CS682: Homework 2

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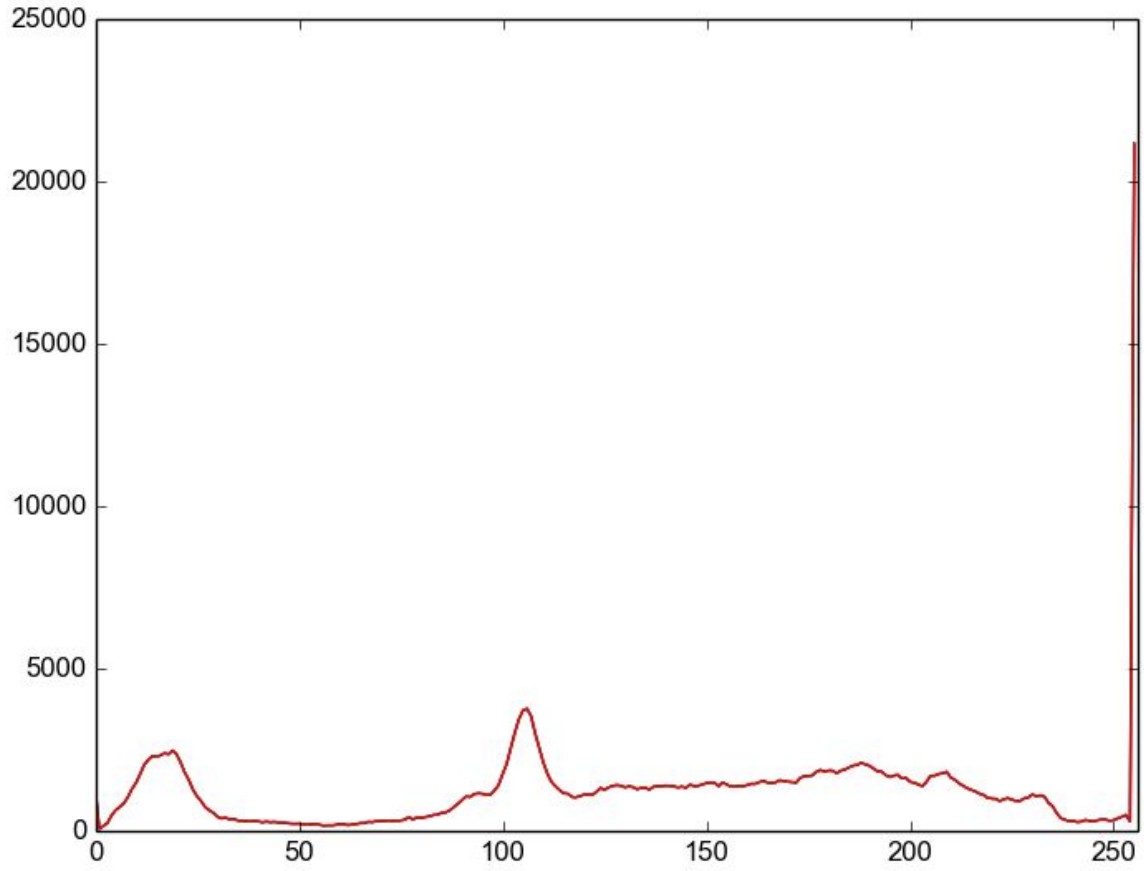
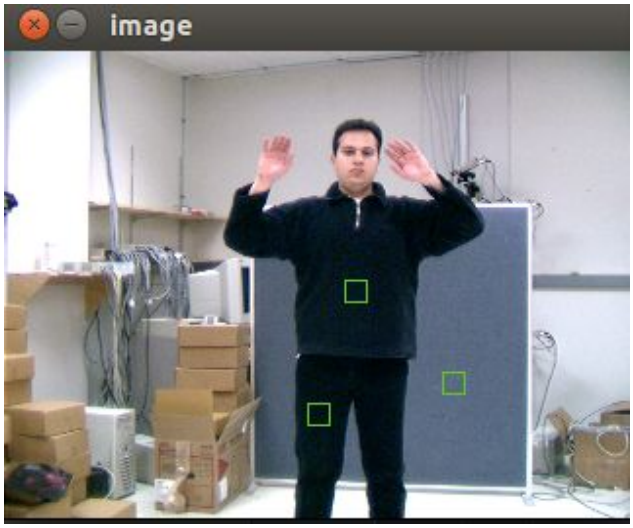
Question 1.1 - Parts 1, 2, 3 and 4

