## **C1**

import pandas as pd In [23]: import matplotlib.pyplot as plt In [3]: df=pd.read\_csv("1\_ionosphere.csv") Out[3]: 1 0.99539 -0.05889 0.85243 0.02306 0.83398 -0.37708 0.03760 ... -0.511 0 1.1 1.00000 -0.18829 0.93035 1.00000 -0.265 0 1 0 -0.36156 -0.10868 -0.93597 -0.04549 ... 1 1 0 1.00000 -0.03365 1.00000 0.00485 1.00000 -0.12062 0.88965 0.01198 -0.402 2 1.00000 -0.45161 1.00000 1.00000 0.71216 -1.00000 0.00000 0.00000 0.906 1 0 3 1.00000 -0.02401 0.94140 0.06531 0.92106 -0.23255 0.77152 -0.16399 -0.651 1 0 1 0.02337 -0.00592 -0.09924 -0.11949 -0.00763 -0.11824 0.14706 0.06637 -0.015 0.08298 345 1 0 0.83508 0.73739 -0.14706 0.84349 -0.05567 0.90441 -0.04622 ... -0.042 346 0.95113 0.00419 0.95183 -0.02723 0.93438 -0.01920 0.94590 0.01606 0.013 1 0 0.031 0.94701 -0.00034 0.93207 -0.03227 0.95177 -0.03431 0.95584 347 1 0 0.02446 348 0.90608 -0.01657 0.98122 -0.01989 0.95691 -0.03646 0.85746 0.00110 -0.020 349 0.84710 0.13533 0.73638 -0.06151 0.87873 0.08260 0.88928 -0.09139 -0.15 1 0 350 rows × 35 columns

```
g1={"g":{'g':1,'b':2}}
In [14]:
          df=df.replace(g1)
          df
Out[14]:
                   0 0.99539 -0.05889
                                       0.85243
                                               0.02306
                                                                                 0.03760 ...
                                                        0.83398 -0.37708
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                1
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                                       0.93035
                                               -0.36156
                                                       -0.10868 -0.93597 1.00000
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                                               0.06531
                                                        0.92106 -0.23255 0.77152
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                                     -0.09924
                                               -0.11949
                                                       -0.00763
                                                               -0.11824 0.14706
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                                                        0.84349 -0.05567 0.90441
                   0 0.83508
                              0.08298
                                      0.73739 -0.14706
                                                                                -0.04622 ... -0.042
           345
                1
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                              0.00419
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                                      0.95183 -0.02723
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           347
                1
                   0
                                       0.93207 -0.03227
                                                        0.95177 -0.03431
                                                                        0.95584
                                                                                             0.031
           348
                     0.90608 -0.01657
                                       0.98122 -0.01989
                                                        0.95691
                                                                -0.03646 0.85746
                                                                                 0.00110 ... -0.020
                1
           349
                   0 0.84710 0.13533 0.73638 -0.06151
                                                        0.87873
                                                                0.08260 0.88928 -0.09139 ...
          350 rows × 35 columns
 In [7]: from sklearn.preprocessing import StandardScaler
          from sklearn.ensemble import RandomForestClassifier
          from sklearn.model selection import train test split
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="ac
          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',
Out[29]: [Text(1420.363636363636363, 1956.96, '0.02306 <= -0.77\ngini = 0.431\nsamples =
                                     160\nvalue = [168, 77]\nclass = Yes'),
                                         Text(1014.5454545454545, 1522.080000000000, 'gini = 0.0\nsamples = 15\nvalu
                                     e = [0, 20] \setminus nclass = No'),
                                         Text(1826.1818181818182, 1522.0800000000000, '-0.17755 <= -0.326\ngini = 0.3
                                     78\nsamples = 145\nvalue = [168, 57]\nclass = Yes'),
                                         Text(811.636363636363636, 1087.2, '0.85243.1 \le 0.702 \setminus i = 0.34 
                                     16\nvalue = [5, 18]\nclass = No'),
                                         Text(405.8181818181818, 652.3200000000002, 'gini = 0.0\nsamples = 7\nvalue =
                                     [0, 12] \setminus nclass = No'),
                                         Text(1217.4545454545455, 652.3200000000002, 'gini = 0.496\nsamples = 9\nvalu
                                     e = [5, 6] \setminus ass = No'),
                                         Text(2840.7272727272725, 1087.2, 0.42267 \le 0.135 \le 0.312 \le 0.312
                                     129\nvalue = [163, 39]\nclass = Yes'),
                                         Text(2029.090909090909, 652.3200000000000, '0.56811 <= -0.051 \ngini = 0.499
                                      \nsamples = 37 \nvalue = [29, 26] \nclass = Yes'),
                                         Text(1623.27272727273, 217.4400000000005, 'gini = 0.191\nsamples = 17\nva
                                     lue = [25, 3]\nclass = Yes'),
                                         Text(2434.9090909091, 217.44000000000005, 'gini = 0.252\nsamples = 20\nval
                                     ue = [4, 23] \setminus class = No'),
                                         Text(3652.3636363636365, 652.3200000000002, '0.18641 <= 0.995 \mid i = 0.161
                                      \nsamples = 92\nvalue = [134, 13]\nclass = Yes'),
                                         Text(3246.5454545454545, 217.4400000000000, 'gini = 0.1\nsamples = 83\nvalu
                                     e = [125, 7] \setminus e = 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
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                                                                                           value = [0, 20]
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                                                                                              class = No
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                                                                     0.85243.1 <= 0.702
                                                                                                                                                                                                                  0.42267 <= 0.135
                                                                               gini = 0.34
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                                                                                                          samples = 9
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                                                 value = [0, 12]
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                                                     class = No
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