IMPORT LIBRARIES

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

LOAD DATA SET

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

Out[2]:

	0	1	2	3	4	5	6	7	8	9	...	51	52	53	54	55	56	57	58	59	60
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	0.0180	0.0084	0.0090	0.0032	R
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	0.0140	0.0049	0.0052	0.0044	R
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	0.0316	0.0164	0.0095	0.0078	R
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	0.0050	0.0044	0.0040	0.0117	R
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	0.0072	0.0048	0.0107	0.0094	R
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
203	0.0187	0.0346	0.0168	0.0177	0.0393	0.1630	0.2028	0.1694	0.2328	0.2684	...	0.0116	0.0098	0.0199	0.0033	0.0101	0.0065	0.0115	0.0193	0.0157	M
204	0.0323	0.0101	0.0298	0.0564	0.0760	0.0958	0.0990	0.1018	0.1030	0.2154	...	0.0061	0.0093	0.0135	0.0063	0.0063	0.0034	0.0032	0.0062	0.0067	M
205	0.0522	0.0437	0.0180	0.0292	0.0351	0.1171	0.1257	0.1178	0.1258	0.2529	...	0.0160	0.0029	0.0051	0.0062	0.0089	0.0140	0.0138	0.0077	0.0031	M
206	0.0303	0.0353	0.0490	0.0608	0.0167	0.1354	0.1465	0.1123	0.1945	0.2354	...	0.0086	0.0046	0.0126	0.0036	0.0035	0.0034	0.0079	0.0036	0.0048	M
207	0.0260	0.0363	0.0136	0.0272	0.0214	0.0338	0.0655	0.1400	0.1843	0.2354	...	0.0146	0.0129	0.0047	0.0039	0.0061	0.0040	0.0036	0.0061	0.0115	M

208 rows × 61 columns

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

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 208 entries, 0 to 207
Data columns (total 61 columns):
 #   Column  Non-Null Count  Dtype  
---  ------  --------------  -----  
 0   0       208 non-null    float64
 1   1       208 non-null    float64
 2   2       208 non-null    float64
 3   3       208 non-null    float64
 4   4       208 non-null    float64
 5   5       208 non-null    float64
 6   6       208 non-null    float64
 7   7       208 non-null    float64
 8   8       208 non-null    float64
 9   9       208 non-null    float64
 10  10      208 non-null    float64
 11  11      208 non-null    float64
 12  12      208 non-null    float64
 13  13      208 non-null    float64
 14  14      208 non-null    float64
 15  15      208 non-null    float64
 16  16      208 non-null    float64
 17  17      208 non-null    float64
 18  18      208 non-null    float64
 19  19      208 non-null    float64
 20  20      208 non-null    float64
 21  21      208 non-null    float64
 22  22      208 non-null    float64
 23  23      208 non-null    float64
 24  24      208 non-null    float64
 25  25      208 non-null    float64
 26  26      208 non-null    float64
 27  27      208 non-null    float64
 28  28      208 non-null    float64
 29  29      208 non-null    float64
 30  30      208 non-null    float64
 31  31      208 non-null    float64
 32  32      208 non-null    float64
 33  33      208 non-null    float64
 34  34      208 non-null    float64
 35  35      208 non-null    float64
 36  36      208 non-null    float64
 37  37      208 non-null    float64
 38  38      208 non-null    float64
 39  39      208 non-null    float64
 40  40      208 non-null    float64
 41  41      208 non-null    float64
 42  42      208 non-null    float64
 43  43      208 non-null    float64
 44  44      208 non-null    float64
 45  45      208 non-null    float64
 46  46      208 non-null    float64
 47  47      208 non-null    float64
 48  48      208 non-null    float64
 49  49      208 non-null    float64
 50  50      208 non-null    float64
 51  51      208 non-null    float64
 52  52      208 non-null    float64
 53  53      208 non-null    float64
 54  54      208 non-null    float64
 55  55      208 non-null    float64
 56  56      208 non-null    float64
 57  57      208 non-null    float64
 58  58      208 non-null    float64
 59  59      208 non-null    float64
 60  60      208 non-null    object 
dtypes: float64(60), object(1)
memory usage: 99.2+ KB
```

In [4]:
```
# Number of row and columns
sonar_data.shape
```

Out[4]: (208, 61)

In [5]:
```
# Stastical measure of data
sonar_data.describe()
```

Out[5]:

	0	1	2	3	4	5	6	7	8	9	...	50	51	52	53
count	208.000000	208.000000	208.000000	208.000000	208.000000	208.000000	208.000000	208.000000	208.000000	208.000000	...	208.000000	208.000000	208.000000	208.000000
mean	0.029164	0.038437	0.043832	0.053892	0.075202	0.104570	0.121747	0.134799	0.178003	0.208259	...	0.016069	0.013420	0.010709	0.010941
std	0.022991	0.032960	0.038428	0.046528	0.055552	0.059105	0.061788	0.085152	0.118387	0.134416	...	0.012008	0.009634	0.007060	0.007301
min	0.001500	0.000600	0.001500	0.005800	0.006700	0.010200	0.003300	0.005500	0.007500	0.011300	...	0.000000	0.000800	0.000500	0.001000
25%	0.013350	0.016450	0.018950	0.024375	0.038050	0.067025	0.080900	0.080425	0.097025	0.111275	...	0.008425	0.007275	0.005075	0.005375
50%	0.022800	0.030800	0.034300	0.044050	0.062500	0.092150	0.106950	0.112100	0.152250	0.182400	...	0.013900	0.011400	0.009550	0.009300
75%	0.035550	0.047950	0.057950	0.064500	0.100275	0.134125	0.154000	0.169600	0.233425	0.268700	...	0.020825	0.016725	0.014900	0.014500
max	0.137100	0.233900	0.305900	0.426400	0.401000	0.382300	0.372900	0.459000	0.682800	0.710600	...	0.100400	0.070900	0.039000	0.035200

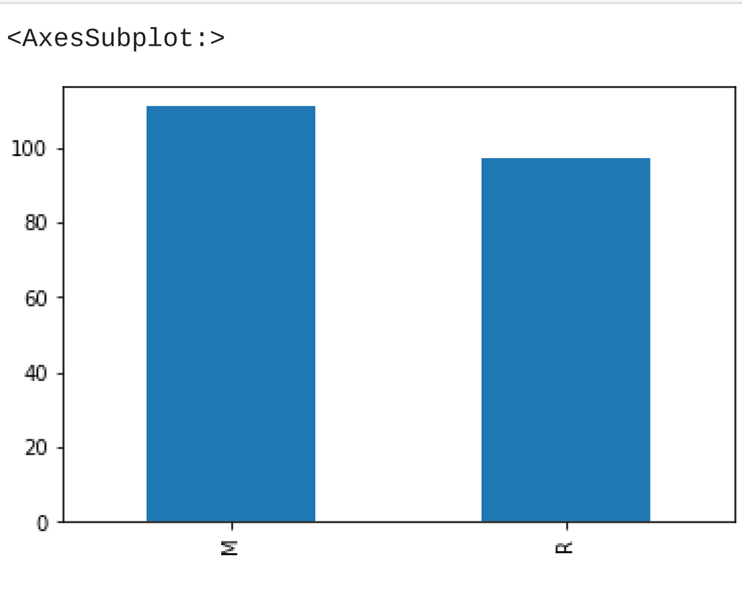
8 rows × 60 columns

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

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

In [7]:
```
sonar_data[60].value_counts().plot(kind='bar')
```

Out[7]: <AxesSubplot:>



In [8]:
```
# M ...MINES
# R ....ROCK
sonar_data.groupby(60).mean()
```

Out[8]:

	0	1	2	3	4	5	6	7	8	9	...	50	51	52	53	54	55	56
60																		
M	0.034989	0.045544	0.050720	0.064768	0.086715	0.111864	0.128359	0.149832	0.213492	0.251022	...	0.019352	0.016014	0.011643	0.012185	0.009923	0.008914	0.007825
R	0.022498	0.030303	0.035951	0.041447	0.062028	0.096224	0.114180	0.117596	0.137392	0.159325	...	0.012311	0.010453	0.009640	0.009518	0.008567	0.007430	0.007814

2 rows × 60 columns

In [9]:
```
sonar_data.groupby(60).median()
```

Out[9]:

	0	1	2	3	4	5	6	7	8	9	...	50	51	52	53	54	55	56	57	58	59
60																					
M	0.0269	0.0353	0.0386	0.0547	0.0748	0.1091	0.1232	0.1298	0.1864	0.2245	...	0.0171	0.0132	0.0101	0.0096	0.0072	0.0074	0.0057	0.0070	0.0070	0.0053
R	0.0201	0.0242	0.0288	0.0350	0.0476	0.0792	0.1015	0.0973	0.1054	0.1264	...	0.0107	0.0088	0.0081	0.0088	0.0077	0.0065	0.0061	0.0052	0.0058	0.0054

2 rows × 60 columns

In [10]:
```
# seprated data and labels
x=sonar_data.drop(columns=60,axis=1)
y=sonar_data[60]
```

In [11]:
```
print(x,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 TESTING DATA

In [12]:
```
# training and labeling data
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_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
```

In [14]:
```
print(x_train.shape)
print(x_test.shape)
```

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

MODEL TRAINING WITH DATA SET

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

In [16]:
```
model.fit(x_train,y_train)
```

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

Model Evaluation

In [17]:
```
# accuracy on the test data
model.score(x_test,y_test)
```

Out[17]: 0.7619047619047619

In [18]:
```
y_pred=model.predict(x_test)
```

In [19]:
```
print(classification_report(y_test,y_pred))
```

```
              precision    recall  f1-score   support

           M       0.75      0.82      0.78        11
           R       0.78      0.70      0.74        10

    accuracy                           0.76        21
   macro avg       0.76      0.76      0.76        21
weighted avg       0.76      0.76      0.76        21
```

In [20]:
```
model1=LogisticRegression()
```

In [21]:
```
# only training data is consider
model1.fit(x_train,y_train)
```

Out[21]:
```
▾ LogisticRegression
LogisticRegression()
```

In [22]:
```
# accuracy of train data
model1.score(x_train,y_train)
```

Out[22]: 0.8342245989304813

In [23]:
```
y_predi=model1.predict(x_train)
```

In [24]:
```
print(classification_report(y_train,y_predi))
```

```
              precision    recall  f1-score   support

           M       0.83      0.86      0.85       100
           R       0.83      0.80      0.82        87

    accuracy                           0.83       187
   macro avg       0.83      0.83      0.83       187
weighted avg       0.83      0.83      0.83       187
```

In [28]:
```
input_data=(0.045544,0.050720,0.064768,0.086715,0.111864,0.128359,0.149832,0.213492,0.251022,0.019352,0.016014,0.011643,0.012185,0.009923,0.008914,
data=np.asarray(input_data) # convert data to numpy array
df=data.reshape(1,-1)
predection=model.predict(df)
print(predection)
if (predection[0]=='M'):
    print('found of rock')
else:
    print('found of mines')
```

In [26]:
```
input_data1=(0.0201,0.0242,0.0288,0.0350,0.0476,0.0792,0.1015,0.0973,0.1054,0.1264,0.0107,0.0088,0.0081,0.0088,0.0077,0.0065,0.0061,0.0052,0.0058,0
daimen=np.asarray(input_data1) # convert data to numpy array
door=data.reshape(1,-1)
predection=model.predict(door)
print(predection)
if (predection[0]=='R'):
    print('found of rock')
else:
    print('found of mines')
```

In [ ]: