Importing necessary libraries.

In [2]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split, GridSearchCV, cross_val_score
from sklearn.preprocessing import LabelEncoder
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score, classification_report, confusion_matrix
```

In [3]:
```
# Load the dataset
df = pd.read_csv("Iris.csv")
```

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

Out[4]:

	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 [5]:
```
 df = df.drop("Id", axis =1)
```

In [6]:
```
df
```

Out[6]:

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

150 rows × 5 columns

In [7]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 150 entries, 0 to 149
Data columns (total 5 columns):
 #   Column         Non-Null Count  Dtype  
---  ------         --------------  -----  
 0   SepalLengthCm  150 non-null    float64
 1   SepalWidthCm   150 non-null    float64
 2   PetalLengthCm  150 non-null    float64
 3   PetalWidthCm   150 non-null    float64
 4   Species        150 non-null    object 
dtypes: float64(4), object(1)
memory usage: 6.0+ KB
```

In [8]:
```
#Display the number of samples for each species
df["Species"].value_counts()
```

Out[8]:
```
Iris-setosa        50
Iris-versicolor    50
Iris-virginica     50
Name: Species, dtype: int64
```

In [9]:
```
# Convert class labels into numerical form
le = LabelEncoder()
df['Species'] = le.fit_transform(df['Species'])
df["Species"]
```

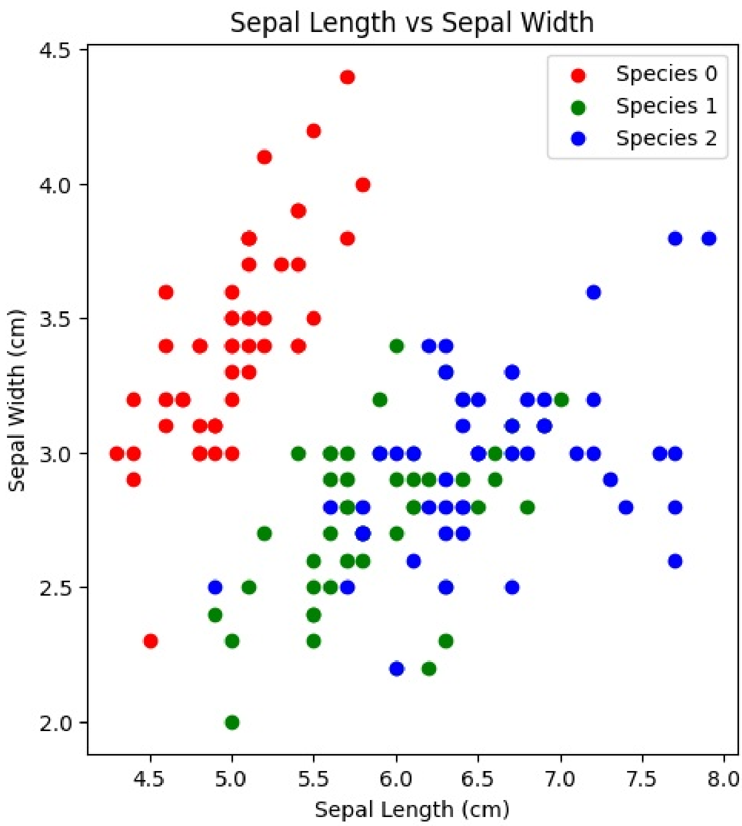
```
Out[9]: 0      0
        1      0
        2      0
        3      0
        4      0
              ..
        145    2
        146    2
        147    2
        148    2
        149    2
        Name: Species, Length: 150, dtype: int32
```

Visualization

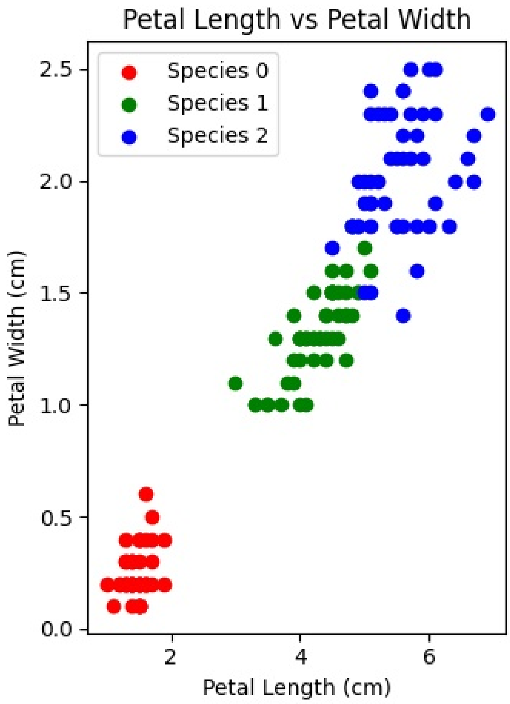
```python
In [10]: species_colors = {0: 'red', 1: 'green', 2: 'blue'}
```

```python
In [11]: # Scatter plots for Sepal Length vs Sepal Width
plt.figure(figsize=(12, 6))
plt.subplot(1, 2, 1)
for species, color in species_colors.items():
    subset = df[df['Species'] == species]
    plt.scatter(subset['SepalLengthCm'], subset['SepalWidthCm'], label=f'Species {species}', color=color)
plt.xlabel('Sepal Length (cm)')
plt.ylabel('Sepal Width (cm)')
plt.title('Sepal Length vs Sepal Width')
plt.legend()
```

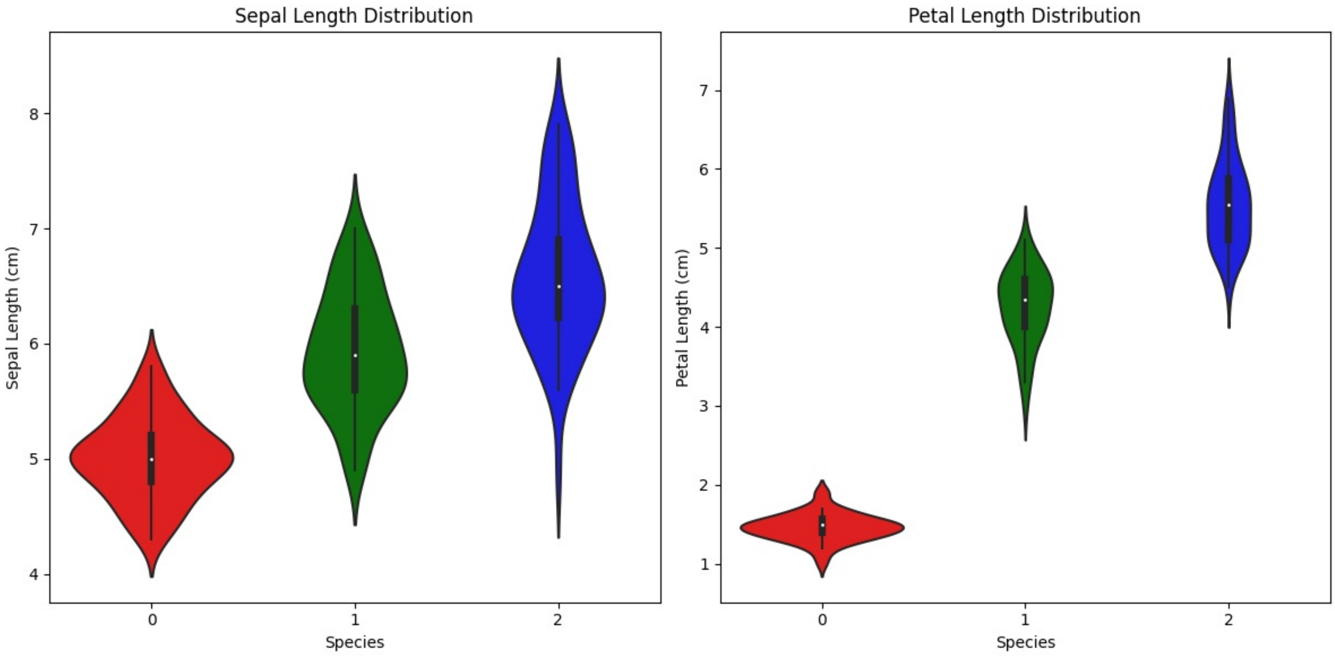
```
Out[11]: <matplotlib.legend.Legend at 0x20325bfaa70>
```




```python
In [12]: # Scatter plots for Petal Length vs Petal Width
plt.subplot(1, 2, 2)
for species, color in species_colors.items():
    subset = df[df['Species'] == species]
    plt.scatter(subset['PetalLengthCm'], subset['PetalWidthCm'], label=f'Species {species}', color=color)
plt.xlabel('Petal Length (cm)')
plt.ylabel('Petal Width (cm)')
plt.title('Petal Length vs Petal Width')
plt.legend()

plt.tight_layout()
plt.show()
```

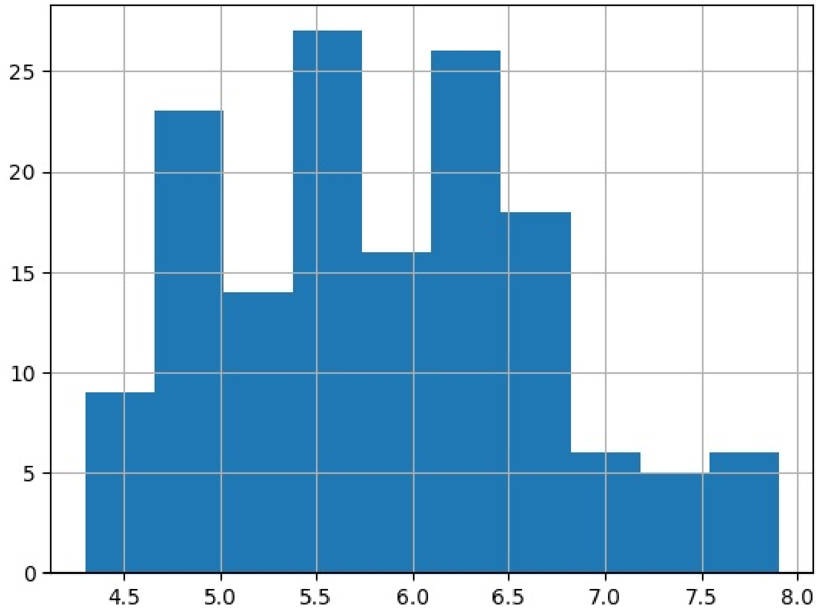


In [13]:
```
# Violin plots for feature distributions
plt.figure(figsize=(12, 6))
plt.subplot(1, 2, 1)
sns.violinplot(x='Species', y='SepalLengthCm', data=df, palette=species_colors)
plt.xlabel('Species')
plt.ylabel('Sepal Length (cm)')
plt.title('Sepal Length Distribution')

plt.subplot(1, 2, 2)
sns.violinplot(x='Species', y='PetalLengthCm', data=df, palette=species_colors)
plt.xlabel('Species')
plt.ylabel('Petal Length (cm)')
plt.title('Petal Length Distribution')

plt.tight_layout()
plt.show()
```



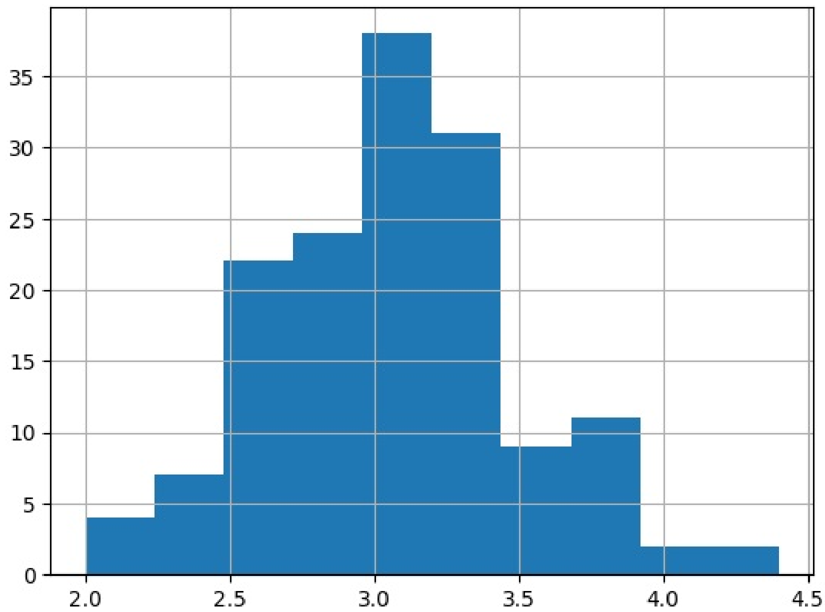
In [15]:
```
# Plotting histogram for each feature
df['SepalLengthCm'].hist()
```

Out[15]: <AxesSubplot: >



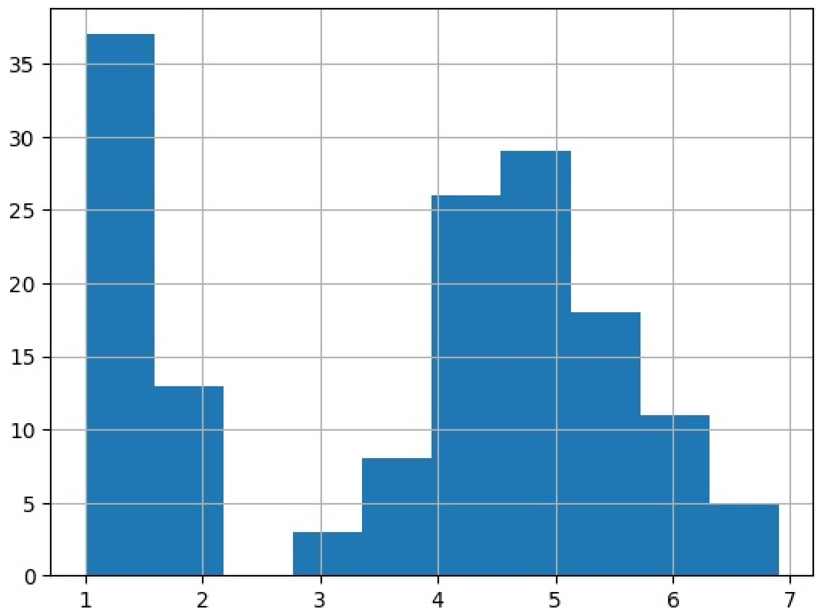
In [16]: `df['SepalWidthCm'].hist()`

Out[16]: <AxesSubplot: >



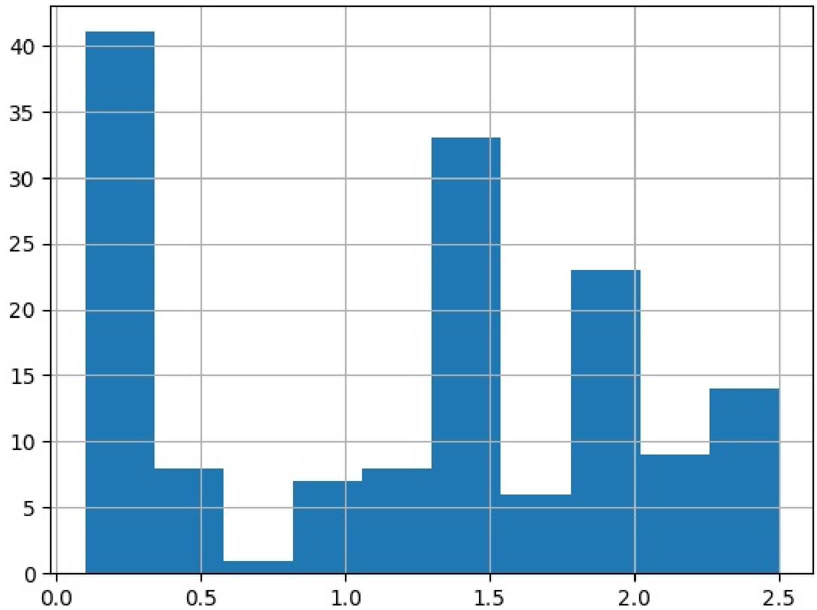
In [17]: `df['PetalLengthCm'].hist()`

Out[17]: <AxesSubplot: >



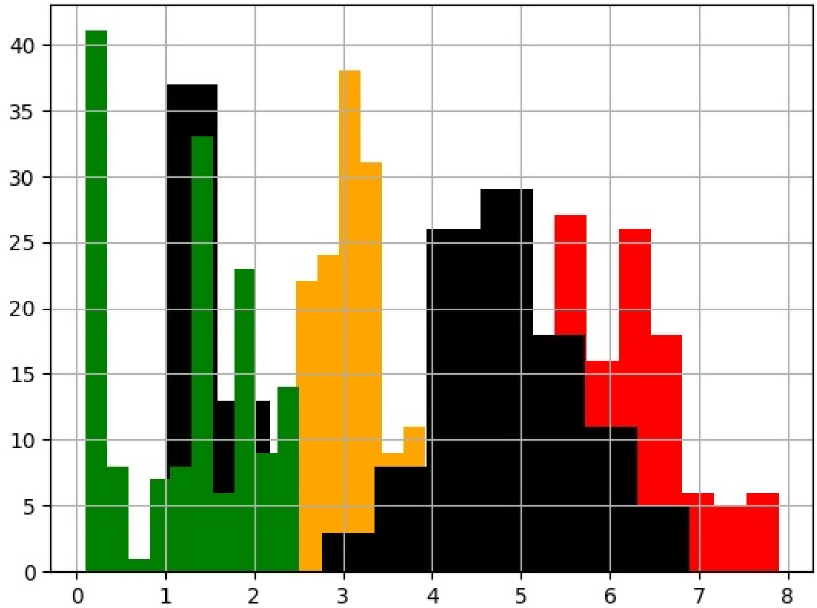
In [18]:
```
df['PetalWidthCm'].hist()
```

Out[18]: <AxesSubplot: >



In [19]:
```
#Plotting histogram for all the features together
df['SepalLengthCm'].hist(color='red')
df['SepalWidthCm'].hist(color='orange')
df['PetalLengthCm'].hist(color='black')
df['PetalWidthCm'].hist(color='green')
```

Out[19]: <AxesSubplot: >

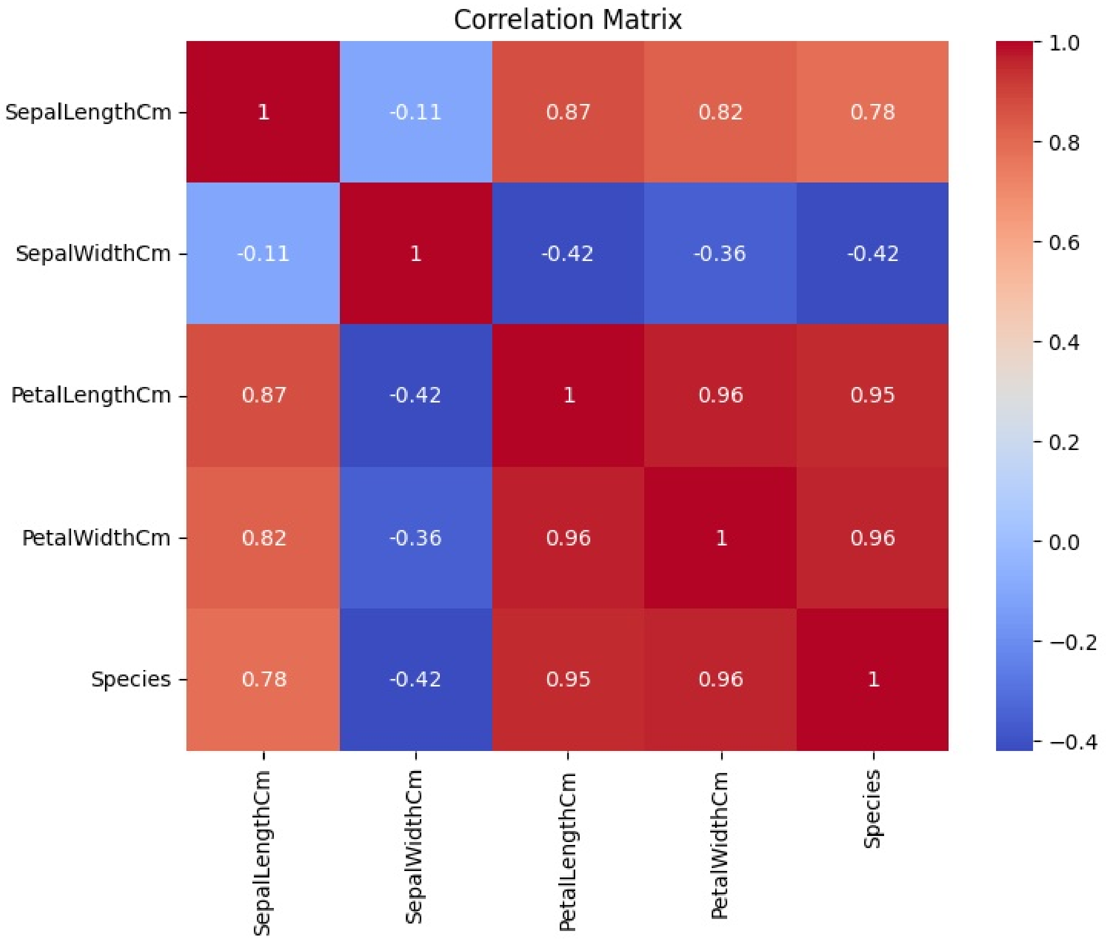


In [20]:
```
# Finding the correlation matrix
df.corr()
```

Out[20]:

	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm	Species
SepalLengthCm	1.000000	-0.109369	0.871754	0.817954	0.782561
SepalWidthCm	-0.109369	1.000000	-0.420516	-0.356544	-0.419446
PetalLengthCm	0.871754	-0.420516	1.000000	0.962757	0.949043
PetalWidthCm	0.817954	-0.356544	0.962757	1.000000	0.956464
Species	0.782561	-0.419446	0.949043	0.956464	1.000000

In [21]:
```
# Correlation matrix and heatmap
corr = df.corr()
plt.figure(figsize=(8, 6))
sns.heatmap(corr, annot=True, cmap='coolwarm')
plt.title('Correlation Matrix')
plt.show()
```



Model Training

In [22]:
```
# Splitting the data into features (X) and target (y)
X = df.drop('Species', axis=1)
y = df["Species"]
# Train-test split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=1)
```

In [23]:
```
# Model 1: Logistic Regression

from sklearn.linear_model import LogisticRegression
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import accuracy_score

# Step 1: Scale the data
scaler = StandardScaler()
X_train_scaled = scaler.fit_transform(X_train)
X_test_scaled = scaler.transform(X_test)

# Step 2: Create and train the Logistic Regression model with increased max_iter
model1 = LogisticRegression(max_iter=1000)  # Increase max_iter to an appropriate value
model1.fit(X_train_scaled, y_train)

# Step 3: Make predictions and calculate accuracy
y_pred1 = model1.predict(X_test_scaled)
accuracy1 = accuracy_score(y_test, y_pred1)
print("Accuracy (Logistic Regression): {:.2f}%".format(accuracy1 * 100))
```

```
Accuracy (Logistic Regression): 95.56%
```

In [24]:
```
# Model 2: K-nearest Neighbors (KNN)
from sklearn.neighbors import KNeighborsClassifier
model2 = KNeighborsClassifier()
model2.fit(X_train, y_train)
y_pred2 = model2.predict(X_test)
accuracy2 = accuracy_score(y_test, y_pred2)
print("Accuracy (KNN): {:.2f}%".format(accuracy2 * 100))
```

```
Accuracy (KNN): 97.78%
```

In [25]:
```
# Model 3: Decision Tree
from sklearn.tree import DecisionTreeClassifier
model3 = DecisionTreeClassifier()
model3.fit(X_train, y_train)
```

```
y_pred3 = model3.predict(X_test)
accuracy3 = accuracy_score(y_test, y_pred3)
print("Accuracy (Decision Tree): {:.2f}%".format(accuracy3 * 100))
```

```
Accuracy (Decision Tree): 95.56%
```

In [26]:

```
from sklearn.linear_model import LogisticRegression
from sklearn.neighbors import KNeighborsClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn.model_selection import cross_val_score
import numpy as np

# Create your machine learning models
model1 = LogisticRegression(max_iter=1000)  # Increased max_iter
model2 = KNeighborsClassifier()
model3 = DecisionTreeClassifier()
best_rf = RandomForestClassifier()

# List of models
models = [model1, model2, model3]
model_names = ["Logistic Regression", "KNN", "Decision Tree"]

# Perform cross-validation and print results
for i, model in enumerate(models):
    cv_scores = cross_val_score(model, X, y, cv=5)
    print(f"{model_names[i]} - Cross-Validation Accuracy: {np.mean(cv_scores):.2f}%")
```

```
Logistic Regression - Cross-Validation Accuracy: 0.97%
KNN - Cross-Validation Accuracy: 0.97%
Decision Tree - Cross-Validation Accuracy: 0.96%
```

Logistic regression and KNN has the good accuracy

In [30]:

```
y_pred1 , y_pred2
```

Out[30]:

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