28. Logistic Regression (Practical) (Binary Classification)

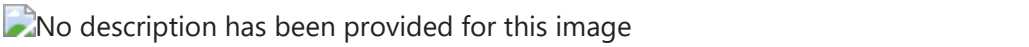
- **Logistic Regression** is one of the most popular Machine Learning algorithms, which comes under the **Supervised Learning Technique**
- It is used for predicting the **categorical dependent variables** using a given set of independent variables
- Therefore, the coutcome must be a categorical or discrete value. It can be either Yes or No, 0 or 1, true or false,etc. but instead of giving the exact value as 0 and 1, **it gives the probablisitic values which lie b/w 0 and 1.**
- The data should be linearly separable

Types of Logistic Regression

On the basis of **categories**, Logistic Regression can be classified into three types:

1. **Binomial:** In binomial logistic regression, there can be two possible types of the dependent variables, such as 0 or 1, Pass or Fail etc.
2. **Multinomial:** In multinomial logistic regression, there can be 3 or more possible **unordered** types of the dependent variables, such as cat, dog or sheep
3. **Ordinal:** In ordinal logistic regression, there can be 5 or more possible **ordered** types of dependent varaibles, such as low, medium or high

- In logistic regression, the prediction is done through **Sigmoid algorithm**



Logistic Regression Equation

The logistic regression equation can be obtained from the Linear Regress Model. The mathematical steps to get Logistic Regression equation are given below:

$$y = \frac{1}{1 + e^{-x}}$$

where:

- y = dependent variable (Bought Product)
- x = independent variable (Salary) (x= m1x1 + m2x2 + b)
- e = Euler's constant-2.71828

In [ ]:

In [3]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

In [5]:
```
dataset = pd.read_csv(r'Data/Social_Network_Ads.csv')
dataset.head(3)
```

Out[5]:

	Age	EstimatedSalary	Purchased
0	19	19000	0
1	35	20000	0
2	26	43000	0

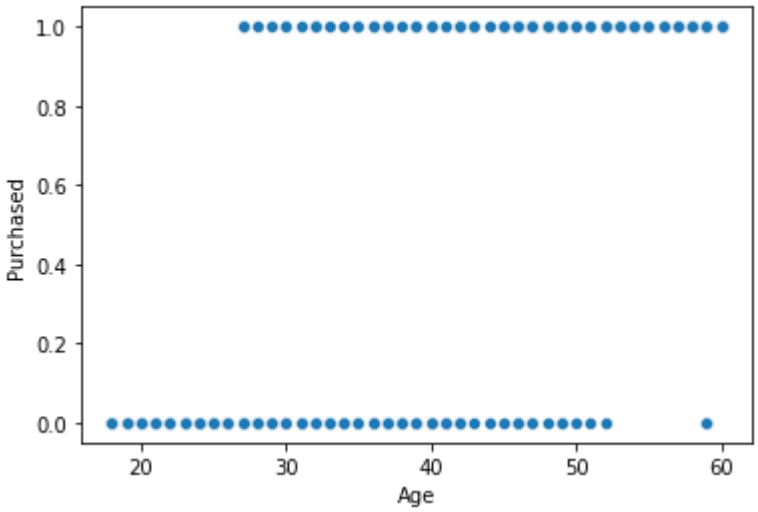
In [9]:
```
# For now, we want to see effect of age on purchase and ignore EstimatedSalary, so
dataset.drop(columns=['EstimatedSalary'], inplace=True)
dataset.head(3)
```

Out[9]:

	Age	Purchased
0	19	0
1	35	0
2	26	0

To see if our data follows Logistic Regression or Not

In [11]:
```
sns.scatterplot(x="Age", y="Purchased", data=dataset)
plt.show()
```



Our data follows logistic regression

1. Next we will split the data into dependent (x) and independent (y) variables

In [13]:
```
# Note that data should be in 2 dimension
x = dataset[['Age']]
y = dataset[['Purchased']]
```

2. Now we will split the data into train and test data

In [14]:
```
from sklearn.model_selection import train_test_split
```

In [15]:
```
x_train, x_test, y_train, y_test = train_test_split(x,y,test_size=0.20, random_stat
```

3. Apply Logistic Regression

In [17]:
```
from sklearn.linear_model import LogisticRegression
```

In [18]:
```
lr = LogisticRegression()
lr.fit(x_train, y_train)
```

```
C:\Users\rashi\AppData\Local\Programs\Python\Python39\lib\site-packages\sklearn\util
s\validation.py:1111: DataConversionWarning: A column-vector y was passed when a 1d
array was expected. Please change the shape of y to (n_samples, ), for example using
ravel().
  y = column_or_1d(y, warn=True)
```

Out[18]:
```
▾ LogisticRegression

LogisticRegression()
```

5. Check the accuracy of model

In [19]:
```
lr.score(x_test, y_test)*100
```

Out[19]:
```
91.25
```

6. Perform predictions on built model

In [20]:
```
lr.predict([[40]])
```

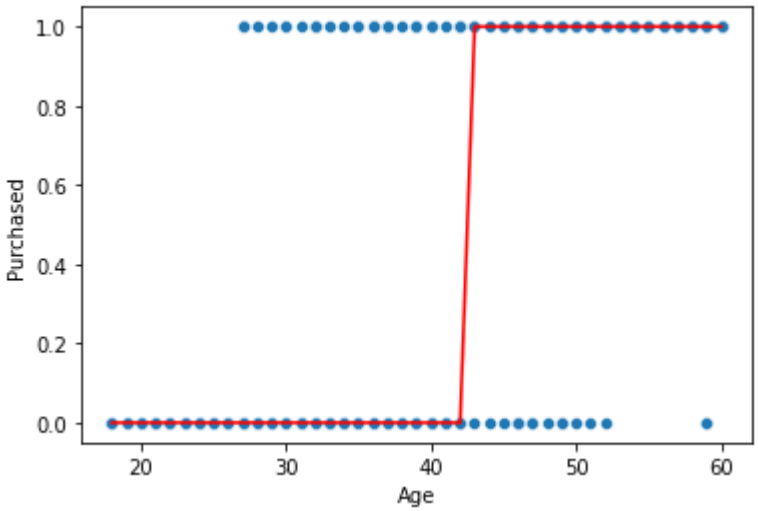
```
C:\Users\rashi\AppData\Local\Programs\Python\Python39\lib\site-packages\sklearn\bas
e.py:450: UserWarning: X does not have valid feature names, but LogisticRegression w
as fitted with feature names
  warnings.warn(
```

Out[20]:
```
array([0], dtype=int64)
```

In [ ]:
```

```

In [22]:
```
sns.scatterplot(x="Age", y="Purchased", data=dataset)
sns.lineplot(x='Age', y=lr.predict(x), data=dataset, color='red')
plt.show()
```



In [ ]: