In [1]:

```
import os
print(os.getcwd())
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
```

```
C:\Users\Anmol Bhatia\ML_Sem5\ML_Assignments
```

In [2]:

```
df = pd.read_csv('car_evaluation.csv', header = None)
```

In [3]:

```
df.head()
```

Out[3]:

	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 [4]:

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

Out[4]:

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

In [5]:

```
df.head()
```

Out[5]:

	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 [6]:

```
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 [7]:

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

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

In [8]:

```
df.shape
```

Out[8]:

```
(1728, 7)
```

In [9]:

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

In [10]:

```
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=42)
```

In [11]:

```
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 [12]:

```
from sklearn.tree import DecisionTreeClassifier
```

In [13]:

```
clf_gini = DecisionTreeClassifier(criterion='gini', max_depth=3, random_state=42)
clf_gini.fit(X_train, y_train)
```

Out[13]:

```
DecisionTreeClassifier(max_depth=3, random_state=42)
```

In [14]:

```
y_pred = clf_gini.predict(X_test)
```

Grid Search CV -

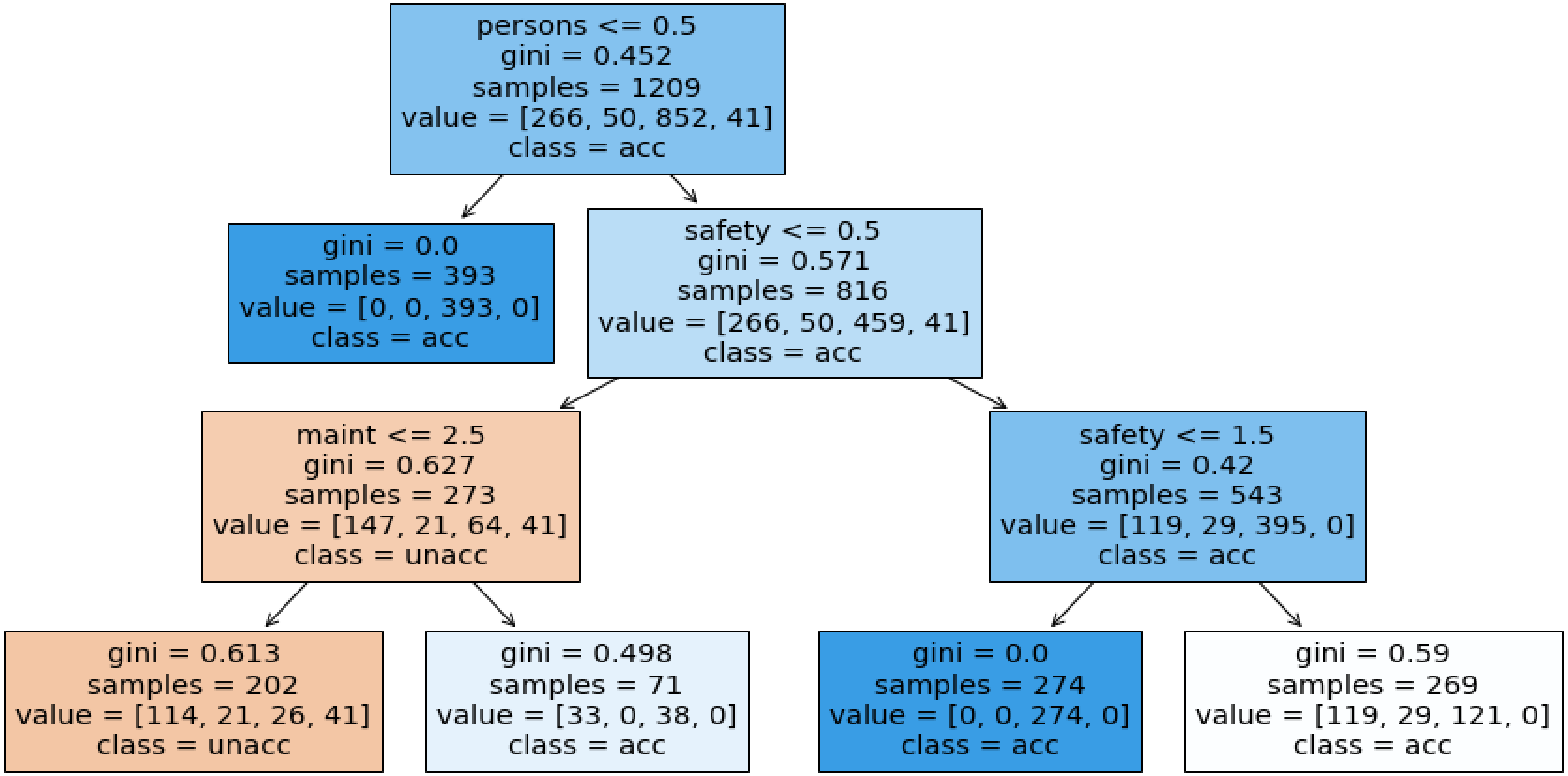
In [15]:

```
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_depth':[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_split': 2}
```

In [16]:

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



In [17]:

```
# 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 [18]:

```
dtc = DecisionTreeClassifier(criterion='gini', max_depth=7,max_features = 6)
dtc.fit(X_train, y_train)
```

Out[18]:

```
DecisionTreeClassifier(max_depth=7, max_features=6)
```

In [19]:

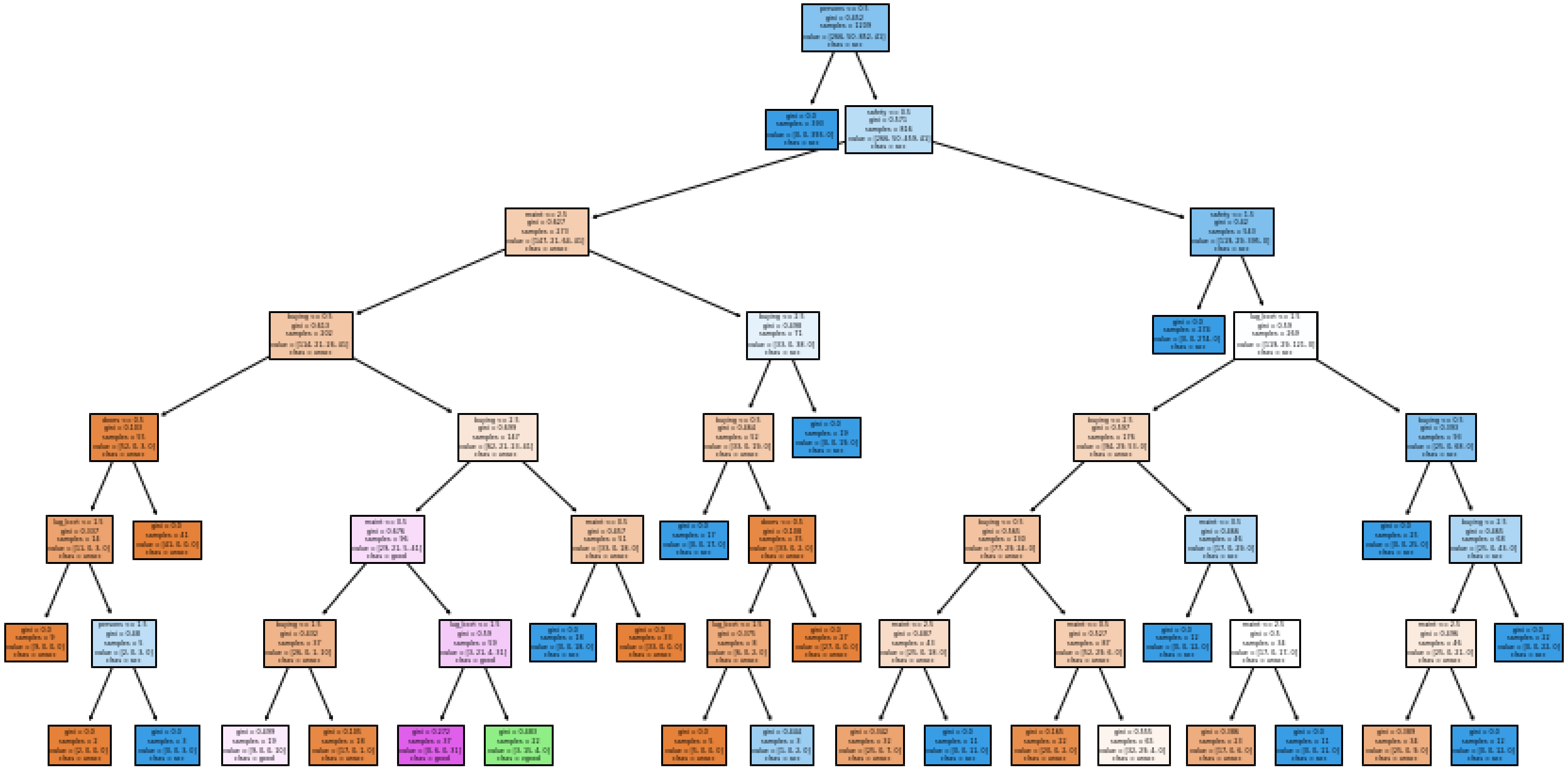
```
y_pred = dtc.predict(X_test)
```

In [20]:

```
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 [21]:
```
from sklearn import tree
plt.figure(figsize=(15,8))
tree.plot_tree(dtc,
feature_names=['buying', 'maint', 'doors', 'persons', 'lug_boot', 'safety'],class_names= list(set(y_train)),filled = True
plt.show()
```



Cross Validation -

```
In [22]: from sklearn.model_selection import cross_val_score
         score=cross_val_score(dtc,X_train,y_train,cv=10,scoring='accuracy')
         score.mean()

Out[22]: 0.920564738292011
```

```
In [23]: from sklearn.model_selection import cross_val_score
         score=cross_val_score(dtc,X_test,y_test,cv=10,scoring='accuracy')
         score.mean()

Out[23]: 0.8959653092006032
```

```
In [24]: from sklearn.metrics import confusion_matrix, classification_report
         cm = confusion_matrix(y_test, y_pred)
```

```
In [25]: print(cm)
```

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

```
In [26]: 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                           0.93       519
   macro avg       0.80      0.80      0.78       519
weighted avg       0.94      0.93      0.93       519
```