In [1]:

```python
# NAME-AKSHAY SINGH ADHIKARI
#TASK-INTERMEDIATE TASK 1
```

In [2]:

```python
# Given is a project as the intermediate task
#decision trees on iris dataset to classify the new species using decision tree
```

In [66]:

```python
# first,importing the python libraries
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

In [67]:

```python
# import dataset
df=pd.read_csv("Iris (2).csv")
df
```

Out[67]:

	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
...	...	...	...	...	...	...
145	146	6.7	3.0	5.2	2.3	Iris-virginica
146	147	6.3	2.5	5.0	1.9	Iris-virginica
147	148	6.5	3.0	5.2	2.0	Iris-virginica
148	149	6.2	3.4	5.4	2.3	Iris-virginica
149	150	5.9	3.0	5.1	1.8	Iris-virginica

150 rows × 6 columns

In [68]:

```
# to see the information about the dataset
df.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 [69]:

```
# to see first 5 records of dataset
df.head()
```

Out[69]:

	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 [70]:

```
# to see statistical data of the data
df.describe()
```

Out[70]:

	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 [71]:

```
# to see last records
df.tail()
```

Out[71]:

	Id	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm	Species
145	146	6.7	3.0	5.2	2.3	Iris-virginica
146	147	6.3	2.5	5.0	1.9	Iris-virginica
147	148	6.5	3.0	5.2	2.0	Iris-virginica
148	149	6.2	3.4	5.4	2.3	Iris-virginica
149	150	5.9	3.0	5.1	1.8	Iris-virginica

In [72]:

```
# to see unique classes
df['Species'].unique()
```

Out[72]:

```
array(['Iris-setosa', 'Iris-versicolor', 'Iris-virginica'], dtype=object)
```

In [73]:

```
#encode the target variable
from sklearn.preprocessing import LabelEncoder
le=LabelEncoder()
df['Species']=le.fit_transform(df['Species'])
```

In [76]:

```
# Here,After encoding,
#  0 denotes iris setosa
#  1 denotes iris-versicolor
#  2 denotes iris-virginica
```

In [75]:

```
df
```

Out[75]:

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

150 rows × 6 columns

In [11]:

```python
# extracting the independent and dependent variables
# for independent variable in X, we will drop species and id column with axis1
x=df.drop(["Species","Id"],axis=1)
y=df["Species"]
```

In [12]:

```python
df
```

Out[12]:

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

150 rows × 6 columns

In [13]:

```python
# Now splitting the data into training and testing dataset
# training :70 and testing :30
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)
```

```
In [14]: print(x_train , x_test)
```

```
     SepalLengthCm  SepalWidthCm  PetalLengthCm  PetalWidthCm
138            6.0           3.0            4.8           1.8
129            7.2           3.0            5.8           1.6
3              4.6           3.1            1.5           0.2
119            6.0           2.2            5.0           1.5
99             5.7           2.8            4.1           1.3
..             ...           ...            ...           ...
113            5.7           2.5            5.0           2.0
114            5.8           2.8            5.1           2.4
86             6.7           3.1            4.7           1.5
69             5.6           2.5            3.9           1.1
91             6.1           3.0            4.6           1.4

[105 rows x 4 columns]      SepalLengthCm  SepalWidthCm  PetalLengthCm  Petal
WidthCm
124            6.7           3.3            5.7           2.1
144            6.7           3.3            5.7           2.5
137            6.4           3.1            5.5           1.8
16             5.4           3.9            1.3           0.4
108            6.7           2.5            5.8           1.8
41             4.5           2.3            1.3           0.3
9              4.9           3.1            1.5           0.1
62             6.0           2.2            4.0           1.0
149            5.9           3.0            5.1           1.8
43             5.0           3.5            1.6           0.6
141            6.9           3.1            5.1           2.3
58             6.6           2.9            4.6           1.3
130            7.4           2.8            6.1           1.9
29             4.7           3.2            1.6           0.2
14             5.8           4.0            1.2           0.2
22             4.6           3.6            1.0           0.2
143            6.8           3.2            5.9           2.3
132            6.4           2.8            5.6           2.2
25             5.0           3.0            1.6           0.2
142            5.8           2.7            5.1           1.9
125            7.2           3.2            6.0           1.8
13             4.3           3.0            1.1           0.1
55             5.7           2.8            4.5           1.3
44             5.1           3.8            1.9           0.4
97             6.2           2.9            4.3           1.3
33             5.5           4.2            1.4           0.2
101            5.8           2.7            5.1           1.9
78             6.0           2.9            4.5           1.5
70             5.9           3.2            4.8           1.8
50             7.0           3.2            4.7           1.4
11             4.8           3.4            1.6           0.2
1              4.9           3.0            1.4           0.2
56             6.3           3.3            4.7           1.6
20             5.4           3.4            1.7           0.2
111            6.4           2.7            5.3           1.9
60             5.0           2.0            3.5           1.0
127            6.1           3.0            4.9           1.8
4              5.0           3.6            1.4           0.2
103            6.3           2.9            5.6           1.8
105            7.6           3.0            6.6           2.1
30             4.8           3.1            1.6           0.2
146            6.3           2.5            5.0           1.9
```

```
80               5.5           2.4            3.8           1.1
18               5.7           3.8            1.7           0.3
123              6.3           2.7            4.9           1.8
```

In [15]:

```
y_test
```

Out[15]:

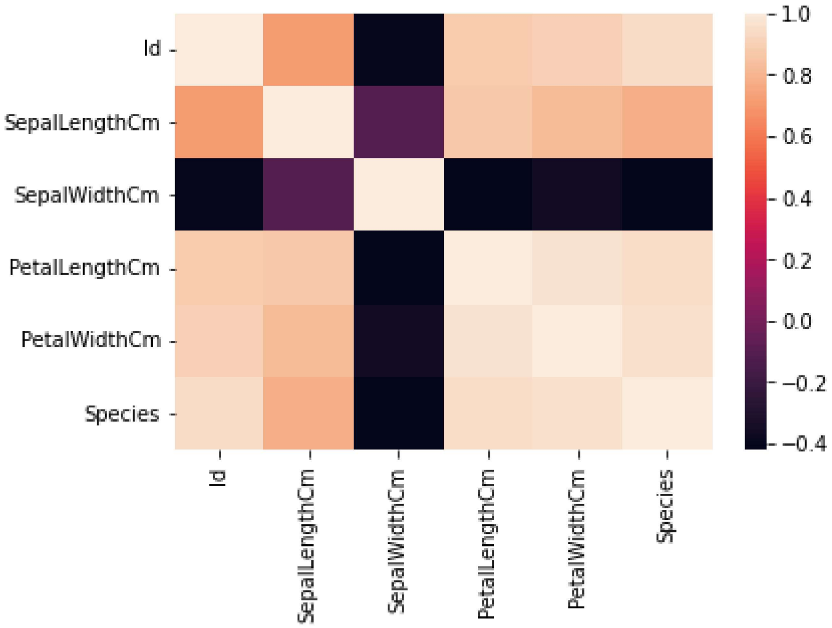
```
124    2
144    2
137    2
16     0
108    2
41     0
9      0
62     1
149    2
43     0
141    2
58     1
130    2
29     0
14     0
22     0
143    2
132    2
25     0
142    2
125    2
13     0
55     1
44     0
97     1
33     0
101    2
78     1
70     1
50     1
11     0
1      0
56     1
20     0
111    2
60     1
127    2
4      0
103    2
105    2
30     0
146    2
80     1
18     0
123    2
Name: Species, dtype: int32
```

In [16]:
```
y_train
```

Out[16]:
```
138    2
129    2
3      0
119    2
99     1
      ..
113    2
114    2
86     1
69     1
91     1
Name: Species, Length: 105, dtype: int32
```

In [17]:
```
sns.heatmap(df.corr())
```

Out[17]:
```
<AxesSubplot:>
```

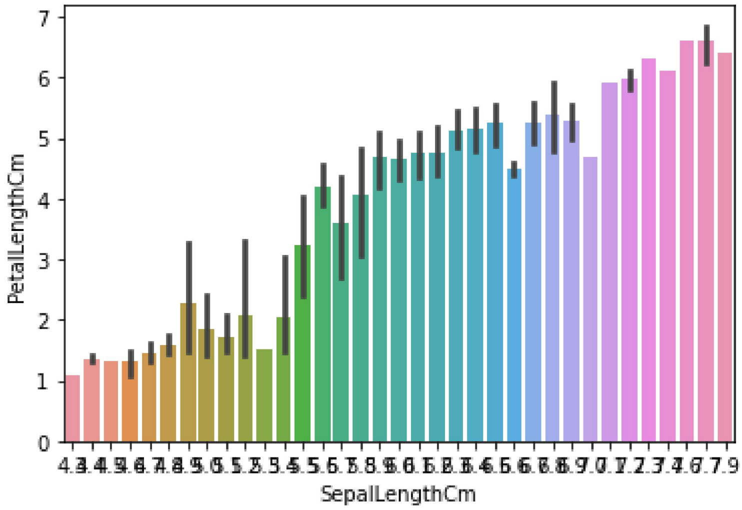


In [18]:

```
import seaborn as sns
sns.barplot(x=df["SepalLengthCm"],y=df['PetalLengthCm'])
```

Out[18]:

```
<AxesSubplot:xlabel='SepalLengthCm', ylabel='PetalLengthCm'>
```



APPLYING DECISION TREE

In [54]:

```
# taking criteria as 'entropy'
from sklearn.tree import DecisionTreeClassifier
clf=DecisionTreeClassifier(criterion='entropy')
clf.fit(x_train,y_train)
```

Out[54]:

```
▾           DecisionTreeClassifier

DecisionTreeClassifier(criterion='entropy')
```

In [55]:

```
# Now predicting the target class
y_pred=clf.predict(x_test)
```

In [56]:

```
y_pred
```

Out[56]:

```
array([2, 2, 2, 0, 2, 0, 0, 1, 2, 0, 2, 1, 2, 0, 0, 0, 2, 2, 0, 2, 2, 0,
       1, 0, 1, 0, 2, 1, 2, 1, 0, 0, 1, 0, 2, 1, 2, 0, 2, 2, 0, 2, 1, 0,
       2])
```

In [57]:

```
# to see shape of training and testing data
```

In [58]:

```
y_test.shape ,y_train.shape ,x_test.shape , x_train.shape
```

Out[58]:

```
((45,), (105,), (45, 4), (105, 4))
```

In [59]:
```
y_test.head()
```

Out[59]:
```
124    2
144    2
137    2
16     0
108    2
Name: Species, dtype: int32
```

In [60]:
```
y_pred[0:5]
```

Out[60]:
```
array([2, 2, 2, 0, 2])
```

In [26]:
```
print("Accuracy:",clf.score(x_test,y_test)*100)
```

```
Accuracy: 97.77777777777777
```

In [27]:
```
print("Accuracy:",clf.score(x_train,y_train)*100)
```

```
Accuracy: 100.0
```

In [28]:
```
# to see confusion _matrix showing the true positive,true negative, false posit
from sklearn.metrics import confusion_matrix
cm=confusion_matrix(y_test,y_pred)
cm
```

Out[28]:
```
array([[17,  0,  0],
       [ 0,  9,  1],
       [ 0,  0, 18]], dtype=int64)
```

In [29]:
```
from sklearn.metrics import precision_recall_fscore_support
precision_recall_fscore_support(y_test,y_pred)
```

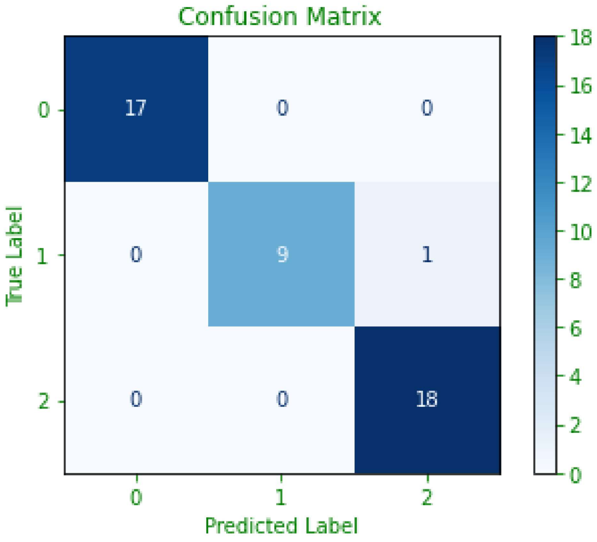
Out[29]:
```
(array([1.        , 1.        , 0.94736842]),
 array([1. , 0.9, 1. ]),
 array([1.        , 0.94736842, 0.97297297]),
 array([17, 10, 18], dtype=int64))
```

In [30]:

```
# visualizing the confusion matrix of data
import matplotlib.pyplot as plt
from sklearn.metrics import plot_confusion_matrix

color = 'green'
matrix = plot_confusion_matrix(clf, x_test, y_test, cmap=plt.cm.Blues)
matrix.ax_.set_title('Confusion Matrix', color=color)
plt.xlabel('Predicted Label', color=color)
plt.ylabel('True Label', color=color)
plt.gcf().axes[0].tick_params(colors=color)
plt.gcf().axes[1].tick_params(colors=color)
plt.show()
```

```
C:\Users\Akshay\AppData\Local\Programs\Python\Python310\lib\site-packages\skl
earn\utils\deprecation.py:87: FutureWarning: Function plot_confusion_matrix i
s deprecated; Function `plot_confusion_matrix` is deprecated in 1.0 and will
be removed in 1.2. Use one of the class methods: ConfusionMatrixDisplay.from_
predictions or ConfusionMatrixDisplay.from_estimator.
  warnings.warn(msg, category=FutureWarning)
```

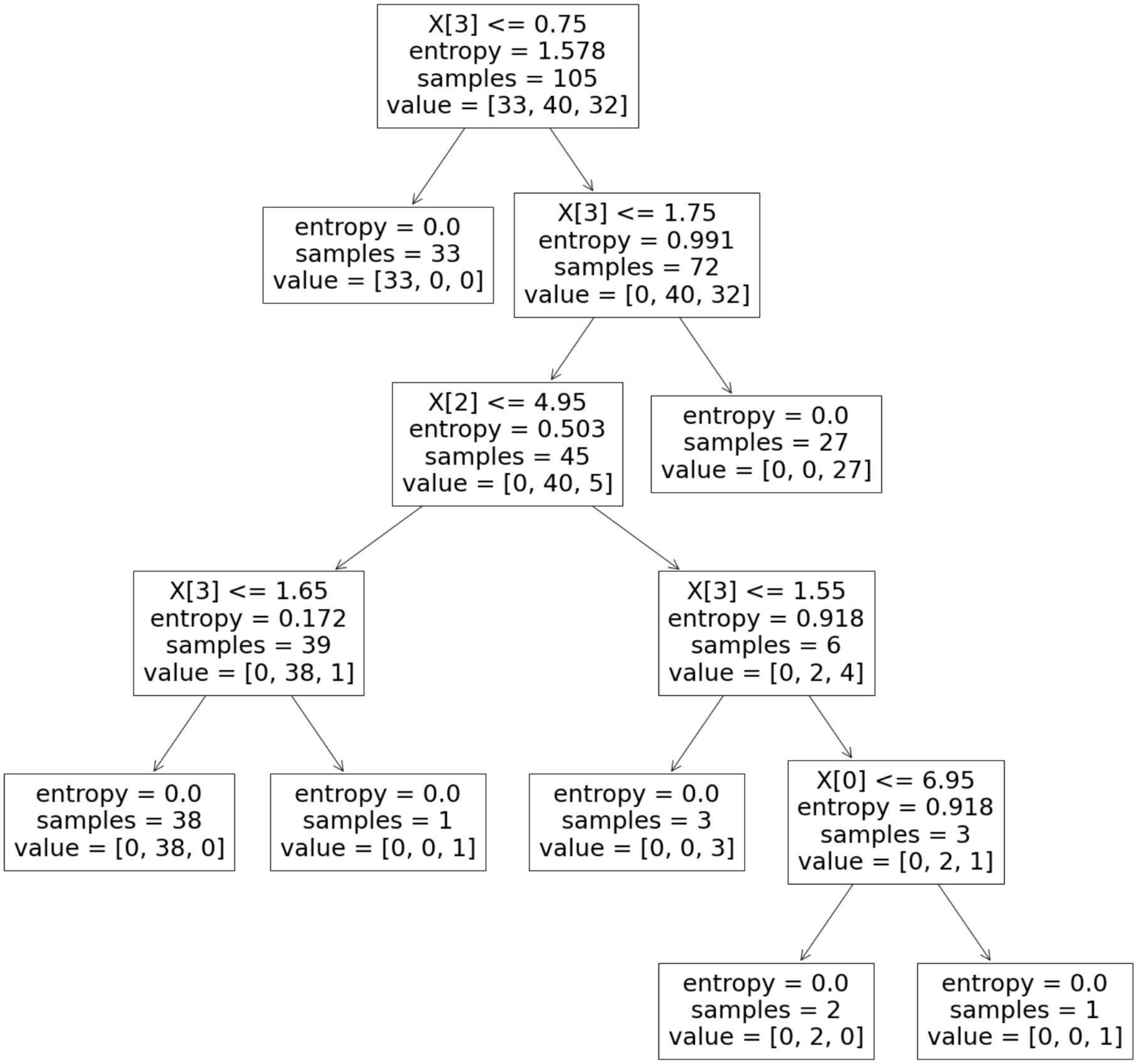


In [31]:

```python
# Visualizing the decision tree using matplotlib
from sklearn import tree
import matplotlib.pyplot as plt
plt.figure(figsize = (25,25))
tree.plot_tree(clf)
```

Out[31]:

```
[Text(0.4444444444444444, 0.9166666666666666, 'X[3] <= 0.75\nentropy = 1.578
\nsamples = 105\nvalue = [33, 40, 32]'),
 Text(0.3333333333333333, 0.75, 'entropy = 0.0\nsamples = 33\nvalue = [33, 0,
0]'),
 Text(0.5555555555555556, 0.75, 'X[3] <= 1.75\nentropy = 0.991\nsamples = 72
\nvalue = [0, 40, 32]'),
 Text(0.4444444444444444, 0.5833333333333334, 'X[2] <= 4.95\nentropy = 0.503
\nsamples = 45\nvalue = [0, 40, 5]'),
 Text(0.2222222222222222, 0.4166666666666667, 'X[3] <= 1.65\nentropy = 0.172
\nsamples = 39\nvalue = [0, 38, 1]'),
 Text(0.1111111111111111, 0.25, 'entropy = 0.0\nsamples = 38\nvalue = [0, 38,
0]'),
 Text(0.3333333333333333, 0.25, 'entropy = 0.0\nsamples = 1\nvalue = [0, 0,
1]'),
 Text(0.6666666666666666, 0.4166666666666667, 'X[3] <= 1.55\nentropy = 0.918
\nsamples = 6\nvalue = [0, 2, 4]'),
 Text(0.5555555555555556, 0.25, 'entropy = 0.0\nsamples = 3\nvalue = [0, 0,
3]'),
 Text(0.7777777777777778, 0.25, 'X[0] <= 6.95\nentropy = 0.918\nsamples = 3\n
value = [0, 2, 1]'),
 Text(0.6666666666666666, 0.08333333333333333, 'entropy = 0.0\nsamples = 2\nv
alue = [0, 2, 0]'),
 Text(0.8888888888888888, 0.08333333333333333, 'entropy = 0.0\nsamples = 1\nv
alue = [0, 0, 1]'),
 Text(0.6666666666666666, 0.5833333333333334, 'entropy = 0.0\nsamples = 27\nv
alue = [0, 0, 27]')]
```



In [32]:
```
# accuracy score for the dataset
from sklearn.metrics import accuracy_score
clf=accuracy_score(y_test,y_pred)
clf
```

Out[32]:
```
0.9777777777777777
```

In [33]:
```
# metrics performance from classification report
from sklearn.metrics import classification_report
print(classification_report(y_test, y_pred))
```

```
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        17
           1       1.00      0.90      0.95        10
           2       0.95      1.00      0.97        18

    accuracy                           0.98        45
   macro avg       0.98      0.97      0.97        45
weighted avg       0.98      0.98      0.98        45
```

In [34]:

```python
# taking entropy as log_loss
from sklearn.tree import DecisionTreeClassifier
clf=DecisionTreeClassifier(criterion='log_loss')
clf.fit(x_train,y_train)
```

Out[34]:

```
▾            DecisionTreeClassifier

DecisionTreeClassifier(criterion='log_loss')
```

In [35]:

```python
# Now predicting the target class
y_pred_1=clf.predict(x_test)
y_pred_1
```

Out[35]:

```
array([2, 2, 2, 0, 2, 0, 0, 1, 2, 0, 2, 1, 2, 0, 0, 0, 2, 2, 0, 2, 2, 0,
       1, 0, 1, 0, 2, 1, 2, 1, 0, 0, 1, 0, 2, 1, 2, 0, 2, 2, 0, 2, 1, 0,
       2])
```

In [36]:

```python
# accuracy score for the dataset
from sklearn.metrics import accuracy_score
clf=accuracy_score(y_test,y_pred_1)
clf
```

Out[36]:

```
0.9777777777777777
```

In [37]:

```python
# metrics performance from classification report
from sklearn.metrics import classification_report
print(classification_report(y_test, y_pred_1))
```

```
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        17
           1       1.00      0.90      0.95        10
           2       0.95      1.00      0.97        18

    accuracy                           0.98        45
   macro avg       0.98      0.97      0.97        45
weighted avg       0.98      0.98      0.98        45
```

In [ ]:

```python

```

In [47]:

```python
# Let's predict the target class(species) using the feature variables
```

In [62]:

```python
y_preds=clf.predict([[5.0,3.6,1.4,0.2]])
y_preds
```

```
C:\Users\Akshay\AppData\Local\Programs\Python\Python310\lib\site-packages\skl
earn\base.py:450: UserWarning: X does not have valid feature names, but Decis
ionTreeClassifier was fitted with feature names
  warnings.warn(
```

Out[62]:

```
array([0])
```

In [ ]:

```
# we get prediction as 0 which denotes iris setosa
```