In [ ]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

In [ ]:
```
from google.colab import files
uploaded = files.upload()
```

Upload widget is only available when the cell has been executed in the current browser session. Please rerun this cell to enable.

```
Saving car_evaluation.csv to car_evaluation.csv
```

In [ ]:
```
from google.colab import drive
drive.mount('/content/gdrive')
```

```
Mounted at /content/gdrive
```

In [ ]:
```
df=pd.read_csv('car_evaluation.csv', header=None)
```

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

Out[ ]:

	0	1	2	3	4	5	6
0	vhigh	vhigh	2	2	small	low	unacc
1	vhigh	vhigh	2	2	small	med	unacc
2	vhigh	vhigh	2	2	small	high	unacc
3	vhigh	vhigh	2	2	med	low	unacc
4	vhigh	vhigh	2	2	med	med	unacc

In [ ]:
```
df.shape
```

Out[ ]:
```
(1728, 7)
```

In [ ]:
```
col_names=['buying','maint','doors','persons','lug_boot','safety','class']

df.columns= col_names

col_names
```

Out[ ]:
```
['buying', 'maint', 'doors', 'persons', 'lug_boot', 'safety', 'class']
```

In [ ]:
```
df
```

Out[ ]:

	buying	maint	doors	persons	lug_boot	safety	class
0	vhigh	vhigh	2	2	small	low	unacc
1	vhigh	vhigh	2	2	small	med	unacc
2	vhigh	vhigh	2	2	small	high	unacc

3	vhigh	vhigh	2	2	med	low	unacc
4	vhigh	vhigh	2	2	med	med	unacc
...	...	...	...	...	...	...	...
1723	low	low	5more	more	med	med	good
1724	low	low	5more	more	med	high	vgood
1725	low	low	5more	more	big	low	unacc
1726	low	low	5more	more	big	med	good
1727	low	low	5more	more	big	high	vgood

1728 rows × 7 columns

In [ ]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1728 entries, 0 to 1727
Data columns (total 7 columns):
 #   Column    Non-Null Count  Dtype 
---  ------    --------------  ----- 
 0   buying    1728 non-null   object
 1   maint     1728 non-null   object
 2   doors     1728 non-null   object
 3   persons   1728 non-null   object
 4   lug_boot  1728 non-null   object
 5   safety    1728 non-null   object
 6   class     1728 non-null   object
dtypes: object(7)
memory usage: 94.6+ KB
```

In [ ]:
```
df.describe()
```

Out[ ]:

	buying	maint	doors	persons	lug_boot	safety	class
count	1728	1728	1728	1728	1728	1728	1728
unique	4	4	4	3	3	3	4
top	vhigh	vhigh	2	2	small	low	unacc
freq	432	432	432	576	576	576	1210

In [ ]:
```
col_names=['buying','maint','doors','persons','lug_boot','safety','class']

for col in col_names:
    print(df[col].value_counts())
```

```
buying
vhigh    432
high     432
med      432
low      432
Name: count, dtype: int64
maint
vhigh    432
high     432
```

```
med      432
low      432
Name: count, dtype: int64
doors
2        432
3        432
4        432
5more    432
Name: count, dtype: int64
persons
2       576
4       576
more    576
Name: count, dtype: int64
lug_boot
small    576
med      576
big      576
Name: count, dtype: int64
safety
low     576
med     576
high    576
Name: count, dtype: int64
class
unacc    1210
acc       384
good       69
vgood      65
Name: count, dtype: int64
```

In [ ]:
```
df.isnull().sum()
```

Out[ ]:

	0
buying	0
maint	0
doors	0
persons	0
lug_boot	0
safety	0
class	0

dtype: int64

In [ ]:
```
X= df.drop(['class'],axis=1)
y=df['class']
```

Sk Learn library to Divide data

In [ ]:
```
from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test =train_test_split(X,y,test_size=0.33,rand
```

33% data in testing

In [ ]:
```
X_train.shape, X_test.shape
```

Out[ ]:
```
((1157, 6), (571, 6))
```

TO check data is normalize or not

In [ ]:
```
X_train.dtypes
```

Out[ ]:

	0
buying	object
maint	object
doors	object
persons	object
lug_boot	object
safety	object

dtype: object

To install Category_Encoders using pip install category_encoders

In [ ]:
```
pip install category_encoders
```

```
Collecting category_encoders
  Downloading category_encoders-2.8.0-py3-none-any.whl.metadata (7.9 kB)
Requirement already satisfied: numpy>=1.14.0 in /usr/local/lib/python3.11/di
st-packages (from category_encoders) (1.26.4)
Requirement already satisfied: pandas>=1.0.5 in /usr/local/lib/python3.11/di
st-packages (from category_encoders) (2.2.2)
Requirement already satisfied: patsy>=0.5.1 in /usr/local/lib/python3.11/dis
t-packages (from category_encoders) (1.0.1)
Requirement already satisfied: scikit-learn>=1.6.0 in /usr/local/lib/python
3.11/dist-packages (from category_encoders) (1.6.1)
Requirement already satisfied: scipy>=1.0.0 in /usr/local/lib/python3.11/dis
t-packages (from category_encoders) (1.13.1)
Requirement already satisfied: statsmodels>=0.9.0 in /usr/local/lib/python3.
11/dist-packages (from category_encoders) (0.14.4)
Requirement already satisfied: python-dateutil>=2.8.2 in /usr/local/lib/pyth
on3.11/dist-packages (from pandas>=1.0.5->category_encoders) (2.8.2)
Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.11/dis
t-packages (from pandas>=1.0.5->category_encoders) (2024.2)
Requirement already satisfied: tzdata>=2022.7 in /usr/local/lib/python3.11/d
ist-packages (from pandas>=1.0.5->category_encoders) (2025.1)
Requirement already satisfied: joblib>=1.2.0 in /usr/local/lib/python3.11/di
st-packages (from scikit-learn>=1.6.0->category_encoders) (1.4.2)
Requirement already satisfied: threadpoolctl>=3.1.0 in /usr/local/lib/python
3.11/dist-packages (from scikit-learn>=1.6.0->category_encoders) (3.5.0)
Requirement already satisfied: packaging>=21.3 in /usr/local/lib/python3.11/
dist-packages (from statsmodels>=0.9.0->category_encoders) (24.2)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.11/dist-pa
ckages (from python-dateutil>=2.8.2->pandas>=1.0.5->category_encoders) (1.1
7.0)
```

```
Downloading category_encoders-2.8.0-py3-none-any.whl (85 kB)
     ---------------------------------------- 0.0/85.7 kB ? eta -:--:--
     ---------------------------------------- 85.7/85.7 kB 3.7 MB/s eta 0:00:0
0
Installing collected packages: category_encoders
Successfully installed category_encoders-2.8.0
```

In [ ]:
```
import category_encoders as ce
```

In [ ]:
```
encoder=ce.OrdinalEncoder(cols=['buying','maint','doors','persons','lug_bo


X_train = encoder.fit_transform (X_train)

X_test = encoder.transform(X_test)
```

In [ ]:
```
X_train.head()
```

Out[ ]:

	buying	maint	doors	persons	lug_boot	safety
48	1	1	1	1	1	1
468	2	1	1	2	2	1
155	1	2	1	1	2	2
1721	3	3	2	1	2	2
1208	4	3	3	1	2	2

In [ ]:
```
X_test.head()
```

Out[ ]:

	buying	maint	doors	persons	lug_boot	safety
599	2	2	4	3	1	2
1201	4	3	3	2	1	3
628	2	2	2	3	3	3
1498	3	2	2	2	1	3
1263	4	3	4	1	1	1

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

In [ ]:
```
clf_gini =DecisionTreeClassifier(criterion='gini',max_depth=3,random_state


clf_gini.fit(X_train,y_train)
```

Out[ ]:
```
DecisionTreeClassifier(max_depth=3, random_state=0)
```
In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading

this page with nbviewer.org.

In [ ]:
```
y_pred_gini=clf_gini.predict(X_test)
```

In [ ]:
```
from sklearn.metrics import accuracy_score

print('Model accuracy score with criterion gini index: {0:0.4f}',format(ac
```

```
Model accuracy score with criterion gini index: {0:0.4f} 0.8021015761821366
```

In [ ]:
```
y_pred_train_gini=clf_gini.predict(X_train)


y_pred_train_gini
```

Out[ ]:
```
array(['unacc', 'unacc', 'unacc', ..., 'unacc', 'unacc', 'acc'],
      dtype=object)
```

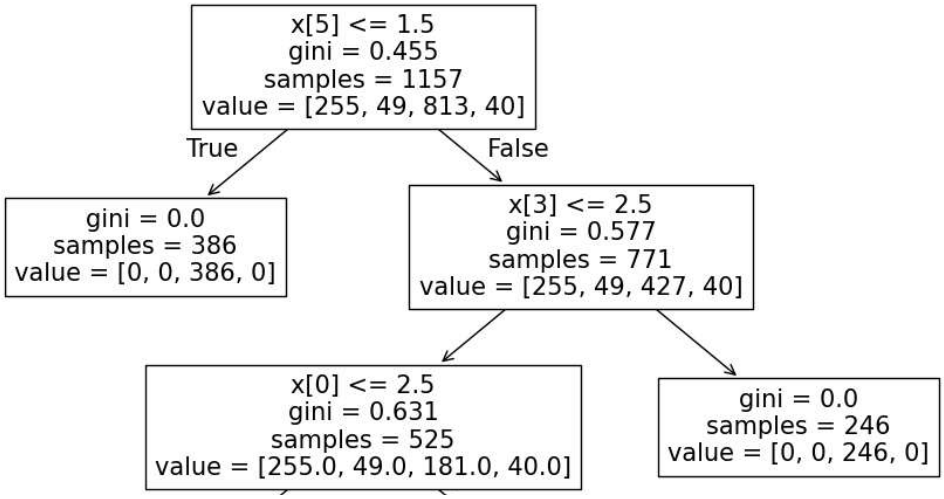
In [ ]:
```
print('Training set accuracy score : {0:0.4f}',format(accuracy_score(y_tra
```

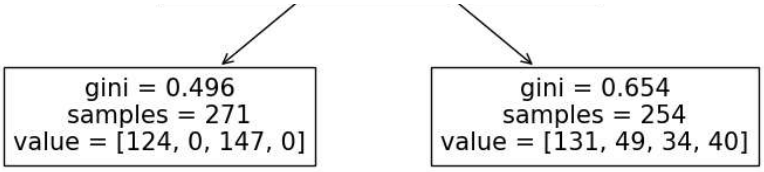
```
Training set accuracy score : {0:0.4f} 0.7865168539325843
```

In [ ]:
```
plt.figure(figsize=(12,8))

from sklearn import tree
tree.plot_tree(clf_gini.fit(X_train,y_train))
```

Out[ ]:
```
[Text(0.4, 0.875, 'x[5] <= 1.5\ngini = 0.455\nsamples = 1157\nvalue = [25
5, 49, 813, 40]'),
 Text(0.2, 0.625, 'gini = 0.0\nsamples = 386\nvalue = [0, 0, 386, 0]'),
 Text(0.30000000000000004, 0.75, 'True  '),
 Text(0.6, 0.625, 'x[3] <= 2.5\ngini = 0.577\nsamples = 771\nvalue = [255,
49, 427, 40]'),
 Text(0.5, 0.75, '  False'),
 Text(0.4, 0.375, 'x[0] <= 2.5\ngini = 0.631\nsamples = 525\nvalue = [255.
0, 49.0, 181.0, 40.0]'),
 Text(0.2, 0.125, 'gini = 0.496\nsamples = 271\nvalue = [124, 0, 147,
0]'),
 Text(0.6, 0.125, 'gini = 0.654\nsamples = 254\nvalue = [131, 49, 34, 4
0]'),
 Text(0.8, 0.375, 'gini = 0.0\nsamples = 246\nvalue = [0, 0, 246, 0]')]
```





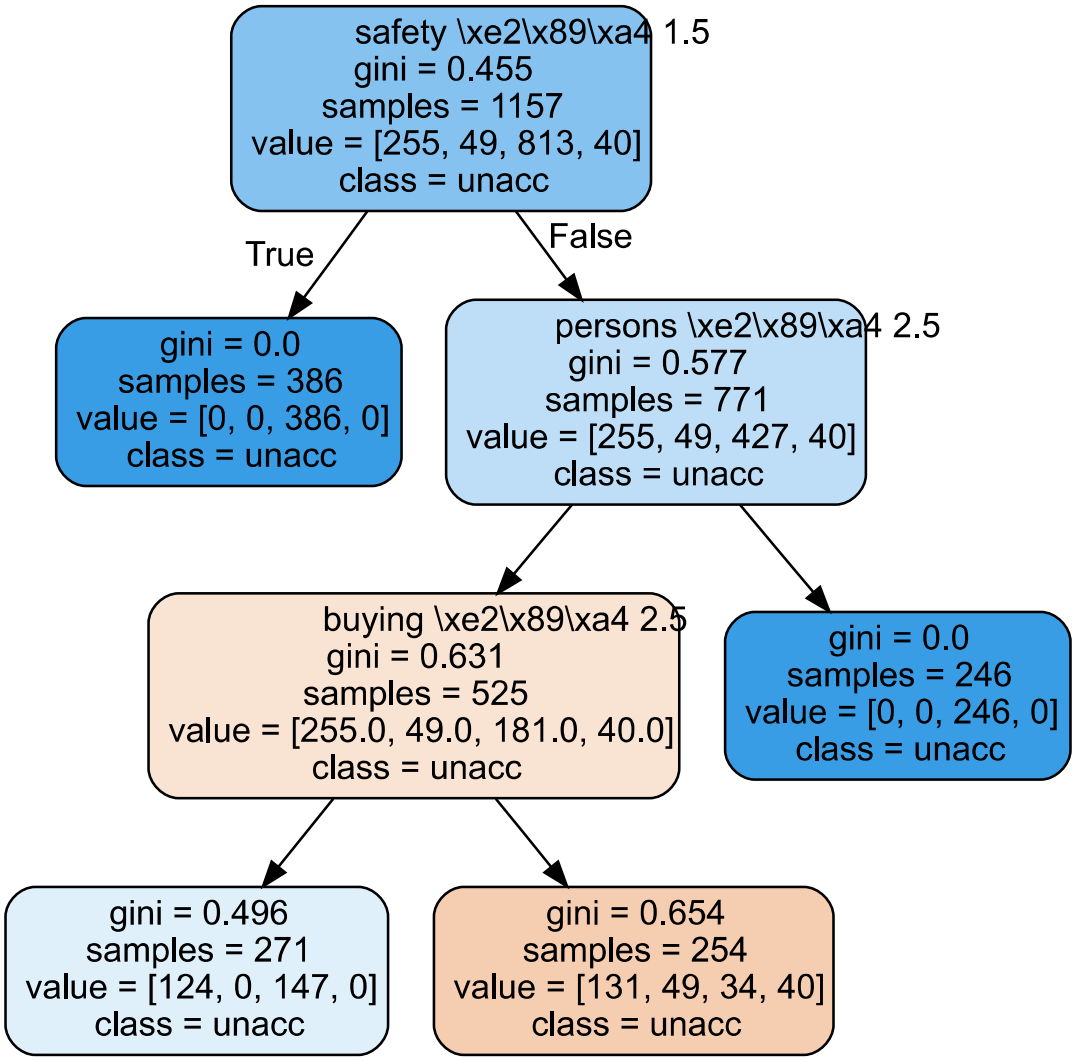
main ML / Experiment / Experiment 3 / Decision_Tree.ipynb ↑ Top

Preview Code Blame Raw

In [ ]:

```
import graphviz
dot_data = tree.export_graphviz(clf_gini, out_file=None, feature_names=X_t
graph = graphviz.Source(dot_data)
graph
```

Out[ ]:



In [ ]:

```
clf_en = DecisionTreeClassifier(criterion='entropy', max_depth=3, random_s


# fit the model
clf_en.fit(X_train, y_train)
```

Out[ ]:

```
DecisionTreeClassifier(criterion='entropy', max_depth=3, random_sta
```

te=0)

In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [ ]:
```
y_pred_en = clf_en.predict(X_test)
```

In [ ]:
```
from sklearn.metrics import accuracy_score

print('Model accuracy score with criterion entropy: {0:0.4f}'. format(accu
```

```
Model accuracy score with criterion entropy: 0.8021
```

In [ ]:
```
y_pred_train_en = clf_en.predict(X_train)

y_pred_train_en
```

Out[ ]:
```
array(['unacc', 'unacc', 'unacc', ..., 'unacc', 'unacc', 'acc'],
      dtype=object)
```

In [ ]:
```
print('Training-set accuracy score: {0:0.4f}'. format(accuracy_score(y_tra
```

```
Training-set accuracy score: 0.7865
```

In [ ]:
```
# print the scores on training and test set

print('Training set score: {:.4f}'.format(clf_en.score(X_train, y_train)))

print('Test set score: {:.4f}'.format(clf_en.score(X_test, y_test)))
```

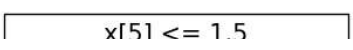
```
Training set score: 0.7865
Test set score: 0.8021
```

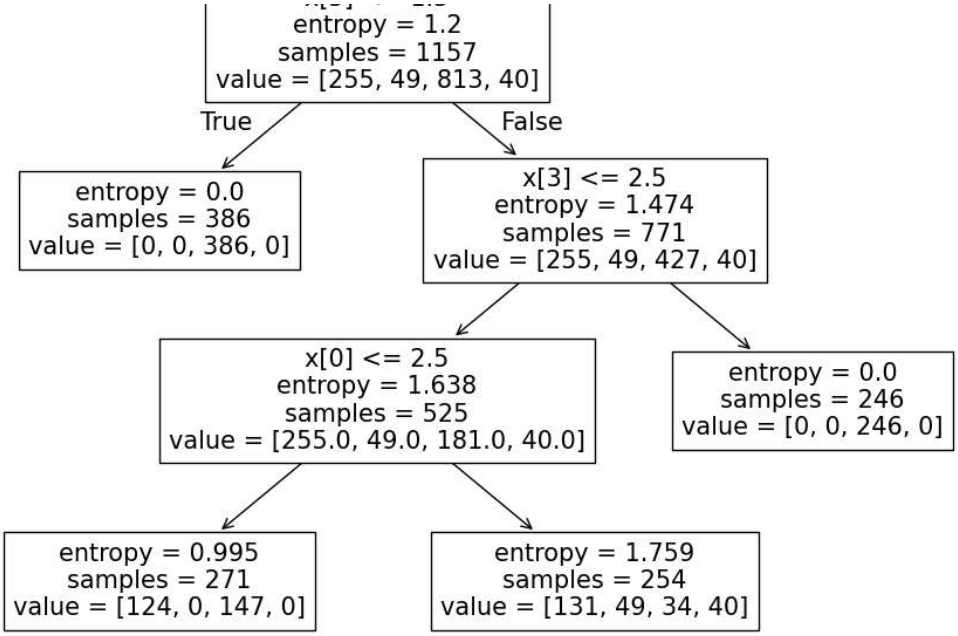
In [ ]:
```
plt.figure(figsize=(12,8))

from sklearn import tree

tree.plot_tree(clf_en.fit(X_train, y_train))
```

Out[ ]:
```
[Text(0.4, 0.875, 'x[5] <= 1.5\nentropy = 1.2\nsamples = 1157\nvalue = [25
5, 49, 813, 40]'),
 Text(0.2, 0.625, 'entropy = 0.0\nsamples = 386\nvalue = [0, 0, 386, 0]'),
 Text(0.30000000000000004, 0.75, 'True  '),
 Text(0.6, 0.625, 'x[3] <= 2.5\nentropy = 1.474\nsamples = 771\nvalue = [2
55, 49, 427, 40]'),
 Text(0.5, 0.75, '  False'),
 Text(0.4, 0.375, 'x[0] <= 2.5\nentropy = 1.638\nsamples = 525\nvalue = [2
55.0, 49.0, 181.0, 40.0]'),
 Text(0.2, 0.125, 'entropy = 0.995\nsamples = 271\nvalue = [124, 0, 147,
0]'),
 Text(0.6, 0.125, 'entropy = 1.759\nsamples = 254\nvalue = [131, 49, 34, 4
0]'),
 Text(0.8, 0.375, 'entropy = 0.0\nsamples = 246\nvalue = [0, 0, 246, 0]')]
```





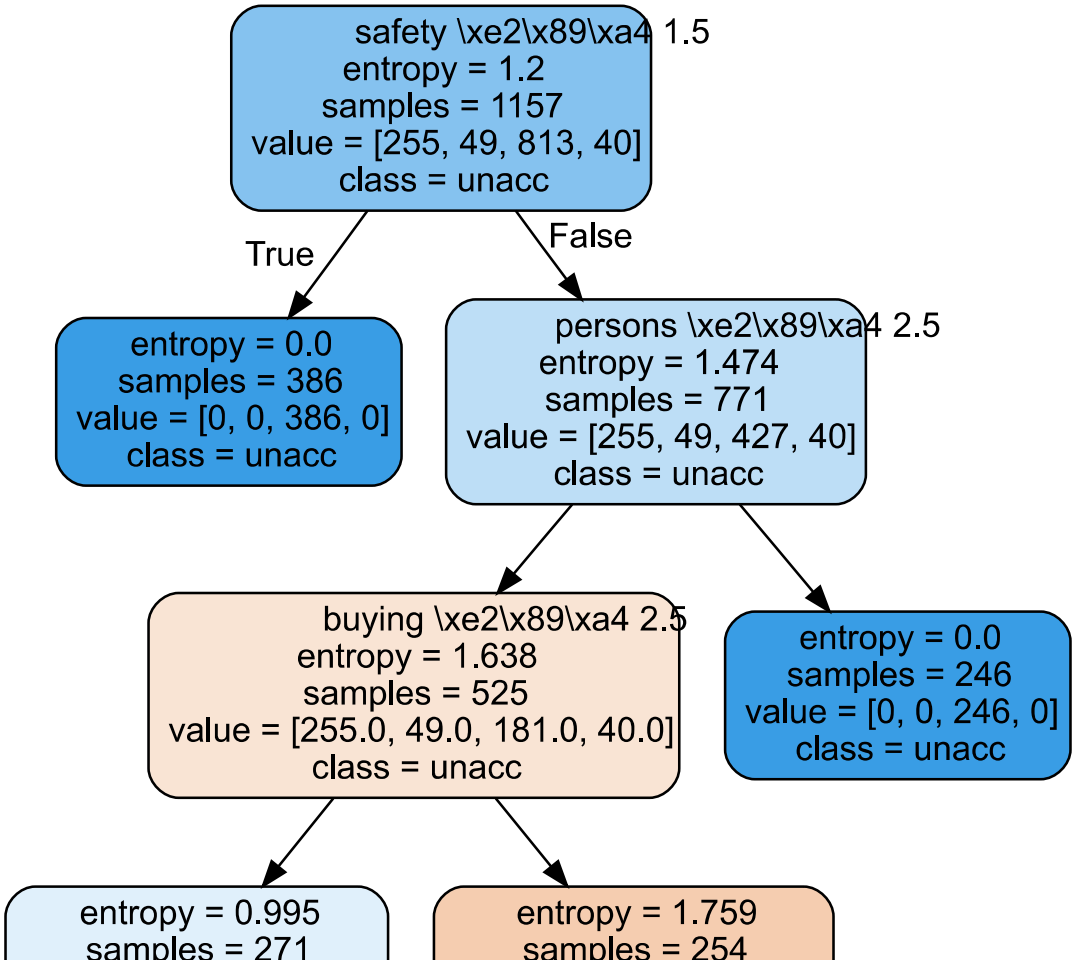
In [ ]:

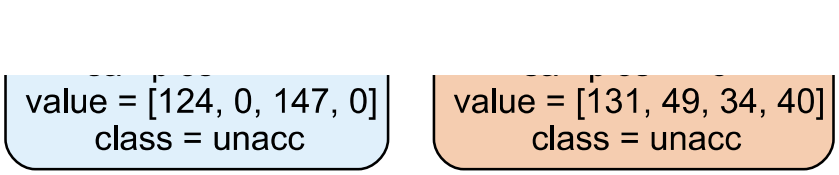
```
import graphviz
dot_data = tree.export_graphviz(clf_en, out_file=None,
                                feature_names=X_train.columns,
                                class_names=y_train,
                                filled=True, rounded=True,
                                special_characters=True)

graph = graphviz.Source(dot_data)

graph
```

Out[ ]:





In [ ]:

```
# Print the Confusion Matrix and slice it into four pieces

from sklearn.metrics import confusion_matrix

cm = confusion_matrix(y_test, y_pred_en)

print('Confusion matrix\n\n', cm)
```

```
Confusion matrix

 [[ 73   0  56   0]
 [ 20   0   0   0]
 [ 12   0 385   0]
 [ 25   0   0   0]]
```