Picture 1: human2.bmp

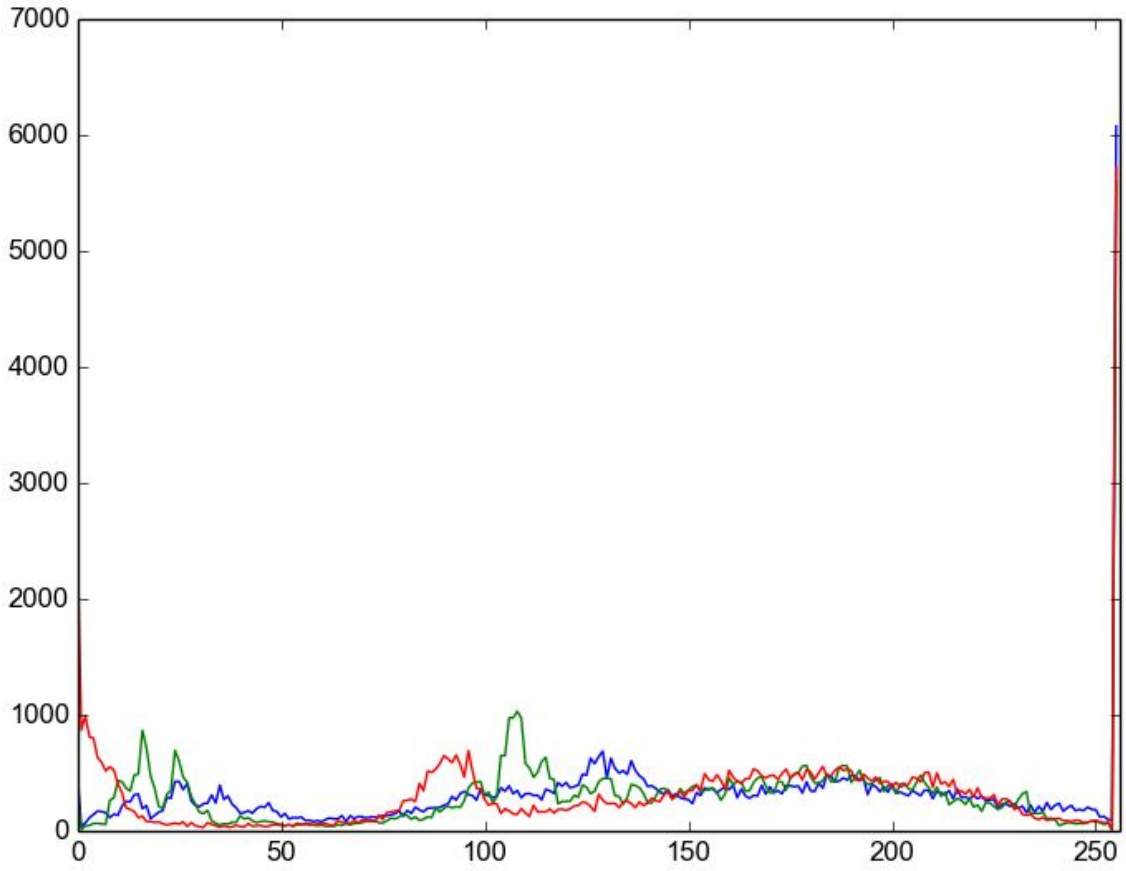
```
/usr/bin/python2.7 /home/bhavika/PycharmProjects/vision/Project2/part1.py
./images/human2.bmp
('Location', 341, 235)
Red: 120, Green: 120, Blue: 120
('Intensity:', 280)
Mean [[142.65609049]
 [142.67986654]
 [142.66554362]], standard deviation: [[71.03639182]
 [71.02780017]
 [71.02632259]]
('Location', 305, 61)
Red: 159, Green: 159, Blue: 159
/home/bhavika/PycharmProjects/vision/Project2/part1.py:26: RuntimeWarning: overflow encountered in ubyte_scalars
('Intensity:', 115)
  print('Intensity:', color[0] + color[1] + color[2] / 3)
Mean [[142.63416016]
 [142.68171224]
 [142.65306641]], standard deviation: [[71.04628898]
 [71.02911376]
 [71.02615648]]
```



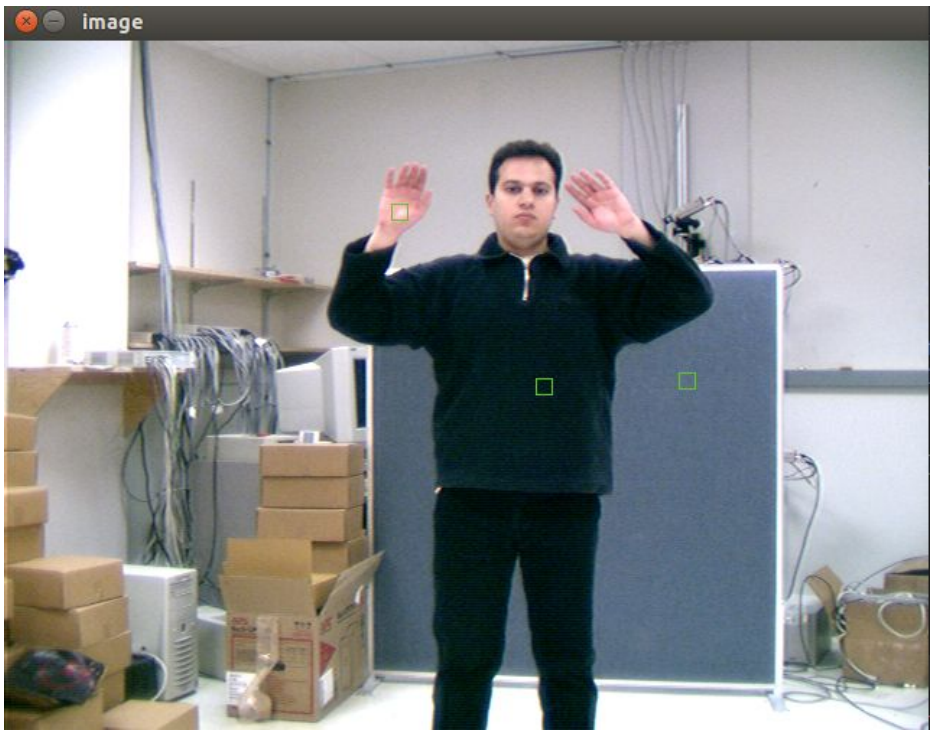
Picture 2: human2.ppm



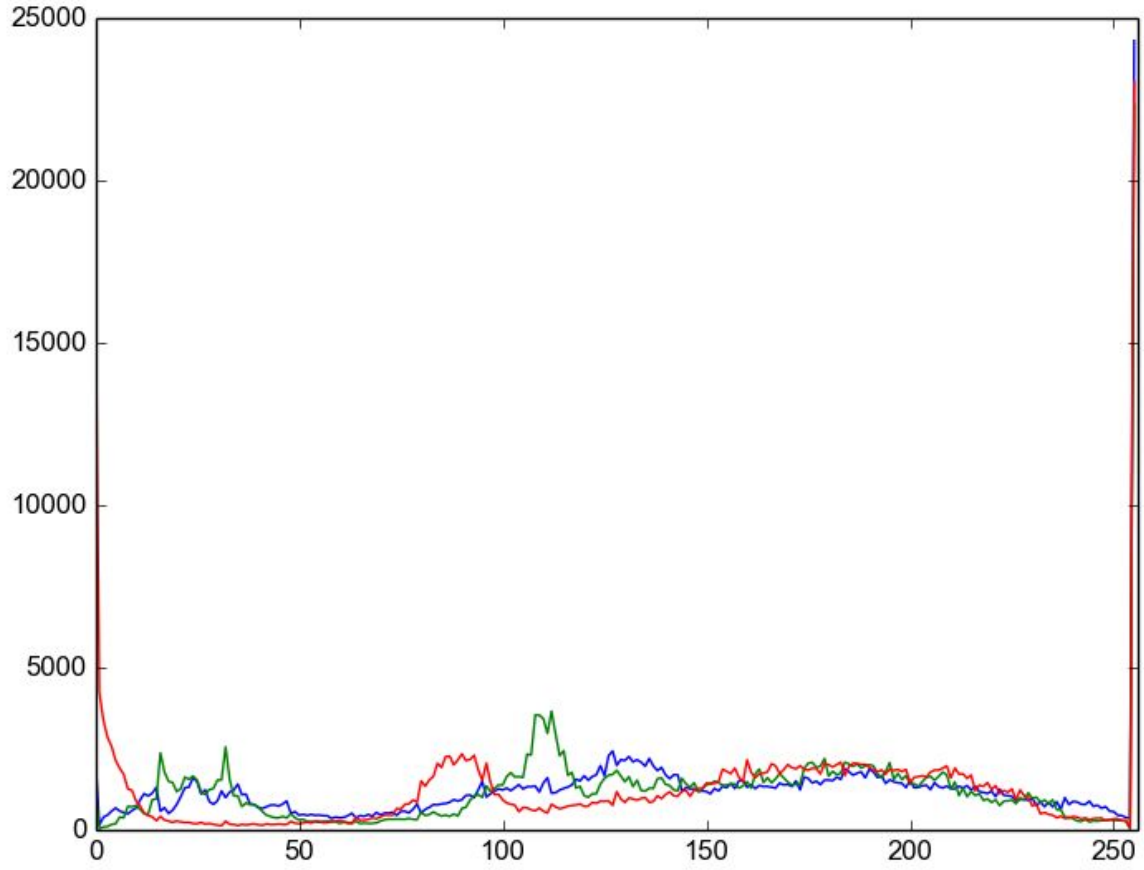

```
/usr/bin/python2.7 /home/bhavika/PycharmProjects/vision/Project2/part1.py
./images/human2.ppm
('Location', 174, 117)
Red: 105, Green: 81, Blue: 51
('Intensity:', 167)
Mean [[145.55796875]
 [142.55091146]
 [142.03848958]], standard deviation: [[70.80426952]
 [70.08044401]
 [75.7319246 ]]
('Location', 155, 180)
Red: 10, Green: 24, Blue: 28
('Intensity:', 55)
Mean [[145.56545573]
 [142.6553776 ]
 [142.09348958]], standard deviation: [[70.79144518]
 [70.02999319]
 [75.66644566]]
('Location', 224, 164)
Red: 3, Green: 17, Blue: 11
('Intensity:', 29)
Mean [[145.51003906]
 [142.70938802]
 [142.09916667]], standard deviation: [[70.84052864]
 [70.03777913]
 [75.66284803]]
```



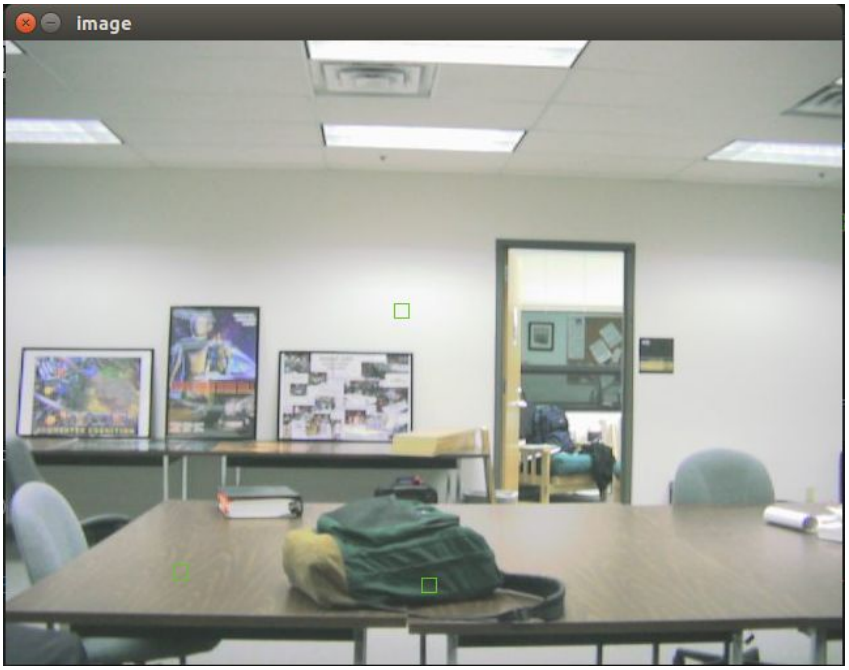
Picture 3: human2.tif



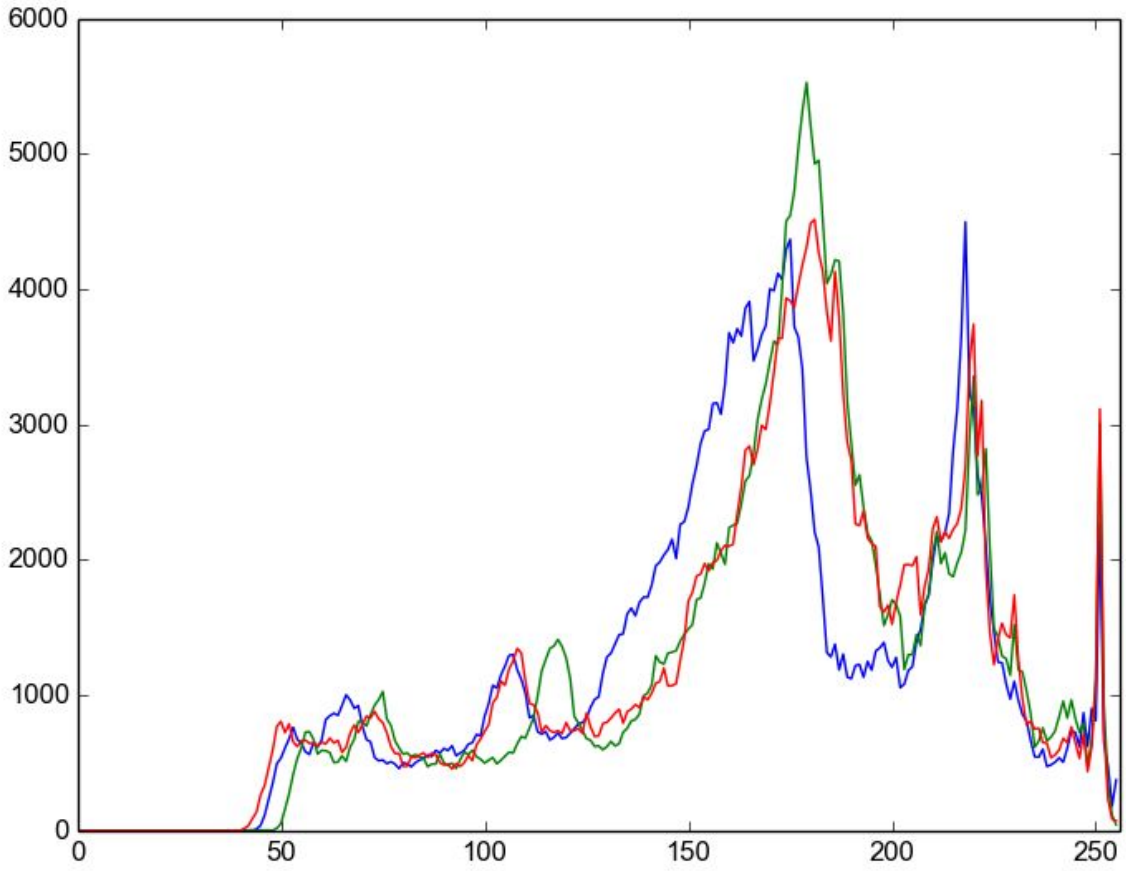
```
/usr/bin/python2.7 /home/bhavika/PycharmProjects/vision/Project2/part1.py
./images/human2.tif
('Location', 467, 230)
/home/bhavika/PycharmProjects/vision/Project2/part1.py:26: RuntimeWarning: overflow encountered in ubyte_scalars
Red: 225, Green: 224, Blue: 203
  print('Intensity:', color[0] + color[1] + color[2] / 3)
('Intensity:', 246)
Mean [[145.37578125]
 [143.70888997]
 [141.20369792]], standard deviation: [[70.87475758]
 [68.6657193 ]
 [76.64735411]]
('Location', 368, 234)
Red: 160, Green: 157, Blue: 120
('Intensity:', 74)
Mean [[145.37601237]
 [143.73370768]
 [141.21741211]], standard deviation: [[70.87428042]
 [68.65468466]
 [76.63140361]]
('Location', 268, 113)
Red: 127, Green: 116, Blue: 111
('Intensity:', 269)
Mean [[145.35404948]
 [143.73638021]
 [141.19632813]], standard deviation: [[70.88494281]
 [68.65639501]
 [76.62243061]]
```



Picture 4: image1.jpeg



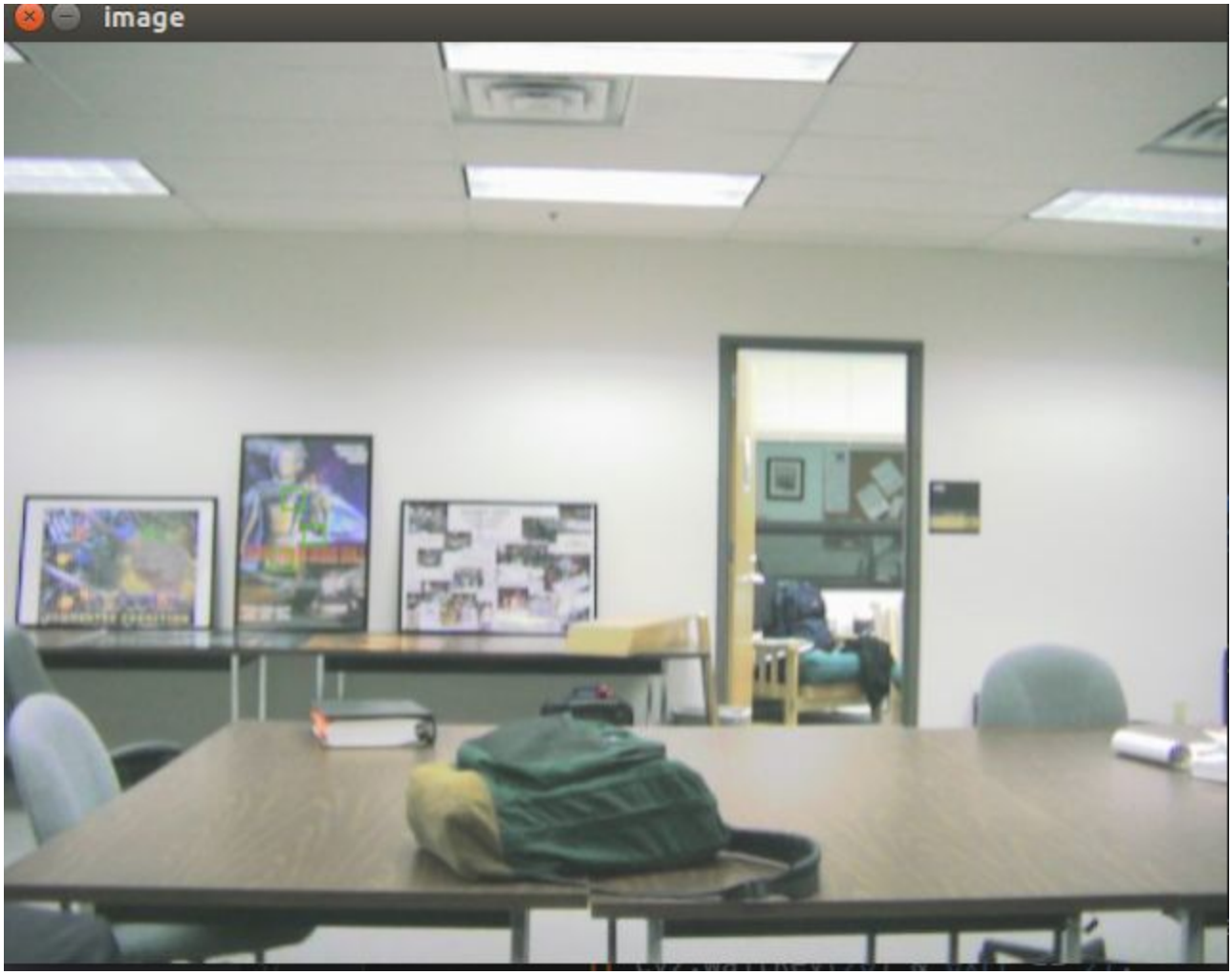

```
/usr/bin/python2.7 /home/bhavika/PycharmProjects/vision/Project2/part1.py
./images/image1.jpeg
('Location', 128, 403)
Red: 177, Green: 179, Blue: 165
('Intensity:', 147)
/home/bhavika/PycharmProjects/vision/Project2/part1.py:27: RuntimeWarning: overflow encountered in ubyte_scalars
  print('Intensity:', color[0] + color[1] + color[2] / 3)
Mean [[164.2123763 ]
 [171.10228516]
 [168.55251628]], standard deviation: [[47.08996432]
 [45.18773232]
 [48.08540399]]
('Location', 318, 413)
Red: 155, Green: 147, Blue: 100
('Intensity:', 298)
Mean [[164.20676107]
 [171.11934245]
 [168.55749674]], standard deviation: [[47.1028296 ]
 [45.17578667]
 [48.07629727]]
('Location', 297, 202)
Red: 191, Green: 193, Blue: 188
('Intensity:', 188)
Mean [[164.17657878]
 [171.1129362 ]
 [168.53676758]], standard deviation: [[47.11873399]
 [45.16851664]
 [48.07464962]]
```



4. Discussion of homogeneity within image windows

Consider the following image - image1.jpeg. I have selected 3 windows (shown in green) that can be seen in the second “framed” poster from the left in the image.

As we can see, the overall colors in that area seem to be mostly white or grey.
I select 3 pixels - (147, 232), (158, 251) and (141, 264) which are quite close to each other. Then, I draw windows around them of size 11 * 11. From the calculated RGB values of those pixels, the average mean of RGB is 164 for red, 171 for green and 168 for blue in all 3 windows. Similarly, standard deviation for each channel also does not vary much in those 3 windows. We can say that those 3 windows are homogenous because the variation in mean of the windows is not much. However, if we were to select a window on the desk or bag area, we get drastically different means & standard deviations. Therefore, homogeneity between windows close to each other is greater than that between windows well separated from each other.




```
/usr/bin/python2.7 /home/bhavika/PycharmProjects/vision/Project2/part1.py
./images/image1.jpeg
('Location', 147, 232)
/home/bhavika/PycharmProjects/vision/Project2/part1.py:26: RuntimeWarning: overflow encountered in ubyte_scalars
Red: 187, Green: 187, Blue: 175
  print('Intensity:', color[0] + color[1] + color[2] / 3)
('Intensity:', 168)
Mean [[164.20638346]
 [171.10056966]
 [168.55285482]], standard deviation: [[47.09052937]
 [45.18742392]
 [48.08400553]]
('Location', 158, 251)
Red: 199, Green: 196, Blue: 189
('Intensity:', 195)
Mean [[164.18775391]
 [171.10690104]
 [168.54482096]], standard deviation: [[47.11421775]
 [45.18685106]
 [48.08982734]]
('Location', 141, 264)
Red: 191, Green: 189, Blue: 176
('Intensity:', 172)
Mean [[164.17328125]
 [171.11446289]
 [168.53458008]], standard deviation: [[47.1383349 ]
 [45.18669778]
 [48.09494214]]
```

Question 1.2

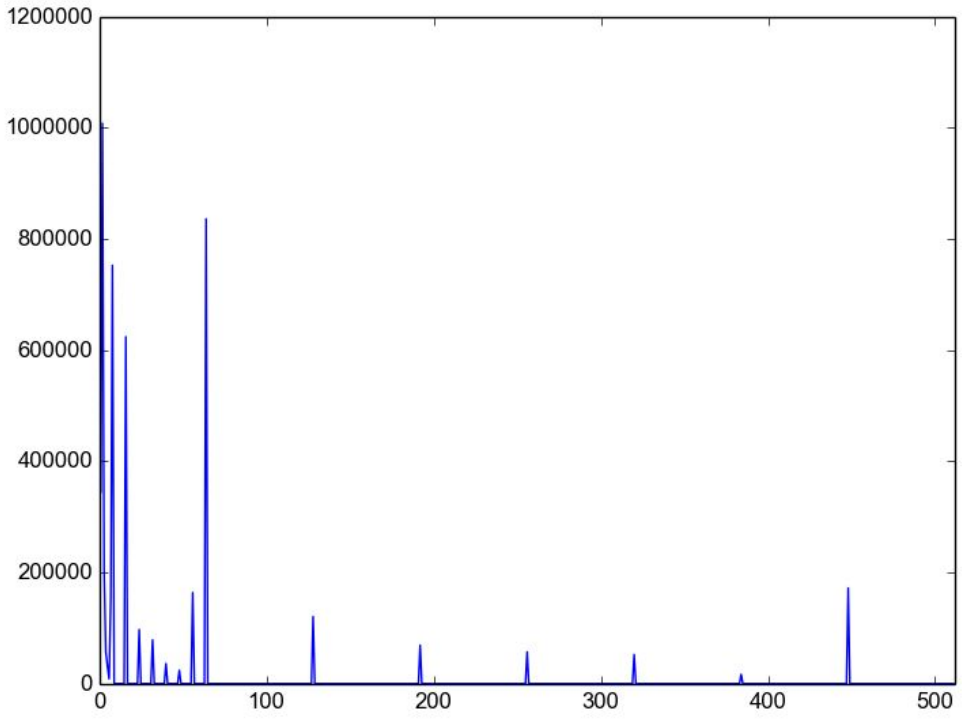
Process:

A. Convert the RGB pixels to a new index for each image. Overall, due to using numpy and bit shifts, I can complete this step is 18-20 seconds for 99 images.

I did this using bit shifts:

b = b >> 5
g = (g >> 5) << 3
r = (r >> 5) << 6

A histogram of the new index looks like this for ST2MainHall4002.jpg when we plot 512 bins:



B. Histogram Comparisons:

I use numpy to calculate histogram intersections pairwise for all 99 images. Similarly, I also calculate the chi-squared measure for each pair of images.

I optimized several steps here using numpy and reusing calculations for pairs of images (similarity of image 1 and image 2 is same as image 2 and image 1).

C. Output matrices after histogram comparisons: