DECISION TREES

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In [2]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
```

TENNIS DATA SET

In [3]:
```
df=pd.read_csv('tennis.csv')
```

In [4]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 14 entries, 0 to 13
Data columns (total 5 columns):
 #   Column    Non-Null Count  Dtype 
---  ------    --------------  ----- 
 0   outlook   14 non-null     object
 1   temp      14 non-null     object
 2   humidity  14 non-null     object
 3   windy     14 non-null     bool  
 4   play      14 non-null     object
dtypes: bool(1), object(4)
memory usage: 590.0+ bytes
```

In [5]:
```
df.head()
```

Out[5]:

	outlook	temp	humidity	windy	play
0	sunny	hot	high	False	no
1	sunny	hot	high	True	no
2	overcast	hot	high	False	yes
3	rainy	mild	high	False	yes
4	rainy	cool	normal	False	yes

In [6]:
```
df.describe()
```

Out[6]:

	outlook	temp	humidity	windy	play
count	14	14	14	14	14
unique	3	3	2	2	2
top	sunny	mild	high	False	yes
freq	5	6	7	8	9

In [7]:
```
df.isnull().sum()
```

Out[7]:
```
outlook     0
temp        0
humidity    0
windy       0
play        0
dtype: int64
```

In [8]:
```
df['windy']=df['windy'].astype(int)
```

In [9]:
```
df.columns
```

Out[9]:
```
Index(['outlook', 'temp', 'humidity', 'windy', 'play'], dtype='obj
ect')
```

In [10]:
```
from sklearn.preprocessing import LabelEncoder

dfencoded = df
columns_to_encode = ['outlook', 'temp', 'humidity', 'windy']
le = LabelEncoder()
for column in columns_to_encode:
    dfencoded[column] = le.fit_transform(dfencoded[column])
```

In [11]:
```
from sklearn.model_selection import train_test_split
```

In [12]:
```
x=dfencoded.drop('play',axis=1)
x
```

Out[12]:

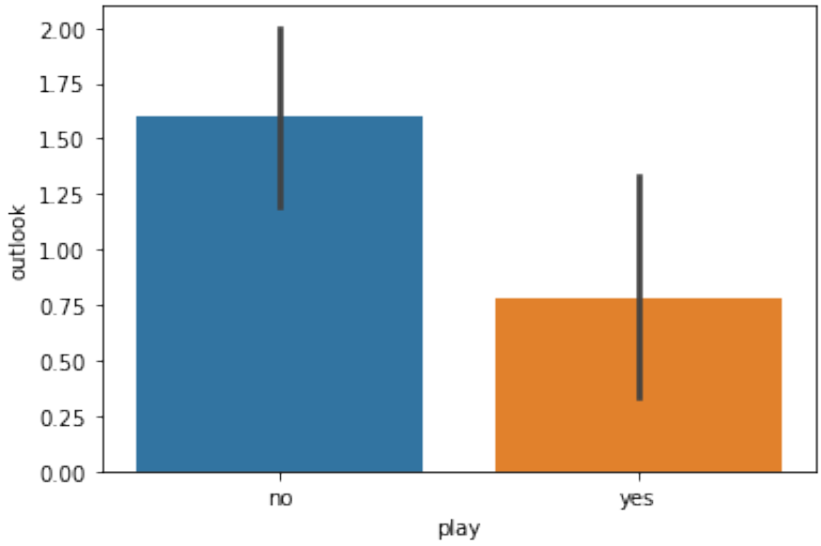
	outlook	temp	humidity	windy
0	2	1	0	0
1	2	1	0	1
2	0	1	0	0
3	1	2	0	0
4	1	0	1	0
5	1	0	1	1
6	0	0	1	1
7	2	2	0	0
8	2	0	1	0
9	1	2	1	0
10	2	2	1	1
11	0	2	0	1
12	0	1	1	0
13	1	2	0	1

In [13]:
```
y=dfencoded['play']
y
```

Out[13]:
```
0      no
1      no
2     yes
3     yes
4     yes
5      no
6     yes
7      no
8     yes
9     yes
10    yes
11    yes
12    yes
13     no
Name: play, dtype: object
```

