```
import pandas as pd
In [23]:
          from sklearn.linear model import LogisticRegression
          import matplotlib.pyplot as plt
In [7]: from sklearn.preprocessing import StandardScaler
          from sklearn.ensemble import RandomForestClassifier
          from sklearn.model selection import train test split
In [3]: | df=pd.read_csv("1_ionosphere.csv")
          df
Out[3]:
                   0 0.99539 -0.05889
                                        0.85243
                                                 0.02306
                                                          0.83398 -0.37708
                                                                                    0.03760 ... -0.51171
                1
                                                                               1.1
                    0
                      1.00000
                               -0.18829
                                        0.93035
                                                -0.36156
                                                         -0.10868
                                                                 -0.93597 1.00000
                                                                                   -0.04549
                                                                                               -0.26569
             1
                1
                    0
                      1.00000
                               -0.03365
                                        1.00000
                                                 0.00485
                                                          1.00000 -0.12062 0.88965
                                                                                    0.01198 ...
                                                                                               -0.40220
                                                                                                         0
                      1.00000
                              -0.45161
                                        1.00000
                                                 1.00000
                                                          0.71216 -1.00000 0.00000
             2
                                                                                    0.00000
                                                                                                0.90695
             3
                    0
                      1.00000
                              -0.02401
                                        0.94140
                                                 0.06531
                                                          0.92106 -0.23255
                                                                          0.77152
                                                                                   -0.16399
                                                                                               -0.65158
                                                                                                         0
                1
                    0
                      0.02337
                               -0.00592
                                        -0.09924
                                                 -0.11949
                                                         -0.00763
                                                                  -0.11824
                                                                           0.14706
                                                                                    0.06637
                                                                                               -0.01535
           345
                    0
                      0.83508
                               0.08298
                                        0.73739 -0.14706
                                                          0.84349 -0.05567 0.90441
                                                                                   -0.04622 ...
                                                                                               -0.04202
                                                                                                         0
                1
           346
                      0.95113
                               0.00419
                                        0.95183 -0.02723
                                                          0.93438 -0.01920
                                                                          0.94590
                                                                                    0.01606 ...
                                                                                                0.01361
           347
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                      0.94701 -0.00034
                                        0.93207 -0.03227
                                                          0.95177 -0.03431 0.95584
                                                                                    0.02446 ...
                                                                                                0.03193
           348
                    n
                      0.90608
                              -0.01657
                                        0.98122 -0.01989
                                                          0.95691 -0.03646 0.85746
                                                                                    0.00110 ...
                                                                                               -0.02099
                                                                                                         0
           349
                     0.84710
                              0.13533
                                        0.73638 -0.06151
                                                          0.87873
                                                                   0.08260  0.88928  -0.09139  ...  -0.15114
                    n
                                                                                                         0
          350 rows × 35 columns
 In [4]: x=df.iloc[:,:10]
          y=df.iloc[:,-1]
          f=StandardScaler().fit_transform(x)
          lo=LogisticRegression()
          lo.fit(f,y)
Out[4]: LogisticRegression()
In [5]: val=[[6,45,234,534,6,3456,345,4,53,45]]
          lo.predict(val)
Out[5]: array(['g'], dtype=object)
In [6]: lo.score(f,y)
Out[6]: 0.8885714285714286
```

```
In [10]: df["g"].value_counts()
Out[10]:
                224
          g
                126
          Name: g, dtype: int64
In [14]: |g1={"g":{'g':1,'b':2}}
          df=df.replace(g1)
          df
Out[14]:
                1
                   0 0.99539 -0.05889
                                       0.85243
                                                0.02306
                                                         0.83398 -0.37708
                                                                              1.1
                                                                                  0.03760 ... -0.51171
                      1.00000
                              -0.18829
                                        0.93035
                                                -0.36156
                                                        -0.10868
                                                                -0.93597 1.00000
                                                                                  -0.04549 ...
                                                                                              -0.26569
                   0 1.00000 -0.03365
                                        1.00000
                                                0.00485
                                                         1.00000 -0.12062 0.88965
                                                                                   0.01198 ...
             1
                1
                                                                                              -0.40220
                      1.00000
                              -0.45161
                                        1.00000
                                                1.00000
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                                                                                  0.00000
                                                                                              0.90695
                   0
                      1.00000
                              -0.02401
                                        0.94140
                                                0.06531
                                                         0.92106 -0.23255
                                                                         0.77152
                                                                                  -0.16399
                                                                                              -0.65158
                      0.02337
                              -0.00592
                                       -0.09924
                                                -0.11949
                                                        -0.00763
                                                                 -0.11824
                                                                         0.14706
                                                                                  0.06637
                                                                                             -0.01535
                      0.83508
                               0.08298
                                        0.73739
                                               -0.14706
                                                                -0.05567
                                                                                  -0.04622 ...
           345
                                                         0.84349
                                                                         0.90441
                                                                                              -0.04202
                               0.00419
                                        0.95183 -0.02723
                                                         0.93438 -0.01920 0.94590
                                                                                  0.01606
           346
                1
                      0.95113
                                                                                              0.01361
           347
                1
                   0
                      0.94701
                              -0.00034
                                        0.93207 -0.03227
                                                         0.95177 -0.03431
                                                                          0.95584
                                                                                  0.02446 ...
                                                                                              0.03193
                                                                                                       0
                                        0.98122 -0.01989
           348
                     0.90608
                              -0.01657
                                                         0.95691 -0.03646 0.85746
                                                                                   0.00110 ...
                                                                                             -0.02099
           349
                   0
                     0.84710
                               0.13533
                                       0.73638 -0.06151
                                                         0.87873
                                                                  0.08260 0.88928 -0.09139 ... -0.15114
          350 rows × 35 columns
In [17]: x1=df.drop(["g"],axis=1)
          y1=df["g"]
          x_train,x_test,y_train,y_test=train_test_split(x1,y1,test_size=0.3)
In [18]: rfc=RandomForestClassifier()
          rfc.fit(x train,y train)
Out[18]: RandomForestClassifier()
In [19]:
          parameter={'max_depth':[1,2,3,4,5],
                      "min_samples_leaf":[5,10,15,20,25],
                      "n_estimators":[10,20,30,40,50]}
In [20]: from sklearn.model_selection import GridSearchCV
          grid search = GridSearchCV(estimator=rfc,param grid=parameter,cv=2,scoring="accurac
          grid search.fit(x train,y train)
Out[20]: GridSearchCV(cv=2, estimator=RandomForestClassifier(),
                         param_grid={'max_depth': [1, 2, 3, 4, 5],
                                       'min_samples_leaf': [5, 10, 15, 20, 25],
                                       'n_estimators': [10, 20, 30, 40, 50]},
                         scoring='accuracy')
```

```
In [21]: grid search.best score
Out[21]: 0.9265293882447021
In [26]:
                     rfc_best=grid_search.best_estimator_
In [29]: | from sklearn.tree import plot_tree
                      plt.figure(figsize=(80,40))
                      plot_tree(rfc_best.estimators_[5],feature_names=x1.columns,class_names=['Yes','No']
Out[29]: [Text(1420.3636363636363, 1956.96, '0.02306 <= -0.77\ngini = 0.431\nsamples = 160

    | value = [168, 77] \rangle = Yes'),

                        Text(1014.54545454545, 1522.080000000000, 'gini = 0.0\nsamples = 15\nvalue =
                      [0, 20] \setminus nclass = No'),
                        Text(1826.1818181818182, 1522.0800000000000, '-0.17755 <= -0.326\ngini = 0.378\ns
                      amples = 145\nvalue = [168, 57]\nclass = Yes'),
                        Text(811.636363636363636, 1087.2, '0.85243.1 \le 0.702 \le 0.34 \le 0.34 \le 10.702 \le 0.34 \le
                      alue = [5, 18]\nclass = No'),
                        Text(405.8181818181818, 652.3200000000002, 'gini = 0.0\nsamples = 7\nvalue = [0,
                      12] \nclass = No'),
                        Text(1217.45454545455, 652.3200000000000, 'gini = 0.496\nsamples = 9\nvalue =
                      [5, 6] \setminus (1),
                        Text(2840.7272727272725, 1087.2, 0.42267 <= 0.135 \ngini = 0.312 \nsamples = 129 \n
                      value = [163, 39]\nclass = Yes'),
                        Text(2029.0909090909, 652.3200000000002, '0.56811 <= -0.051\ngini = 0.499\nsamp
                      les = 37\nvalue = [29, 26]\nclass = Yes'),
                        Text(1623.27272727273, 217.4400000000005, 'gini = 0.191\nsamples = 17\nvalue =
                      [25, 3]\nclass = Yes'),
                        Text(2434.909090909091, 217.44000000000000, 'gini = 0.252\nsamples = 20\nvalue =
                      [4, 23]\nclass = No'),
                        Text(3652.3636363636365, 652.3200000000002, '0.18641 <= 0.995\ngini = 0.161\nsamp
                      les = 92\nvalue = [134, 13]\nclass = Yes'),
                        Text(3246.5454545454545, 217.44000000000005, 'gini = 0.1\nsamples = 83\nvalue =
                      [125, 7] \setminus class = Yes'),
                        Text(4058.181818181818, 217.4400000000005, 'gini = 0.48\nsamples = 9\nvalue =
                      [9, 6]\nclass = Yes')]
                                                                      0.02306 <= -0.77
                                                                          gini = 0.431
                                                                        samples = 160
                                                                      value = [168, 77]
                                                                           class = Yes
                                                                                      -0.17755 <= -0.326
                                                          gini = 0.0
                                                                                           gini = 0.378
                                                        samples = 15
                                                                                          samples = 145
                                                       value = [0, 20]
                                                                                        value = [168, 57]
                                                          class = No
                                                                                            class = Yes
                                          0.85243.1 <= 0.702
                                                                                                                                   0.42267 <= 0.135
                                                 gini = 0.34
                                                                                                                                      gini = 0.312
                                                                                                                                     samples = 129
                                               samples = 16
                                              value = [5, 18]
                                                                                                                                   value = [163, 39]
                                                 class = No
                                                                                                                                        class = Yes
                                                                                               0.56811 \le -0.051
                                                                                                                                                                     0.18641 <= 0.995
                                                                  gini = 0.496
                                                                                                    gini = 0.499
                                                                                                                                                                         gini = 0.161
                               samples = 7
                                                                 samples = 9
                                                                                                                                                                        samples = 92
                                                                                                   samples = 37
                              value = [0, 12]
                                                                 value = [5, 6]
                                                                                                 value = [29, 26]
                                                                                                                                                                      value = [134, 13]
                                class = No
                                                                  class = No
                                                                                                     class = Yes
                                                                                                                                                                          class = Yes
                                                                                                                                                                                           gini = 0.48
                                                                                                                     gini = 0.252
                                                                                  gini = 0.191
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value = [125, 7]
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                                                                                   class = Yes
                                                                                                                      class = No
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                                                                                                                                                                                           class = Yes
```

In [ ]: