Company Dataset

In [4]:

```
import pandas as pd
import numpy as np
from sklearn.model_selection import KFold
from sklearn.model_selection import cross_val_score
from sklearn.ensemble import BaggingClassifier
from sklearn.tree import DecisionTreeClassifier
import warnings
warnings.filterwarnings('ignore')
```

In [6]:

```
company = pd.read_csv("C:/Users/HP/Downloads/Company_Data.csv")
company
```

Out[6]:

	Sales	CompPrice	Income	Advertising	Population	Price	ShelveLoc	Age	Education	U
0	9.50	138	73	11	276	120	Bad	42	17	
1	11.22	111	48	16	260	83	Good	65	10	
2	10.06	113	35	10	269	80	Medium	59	12	
3	7.40	117	100	4	466	97	Medium	55	14	
4	4.15	141	64	3	340	128	Bad	38	13	
...	...	...	...	...	...	...	...	...	...	
395	12.57	138	108	17	203	128	Good	33	14	
396	6.14	139	23	3	37	120	Medium	55	11	
397	7.41	162	26	12	368	159	Medium	40	18	
398	5.94	100	79	7	284	95	Bad	50	12	
399	9.71	134	37	0	27	120	Good	49	16	

400 rows × 11 columns

In [7]:

```
company.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 400 entries, 0 to 399
Data columns (total 11 columns):
 #   Column       Non-Null Count  Dtype  
---  ------       --------------  -----  
 0   Sales        400 non-null    float64
 1   CompPrice    400 non-null    int64  
 2   Income       400 non-null    int64  
 3   Advertising  400 non-null    int64  
 4   Population   400 non-null    int64  
 5   Price        400 non-null    int64  
 6   ShelveLoc    400 non-null    object 
 7   Age          400 non-null    int64  
 8   Education    400 non-null    int64  
 9   Urban        400 non-null    object 
 10  US           400 non-null    object 
dtypes: float64(1), int64(7), object(3)
memory usage: 34.5+ KB
```

In [8]:

```
company.describe()
```

Out[8]:

	Sales	CompPrice	Income	Advertising	Population	Price	Age	E
count	400.000000	400.000000	400.000000	400.000000	400.000000	400.000000	400.000000	40
mean	7.496325	124.975000	68.657500	6.635000	264.840000	115.795000	53.322500	1
std	2.824115	15.334512	27.986037	6.650364	147.376436	23.676664	16.200297	
min	0.000000	77.000000	21.000000	0.000000	10.000000	24.000000	25.000000	1
25%	5.390000	115.000000	42.750000	0.000000	139.000000	100.000000	39.750000	1
50%	7.490000	125.000000	69.000000	5.000000	272.000000	117.000000	54.500000	1
75%	9.320000	135.000000	91.000000	12.000000	398.500000	131.000000	66.000000	1
max	16.270000	175.000000	120.000000	29.000000	509.000000	191.000000	80.000000	1

In [9]:

```
company.shape
```

Out[9]:

```
(400, 11)
```

In [10]:

```
company.isnull().sum()
```

Out[10]:

```
Sales          0
CompPrice      0
Income         0
Advertising    0
Population     0
Price          0
ShelveLoc      0
Age            0
Education      0
Urban          0
US             0
dtype: int64
```

In [11]:

```
from sklearn import preprocessing
label_encoder = preprocessing.LabelEncoder()
```

In [12]:

```
label_encoder
```

Out[12]:

```
LabelEncoder()
```

In [13]:

```
company['ShelveLoc'] = label_encoder.fit_transform(company['ShelveLoc'])
company['Urban'] = label_encoder.fit_transform(company['Urban'])
company['US'] = label_encoder.fit_transform(company['US'])
company.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 400 entries, 0 to 399
Data columns (total 11 columns):
 #   Column       Non-Null Count  Dtype  
---  ------       --------------  -----  
 0   Sales        400 non-null    float64
 1   CompPrice    400 non-null    int64  
 2   Income       400 non-null    int64  
 3   Advertising  400 non-null    int64  
 4   Population   400 non-null    int64  
 5   Price        400 non-null    int64  
 6   ShelveLoc    400 non-null    int32  
 7   Age          400 non-null    int64  
 8   Education    400 non-null    int64  
 9   Urban        400 non-null    int32  
 10  US           400 non-null    int32  
dtypes: float64(1), int32(3), int64(7)
memory usage: 29.8 KB
```

