02_PW_Sol

November 7, 2018

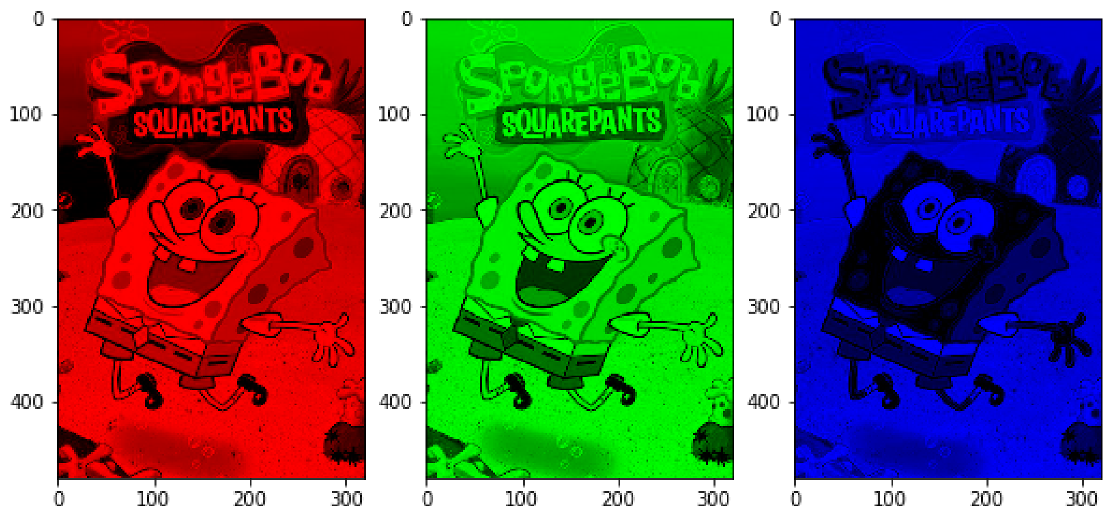
1 PW 02 : Exercice 1 Numpy tutorial

In [22]:
```
import imageio
import matplotlib.pyplot as plt
import numpy as np
%matplotlib inline
img_name = './PW02/ex1-numpy/sponge-bob.jpg'

img = imageio.imread(img_name)
print(img.shape)
img_tinted = img * [0.8, 0.8, 0.8]

plt.figure(figsize=(10, 10))

# Show the original image
plt.subplot(1, 2, 1)
plt.imshow(img)

# Show the tinted image
plt.subplot(1, 2, 2)
# A slight gotcha with imshow is that it might give strange results
# if presented with data that is not uint8. To work around this, we
# explicitly cast the image to uint8 before displaying it.
plt.imshow(np.uint8(img_tinted))

plt.show()
```

```
(480, 320, 3)
```

In [12]:
```
###########################################################################
# TODO:                                                                   #
# Show the red, green and blue components of the image in 3 different #
# sub-plots                                                               #
###########################################################################
#ăIf we have a look at the array in "img" we can see that it has 3 different
# values per index. These are the values for red, green and blue.
# To display each channel seperatly we need to take only the value at a specific inde

img = imageio.imread(img_name)
img_red = img * [1.0, 0.0, 0.0]
img_green = img * [0.0, 1.0, 0.0]
img_blue = img * [0.0, 0.0, 1.0]

plt.figure(figsize=(10, 10))

# Show the red channel
plt.subplot(1, 3, 1)
plt.imshow(np.uint8(img_red))

# Show the green channel
plt.subplot(1, 3, 2)
plt.imshow(np.uint8(img_green))
```

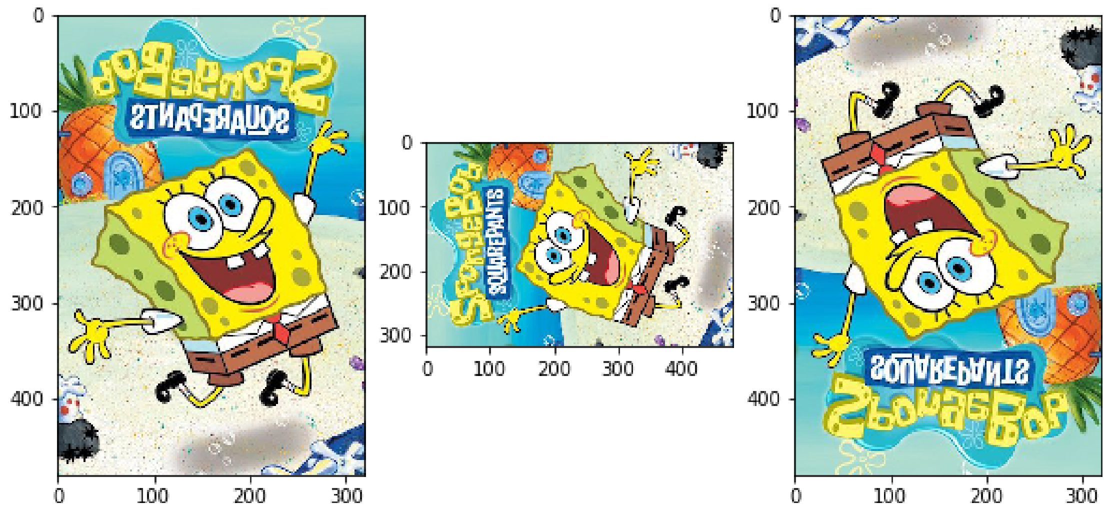
```
# Show the blue channel
plt.subplot(1, 3, 3)
plt.imshow(np.uint8(img_blue))

plt.show()

#############################################################################
#                              END OF YOUR CODE                             #
#############################################################################
```



In [13]:

```
#############################################################################
# TODO:                                                                     #
# Perform the following distorsion of the image and display it              #
#   - vertical flip                                                         #
#   - rotation 90 degrees                                                   #
#   - horizontal flip
# Hint: have a look at the np.fliplr() function                             #
#############################################################################



img = imageio.imread(img_name)
# Vertical Flip ("mirroring")
img_flipped_lr = np.fliplr(img)
#ărotation 90 degrees
img_rot90 = np.rot90(img)
# horizontal flip
img_flipped_ud = np.flipud(img)
```

```
plt.figure(figsize=(10, 10))

# Show the flipped lr image
plt.subplot(1, 3, 1)
plt.imshow(np.uint8(img_flipped_lr))

# Show the rotated image
plt.subplot(1, 3, 2)
plt.imshow(np.uint8(img_rot90))

# Show the flipped ud image
plt.subplot(1, 3, 3)
plt.imshow(np.uint8(img_flipped_ud))

plt.show()


########################################################################
#                          END OF YOUR CODE                            #
########################################################################
```



2 PW 02 : Exercice 2 Classification system with KNN - Student dataset

a. Getting started

a) Read the training data from file ex1-data-train.csv. The first two columns are x1 and x2. The last column holds the class label y.

```
In [18]: import pandas as pd
```

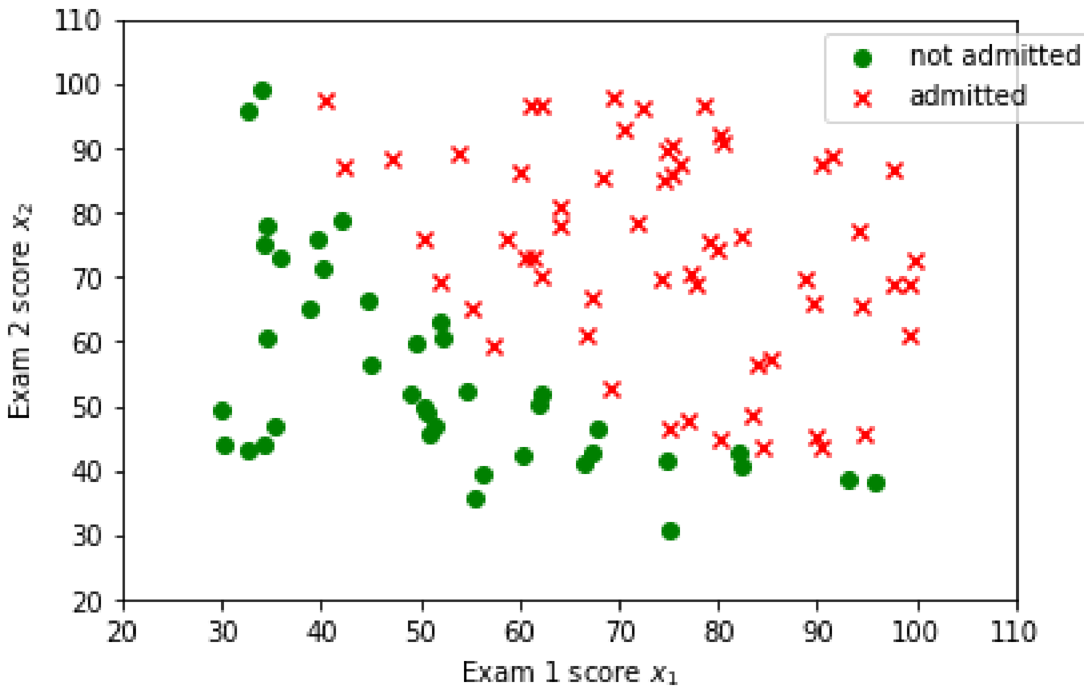
```python
dataset = pd.read_csv('./PW02/ex2-student-dataset/ex1-data-train.csv',names=['x1','x2
dataset.head()
```

Out[18]:
```
<div>
<style scoped>
    .dataframe tbody tr th:only-of-type {
        vertical-align: middle;
    }

    .dataframe tbody tr th {
        vertical-align: top;
    }

    .dataframe thead th {
        text-align: right;
    }
</style>
<table border="1" class="dataframe">
  <thead>
    <tr style="text-align: right;">
      <th></th>
      <th>x1</th>
      <th>x2</th>
      <th>y</th>
    </tr>
  </thead>
  <tbody>
    <tr>
      <th>0</th>
      <td>34.623660</td>
      <td>78.024693</td>
      <td>0</td>
    </tr>
    <tr>
      <th>1</th>
      <td>30.286711</td>
      <td>43.894998</td>
      <td>0</td>
    </tr>
    <tr>
      <th>2</th>
      <td>35.847409</td>
      <td>72.902198</td>
      <td>0</td>
    </tr>
    <tr>
      <th>3</th>
      <td>60.182599</td>
```

```
      <td>86.308552</td>
      <td>1</td>
    </tr>
    <tr>
      <th>4</th>
      <td>79.032736</td>
      <td>75.344376</td>
      <td>1</td>
    </tr>
  </tbody>
</table>
</div>
```


b) Plot the training data using a scatter plot. You should get something similar to what is displayed in Figure 1.

In [33]:
```
x1 = dataset['x1'].values
x2 = dataset['x2'].values
y = dataset['y'].values

x1_0 = []
x1_1 = []
x2_0 = []
x2_1 = []

for i in np.arange(len(x1)):
    if y[i] == 0:
        x1_0.append(x1[i])
        x2_0.append(x2[i])
    else:
        x1_1.append(x1[i])
        x2_1.append(x2[i])

plt.scatter(x1_0,x2_0,marker='o',color='green',label='not admitted')
plt.scatter(x1_1,x2_1,marker='x',color='red',label='admitted')
plt.xlabel('Exam 1 score $x_1$')
plt.ylabel('Exam 2 score $x_2$')
plt.legend(bbox_to_anchor=(1.1, 1))
axes = plt.gca()
axes.set_xlim([20,110])
axes.set_ylim([20,110])
plt.show()

test = (50,50)
```



c) Build a dummy recognition system that takes decisions randomly.

```
In [34]: import random

         def dummy_decisions():
             rnd = random.uniform(0, 1)
             if rnd > 0.5:
                 return 1
             else:
                 return 0
```

d) Compute the performance Ncorrect/N of this system on the test set ex1-data-test.csv, with N the number of test samples and Ncorrect the number of correct decision in com- parison to the ground truth.

```
In [35]: N = len(y)
         def performance_dummy(y):
             N_correct = 0

             for i in y:
                 dec = dummy_decisions()
                 if dec == i:
                     N_correct += 1
             return N_correct

         print(performance_dummy(y))
```

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b. KNN classifier

In [36]:
```
def euclidianDistance(point_A,point_B):
    #return np.sqrt(np.sum(np.power((a-b),2.0)))
    return np.sqrt(sum([(a - b) ** 2 for a, b in zip(point_A, point_B)]))


#euclidian distance between all the point from a and the unique point b
def euclidianDistanceVec(X_train,X_test):
    euclidianDistanceList = []
    [euclidianDistanceList.append(euclidianDistance(i,X_test)) for i in X_train]
    return euclidianDistanceList

def knn(X_train, X_test, y, k):
    y_pred = []
    #calculate the distance from 1 point of test to all points of train
    for i in X_test:
        dist_X_test = euclidianDistanceVec(X_train, i)
        #get the k smallest distances
        kNNs = nsmallest(k, dist_X_test)
        #for each NN get the index class of the point
        classification_vec = []
        index_of_kNN = []
        for dist in kNNs:
            index_of_kNN.append(dist_X_test.index(dist))
        for ind in index_of_kNN:
            classification_vec.append(y[ind])
            #Now we got the classes for each kNN we need to make a decision
        if len(classification_vec) % 2 == 0 and classification_vec.count(0) == classi
            sum_0 = 0
            sum_1 = 0
            for a in range(len(classification_vec)):
                if classification_vec[a] == 0:
                    sum_0 += dist_X_test[index_of_kNN[a]]
                else:
                    sum_1 += dist_X_test[index_of_kNN[a]]
            if sum_0 < sum_1:
                y_pred.append(0)
            else:
                y_pred.append(1)
        else:
            counts = np.bincount(np.array(classification_vec))
            y_pred.append(np.argmax(counts))
    return y_pred
```

Compute the performance of the system as a function of k = 1 . . . 7. What value of k gives you the best performances ?

```
In [38]: from heapq import nsmallest

         # prepare the points

         X_train = list(zip(x1,x2))

         #load test set

         dataset_test = pd.read_csv('./PW02/ex2-student-dataset/ex1-data-test.csv',names=['x1'

         x1_test = dataset_test['x1'].values
         x2_test = dataset_test['x2'].values
         y_test = dataset_test['y'].values

         X_test = list(zip(x1_test,x2_test))

         for k in range(1,8):
             ypred = knn(X_train, X_test, y, k)
             counter = 0
             for i in range(len(y)):
                 if y_test[i] == ypred[i]:
                     counter += 1
             print(counter/N)
```

```
0.96
0.96
0.97
0.96
0.92
0.95
0.91
```

Comment your result.

My implemenation takes, if k is even, the total sum of distances of NNs and takes the class with the smaller sum. (There are many other possible solution)

3 PW 02 : Exercice 3 Classification system with KNN - MNIST dataset