In [1]:
```
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
import seaborn as sns
from sklearn import datasets
from sklearn.model_selection import train_test_split
from sklearn.tree import  DecisionTreeClassifier
from sklearn import tree
from sklearn.metrics import classification_report
from sklearn import preprocessing
```

In [2]:
```
data = pd.read_csv('Company_Data.csv')
data
```

Out[2]:

	Sales	CompPrice	Income	Advertising	Population	Price	ShelveLoc	Age	Education	Urban	US
0	9.50	138	73	11	276	120	Bad	42	17	Yes	Yes
1	11.22	111	48	16	260	83	Good	65	10	Yes	Yes
2	10.06	113	35	10	269	80	Medium	59	12	Yes	Yes
3	7.40	117	100	4	466	97	Medium	55	14	Yes	Yes
4	4.15	141	64	3	340	128	Bad	38	13	Yes	No
...	...	...	...	...	...	...	...	...	...	...	...
395	12.57	138	108	17	203	128	Good	33	14	Yes	Yes
396	6.14	139	23	3	37	120	Medium	55	11	No	Yes
397	7.41	162	26	12	368	159	Medium	40	18	Yes	Yes
398	5.94	100	79	7	284	95	Bad	50	12	Yes	Yes
399	9.71	134	37	0	27	120	Good	49	16	Yes	Yes

