Report_ImagesProject

March 1, 2017

1 Classify Real Images and Computer Generated Images

```
In [1]: from PIL import Image
        import glob
        import numpy as np
        from pylab import *
        # read all of the real images
        image_list_real = [Image.open(filename) for filename in glob.glob('/Users/Y
```

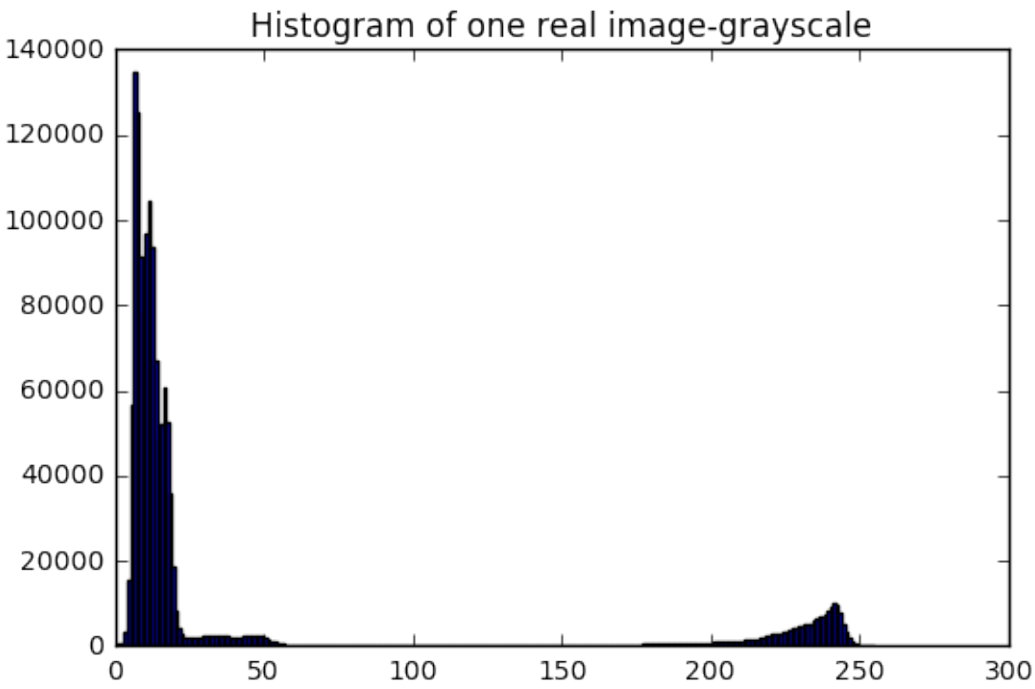
1.1 Method 1: Grayscale Classifying

1.1.1 Main Idea: Compute the sum of difference between (neighbor) points of grayscale histogram (How smooth of the histogram)

```
In [2]: # Function of Calculating the difference,
        # Dividing by (row*col), which is the total pixels,
        # to normalize the value of bins
        def cal_dif(his,row,col):
            s = 0
            for index in range(len(his)-1):
                s = np.absolute((his[index]-his[index+1])/(row*col))+s
            return s
```

Simple illustration of one of the real images

```
In [3]: gray = np.asarray(image_list_real[0].convert('L'))
        [row,col] = np.shape(gray)
        y, x, _ = plt.hist(gray.flatten(),bins = 255)
        plt.title("Histogram of one real image-grayscale")
        plt.show()
        cal_dif(y,row,col)
```




```
Out[3]: 0.25654861111111138
```

1.1.2 Build the statistical model

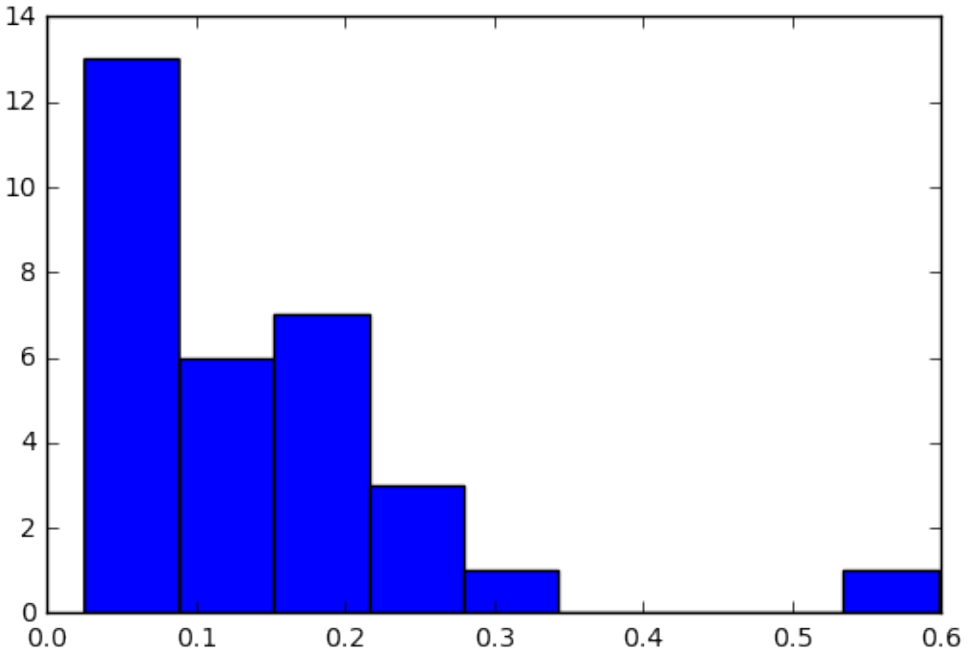
```
In [4]: #for real images
        result = []
        for index in range(len(image_list_real)):
            gray = np.asarray(image_list_real[index].convert('L'))
            [row,col] = np.shape(gray)
            y, x, _ = plt.hist(gray.flatten(),bins = 255)
            plt.cla()
            plt.clf()
            plt.close('all')
            result.append(cal_dif(y,row,col))
```

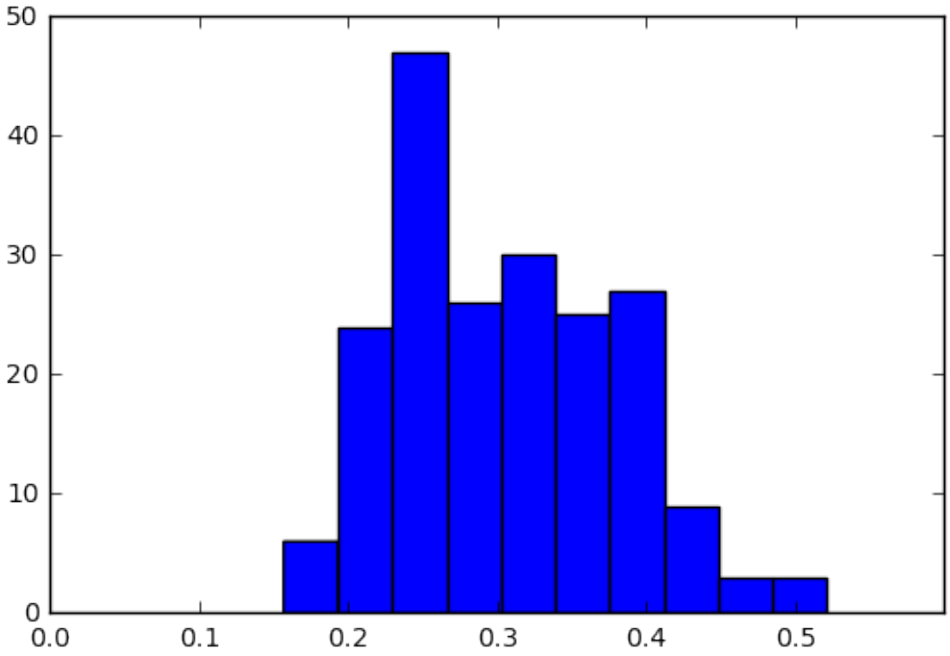
```
In [5]: # for computer generated images
        number = 0
        result_cg = []
        for filename in glob.glob('/Users/Yixiao/Desktop/TrainingSetSynthetic/*'):
            im_cg = Image.open(filename)
            gray = np.asarray(im_cg.convert('L'))
            [row,col] = np.shape(gray)
            y, x, _ = plt.hist(gray.flatten(),bins = 255)
            plt.cla()
            plt.clf()
```

```
            plt.close('all')
            result_cg.append(cal_dif(y,row,col))
            #number = number+1
            #if(number >80):
                #break
```

1.1.3 Histogram of Real Images and Computer generated Images

```
In [6]: fig, ax1 = plt.subplots()
        fig, ax2 = plt.subplots()
        y_r,x_r,_ = ax1.hist(result,bins = 'auto')
        y_c,x_c,_ = ax2.hist(result_cg,bins = 'auto')
        ax2.set_xlim(0,0.6)
        plt.show()
```

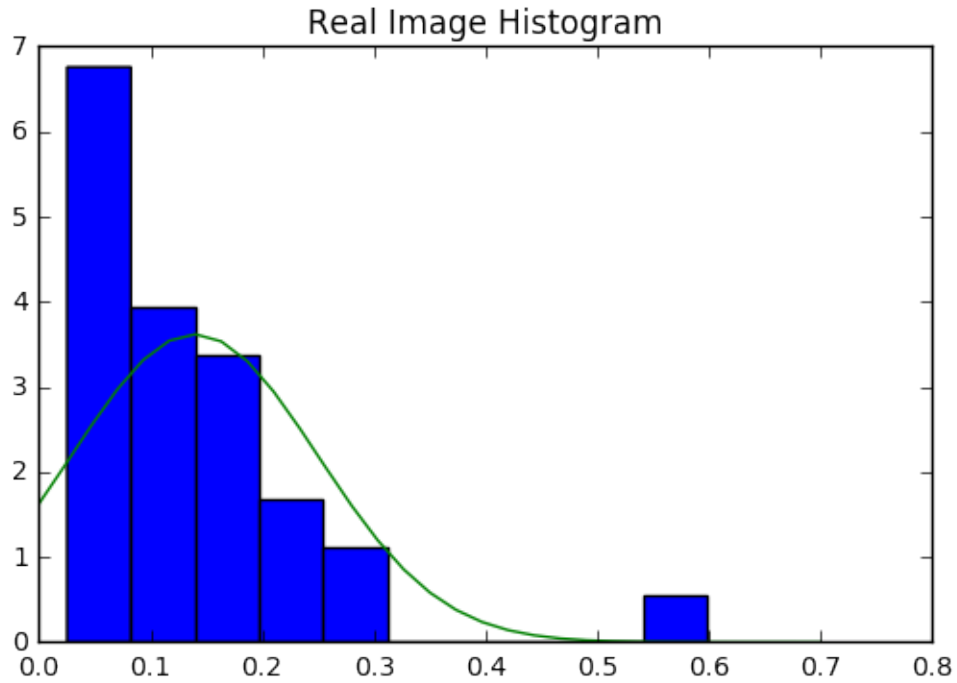


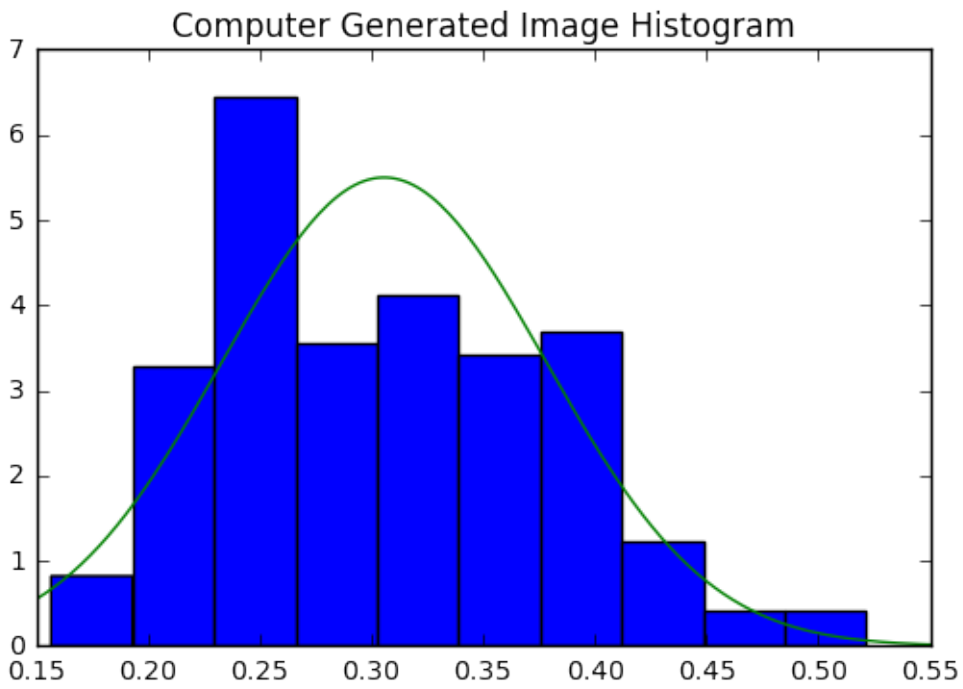


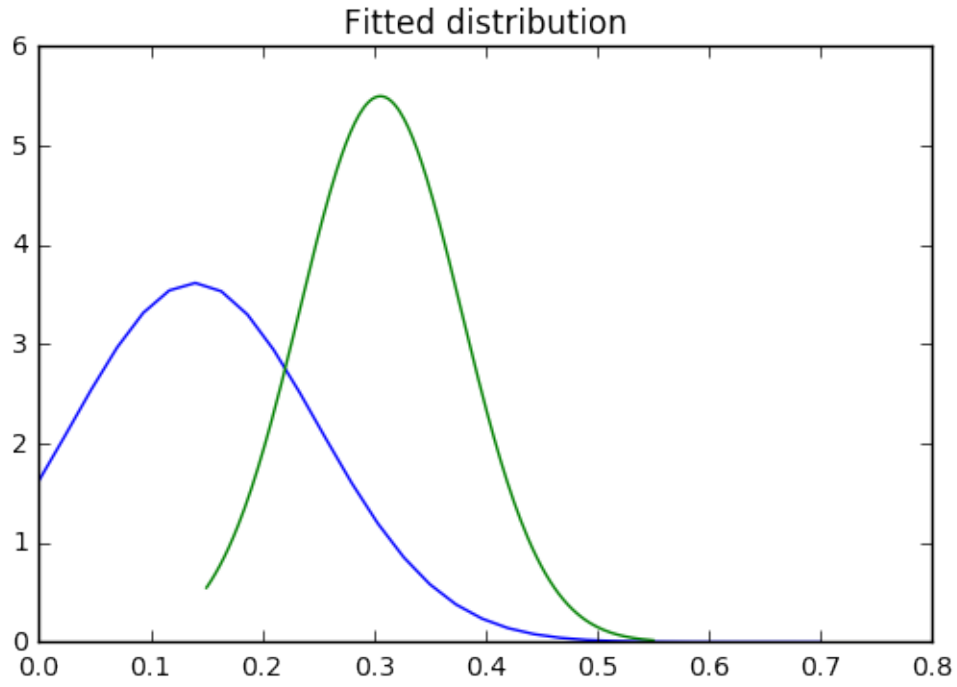
1.1.4 Find threshold based on the proposed Model

In [7]:
```
from scipy import stats
# fit the norm distribution model
# plot normed histogram
plt.hist(result, normed=True)

# find minimum and maximum of xticks, so we know
# where we should compute theoretical distribution
xt = plt.xticks()[0]
xmin, xmax = min(xt), max(xt)
lnspc1 = np.linspace(xmin, xmax, len(result))

# lets try the normal distribution first
m1, s1 = stats.norm.fit(result) # get mean and standard deviation
pdf_g1 = stats.norm.pdf(lnspc1, m1, s1) # now get theoretical values in our
plt.plot(lnspc1, pdf_g1, label="Norm")
plt.title("Real Image Histogram")
plt.show()


#fit the computer generated images
# plot normed histogram
plt.hist(result_cg, normed=True)
```

```
# find minimum and maximum of xticks, so we know
# where we should compute theoretical distribution
xt = plt.xticks()[0]
xmin, xmax = min(xt), max(xt)
lnspc2 = np.linspace(xmin, xmax, len(result_cg))

# lets try the normal distribution first
m2, s2 = stats.norm.fit(result_cg) # get mean and standard deviation
pdf_g2 = stats.norm.pdf(lnspc2, m2, s2) # now get theoretical values in ou
plt.plot(lnspc2, pdf_g2, label="Norm")
plt.title("Computer Generated Image Histogram")
plt.show()

fig,ax1 = plt.subplots()
ax1.plot(lnspc1, pdf_g1, label="Norm")
ax1.plot(lnspc2, pdf_g2, label="Norm")
#ax1.plot(lnspc2,mlab.normpdf(lnspc2, m2, s2)/mlab.normpdf(lnspc2, m1, s2),
plt.title("Fitted distribution")
plt.show()
```




Computer Generated Image Histogram
0
1
2
3
4
5
6
7
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.55


Fitted distribution
0
1
2
3
4
5
6
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8

1.1.5 Choosing Threshold based on the model

```
In [8]: [m1,s1,m2,s2]
```

```
Out[8]: [0.1393765794524254,
         0.11024770784019662,
         0.30573896604938278,
         0.072545486304158122]
```

1.1.6 find the accuracy of the model

```
In [9]: #false positive
        threshold = 0.25
        fp = len([x for x in result if x>=threshold])/len(result)
        #True positive
        tp = len([x for x in result_cg if x>=threshold])/len(result_cg)
        [fp,tp]
```

```
Out[9]: [0.0967741935483871, 0.735]
```

1.2 Appendix: Alternative Methods we've discussed

1.2.1 Method 2: Gradient (Not accurate when compared with method 1)

The image gradient is the vector $\nabla I = [I_x, I_y]^T$. The gradient magnitude is calculated by $|\nabla I| = \sqrt{I_x^2 + I_y^2}$

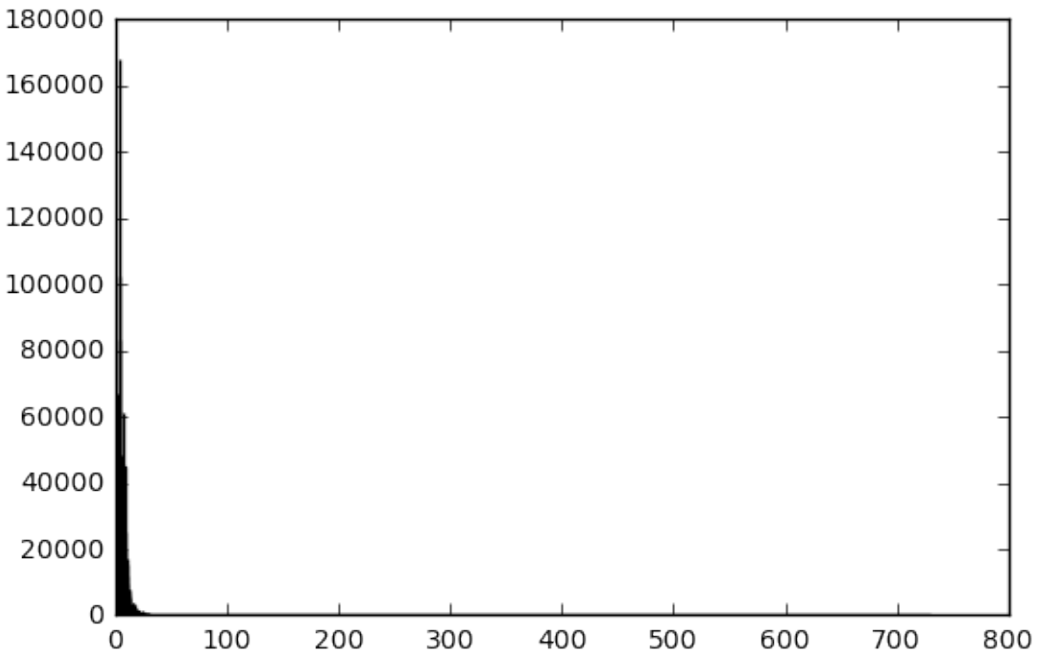
Computing the image derivatives can be done using discrete approximations. These are most easily implemented as convolutions: $Ix = I * D_x$ and $Iy = I * D_y$.

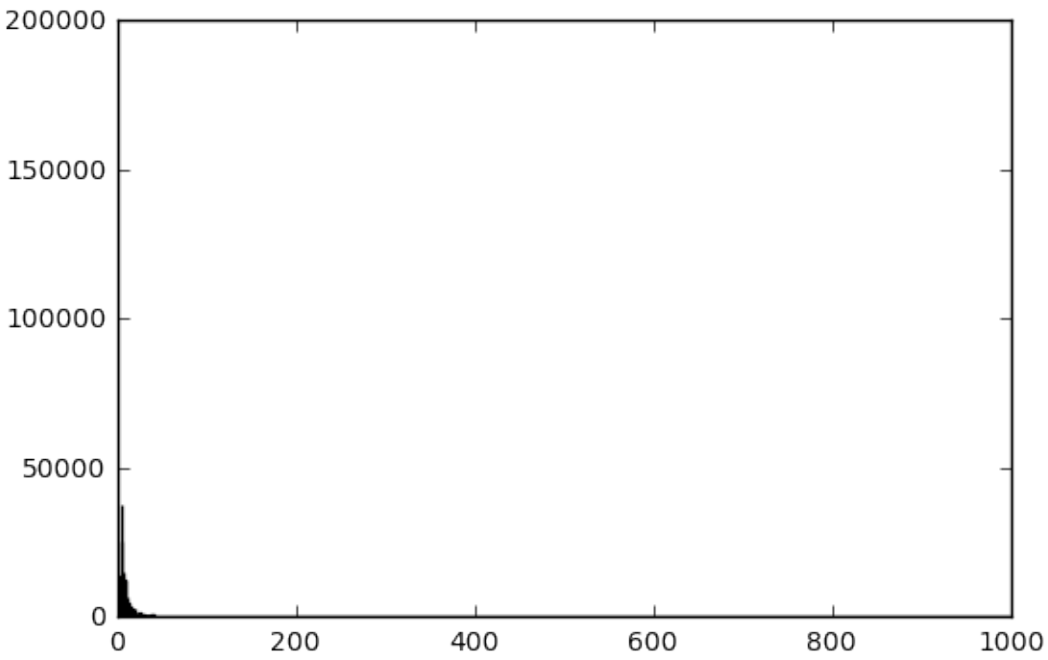
Sobel filters:

$$D_x = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix} \quad D_y = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}$$

```
In [12]: from PIL import Image
         import glob
         import numpy as np
         from pylab import *
         # read all of the real images
         image_real_m2 = [Image.open(filename).convert('L') for filename in glob.gl
         from scipy.ndimage import filters
         def get_mag(im):
             im_real = np.asarray(im)
             imx = zeros(im_real.shape)
             filters.sobel(im_real,1,imx)
             imy = zeros(im_real.shape)
             filters.sobel(im_real,0,imy)
             magnitude = sqrt(imx**2+imy**2)
             return magnitude
```

```
In [13]: i = Image.open("/Users/Yixiao/Desktop/TrainingSetSynthetic/image99.png").c
         magnitude = get_mag(image_real_m2[0])
         y_m, x_m, _ = plt.hist(magnitude.flatten(),bins = 'auto')
         #plt.ylim((-100,500000))
         plt.show()
         magnitude = get_mag(i)
         y_m, x_m, _ = plt.hist(magnitude.flatten(),bins = 'auto')
         #plt.ylim((-100,500000))
         plt.show()
```



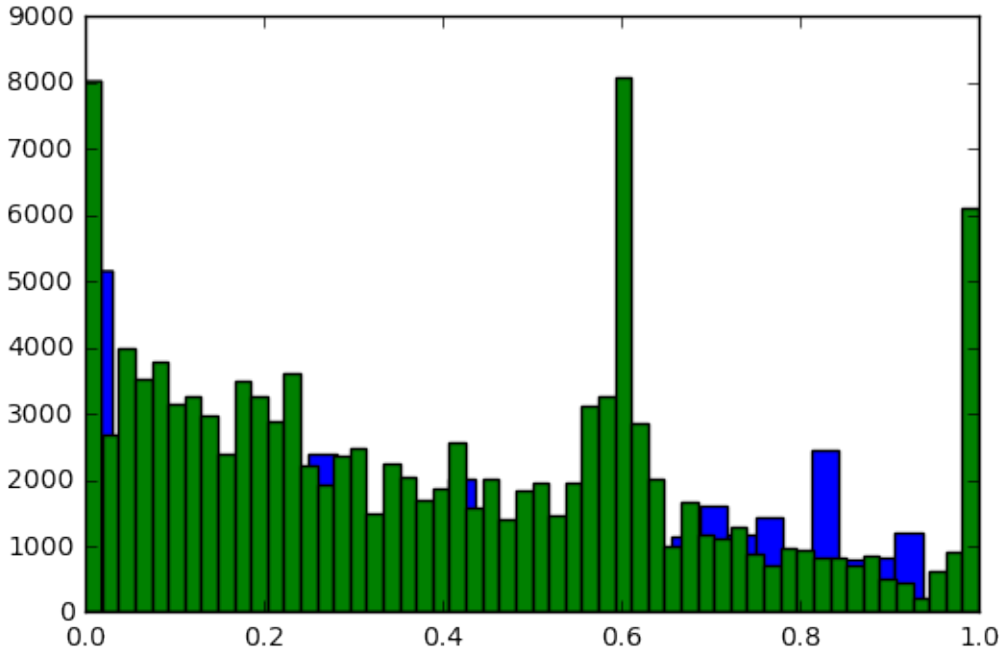



```
In [14]: i = Image.open("/Users/Yixiao/Desktop/TrainingSetSynthetic/image99.png").c
         magnitude = get_mag(image_real_m2[0])
         y_m, x_m, _ = plt.hist(magnitude.flatten(),bins = 'auto')
         r = np.amax(y_m)
         magnitude = get_mag(i)
         y_m, x_m, _ = plt.hist(magnitude.flatten(),bins = 'auto')
         c = np.amax(y_m)
```

1.2.2 Method 3: HSV: using saturation (Bad performance)

```
In [17]: import matplotlib.colors as colors
         sa1 = []
         sa2 = []
         count1 = 0
         count2 = 0
         for filename in glob.glob('/Users/Yixiao/Desktop/TrainingSetSynthetic/*'):
             im = Image.open(filename)
             array=np.asarray(im)
             arr=(array.astype(float))/255.0
             img_hsv = colors.rgb_to_hsv(arr[:,:,:3])
             sa1.append(img_hsv[:,1].flatten())
             count1 = count1+1
             if(count1>20):
                 break
         for filename in glob.glob('/Users/Yixiao/Desktop/TrainingSetScenes/*'):
```

```
        im = Image.open(filename)
        array=np.asarray(im)
        arr=(array.astype(float))/255.0
        img_hsv = colors.rgb_to_hsv(arr[:,:,:3])
        sa2.append(img_hsv[:,1].flatten())
        count2 = count2+1
        if(count2>20):
            break
    r1 = np.concatenate(np.asarray(sa1))
    r2 = np.concatenate(np.asarray(sa2))


    plt.hist(r1,bins = 'auto')
    plt.hist(r2,bins = 'auto')
    plt.show()
```



In [ ]: