# Naive Bayes Classification

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## 1 Naive Bayes Classification

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[1]:
```
import pandas as pd
import seaborn as sns

from sklearn.preprocessing import LabelEncoder
from sklearn.naive_bayes import GaussianNB
from sklearn.model_selection import train_test_split
from sklearn.metrics import confusion_matrix, classification_report,␣
 ↪balanced_accuracy_score, accuracy_score
```

[2]:
```
file = "seeds_dataset.csv"
df = pd.read_csv(file, names = ["Area", "Perimeter", "Compactness", "Length of␣
 ↪kernel", "Width of kernel", "Asymmetry coefficient", "Length of kernel␣
 ↪groove", "Class"])
```

[3]:
```
df.head()
```

[3]:

| | Area | Perimeter | Compactness | Length of kernel | Width of kernel | \ |
|---|---|---|---|---|---|---|
| 0 | 15.26 | 14.84 | 0.8710 | 5.763 | 3.312 | |
| 1 | 14.88 | 14.57 | 0.8811 | 5.554 | 3.333 | |
| 2 | 14.29 | 14.09 | 0.9050 | 5.291 | 3.337 | |
| 3 | 13.84 | 13.94 | 0.8955 | 5.324 | 3.379 | |
| 4 | 16.14 | 14.99 | 0.9034 | 5.658 | 3.562 | |

| | Asymmetry coefficient | Length of kernel groove | Class |
|---|---|---|---|
| 0 | 2.221 | 5.220 | 1 |
| 1 | 1.018 | 4.956 | 1 |
| 2 | 2.699 | 4.825 | 1 |
| 3 | 2.259 | 4.805 | 1 |
| 4 | 1.355 | 5.175 | 1 |

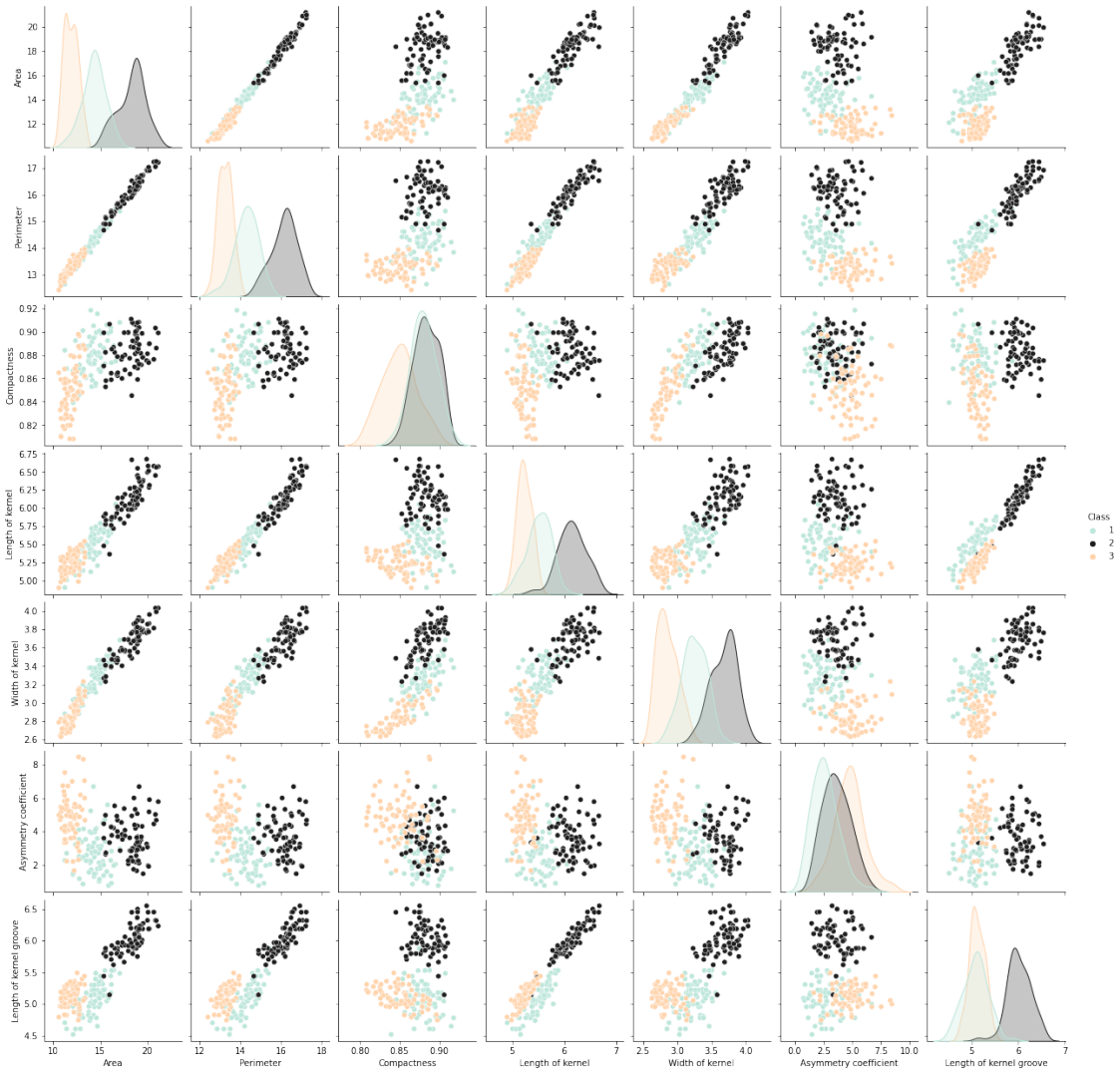
[4]:
```
df.describe()
```

[4]:
```
              Area   Perimeter  Compactness  Length of kernel  Width of kernel  \
count   210.000000  210.000000   210.000000        210.000000       210.000000
mean     14.847524   14.559286     0.870999          5.628533         3.258605
std       2.909699    1.305959     0.023629          0.443063         0.377714
min      10.590000   12.410000     0.808100          4.899000         2.630000
25%      12.270000   13.450000     0.856900          5.262250         2.944000
50%      14.355000   14.320000     0.873450          5.523500         3.237000
75%      17.305000   15.715000     0.887775          5.979750         3.561750
max      21.180000   17.250000     0.918300          6.675000         4.033000

       Asymmetry coefficient  Length of kernel groove       Class
count             210.000000               210.000000  210.000000
mean                3.700201                 5.408071    2.000000
std                 1.503557                 0.491480    0.818448
min                 0.765100                 4.519000    1.000000
25%                 2.561500                 5.045000    1.000000
50%                 3.599000                 5.223000    2.000000
75%                 4.768750                 5.877000    3.000000
max                 8.456000                 6.550000    3.000000
```

[5]:
```
sns.pairplot(df, hue='Class', palette='icefire')
```

[5]:
```
<seaborn.axisgrid.PairGrid at 0x7ff4453c2190>
```




[6]:
```
df["Class"].value_counts()
```

[6]:
```
3    70
2    70
1    70
Name: Class, dtype: int64
```

[7]:
```
X = df.iloc[:, :-1]
y = df.iloc[:, -1]
```

[8]:
```
x_train, x_test, y_train, y_test = train_test_split(X, y, test_size = 0.25,␣
↪random_state = 0)
```

[9]:
```
gnb = GaussianNB()
gnb.fit(x_train, y_train)
```

[9]:
```
GaussianNB()
```

[10]:
```
y_pred = gnb.predict(x_test)
```

[11]:
```
print(confusion_matrix(y_test, y_pred))
```

```
[[16  1  0]
 [ 5 16  0]
 [ 0  0 15]]
```

[12]:
```
print(classification_report(y_test, y_pred))
```

```
              precision    recall  f1-score   support

           1       0.76      0.94      0.84        17
           2       0.94      0.76      0.84        21
           3       1.00      1.00      1.00        15

    accuracy                           0.89        53
   macro avg       0.90      0.90      0.89        53
weighted avg       0.90      0.89      0.89        53
```

[13]:
```
acc = round(accuracy_score(y_test, y_pred) * 100, 2)
print("Accuracy Score:", acc, "%")
```

```
Accuracy Score: 88.68 %
```

[14]:
```
bas = round(balanced_accuracy_score(y_test, y_pred) * 100, 2)
print("Balanced Accuracy Score:", bas, "%")
```

```
Balanced Accuracy Score: 90.1 %
```