400 rows × 11 columns

In [3]:
```
data.shape
```

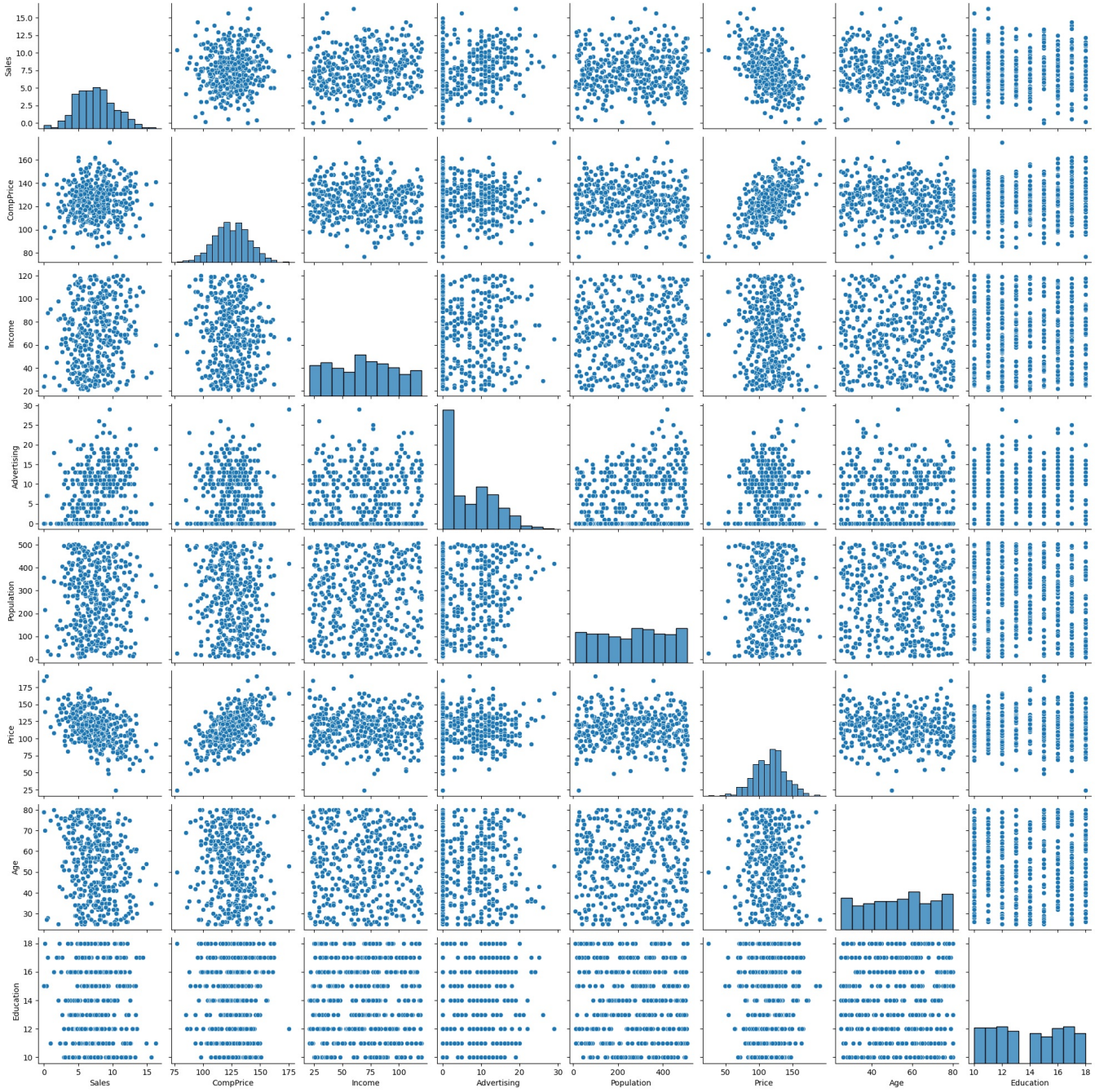
Out[3]:
```
(400, 11)
```

In [4]:
```
data.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 [5]:
```
sns.pairplot(data)
```

Out[5]:
```
<seaborn.axisgrid.PairGrid at 0x1ba355750a0>
```



In [6]:
```
plt.figure(figsize=(20,10))
sns.heatmap(data.corr(),annot=True)
```

Out[6]:
```
<AxesSubplot:>
```

In [7]:
```
label_encoder = preprocessing.LabelEncoder()
data['ShelveLoc']= label_encoder.fit_transform(data['ShelveLoc'])
data['Urban']= label_encoder.fit_transform(data['Urban'])
data['US']= label_encoder.fit_transform(data['US'])
```

In [8]:
```
data
```

Out[8]:

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

400 rows × 11 columns

In [9]:
```
x=data.iloc[:,0:6]
y=data['ShelveLoc']
```

In [10]:
```
x
```

Out[10]:

	Sales	CompPrice	Income	Advertising	Population	Price
0	9.50	138	73	11	276	120
1	11.22	111	48	16	260	83
2	10.06	113	35	10	269	80
3	7.40	117	100	4	466	97
4	4.15	141	64	3	340	128
...	...	...	...	...	...	...
395	12.57	138	108	17	203	128
396	6.14	139	23	3	37	120
397	7.41	162	26	12	368	159
398	5.94	100	79	7	284	95