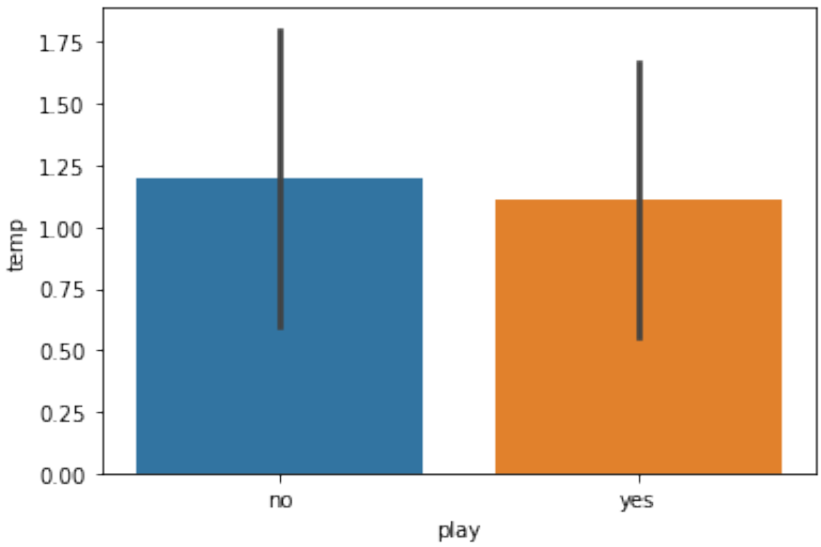
In [14]:
```
sns.barplot(x='play',y='outlook',data=df)
```

Out[14]: <AxesSubplot:xlabel='play', ylabel='outlook'>



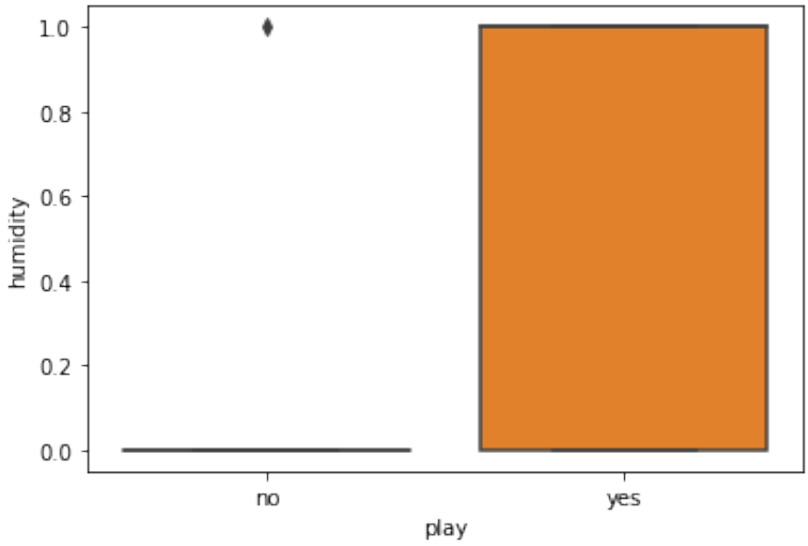
In [15]:
```
sns.barplot(x='play',y='temp',data=df)
```

Out[15]: <AxesSubplot:xlabel='play', ylabel='temp'>



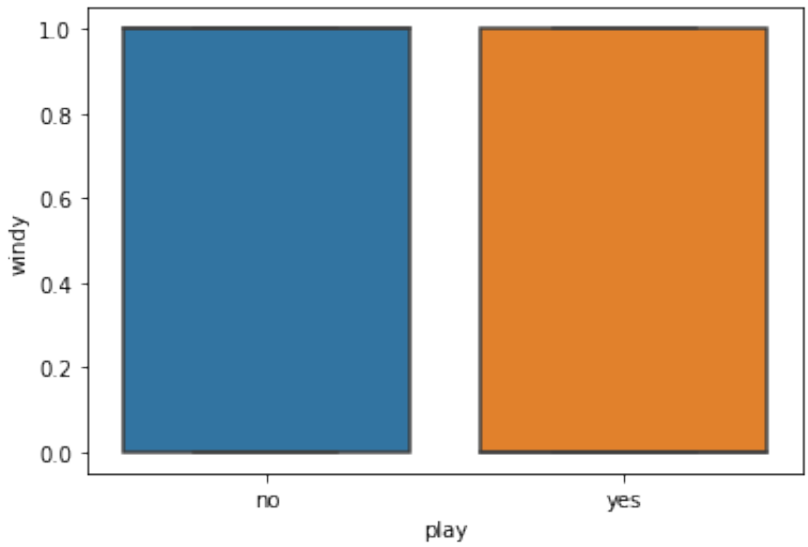
In [16]:
```
sns.boxplot(x='play',y='humidity',data=df)
```

