Spring 2023: CS5710 – Machine Learning

In-Class Programming Assignment-4

GitHub Link - https://github.com/raimukul/MachineLearning_Assignments

Video link-
https://drive.google.com/file/d/12RFhEuUN1nxvux8EN39QYeSSReYUybeZ/view?usp=sharing

Code:

1. Pandas

1. Read the provided CSV file 'data.csv'.

https://drive.google.com/drive/folders/1h8C3mLsso-R-sIOLsvoYwPLzy2fJ4IOF?usp=sharing

2. Show the basic statistical description of the data.

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

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

5. Filter the data frame to select the rows with calories values between 500 and 1000.

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

7. Create a new "df_modified" data frame that contains all the columns from df except for "Maxpulse".

8. Delete the "Maxpulse" column from the main df dataframe

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

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

In [1]:

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


import pandas as pd

df = pd.read_csv('/content/drive/MyDrive/Colab Notebooks/data/data.csv')
```

In [17]:

```
print(df)
```

```
     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
..        ...    ...       ...       ...
164        60    105       140     290.8
165        60    110       145     300.0
166        60    115       145     310.2
167        75    120       150     320.4
168        75    125       150     330.4

[169 rows x 4 columns]
```

In [2]:

```
df = pd.DataFrame(df)
```

In [3]:

```
#Show the basic statistical description about the data.
df=df.describe()
df
```

Out[3]:

	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

	Duration	Pulse	Maxpulse	Calories
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

In [4]:

```
#Check if the data has null values.
df = pd.read_csv('/content/drive/MyDrive/Colab Notebooks/data/data.csv')
df.isnull()
```

Out[4]:

	Duration	Pulse	Maxpulse	Calories
0	False	False	False	False
1	False	False	False	False
2	False	False	False	False
3	False	False	False	False
4	False	False	False	False
...	...	...	...	...
164	False	False	False	False
165	False	False	False	False

	Duration	Pulse	Maxpulse	Calories
166	False	False	False	False
167	False	False	False	False
168	False	False	False	False

169 rows × 4 columns

In [5]:

```
#checking is there any null value is there or not.
df.isnull().values.any()
```

Out[5]:

```
True
```

In [7]:

```
# a. Replace the null values with the mean
new_df=df.fillna(df.mean())
```

In [10]:

```
new_df.isnull().values.any()
```

Out[10]:

```
False
```

In [11]:

```
#4. Select at least two columns and aggregate the data using: min, max, count, mean
# by using groupby function with aggregation to get mean, min and max values
```

```python
result = df.groupby('Duration').agg({'Calories': ['mean', 'min', 'max']})


print("Mean, min, and max values are")

print(result)
```

```
Mean, min, and max values are
             Calories
                 mean     min     max
Duration
15          87.350000    50.5   124.2
20         151.600000    50.3   229.4
25         244.200000   244.2   244.2
30         192.125000    86.2   319.2
45         273.236364   100.7   406.0
60         339.675000   215.2   486.0
75         325.400000   320.4   330.4
80         643.100000   643.1   643.1
90         541.800000   466.4   700.0
120        666.833333   500.0  1000.1
150        939.400000   816.0  1115.0
160        943.700000   853.0  1034.4
180        733.600000   600.1   800.4
210       1618.200000  1376.0  1860.4
270       1729.000000  1729.0  1729.0
300       1500.200000  1500.2  1500.2
```

In [12]:

```python
#5. Filter the dataframe to select the rows with calories values between 500 and 1000.

df.query('Calories < 1000 and Calories > 500')
```

Out[12]:

	Duration	Pulse	Maxpulse	Calories
51	80	123	146	643.1
62	160	109	135	853.0
65	180	90	130	800.4

	Duration	Pulse	Maxpulse	Calories
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
90	180	101	127	600.1
99	90	93	124	604.1
103	90	90	100	500.4
106	180	90	120	800.3
108	90	90	120	500.3

In [13]:

```
# 6. Filter the dataframe to select the rows with calories values > 500
and pulse < 100
df.query('Calories > 500 and Pulse < 100')
```

Out[13]:

	Duration	Pulse	Maxpulse	Calories
65	180	90	130	800.4

	Duration	Pulse	Maxpulse	Calories
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

In [14]:

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

df_modified=df.drop(columns=["Maxpulse"])

df_modified
```

Out[14]:

	Duration	Pulse	Calories
0	60	110	409.1
1	60	117	479.0
2	60	103	340.0
3	45	109	282.4

	Duration	Pulse	Calories
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

In [17]:

```
# 8. Delete the “Maxpulse” column from the main df dataframe
df.drop(columns=["Maxpulse"], axis=1, inplace=True)
df
```

Out[17]:

	Duration	Pulse	Calories
0	60	110	409.1
1	60	117	479.0
2	60	103	340.0
3	45	109	282.4

	Duration	Pulse	Calories
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

In [22]:

```
#9. Convert the datatype of Calories column to int datatype.
df=df.fillna(df.mean())
df = df.astype({'Calories':'int'})

print(df.dtypes)
```

```
Duration    int64
Pulse       int64
Calories    int64
dtype: object
```

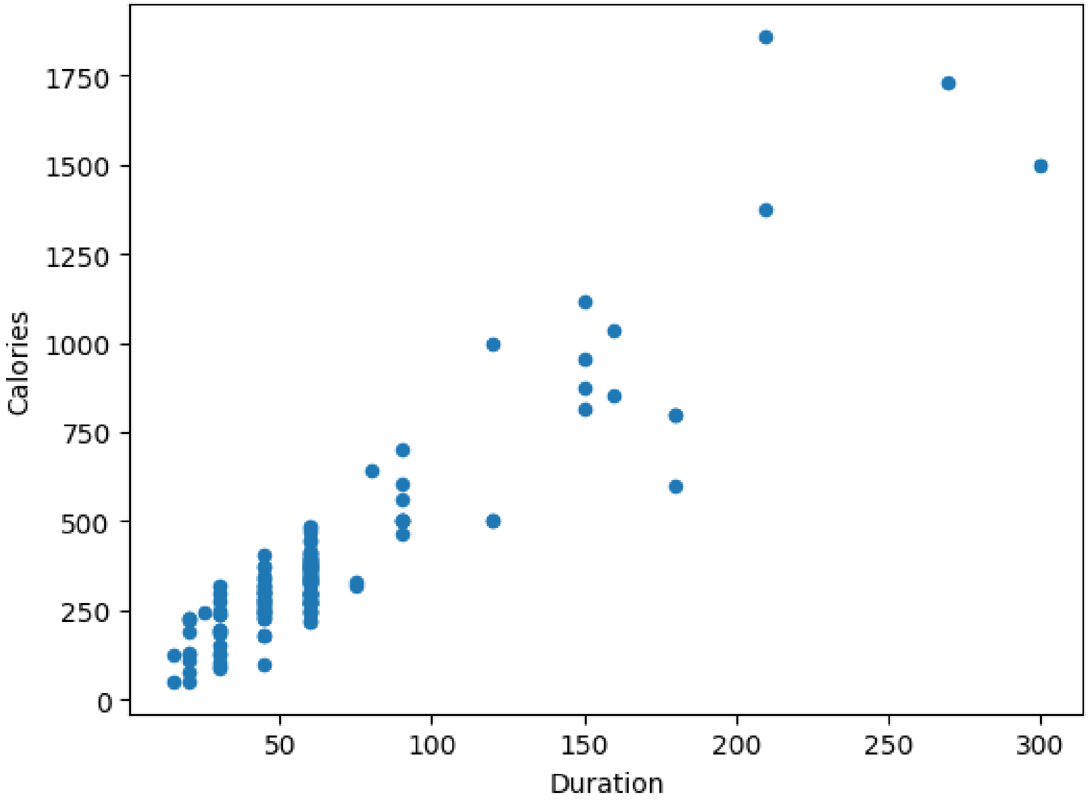
In [23]:

```
#Using pandas create a scatter plot for the two columns (Duration and
Calories).
df.plot(kind = 'scatter', x = 'Duration', y = 'Calories')
```

```
/usr/local/lib/python3.9/dist-packages/pandas/plotting/_matplotlib/core.py:11
14: UserWarning: No data for colormapping provided via 'c'. Parameters 'cmap'
will be ignored
  scatter = ax.scatter(
```

Out[23]:

```
<Axes: xlabel='Duration', ylabel='Calories'>
```



1. (Titanic Dataset)

1. Find the correlation between ‘survived’ (target column) and ‘sex’ column for the Titanic use case inclass.

a. Do you think we should keep this feature?

2. Do at least two visualizations to describe or show correlations.

3. Implement Naïve Bayes method using scikit-learn library and report the accuracy.

In [24]:

```
#import data
```

```
test_df = pd.read_csv("/content/drive/MyDrive/Colab
Notebooks/Dataset/test.csv")
```

```
train_df = pd.read_csv("/content/drive/MyDrive/Colab
Notebooks/Dataset/train.csv")
```

In [25]:

```
#Data ANalysis
train_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 891 entries, 0 to 890
Data columns (total 12 columns):
 #   Column       Non-Null Count  Dtype  
---  ------       --------------  -----  
 0   PassengerId  891 non-null    int64  
 1   Survived     891 non-null    int64  
 2   Pclass       891 non-null    int64  
 3   Name         891 non-null    object 
 4   Sex          891 non-null    object 
 5   Age          714 non-null    float64
 6   SibSp        891 non-null    int64  
 7   Parch        891 non-null    int64  
 8   Ticket       891 non-null    object 
 9   Fare         891 non-null    float64
 10  Cabin        204 non-null    object 
 11  Embarked     889 non-null    object 
dtypes: float64(2), int64(5), object(5)
memory usage: 83.7+ KB
```

In [26]:

```
train_df.describe()
```

Out[26]:

	PassengerId	Survived	Pclass	Age	SibSp	Parch	Fare
count	891.000000	891.000000	891.000000	714.000000	891.000000	891.000000	891.000000

	PassengerId	Survived	Pclass	Age	SibSp	Parch	Fare
mean	446.000000	0.383838	2.308642	29.699118	0.523008	0.381594	32.204208
std	257.353842	0.486592	0.836071	14.526497	1.102743	0.806057	49.693429
min	1.000000	0.000000	1.000000	0.420000	0.000000	0.000000	0.000000
25%	223.500000	0.000000	2.000000	20.125000	0.000000	0.000000	7.910400
50%	446.000000	0.000000	3.000000	28.000000	0.000000	0.000000	14.454200
75%	668.500000	1.000000	3.000000	38.000000	1.000000	0.000000	31.000000
max	891.000000	1.000000	3.000000	80.000000	8.000000	6.000000	512.329200

In [27]:

```
import seaborn as sns
%matplotlib inline
from matplotlib import pyplot as plt

survived = 'Survived'
not_survived = 'not survived'
fig, axes = plt.subplots(nrows=1, ncols=2,figsize=(10, 4))
women = train_df[train_df['Sex']=='female']
men = train_df[train_df['Sex']=='male']
ax = sns.distplot(women[women['Survived']==1].Age.dropna(), bins=18, label
= survived, ax = axes[0], kde =False)
ax = sns.distplot(women[women['Survived']==0].Age.dropna(), bins=40, label
= not_survived, ax = axes[0], kde =False)
ax.legend()
ax.set_title('Female')
ax = sns.distplot(men[men['Survived']==1].Age.dropna(), bins=18, label =
survived, ax = axes[1], kde = False)
```

```
ax = sns.distplot(men[men['Survived']==0].Age.dropna(), bins=40, label =
not_survived, ax = axes[1], kde = False)

ax.legend()

_ = ax.set_title('Male')
```

```
<ipython-input-27-0cf8acbfe0d6>:10: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  ax = sns.distplot(women[women['Survived']==1].Age.dropna(), bins=18, label
= survived, ax = axes[0], kde =False)
<ipython-input-27-0cf8acbfe0d6>:11: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

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  ax = sns.distplot(women[women['Survived']==0].Age.dropna(), bins=40, label
= not_survived, ax = axes[0], kde =False)
<ipython-input-27-0cf8acbfe0d6>:14: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

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similar flexibility) or `histplot` (an axes-level function for histograms).

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https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  ax = sns.distplot(men[men['Survived']==1].Age.dropna(), bins=18, label = su
rvived, ax = axes[1], kde = False)
<ipython-input-27-0cf8acbfe0d6>:15: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751
```
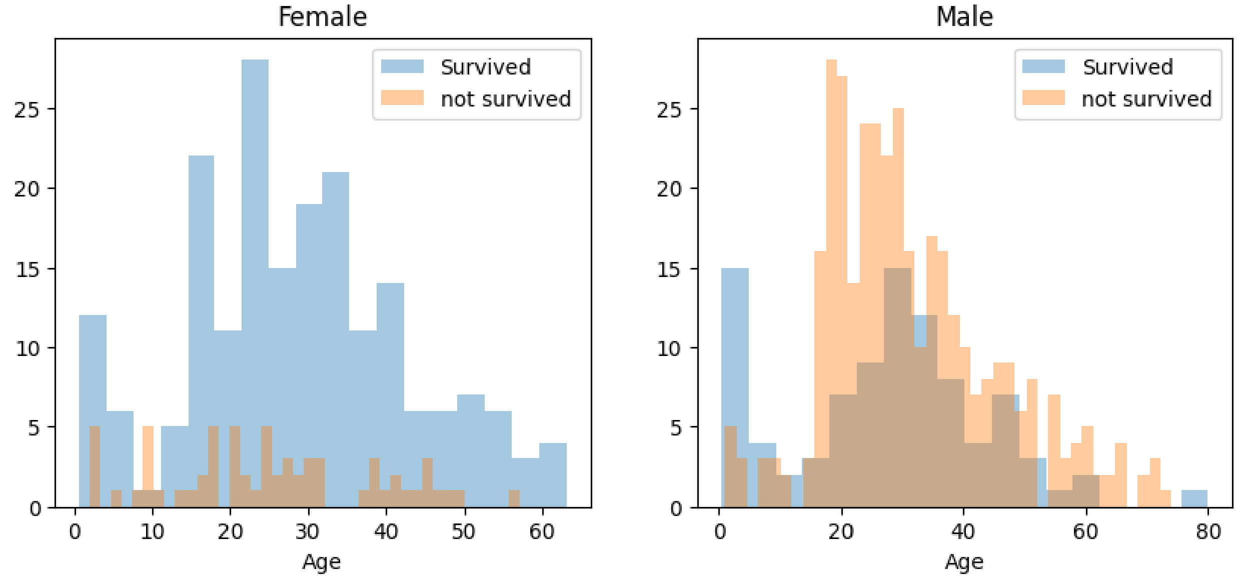
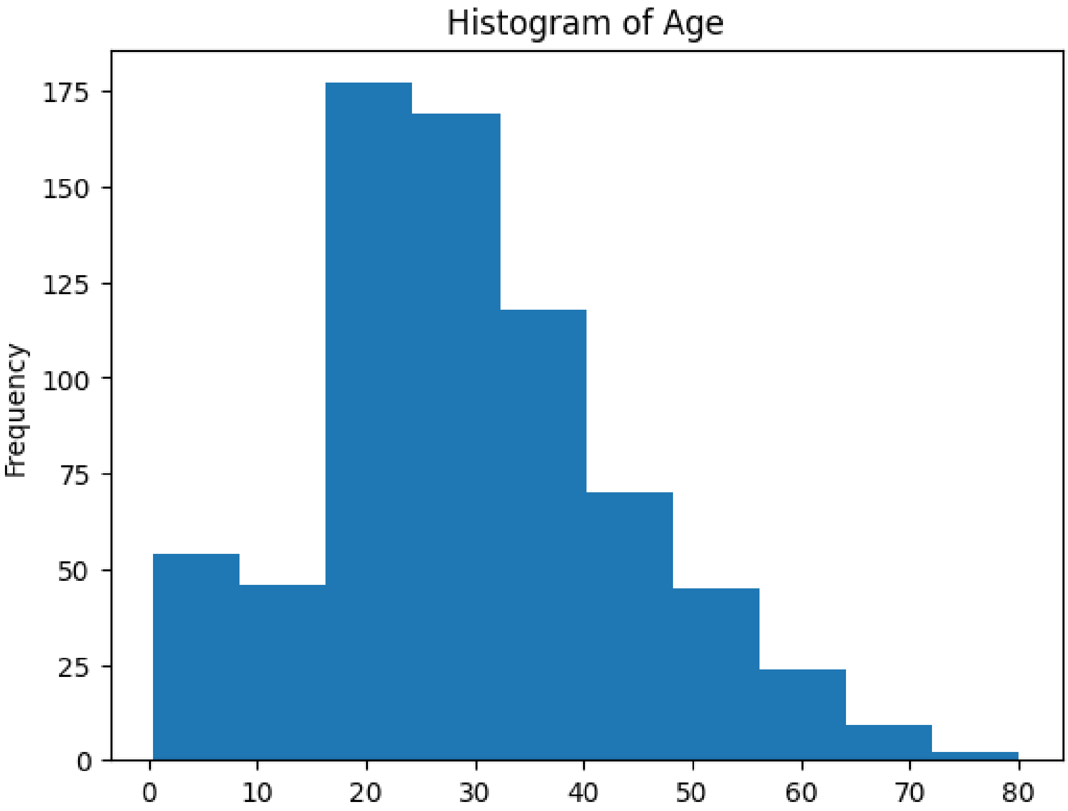

```
  ax = sns.distplot(men[men['Survived']==0].Age.dropna(), bins=40, label = no
t_survived, ax = axes[1], kde = False)
```



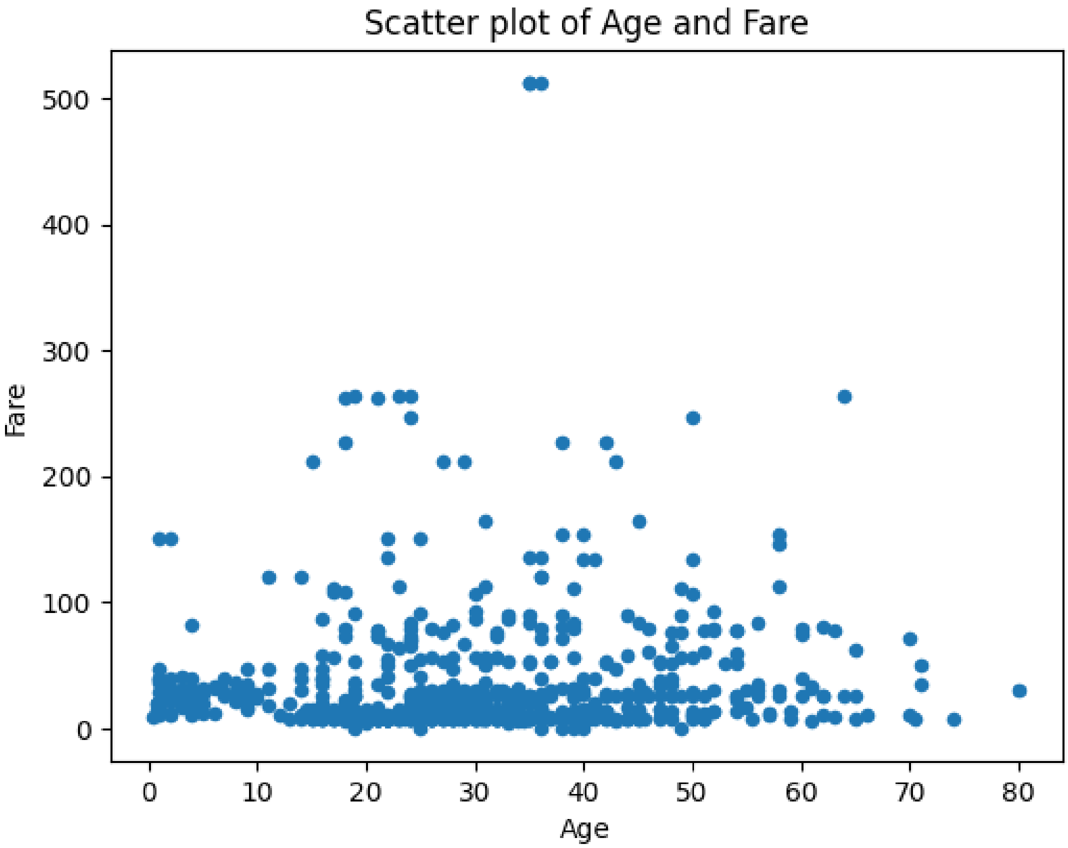
In [30]:

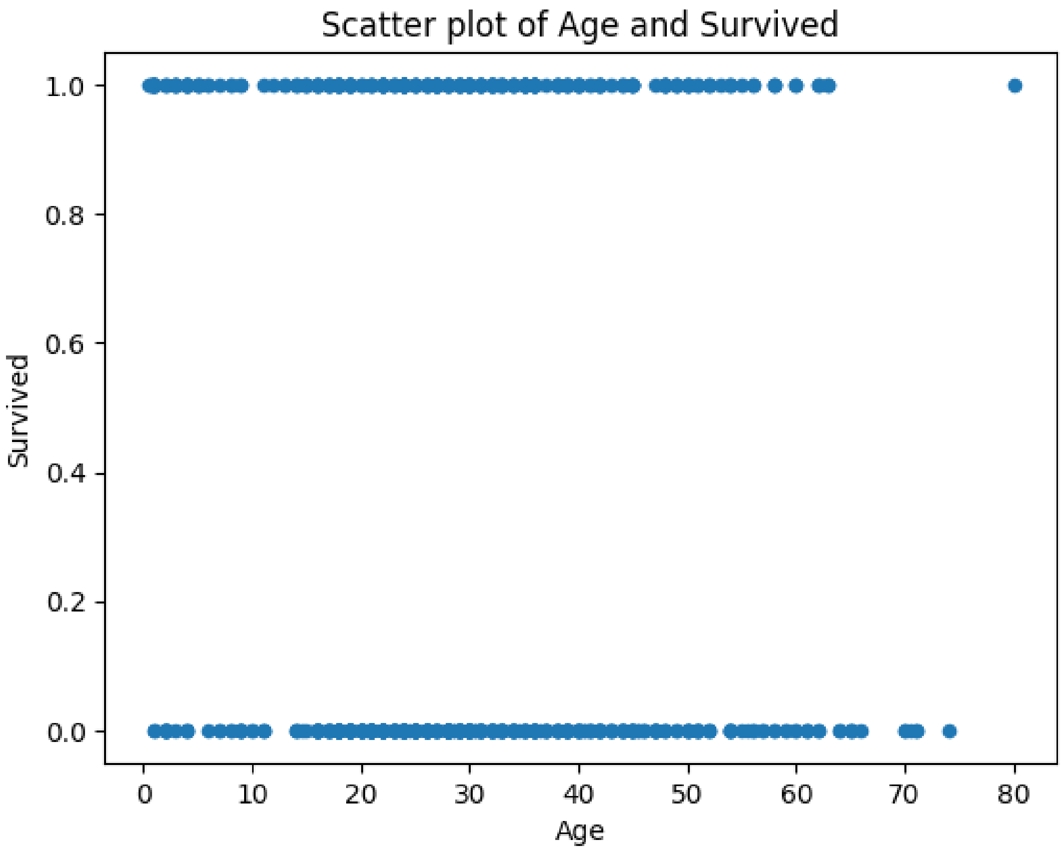
```
from matplotlib import pyplot as plt

import pandas as pd

import numpy as np

from sklearn.naive_bayes import GaussianNB

from sklearn.metrics import accuracy_score


train_data = pd.read_csv('/content/drive/MyDrive/Colab
Notebooks/Dataset/train.csv')

test_data = pd.read_csv('/content/drive/MyDrive/Colab
Notebooks/Dataset/test.csv')


# Find the correlation between Survived and Sex

corr =
train_data['Survived'].corr(train_data['Sex'].astype('category').cat.codes
)

print("Correlation between Survived and Sex: ",corr)
print('a. Do you think we should keep this feature?')

print('Yes, we should keep this feature as it has a correlation of', corr,
'with the target variable but some other features can be dropped as they
have very less correlation with the target variable.')


# Do at least two visualizations to describe the data

# Histogram of age

train_data['Age'].plot.hist(title='Histogram of Age')

plt.show()


# Scatter plot of age and fare

train_data.plot.scatter(x='Age', y='Fare', title='Scatter plot of Age and
Fare')

plt.show()


# Plot between age and survived

train_data.plot.scatter(x='Age', y='Survived', title='Scatter plot of Age
and Survived')

plt.show()
```

```
Correlation between Survived and Sex:  -0.5433513806577555
a. Do you think we should keep this feature?
Yes, we should keep this feature as it has a correlation of -0.54335138065775
55 with the target variable but some other features can be dropped as they ha
ve very less correlation with the target variable.
```



```
/usr/local/lib/python3.9/dist-packages/pandas/plotting/_matplotlib/core.py:11
14: UserWarning: No data for colormapping provided via 'c'. Parameters 'cmap'
will be ignored
  scatter = ax.scatter(
```


Scatter plot of Age and Fare
Fare
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
Age



2. (Glass Dataset)

1. Implement Naïve Bayes method using scikit-learn 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 Do at least two visualizations to describe or show correlations in the Glass Dataset.

In [32]:

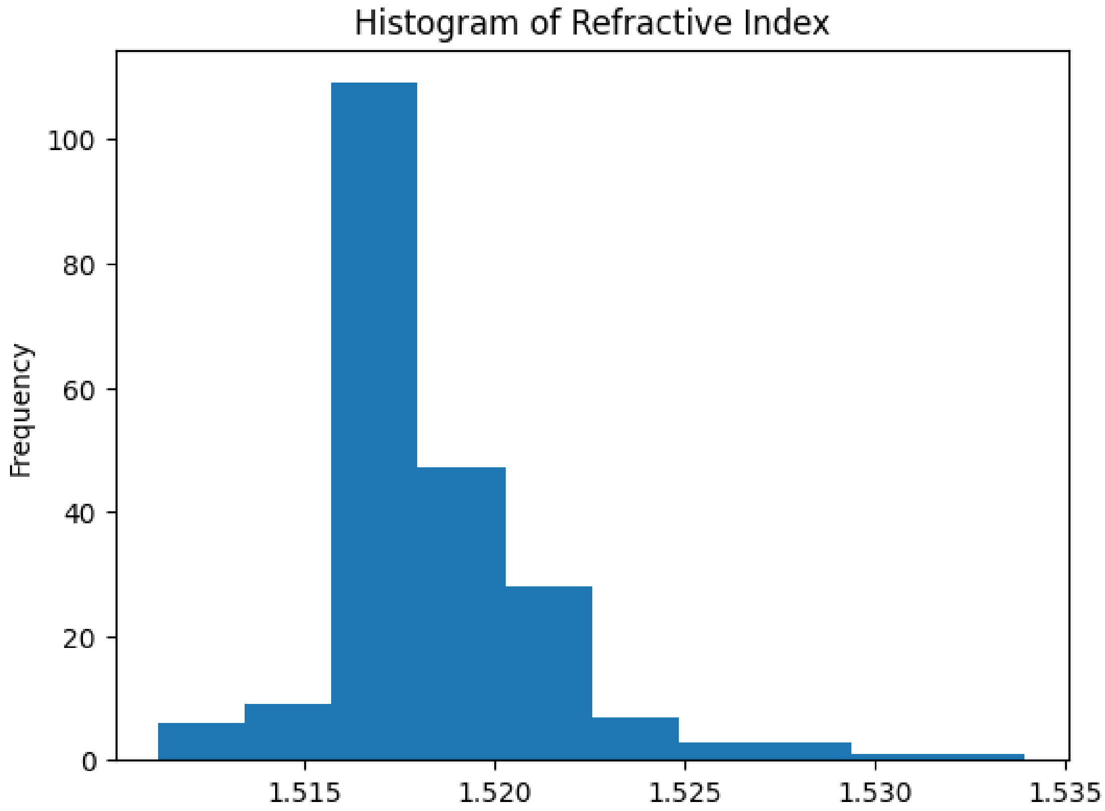
```
import pandas as pd

import numpy as np

import matplotlib.pyplot as plt

from sklearn.naive_bayes import GaussianNB

from sklearn.svm import SVC

from sklearn.model_selection import train_test_split

from sklearn.metrics import classification_report, accuracy_score

import warnings
```

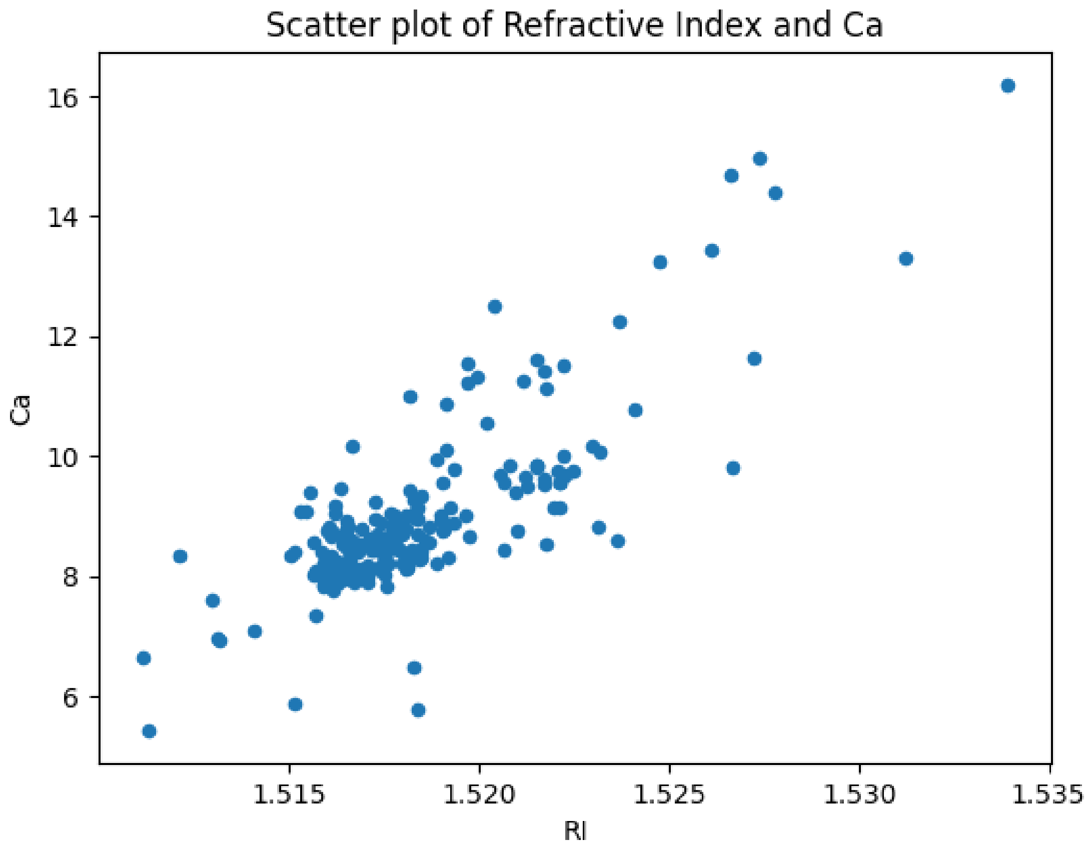
```
warnings.filterwarnings("ignore")


# a. read glass.csv file as a dataframe
glass_data = pd.read_csv('/content/drive/MyDrive/Colab Notebooks/Dataset/glass.csv')


# b. Use train_test_split to create training and testing part
# Split the data into training and testing data
X_train, X_test, y_train, y_test = train_test_split(glass_data.drop('Type', axis=1), glass_data['Type'], test_size=0.3, random_state=42)


# implement Naïve Bayes method using scikit-learn library and Evaluate the model on testing part using score and classification_report
# Create a Gaussian Classifier
model = GaussianNB()


# Train the model using the training sets
model.fit(X_train, y_train)


# Predict the response for test dataset
y_pred = model.predict(X_test)


# Calculate the accuracy of the model
print("Accuracy of the Naive Bayes model: ", accuracy_score(y_test, y_pred))


# Print classification report
print('Classification Report for Naive Bayes model: ')
print(classification_report(y_test, y_pred))
```

```
# Use SVM method using scikit-learn library and Evaluate the model on testing part using score and classification_report

# Create a SVM Classifier

model = SVC(kernel='linear')


# Train the model using the training sets

model.fit(X_train, y_train)


# Predict the response for test dataset

y_pred = model.predict(X_test)


# Calculate the accuracy of the model

print("Accuracy of the SVM model: ", accuracy_score(y_test, y_pred))


# Print classification report

print('Classification Report for SVM model: ')

print(classification_report(y_test, y_pred))



# Do at least two visualizations to describe or show correlations in the Glass Dataset

# Histogram of refractive index

glass_data['RI'].plot.hist(title='Histogram of Refractive Index')

plt.show()


# Scatter plot of refractive index and Ca

glass_data.plot.scatter(x='RI', y='Ca', title='Scatter plot of Refractive Index and Ca')

plt.show()


print('Which algorithm you got better accuracy? Can you justify why?')

# accuracy of Naive Bayes model:  0.3076923076923077
```

```python
# accuracy of SVM model:  0.676923076923077

print('SVM model has better accuracy than Naive Bayes model. This is
because SVM model tries to find the best possible decision boundary
between the data points of different classes. It tries to maximize the
margin between the decision boundary and the data points. On the other
hand, Naive Bayes model assumes that the features are independent of each
other and tries to find the probability of the data point belonging to a
particular class. Hence, SVM model has better accuracy than Naive Bayes
model.')
```

```
Accuracy of the Naive Bayes model:  0.3076923076923077
Classification Report for Naive Bayes model:
              precision    recall  f1-score   support

           1       0.00      0.00      0.00        19
           2       0.40      0.17      0.24        23
           3       0.08      0.75      0.15         4
           5       0.33      0.17      0.22         6
           6       0.75      1.00      0.86         3
           7       0.90      0.90      0.90        10

    accuracy                           0.31        65
   macro avg       0.41      0.50      0.40        65
weighted avg       0.35      0.31      0.29        65

Accuracy of the SVM model:  0.676923076923077
Classification Report for SVM model:
              precision    recall  f1-score   support

           1       0.65      0.79      0.71        19
           2       0.59      0.70      0.64        23
           3       0.00      0.00      0.00         4
           5       0.75      0.50      0.60         6
           6       0.50      0.33      0.40         3
           7       1.00      0.90      0.95        10

    accuracy                           0.68        65
   macro avg       0.58      0.54      0.55        65
weighted avg       0.65      0.68      0.65        65
```


Histogram of Refractive Index
Frequency
0
20
40
60
80
100
1.515
1.520
1.525
1.530
1.535



```
Which algorithm you got better accuracy? Can you justify why?
SVM model has better accuracy than Naive Bayes model. This is because SVM mod
el tries to find the best possible decision boundary between the data points
of different classes. It tries to maximize the margin between the decision bo
undary and the data points. On the other hand, Naive Bayes model assumes that
the features are independent of each other and tries to find the probability
of the data point belonging to a particular class. Hence, SVM model has bette
r accuracy than Naive Bayes model.
```