399	9.71	134	37	0	27	120

400 rows × 6 columns

In [11]:
```
y
```

Out[11]:
```
0      0
1      1
2      2
3      2
4      0
      ..
395    1
396    2
397    2
398    0
399    1
Name: ShelveLoc, Length: 400, dtype: int32
```

In [12]:
```
data['ShelveLoc'].unique()
```

Out[12]:
```
array([0, 1, 2])
```

In [13]:
```
data.ShelveLoc.value_counts()
```

Out[13]:
```
2    219
0     96
1     85
Name: ShelveLoc, dtype: int64
```

In [14]:
```
colnames = list(data.columns)
colnames
```

Out[14]:
```
['Sales',
 'CompPrice',
 'Income',
 'Advertising',
 'Population',
 'Price',
 'ShelveLoc',
 'Age',
 'Education',
 'Urban',
 'US']
```

In [15]:
```
x_train, x_test,y_train,y_test = train_test_split(x,y, test_size=0.2,random_state=40)
```

In [16]:
```
model = DecisionTreeClassifier(criterion = 'entropy',max_depth=3)
model.fit(x_train,y_train)
```

Out[16]:
```
DecisionTreeClassifier(criterion='entropy', max_depth=3)
```

In [17]:
```
tree.plot_tree(model);
```

In [19]:
```
fn=['Sales',    'CompPrice',    'Income',       'Advertising',  'Population',   'Price']
cn=['Bad', 'Good', 'Medium']
fig, axes = plt.subplots(nrows = 1,ncols = 1,figsize = (4,4), dpi=300)
tree.plot_tree(model, feature_names = fn, class_names=cn,filled = True);
```

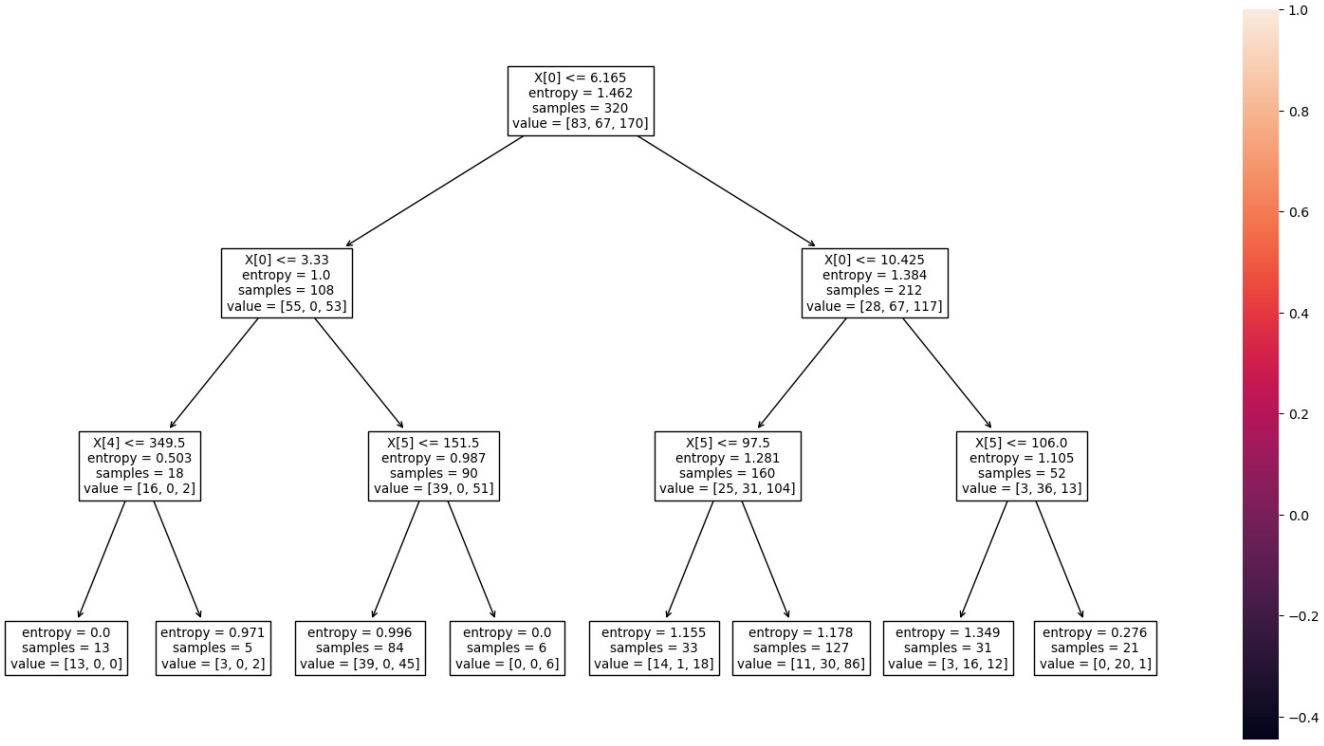
In [20]:
```
model.feature_importances_
```

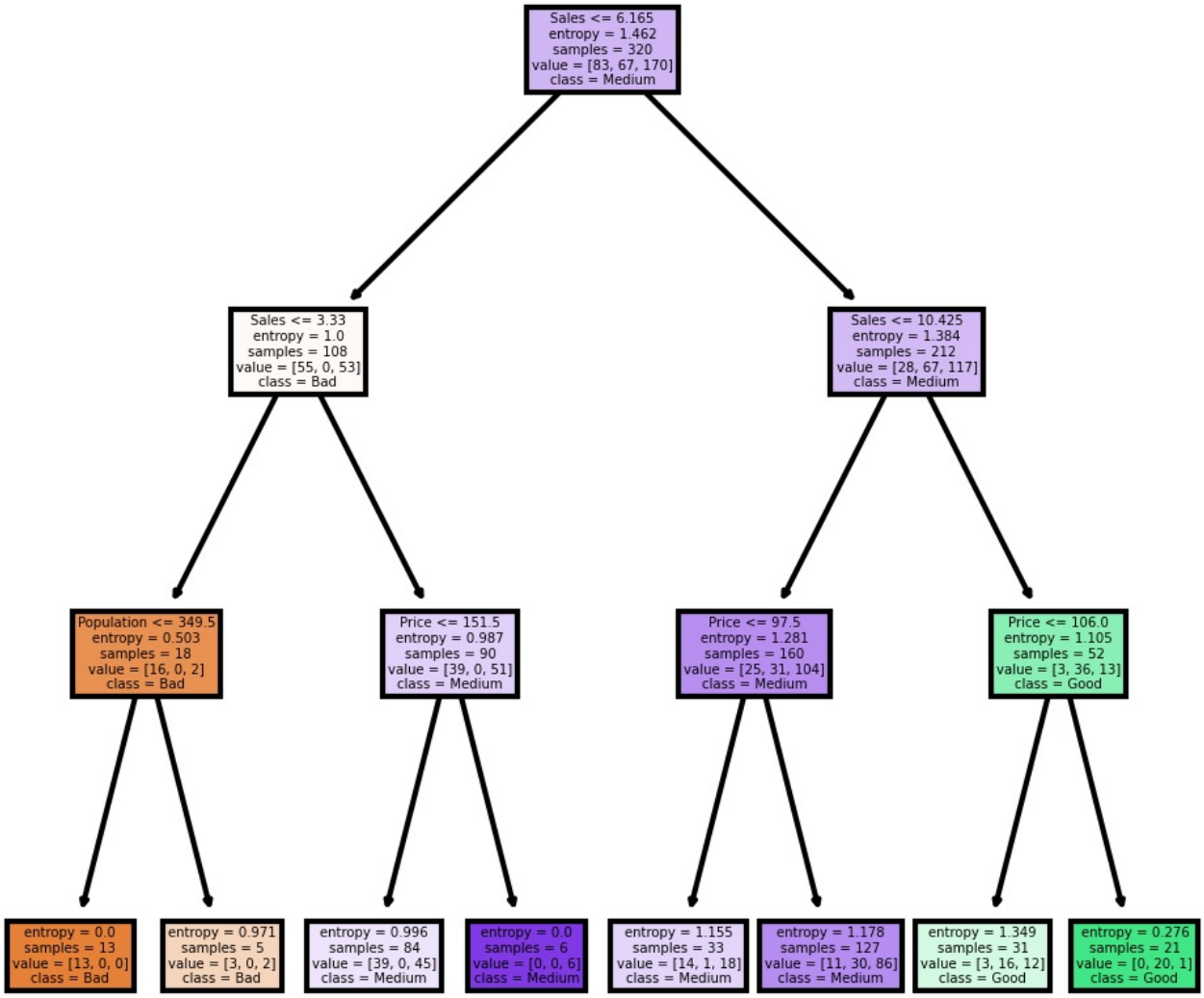
Out[20]:
```
array([0.74692591, 0.        , 0.        , 0.        , 0.02920061,
       0.22387348])
```

In [21]:
```
feature_imp = pd.Series(model.feature_importances_,index=fn).sort_values(ascending=False)
feature_imp
```

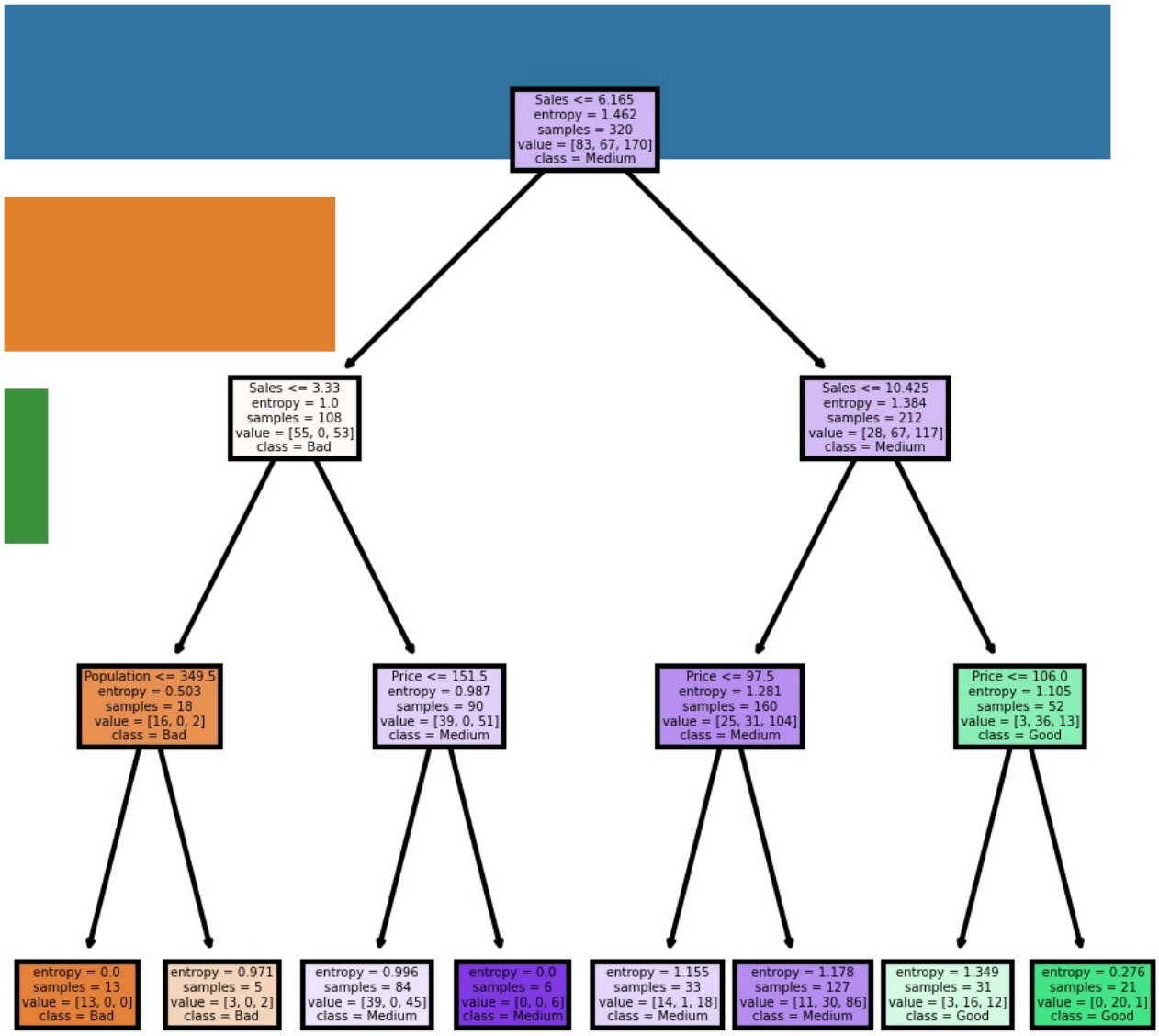
Out[21]:
```
Sales          0.746926
Price          0.223873
Population     0.029201
CompPrice      0.000000
Income         0.000000
Advertising    0.000000
dtype: float64
```

In [22]:
```
sns.barplot(x=feature_imp, y=feature_imp.index)
plt.xlabel('Feature Importance Score')
plt.ylabel('Features')
plt.title("Visualizing Important Features")
plt.show()
```




Sales <= 6.165
entropy = 1.462
samples = 320
value = [83, 67, 170]
class = Medium
Sales <= 3.33
entropy = 1.0
samples = 108
value = [55, 0, 53]
class = Bad
Sales <= 10.425
entropy = 1.384
samples = 212
value = [28, 67, 117]
class = Medium
Population <= 349.5
entropy = 0.503
samples = 18
value = [16, 0, 2]
class = Bad
Price <= 151.5
entropy = 0.987
samples = 90
value = [39, 0, 51]
class = Medium
Price <= 97.5
entropy = 1.281
samples = 160
value = [25, 31, 104]
class = Medium
Price <= 106.0
entropy = 1.105
samples = 52
value = [3, 36, 13]
class = Good
entropy = 0.0
samples = 13
value = [13, 0, 0]
class = Bad
entropy = 0.971
samples = 5
value = [3, 0, 2]
class = Bad
entropy = 0.996
samples = 84
value = [39, 0, 45]
class = Medium
entropy = 0.0
samples = 6
value = [0, 0, 6]
class = Medium
entropy = 1.155
samples = 33
value = [14, 1, 18]
class = Medium
entropy = 1.178
samples = 127
value = [11, 30, 86]
class = Medium
entropy = 1.349
samples = 31
value = [3, 16, 12]
class = Good
entropy = 0.276
samples = 21
value = [0, 20, 1]
class = Good

Visualizing Important Features



In [24]:
```
preds = model.predict(x_test)
pd.Series(preds).value_counts()
```

Out[24]:
```
2    63
1    13
0     4
dtype: int64
```

In [25]:
```
preds
```

Out[25]:
```
array([2, 2, 2, 2, 2, 2, 2, 1, 2, 1, 2, 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 1,
       2, 2, 2, 2, 2, 2, 1, 1, 1, 2, 1, 2, 2, 1, 2, 2, 2, 2, 2, 2, 0, 2,
       2, 2, 2, 2, 2, 2, 0, 2, 2, 2, 2, 1, 1, 2, 2, 0, 2, 2, 1, 2, 2, 2,
       2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 0, 2, 2, 2])
```

In [26]:
```
pd.crosstab(y_test,preds)
```

Out[26]:

col_0	0	1	2
ShelveLoc			
0	1	0	12
1	0	8	10
2	3	5	41

In [27]:
```
np.mean(preds==y_test)
```

Out[27]:
```
0.625
```

In [28]:
```
model_gini = DecisionTreeClassifier(criterion='gini', max_depth=3)
```

In [29]:
```
model_gini.fit(x_train, y_train)
```

Out[29]:
```
DecisionTreeClassifier(max_depth=3)
```

In [30]:
```
pred=model.predict(x_test)
np.mean(preds==y_test)
```

Out[30]:
```
0.625
```

In [31]:
```
model.feature_importances_
```

Out[31]:
```
array([0.74692591, 0.        , 0.        , 0.        , 0.02920061,
       0.22387348])
```

In [32]:
```
from sklearn.tree import DecisionTreeRegressor
```

In [33]:
```
array = data.values
X = array[:,0:6]
y = array[:,3]
```

In [34]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.33, random_state=1)
```

In [35]:
```
model = DecisionTreeRegressor()
model.fit(X_train, y_train)
```

Out[35]:
```
DecisionTreeRegressor()
```

In [36]:
```
model.score(X_test,y_test)
```

Out[36]:
```
0.9894098230386015
```

In [ ]:
```

```