Data Analytics III

- Implement Simple Naïve Bayes classification algorithm using Python/R on iris.csv dataset.
- Compute Confusion matrix to find TP, FP, TN, FN, Accuracy, Error rate, Precision, Recall on the given dataset.

In [2]:
```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
import seaborn as sns
from sklearn import datasets
from sklearn.naive_bayes import GaussianNB
from sklearn.metrics import make_scorer, accuracy_score,preci
from sklearn.metrics import classification_report
from sklearn.metrics import confusion_matrix
from sklearn.metrics import accuracy_score ,precision_score,r
```

Loading Data set

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

Out [3]:

	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 [4]:
```
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 [5]:
```
df.isnull().sum
```

Out [5]:
```
<bound method NDFrame._add_numeric_operations.<locals>.sum of        Id
SepalLengthCm  SepalWidthCm  PetalLengthCm  PetalWidthCm  Species
0    False          False         False          False         False
False
1    False          False         False          False         False
False
2    False          False         False          False         False
False
3    False          False         False          False         False
False
4    False          False         False          False         False
False
..     ...            ...           ...            ...           ...
...
145  False          False         False          False         False
False
146  False          False         False          False         False
False
147  False          False         False          False         False
False
148  False          False         False          False         False
False
149  False          False         False          False         False
False

[150 rows x 6 columns]>
```

In [6]:
```
df = df.drop(columns= ['Id'])
df.head()
```

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

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

Out [7]:

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

In [8]:

```
df['Species'].value_counts()
```

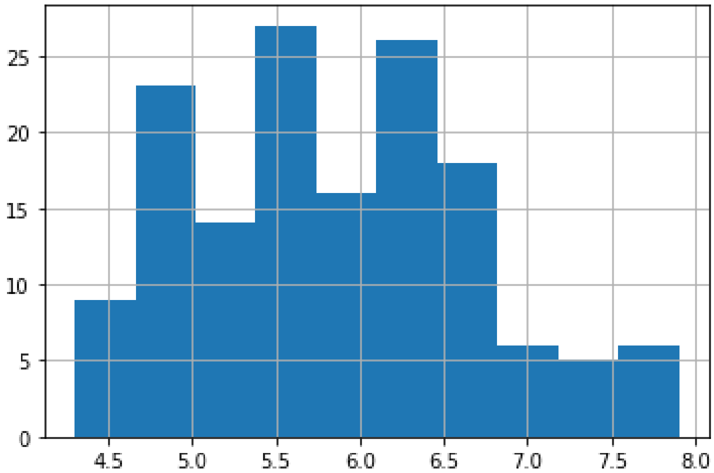
Out [8]:

```
Iris-setosa        50
Iris-versicolor    50
Iris-virginica     50
Name: Species, dtype: int64
```

In [9]:

```
df['SepalLengthCm'].hist()
```

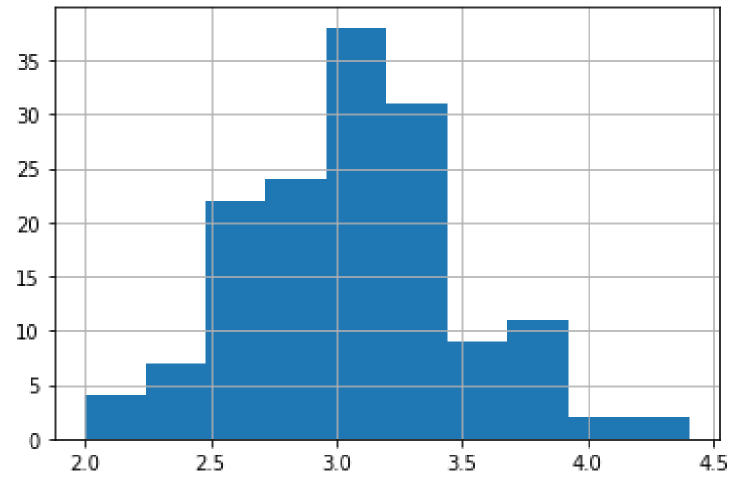
Out [9]: <matplotlib.axes._subplots.AxesSubplot at 0x7fdb8e2e2e20>



In [10]:

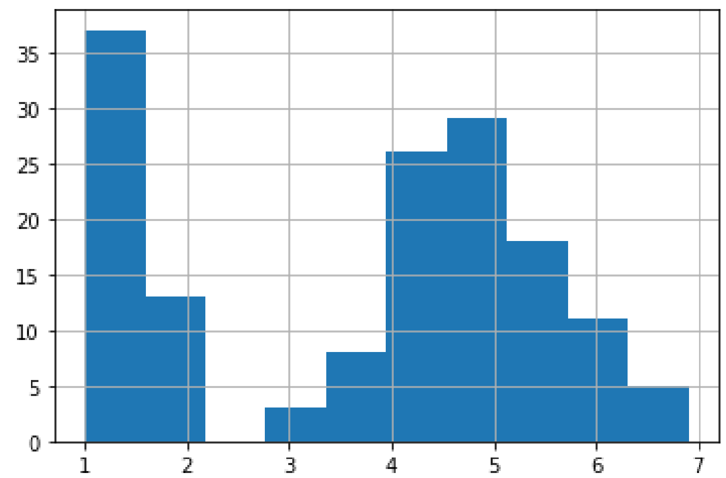
```
df['SepalWidthCm'].hist()
```

Out [10]: <matplotlib.axes._subplots.AxesSubplot at 0x7fdb8623e670>



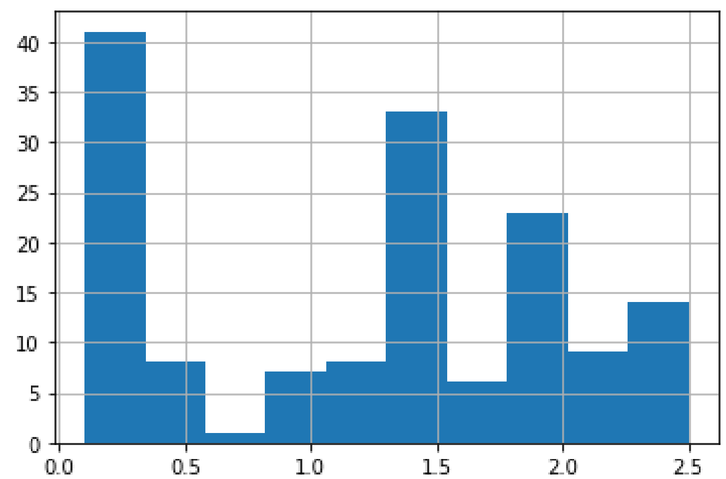
In [11]:
```
df['PetalLengthCm'].hist()
```

Out [11]: <matplotlib.axes._subplots.AxesSubplot at 0x7fdb85d06340>



In [12]:
```
df['PetalWidthCm'].hist()
```

Out [12]: <matplotlib.axes._subplots.AxesSubplot at 0x7fdb85c84e50>

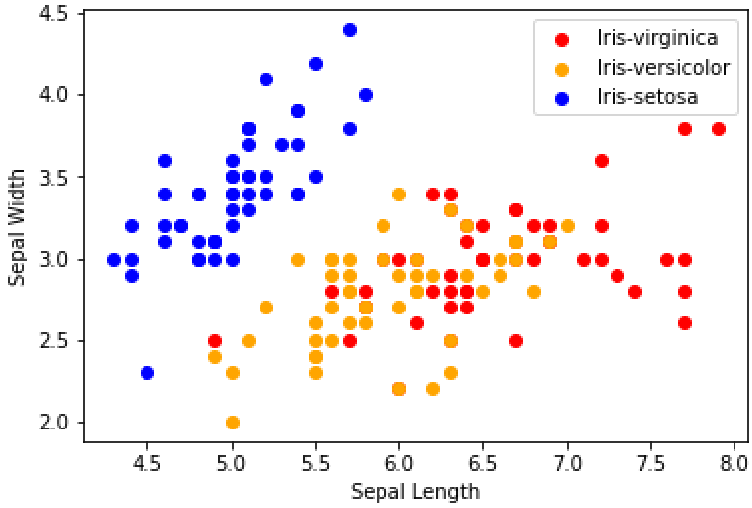


In [13]:
```
# Scatterplot
colors = ['red', 'orange', 'blue']
species = ['Iris-virginica','Iris-versicolor','Iris-setosa']
```

In [14]:

