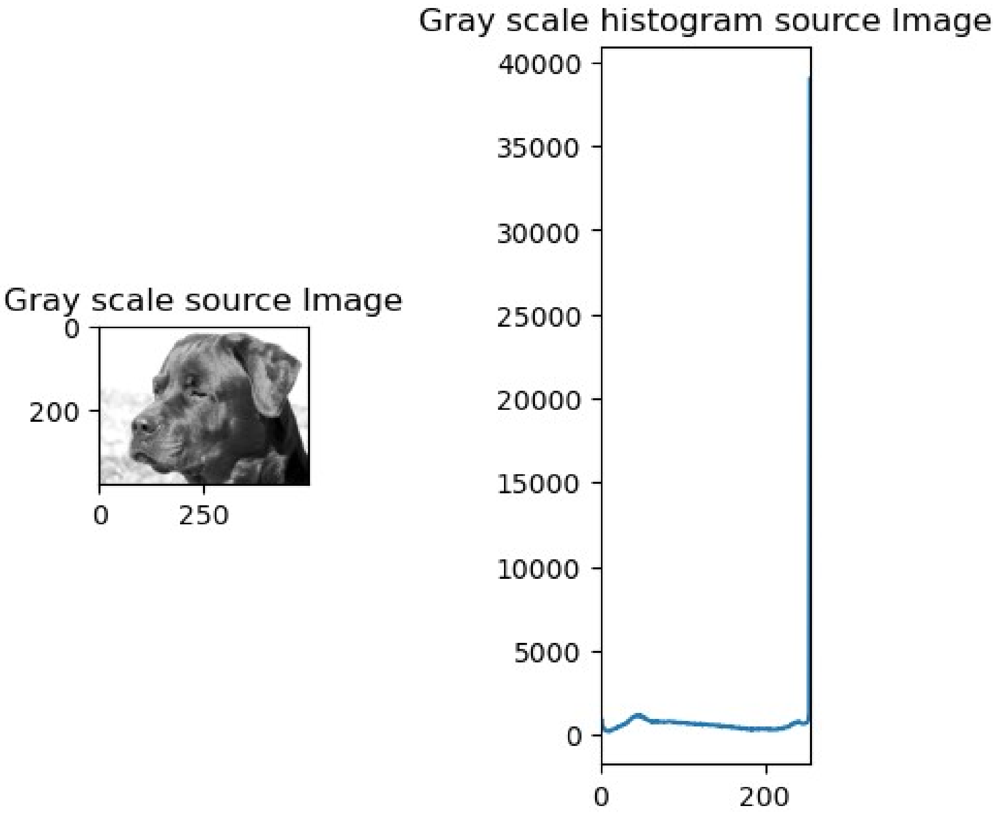
```
# plotting the first two images found in each bread
for bread in list(files_dict.keys()):
    files = files_dict[bread][0:2]
    for file in files:
        file = file.replace(bread+"/",bread+"/cropped_images/")
        image = cv.imread(file,cv.IMREAD_GRAYSCALE)
        plt.subplot(1,4,1)
        plt.imshow(image,cmap='gray')
        plt.title('Gray scale source Image')
        plt.subplot(1,4,3)
        hist,bin = np.histogram(image.ravel(),256,[0,255])
        plt.xlim([0,255])
        plt.plot(hist)
        plt.title('Gray scale histogram source Image')
        plt.show()
```

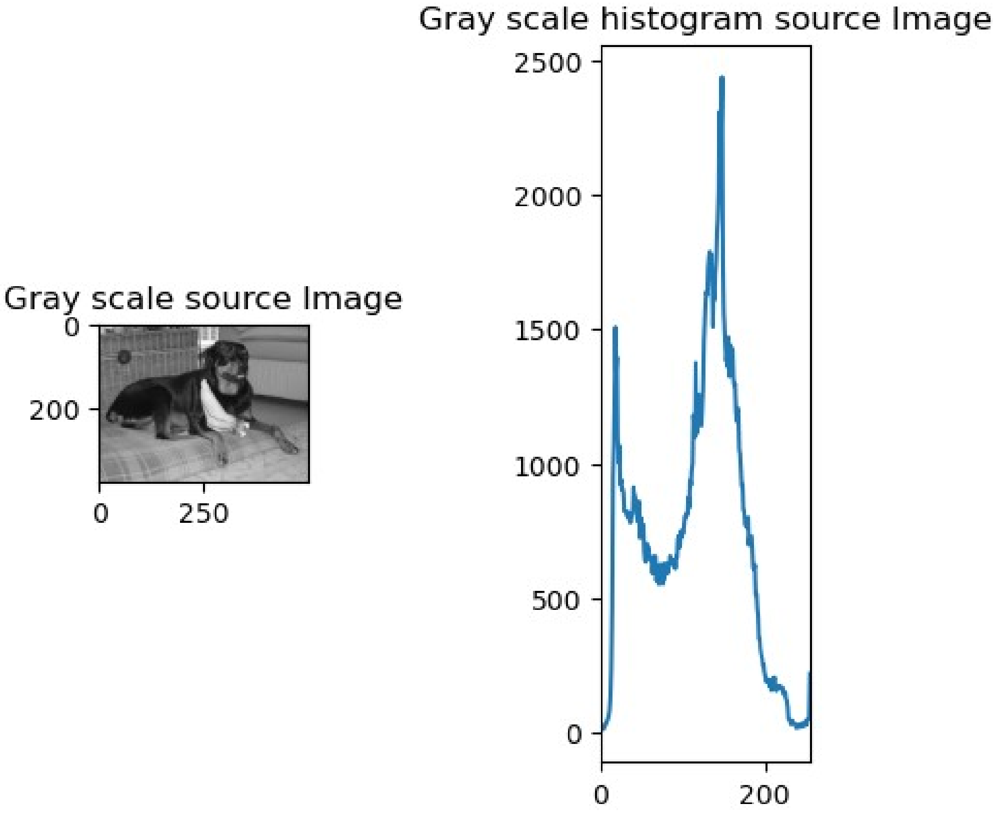

Gray scale source Image
0
200
0
250
Gray scale histogram source Image
3000
2500
2000
1500
1000
500
0
0
200

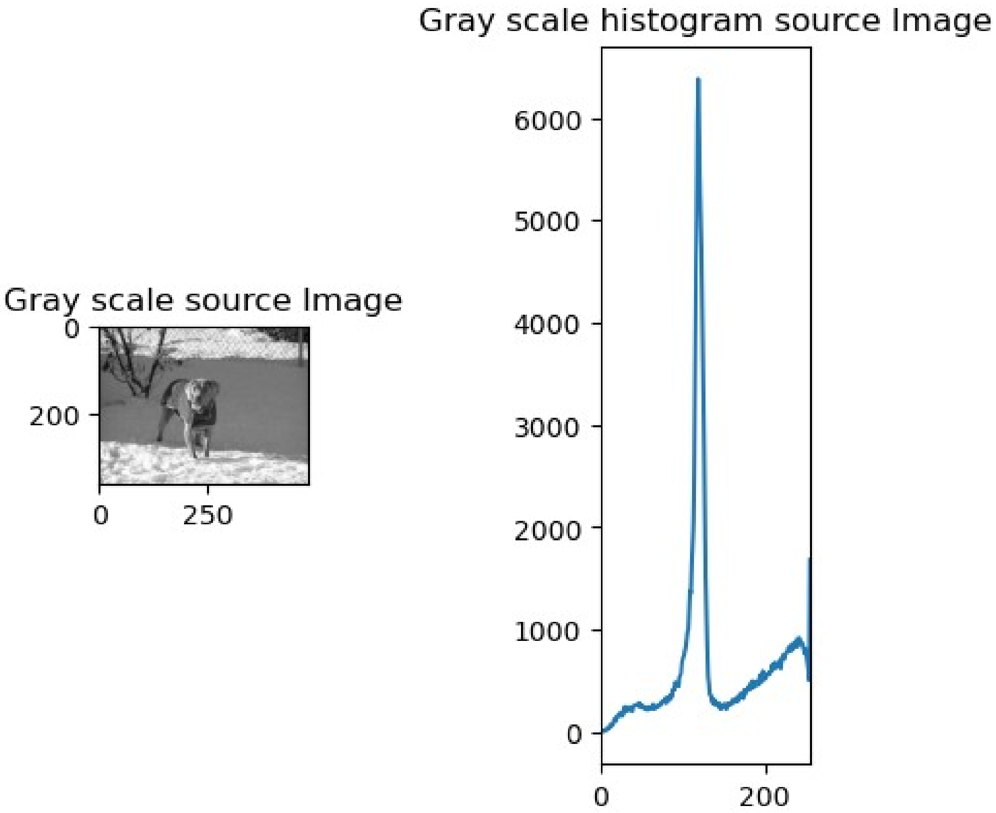

Gray scale source Image
0
200
0
250
Gray scale histogram source Image
2500
2000
1500
1000
500
0
0
200


Gray scale source Image
0
100
200
0
200
Gray scale histogram source Image
4000
3500
3000
2500
2000
1500
1000
500
0
0
200

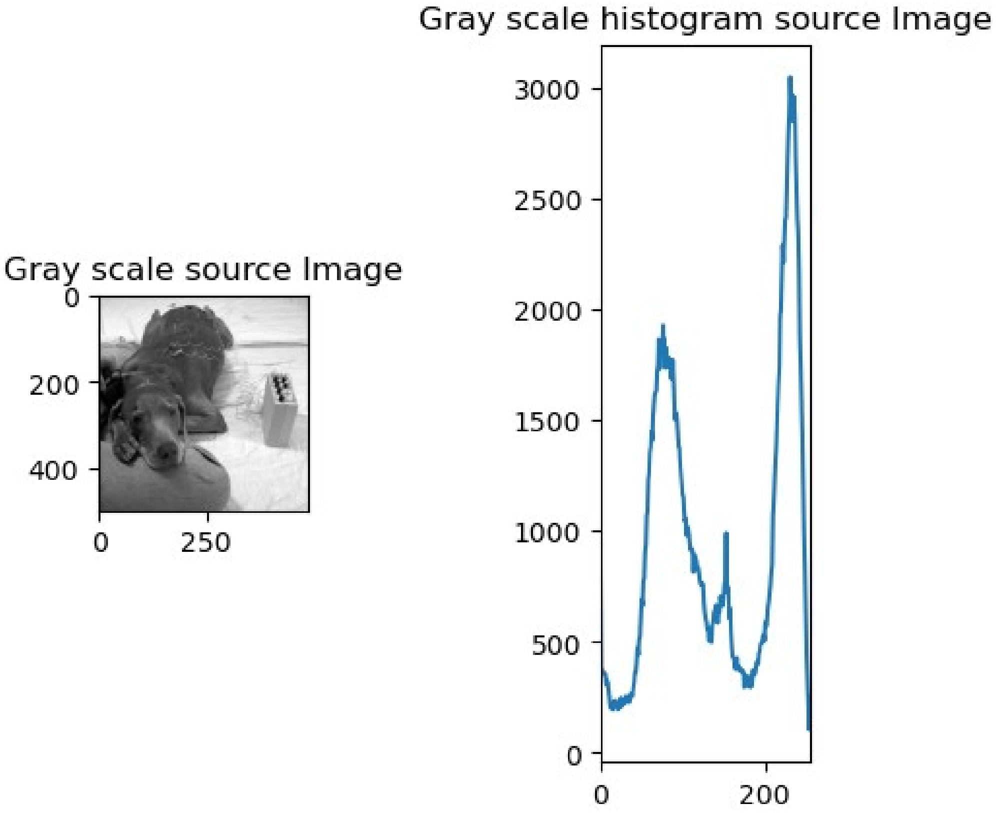

Gray scale source Image
0
200
0
250
Gray scale histogram source Image
2000
1500
1000
500
0
0
200


Gray scale source Image
0
200
0
250
Gray scale histogram source Image
40000
35000
30000
25000
20000
15000
10000
5000
0
0
200


Gray scale source Image
0
200
0
250
Gray scale histogram source Image
2500
2000
1500
1000
500
0
0
200

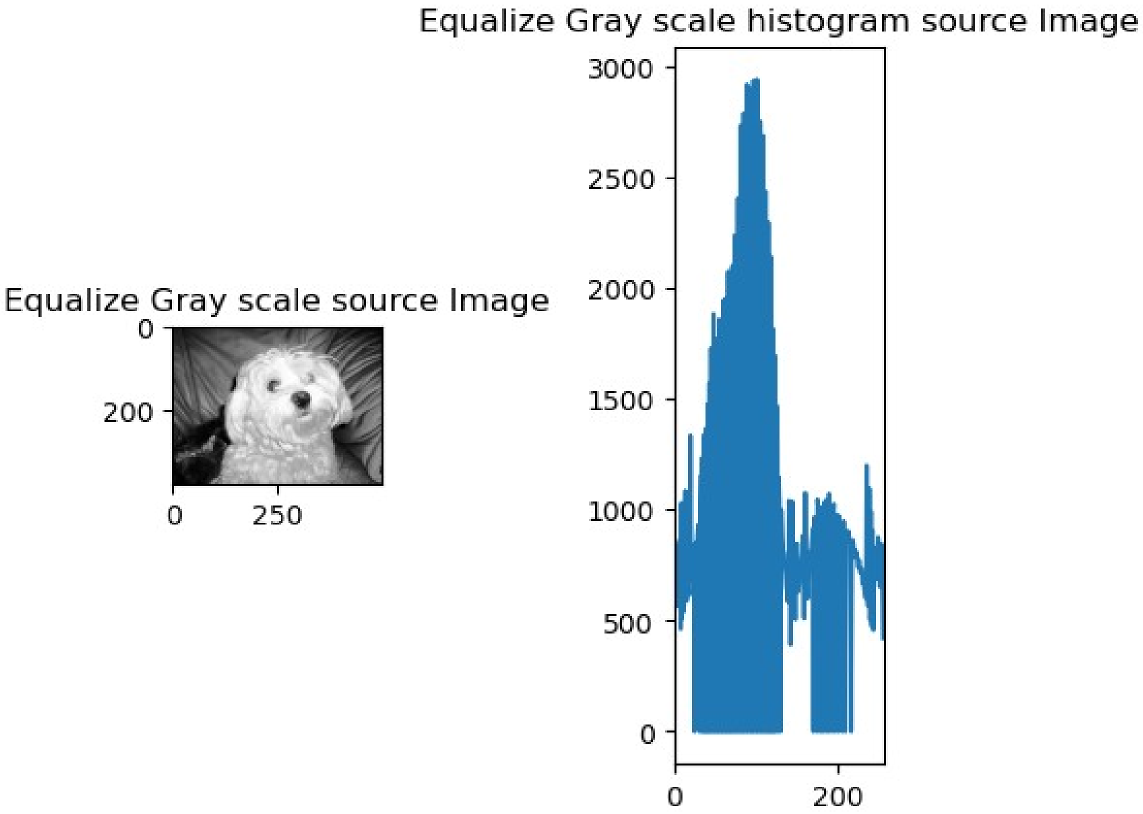

Gray scale source Image

Gray scale histogram source Image

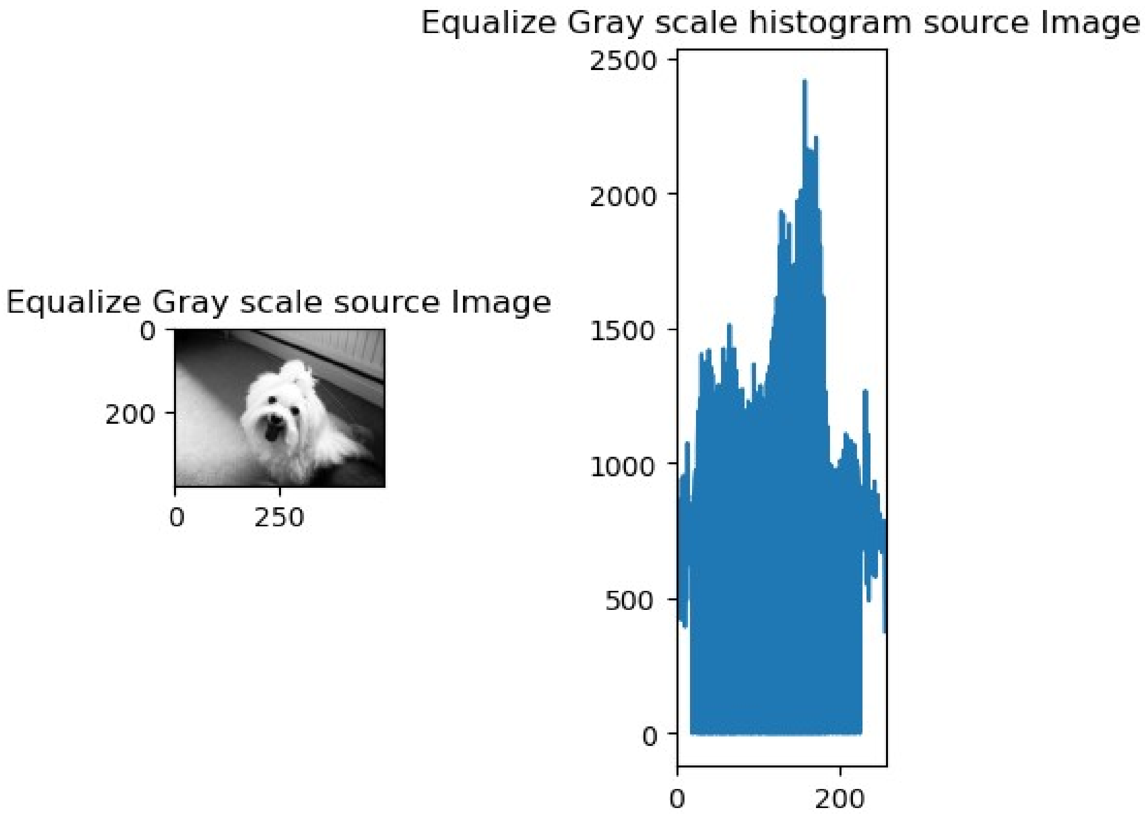

Gray scale source Image

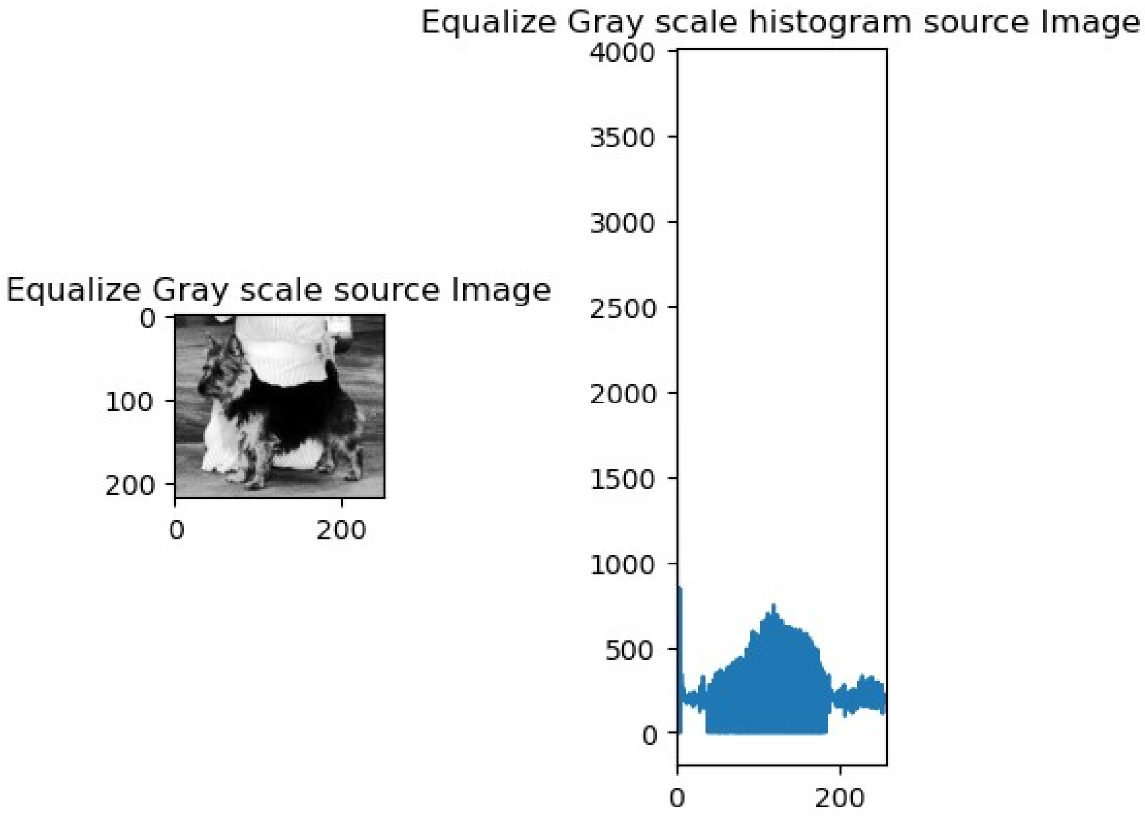
Gray scale histogram source Image

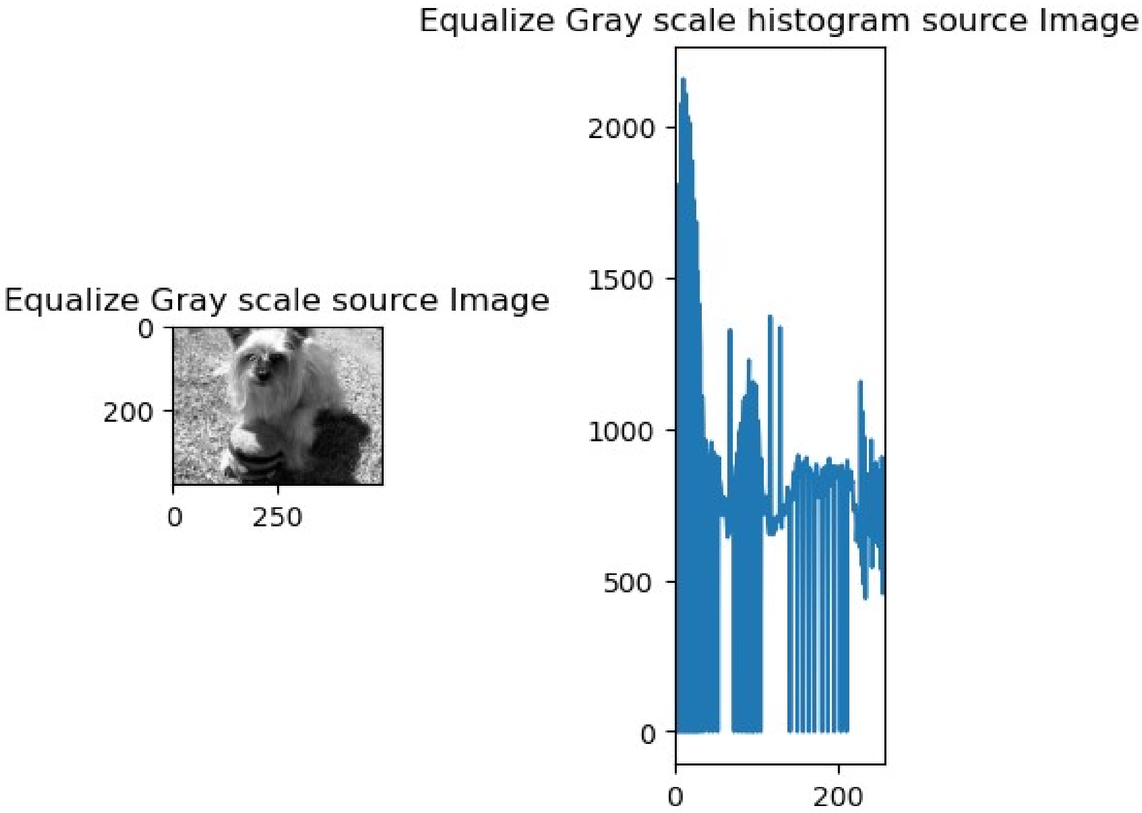
```
# plotting equalize histograms the first two images found in each
bread
for bread in list(files_dict.keys()):
    files = files_dict[bread][0:2]
    for file in files:
        file = file.replace(bread+"/",bread+"/cropped_images/")
        image = cv.imread(file,cv.IMREAD_GRAYSCALE)
        image = cv.equalizeHist(image)
        plt.subplot(1,4,1)
        plt.imshow(image,cmap='gray')
        plt.title('Equalize Gray scale source Image')
        plt.subplot(1,4,3)
        hist,bin = np.histogram(image.ravel(),256,[0,255])
        plt.xlim([0,255])
        plt.plot(hist)
        plt.title('Equalize Gray scale histogram source Image')
        plt.show()
```


Equalize Gray scale source Image

Equalize Gray scale histogram source Image

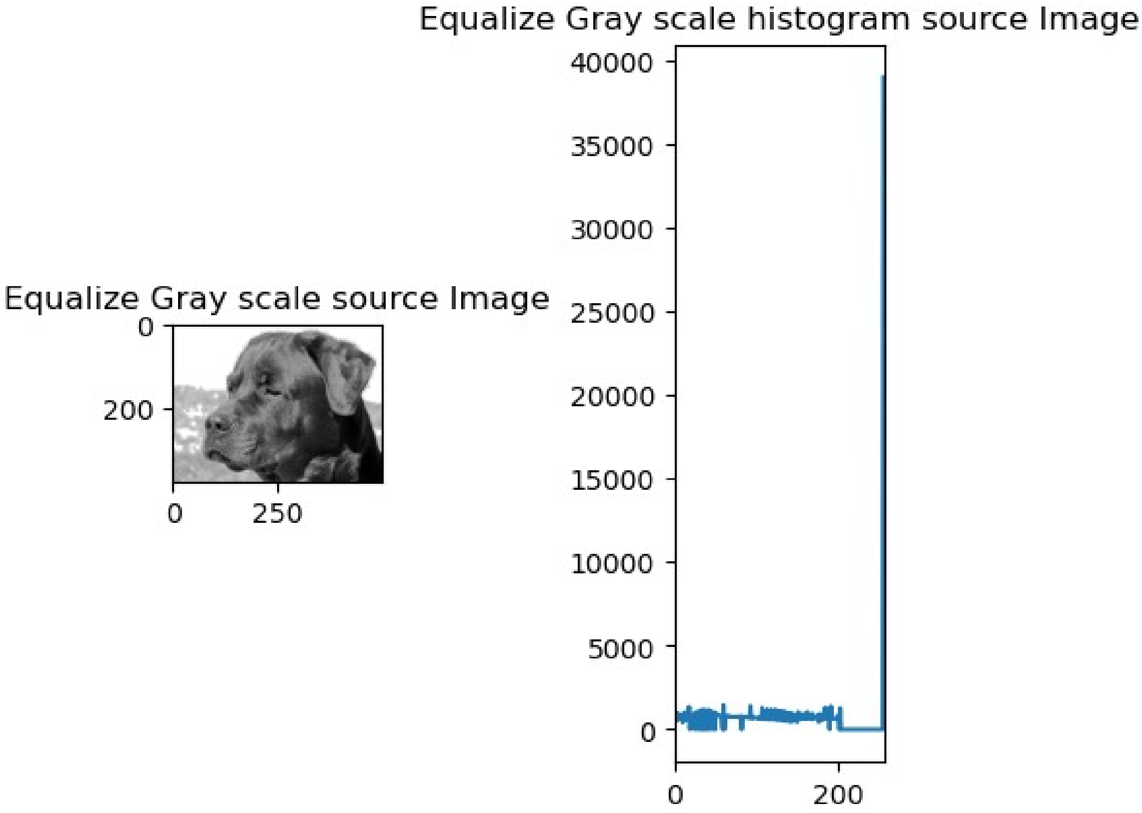

Equalize Gray scale source Image
0
200
0
250
Equalize Gray scale histogram source Image
2500
2000
1500
1000
500
0
0
200


Equalize Gray scale source Image
0
100
200
0
200
Equalize Gray scale histogram source Image
4000
3500
3000
2500
2000
1500
1000
500
0
0
200



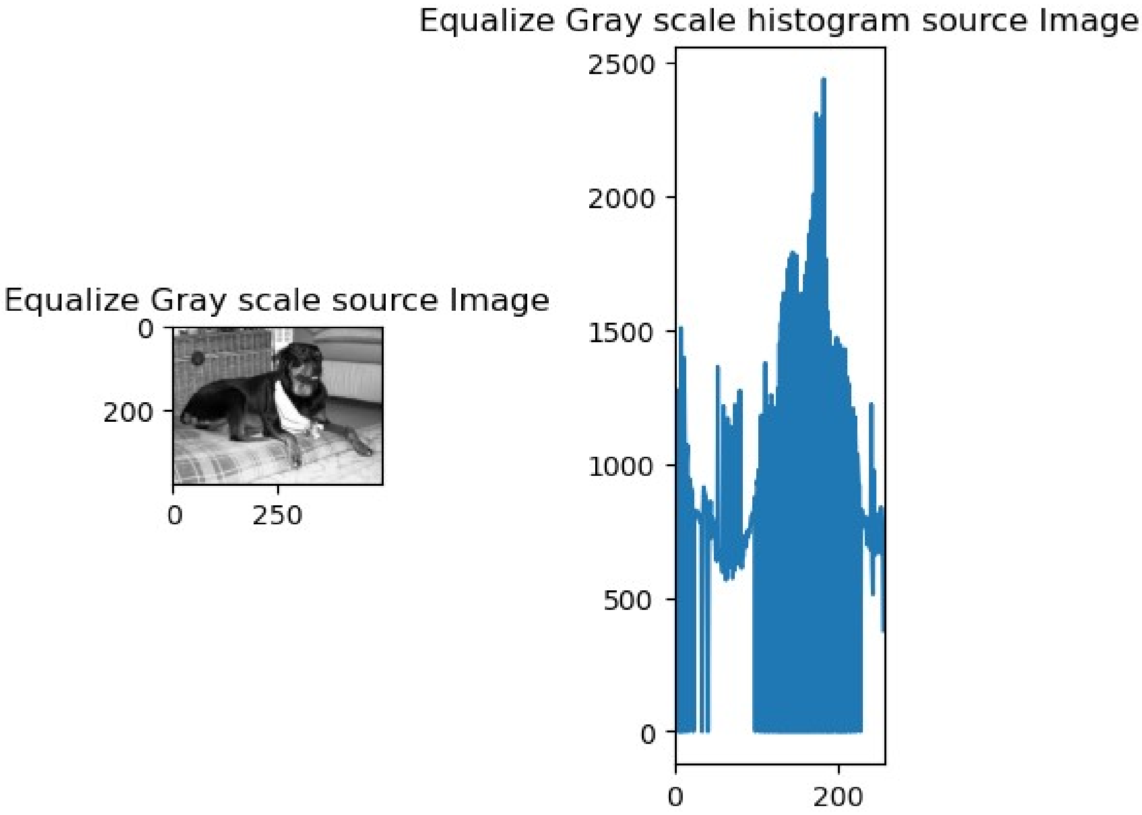
Equalize Gray scale source Image

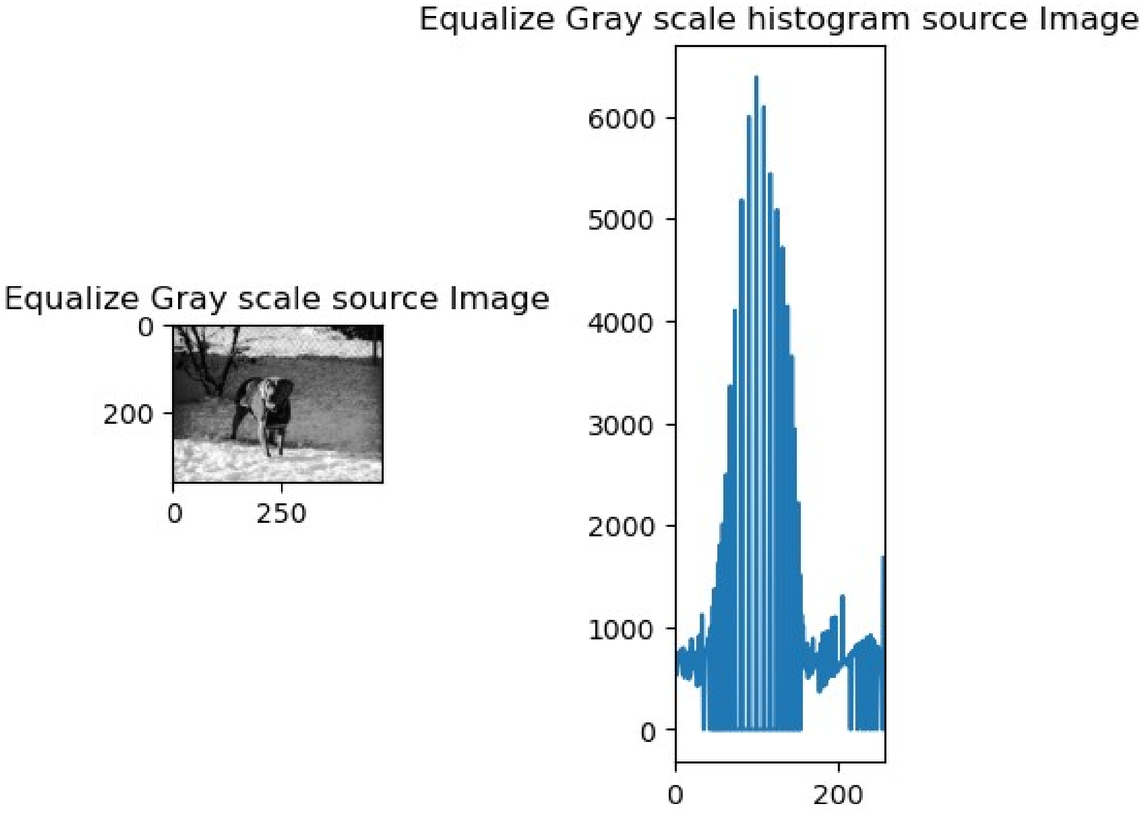
Equalize Gray scale histogram source Image

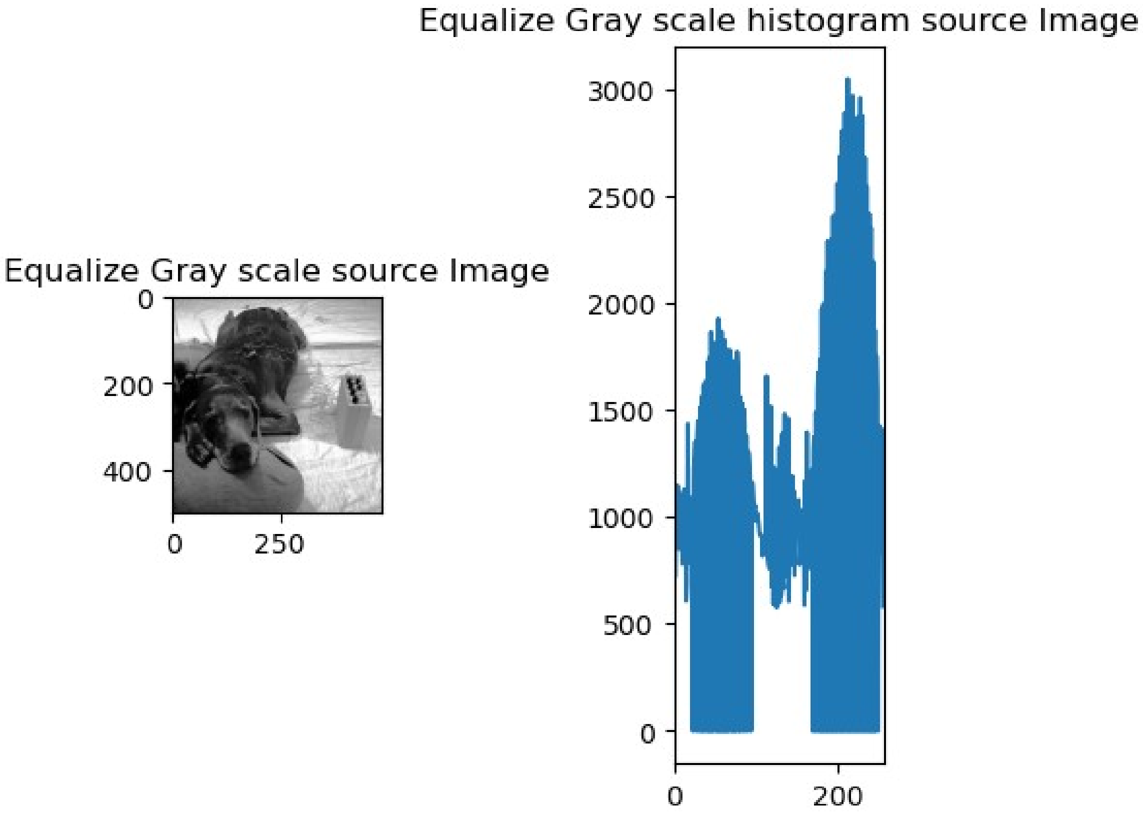


Equalize Gray scale source Image

Equalize Gray scale histogram source Image


Equalize Gray scale source Image
0
200
0
250
Equalize Gray scale histogram source Image
2500
2000
1500
1000
500
0
0
200

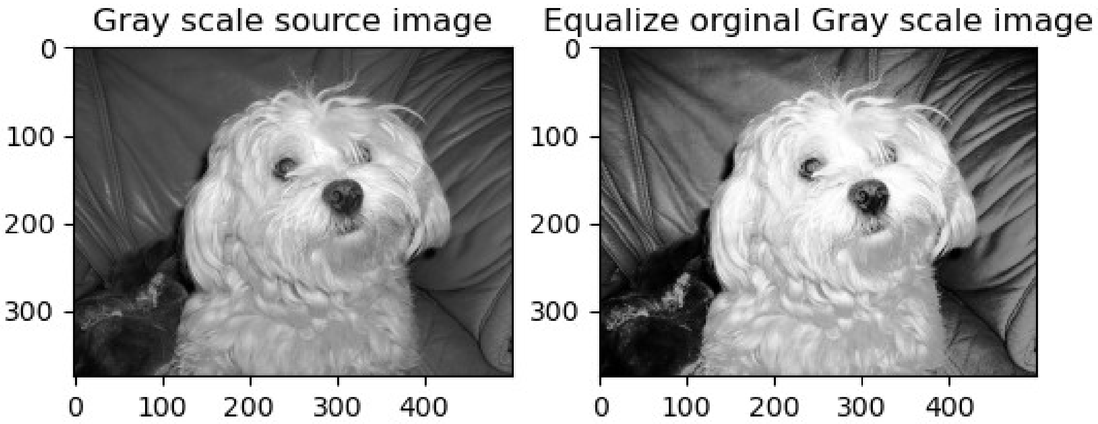

Equalize Gray scale source Image
0
200
0
250
Equalize Gray scale histogram source Image
6000
5000
4000
3000
2000
1000
0
0
200



Equalize Gray scale source Image

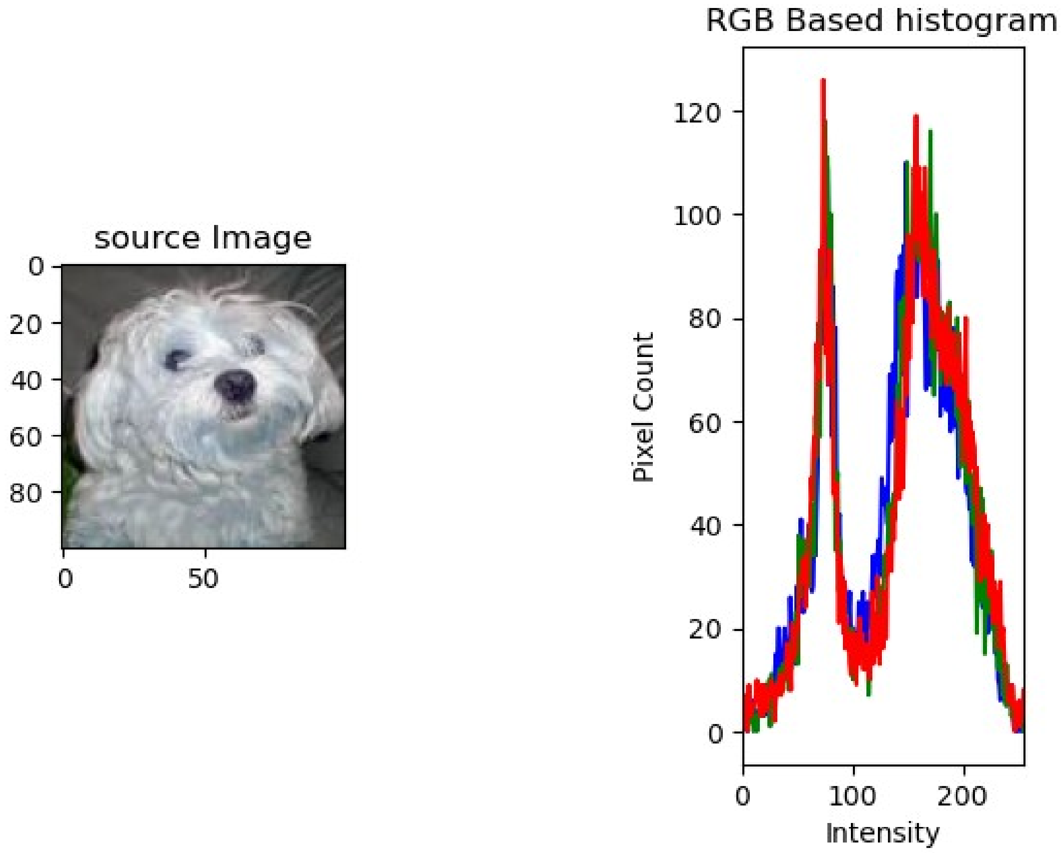
Equalize Gray scale histogram source Image

```
selected_image = files_dict["n02085936-Maltese_dog"][0]
selected_image = selected_image.replace("n02085936-
Maltese_dog/","n02085936-Maltese_dog/cropped_images/")
image = cv.imread(selected_image,0)
equ_image = cv.equalizeHist(image)
plt.subplot(1,2,1)
plt.imshow(image,cmap='gray')
plt.title('Gray scale source image')
plt.subplot(1,2,2)
plt.imshow(equ_image,cmap="gray")
plt.title('Equalize orginal Gray scale image')
plt.show()
```



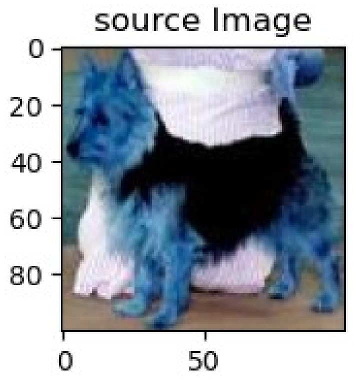
observation - Grey scale image is converted to Equalize original grey scale image which brightend the image.

```
# plotting RGB histograms the first found image in each bread
for bread in list(files_dict.keys()):
    file = files_dict[bread][0]
    file = file.replace(bread+"\\",bread+"\\cropped_images\\")
    image = cv.imread(file)
    plt.subplot(1,3,1)
    plt.imshow(image)
    plt.title('source Image')
    plt.subplot(1,3,3)
    color = ('b','g','r')
    for index,value in enumerate(color):
        histogram = cv.calcHist([image],[index],None,[256],[0,256])
        plt.plot(histogram,color = value)
        plt.xlim([0,256])
        plt.title('RGB Based histogram')
        plt.xlabel("Intensity")
        plt.ylabel("Pixel Count")
    plt.show()
```

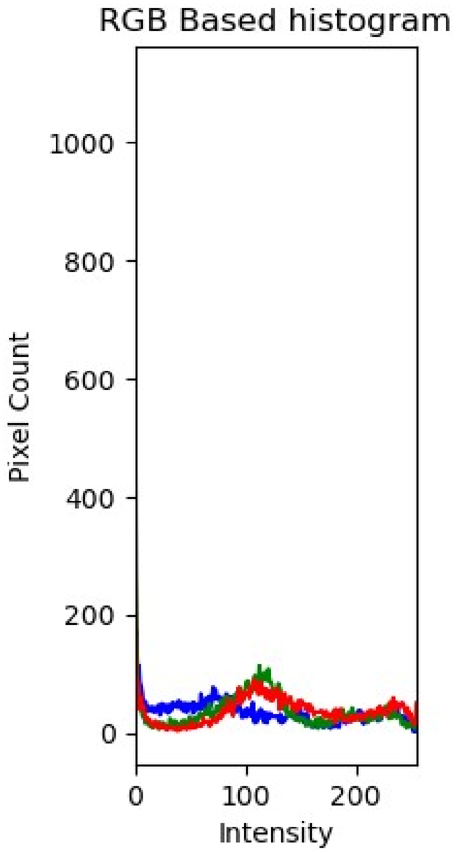


source Image

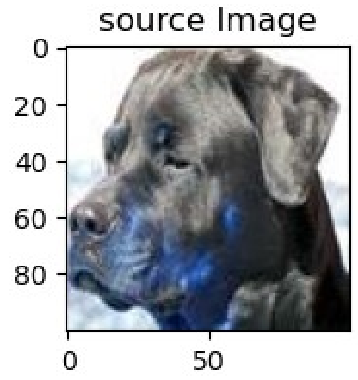
RGB Based histogram

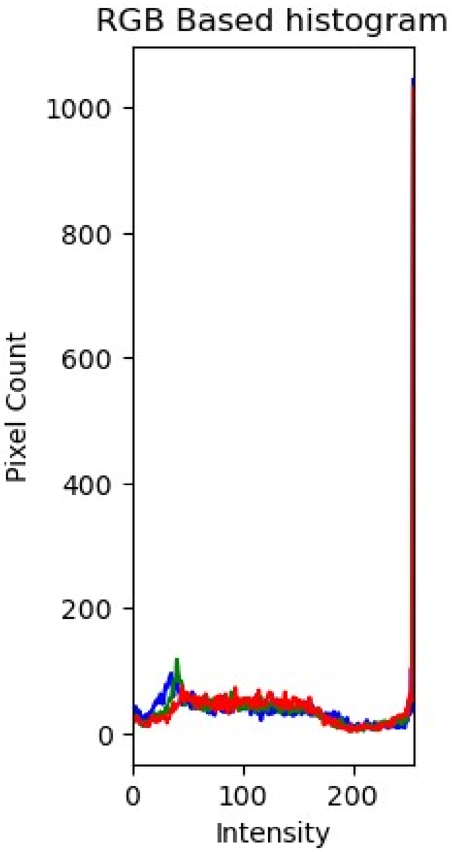


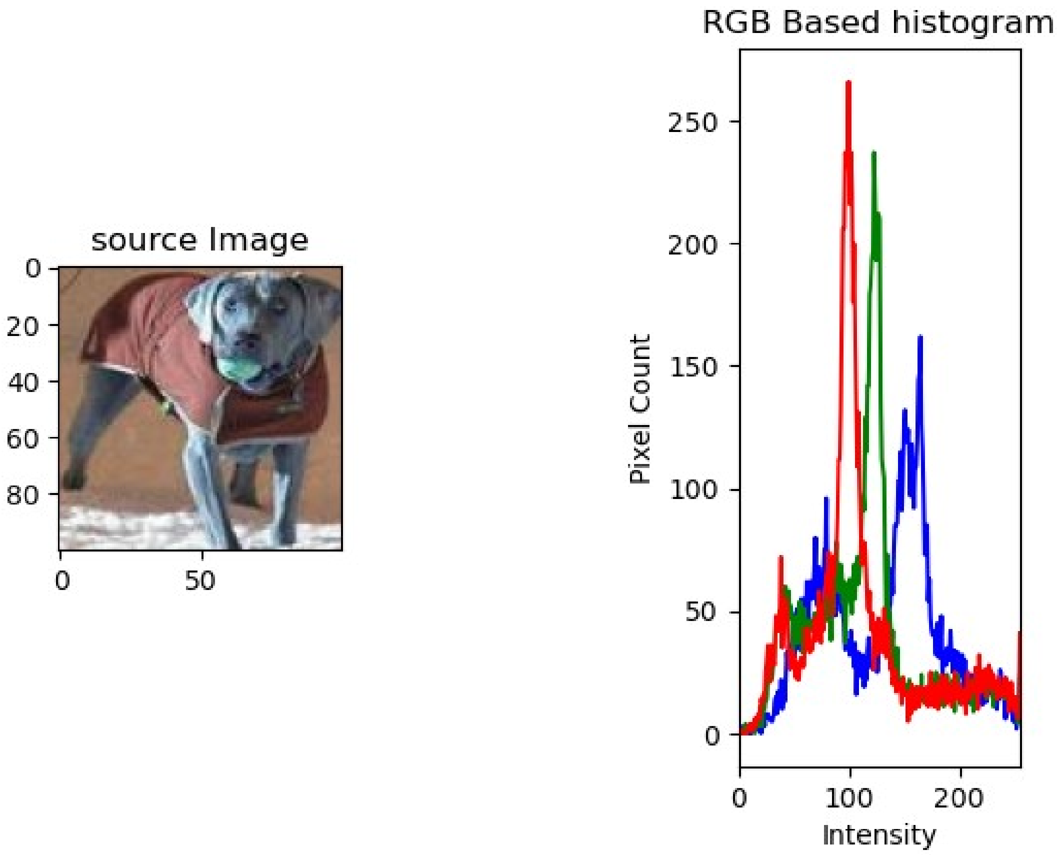
source Image



RGB Based histogram


source Image
0
20
40
60
80
0
50


RGB Based histogram
Pixel Count
1000
800
600
400
200
0
0
100
200
Intensity



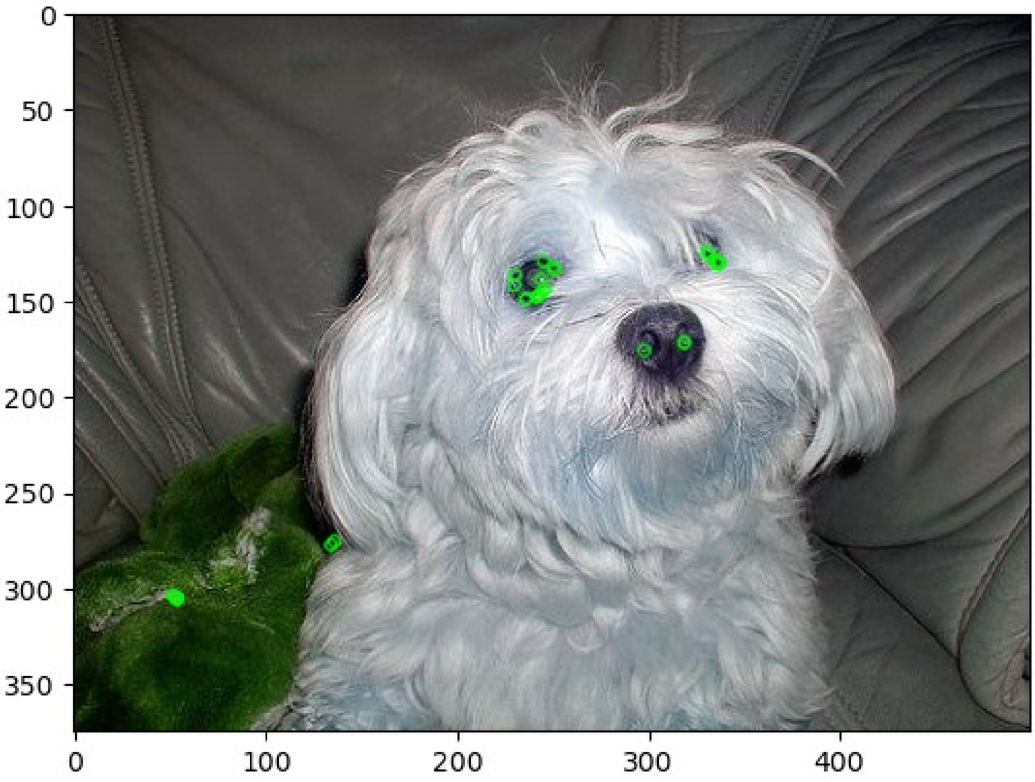
```
bread_chosen =['n02085936-Maltese_dog', 'n02096294-
Australian_terrier']

#same class distance calculator
files = files_dict[bread_chosen[0]][0:2]
image_vector_representation =[]
for file in files:
    image = cv.imread(file)
    gray_scale_image = cv.cvtColor(image, cv.COLOR_BGR2GRAY)
    hist = cv.calcHist([gray_scale_image],[0],None,[256],[0,256])
    image_vector_representation.append(hist)

print("Euclidean distance metrics calculation:
",cv.norm(image_vector_representation[0],\

image_vector_representation[1],normType=cv.NORM_L2))
print("Manhattan distance metrics
calculation:",cv.norm(image_vector_representation[0],\

image_vector_representation[1],normType=cv.NORM_L1))
print("Bhattacharyya distance metrics
calculation:",cv.compareHist(image_vector_representation[0],\
image_vector_representation[1],cv.HISTCMP_BHATTACHARYYA))
print("Histogram Intersection distance metrics
calculation:",cv.compareHist(image_vector_representation[0],\

image_vector_representation[1],cv.HISTCMP_INTERSECT))
```

```
Euclidean distance metrics calculation:  10803.583387006369
Manhattan distance metrics calculation: 120212.0
Bhattacharyya distance metrics calculation: 0.29555684413926364
Histogram Intersection distance metrics calculation: 127394.0
```

```
#different class distance calculator
files=[]
files.append(files_dict[bread_chosen[0]][0])
files.append(files_dict[bread_chosen[1]][0])
image_vector_representation =[]
for file in files:
    image = cv.imread(file)
    gray_scale_image = cv.cvtColor(image, cv.COLOR_BGR2GRAY)
    hist = cv.calcHist([gray_scale_image],[0],None,[256],[0,256])
    image_vector_representation.append(hist)

print("Euclidean distance metrics calculation:
",cv.norm(image_vector_representation[0],\

image_vector_representation[1],normType=cv.NORM_L2))
print("Manhattan distance metrics
calculation:",cv.norm(image_vector_representation[0],\

image_vector_representation[1],normType=cv.NORM_L1))
print("Bhattacharyya distance metrics
calculation:",cv.compareHist(image_vector_representation[0],\

image_vector_representation[1],cv.HISTCMP_BHATTACHARYYA))
print("Histogram Intersection distance metrics
calculation:",cv.compareHist(image_vector_representation[0],\

image_vector_representation[1],cv.HISTCMP_INTERSECT))
```

```
Euclidean distance metrics calculation:  14110.096456084204
Manhattan distance metrics calculation: 161694.0
Bhattacharyya distance metrics calculation: 0.45004887720375086
Histogram Intersection distance metrics calculation: 40153.0
```

```
#ORB implementation
bread_chosen ='n02085936-Maltese_dog'
file = files_dict[bread_chosen][0]
image = cv.imread(file)
orb = cv.ORB_create(edgeThreshold=2,patchSize=3, nlevels=8,
fastThreshold=20,scaleFactor=1.2,\
WTA_K=2,scoreType=cv.ORB_HARRIS_SCORE,firstLevel=0, nfeatures=30)
kp = orb.detect(image,None)
img = cv.drawKeypoints(image, kp, None, color=(0,255,0))
plt.imshow(img)
plt.show()
print("Key points extracted "+str(len(kp)))
```

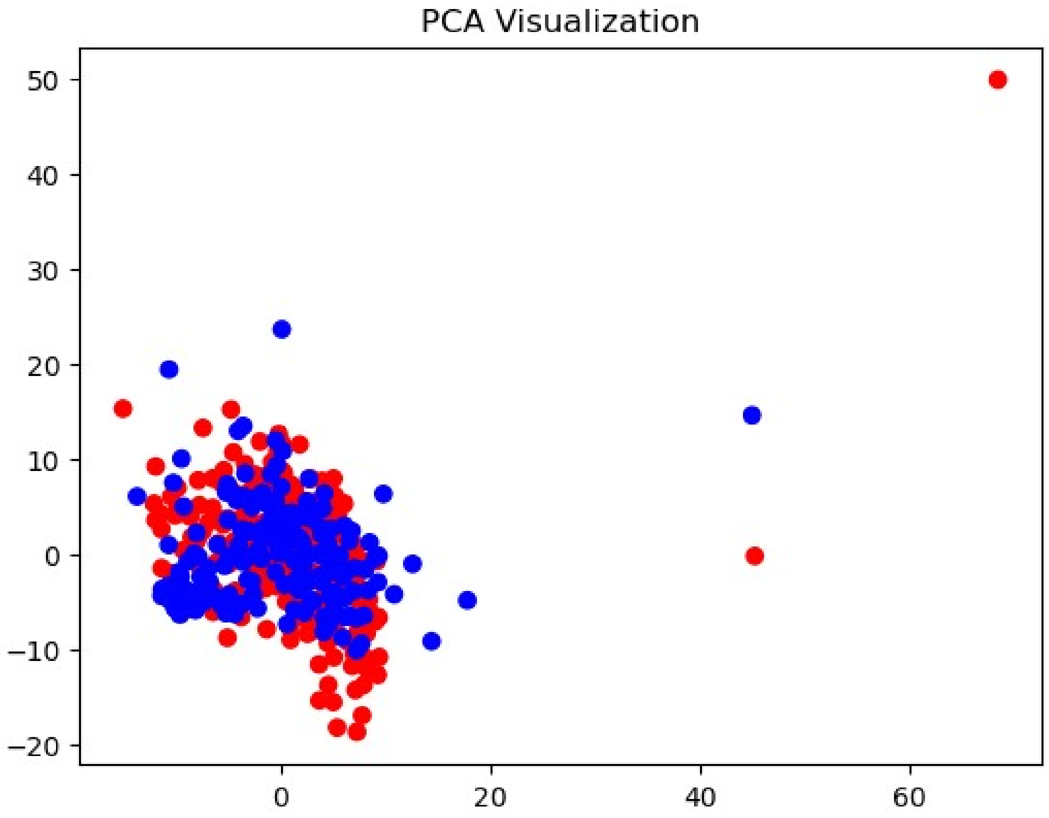


```
Key points extracted 30
```

observations - key points extracted - 30 with edgethresold - 2 and patchsize - 3.

```
#PCA Implementation
bread_chosen =['n02085936-Maltese_dog', 'n02096294-
Australian_terrier']
gray_scale_histogram_df = pd.DataFrame()
for bread in bread_chosen:
    for files in files_dict[bread]:
        image = cv.imread(files)
        gray_image = cv.cvtColor(image, cv.COLOR_BGR2GRAY)
        histogram = cv.calcHist([gray_image],[0],None,[256],[0,256])
        df = pd.DataFrame(histogram).T
        df['label']=bread
```

```
gray_scale_histogram_df=pd.concat([gray_scale_histogram_df,df],ignore_
index=True)

intrim_df = gray_scale_histogram_df.loc[:,:255]
std_scaler = StandardScaler()
intrim_df_standardization =
pd.DataFrame(std_scaler.fit_transform(intrim_df),
columns=intrim_df.columns)
pca = PCA(n_components=2)
PCA_analysis = pca.fit_transform(intrim_df_standardization)

pca_df=pd.DataFrame(PCA_analysis)
color_list = [ "red" if i == 'n02085936-Maltese_dog' else "blue" for i
in gray_scale_histogram_df['label'].tolist() ]
plt.title('PCA Visualization')
plt.scatter(pca_df[0].tolist(), pca_df[1].tolist(), c=color_list)
plt.show()
```


PCA Visualization