Out[16]: <AxesSubplot:xlabel='play', ylabel='humidity'>



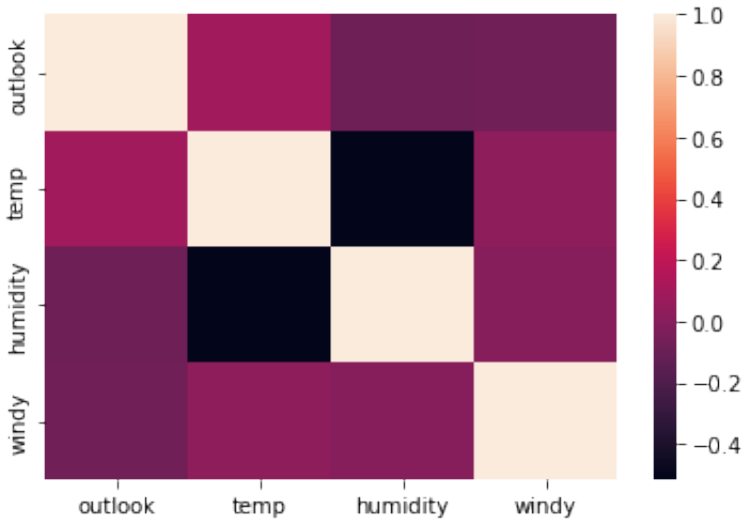
In [17]:
```
sns.boxplot(x='play',y='windy',data=df)
```

Out[17]: <AxesSubplot:xlabel='play', ylabel='windy'>



In [18]:
```
sns.heatmap(df.corr())
```

Out[18]: <AxesSubplot:>



In [19]:
```
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.3)
```

In [20]:
```
from sklearn.tree import DecisionTreeClassifier
```

In [21]:
```
dt=DecisionTreeClassifier()
```

In [22]:
```
dt.fit(x_train,y_train)
```

Out[22]: DecisionTreeClassifier()

In [23]:
```
pred=dt.predict(x_test)
```

In [24]:
```
from sklearn.metrics import classification_report,confusion_matrix
```

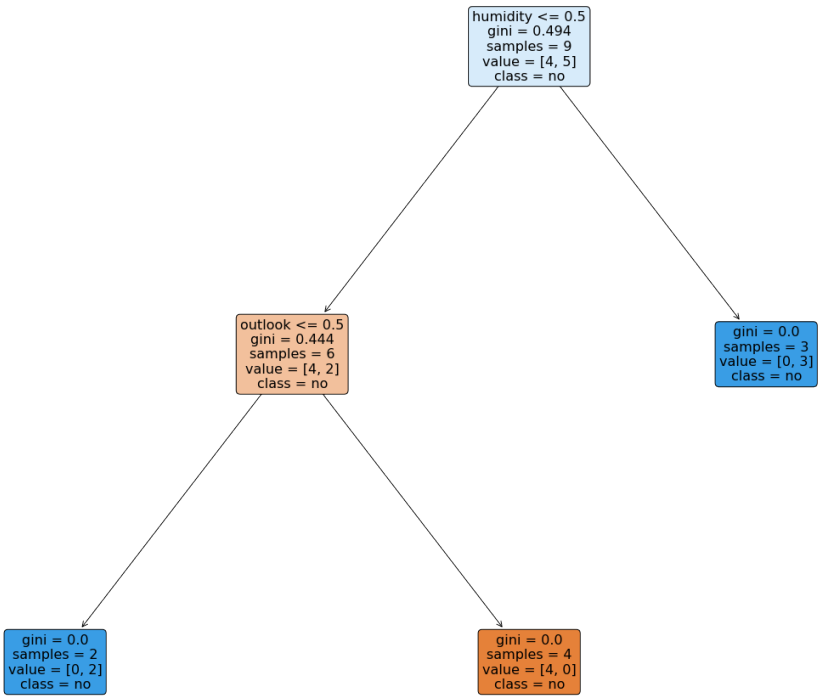
In [25]:
```
print(classification_report(y_test,pred))
```

```
              precision    recall  f1-score   support

          no       0.00      0.00      0.00         1
         yes       0.75      0.75      0.75         4

    accuracy                           0.60         5
   macro avg       0.38      0.38      0.38         5
weighted avg       0.60      0.60      0.60         5
```

In [26]:
```
print(confusion_matrix(y_test,pred))
```

```
[[0 1]
 [1 3]]
```

In [27]:
```
from sklearn.tree import plot_tree
plt.figure(figsize=(25,20))
a = plot_tree(dt,feature_names=x.columns,class_names=y,filled=True,
```



IRIS DATASET

In [28]:
```
from sklearn import datasets
iris=pd.read_csv('Iris.csv')
```

In [29]:
```
iris.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 150 entries, 0 to 149
Data columns (total 6 columns):
 #   Column         Non-Null Count  Dtype  
---  ------         --------------  -----  
 0   Id             150 non-null    int64  
 1   SepalLengthCm  150 non-null    float64
 2   SepalWidthCm   150 non-null    float64
 3   PetalLengthCm  150 non-null    float64
 4   PetalWidthCm   150 non-null    float64
 5   Species        150 non-null    object 
dtypes: float64(4), int64(1), object(1)
memory usage: 7.2+ KB
```

In [30]:
```
iris.describe()
```

Out[30]:

	Id	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm
count	150.000000	150.000000	150.000000	150.000000	150.000000
mean	75.500000	5.843333	3.054000	3.758667	1.198667
std	43.445368	0.828066	0.433594	1.764420	0.763161
min	1.000000	4.300000	2.000000	1.000000	0.100000
25%	38.250000	5.100000	2.800000	1.600000	0.300000
50%	75.500000	5.800000	3.000000	4.350000	1.300000
75%	112.750000	6.400000	3.300000	5.100000	1.800000
max	150.000000	7.900000	4.400000	6.900000	2.500000

In [31]:
```
iris.head()
```

Out[31]:

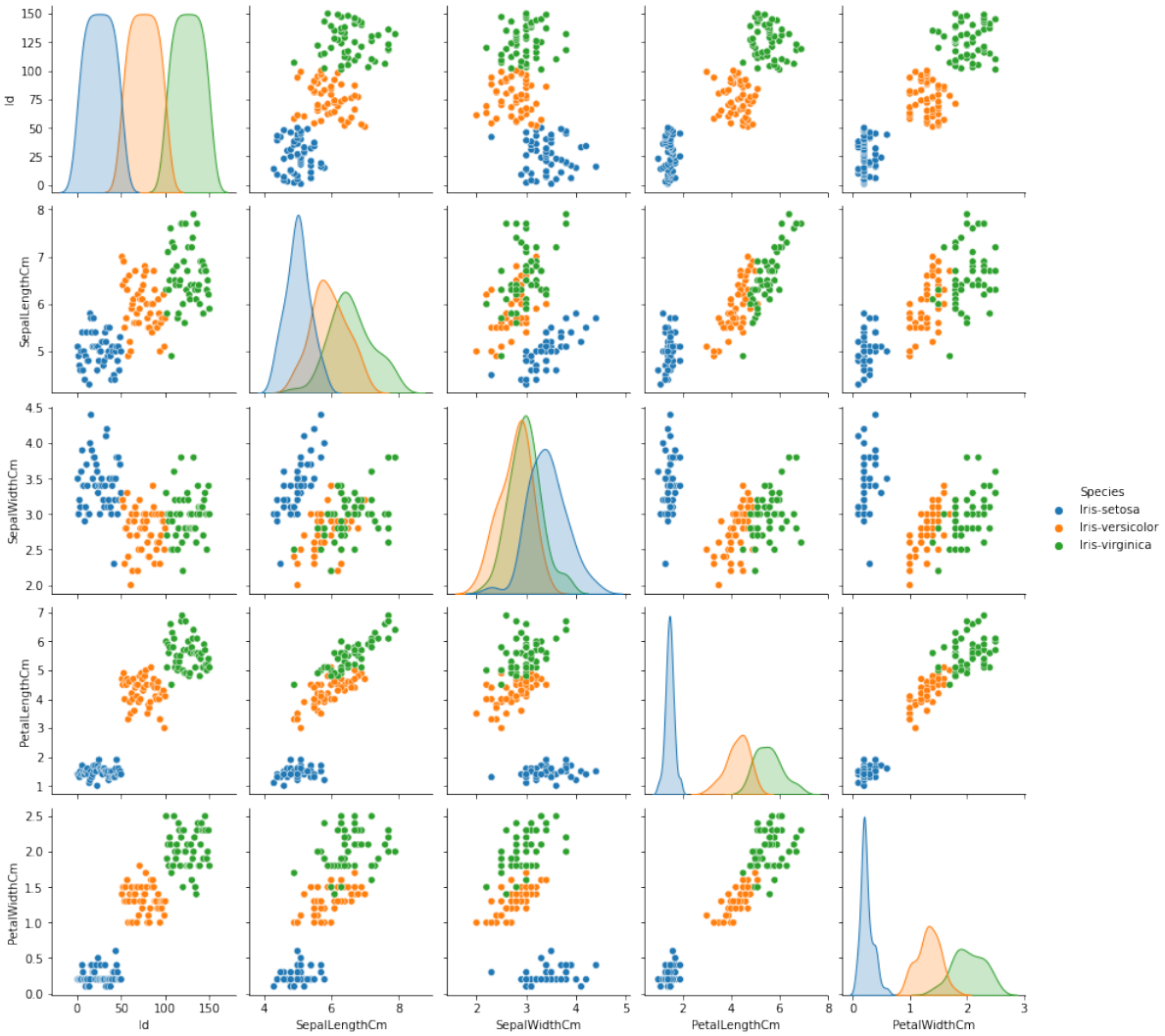
	Id	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm	Species
0	1	5.1	3.5	1.4	0.2	Iris-setosa
1	2	4.9	3.0	1.4	0.2	Iris-setosa
2	3	4.7	3.2	1.3	0.2	Iris-setosa
3	4	4.6	3.1	1.5	0.2	Iris-setosa
4	5	5.0	3.6	1.4	0.2	Iris-setosa

In [32]:
```
iris.isnull().sum()
```

Out[32]:
```
Id               0
SepalLengthCm    0
SepalWidthCm     0
PetalLengthCm    0
PetalWidthCm     0
Species          0
dtype: int64
```

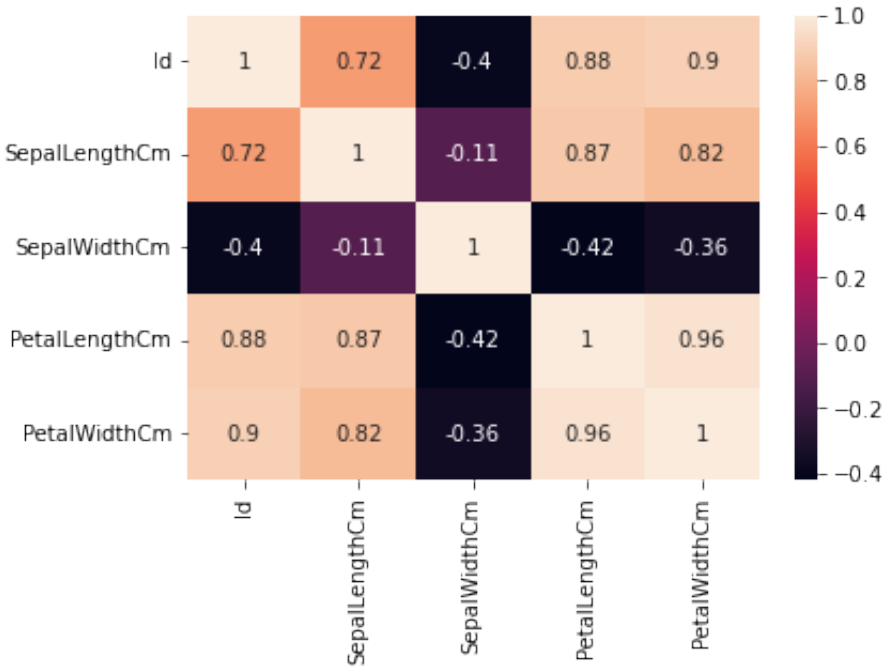
In [33]:
```
sns.pairplot(iris,hue='Species')
```

Out[33]:
```
<seaborn.axisgrid.PairGrid at 0x13a349130>
```



In [34]:
```
sns.heatmap(iris.corr(),annot=True)
```

Out[34]: <AxesSubplot:>



In [35]:
```
iris.columns
```

Out[35]:
```
Index(['Id', 'SepalLengthCm', 'SepalWidthCm', 'PetalLengthCm', 'Pe
talWidthCm',
       'Species'],
      dtype='object')
```

In [36]:
```
x=iris.iloc[:,:-1]
x
```

0	1	5.1	3.5	1.4	0.2
1	2	4.9	3.0	1.4	0.2
2	3	4.7	3.2	1.3	0.2
3	4	4.6	3.1	1.5	0.2
4	5	5.0	3.6	1.4	0.2
...	...	...	...	...	...
145	146	6.7	3.0	5.2	2.3
146	147	6.3	2.5	5.0	1.9
147	148	6.5	3.0	5.2	2.0
148	149	6.2	3.4	5.4	2.3
149	150	5.9	3.0	5.1	1.8

150 rows × 5 columns

In [37]:
```
"""dfencoded = iris
columns_to_encode = ['Species']
le = LabelEncoder()
for column in columns_to_encode:
    dfencoded[column] = le.fit_transform(dfencoded[column])"""
```

Out[37]:
```
"dfencoded = iris\ncolumns_to_encode = ['Species']\nle = LabelEnco
der()\nfor column in columns_to_encode:\n    dfencoded[column] = l
e.fit_transform(dfencoded[column])"
```

In [38]:
```
y=iris['Species']
y
```

Out[38]:
```
0         Iris-setosa
1         Iris-setosa
2         Iris-setosa
3         Iris-setosa
4         Iris-setosa
             ...
145    Iris-virginica
146    Iris-virginica
147    Iris-virginica
148    Iris-virginica
149    Iris-virginica
Name: Species, Length: 150, dtype: object
```

In [39]:
```
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.3)
```

In [40]:
```
from sklearn.tree import DecisionTreeClassifier
```

In [42]:
```
dt.fit(x_train,y_train)
```

Out[42]:
```
DecisionTreeClassifier()
```

In [43]:
```
pred=dt.predict(x_test)
```

In [44]:
```
from sklearn.metrics import classification_report,confusion_matrix
```

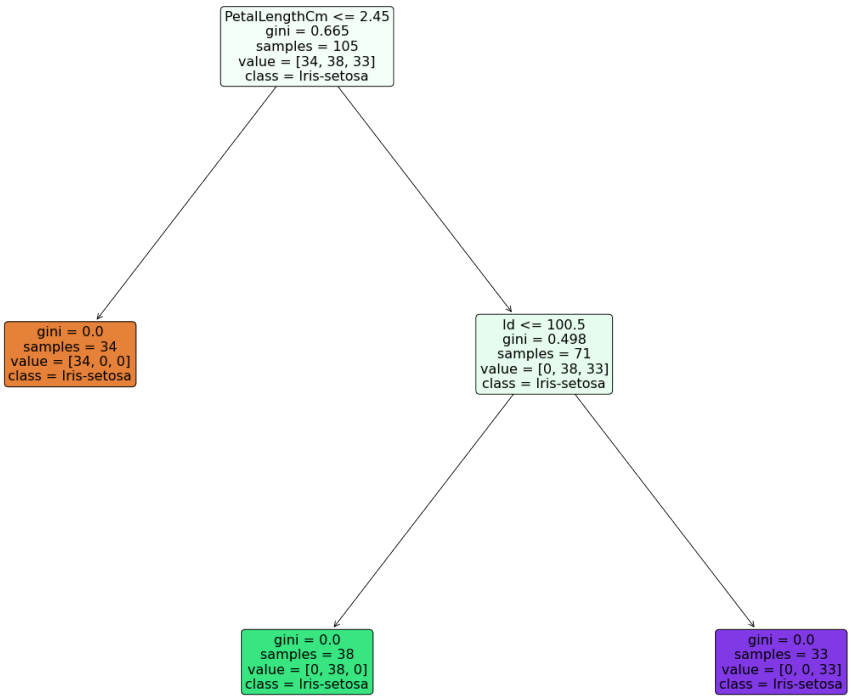
In [45]:
```
print(classification_report(y_test,pred))
```

```
                 precision    recall  f1-score   support

    Iris-setosa       1.00      1.00      1.00        16
Iris-versicolor       1.00      1.00      1.00        12
 Iris-virginica       1.00      1.00      1.00        17

       accuracy                           1.00        45
      macro avg       1.00      1.00      1.00        45
   weighted avg       1.00      1.00      1.00        45
```

In [46]:
```
print(confusion_matrix(y_test,pred))
```

```
[[16  0  0]
 [ 0 12  0]
 [ 0  0 17]]
```

In [47]:
```
t plot_tree
20))
e_names=x.columns,class_names=y,filled=True,rounded=True, fontsize=1
```



BOSTON HOUSING DATASET

In [430]:
```
bstn=pd.read_csv('HousingData.csv')
p=bstn['MEDV']
ft=bstn.drop('MEDV',axis=1)
```

In [431]:
```
ft.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 506 entries, 0 to 505
Data columns (total 13 columns):
 #   Column   Non-Null Count  Dtype  
---  ------   --------------  -----  
 0   CRIM     486 non-null    float64
 1   ZN       486 non-null    float64
 2   INDUS    486 non-null    float64
 3   CHAS     486 non-null    float64
 4   NOX      506 non-null    float64
 5   RM       506 non-null    float64
 6   AGE      486 non-null    float64
 7   DIS      506 non-null    float64
 8   RAD      506 non-null    int64  
 9   TAX      506 non-null    int64  
 10  PTRATIO  506 non-null    float64
 11  B        506 non-null    float64
 12  LSTAT    486 non-null    float64
dtypes: float64(11), int64(2)
memory usage: 51.5 KB
```

In [432]:
```
p.info()
```

```
<class 'pandas.core.series.Series'>
RangeIndex: 506 entries, 0 to 505
Series name: MEDV
Non-Null Count  Dtype  
--------------  -----  
506 non-null    float64
dtypes: float64(1)
memory usage: 4.1 KB
```

In [433]:
```
ft.describe()
```

Out[433]:

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE
count	486.000000	486.000000	486.000000	486.000000	506.000000	506.000000	486.000000
mean	3.611874	11.211934	11.083992	0.069959	0.554695	6.284634	68.518519
std	8.720192	23.388876	6.835896	0.255340	0.115878	0.702617	27.999513
min	0.006320	0.000000	0.460000	0.000000	0.385000	3.561000	2.900000
25%	0.081900	0.000000	5.190000	0.000000	0.449000	5.885500	45.175000
50%	0.253715	0.000000	9.690000	0.000000	0.538000	6.208500	76.800000
75%	3.560263	12.500000	18.100000	0.000000	0.624000	6.623500	93.975000
max	88.976200	100.000000	27.740000	1.000000	0.871000	8.780000	100.000000

In [434]:
```
ft.head()
```

Out[434]:

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE	DIS	RAD	TAX	PTRATIO	B
0	0.00632	18.0	2.31	0.0	0.538	6.575	65.2	4.0900	1	296	15.3	396.90
1	0.02731	0.0	7.07	0.0	0.469	6.421	78.9	4.9671	2	242	17.8	396.90
2	0.02729	0.0	7.07	0.0	0.469	7.185	61.1	4.9671	2	242	17.8	392.83
3	0.03237	0.0	2.18	0.0	0.458	6.998	45.8	6.0622	3	222	18.7	394.63
4	0.06905	0.0	2.18	0.0	0.458	7.147	54.2	6.0622	3	222	18.7	396.90

In [435]:
```
ft.isnull().sum()
```

Out[435]:
```
CRIM       20
ZN         20
INDUS      20
CHAS       20
NOX         0
RM          0
AGE        20
DIS         0
RAD         0
TAX         0
PTRATIO     0
B           0
LSTAT      20
dtype: int64
```

In [436]:
```
ft.columns
```

Out[436]:
```
Index(['CRIM', 'ZN', 'INDUS', 'CHAS', 'NOX', 'RM', 'AGE', 'DIS', '
RAD', 'TAX',
       'PTRATIO', 'B', 'LSTAT'],
      dtype='object')
```

In [437]:
```
ft[['CRIM','ZN','INDUS','AGE','LSTAT','CHAS']] = ft[['CRIM','ZN','I
```

In [438]:
```
ft.isnull().sum()
```

Out[438]:
```
CRIM       0
ZN         0
INDUS      0
CHAS       0
NOX        0
RM         0
AGE        0
DIS        0
RAD        0
TAX        0
PTRATIO    0
B          0
LSTAT      0
dtype: int64
```

In [439]:
```
NOX', 'RM', 'AGE', 'DIS','PTRATIO', 'B', 'LSTAT']]=ft[['CRIM', 'ZN'
```

In [440]:
```
ft.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 506 entries, 0 to 505
Data columns (total 13 columns):
 #   Column   Non-Null Count  Dtype  
---  ------   --------------  -----  
 0   CRIM     506 non-null    int64  
 1   ZN       506 non-null    int64  
 2   INDUS    506 non-null    int64  
 3   CHAS     506 non-null    int64  
 4   NOX      506 non-null    int64  
 5   RM       506 non-null    int64  
 6   AGE      506 non-null    int64  
 7   DIS      506 non-null    int64  
 8   RAD      506 non-null    int64  
 9   TAX      506 non-null    int64  
 10  PTRATIO  506 non-null    int64  
 11  B        506 non-null    int64  
 12  LSTAT    506 non-null    int64  
dtypes: int64(13)
memory usage: 51.5 KB
```

In [441]:
```
from sklearn.metrics import r2_score
def performance_metric(y_true, y_predict):
    """ Calculates and returns the performance score between
        true (y_true) and predicted (y_predict) values based on the

    score = r2_score(y_true, y_predict)

    # Return the score
    return score
```

In [442]:
```
x=bstn.iloc[:,:-1]
x
```

Out[442]:

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE	DIS	RAD	TAX	PTRATIO	B	L
0	0.00632	18.0	2.31	0.0	0.538	6.575	65.2	4.0900	1	296	15.3	396.90	
1	0.02731	0.0	7.07	0.0	0.469	6.421	78.9	4.9671	2	242	17.8	396.90	
2	0.02729	0.0	7.07	0.0	0.469	7.185	61.1	4.9671	2	242	17.8	392.83	
3	0.03237	0.0	2.18	0.0	0.458	6.998	45.8	6.0622	3	222	18.7	394.63	
4	0.06905	0.0	2.18	0.0	0.458	7.147	54.2	6.0622	3	222	18.7	396.90	
...	...	...	...	...	...	...	...	...	...	...	...	...	
501	0.06263	0.0	11.93	0.0	0.573	6.593	69.1	2.4786	1	273	21.0	391.99	
502	0.04527	0.0	11.93	0.0	0.573	6.120	76.7	2.2875	1	273	21.0	396.90	
503	0.06076	0.0	11.93	0.0	0.573	6.976	91.0	2.1675	1	273	21.0	396.90	
504	0.10959	0.0	11.93	0.0	0.573	6.794	89.3	2.3889	1	273	21.0	393.45	
505	0.04741	0.0	11.93	0.0	0.573	6.030	NaN	2.5050	1	273	21.0	396.90	

In [443]:
```
bstn['MEDV']=bstn['MEDV'].astype(int)
y=bstn.iloc[:,-1]
y
```

Out[443]:
```
0      24
1      21
2      34
3      33
4      36
       ..
501    22
502    20
503    23
504    22
505    11
Name: MEDV, Length: 506, dtype: int64
```

In [449]:
```
X_train, X_test, y_train, y_test = train_test_split(x,y, test_size=
```

In [450]:
```
dt.fit(x_train,y_train)
```

Out[450]:
```
DecisionTreeClassifier()
```

In [451]:
```
pred=dt.predict(x_test)
```

In [452]:
```
from sklearn.metrics import classification_report,confusion_matrix
```

In [453]:
```
print(classification_report(y_test,pred))
```

```
              precision    recall  f1-score   support

           5       0.00      0.00      0.00         1
           7       0.00      0.00      0.00         2
           8       0.00      0.00      0.00         0
           9       0.00      0.00      0.00         2
          10       0.00      0.00      0.00         4
          11       0.00      0.00      0.00         0
          12       0.00      0.00      0.00         2
          13       0.00      0.00      0.00         4
          14       0.00      0.00      0.00         4
          15       0.33      0.33      0.33         3
          16       0.00      0.00      0.00         3
          17       0.00      0.00      0.00         7
          18       0.00      0.00      0.00         7
          19       0.00      0.00      0.00         8
          20       0.17      0.09      0.12        11
          21       0.00      0.00      0.00         5
          22       0.00      0.00      0.00         4
```

In [454]:
```
print(confusion_matrix(y_test,pred))
```

```
[[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]]
```

In [ ]:

In [ ]:

In [ ]: