**Batch: A1** **Experiment Number:8**

**Roll Number: 16010422012** **Name: Ayaan Bhoje**

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**Aim of the Experiment:** To implement Decision Tree Algorithm (ID3 using library)

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**Program/ Steps:**

In [1]:
```
import pandas as pd
df = pd.read_csv("titanic_data.csv")
df.head()
```

Out[1]:

| | PassengerId | Survived | Pclass | Name | Sex | Age | SibSp | Parch | Ticket | Fare | Cabin | Embarked |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 3 | Braund, Mr. Owen Harris | male | 22.0 | 1 | 0 | A/5 21171 | 7.2500 | NaN | S |
| 1 | 2 | 1 | 1 | Cumings, Mrs. John Bradley (Florence Briggs Th... | female | 38.0 | 1 | 0 | PC 17599 | 71.2833 | C85 | C |
| 2 | 3 | 1 | 3 | Heikkinen, Miss. Laina | female | 26.0 | 0 | 0 | STON/O2. 3101282 | 7.9250 | NaN | S |
| 3 | 4 | 1 | 1 | Futrelle, Mrs. Jacques Heath (Lily May Peel) | female | 35.0 | 1 | 0 | 113803 | 53.1000 | C123 | S |
| 4 | 5 | 0 | 3 | Allen, Mr. William Henry | male | 35.0 | 0 | 0 | 373450 | 8.0500 | NaN | S |

In [3]:
```
df.drop(['PassengerId','Name','SibSp','Parch','Ticket','Cabin','Embarked'],axis='columns',inplace=True)
```

In [4]:
```
df.head()
```

Out[4]:

| | Survived | Pclass | Sex | Age | Fare |
|---|---|---|---|---|---|
| 0 | 0 | 3 | male | 22.0 | 7.2500 |
| 1 | 1 | 1 | female | 38.0 | 71.2833 |
| 2 | 1 | 3 | female | 26.0 | 7.9250 |
| 3 | 1 | 1 | female | 35.0 | 53.1000 |
| 4 | 0 | 3 | male | 35.0 | 8.0500 |

In [5]:
```
dfnew = df.head(50)
df1 = dfnew.drop('Survived', axis='columns')
target  = dfnew.Survived
```

In [6]:
```
#Label Encoding
from sklearn import preprocessing
label_encoder = preprocessing.LabelEncoder()
df1['Sex'] = label_encoder.fit_transform(df1['Sex'])
```

In [7]:
```
#Removing Null Values
df1.Age = df1.Age.fillna(df1.Age.mean())
df1.head()
```

Out[7]:

| | Pclass | Sex | Age | Fare |
|---|---|---|---|---|
| 0 | 3 | 1 | 22.0 | 7.2500 |
| 1 | 1 | 0 | 38.0 | 71.2833 |
| 2 | 3 | 0 | 26.0 | 7.9250 |
| 3 | 1 | 0 | 35.0 | 53.1000 |
| 4 | 3 | 1 | 35.0 | 8.0500 |

In [8]:
```
from sklearn.tree import DecisionTreeClassifier

#Splitting up the dataset
from sklearn.model_selection import train_test_split
X_train2, X_test2, y_train2, y_test2 = train_test_split(df1,target,test_size=0.2)

#Training the decision tree classifier
m2 = DecisionTreeClassifier(criterion='gini')
m2.fit(X_train2,y_train2)

#Predicting the response for test data
y_pred2 = m2.predict(X_test2)

#Classification Report
from sklearn.metrics import classification_report
print(classification_report(y_test2,y_pred2))
```

```
              precision    recall  f1-score   support

           0       1.00      0.67      0.80         6
           1       0.67      1.00      0.80         4

    accuracy                           0.80        10
   macro avg       0.83      0.83      0.80        10
weighted avg       0.87      0.80      0.80        10
```

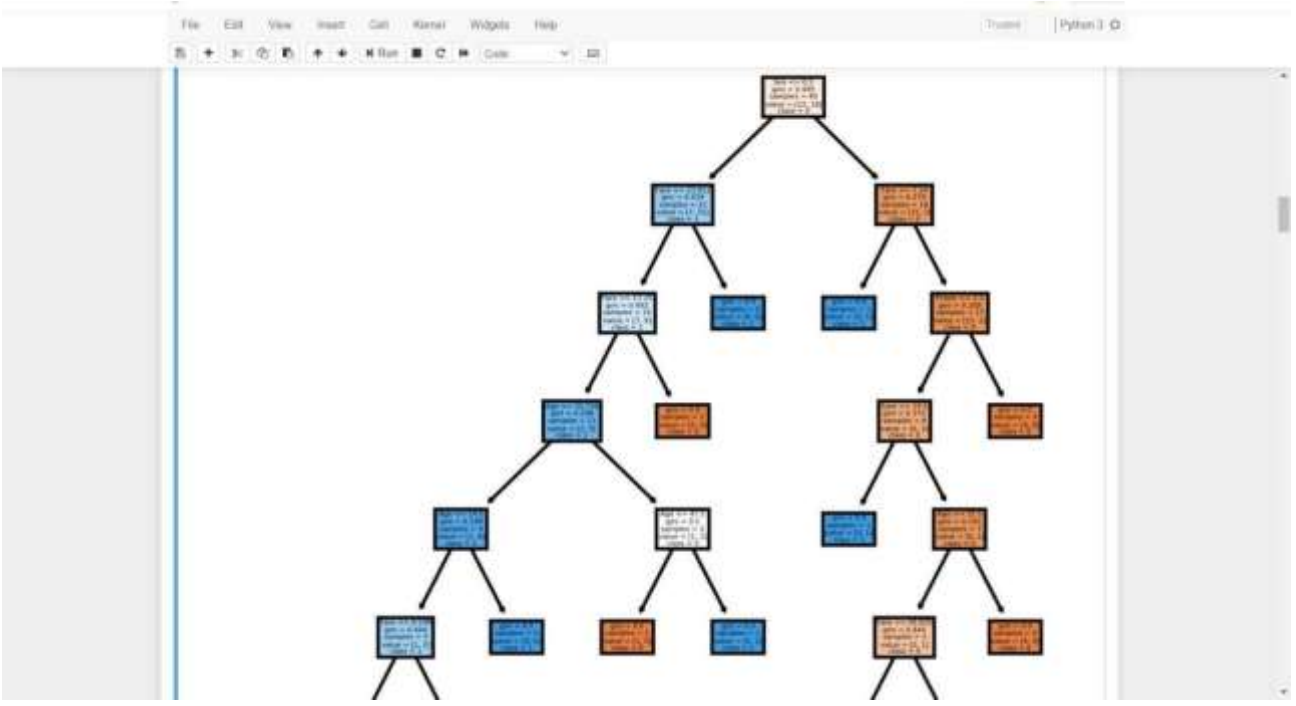
In [9]:
```
#Accuracy
print("accuracy: ", m2.score(X_test2,y_test2))
```

```
accuracy:  0.8
```

In [11]:
```
#Confusion Matrix
from sklearn.metrics import confusion_matrix
print(confusion_matrix(y_test2,y_pred2))
```

```
[[4 2]
 [0 4]]
```

In [14]:
```
target = target.astype('str')
```



In [17]:
```
#Example 1
import pandas as pd
df = pd.read_csv("titanic_data.csv")
df2 = df.head(50).drop('Cabin', axis = 1)
df2
```

Out[17]:

| | PassengerId | Survived | Pclass | Name | Sex | Age | SibSp | Parch | Ticket | Fare | Embarked |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 3 | Braund, Mr. Owen Harris | male | 22.0 | 1 | 0 | A/5 21171 | 7.2500 | S |
| 1 | 2 | 1 | 1 | Cumings, Mrs. John Bradley (Florence Briggs Th... | female | 38.0 | 1 | 0 | PC 17599 | 71.2833 | C |
| 2 | 3 | 1 | 3 | Heikkinen, Miss. Laina | female | 26.0 | 0 | 0 | STON/O2. 3101282 | 7.9250 | S |
| 3 | 4 | 1 | 1 | Futrelle, Mrs. Jacques Heath (Lily May Peel) | female | 35.0 | 1 | 0 | 113803 | 53.1000 | S |
| 4 | 5 | 0 | 3 | Allen, Mr. William Henry | male | 35.0 | 0 | 0 | 373450 | 8.0500 | S |
| 5 | 6 | 0 | 3 | Moran, Mr. James | male | NaN | 0 | 0 | 330877 | 8.4583 | Q |
| 6 | 7 | 0 | 1 | McCarthy, Mr. Timothy J | male | 54.0 | 0 | 0 | 17463 | 51.8625 | S |
| 7 | 8 | 0 | 3 | Palsson, Master. Gosta Leonard | male | 2.0 | 3 | 1 | 349909 | 21.0750 | S |
| 8 | 9 | 1 | 3 | Johnson, Mrs. Oscar W (Elisabeth Vilhelmina Berg) | female | 27.0 | 0 | 2 | 347742 | 11.1333 | S |
| 9 | 10 | 1 | 2 | Nasser, Mrs. Nicholas (Adele Achem) | female | 14.0 | 1 | 0 | 237736 | 30.0708 | C |
| 10 | 11 | 1 | 3 | Sandstrom, Miss. Marguerite Rut | female | 4.0 | 1 | 1 | PP 9549 | 16.7000 | S |
| 11 | 12 | 1 | 1 | Bonnell, Miss. Elizabeth | female | 58.0 | 0 | 0 | 113783 | 26.5500 | S |
| 12 | 13 | 0 | 3 | Saundercock, Mr. William Henry | male | 20.0 | 0 | 0 | A/5. 2151 | 8.0500 | S |
| 13 | 14 | 0 | 3 | Andersson, Mr. Anders Johan | male | 39.0 | 1 | 5 | 347082 | 31.2750 | S |

In [18]:
```
from sklearn import preprocessing
label_encoder = preprocessing.LabelEncoder()

#Label Encoding
df2.loc[:,('Name')] = label_encoder.fit_transform(df2['Name'])
df2.loc[:,('Sex')] = label_encoder.fit_transform(df2['Sex'])
df2.loc[:,('Ticket')] = label_encoder.fit_transform(df2['Ticket'])

#Handling Null Values
df2.loc[:,('Age')] = df2.Age.fillna(df2.Age.mean())

em_dummies = pd.get_dummies(df2['Embarked'], drop_first=True)
df2[['Embarked_Q','Embarked_S']] = em_dummies
df2.head()
```

Out[18]:

| | PassengerId | Survived | Pclass | Name | Sex | Age | SibSp | Parch | Ticket | Fare | Embarked | Embarked_Q | Embarked_S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 3 | 7 | 1 | 22.0 | 1 | 0 | 38 | 7.2500 | S | 0 | 1 |
| 1 | 2 | 1 | 1 | 9 | 0 | 38.0 | 1 | 0 | 42 | 71.2833 | C | 0 | 0 |
| 2 | 3 | 1 | 3 | 16 | 0 | 26.0 | 0 | 0 | 48 | 7.9250 | S | 0 | 1 |
| 3 | 4 | 1 | 1 | 13 | 0 | 35.0 | 1 | 0 | 3 | 53.1000 | S | 0 | 1 |
| 4 | 5 | 0 | 3 | 1 | 1 | 35.0 | 0 | 0 | 34 | 8.0500 | S | 0 | 1 |

In [19]:
```
df2.drop(['Embarked'],axis=1,inplace=True)
df2.head()
```

Out[19]:

| | PassengerId | Survived | Pclass | Name | Sex | Age | SibSp | Parch | Ticket | Fare | Embarked_Q | Embarked_S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 3 | 7 | 1 | 22.0 | 1 | 0 | 38 | 7.2500 | 0 | 1 |
| 1 | 2 | 1 | 1 | 9 | 0 | 38.0 | 1 | 0 | 42 | 71.2833 | 0 | 0 |
| 2 | 3 | 1 | 3 | 16 | 0 | 26.0 | 0 | 0 | 48 | 7.9250 | 0 | 1 |
| 3 | 4 | 1 | 1 | 13 | 0 | 35.0 | 1 | 0 | 3 | 53.1000 | 0 | 1 |
| 4 | 5 | 0 | 3 | 1 | 1 | 35.0 | 0 | 0 | 34 | 8.0500 | 0 | 1 |

In [20]:
```
#Getting the target column
target1  = df2.Survived
df2 = df2.drop('Survived', axis='columns')
```

In [21]:
```
target1 = target1.astype('float')
```

In [22]:
```
from sklearn.tree import DecisionTreeClassifier

#Splitting up the dataset
from sklearn.model_selection import train_test_split
X_train1, X_test1, y_train1, y_test1 = train_test_split(df2,target1,test_size=0.2)

#Training the decision tree classifier
m1 = DecisionTreeClassifier(criterion='entropy')
m1.fit(X_train1,y_train1)

#Predicting the response for test data
y_pred1 = m1.predict(X_test1)

#Classification Report
from sklearn.metrics import classification_report
print(classification_report(y_test1,y_pred1))
```

```
              precision    recall  f1-score   support

         0.0       0.88      0.88      0.88         8
         1.0       0.50      0.50      0.50         2

    accuracy                           0.80        10
   macro avg       0.69      0.69      0.69        10
weighted avg       0.80      0.80      0.80        10
```

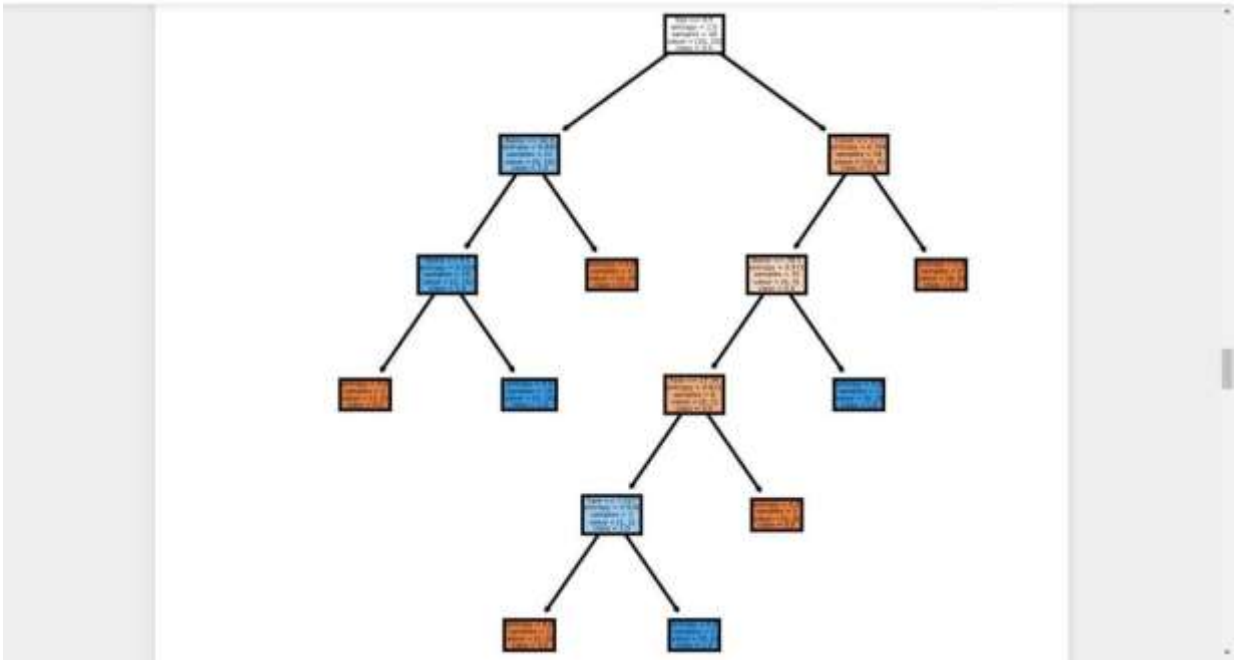
In [23]:
```
#Accuracy
print("accuracy: ", m1.score(X_test1,y_test1))
```

```
accuracy:  0.8
```

In [24]:
```
#Confusion Matrix
from sklearn.metrics import confusion_matrix
print(confusion_matrix(y_test1,y_pred1))
```

```
[[7 1]
 [1 1]]
```

```
target1 = target1.astype('str')

from sklearn import tree
%matplotlib inline
from matplotlib import pyplot as plt
fig1,axes1 = plt.subplots(nrows=1,ncols=1,figsize=(4,4),dpi=400)
tree.plot_tree(m1,feature_names=df2.columns,class_names=target1,filled=True, fontsize=2)
```



In [26]:
```
#Example3

df3 = pd.read_csv("titanic_data.csv")
df3.head()
X = df3.drop(['Fare','Age','Cabin'], axis=1)
X['Family'] = X['SibSp'] + X['Parch']
X = X.drop(['SibSp', 'Parch'], axis = 1)
X.head()
```

Out[26]:

| | PassengerId | Survived | Pclass | Name | Sex | Ticket | Embarked | Family |
|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 3 | Braund, Mr. Owen Harris | male | A/5 21171 | S | 1 |
| 1 | 2 | 1 | 1 | Cumings, Mrs. John Bradley (Florence Briggs Th... | female | PC 17599 | C | 1 |
| 2 | 3 | 1 | 3 | Heikkinen, Miss. Laina | female | STON/O2. 3101282 | S | 0 |
| 3 | 4 | 1 | 1 | Futrelle, Mrs. Jacques Heath (Lily May Peel) | female | 113803 | S | 1 |
| 4 | 5 | 0 | 3 | Allen, Mr. William Henry | male | 373450 | S | 0 |

In [27]:
```
def weClass(x):
    if x==1:
        return x*2
    elif x==2:
        return x*3
    else:
        return x*4

X['Weighted_class'] = X['Pclass'].apply(weClass)
X.head()
```

Out[27]:

| | PassengerId | Survived | Pclass | Name | Sex | Ticket | Embarked | Family | Weighted_class |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 3 | Braund, Mr. Owen Harris | male | A/5 21171 | S | 1 | 12 |
| 1 | 2 | 1 | 1 | Cumings, Mrs. John Bradley (Florence Briggs Th... | female | PC 17599 | C | 1 | 2 |
| 2 | 3 | 1 | 3 | Heikkinen, Miss. Laina | female | STON/O2. 3101282 | S | 0 | 12 |
| 3 | 4 | 1 | 1 | Futrelle, Mrs. Jacques Heath (Lily May Peel) | female | 113803 | S | 1 | 2 |
| 4 | 5 | 0 | 3 | Allen, Mr. William Henry | male | 373450 | S | 0 | 12 |

In [28]:
```
newdf=X.drop(['Pclass'], axis = 1)
newdf.head()
```

Out[28]:

| | PassengerId | Survived | Name | Sex | Ticket | Embarked | Family | Weighted_class |
|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 0 | Braund, Mr. Owen Harris | male | A/5 21171 | S | 1 | 12 |
| 1 | 2 | 1 | Cumings, Mrs. John Bradley (Florence Briggs Th... | female | PC 17599 | C | 1 | 2 |
| 2 | 3 | 1 | Heikkinen, Miss. Laina | female | STON/O2. 3101282 | S | 0 | 12 |
| 3 | 4 | 1 | Futrelle, Mrs. Jacques Heath (Lily May Peel) | female | 113803 | S | 1 | 2 |
| 4 | 5 | 0 | Allen, Mr. William Henry | male | 373450 | S | 0 | 12 |

In [29]:
```
from sklearn import preprocessing
label_encoder = preprocessing.LabelEncoder()

#Label Encoding
newdf.loc[:,('Name')] = label_encoder.fit_transform(newdf['Name'])
newdf.loc[:,('Sex')] = label_encoder.fit_transform(newdf['Sex'])
newdf.loc[:,('Ticket')] = label_encoder.fit_transform(newdf['Ticket'])


em_dummies = pd.get_dummies(X['Embarked'], drop_first=True)
newdf[['Embarked_Q','Embarked_S']] = em_dummies
newdf =  newdf.drop(['Embarked'], axis =1 )
newdf.head()
```

Out[29]:

| | PassengerId | Survived | Name | Sex | Ticket | Family | Weighted_class | Embarked_Q | Embarked_S |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 108 | 1 | 523 | 1 | 12 | 0 | 1 |
| 1 | 2 | 1 | 190 | 0 | 596 | 1 | 2 | 0 | 0 |
| 2 | 3 | 1 | 353 | 0 | 669 | 0 | 12 | 0 | 1 |
| 3 | 4 | 1 | 272 | 0 | 49 | 1 | 2 | 0 | 1 |
| 4 | 5 | 0 | 15 | 1 | 472 | 0 | 12 | 0 | 1 |

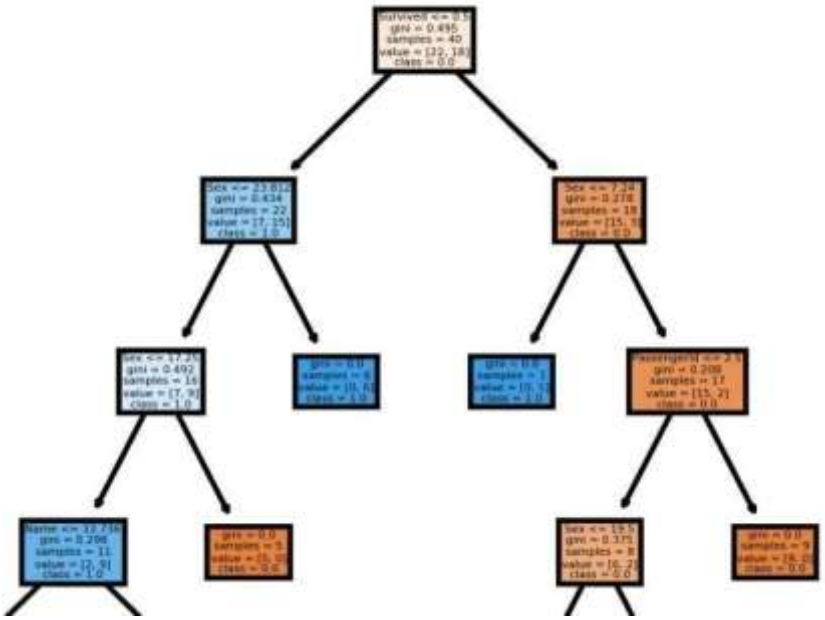
In [31]:

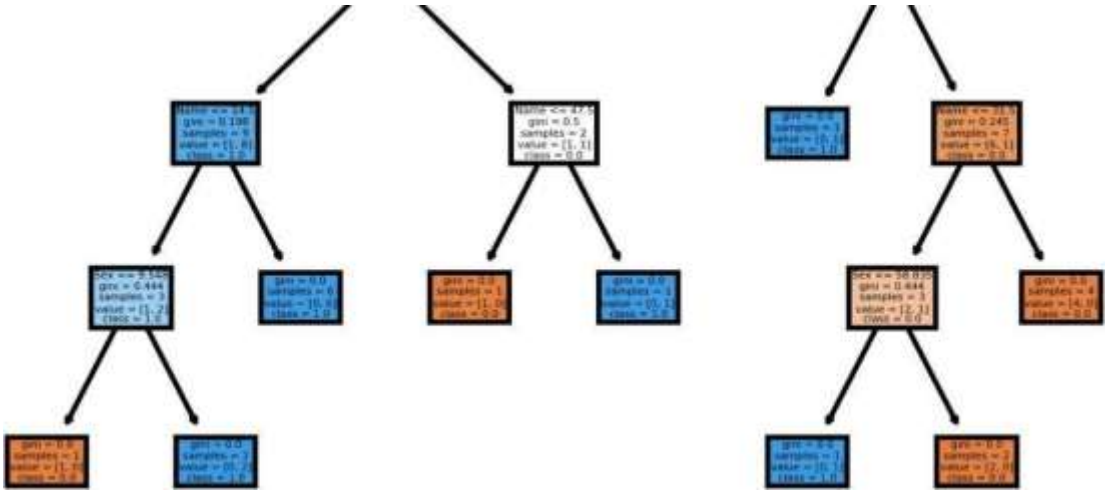
```
y = newdf.Survived
y = y.astype('float')
```

In [32]:

```
from sklearn.tree import DecisionTreeClassifier

#Splitting up the dataset
from sklearn.model_selection import train_test_split
X_train1, X_test1, y_train1, y_test1 = train_test_split(newdf,y,test_size=0.2)

#Training the decision tree classifier
m1 = DecisionTreeClassifier(criterion='entropy')
m1.fit(X_train1,y_train1)

#Predicting the response for test data
y_pred1 = m1.predict(X_test1)

#Classification Report
from sklearn.metrics import classification_report
print(classification_report(y_test1,y_pred1))
```

```
              precision    recall  f1-score   support

         0.0       1.00      1.00      1.00       100
         1.0       1.00      1.00      1.00        79

    accuracy                           1.00       179
   macro avg       1.00      1.00      1.00       179
weighted avg       1.00      1.00      1.00       179
```





**Outcomes:CO 5: Understand fundamentals of learning in AI**

**Conclusion:**

We learnt how to make a decision tree and test data and accuracy of that decision tree

**References:**


- Stuart Russell and PeterNorvig,ArtificialIntelligence:AModernApproach,Second Edition, PearsonPublication

ElaineRich,KevinKnight,ArtificialIntelligence, TataMcGrawHill,1999