```
for i in range(3):
    x = df[df['Species'] == species[i]]
    plt.scatter(x['SepalLengthCm'], x['SepalWidthCm'], c = co
plt.xlabel("Sepal Length")
plt.ylabel("Sepal Width")
plt.legend()
```

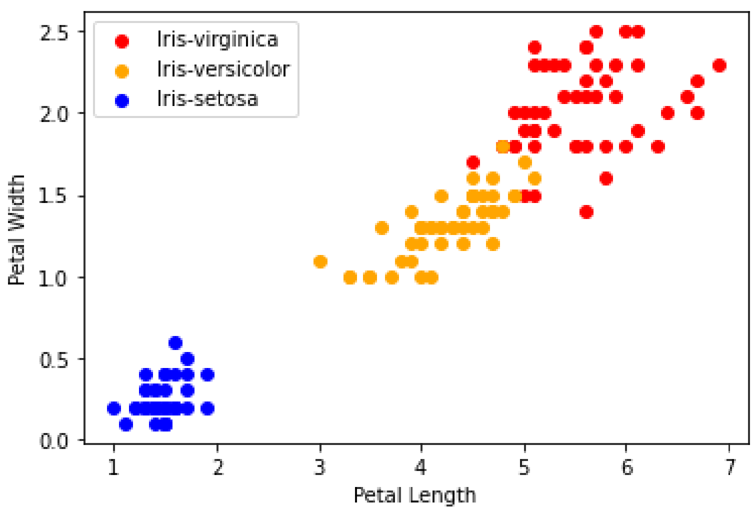
Out [14]: <matplotlib.legend.Legend at 0x7fdb85bf7790>



In [15]:

```
for i in range(3):
    x = df[df['Species'] == species[i]]
    plt.scatter(x['PetalLengthCm'], x['PetalWidthCm'], c = co
plt.xlabel("Petal Length")
plt.ylabel("Petal Width")
plt.legend()
```

Out [15]: <matplotlib.legend.Legend at 0x7fdb85b78820>

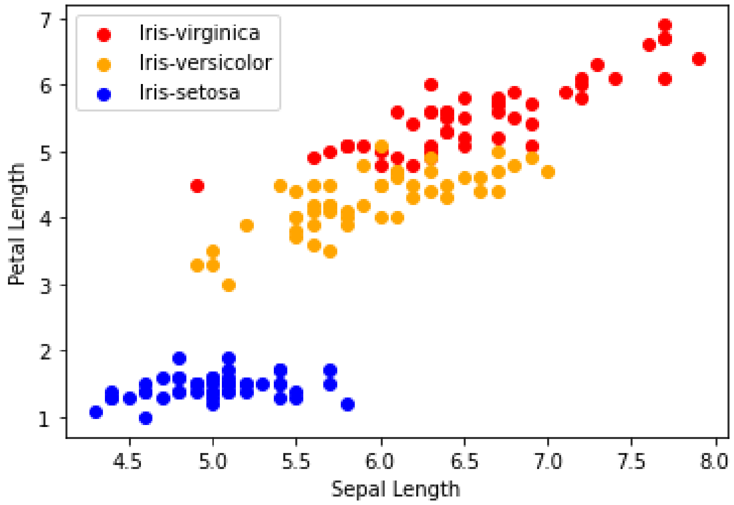


In [16]:

```
for i in range(3):
    x = df[df['Species'] == species[i]]
    plt.scatter(x['SepalLengthCm'], x['PetalLengthCm'], c = c
plt.xlabel("Sepal Length")
```

```python
plt.ylabel("Petal Length")
plt.legend()
```

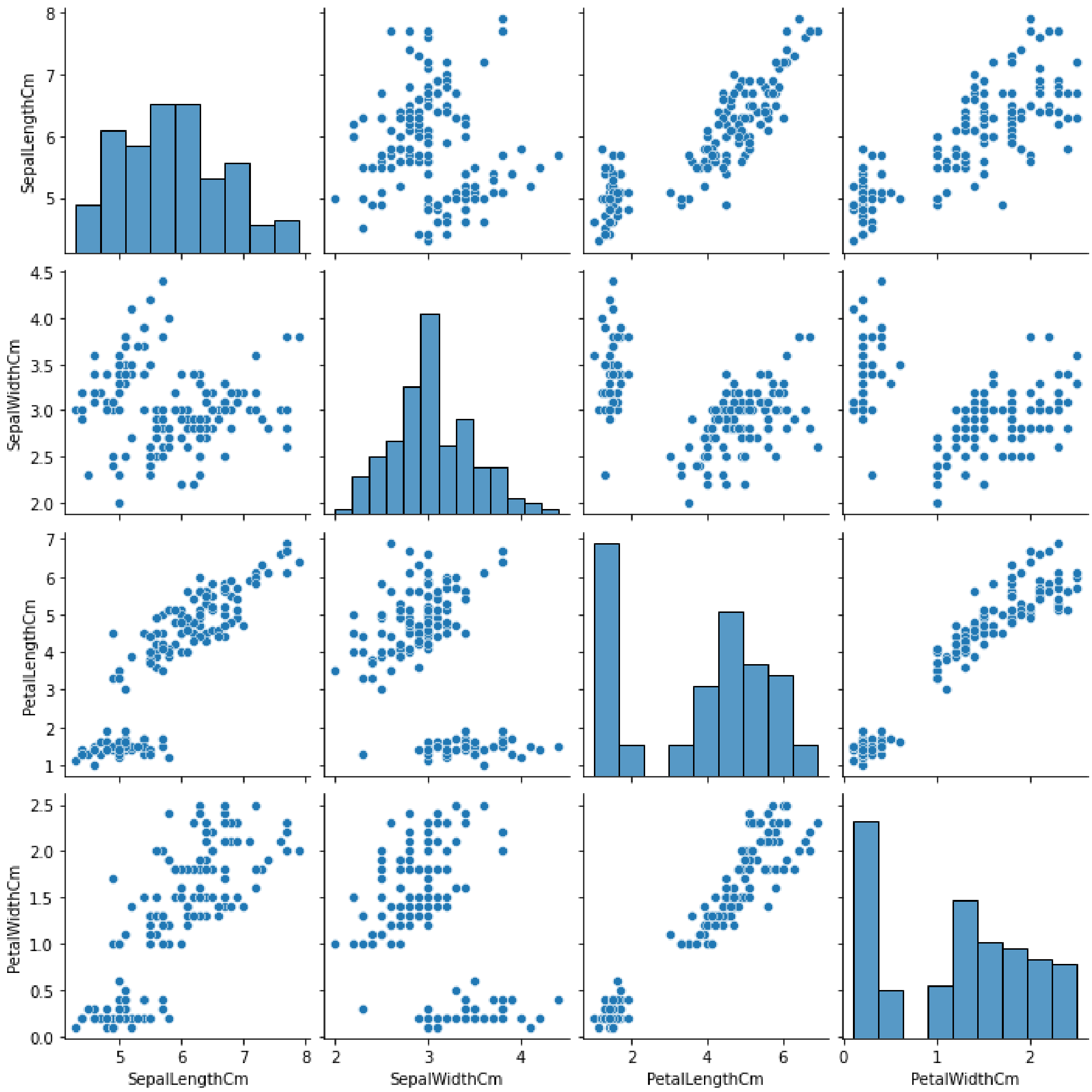
Out [16]: <matplotlib.legend.Legend at 0x7fdb85c805b0>



In [17]:

```python
sns.pairplot(df)
```

Out [17]: <seaborn.axisgrid.PairGrid at 0x7fdb85c03d30>



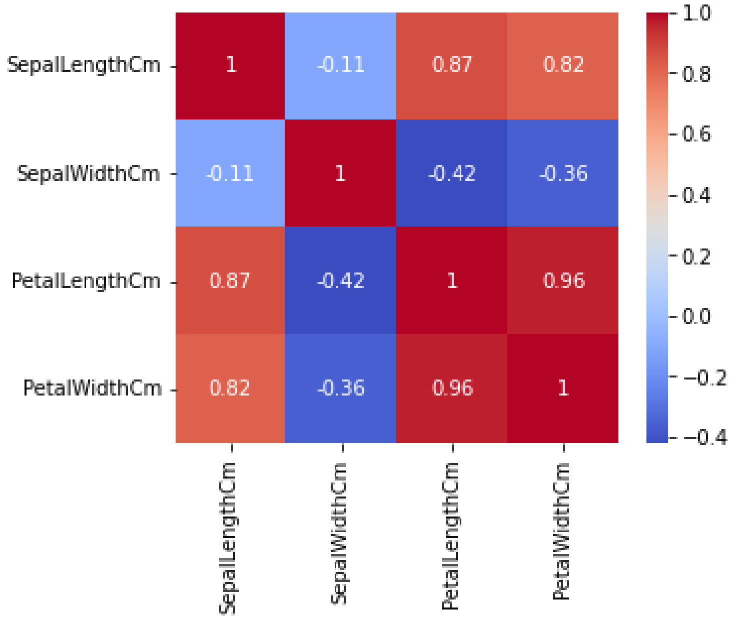
In [18]:
```python
df.corr()
```

Out [18]:

	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm
SepalLengthCm	1.000000	-0.109369	0.871754	0.817954
SepalWidthCm	-0.109369	1.000000	-0.420516	-0.356544
PetalLengthCm	0.871754	-0.420516	1.000000	0.962757
PetalWidthCm	0.817954	-0.356544	0.962757	1.000000

In [19]:
```python
corr = df.corr()
fig, ax = plt.subplots(figsize=(5,4))
sns.heatmap(corr, annot=True, ax=ax, cmap = 'coolwarm')
```

Out [19]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fdb85345820>
```



In [20]:
```python
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()
```

In [21]:
```python
df['Species'] = le.fit_transform(df['Species'])
df.head()
```

Out [21]:

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

In [33]:
```
X = df.iloc[:,:-1]
```

In [34]:
```
X
```

Out [34]:

	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm
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 × 4 columns

In [22]:
```
from sklearn.model_selection import train_test_split
# train - 70
# test - 30
X = df.drop(columns=['Species'])
Y = df['Species']
x_train, x_test, y_train, y_test = train_test_split(X, Y, tes
```

In [25]:
```
X
```

Out [25]:

	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm
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

	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm
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 × 4 columns

In [23]:
```
Y
```

Out [23]:
```
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: int64
```

In [35]:
```
gaussian = GaussianNB()
gaussian.fit(x_train, y_train)
Y_pred = gaussian.predict(x_test)
```

In [36]:
```

accuracy_nb=round(accuracy_score(y_test,Y_pred)* 100, 2)
acc_gaussian = round(gaussian.score(x_train, y_train) * 100,

cm = confusion_matrix(y_test, Y_pred)
accuracy = accuracy_score(y_test,Y_pred)
precision =precision_score(y_test, Y_pred,average='micro')
recall =  recall_score(y_test, Y_pred,average='micro')
f1 = f1_score(y_test,Y_pred,average='micro')
print('Confusion matrix for Naive Bayes\n',cm)
print('accuracy_Naive Bayes: %.3f' %accuracy)
print('precision_Naive Bayes: %.3f' %precision)
print('recall_Naive Bayes: %.3f' %recall)
print('f1-score_Naive Bayes : %.3f' %f1)
```

```
Confusion matrix for Naive Bayes
 [[15  0  0]
 [ 0 11  0]
 [ 0  2 17]]
accuracy_Naive Bayes: 0.956
precision_Naive Bayes: 0.956
recall_Naive Bayes: 0.956
f1-score_Naive Bayes : 0.956
```

In [ ]:
```

```

In [ ]:

```

```

In [ ]:

```

```