Decision Trees with Pruning

In [ ]:
```
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline
from sklearn.datasets import load_iris
```

In [2]:
```
iris = load_iris()
```

In [3]:
```
iris
```

Out[3]:
```
{'data': array([[5.1, 3.5, 1.4, 0.2],
        [4.9, 3. , 1.4, 0.2],
        [4.7, 3.2, 1.3, 0.2],
        [4.6, 3.1, 1.5, 0.2],
        [5. , 3.6, 1.4, 0.2],
        [5.4, 3.9, 1.7, 0.4],
        [4.6, 3.4, 1.4, 0.3],
        [5. , 3.4, 1.5, 0.2],
        [4.4, 2.9, 1.4, 0.2],
        [4.9, 3.1, 1.5, 0.1],
        [5.4, 3.7, 1.5, 0.2],
        [4.8, 3.4, 1.6, 0.2],
        [4.8, 3. , 1.4, 0.1],
        [4.3, 3. , 1.1, 0.1],
        [5.8, 4. , 1.2, 0.2],
        [5.7, 4.4, 1.5, 0.4],
        [5.4, 3.9, 1.3, 0.4],
        [5.1, 3.5, 1.4, 0.3],
        [5.7, 3.8, 1.7, 0.3],
```

In [4]:
```
iris.data
```

Out[4]:
```
array([[5.1, 3.5, 1.4, 0.2],
       [4.9, 3. , 1.4, 0.2],
       [4.7, 3.2, 1.3, 0.2],
       [4.6, 3.1, 1.5, 0.2],
       [5. , 3.6, 1.4, 0.2],
       [5.4, 3.9, 1.7, 0.4],
       [4.6, 3.4, 1.4, 0.3],
       [5. , 3.4, 1.5, 0.2],
       [4.4, 2.9, 1.4, 0.2],
       [4.9, 3.1, 1.5, 0.1],
       [5.4, 3.7, 1.5, 0.2],
       [4.8, 3.4, 1.6, 0.2],
       [4.8, 3. , 1.4, 0.1],
       [4.3, 3. , 1.1, 0.1],
       [5.8, 4. , 1.2, 0.2],
       [5.7, 4.4, 1.5, 0.4],
       [5.4, 3.9, 1.3, 0.4],
       [5.1, 3.5, 1.4, 0.3],
       [5.7, 3.8, 1.7, 0.3],
```

In [5]:
```
iris.target
```

Out[5]:
```
array([0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2,
       2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,
       2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2])
```

In [6]:
```
import seaborn as sns
```

In [8]:
```
df = sns.load_dataset('iris')
```

In [9]:
```
df.head()
```

Out[9]:

	sepal_length	sepal_width	petal_length	petal_width	species
0	5.1	3.5	1.4	0.2	setosa
1	4.9	3.0	1.4	0.2	setosa
2	4.7	3.2	1.3	0.2	setosa
3	4.6	3.1	1.5	0.2	setosa
4	5.0	3.6	1.4	0.2	setosa

In [10]:
```
#independent and Dependent Features
X = df.iloc[:,:-1]
y = iris.target
```

In [11]:
```
X,y
```

Out[11]:
```
(     sepal_length  sepal_width  petal_length  petal_width
 0             5.1          3.5           1.4          0.2
 1             4.9          3.0           1.4          0.2
 2             4.7          3.2           1.3          0.2
 3             4.6          3.1           1.5          0.2
 4             5.0          3.6           1.4          0.2
 ..            ...          ...           ...          ...
 145           6.7          3.0           5.2          2.3
 146           6.3          2.5           5.0          1.9
 147           6.5          3.0           5.2          2.0
 148           6.2          3.4           5.4          2.3
 149           5.9          3.0           5.1          1.8

 [150 rows x 4 columns],
 array([0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
        0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
        0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
        1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
        1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2,
        2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,
        2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2]))
```

In [13]:
```
#Train test Split
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, random_state=42)
```

In [14]:
```
X_train
```

Out[14]:

	sepal_length	sepal_width	petal_length	petal_width
96	5.7	2.9	4.2	1.3
105	7.6	3.0	6.6	2.1
66	5.6	3.0	4.5	1.5
0	5.1	3.5	1.4	0.2
122	7.7	2.8	6.7	2.0
...	...	...	...	...
71	6.1	2.8	4.0	1.3
106	4.9	2.5	4.5	1.7
14	5.8	4.0	1.2	0.2
92	5.8	2.6	4.0	1.2
102	7.1	3.0	5.9	2.1

100 rows × 4 columns

In [19]:
```
from sklearn.tree import DecisionTreeClassifier
```

Post Pruning Decision Tree

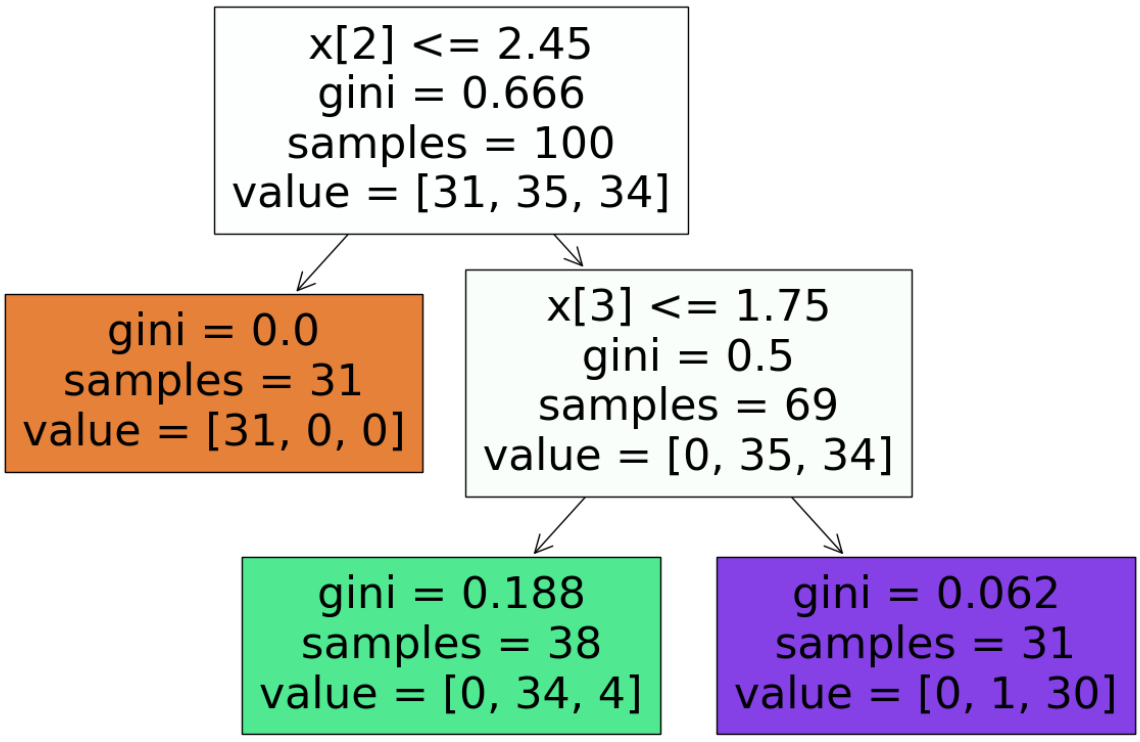
In [20]:
```
treemodel = DecisionTreeClassifier(max_depth=2)
```

In [21]:
```
treemodel.fit(X_train, y_train)
```

Out[21]:
```
DecisionTreeClassifier
DecisionTreeClassifier(max_depth=2)
```

In [30]:
```
from sklearn import tree
plt.figure(figsize=(15,10))
tree.plot_tree(treemodel, filled=True)
```

Out[30]:
```
[Text(0.4, 0.8333333333333334, 'x[2] <= 2.45\ngini = 0.666\nsamples = 100\nvalue = [31, 35, 3
4]'),
 Text(0.2, 0.5, 'gini = 0.0\nsamples = 31\nvalue = [31, 0, 0]'),
 Text(0.6, 0.5, 'x[3] <= 1.75\ngini = 0.5\nsamples = 69\nvalue = [0, 35, 34]'),
 Text(0.4, 0.16666666666666666, 'gini = 0.188\nsamples = 38\nvalue = [0, 34, 4]'),
 Text(0.8, 0.16666666666666666, 'gini = 0.062\nsamples = 31\nvalue = [0, 1, 30]')]
```



In [31]:
```
#Prediction
```

In [32]:
```
y_pred = treemodel.predict(X_test)
```

In [33]:
```
y_pred
```

Out[33]:
```
array([1, 0, 2, 1, 1, 0, 1, 2, 1, 1, 2, 0, 0, 0, 0, 1, 2, 1, 1, 2, 0, 2,
       0, 2, 2, 2, 2, 2, 0, 0, 0, 0, 1, 0, 0, 2, 1, 0, 0, 0, 2, 1, 1, 0,
       0, 1, 1, 2, 1, 2])
```

In [34]:
```
from sklearn.metrics import classification_report, accuracy_score
```

In [35]:
```
score = accuracy_score(y_pred, y_test)
```

In [36]:
```
score
```

Out[36]:
```
0.98
```

In [59]:
```
print(classification_report(y_pred, y_test))
```

```
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        19
           1       1.00      0.94      0.97        16
           2       0.94      1.00      0.97        15

    accuracy                           0.98        50
   macro avg       0.98      0.98      0.98        50
weighted avg       0.98      0.98      0.98        50
```

Pre Pruning Decision Tree

In [60]:
```
parameter = {
    "criterion":["gini","entropy","log_loss"],
    "splitter":["best","random"],
    "max_depth":[1,2,3,4,5],
    "max_features": ['auto','sqrt','log2']
}
```

In [61]:
```
from sklearn.model_selection import GridSearchCV
```

In [62]:
```
treemodel=DecisionTreeClassifier()
cv=GridSearchCV(treemodel, param_grid=parameter, cv=5, scoring='accuracy')
```

In [63]:
```
cv.fit(X_train, y_train)
```

```
features='auto'` has been deprecated in 1.1 and will be removed in 1.3. To keep the past behavi
our, explicitly set `max_features='sqrt'`.
  warnings.warn(
C:\Users\RISHABH\anaconda3\lib\site-packages\sklearn\tree\_classes.py:269: FutureWarning: `max_
features='auto'` has been deprecated in 1.1 and will be removed in 1.3. To keep the past behavi
our, explicitly set `max_features='sqrt'`.
  warnings.warn(
C:\Users\RISHABH\anaconda3\lib\site-packages\sklearn\tree\_classes.py:269: FutureWarning: `max_
features='auto'` has been deprecated in 1.1 and will be removed in 1.3. To keep the past behavi
our, explicitly set `max_features='sqrt'`.
  warnings.warn(
C:\Users\RISHABH\anaconda3\lib\site-packages\sklearn\tree\_classes.py:269: FutureWarning: `max_
features='auto'` has been deprecated in 1.1 and will be removed in 1.3. To keep the past behavi
our, explicitly set `max_features='sqrt'`.
  warnings.warn(
C:\Users\RISHABH\anaconda3\lib\site-packages\sklearn\tree\_classes.py:269: FutureWarning: `max_
features='auto'` has been deprecated in 1.1 and will be removed in 1.3. To keep the past behavi
our, explicitly set `max_features='sqrt'`.
  warnings.warn(
```

In [64]:
```
cv.best_params_
```

Out[64]:
```
{'criterion': 'gini',
 'max_depth': 2,
 'max_features': 'log2',
 'splitter': 'best'}
```

In [65]:
```
y_test
```

Out[65]:
```
array([1, 0, 2, 1, 1, 0, 1, 2, 1, 1, 2, 0, 0, 0, 0, 1, 2, 1, 1, 2, 0, 2,
       0, 2, 2, 2, 2, 2, 0, 0, 0, 0, 1, 0, 0, 2, 1, 0, 0, 0, 2, 1, 1, 0,
       0, 1, 2, 2, 1, 2])
```

In [66]:
```
y_pred
```

Out[66]:
```
array([1, 0, 2, 1, 1, 0, 1, 2, 1, 1, 2, 0, 0, 0, 0, 1, 2, 1, 1, 2, 0, 2,
       0, 2, 2, 2, 2, 2, 0, 0, 0, 0, 1, 0, 0, 2, 1, 0, 0, 0, 2, 1, 1, 0,
       0, 1, 1, 2, 1, 2])
```

In [67]:
```
y_pred = cv.predict(X_test)
```

In [68]:
```
y_pred
```

Out[68]:
```
array([1, 0, 2, 1, 1, 0, 1, 2, 1, 1, 2, 0, 0, 0, 0, 1, 2, 1, 1, 2, 0, 2,
       0, 2, 2, 2, 2, 2, 0, 0, 0, 0, 1, 0, 0, 2, 1, 0, 0, 0, 2, 1, 1, 0,
       0, 1, 1, 2, 1, 2])
```

In [69]:
```
from sklearn.metrics import classification_report, accuracy_score
```

In [70]:
```
score = accuracy_score(y_pred, y_test)
```

In [71]:
```
score
```

Out[71]:
```
0.98
```

In [72]:
```
print(classification_report(y_pred,y_test))
```

```
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        19
           1       1.00      0.94      0.97        16
           2       0.94      1.00      0.97        15

    accuracy                           0.98        50
   macro avg       0.98      0.98      0.98        50
weighted avg       0.98      0.98      0.98        50
```