In [14]:

```
company['value']= company['Sales'].apply(lambda Sales: 'High' if Sales <=7.49 else 'Low')
```

In [15]:

```
company.head()
```

Out[15]:

	Sales	CompPrice	Income	Advertising	Population	Price	ShelveLoc	Age	Education	Urba
0	9.50	138	73	11	276	120	0	42	17	
1	11.22	111	48	16	260	83	1	65	10	
2	10.06	113	35	10	269	80	2	59	12	
3	7.40	117	100	4	466	97	2	55	14	
4	4.15	141	64	3	340	128	0	38	13	

In [16]:

```
company.drop(['Sales'],axis=1)
```

Out[16]:

	CompPrice	Income	Advertising	Population	Price	ShelveLoc	Age	Education	Urban	U
0	138	73	11	276	120	0	42	17	1	
1	111	48	16	260	83	1	65	10	1	
2	113	35	10	269	80	2	59	12	1	
3	117	100	4	466	97	2	55	14	1	
4	141	64	3	340	128	0	38	13	1	
...	...	...	...	...	...	...	...	...	...	
395	138	108	17	203	128	1	33	14	1	
396	139	23	3	37	120	2	55	11	0	
397	162	26	12	368	159	2	40	18	1	
398	100	79	7	284	95	0	50	12	1	
399	134	37	0	27	120	1	49	16	1	

400 rows × 11 columns

In [17]:

```
company['value'] = label_encoder.fit_transform(company['value'])
```

In [18]:

```
company.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 400 entries, 0 to 399
Data columns (total 12 columns):
 #   Column       Non-Null Count  Dtype  
---  ------       --------------  -----  
 0   Sales        400 non-null    float64
 1   CompPrice    400 non-null    int64  
 2   Income       400 non-null    int64  
 3   Advertising  400 non-null    int64  
 4   Population   400 non-null    int64  
 5   Price        400 non-null    int64  
 6   ShelveLoc    400 non-null    int32  
 7   Age          400 non-null    int64  
 8   Education    400 non-null    int64  
 9   Urban        400 non-null    int32  
 10  US           400 non-null    int32  
 11  value        400 non-null    int32  
dtypes: float64(1), int32(4), int64(7)
memory usage: 31.4 KB
```

In [19]:

```
x = company.iloc[:,1:11]
y = company.iloc[:,11]
```

In [20]:

```
x
```

Out[20]:

	CompPrice	Income	Advertising	Population	Price	ShelveLoc	Age	Education	Urban	U
0	138	73	11	276	120	0	42	17	1	
1	111	48	16	260	83	1	65	10	1	
2	113	35	10	269	80	2	59	12	1	
3	117	100	4	466	97	2	55	14	1	
4	141	64	3	340	128	0	38	13	1	
...	...	...	...	...	...	...	...	...	...	
395	138	108	17	203	128	1	33	14	1	
396	139	23	3	37	120	2	55	11	0	
397	162	26	12	368	159	2	40	18	1	
398	100	79	7	284	95	0	50	12	1	
399	134	37	0	27	120	1	49	16	1	

400 rows × 10 columns

In [21]:

```
y
```

Out[21]:

```
0      1
1      1
2      1
3      0
4      0
      ..
395    1
396    0
397    0
398    0
399    1
Name: value, Length: 400, dtype: int32
```

In [22]:

```
from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test = train_test_split(x,y, test_size=0.3, random_state=40)
```

In [23]:

```
model=DecisionTreeClassifier(criterion='entropy', max_depth=11)
model.fit(x_train,y_train)
```

Out[23]:

```
DecisionTreeClassifier(criterion='entropy', max_depth=11)
```

In [24]:

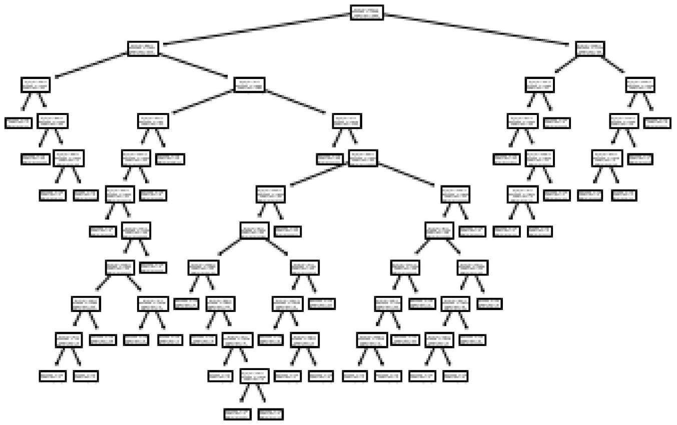
```
model.get_n_leaves()
```

Out[24]:

```
42
```

In [25]:

```
#plot the Decision Tree
from sklearn import tree
tree.plot_tree(model);
```



In [26]:

```
#Predicting on test data
preds= model.predict(x_test)
#Accuracy on test data
print('Test data Accuracy is:',np.mean(preds==y_test))
```

```
Test data Accuracy is: 0.6833333333333333
```

In [27]:

```
#Predicting on train data
predt= model.predict(x_train)
#Accuracy on train data
print('Train data Accuracy is:',np.mean(predt==y_train))
```

```
Train data Accuracy is: 1.0
```

In [28]:

```
kfold = KFold(n_splits=10)
cart = DecisionTreeClassifier()
num_trees = 100
model = BaggingClassifier(base_estimator=cart, n_estimators=num_trees)
results = cross_val_score(model, x, y, cv=kfold)
print(results.mean())
```

```
0.8175000000000001
```

In [29]:

```
# Random Forest Classification
from pandas import read_csv
from sklearn.model_selection import KFold
from sklearn.model_selection import cross_val_score
from sklearn.ensemble import RandomForestClassifier
num_trees = 100
max_features = 3
kfold = KFold(n_splits=10)
model = RandomForestClassifier(n_estimators=num_trees, max_features=max_features)
results = cross_val_score(model, x, y, cv=kfold)
print(results.mean())
```

```
0.8175000000000001
```

In [30]:

```
# AdaBoost Classification
from pandas import read_csv
from sklearn.model_selection import KFold
from sklearn.model_selection import cross_val_score
from sklearn.ensemble import AdaBoostClassifier




num_trees = 10
kfold = KFold(n_splits=10)
model = AdaBoostClassifier(n_estimators=num_trees)
results = cross_val_score(model, x, y, cv=kfold)
print(results.mean())
```

```
0.7825
```

In [31]:

```
# Stacking Ensemble for Classification
from pandas import read_csv
from sklearn.model_selection import KFold
from sklearn.model_selection import cross_val_score
from sklearn.linear_model import LogisticRegression
from sklearn.tree import DecisionTreeClassifier
from sklearn.svm import SVC
from sklearn.ensemble import VotingClassifier
kfold = KFold(n_splits=10)

# create the sub models
estimators = []
model1 = LogisticRegression(max_iter=500)
estimators.append(('logistic', model1))
model2 = DecisionTreeClassifier()
estimators.append(('cart', model2))
model3 = SVC()
estimators.append(('svm', model3))

# create the ensemble model
ensemble = VotingClassifier(estimators)
results = cross_val_score(ensemble, x, y, cv=kfold)
print(results.mean())
```

```
0.79
```

Fraud check dataset

In [32]:

```
import pandas as pd
import numpy as np
from sklearn.model_selection import KFold
from sklearn.model_selection import cross_val_score
from sklearn.ensemble import BaggingClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn.model_selection import train_test_split
from sklearn import tree
from sklearn.metrics import classification_report
import warnings
warnings.filterwarnings('ignore')
```

In [33]:

```
fraud = pd.read_csv("C:/Users/HP/Downloads/Fraud_check.csv")
```

In [34]:

```
fraud.head()
```

Out[34]:

	Undergrad	Marital.Status	Taxable.Income	City.Population	Work.Experience	Urban
0	NO	Single	68833	50047	10	YES
1	YES	Divorced	33700	134075	18	YES
2	NO	Married	36925	160205	30	YES
3	YES	Single	50190	193264	15	YES
4	NO	Married	81002	27533	28	NO

In [35]:

```
fraud.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 600 entries, 0 to 599
Data columns (total 6 columns):
 #   Column           Non-Null Count  Dtype 
---  ------           --------------  ----- 
 0   Undergrad        600 non-null    object
 1   Marital.Status   600 non-null    object
 2   Taxable.Income   600 non-null    int64 
 3   City.Population  600 non-null    int64 
 4   Work.Experience  600 non-null    int64 
 5   Urban            600 non-null    object
dtypes: int64(3), object(3)
memory usage: 28.2+ KB
```

In [36]:

```
fraud.describe()
```

Out[36]:

	Taxable.Income	City.Population	Work.Experience
count	600.000000	600.000000	600.000000
mean	55208.375000	108747.368333	15.558333
std	26204.827597	49850.075134	8.842147
min	10003.000000	25779.000000	0.000000
25%	32871.500000	66966.750000	8.000000
50%	55074.500000	106493.500000	15.000000
75%	78611.750000	150114.250000	24.000000
max	99619.000000	199778.000000	30.000000

In [37]:

```
fraud.isnull().sum()
```

Out[37]:

```
Undergrad          0
Marital.Status     0
Taxable.Income     0
City.Population    0
Work.Experience    0
Urban              0
dtype: int64
```

In [38]:

```
f1 = fraud.rename({'Marital.Status': 'MarStat','Taxable.Income': 'TaxInc','City.Population'
f1
```

Out[38]:

	Undergrad	MarStat	TaxInc	CityPop	WorkExp	Urban
0	NO	Single	68833	50047	10	YES
1	YES	Divorced	33700	134075	18	YES
2	NO	Married	36925	160205	30	YES
3	YES	Single	50190	193264	15	YES
4	NO	Married	81002	27533	28	NO
...	...	...	...	...	...	...
595	YES	Divorced	76340	39492	7	YES
596	YES	Divorced	69967	55369	2	YES
597	NO	Divorced	47334	154058	0	YES
598	YES	Married	98592	180083	17	NO
599	NO	Divorced	96519	158137	16	NO

600 rows × 6 columns

In [39]:

```
from sklearn import preprocessing
label_encoder= preprocessing.LabelEncoder()
```

In [40]:

```
f1['Undergrad'] = label_encoder.fit_transform(f1['Undergrad'])
f1['MarStat'] = label_encoder.fit_transform(f1['MarStat'])
f1['Urban'] = label_encoder.fit_transform(f1['Urban'])
f1.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 600 entries, 0 to 599
Data columns (total 6 columns):
 #   Column     Non-Null Count  Dtype
---  ------     --------------  -----
 0   Undergrad  600 non-null    int32
 1   MarStat    600 non-null    int32
 2   TaxInc     600 non-null    int64
 3   CityPop    600 non-null    int64
 4   WorkExp    600 non-null    int64
 5   Urban      600 non-null    int32
dtypes: int32(3), int64(3)
memory usage: 21.2 KB
```

In [41]:

```
f1['Tax']= f1['TaxInc'].apply(lambda TaxInc : 'Risky' if TaxInc<=30000 else 'Good')
```

