AIM:- For a given dataset (e.g. iris data set) D of size N×M with N:Number of samples and M: number of features, design a Bayesian classifier/ Support vector machine/ Decision tree to classify the test data. Divide the data set into training or testing data according to random percentage split. (assume the underlying distribution to Gaussian).

In 1
```
# Importing required libraries
import numpy as np
import pandas as pd
```
Executed at 2023.10.09 20:10:54 in 7ms

In 2
```
# Collecting iris dataset
df = pd.read_csv("..//Iris.csv")
# Display the first few rows of the dataset to inspect its structure and content.
print("First 5 rows of iris dataset are:-\n", df.head())
```
Executed at 2023.10.09 20:10:55 in 66ms

```
First 5 rows of iris dataset are:-
    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 3
```
# Check the dimensions of the dataset (number of rows and columns).
print("Dimension of the dataset: ", df.shape)
```
Executed at 2023.10.09 20:10:55 in 19ms

```
Dimension of the dataset:  (150, 5)
```

In 4
```
# Identify the data types of each column (numeric, categorical, text, etc.).
print("Data types of each column:\n", df.dtypes)
```
Executed at 2023.10.09 20:10:55 in 34ms

```
Data types of each column:
 SepalLengthCm    float64
SepalWidthCm     float64
PetalLengthCm    float64
PetalWidthCm     float64
Species           object
dtype: object
```

In 5
```
# Finding Unique categories of species column
print("Types of Species: ", df['Species'].unique())
```
Executed at 2023.10.09 20:10:55 in 45ms

```
Types of Species:  ['Iris-setosa' 'Iris-versicolor' 'Iris-virginica']
```

In 6
```
# Mapping Categorical column with float64 values
df['Species'] = df['Species'].map({'Iris-setosa': 0, 'Iris-versicolor': 1, 'Iris-virginica': 2})
```
Executed at 2023.10.09 20:10:55 in 156ms

In 7
```
# Features and target variable selection
features = df.drop('Species', axis='columns')
target = df.Species
```
Executed at 2023.10.09 20:10:55 in 202ms

In 8
```
features
```
Executed at 2023.10.09 20:10:55 in 253ms

Out 8

1-10 150 rows × 4 columns pd.DataFrame

	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
5	5.4	3.9	1.7	0.4
6	4.6	3.4	1.4	0.3

In 9
```
target
```
Executed at 2023.10.09 20:10:55 in 227ms

Out 9

1-10 Length: 150, dtype: int64 pd.Series

	Species
0	0
1	0
2	0
3	0
4	0
5	0
6	0

In 10
```
# Concatenating the Species column after map with features to get updated dataset
features = pd.concat([features,target], axis='columns')
features.head()
```
Executed at 2023.10.09 20:10:55 in 228ms

Out 10

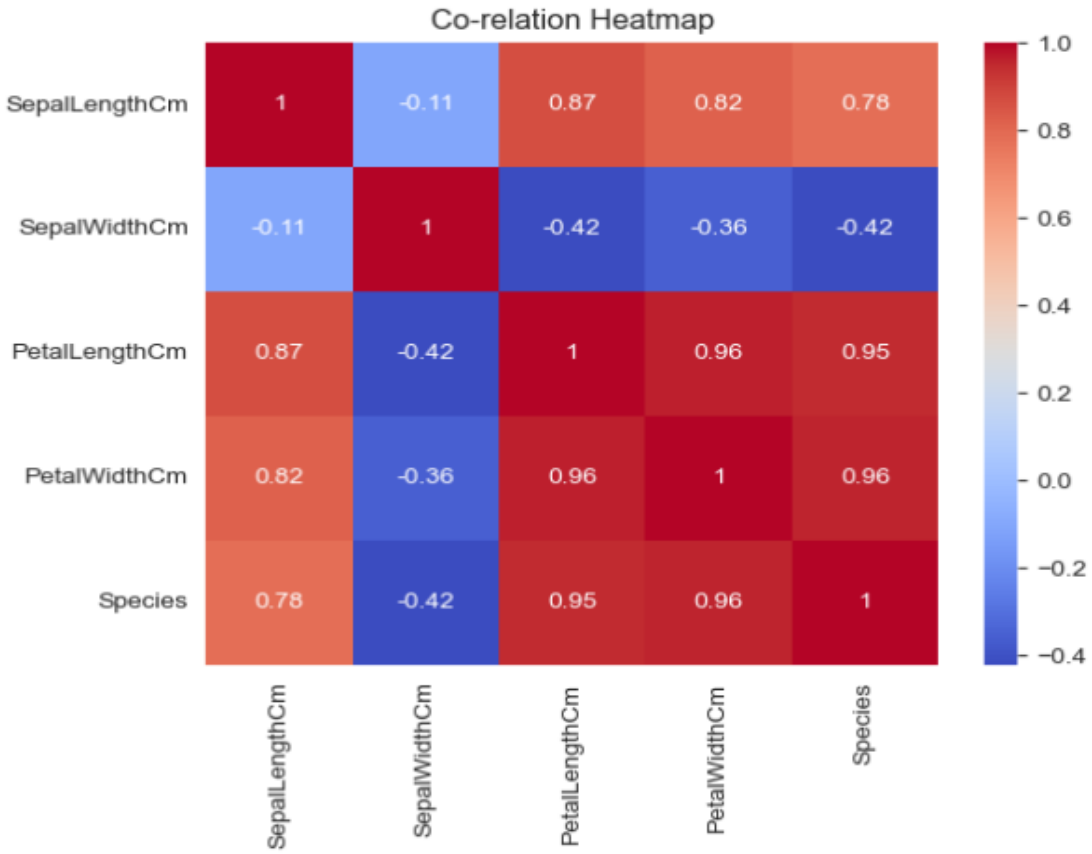
5 rows 5 rows × 5 columns pd.DataFrame

	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 11
```
# Checking for NaN values
features.columns[features.isna().any()]
```
Executed at 2023.10.09 20:10:55 in 205ms

Out 11
```
Index([], dtype='object')
```

In 12
```
# Plotting the Co-relation between different features
import seaborn as sns
import matplotlib.pyplot as plt
sns.heatmap(df.corr(), annot=True, cmap='coolwarm')
plt.title("Co-relation Heatmap")
plt.show()
```
Executed at 2023.10.09 20:10:55 in 766ms



In 13
```
from sklearn.model_selection import train_test_split
# Splitting the dataset(70% training, 30%testing)
X_train, X_test, y_train, y_test = train_test_split(features, target, test_size=0.3)
# Display the size of the training and testing sets
print(f'Training set size: {X_train.shape[0]} samples \nTest set size: {X_test.shape[0]} samples')
```
Executed at 2023.10.09 20:10:56 in 459ms

```
Training set size: 105 samples
Test set size: 45 samples
```

In 14
```
from sklearn.naive_bayes import GaussianNB
# Adding naive bayes to the model
model = GaussianNB()
```
Executed at 2023.10.09 20:10:56 in 14ms

In 15
```
# Training the model with .fit
model.fit(X_train, y_train)
```
Executed at 2023.10.09 20:10:56 in 83ms

Out 15
```
GaussianNB
GaussianNB()
```

In 16
```
# Mean accuracy score of the model
model.score(X_test, y_test)
```
Executed at 2023.10.09 20:10:56 in 74ms

Out 16
```
1.0
```

In 17
```
# Sample of feature_test set
X_test[0:10]
```
Executed at 2023.10.09 20:10:56 in 73ms

Out 17

10 rows × 5 columns pd.DataFrame

	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm	Species
120	6.9	3.2	5.7	2.3	2
33	5.5	4.2	1.4	0.2	0
57	4.9	2.4	3.3	1.0	1
102	7.1	3.0	5.9	2.1	2
119	6.0	2.2	5.0	1.5	2
126	6.2	2.8	4.8	1.8	2
69	5.6	2.5	3.9	1.1	1

In 18

```
# Sample of target_test set
y_test[0:10]
```

Executed at 2023.10.09 20:10:56 in 51ms

Out 18

10 rows Length: 10, dtype: int64 pd.Series

	Species
120	2
33	0
57	1
102	2
119	2
126	2
69	1

In 19

```
# Making prediction on the train model through feature_test set
y_predict = model.predict(X_test)
y_predict[0:10]
```

Executed at 2023.10.09 20:10:56 in 46ms

Out 19

10 rows × 1 columns np.ndarray

	0
0	2
1	0
2	1
3	2
4	2
5	2
6	1

In 20

```
# Probability of the prediction
y_probs = model.predict_proba(X_test)
y_probs[:10]
```

Executed at 2023.10.09 20:10:56 in 35ms

Out 20

10 rows × 3 columns np.ndarray

	0	1	2
3	0.0	0.0	1.0
4	0.0	0.0	1.0
5	0.0	0.0	1.0
6	0.0	1.0	0.0
7	0.0	0.0	1.0
8	0.0	1.0	0.0
9	0.0	1.0	0.0

In 21

```
from sklearn.model_selection import cross_val_score
# Calculate the score using cross validation
cross_val_score(GaussianNB(), X_train, y_train, cv=5)
```

Executed at 2023.10.09 20:10:56 in 175ms

Out 21

5 rows × 1 columns np.ndarray

	0
0	1.0
1	1.0
2	1.0
3	1.0
4	1.0

In 22

```
from sklearn.metrics import confusion_matrix
# Calculate the confusion matrix
conf_matrix = confusion_matrix(y_test, y_predict)
print("Confusion Matrix is:\n", conf_matrix)
```

Executed at 2023.10.09 20:10:56 in 131ms

```
Confusion Matrix is:
 [[12  0  0]
 [ 0 16  0]
 [ 0  0 17]]
```

In 23

```
# Create a DataFrame for the confusion matrix
df_cm = pd.DataFrame(conf_matrix, columns=np.unique(y_test), index=np.unique(y_test))
# Add title and labels
plt.title('Confusion Matrix Heatmap')
df_cm.index.name = 'Actual'
df_cm.columns.name = 'Predicted'
sns.heatmap(df_cm, annot=True, cmap='PiYG')
plt.show()
```

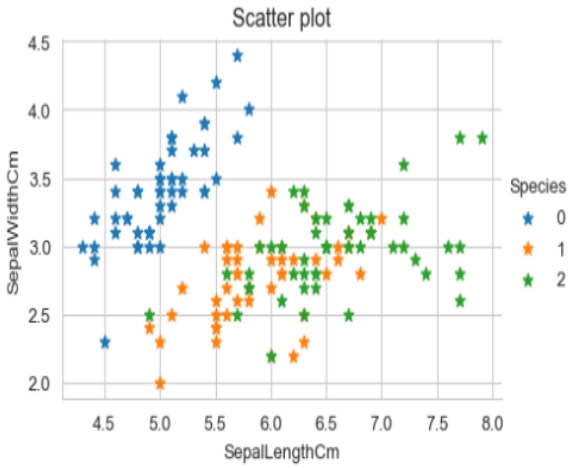
Executed at 2023.10.09 20:10:56 in 371ms

In 24

```
# Visualizing the relationship between two numerical columns with parameter Species to color datapoints uniquely.
sns.FacetGrid(df, hue="Species", aspect=1.5).map(plt.scatter, "SepalLengthCm", "SepalWidthCm", marker='*').add_legend()
plt.title('Scatter plot')
plt.show()
```

Executed at 2023.10.09 20:10:57 in 683ms

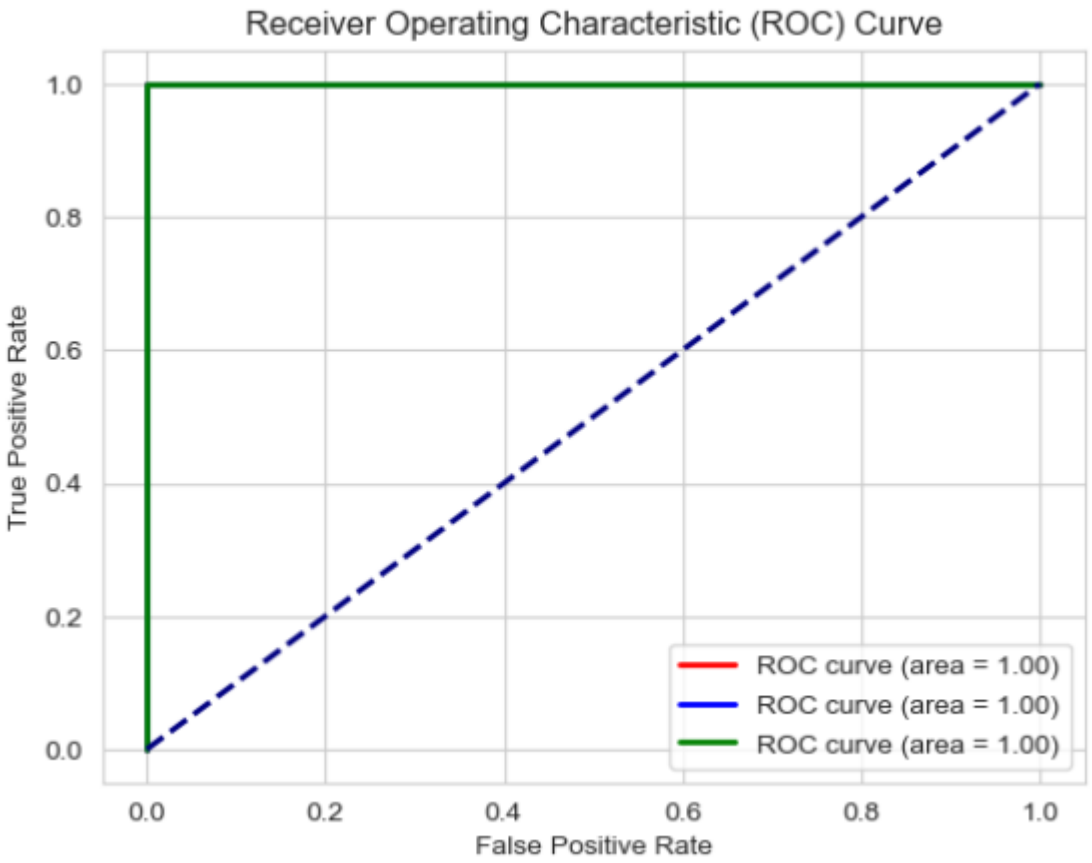
```
C:\Users\shank\anaconda3\Lib\site-packages\seaborn\axisgrid.py:118: UserWarning: The figure layout has changed to tight
  self._figure.tight_layout(*args, **kwargs)
```



In 25

```
from sklearn.metrics import roc_curve, auc
from sklearn.preprocessing import label_binarize

# Binarize the labels
y_test_bin = label_binarize(y_test, classes=np.unique(y_test))

# Compute ROC curve for each class
fpr = dict()
tpr = dict()
roc_auc = dict()
for i in range(len(np.unique(y_test))):
    fpr[i], tpr[i], _ = roc_curve(y_test_bin[:, i], y_probs[:, i])
    roc_auc[i] = auc(fpr[i], tpr[i])

# Plot ROC curve for each class
plt.figure()
colors = ['red', 'blue', 'green']
for i, color in zip(range(len(np.unique(y_test))), colors):
    plt.plot(fpr[i], tpr[i], color=color, lw=2, label='ROC curve (area = {:.2f})'.format(roc_auc[i]))

plt.plot([0, 1], [0, 1], color='navy', lw=2, linestyle='--')
plt.xlabel('False Positive Rate')
plt.ylabel('True Positive Rate')
plt.title('Receiver Operating Characteristic (ROC) Curve')
plt.legend(loc="lower right")
plt.show()
```

Executed at 2023.10.09 20:10:57 in 329ms



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