Ex_05_Implementation_of_Logistic_Regression_Using_Gradient_DescentA

May 8, 2023

[24]:
```
import numpy as np
import matplotlib.pyplot as plt
from scipy import optimize
```

[25]:
```
data = np.loadtxt("/content/ex2data1.txt",delimiter=",")
X = data[:, [0,1]]
Y = data[:,2]
```

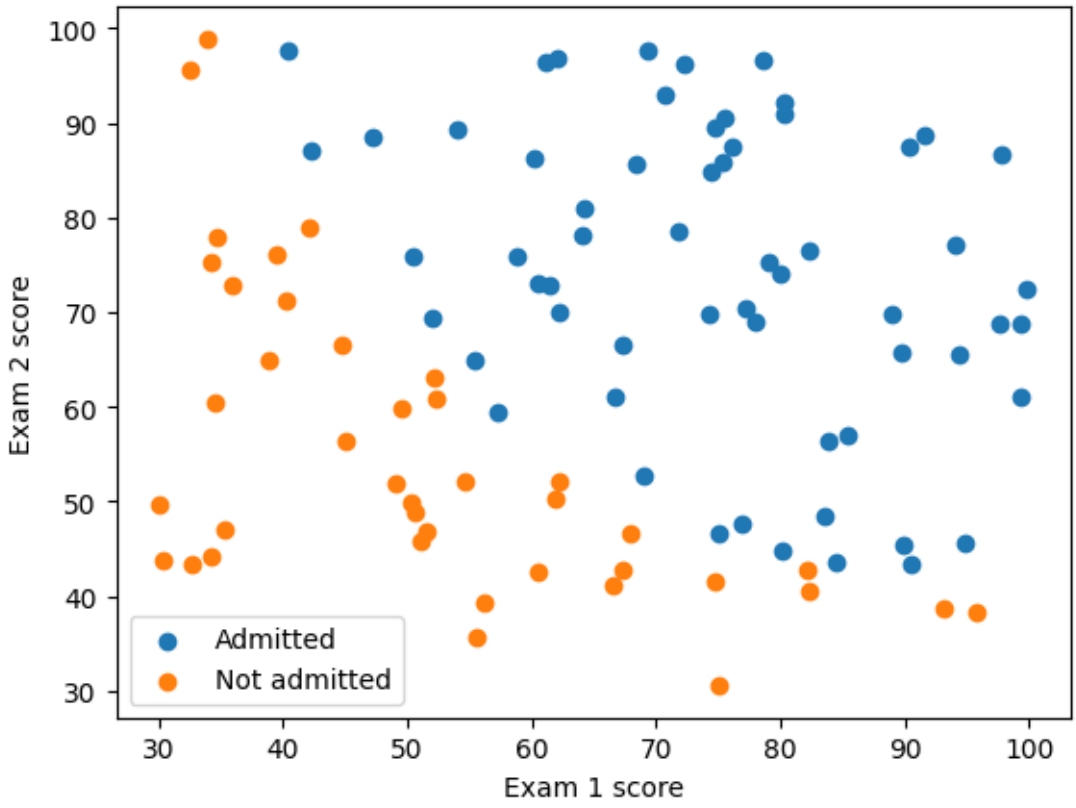
[26]:
```
X[:5]
```

[26]:
```
array([[34.62365962, 78.02469282],
       [30.28671077, 43.89499752],
       [35.84740877, 72.90219803],
       [60.18259939, 86.3085521 ],
       [79.03273605, 75.34437644]])
```

[27]:
```
Y[:5]
```

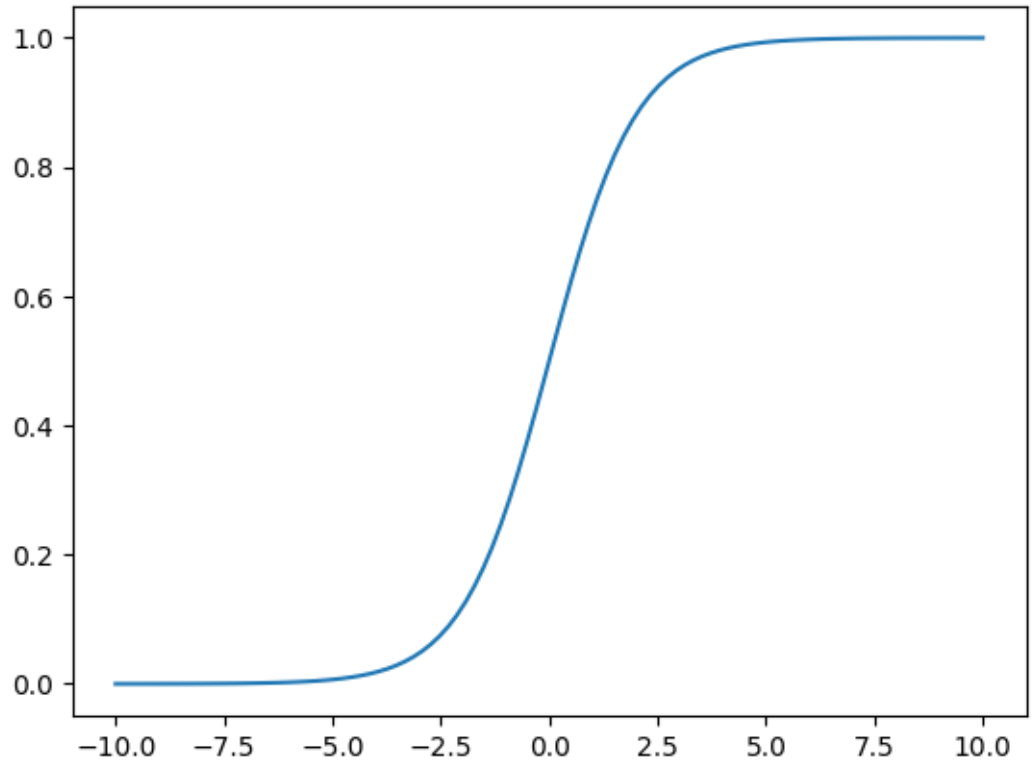
[27]:
```
array([0., 0., 0., 1., 1.])
```

[28]:
```
plt.figure()
plt.scatter(X[y == 1][:, 0], X[y == 1][:, 1], label="Admitted")
plt.scatter(X[y == 0][:, 0], X[y == 0][:, 1], label="Not admitted")
plt.xlabel("Exam 1 score")
plt.ylabel("Exam 2 score")
plt.legend()
plt.show()
```



[29]:
```
def sigmoid(z):
    return 1 / (1 + np.exp(-z))
```

[30]:
```
plt.plot()
X_plot = np.linspace(-10, 10, 100)
plt.plot(X_plot, sigmoid(X_plot))
plt.show()
```



[31]:
```
def costFunction(theta, X, y):
    h = sigmoid(np.dot(X, theta))
    J = -(np.dot(y, np.log(h)) + np.dot(1 - y, np.log(1 - h))) / X.shape[0]
    grad = np.dot(X.T, h - y) / X.shape[0]
    return J, grad
```

[32]:
```
X_train = np.hstack((np.ones((X.shape[0], 1)), X))
theta = np.array([0, 0, 0])
J, grad = costFunction(theta, X_train, y)
print(J)
print(grad)
```

```
0.6931471805599452
[ -0.1        -12.00921659 -11.26284221]
```

[33]:
```
X_train = np.hstack((np.ones((X.shape[0], 1)), X))
theta = np.array([-24, 0.2, 0.2])
J, grad = costFunction(theta, X_train, y)
print(J)
print(grad)
```

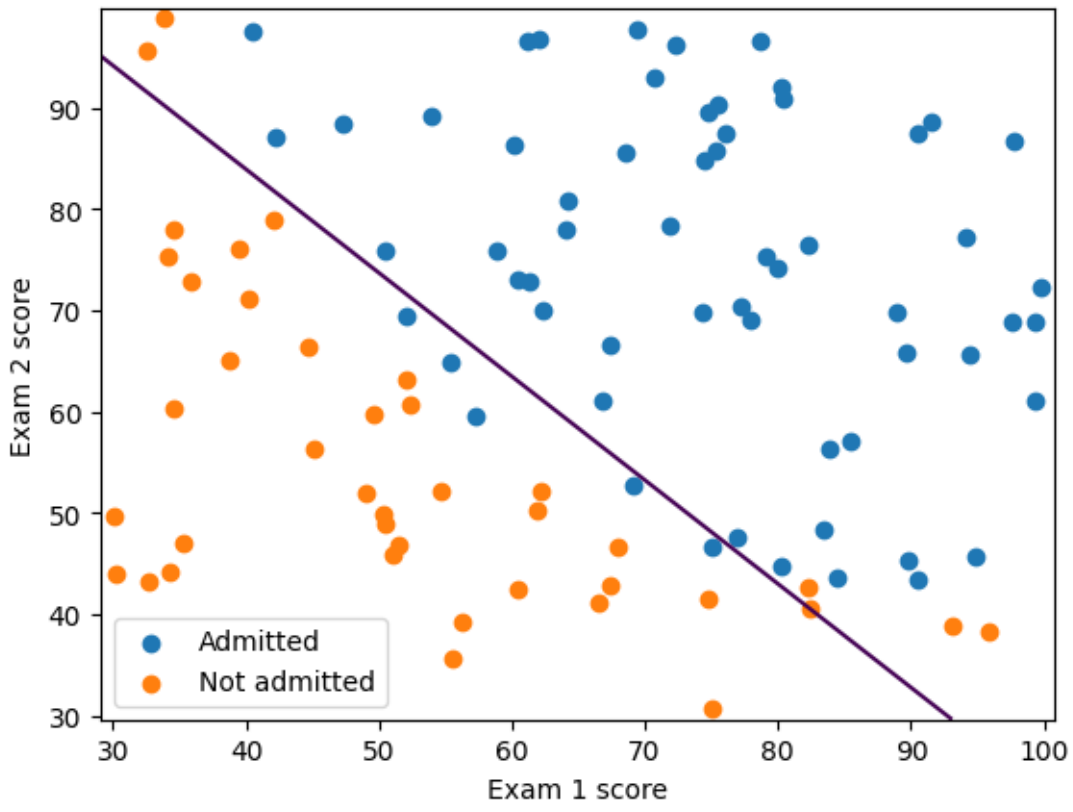
```
0.2183301938265977
[0.04290299 2.56623412 2.64679737]
```

[34]:
```
def cost(theta, X, y):
    h = sigmoid(np.dot(X, theta))
    J = - (np.dot(y, np.log(h)) + np.dot(1 - y, np.log(1 - h))) / X.shape[0]
    return J


def gradient(theta, X, y):
    h = sigmoid(np.dot(X, theta))
    grad = np.dot(X.T, h - y) / X.shape[0]
    return grad


X_train = np.hstack((np.ones((X.shape[0], 1)), X))
theta = np.array([0, 0, 0])
res = optimize.minimize(fun=cost, x0=theta, args=(X_train, y),
                        method='Newton-CG', jac=gradient)
print(res.fun)
print(res.x)
```

```
0.20349770158945205
[-25.16134246   0.20623179   0.20147167]
```

[35]:
```
def plotDecisionBoundary(theta, X, y):
    x_min, x_max = X[:, 0].min() - 1, X[:, 0].max() + 1
    y_min, y_max = X[:, 1].min() - 1, X[:, 1].max() + 1
    xx, yy = np.meshgrid(np.arange(x_min, x_max, 0.1),
                         np.arange(y_min, y_max, 0.1))
    X_plot = np.c_[xx.ravel(), yy.ravel()]
    X_plot = np.hstack((np.ones((X_plot.shape[0], 1)), X_plot))
    y_plot = np.dot(X_plot, theta).reshape(xx.shape)

    plt.figure()
    plt.scatter(X[y == 1][:, 0], X[y == 1][:, 1], label="Admitted")
    plt.scatter(X[y == 0][:, 0], X[y == 0][:, 1], label="Not admitted")
    plt.contour(xx, yy, y_plot, levels=[0])
    plt.xlabel("Exam 1 score")
    plt.ylabel("Exam 2 score")
    plt.legend()
    plt.show()
```

[36]:
```
plotDecisionBoundary(res.x, X, y)
```



[37]:
```
prob = sigmoid(np.dot(np.array([1, 45, 85]), res.x))
print(prob)
```

```
0.7762907420026233
```

[38]:
```
def predict(theta, X):
    X_train = np.hstack((np.ones((X.shape[0], 1)), X))
    prob = sigmoid(np.dot(X_train, theta))
    return (prob >= 0.5).astype(int)
```

[39]:
```
np.mean(predict(res.x, X) == y)
```

[39]: 0.89