In [42]:

```
f1
```

Out[42]:

	Undergrad	MarStat	TaxInc	CityPop	WorkExp	Urban	Tax
0	0	2	68833	50047	10	1	Good
1	1	0	33700	134075	18	1	Good
2	0	1	36925	160205	30	1	Good
3	1	2	50190	193264	15	1	Good
4	0	1	81002	27533	28	0	Good
...	...	...	...	...	...	...	...
595	1	0	76340	39492	7	1	Good
596	1	0	69967	55369	2	1	Good
597	0	0	47334	154058	0	1	Good
598	1	1	98592	180083	17	0	Good
599	0	0	96519	158137	16	0	Good

600 rows × 7 columns

In [43]:

```
f1=f1.drop(['TaxInc'],axis=1)
f1
```

Out[43]:

	Undergrad	MarStat	CityPop	WorkExp	Urban	Tax
0	0	2	50047	10	1	Good
1	1	0	134075	18	1	Good
2	0	1	160205	30	1	Good
3	1	2	193264	15	1	Good
4	0	1	27533	28	0	Good
...	...	...	...	...	...	...
595	1	0	39492	7	1	Good
596	1	0	55369	2	1	Good
597	0	0	154058	0	1	Good
598	1	1	180083	17	0	Good
599	0	0	158137	16	0	Good

600 rows × 6 columns

In [45]:

```
f1['Tax'] = label_encoder.fit_transform(f1['Tax'])
```

In [46]:

```
f1.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 600 entries, 0 to 599
Data columns (total 6 columns):
 #   Column     Non-Null Count  Dtype
---  ------     --------------  -----
 0   Undergrad  600 non-null    int32
 1   MarStat    600 non-null    int32
 2   CityPop    600 non-null    int64
 3   WorkExp    600 non-null    int64
 4   Urban      600 non-null    int32
 5   Tax        600 non-null    int64
dtypes: int32(3), int64(3)
memory usage: 21.2 KB
```

In [47]:

```
x=f1.iloc[:,0:5]
y=f1.iloc[:,5]
```

In [48]:

```
x
```

Out[48]:

	Undergrad	MarStat	CityPop	WorkExp	Urban
0	0	2	50047	10	1
1	1	0	134075	18	1
2	0	1	160205	30	1
3	1	2	193264	15	1
4	0	1	27533	28	0
...	...	...	...	...	...
595	1	0	39492	7	1
596	1	0	55369	2	1
597	0	0	154058	0	1
598	1	1	180083	17	0
599	0	0	158137	16	0

600 rows × 5 columns

In [49]:

```
y
```

Out[49]:

```
0      0
1      0
2      0
3      0
4      0
      ..
595    0
596    0
597    0
598    0
599    0
Name: Tax, Length: 600, dtype: int64
```

In [50]:

```
y.value_counts()
```

Out[50]:

```
0    476
1    124
Name: Tax, dtype: int64
```

In [51]:

```
#Splitting data into training and testing data set
x_train,x_test,y_train,y_test= train_test_split(x,y, test_size=0.2, random_state=40)
```

In [52]:

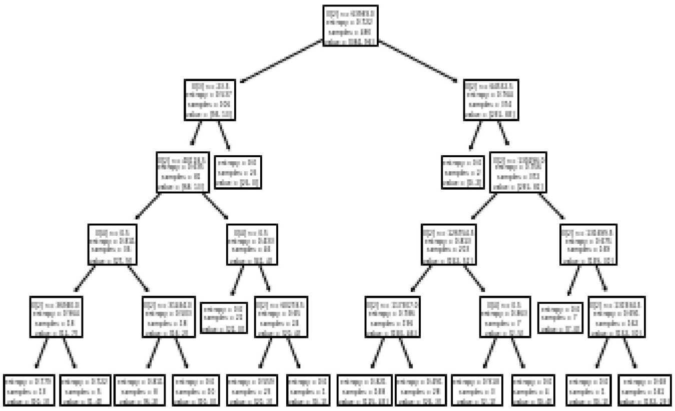
```
model=DecisionTreeClassifier(criterion='entropy', max_depth=5)
model.fit(x_train,y_train)
```

Out[52]:

```
DecisionTreeClassifier(criterion='entropy', max_depth=5)
```

In [53]:

```
#plot the Decision Tree
tree.plot_tree(model);
```



In [54]:

```
model.get_n_leaves()
```

Out[54]:

```
16
```

In [55]:

```
#Predicting on test data
preds=model.predict(x_test)
pd.Series(preds).value_counts()
```

Out[55]:

```
0    117
1      3
dtype: int64
```

In [56]:

```
print('Test Data Accuracy:',np.mean(preds==y_test))
```

```
Test Data Accuracy: 0.775
```

In [57]:

```
#Predicting on Train Data
predt= model.predict(x_train)
pd.Series(predt).value_counts()
```

Out[57]:

```
0    467
1     13
dtype: int64
```

In [58]:

```
print('Test Data Accuracy:',np.mean(predt==y_train))
```

```
Test Data Accuracy: 0.8229166666666666
```

In [59]:

```
#Classification report for y test
print(classification_report(preds,y_test))
```

```
              precision    recall  f1-score   support

           0       0.99      0.78      0.87       117
           1       0.07      0.67      0.13         3

    accuracy                           0.78       120
   macro avg       0.53      0.72      0.50       120
weighted avg       0.97      0.78      0.85       120
```

In [60]:

```
X = f1.iloc[:,0:5]
Y = f1.iloc[:,5]


kfold = KFold(n_splits=10)
cart = DecisionTreeClassifier()
num_trees = 100
model = BaggingClassifier(base_estimator=cart, n_estimators=num_trees)
results = cross_val_score(model, X, Y, cv=kfold)
print(results.mean())
```

```
0.735
```

In [61]:

```
# Random Forest Classification
from pandas import read_csv
from sklearn.model_selection import KFold
from sklearn.model_selection import cross_val_score
from sklearn.ensemble import RandomForestClassifier
```

In [62]:

```
X = f1.iloc[:,0:5]
Y = f1.iloc[:,5]
num_trees = 100
max_features = 3
kfold = KFold(n_splits=10)
model = RandomForestClassifier(n_estimators=num_trees, max_features=max_features)
results = cross_val_score(model, X, Y, cv=kfold)
print(results.mean())
```

```
0.7466666666666667
```

In [63]:

```
# AdaBoost Classification
from pandas import read_csv
from sklearn.model_selection import KFold
from sklearn.model_selection import cross_val_score
from sklearn.ensemble import AdaBoostClassifier

X = f1.iloc[:,0:5]
Y = f1.iloc[:,5]

num_trees = 10
kfold = KFold(n_splits=10)
model = AdaBoostClassifier(n_estimators=num_trees)
results = cross_val_score(model, X, Y, cv=kfold)
print(results.mean())
```

```
0.7916666666666666
```

In [64]:

```
# Stacking Ensemble for Classification
from pandas import read_csv
from sklearn.model_selection import KFold
from sklearn.model_selection import cross_val_score
from sklearn.linear_model import LogisticRegression
from sklearn.tree import DecisionTreeClassifier
from sklearn.svm import SVC
from sklearn.ensemble import VotingClassifier

X = f1.iloc[:,0:5]
Y = f1.iloc[:,5]
kfold = KFold(n_splits=10)

# create the sub models
estimators = []
model1 = LogisticRegression(max_iter=500)
estimators.append(('logistic', model1))
model2 = DecisionTreeClassifier()
estimators.append(('cart', model2))
model3 = SVC()
estimators.append(('svm', model3))

# create the ensemble model
ensemble = VotingClassifier(estimators)
results = cross_val_score(ensemble, X, Y, cv=kfold)
print(results.mean())
```

```
0.7933333333333332
```

In [ ]: