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J036

```
In [2]: import os
print(os.getcwd())
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline

C:\Users\User-1

In [3]: df = pd.read_csv('car_evaluation.csv', header = None)

In [4]: df.head()

Out[4]:
```

	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 [5]: col_names = ['buying', 'maint', 'doors', 'persons', 'lug_boot', 'safety',
                    , 'class']
df.columns = col_names
col_names

Out[5]: ['buying', 'maint', 'doors', 'persons', 'lug_boot', 'safety', 'class']

In [6]: df.head()

Out[6]:
```

	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

```
In [7]: 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 [8]: for i in col_names:
print(df[i].value_counts())

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

In [9]: df.shape

Out[9]: (1728, 7)

In [10]: X = df.drop(['class'],axis = 1)
y = df['class']

In [11]: 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,ra
ndom_state=42)

In [12]: from sklearn.preprocessing import OrdinalEncoder
enc = OrdinalEncoder()
X_train = enc.fit_transform(X_train)
X_test = enc.transform(X_test)
```

Gini index as criterion

```
In [13]: from sklearn.tree import DecisionTreeClassifier

In [14]: clf_gini = DecisionTreeClassifier(criterion='gini', max_depth=3, random_
state=42)
clf_gini.fit(X_train, y_train)

Out[14]: DecisionTreeClassifier(max_depth=3, random_state=42)

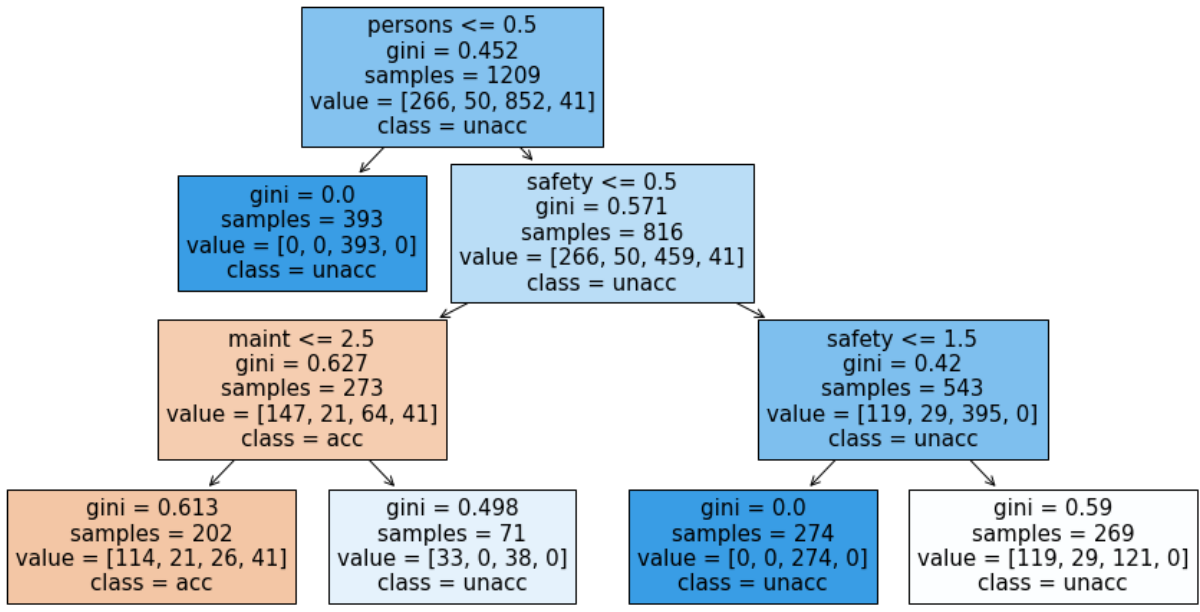
In [15]: y_pred = clf_gini.predict(X_test)
```

Grid Search Cv

```
In [48]: from sklearn.model_selection import GridSearchCV
option=['gini','entropy']
weight_option=['auto','sqrt','log2']
param_grid = {'criterion': option , 'max_features':[2,3,4,5,6] , 'max_de
pth':[4,5,6,7] , 'min_samples_split':[2,3,4,5]}
grid=GridSearchCV(clf_gini,param_grid,cv=3,scoring='accuracy')
grid.fit(X_train,y_train)
print(grid.best_score_)
print(grid.best_params_)

0.9247311827956989
{'criterion': 'gini', 'max_depth': 7, 'max_features': 6, 'min_samples_sp
lit': 2}

In [49]: from sklearn import tree
plt.figure(figsize=(15,8))
tree.plot_tree(clf_gini,
               feature_names=['buying', 'maint', 'doors', 'persons', 'lu
g_boot', 'safety'],
               class_names= list(set(y_train)),
               filled = True)
plt.show()
```



```
In [50]: # Check for underfitting

print(f'Training set score: {clf_gini.score(X_train,y_train)}')
print(f'Test set score: {clf_gini.score(X_test,y_test)}')

Training set score: 0.7775020678246485
Test set score: 0.7572254335260116
```

Model after grid search

```
In [51]: dtc = DecisionTreeClassifier(criterion='gini', max_depth=7,max_features
= 6)
dtc.fit(X_train, y_train)

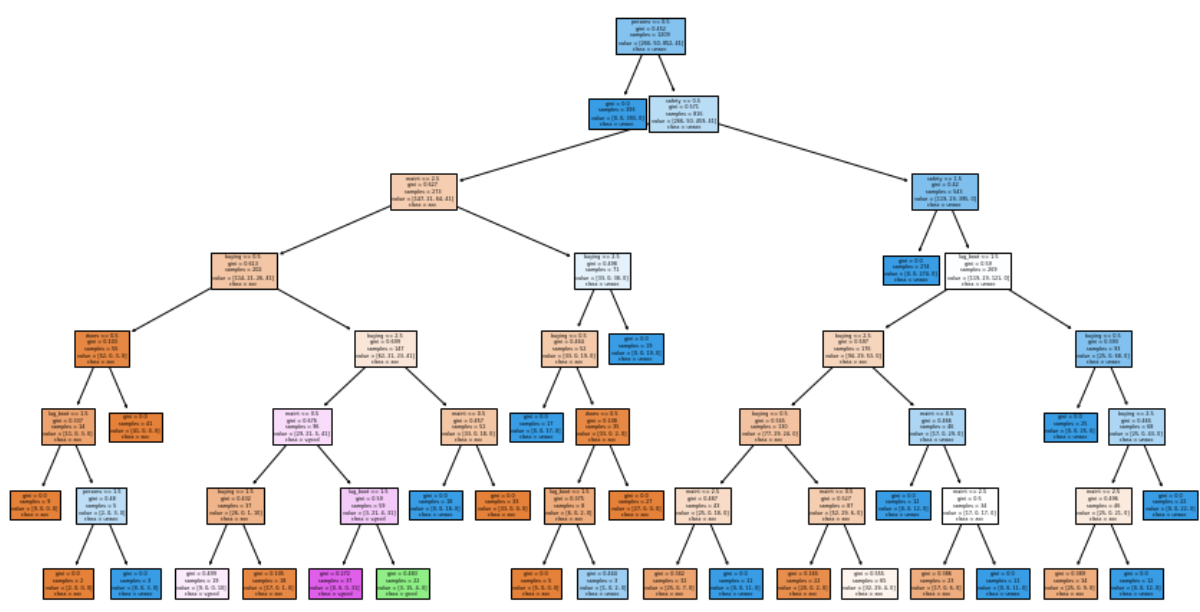
Out[51]: DecisionTreeClassifier(max_depth=7, max_features=6)

In [61]: y_pred = dtc.predict(X_test)

In [53]: print(f'Training set score: {dtc.score(X_train,y_train)}')
print(f'Test set score: {dtc.score(X_test,y_test)}')

Training set score: 0.9330024813895782
Test set score: 0.9344894026974951

In [54]: from sklearn import tree
plt.figure(figsize=(15,8))
tree.plot_tree(dtc,
               feature_names=['buying', 'maint', 'doors', 'persons', 'lu
g_boot', 'safety'],
               class_names= list(set(y_train)),
               filled = True)
plt.show()
```



Cross validation

```
In [55]: from sklearn.model_selection import cross_val_score
score=cross_val_score(dtc,X_train,y_train,cv=10,scoring='accuracy')
score.mean()

Out[55]: 0.920564738292011

In [57]: from sklearn.model_selection import cross_val_score
score=cross_val_score(dtc,X_test,y_test,cv=10,scoring='accuracy')
score.mean()

Out[57]: 0.8978883861236803

In [62]: from sklearn.metrics import confusion_matrix, classification_report
cm = confusion_matrix(y_test, y_pred)

In [63]: print(cm)

[[109  4  1  4]
 [ 10  6  0  3]
 [ 11  0 346  1]
 [  0  0  0 24]]

In [64]: print(classification_report(y_test, y_pred))

              precision    recall  f1-score   support

    acc              0.84       0.92       0.88        118
    good              0.60       0.32       0.41         19
    unacc             1.00       0.97       0.98        358
    vgood             0.75       1.00       0.86         24

   accuracy                   0.80       0.80       0.78        519
  macro avg              0.80       0.80       0.93        519
 weighted avg              0.94       0.93       0.93        519
```

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In [ ]:
```