Data Analysis and Visualization Lab

Assignment 01

TASK 1: Basic DataFrame Operations

```
import pandas as p
```

I. Download a dataset of your choice (CSV, Excel, or any other format). And load the dataset into a Pandas DataFrame.

```
data = p.read_excel('data.xlsx', sheet_name="Sheet1")
```

II. Display the first 5 rows of the dataset.

```
data.head()
```

```
                Movies            Director                Actor  \
0  Kho Gaye Hum Kahan  Arjun Varain Singh  Sidhant Chaturvedi
1      Anyone But You          Will Gluck         Glen Powell
2    Cruel Intentions        Roger Kumble      Ryan Phillippe
3     It Ends With Us      Justin Baldoni      Justin Baldoni
4         The Voyeurs       Michael Mohan       Justice Smith

              Actress  Rating Censor  Year  Length
0      Ananya Pandey     8.0     No  2023   135.0
1     Sydney Sweeney     6.6     No  2024   113.0
2  Reese Witherspoon     6.8    Yes  1999    97.0
3       Blake Lively     NaN     No  2024     NaN
4     Sydney Sweeney     6.1    Yes  2021   116.0
```

II. Check for missing values and handle them appropriately.

```
data.isnull().sum()
```

```
Movies      0
Director    0
Actor       0
Actress     0
Rating      1
Censor      0
Year        0
Length      1
dtype: int64
```

```
data['Length'].fillna(data['Length'].mean(), inplace=True)
data['Rating'].fillna(data['Rating'].mean(), inplace=True)
data
```

```
               Movies            Director               Actor  \
0  Kho Gaye Hum Kahan  Arjun Varain Singh  Sidhant Chaturvedi
1      Anyone But You          Will Gluck         Glen Powell
2    Cruel Intentions        Roger Kumble      Ryan Phillippe
3     It Ends With Us      Justin Baldoni      Justin Baldoni
4         The Voyeurs       Michael Mohan       Justice Smith
5           Body Heat     Lawrence Kasdan        William Hurt

             Actress  Rating Censor  Year  Length
0      Ananya Pandey    8.00     No  2023   135.0
1     Sydney Sweeney    6.60     No  2024   113.0
2  Reese Witherspoon    6.80    Yes  1999    97.0
3       Blake Lively    6.98     No  2024   114.8
4     Sydney Sweeney    6.10    Yes  2021   116.0
5    Kathleen Turner    7.40    Yes  1981   113.0
```

II. Get a summary of the dataset using describe().

```
data.describe()
```

```
         Rating     Year      Length
count  6.000000     6.00    6.000000
mean   6.980000  2012.00  114.800000
std    0.658483    18.00   12.106197
min    6.100000  1981.00   97.000000
25%    6.650000  2004.50  113.000000
50%    6.890000  2022.00  113.900000
75%    7.295000  2023.75  115.700000
max    8.000000  2024.00  135.000000
```

III. Select a subset of columns from the DataFrame. Use both label-based and position-based indexing.

```
sub_data_by_index = data[['Actor','Actress']]
sub_data_by_index
```

```
                Actor           Actress
0  Sidhant Chaturvedi      Ananya Pandey
1         Glen Powell     Sydney Sweeney
2      Ryan Phillippe  Reese Witherspoon
3      Justin Baldoni       Blake Lively
4       Justice Smith     Sydney Sweeney
5        William Hurt    Kathleen Turner
```

```
sub_data_by_pos = data.iloc[:,[0,1,2]]
sub_data_by_pos
```

```
               Movies            Director               Actor
0  Kho Gaye Hum Kahan  Arjun Varain Singh  Sidhant Chaturvedi
1      Anyone But You          Will Gluck         Glen Powell
2    Cruel Intentions        Roger Kumble      Ryan Phillippe
3     It Ends With Us      Justin Baldoni      Justin Baldoni
```

```
4         The Voyeurs       Michael Mohan       Justice Smith
5           Body Heat     Lawrence Kasdan        William Hurt
```

III. Create a new DataFrame by filtering rows based on a condition.

```
new_data = data[data['Censor'] == "Yes"]
new_data
```

```
             Movies         Director           Actor            Actress  \
2  Cruel Intentions     Roger Kumble  Ryan Phillippe  Reese Witherspoon
4       The Voyeurs    Michael Mohan   Justice Smith     Sydney Sweeney
5         Body Heat  Lawrence Kasdan    William Hurt    Kathleen Turner

   Rating Censor  Year  Length
2     6.8    Yes  1999    97.0
4     6.1    Yes  2021   116.0
5     7.4    Yes  1981   113.0
```

TASK 2: Data Cleaning and Preprocessing

II. Create a new column by applying a mathematical operation on existing columns. Convert a categorical variable into numerical representation (e.g., using one-hot encoding).

```
data = p.get_dummies(data, columns=['Censor'], drop_first=True)
data
```

```
                Movies            Director                Actor  \
0  Kho Gaye Hum Kahan  Arjun Varain Singh  Sidhant Chaturvedi
1      Anyone But You          Will Gluck         Glen Powell
2    Cruel Intentions        Roger Kumble      Ryan Phillippe
3     It Ends With Us      Justin Baldoni      Justin Baldoni
4         The Voyeurs       Michael Mohan       Justice Smith
5           Body Heat     Lawrence Kasdan        William Hurt

              Actress  Rating  Year  Length  Censor_Yes
0      Ananya Pandey    8.00  2023   135.0           0
1     Sydney Sweeney    6.60  2024   113.0           0
2  Reese Witherspoon    6.80  1999    97.0           1
3       Blake Lively    6.98  2024   114.8           0
4     Sydney Sweeney    6.10  2021   116.0           1
5    Kathleen Turner    7.40  1981   113.0           1
```

III. Group the data by a specific column. Apply aggregation functions (sum, mean, count) to the grouped data. Present the results in a meaningful way.

```
data.groupby("Year")["Movies"].agg(list).reset_index().mean()
```

```
C:\Users\HP\AppData\Local\Temp\ipykernel_5904\1789202964.py:1: FutureWarning:
The default value of numeric_only in DataFrame.mean is deprecated. In a
future version, it will default to False. In addition, specifying
'numeric_only=None' is deprecated. Select only valid columns or specify the
value of numeric_only to silence this warning.
  data.groupby("Year")["Movies"].agg(list).reset_index().mean()
```

```
Year    2009.6
dtype: float64
```

```
data.groupby("Length")["Movies"].agg(list).reset_index().mean()
```

```
C:\Users\HP\AppData\Local\Temp\ipykernel_5904\387590397.py:1: FutureWarning:
The default value of numeric_only in DataFrame.mean is deprecated. In a
future version, it will default to False. In addition, specifying
'numeric_only=None' is deprecated. Select only valid columns or specify the
value of numeric_only to silence this warning.
  data.groupby("Length")["Movies"].agg(list).reset_index().mean()
```

```
Length    115.16
dtype: float64
```

```
data.groupby("Rating")["Movies"].agg(list).reset_index().mean()
```

```
C:\Users\HP\AppData\Local\Temp\ipykernel_5904\2275640151.py:1: FutureWarning:
The default value of numeric_only in DataFrame.mean is deprecated. In a
future version, it will default to False. In addition, specifying
'numeric_only=None' is deprecated. Select only valid columns or specify the
value of numeric_only to silence this warning.
  data.groupby("Rating")["Movies"].agg(list).reset_index().mean()
```

```
Rating    6.98
dtype: float64
```

TASK 3: Load two different datasets. Merge them using different types of joins (inner, outer, left, right). Analyze the impact of each type of join on the merged dataset.

```
movies = p.read_excel("data.xlsx", sheet_name='Sheet1')
genre = p.read_excel("data.xlsx", sheet_name='Genres')
```

```
inner_join_result = p.merge(movies, genre, on='Movies', how='inner')
print("\nInner Join Result:")
print(inner_join_result)
```

```
Inner Join Result:
               Movies            Director               Actor  \
0  Kho Gaye Hum Kahan  Arjun Varain Singh  Sidhant Chaturvedi
1      Anyone But You          Will Gluck         Glen Powell
2    Cruel Intentions        Roger Kumble      Ryan Phillippe
3     It Ends With Us      Justin Baldoni      Justin Baldoni
4         The Voyeurs       Michael Mohan       Justice Smith
5           Body Heat     Lawrence Kasdan        William Hurt

             Actress  Rating Censor  Year  Length       Genre Sub-Genre
0      Ananya Pandey     8.0     No  2023   135.0       Drama   Rom-Com
1     Sydney Sweeney     6.6     No  2024   113.0      Comdey  Romantic
2  Reese Witherspoon     6.8    Yes  1999    97.0  Teen Drama  Thriller
```

```
3       Blake Lively     NaN     No  2024     NaN       Drama  Romantic
4     Sydney Sweeney     6.1    Yes  2021   116.0      Erotic  Thriller
5    Kathleen Turner     7.4    Yes  1981   113.0      Erotic  Thriller
```

```
outer_join_result = p.merge(movies, genre, on='Movies', how='outer')
print("\nOuter Join Result:")
print(outer_join_result)
```

```
Outer Join Result:
               Movies            Director               Actor  \
0  Kho Gaye Hum Kahan  Arjun Varain Singh  Sidhant Chaturvedi
1      Anyone But You          Will Gluck         Glen Powell
2    Cruel Intentions        Roger Kumble      Ryan Phillippe
3     It Ends With Us      Justin Baldoni      Justin Baldoni
4         The Voyeurs       Michael Mohan       Justice Smith
5           Body Heat     Lawrence Kasdan        William Hurt

             Actress  Rating Censor  Year  Length       Genre Sub-Genre
0      Ananya Pandey     8.0     No  2023   135.0       Drama   Rom-Com
1     Sydney Sweeney     6.6     No  2024   113.0      Comdey  Romantic
2  Reese Witherspoon     6.8    Yes  1999    97.0  Teen Drama  Thriller
3       Blake Lively     NaN     No  2024     NaN       Drama  Romantic
4     Sydney Sweeney     6.1    Yes  2021   116.0      Erotic  Thriller
5    Kathleen Turner     7.4    Yes  1981   113.0      Erotic  Thriller
```

```
left_join_result = p.merge(movies, genre, on='Movies', how='left')
print("\nLeft Join Result:")
print(left_join_result)
```

```
Left Join Result:
               Movies            Director               Actor  \
0  Kho Gaye Hum Kahan  Arjun Varain Singh  Sidhant Chaturvedi
1      Anyone But You          Will Gluck         Glen Powell
2    Cruel Intentions        Roger Kumble      Ryan Phillippe
3     It Ends With Us      Justin Baldoni      Justin Baldoni
4         The Voyeurs       Michael Mohan       Justice Smith
5           Body Heat     Lawrence Kasdan        William Hurt

             Actress  Rating Censor  Year  Length       Genre Sub-Genre
0      Ananya Pandey     8.0     No  2023   135.0       Drama   Rom-Com
1     Sydney Sweeney     6.6     No  2024   113.0      Comdey  Romantic
2  Reese Witherspoon     6.8    Yes  1999    97.0  Teen Drama  Thriller
3       Blake Lively     NaN     No  2024     NaN       Drama  Romantic
4     Sydney Sweeney     6.1    Yes  2021   116.0      Erotic  Thriller
5    Kathleen Turner     7.4    Yes  1981   113.0      Erotic  Thriller
```

```
right_join_result = p.merge(movies, genre, on='Movies', how='right')
print("\nRight Join Result:")
print(right_join_result)
```

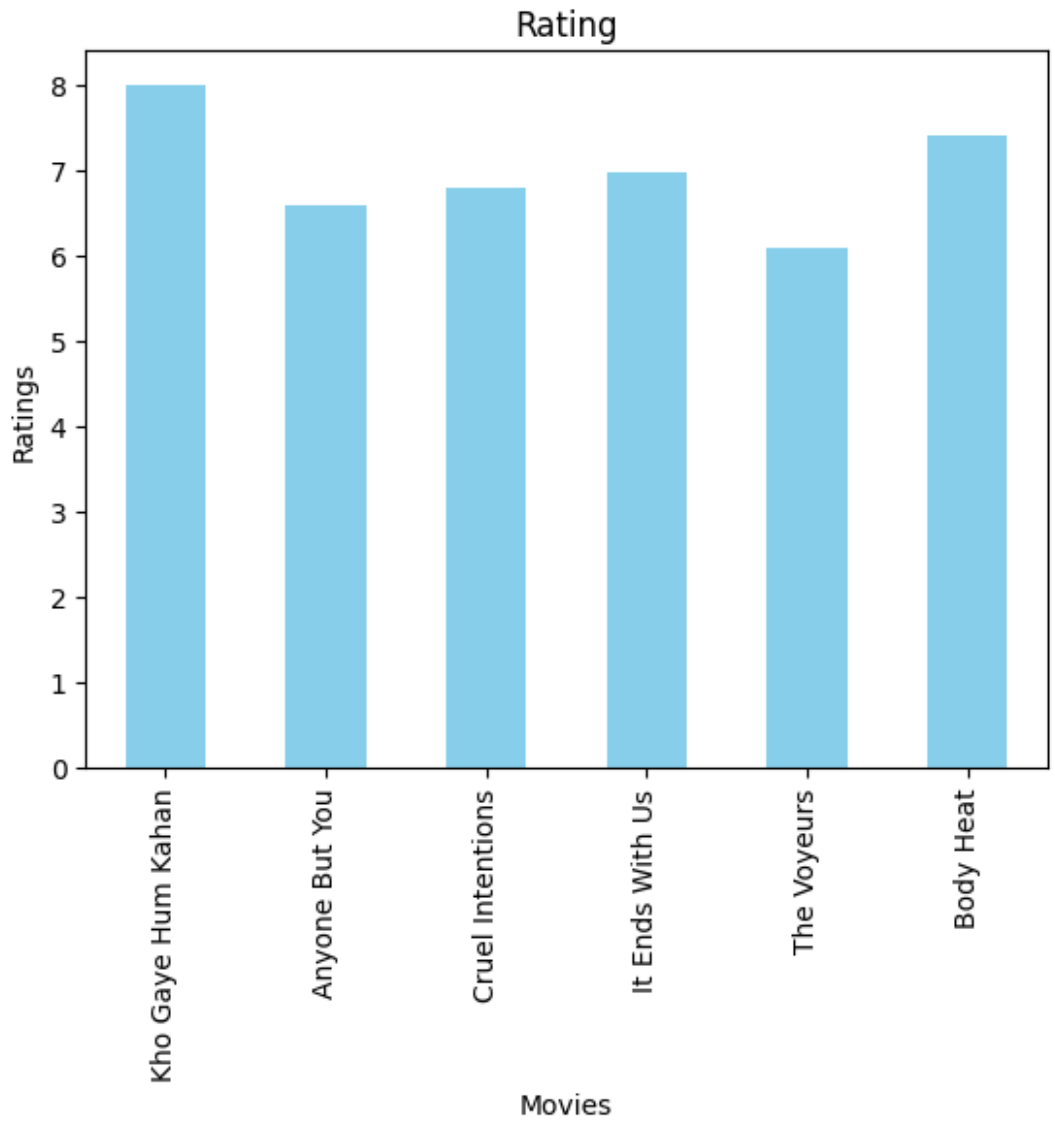
```
Right Join Result:
              Movies            Director               Actor  \
0  Kho Gaye Hum Kahan  Arjun Varain Singh  Sidhant Chaturvedi
1      Anyone But You          Will Gluck         Glen Powell
2    Cruel Intentions        Roger Kumble      Ryan Phillippe
3     It Ends With Us      Justin Baldoni      Justin Baldoni
4         The Voyeurs       Michael Mohan       Justice Smith
5           Body Heat     Lawrence Kasdan        William Hurt

             Actress  Rating Censor  Year  Length       Genre Sub-Genre
0      Ananya Pandey     8.0     No  2023   135.0       Drama   Rom-Com
1     Sydney Sweeney     6.6     No  2024   113.0      Comdey  Romantic
2  Reese Witherspoon     6.8    Yes  1999    97.0  Teen Drama  Thriller
3       Blake Lively     NaN     No  2024     NaN       Drama  Romantic
4     Sydney Sweeney     6.1    Yes  2021   116.0      Erotic  Thriller
5    Kathleen Turner     7.4    Yes  1981   113.0      Erotic  Thriller
```

TASK 4: Visualization

I. Create a bar plot, line plot, and scatter plot using Pandas plotting functions. Customize the plots to make them more informative.

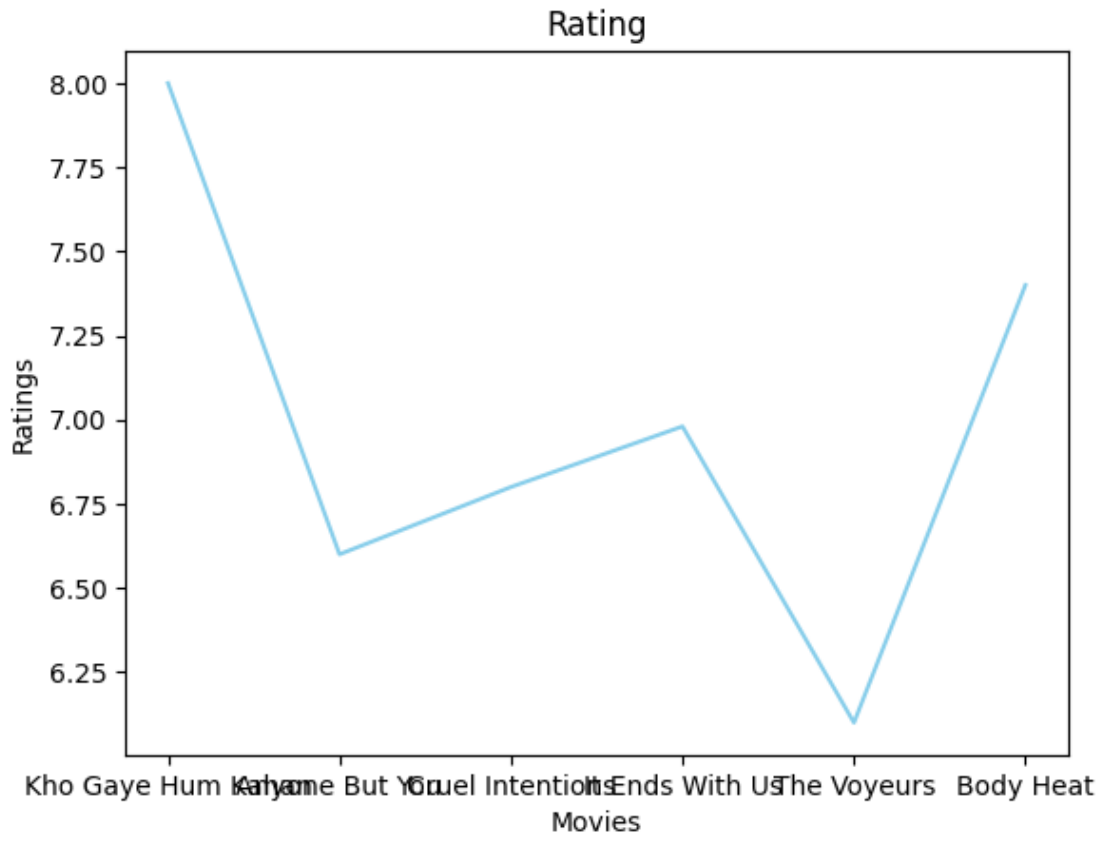
```
data.plot(kind='bar', x='Movies', y='Rating', color='skyblue', legend=False,
title='Rating', ylabel="Ratings", xlabel="Movies")
```

```
<Axes: title={'center': 'Rating'}, xlabel='Movies', ylabel='Ratings'>
```



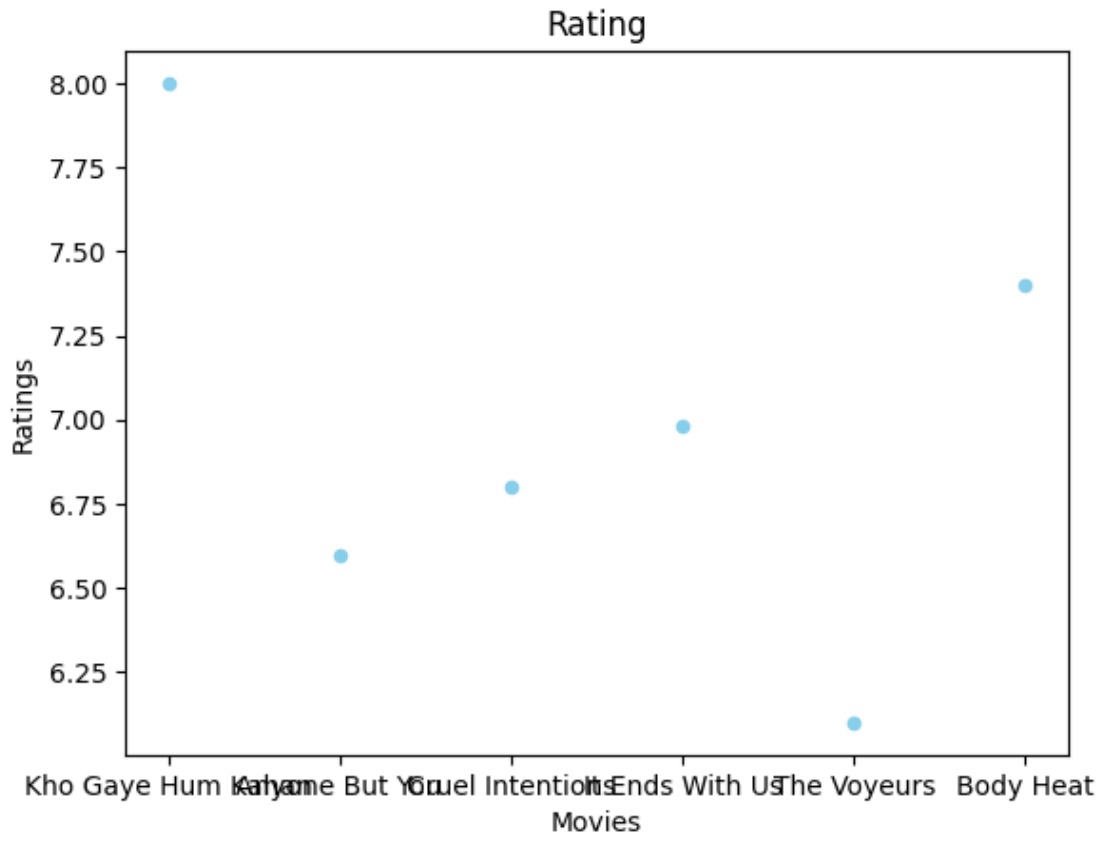

```
data.plot(kind='line', x='Movies', y='Rating', color='skyblue', legend=False,
title='Rating', ylabel="Ratings", xlabel="Movies")
```

```
<Axes: title={'center': 'Rating'}, xlabel='Movies', ylabel='Ratings'>
```




```
data.plot(kind='scatter', x='Movies', y='Rating', color='skyblue',
legend=False, title='Rating', ylabel="Ratings", xlabel="Movies")
```

```
<Axes: title={'center': 'Rating'}, xlabel='Movies', ylabel='Ratings'>
```

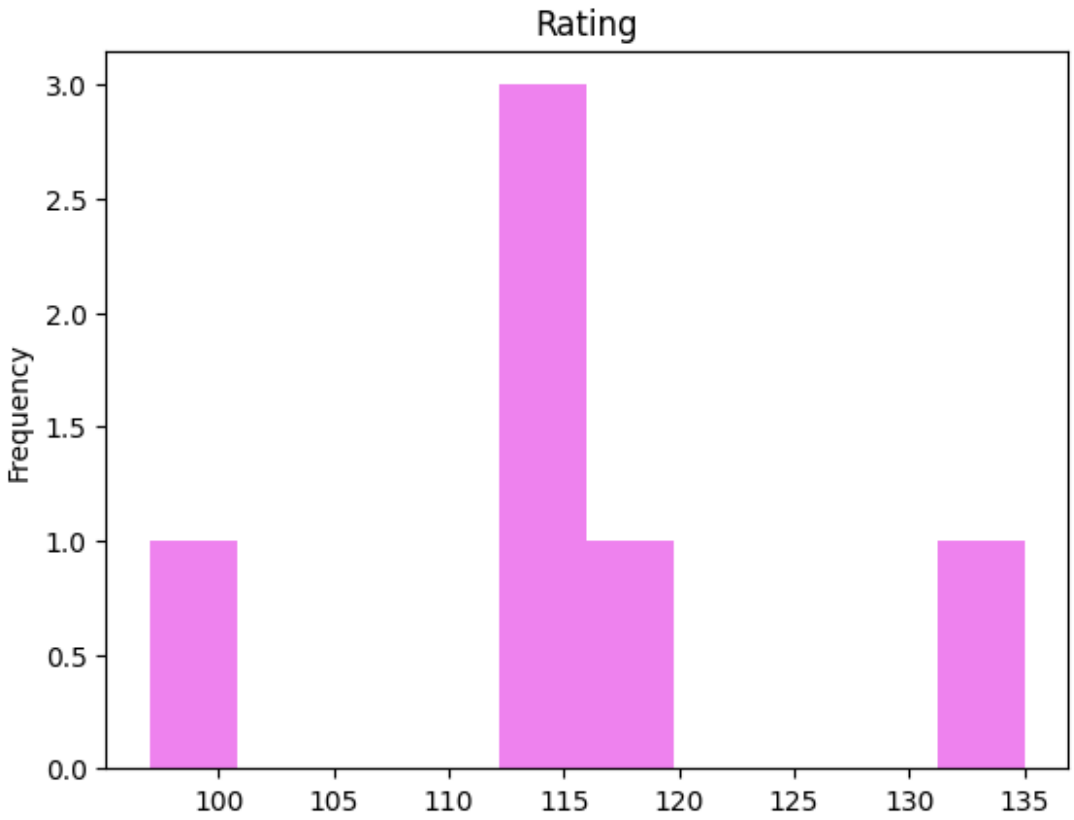


II. Visualize the correlation matrix of numerical columns. Highlight highly correlated features.

III. Create histograms and box plots for numerical columns. Analyze the distribution and presence of outliers

```
data.plot(kind='hist', x='Movies', y='Length', color='violet', legend=False,
title='Rating')
```

```
<Axes: title={'center': 'Rating'}, ylabel='Frequency'>
```



TASK 5: Basic NumPy Operations

```
import numpy as np
```

1. Create a NumPy array 'arr' with values from 1 to 10.

```
arr = np.arange(1,11, dtype="int32")
arr
```

```
array([ 1,  2,  3,  4,  5,  6,  7,  8,  9, 10])
```

2. Create another NumPy array 'arr2' with values from 11 to 20.

```
arr2 = np.arange(11,21, dtype="int32")
arr2
```

```
array([11, 12, 13, 14, 15, 16, 17, 18, 19, 20])
```

3. Add, subtract, multiply, and divide 'arr' and 'arr2'. Print the results.

```
print(f"The sum of the arrays is: {arr+arr2}")
print(f"The difference of the arrays is: {arr-arr2}")
print(f"The multiplication of the arrays is: {arr*arr2}")
print(f"The division of the arrays is: {arr/arr2}")
```

```
The sum of the arrays is: [12 14 16 18 20 22 24 26 28 30]
The difference of the arrays is: [-10 -10 -10 -10 -10 -10 -10 -10 -10 -10]
The multiplication of the arrays is: [ 11  24  39  56  75  96 119 144 171
200]
```

```
The division of the arrays is: [0.09090909 0.16666667 0.23076923 0.28571429
0.33333333 0.375
 0.41176471 0.44444444 0.47368421 0.5       ]
```

TASK 6: Array Manipulation

1. Reshape 'arr' into a 2x5 matrix.

```
new_arr = arr.reshape(2,5)
new_arr
```

```
array([[ 1,  2,  3,  4,  5],
       [ 6,  7,  8,  9, 10]])
```

2. Transpose the matrix obtained in the previous step.

```
new_arr.transpose()
```

```
array([[ 1,  6],
       [ 2,  7],
       [ 3,  8],
       [ 4,  9],
       [ 5, 10]])
```

3. Flatten the transposed matrix into a 1D array.

```
new_arr.reshape(1,10)
```

```
array([[ 1,  2,  3,  4,  5,  6,  7,  8,  9, 10]])
```

4. Stack 'arr' and 'arr2' vertically. Print the result.

```
np.vstack((arr, arr2))
```

```
array([[ 1,  2,  3,  4,  5,  6,  7,  8,  9, 10],
       [11, 12, 13, 14, 15, 16, 17, 18, 19, 20]])
```

TASK 7: Statistical Operations

1. Calculate the mean, median, and standard deviation of 'arr'.

```
std = np.std(arr)
med = np.median(arr)
mean = np.mean(arr)
print(f"The median is: {med}")
print(f"The mean is: {mean}")
print(f"The standard deviation is: {std}")
```

```
The median is: 5.5
The mean is: 5.5
The standard deviation is: 2.8722813232690143
```

2. Find the maximum and minimum values in 'arr'.

```
print(f"The max is is: {max(arr)}")
print(f"The min is: {min(arr)}")
```

```
The max is is: 10
The min is: 1
```

3. Normalize 'arr' (subtract the mean and divide by the standard deviation).

```
normal_array = []
for data in arr:
    normal_array.append((data-mean)/std)
print(f"Normalized Array: {normal_array}")
```

```
Normalized Array: [-1.5666989036012806, -1.2185435916898848, -
0.8703882797784892, -0.5222329678670935, -0.17407765595569785,
0.17407765595569785, 0.5222329678670935, 0.8703882797784892,
1.2185435916898848, 1.5666989036012806]
```

TASK 8: Boolean Indexing

1. Create a boolean array 'bool_arr' for elements in 'arr' greater than 5.

```
bool_arr = list(map((lambda x: x>5), arr))
bool_arr
```

```
[False, False, False, False, False, True, True, True, True, True]
```

2. Use 'bool_arr' to extract the elements from 'arr' that are greater than 5.

```
bool_arr2 = arr[bool_arr]
bool_arr2
```

```
array([ 6,  7,  8,  9, 10])
```

TASK 9: Random Module

1. Generate a 3x3 matrix with random values between 0 and 1.

```
rand_arr = np.random.randint(0,1, (3,3))
rand_arr
```

```
array([[0, 0, 0],
       [0, 0, 0],
       [0, 0, 0]])
```

2. Create an array of 10 random integers between 1 and 100.

```
rand_arr = np.random.randint(1,100, (1,10))
rand_arr
```

```
array([[72, 77, 34, 91, 67, 59, 36, 48, 78, 16]])
```

3. Shuffle the elements of 'arr' randomly.

```
np.random.shuffle(arr)
arr
```

```
array([ 9,  5,  3,  7,  6,  8,  2,  4,  1, 10])
```

TASK 10: Random Module

1. Apply the square root function to all elements in 'arr'.

```
list(map(lambda x: np.sqrt(x),arr))
```

```
[3.0,
 2.23606797749979,
 1.7320508075688772,
 2.6457513110645907,
 2.449489742783178,
 2.8284271247461903,
 1.4142135623730951,
 2.0,
 1.0,
 3.1622776601683795]
```

OR

```
square_root = np.sqrt(arr)
square_root
```

```
array([3.        , 2.23606798, 1.73205081, 2.64575131, 2.44948974,
       2.82842712, 1.41421356, 2.        , 1.        , 3.16227766])
```

2. Use the exponential function to calculate exex for each element in 'arr'.

```
exponential_array = np.exp(arr)
print(exponential_array)
```

```
[8.10308393e+03 1.48413159e+02 2.00855369e+01 1.09663316e+03
 4.03428793e+02 2.98095799e+03 7.38905610e+00 5.45981500e+01
 2.71828183e+00 2.20264658e+04]
```

TASK 11: Linear Algebra Operations

1. Create a 3x3 matrix 'mat_a' with random values.

```
mat_a = np.matrix(np.random.randint(0,100, (3,3)))
mat_a
```

```
matrix([[82, 26, 45],
        [34, 92,  0],
        [25, 19, 26]])
```

2. Create a 3x1 matrix 'vec_b' with random values.

```
vec_b = np.matrix(np.random.randint(0,100, (3,1)))
vec_b
```

```
matrix([[32],
        [98],
        [60]])
```

3. Multiply 'mat_a' and 'vec_b' using the dot product.

```
mat_a.dot(vec_b)
```

```
matrix([[ 7872],
        [10104],
        [ 4222]])
```

TASK 12: Broadcasting

1. Create a 2D array 'matrix' with values from 1 to 9.

```
matrix = np.arange(1,9)
matrix
```

```
array([1, 2, 3, 4, 5, 6, 7, 8])
```

2. Subtract the mean of each row from each element in that row.

```
matrix = [[1, 2, 3],
          [4, 5, 6],
          [7, 8, 9]]

mean_row = []
for x in range(len(matrix)):
    for y in range(len(matrix)):
        mean_row.append(matrix[x][y]-np.mean(matrix[x]))
mean_row
```

```
[-1.0, 0.0, 1.0, -1.0, 0.0, 1.0, -1.0, 0.0, 1.0]
```

```
mean_row = []
for x in range(len(matrix)):
    for y in range(len(matrix)):
        matrix[x][y]=matrix[x][y]-np.mean(matrix[x])
matrix
```

```
[[-1.0, 0.6666666666666667, 2.111111111111111],
 [-1.0, 1.6666666666666665, 3.777777777777778],
 [-1.0, 2.666666666666667, 5.444444444444445]]
```

```
vertopal convert assignment.ipynb --to docx
```

```
  Cell In[113], line 1
    vertopal convert assignment.ipynb --to docx
              ^
SyntaxError: invalid syntax
```