Machine Learning Assignment – 2

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1. Pandas

    1. Read the provided CSV file 'data.csv'. https://drive.google.com/drive/folders/1h8C3mLsso-R-sIOLsvoYwPLzy2fJ4IOF?usp=sharing

In [3]:
```
import pandas as pd
import numpy as np
import random as rnd

import warnings # current version generates a bunch of warnings that we'll ignore
warnings.filterwarnings("ignore")

# visualization
import seaborn as sns
import matplotlib.pyplot as plt

# machine learning
from sklearn.linear_model import LogisticRegression, RidgeClassifierCV
from sklearn.svm import SVC, LinearSVC
from sklearn.ensemble import (RandomForestClassifier, GradientBoostingClassifier)
from sklearn.neighbors import KNeighborsClassifier
from sklearn.naive_bayes import GaussianNB
from sklearn.linear_model import Perceptron
from sklearn.linear_model import SGDClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn.model_selection import cross_val_score, GridSearchCV
from sklearn.metrics import accuracy_score
from sklearn import preprocessing
```

- Read the provided CSV file

1 Pandas

In [4]:
```
#1. Read the provided CSV file 'data.csv'.

data = pd.read_csv("C:\\Users\\rnare\\Downloads\\data.csv")
data.head()
```

Out[4]:

	Duration	Pulse	Maxpulse	Calories
0	60	110	130	409.1
1	60	117	145	479.0
2	60	103	135	340.0
3	45	109	175	282.4
4	45	117	148	406.0

Github Link: https://github.com/AkhilPatlori/MachineLearningAssignment2

2. Show the basic statistical description about the data.

```
In [5]: # 2. Show the basic statistical description about the data.

        data.describe()
```

Out[5]:

	Duration	Pulse	Maxpulse	Calories
count	169.000000	169.000000	169.000000	164.000000
mean	63.846154	107.461538	134.047337	375.790244
std	42.299949	14.510259	16.450434	266.379919
min	15.000000	80.000000	100.000000	50.300000
25%	45.000000	100.000000	124.000000	250.925000
50%	60.000000	105.000000	131.000000	318.600000
75%	60.000000	111.000000	141.000000	387.600000
max	300.000000	159.000000	184.000000	1860.400000

3. Check if the data has null values. a. Replace the null values with the mean

```
In [6]: # 3.Check if the data has null values

        df = pd.DataFrame(data)

        print(df.isnull().sum())
```

```
Duration    0
Pulse       0
Maxpulse    0
Calories    5
dtype: int64
```

In [27]:
```
# 3a.  Replace the null values with the mean

mean_value=df['Calories'].mean()
df['Calories'].fillna(value=mean_value,inplace=True)
df
```

Out[27]:

	Duration	Pulse	Calories
0	60	110	409
1	60	117	479
2	60	103	340
3	45	109	282
4	45	117	406
...	...	...	...
164	60	105	290
165	60	110	300
166	60	115	310
167	75	120	320
168	75	125	330

169 rows × 3 columns

4. Select at least two columns and aggregate the data using: min, max, count, mean.

In [8]:
```
# 4.Select at least two columns and aggregate the data using: min, max, count, mean.

agg_data = df[['Pulse','Maxpulse']].agg(['min','max','count','mean'])

print(agg_data)
```

```
            Pulse    Maxpulse
min     80.000000  100.000000
max    159.000000  184.000000
count  169.000000  169.000000
mean   107.461538  134.047337
```

5. Filter the dataframe to select the rows with calories values between 500 and1000.

```
In [9]: # 5.Filter the dataframe to select the rows with calories values between 500 and 1000.
        df[(df['Calories'] >= 500) & (df['Calories'] <= 1000)]
```

Out[9]:

	Duration	Pulse	Maxpulse	Calories
51	80	123	146	643.1
62	160	109	135	853.0
65	180	90	130	800.4
66	150	105	135	873.4
67	150	107	130	816.0
72	90	100	127	700.0
73	150	97	127	953.2
75	90	98	125	563.2
78	120	100	130	500.4
83	120	100	130	500.0
90	180	101	127	600.1
99	90	93	124	604.1
101	90	90	110	500.0
102	90	90	100	500.0
103	90	90	100	500.4
106	180	90	120	800.3
108	90	90	120	500.3

6. Filter the dataframe to select the rows with calories values > 500 and pulse <100

```
In [10]: # 6. Filter the dataframe to select the rows with calories values > 500 and pulse < 100.
         df[(df['Calories']>500) & (df['Pulse']<100)]
```

Out[10]:

	Duration	Pulse	Maxpulse	Calories
65	180	90	130	800.4
70	150	97	129	1115.0
73	150	97	127	953.2
75	90	98	125	563.2
99	90	93	124	604.1
103	90	90	100	500.4
106	180	90	120	800.3
108	90	90	120	500.3

7. Create a new “df_modified” dataframe that contains all the columns from df except for “Maxpulse”.

```
In [11]: # 7. Create a new "df_modified" dataframe that contains all the columns from df except for "Maxpulse".

df_modified= df.drop("Maxpulse",axis=1)
df_modified
```

Out[11]:

	Duration	Pulse	Calories
0	60	110	409.1
1	60	117	479.0
2	60	103	340.0
3	45	109	282.4
4	45	117	406.0
...	...	...	...
164	60	105	290.8
165	60	110	300.0
166	60	115	310.2
167	75	120	320.4
168	75	125	330.4

169 rows × 3 columns

8. Delete the “Maxpulse” column from the main df dataframe

```
In [12]: # 8. Delete the "Maxpulse" column from the main df dataframe
df= df.drop("Maxpulse",axis=1)
df
```

Out[12]:

	Duration	Pulse	Calories
0	60	110	409.1
1	60	117	479.0
2	60	103	340.0
3	45	109	282.4
4	45	117	406.0
...	...	...	...
164	60	105	290.8
165	60	110	300.0
166	60	115	310.2
167	75	120	320.4
168	75	125	330.4

169 rows × 3 columns

9. Convert the datatype of Calories column to int datatype.

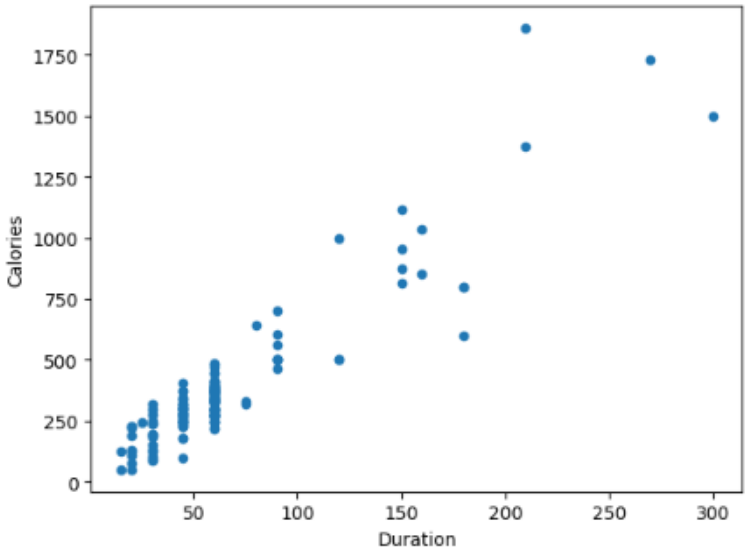
```
In [13]: # 9. Convert the datatype of Calories column to int datatype.

df['Calories'] = df['Calories'].astype(int)
df.dtypes
```

```
Out[13]: Duration    int64
         Pulse       int64
         Calories    int32
         dtype: object
```

10. Using pandas create a scatter plot for the two columns (Duration and Calories).

```
In [14]: # 10. Using pandas create a scatter plot for the two columns (Duration and Calories).
         df.plot.scatter( x = 'Duration', y = 'Calories')
```

```
Out[14]: <Axes: xlabel='Duration', ylabel='Calories'>
```



2. Scikit-learn

1. Implement Naïve Bayes method using scikit-learnlibrary.

   a. Use the glass dataset available in Link also provided in your assignment.

   b. Use train_test_split to create training and testing part.

2. Evaluate the model on testing part using score and classification_report(y_true, y_pred)

2 Glass Dataset

In [15]:
```
from sklearn.metrics import confusion_matrix
from sklearn.metrics import classification_report
from sklearn.model_selection import train_test_split
```

In [16]:
```
# 1. Implement Naïve Bayes method using scikit-learn library.

glass = pd.read_csv("C:\\Users\\rnare\\Downloads\\glass.csv")
glass.head()
```

Out[16]:

	RI	Na	Mg	Al	Si	K	Ca	Ba	Fe	Type
0	1.52101	13.64	4.49	1.10	71.78	0.06	8.75	0.0	0.0	1
1	1.51761	13.89	3.60	1.36	72.73	0.48	7.83	0.0	0.0	1
2	1.51618	13.53	3.55	1.54	72.99	0.39	7.78	0.0	0.0	1
3	1.51766	13.21	3.69	1.29	72.61	0.57	8.22	0.0	0.0	1
4	1.51742	13.27	3.62	1.24	73.08	0.55	8.07	0.0	0.0	1

In [17]:
```
glass.corr().style.background_gradient(cmap="Greens")

# cmap indicates the correlation matrix for the coulmns in dataset
```

Out[17]:

	RI	Na	Mg	Al	Si	K	Ca	Ba	Fe	Type
RI	1.000000	-0.191885	-0.122274	-0.407326	-0.542052	-0.289833	0.810403	-0.000386	0.143010	-0.164237
Na	-0.191885	1.000000	-0.273732	0.156794	-0.069809	-0.266087	-0.275442	0.326603	-0.241346	0.502898
Mg	-0.122274	-0.273732	1.000000	-0.481799	-0.165927	0.005396	-0.443750	-0.492262	0.083060	-0.744993
Al	-0.407326	0.156794	-0.481799	1.000000	-0.005524	0.325958	-0.259592	0.479404	-0.074402	0.598829
Si	-0.542052	-0.069809	-0.165927	-0.005524	1.000000	-0.193331	-0.208732	-0.102151	-0.094201	0.151565
K	-0.289833	-0.266087	0.005396	0.325958	-0.193331	1.000000	-0.317836	-0.042618	-0.007719	-0.010054
Ca	0.810403	-0.275442	-0.443750	-0.259592	-0.208732	-0.317836	1.000000	-0.112841	0.124968	0.000952
Ba	-0.000386	0.326603	-0.492262	0.479404	-0.102151	-0.042618	-0.112841	1.000000	-0.058692	0.575161
Fe	0.143010	-0.241346	0.083060	-0.074402	-0.094201	-0.007719	0.124968	-0.058692	1.000000	-0.188278
Type	-0.164237	0.502898	-0.744993	0.598829	0.151565	-0.010054	0.000952	0.575161	-0.188278	1.000000

In [18]:
```
x=glass.iloc[:,:-1].values
y=glass['Type'].values
```

In [19]:
```
# 1b. Use train_test_split to create training and testing part.
from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size = 0.30, random_state = 0)
```

In [20]:

```
# Evaluating the model on testing part using score and
# 1. Gaussian Naive Bayes
from sklearn.naive_bayes import GaussianNB
classifier = GaussianNB()
classifier.fit(x_train, y_train)

y_pred = classifier.predict(x_test)

# Summary of the predictions made by the classifier
print("Classification Report:")
print(classification_report(y_test, y_pred))
# Accuracy score
from sklearn.metrics import accuracy_score
print('accuracy is',accuracy_score(y_pred,y_test))

# GaussianNB()- function creates an instance of the Gaussian Naive Bayes classifier,
# fit()- train the classifier on x_train and y_train data
# predict() -predicts the x_test data and stores in y_pred
# classification_report()- generate a summary of the predictions made by the classifier, including precision, recall, and F1-
# confusion_matrix() generates a confusion matrix that summarizes the number of TP, FP, TN, FN for each class
# accuracy_score()- accuracy of the classifier by comparing the predicted values y_pred with true values y_test
```

```
Classification Report:
              precision    recall  f1-score   support

           1       0.39      0.86      0.54        21
           2       0.50      0.12      0.19        26
           3       0.00      0.00      0.00         7
           5       0.00      0.00      0.00         2
           6       0.67      1.00      0.80         2
           7       0.88      1.00      0.93         7

    accuracy                           0.46        65
   macro avg       0.41      0.50      0.41        65
weighted avg       0.44      0.46      0.37        65

accuracy is 0.46153846153846156
```

1. Implement linear SVM method using scikit library

    a. Use the glass dataset available in Link also provided in your assignment.

    b. Use train_test_split to create training and testing part.

2. Evaluate the model on testing part using score and classification_report(y_true, y_pred)

In [21]:

```
#Multi nomial NaiveBayes and GaussianNaiveBayes gives accurate values in Naive Bayes
```

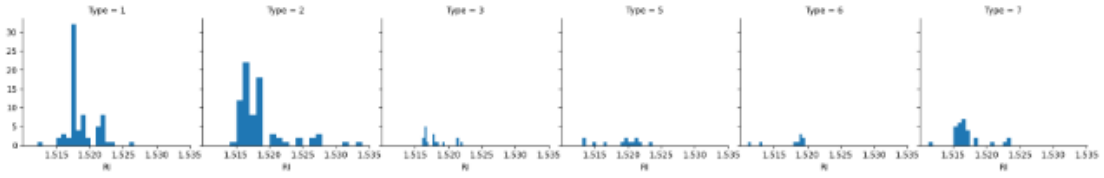
In [22]:

```
#1. Implement Linear SVM method using scikit library
#       a. Use the glass dataset available
# Support Vector Machine's
from sklearn.svm import SVC, LinearSVC

classifier = LinearSVC()
classifier.fit(x_train, y_train)

y_pred = classifier.predict(x_test)

# Summary of the predictions made by the classifier
print("Classification Report:")
print(classification_report(y_test, y_pred))
# Accuracy score
from sklearn.metrics import accuracy_score
print('accuracy is',accuracy_score(y_pred,y_test))

# LinerSVC()- Linear support vector classifier
```

```
Classification Report:
              precision    recall  f1-score   support

           1       0.00      0.00      0.00        21
           2       0.42      0.96      0.59        26
           3       0.00      0.00      0.00         7
           5       0.00      0.00      0.00         2
           6       0.00      0.00      0.00         2
           7       1.00      0.71      0.83         7

    accuracy                           0.46        65
   macro avg       0.24      0.28      0.24        65
weighted avg       0.28      0.46      0.33        65

accuracy is 0.46153846153846156
```

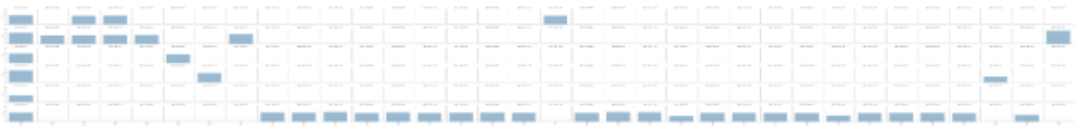
In [23]:
```
# Do at least two visualizations to describe or show correlations in the Glass Dataset
g = sns.FacetGrid(glass, col='Type')
g.map(plt.hist,'RI',bins=20)

# Creates a FaceGrid based on glass DataFrame, specifies that grid should be divided into columns based on 'Type'
# plots a histogram on each grid cell showing the distribution of 'RI' variable within each 'Type' group and 20 bins are use
```

Out[23]: <seaborn.axisgrid.FacetGrid at 0x17bd6b08050>



In [24]:
```
grid = sns.FacetGrid(glass, row='Type',col='Ba',height=2.2,aspect=1.6)
grid.map(sns.barplot,'Al','Ca',alpha=.5,ci=None)
grid.add_legend()
```

Out[24]: <seaborn.axisgrid.FacetGrid at 0x17bd3b9dc10>



In [25]:
```
#Which algorithm you got better accuracy? Can you justify why?
Gaussian Naive Bayes algorithm gives better accuracy than other algorithms. This is used when features are not discrete.
```

In [ ]: