In [1]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
```

In [2]:

```
filename = 'ex2data1.txt'
```

In [3]:

```
data = pd.read_csv(filename, names=['Exam1', 'Exam2', 'Admitted'])
```

In [4]:

```
data.head()
```

Out[4]:

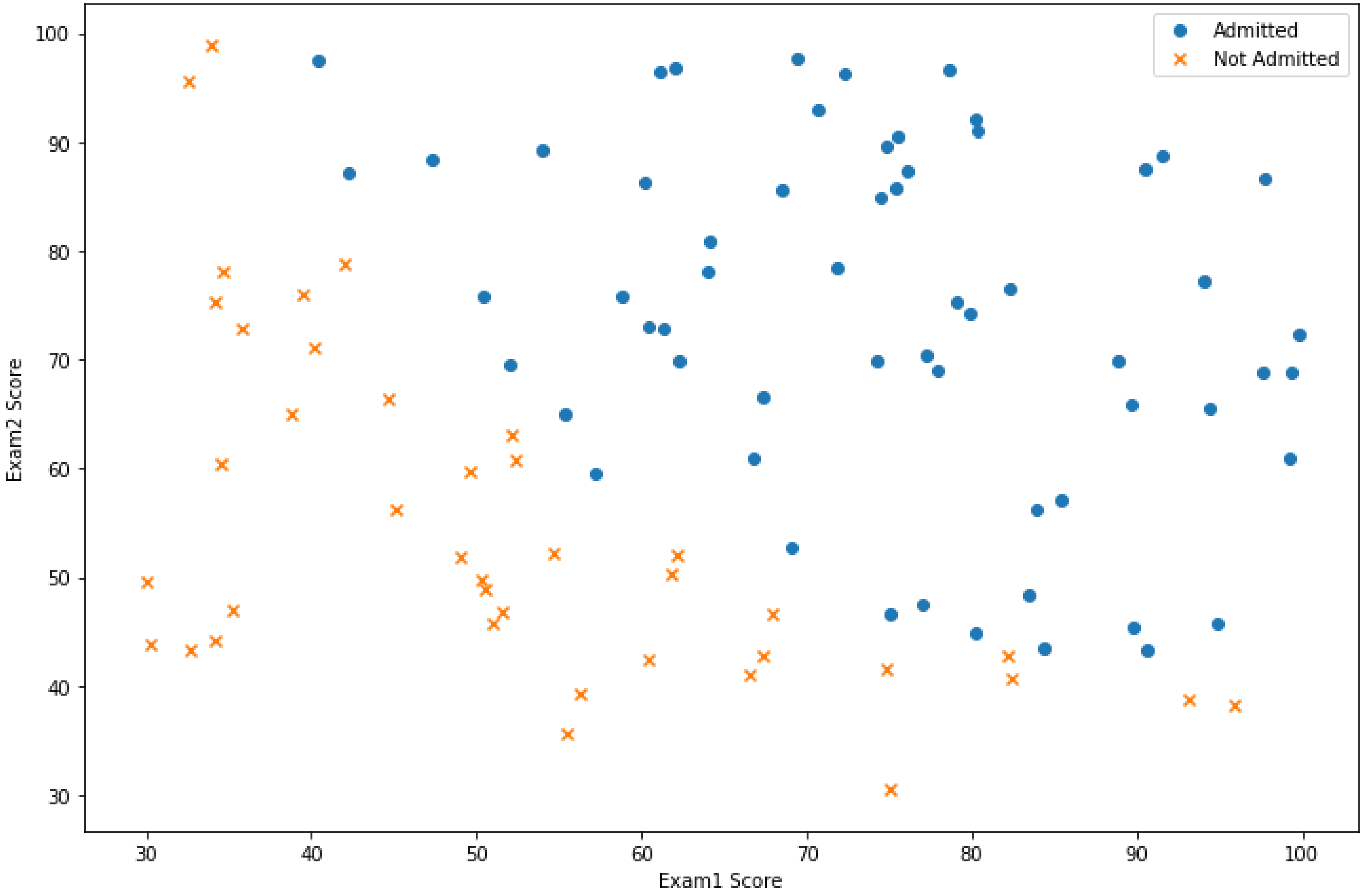
	Exam1	Exam2	Admitted
0	34.623660	78.024693	0
1	30.286711	43.894998	0
2	35.847409	72.902198	0
3	60.182599	86.308552	1
4	79.032736	75.344376	1

In [6]:

```
positive = data[data['Admitted'].isin([1])]
negative = data[data['Admitted'].isin([0])]

#For creating 1200 X 800 pixels
fig, ax = plt.subplots(figsize=(12,8))
ax.scatter(positive['Exam1'], positive['Exam2'], marker='o', label='Admitted')
ax.scatter(negative['Exam1'], negative['Exam2'], marker='x', label='Not Admitted')
#Used to show objects at right top corner
ax.legend()
ax.set_xlabel('Exam1 Score')
ax.set_ylabel('Exam2 Score')
```

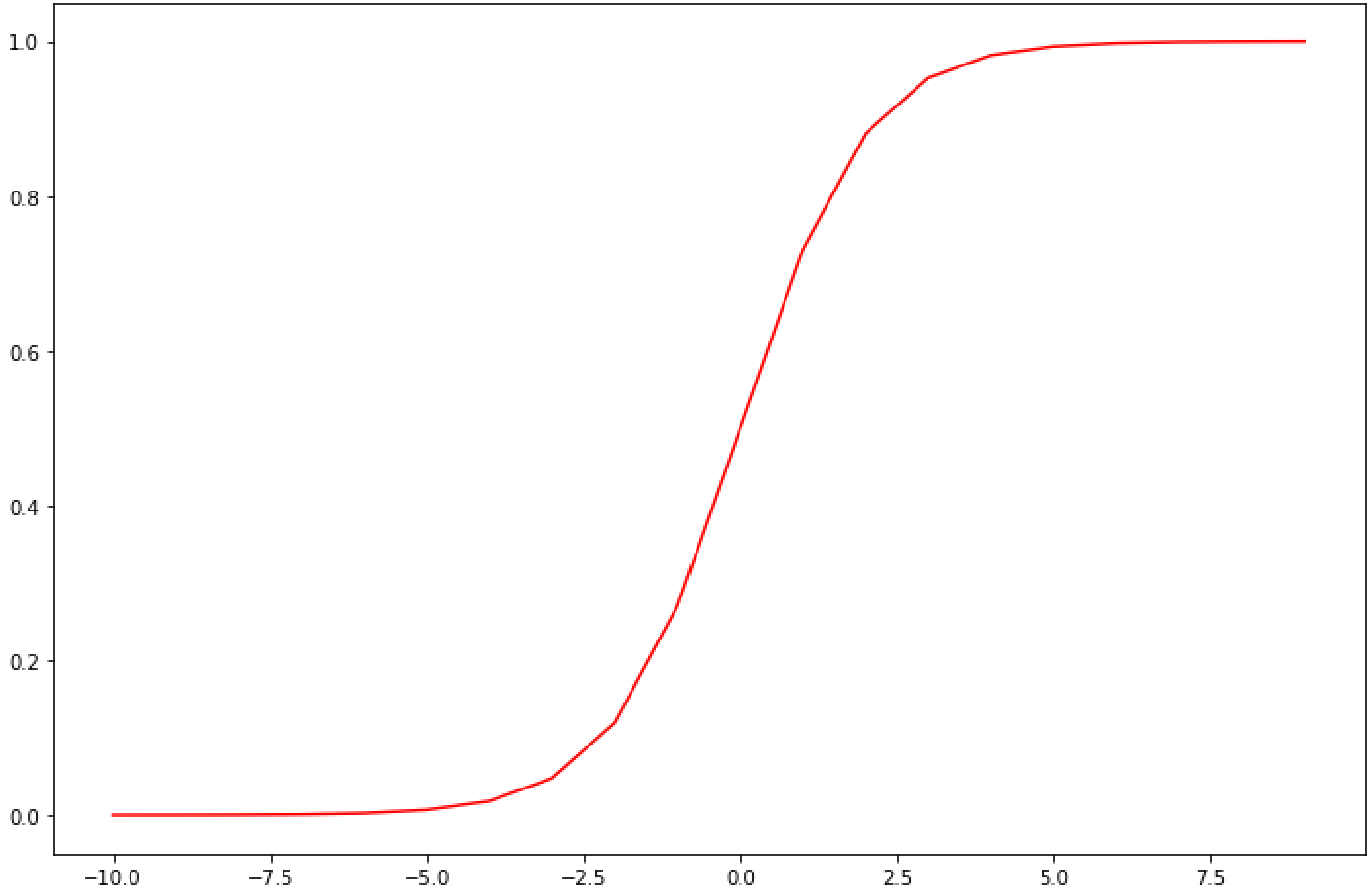
```
Out[6]: Text(0,0.5,u'Exam2 Score')
```



```
In [8]: def sigmoid(z):
            g =  1 / (1 + np.exp(-z))
            return g
```

In [53]:
```
nums = np.arange(-10, 10, step=1)
fig, ax = plt.subplots(figsize=(12,8))
ax.plot(nums, sigmoid(nums), 'r')
```

Out[53]:
```
[<matplotlib.lines.Line2D at 0x7f0372256950>]
```



In [50]:

```
def cost(theta, X, y):
    theta = np.matrix(theta)
    X  = np.matrix(X)
    y = np.matrix(y)
    first = np.multiply(-y, np.log(sigmoid(X * theta.T)))
    second = np.multiply((1-y) ,np.log(1 - sigmoid(X * theta.T)))
    return (np.sum(first-second))/(len(X))
```

In [ ]:

```
data.insert(0, 'Ones', 1)
```

In [51]:

```
# set X (training data) and y (target variable)
cols = data.shape[1]
X = data.iloc[:,0:cols-1]
y = data.iloc[:,cols-1:cols]

#convert to numpy arrays and initalize the parameter array theta
X = np.array(X.values)
y = np.array(y.values)
theta = np.zeros(3)
```

In [43]:

```
X.shape, y.shape, theta.shape
```

Out[43]:

```
((100, 3), (100, 1), (3,))
```

In [44]:

```
cost(theta, X, y)
```

Out[44]:

```
0.6931471805599453
```

In [45]:

```
def gradient(theta, X, y):
    theta = np.matrix(theta)
    X = np.matrix(X)
    y = np.matrix(y)

    parameters = int(theta.ravel().shape[1])
    grad = np.zeros(parameters)

    error = sigmoid(X * theta.T) - y

    for i in range(parameters):
        term = np.multiply(error, X[:,i])
        grad[i] = np.sum(term) / len(X)

    return grad
```

In [46]:

```
import scipy.optimize as opt
result = opt.fmin_tnc(func=cost, x0=theta, fprime=gradient, args=(X, y))
cost(result[0], X, y)
```

Out[46]:

```
0.20349770158947458
```

In [36]:

```
X.shape, y.shape
```

Out[36]:

```
((100, 3), (100, 1))
```

In [38]:

```
gradient(theta, X, y)
```

Out[38]:

```
array([ -0.1       , -12.00921659, -11.26284221])
```

In [47]:

```
def predict(theta, X):
    probability = sigmoid(X * theta.T)
    return[1 if x>= 0.5 else 0 for x in probability]
```

In [48]:

```
theta_min = np.matrix(result[0])
predictions = predict(theta_min, X)
correct = [1 if ((a == 1 and b == 1) or (a == 0 and b == 0)) else 0 for (a, b) in zip(predictions, y)]
accuracy = (sum(map(int, correct)) % len(correct))
print 'accuracy = {0}%'.format(accuracy)
```

```
accuracy = 89%
```