Logistic regression

🔶 Logistic regression is an algorithm that can help us answering yes or no questions by predicting the probability something happening or not happening.

🔶 Logistic regression is a classification algorithm despite its name has regression in it. It predicts two binary dependent output either as 0 or 1 based on the input variables.

🔶The regression in its name means we are using the same algorithm as used in linear regression. The difference is that the output is mapped using a logistic/sigmoid function so that it will be in a range between 0 and 1. Any output value < 0.5 will be classified as 0 and any value >= 0.5 will be classified as 1.

🔶 In this notebook, the sklearn logistic regression algorithm is implemented on a simulated seperable dataset with two features

Import libraries

In [1]:

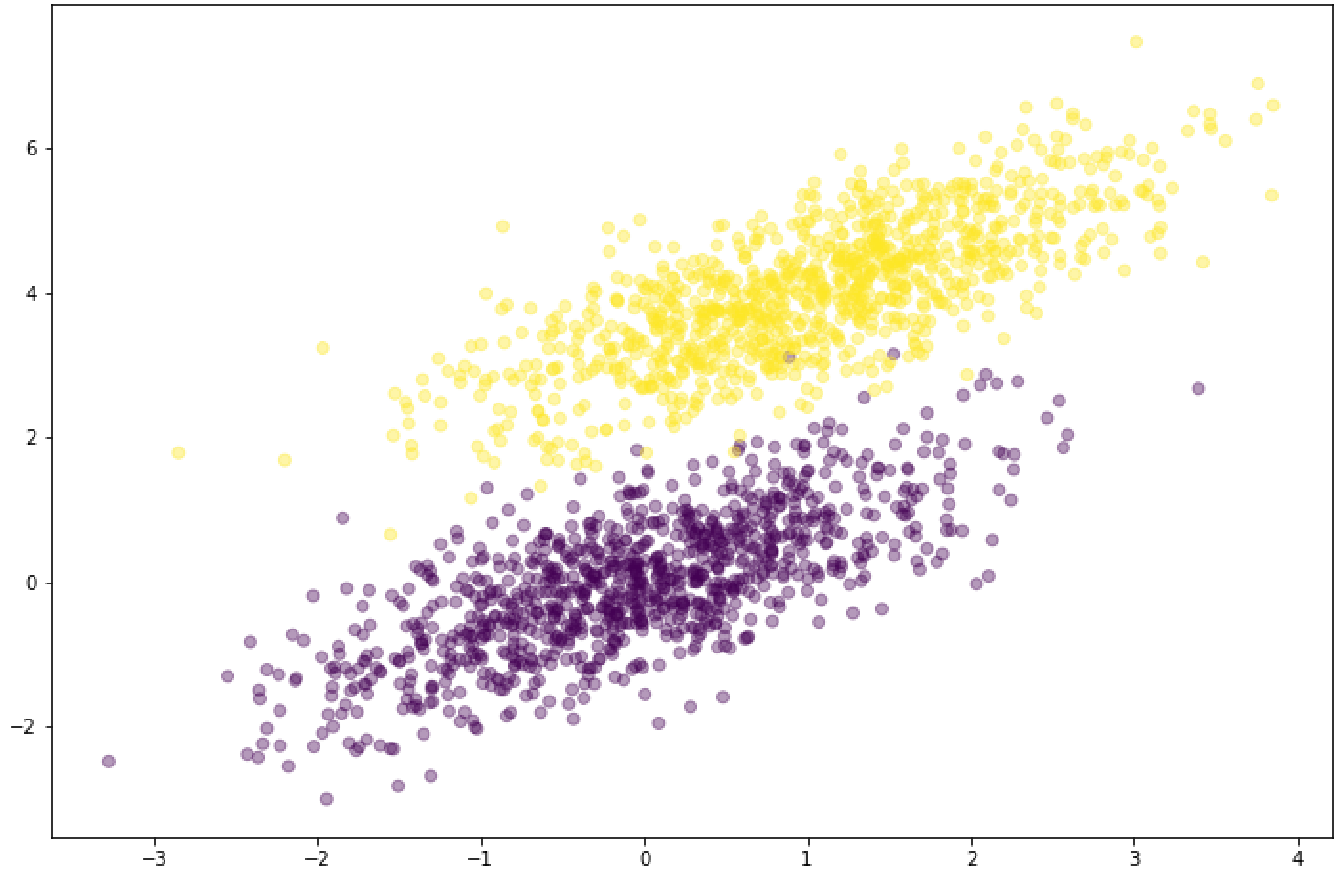
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
from sklearn.linear_model import LogisticRegression
```

Simulating data

The data used in this notebook are simulated using np.random.multivariate_normal to create two seperable features. Credit to git repo

In [2]:

```
np.random.seed(42)
num_observations = 1000

x1 = np.random.multivariate_normal([0, 0], [[1, .75],[.75, 1]], num_observations)
x2 = np.random.multivariate_normal([1, 4], [[1, .75],[.75, 1]], num_observations)
features = np.vstack((x1, x2)).astype(np.float32)
labels = np.hstack((np.zeros(num_observations),
                              np.ones(num_observations)))

#Displaying the output

plt.figure(figsize=(12,8))
plt.scatter(features[:, 0], features[:, 1], c = labels, alpha = .4)
plt.show()
```



Split data to train and test dataset

In [3]:

```
df = pd.DataFrame()
```

In [4]:

```
df['feature_1'] = features[:,0]
df['feature_2'] = features[:,1]
df['label'] = labels.astype(int)
```

In [5]:

```
df.head()
```

Out[5]:

	feature_1	feature_2	label
0	-0.415750	-0.513517	0
1	-1.144330	-0.067385	0
2	0.301810	0.136251	0
3	-1.748547	-1.205889	0
4	0.247329	0.630977	0

In [6]:

```
df = df.sample(frac=1, random_state=42).reset_index(drop=True)
```

In [7]:

```
train_frac = 0.7
```

```
train_size = int(df.shape[0] * train_frac)
x = np.array(df.iloc[:,0:2])
y = np.array(df.iloc[:,2])
x_train = x[0:train_size,:]
y_train = y[0:train_size]
x_test = x[train_size:,:]
y_test = y[train_size:]
```

In [8]:

```
print ('training size is {}\ntest size is {}'.format(x_train.shape[0], x_test.shape[0
```

```
training size is 1400
test size is 600
```

Initialize the model

In [9]:

```
clf = LogisticRegression(random_state=42)
clf.fit(x_train, y_train)
coef = clf.coef_
intercept = clf.intercept_
train_accuracy = clf.score(x_train, y_train)
print ('training accuracy {}'.format(train_accuracy))
```

```
training accuracy 0.9935714285714285
```

Predict using gradient descent method

In [10]:

```
y_pred_train = clf.predict(x_train)
y_pred_test = clf.predict(x_test)
test_accuracy = clf.score(x_test, y_test)
```

In [11]:

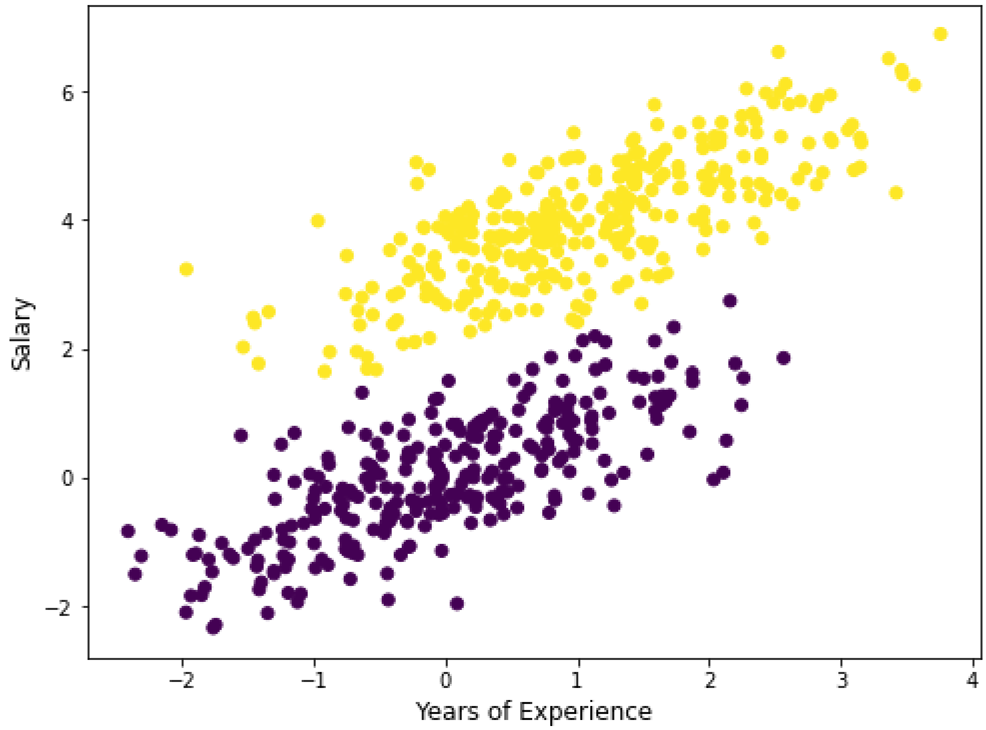
```
# print the test data, predicted test data and the error
print('y_test\n {}\n\ny_pred_test\n {}\n\ntest accuracy {}\n\ncoef {} intercept {}'
      .format(y_test[0:20], y_pred_test[0:20], test_accuracy, coef, intercept))
```

```
y_test
 [0 0 0 1 1 1 0 1 1 0 0 0 0 1 0 0 1 1 0 1]

y_pred_test
 [0 0 0 1 1 1 0 1 1 0 0 0 0 1 0 0 1 1 0 1]

test accuracy 0.995

coef [[-2.22854218  4.55550901]] intercept [-8.20091535]
```

Visulize fitted results using both method

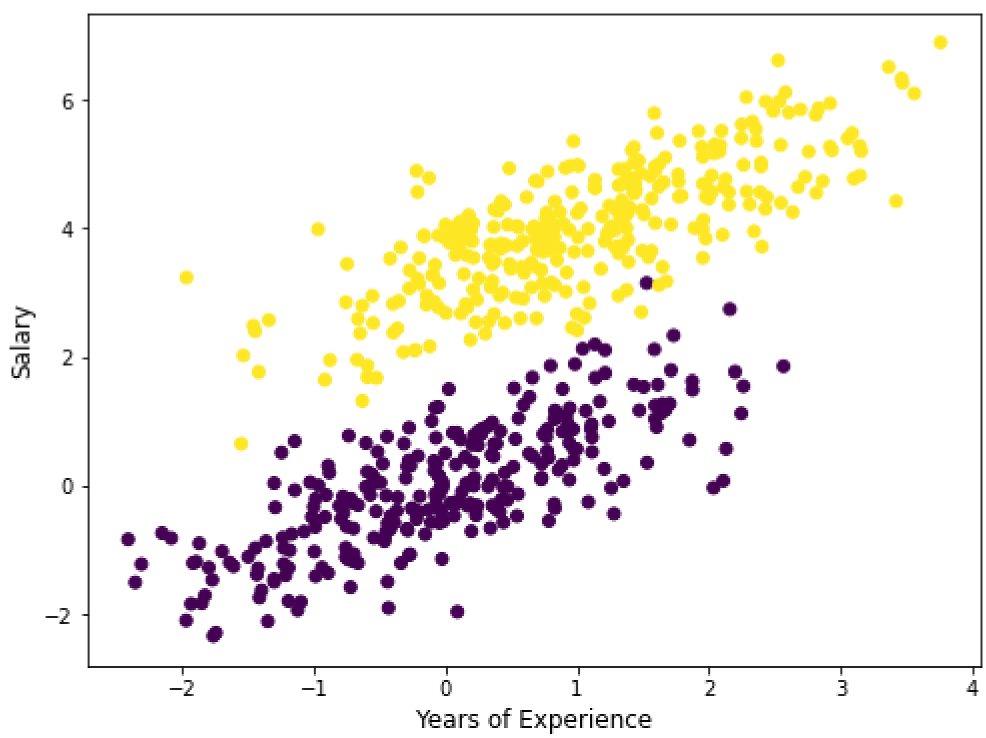
In [12]:

```
fig = plt.figure(figsize=(8,6))
plt.scatter(x_test[:,0], x_test[:,1], c=y_pred_test)
plt.title('', fontsize=14)
plt.xlabel('Years of Experience', fontsize=12)
plt.ylabel('Salary', fontsize=12)
plt.show()
```



In [13]:

```
fig = plt.figure(figsize=(8,6))
plt.scatter(x_test[:,0], x_test[:,1], c=y_test)
plt.title('', fontsize=14)
plt.xlabel('Years of Experience', fontsize=12)
plt.ylabel('Salary', fontsize=12)
plt.show()
```



In [ ]: