In [1]:
```
import numpy as np
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score
```

Data Collection and Data Processing

In [2]:
```
sonar_data = pd.read_csv('sonar data.csv', header=None)
```

In [3]:
```
sonar_data.head()
```

Out[3]:

	0	1	2	3	4	5	6	7	8	9	...	51	52	53	54	55	
0	0.0200	0.0371	0.0428	0.0207	0.0954	0.0986	0.1539	0.1601	0.3109	0.2111	...	0.0027	0.0065	0.0159	0.0072	0.0167	0
1	0.0453	0.0523	0.0843	0.0689	0.1183	0.2583	0.2156	0.3481	0.3337	0.2872	...	0.0084	0.0089	0.0048	0.0094	0.0191	0
2	0.0262	0.0582	0.1099	0.1083	0.0974	0.2280	0.2431	0.3771	0.5598	0.6194	...	0.0232	0.0166	0.0095	0.0180	0.0244	0
3	0.0100	0.0171	0.0623	0.0205	0.0205	0.0368	0.1098	0.1276	0.0598	0.1264	...	0.0121	0.0036	0.0150	0.0085	0.0073	0
4	0.0762	0.0666	0.0481	0.0394	0.0590	0.0649	0.1209	0.2467	0.3564	0.4459	...	0.0031	0.0054	0.0105	0.0110	0.0015	0

5 rows × 61 columns

In [4]:
```
# number of rows and columns
sonar_data.shape
```

Out[4]:
```
(208, 61)
```

In [5]:
```
sonar_data.describe()
```

Out[5]:

	0	1	2	3	4	5	6	7	8	
count	208.000000	208.000000	208.000000	208.000000	208.000000	208.000000	208.000000	208.000000	208.000000	208.0000
mean	0.029164	0.038437	0.043832	0.053892	0.075202	0.104570	0.121747	0.134799	0.178003	0.2082
std	0.022991	0.032960	0.038428	0.046528	0.055552	0.059105	0.061788	0.085152	0.118387	0.1344
min	0.001500	0.000600	0.001500	0.005800	0.006700	0.010200	0.003300	0.005500	0.007500	0.0113
25%	0.013350	0.016450	0.018950	0.024375	0.038050	0.067025	0.080900	0.080425	0.097025	0.1112
50%	0.022800	0.030800	0.034300	0.044050	0.062500	0.092150	0.106950	0.112100	0.152250	0.1824
75%	0.035550	0.047950	0.057950	0.064500	0.100275	0.134125	0.154000	0.169600	0.233425	0.2687
max	0.137100	0.233900	0.305900	0.426400	0.401000	0.382300	0.372900	0.459000	0.682800	0.7106

8 rows × 60 columns

In [6]:
```
sonar_data[60].value_counts()
```

Out[6]:
```
M    111
R     97
Name: 60, dtype: int64
```

In [7]:
```
sonar_data.groupby(60).mean()
```

Out[7]:

60	0	1	2	3	4	5	6	7	8	9	...	50	5
M	0.034989	0.045544	0.050720	0.064768	0.086715	0.111864	0.128359	0.149832	0.213492	0.251022	...	0.019352	0.01601
R	0.022498	0.030303	0.035951	0.041447	0.062028	0.096224	0.114180	0.117596	0.137392	0.159325	...	0.012311	0.01045

2 rows × 60 columns

In [8]:
```
# separating data and Labels
X = sonar_data.drop(columns=60, axis=1)
Y = sonar_data[60]
```

In [10]:
```
print(X)
print(Y)
```

```
        0       1       2       3       4       5       6       7       8   \
0    0.0200  0.0371  0.0428  0.0207  0.0954  0.0986  0.1539  0.1601  0.3109
1    0.0453  0.0523  0.0843  0.0689  0.1183  0.2583  0.2156  0.3481  0.3337
2    0.0262  0.0582  0.1099  0.1083  0.0974  0.2280  0.2431  0.3771  0.5598
3    0.0100  0.0171  0.0623  0.0205  0.0205  0.0368  0.1098  0.1276  0.0598
4    0.0762  0.0666  0.0481  0.0394  0.0590  0.0649  0.1209  0.2467  0.3564
..      ...     ...     ...     ...     ...     ...     ...     ...     ...
203  0.0187  0.0346  0.0168  0.0177  0.0393  0.1630  0.2028  0.1694  0.2328
204  0.0323  0.0101  0.0298  0.0564  0.0760  0.0958  0.0990  0.1018  0.1030
205  0.0522  0.0437  0.0180  0.0292  0.0351  0.1171  0.1257  0.1178  0.1258
206  0.0303  0.0353  0.0490  0.0608  0.0167  0.1354  0.1465  0.1123  0.1945
207  0.0260  0.0363  0.0136  0.0272  0.0214  0.0338  0.0655  0.1400  0.1843

        9   ...      50      51      52      53      54      55      56  \
0    0.2111  ...  0.0232  0.0027  0.0065  0.0159  0.0072  0.0167  0.0180
1    0.2872  ...  0.0125  0.0084  0.0089  0.0048  0.0094  0.0191  0.0140
2    0.6194  ...  0.0033  0.0232  0.0166  0.0095  0.0180  0.0244  0.0316
3    0.1264  ...  0.0241  0.0121  0.0036  0.0150  0.0085  0.0073  0.0050
4    0.4459  ...  0.0156  0.0031  0.0054  0.0105  0.0110  0.0015  0.0072
..      ...  ...     ...     ...     ...     ...     ...     ...     ...
203  0.2684  ...  0.0203  0.0116  0.0098  0.0199  0.0033  0.0101  0.0065
204  0.2154  ...  0.0051  0.0061  0.0093  0.0135  0.0063  0.0063  0.0034
205  0.2529  ...  0.0155  0.0160  0.0029  0.0051  0.0062  0.0089  0.0140
206  0.2354  ...  0.0042  0.0086  0.0046  0.0126  0.0036  0.0035  0.0034
207  0.2354  ...  0.0181  0.0146  0.0129  0.0047  0.0039  0.0061  0.0040

        57      58      59
0    0.0084  0.0090  0.0032
1    0.0049  0.0052  0.0044
2    0.0164  0.0095  0.0078
3    0.0044  0.0040  0.0117
4    0.0048  0.0107  0.0094
..      ...     ...     ...
203  0.0115  0.0193  0.0157
204  0.0032  0.0062  0.0067
205  0.0138  0.0077  0.0031
206  0.0079  0.0036  0.0048
207  0.0036  0.0061  0.0115

[208 rows x 60 columns]
0      R
1      R
2      R
3      R
4      R
      ..
203    M
204    M
205    M
206    M
207    M
Name: 60, Length: 208, dtype: object
```

Training and Test data

In [12]:
```
X_train, X_test, Y_train, Y_test = train_test_split(X, Y, test_size = 0.1, stratify=Y, random_state=1
```

In [13]:
```
print(X.shape, X_train.shape, X_test.shape)
```

```
(208, 60) (187, 60) (21, 60)
```

In [14]:
```
print(X_train)
print(Y_train)
```

```
        0       1       2       3       4       5       6       7       8   \
115  0.0414  0.0436  0.0447  0.0844  0.0419  0.1215  0.2002  0.1516  0.0818
38   0.0123  0.0022  0.0196  0.0206  0.0180  0.0492  0.0033  0.0398  0.0791
56   0.0152  0.0102  0.0113  0.0263  0.0097  0.0391  0.0857  0.0915  0.0949
123  0.0270  0.0163  0.0341  0.0247  0.0822  0.1256  0.1323  0.1584  0.2017
18   0.0270  0.0092  0.0145  0.0278  0.0412  0.0757  0.1026  0.1138  0.0794
..      ...     ...     ...     ...     ...     ...     ...     ...     ...
140  0.0412  0.1135  0.0518  0.0232  0.0646  0.1124  0.1787  0.2407  0.2682
5    0.0286  0.0453  0.0277  0.0174  0.0384  0.0990  0.1201  0.1833  0.2105
154  0.0117  0.0069  0.0279  0.0583  0.0915  0.1267  0.1577  0.1927  0.2361
131  0.1150  0.1163  0.0866  0.0358  0.0232  0.1267  0.2417  0.2661  0.4346
203  0.0187  0.0346  0.0168  0.0177  0.0393  0.1630  0.2028  0.1694  0.2328

        9   ...      50      51      52      53      54      55      56  \
115  0.1975  ...  0.0222  0.0045  0.0136  0.0113  0.0053  0.0165  0.0141
38   0.0475  ...  0.0149  0.0125  0.0134  0.0026  0.0038  0.0018  0.0113
56   0.1504  ...  0.0048  0.0049  0.0041  0.0036  0.0013  0.0046  0.0037
123  0.2122  ...  0.0197  0.0189  0.0204  0.0085  0.0043  0.0092  0.0138
18   0.1520  ...  0.0045  0.0084  0.0010  0.0018  0.0068  0.0039  0.0120
..      ...  ...     ...     ...     ...     ...     ...     ...     ...
140  0.2058  ...  0.0798  0.0376  0.0143  0.0272  0.0127  0.0166  0.0095
5    0.3039  ...  0.0104  0.0045  0.0014  0.0038  0.0013  0.0089  0.0057
154  0.2169  ...  0.0039  0.0053  0.0029  0.0020  0.0013  0.0029  0.0020
131  0.5378  ...  0.0228  0.0099  0.0065  0.0085  0.0166  0.0110  0.0190
203  0.2684  ...  0.0203  0.0116  0.0098  0.0199  0.0033  0.0101  0.0065

        57      58      59
115  0.0077  0.0246  0.0198
38   0.0058  0.0047  0.0071
56   0.0011  0.0034  0.0033
123  0.0094  0.0105  0.0093
18   0.0132  0.0070  0.0088
..      ...     ...     ...
140  0.0225  0.0098  0.0085
5    0.0027  0.0051  0.0062
154  0.0062  0.0026  0.0052
131  0.0141  0.0068  0.0086
203  0.0115  0.0193  0.0157

[187 rows x 60 columns]
115    M
38     R
56     R
123    M
18     R
      ..
140    M
5      R
154    M
131    M
203    M
Name: 60, Length: 187, dtype: object
```

Model Training --> Logistic Regression

In [15]:
```
model = LogisticRegression()
```

In [16]:
```
#training the Logistic Regression model with training data
model.fit(X_train, Y_train)
```

Out[16]:
```
LogisticRegression()
```

Model Evaluation

In [17]:
```
#accuracy on training data
X_train_prediction = model.predict(X_train)
training_data_accuracy = accuracy_score(X_train_prediction, Y_train)
```

In [18]:
```
print('Accuracy on training data : ', training_data_accuracy)
```

```
Accuracy on training data :  0.8342245989304813
```

In [19]:
```
#accuracy on test data
X_test_prediction = model.predict(X_test)
test_data_accuracy = accuracy_score(X_test_prediction, Y_test)
```

In [20]:
```
print('Accuracy on test data : ', test_data_accuracy)
```

```
Accuracy on test data :  0.7619047619047619
```

Making a Predictive System

In [21]:
```
input_data = (0.0307,0.0523,0.0653,0.0521,0.0611,0.0577,0.0665,0.0664,0.1460,0.2792,0.3877,0.4992,0.4
```

In [22]:
```
# changing the input_data to a numpy array
input_data_as_numpy_array = np.asarray(input_data)

# reshape the np array as we are predicting for one instance
input_data_reshaped = input_data_as_numpy_array.reshape(1,-1)

prediction = model.predict(input_data_reshaped)
print(prediction)

if (prediction[0]=='R'):
  print('The object is a Rock')
else:
  print('The object is a mine')
```

```
['M']
The object is a mine
```

In [ ]:
```

```