Tutorial on Supervised Learning

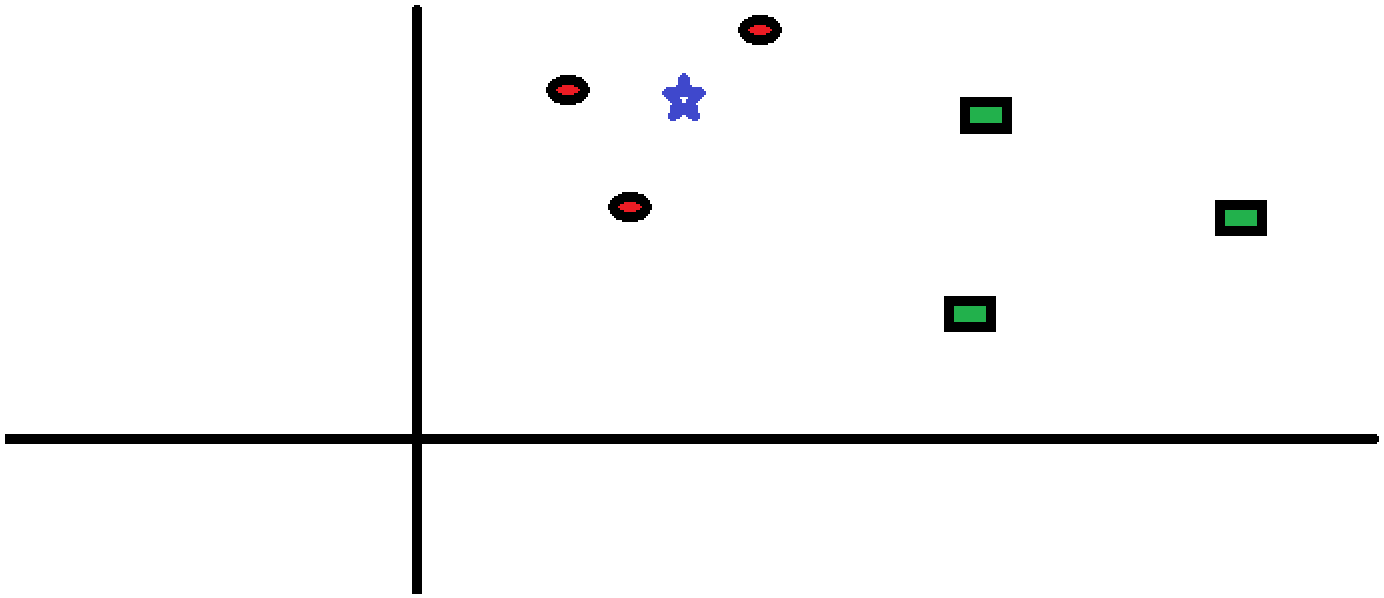
Part 2 : Classification using k-Nearest Neighbor (k-NN) (implemented in Python from scratch)

Quick Recap

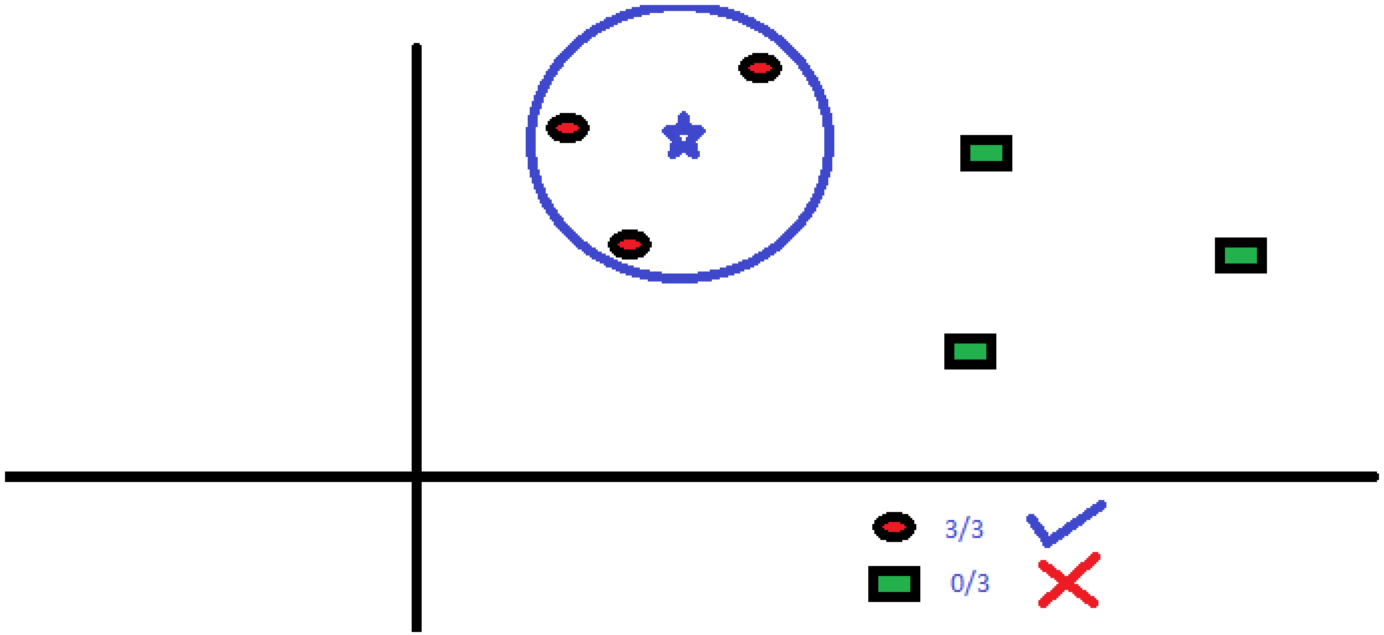
k-NN - A lazy learner !

It doesn’t learn a discriminative function from the training data, but “memorizes” the training dataset instead.

Example - With given data below, classify a new point (denoted by the blue star), which can belong in either red or green class.



Assume k = 3. Then based on the class votes received from the 3-nearest neighbors, Blue Star will be classified into the majority class.



Pre-requisite

- **Euclidean distance** between two points
- How **voting** works
- Dataset knowledge : **Titanic dataset (used previously in the tutorial on Naive Bayes)**

- With given dataset: Memorize a person's *Age* and *Fare*; supervision (label): he/she *survived* or not.
- Classifying a new datapoint: Using *Age* and *Fare* our learner will predict whether the person survives or not.

In [1]:

```
# necessary dependencies

import numpy as np
import pandas as pd
from collections import Counter
```

In [2]:

```
# load training data

data=pd.read_csv("./train.csv")[["Survived","Age","Fare"]]
data=data.fillna(data.mean())
data.head()
```

Out[2]:

	Survived	Age	Fare
0	0	22.0	7.2500
1	1	38.0	71.2833
2	1	26.0	7.9250
3	1	35.0	53.1000
4	0	35.0	8.0500

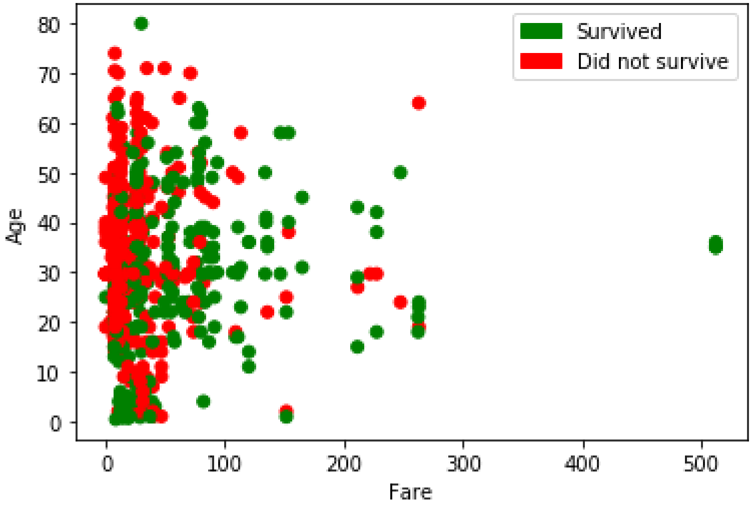
In [3]:

```
# load test data

passenger_id=pd.read_csv("./test.csv")["PassengerId"]
test_data=pd.read_csv("./test.csv")[["Age","Fare"]]
test_data=test_data.fillna(test_data.mean())
print(test_data.head())
test_data=test_data.values
```

```
    Age     Fare
0  34.5   7.8292
1  47.0   7.0000
2  62.0   9.6875
3  27.0   8.6625
4  22.0  12.2875
```

We need to visualize the training data to understand how k-NN works.

In [5]:
```
import matplotlib.pyplot as plt
import matplotlib.patches as mpatches

col=data["Survived"]
colormap = np.array(['r', 'g'])
plt.scatter( x=data["Fare"],y=data["Age"], c=colormap[col])
surv = mpatches.Patch(color='g', label='Survived')
notSurv = mpatches.Patch(color='r', label='Did not survive')
plt.xlabel('Fare')
plt.ylabel('Age')
plt.legend(handles=[surv,notSurv])
plt.show()
```



In [6]:

```
def compute_distances_one_loop(new_points, X_train):
    #X_Train = all of our given training samples,
    # new_points = our new points on which we want to predict

    num_test = len(new_points)
    num_train =X_train.shape[0]
    dists = np.zeros((num_test, num_train))
    for i in range(num_test):

        # for each test point, computing Euclidean distance from all points in X
_train
        difference = new_points[i] - X_train
        difference = np.square(difference)
        sum1 = np.sum(difference, axis=1)
        dists[i] = np.sqrt(sum1)
    return dists
```

In [7]:

```
# Now that we have distance from each point, we will simply find out the distanc
e which is the least
def predict(dists, training_labels, k=3):
    closest_y = []
    rank = list(np.argsort(dists))
    for x in range(0, k):
        closest_y.append(training_labels[rank[x]])
    closest_y = np.asarray(closest_y)
    c=Counter(closest_y)
    return (c.most_common()[0][0])
```

In [8]:

```
dists=compute_distances_one_loop(test_data,data[["Fare","Age"]])
print('Training instances: {}'.format(data.shape[0]))
print('Testing instances: {}'.format(test_data.shape[0]))

Results=[]
for x in dists:
    Results.append(predict(x, data["Survived"]))
```

```
Training instances: 891
Testing instances: 418
```

In [9]:

```
# storing the results
f=open("result.csv","w")
f.write("PassengerId,Survived")
for i in range(0, len(Results)):
    f.write("\n")
    f.write(str(passenger_id[i])+","+ str(Results[i]))

f.close()
```

Let's compare the performance of our implementation with the kNN classifier of **scikit-learn**

In [10]:

```
from sklearn.neighbors import KNeighborsClassifier

neigh = KNeighborsClassifier(n_neighbors=3)
neigh.fit(data[["Fare","Age"]], data["Survived"])
scikit_result=neigh.predict(test_data)



count=0
notr=[]
for i in range(0, len(scikit_result)):
    if scikit_result[i]==Results[i]:
        count+=1
    else:
        notr.append(i)

print ("TOTAL INSTANCES: {}".format(len(scikit_result)))
print ("RESULTS MATCHED B/W IMPLEMENTED KNN AND SCIKIT-LEARN INBUILT KNN: {}/{}"
.format(count, len(scikit_result)))
```

```
TOTAL INSTANCES: 418
RESULTS MATCHED B/W IMPLEMENTED KNN AND SCIKIT-LEARN INBUILT KNN: 416/418
```

End of Part 2