Aim: Practical based on Pandas Data Structures

IDE:

What is Python Pandas?

Pandas is a powerful, open-source data analysis and manipulation package for Python. It provides data structures and functions needed to work on structured data seamlessly and efficiently.

What Is Pandas Used For?

Pandas is extensively used for:

- Data Cleaning: Handling missing values, duplications, and incorrect data formats.
- Data Manipulation: Filtering, transforming, and merging datasets.
- Data Analysis: Performing statistical analysis and aggregations.
- Data Visualization: Creating plots and charts to visualize data trends and patterns.
- Time Series Analysis: Handling and manipulating time series data.

Run the following command to install Pandas:

```
pip install pandas
```

```
import pandas as pd
```

```
print(pd._version_)
```

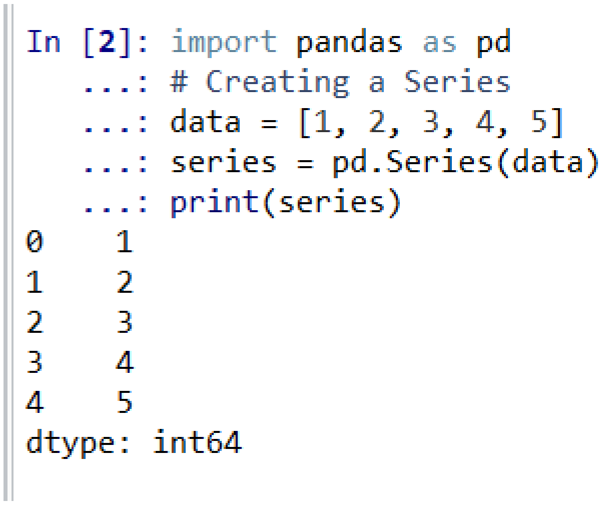
Pandas Series

A Pandas Series is a one-dimensional labeled array capable of holding any data type. It is similar to a column in a spreadsheet or a SQL table.

Example:

```
import pandas as pd
# Creating a Series
data = [1, 2, 3, 4, 5]
series = pd.Series(data)
print(series)
```

Output:



```
In [2]: import pandas as pd
   ...: # Creating a Series
   ...: data = [1, 2, 3, 4, 5]
   ...: series = pd.Series(data)
   ...: print(series)
0    1
1    2
2    3
3    4
4    5
dtype: int64
```

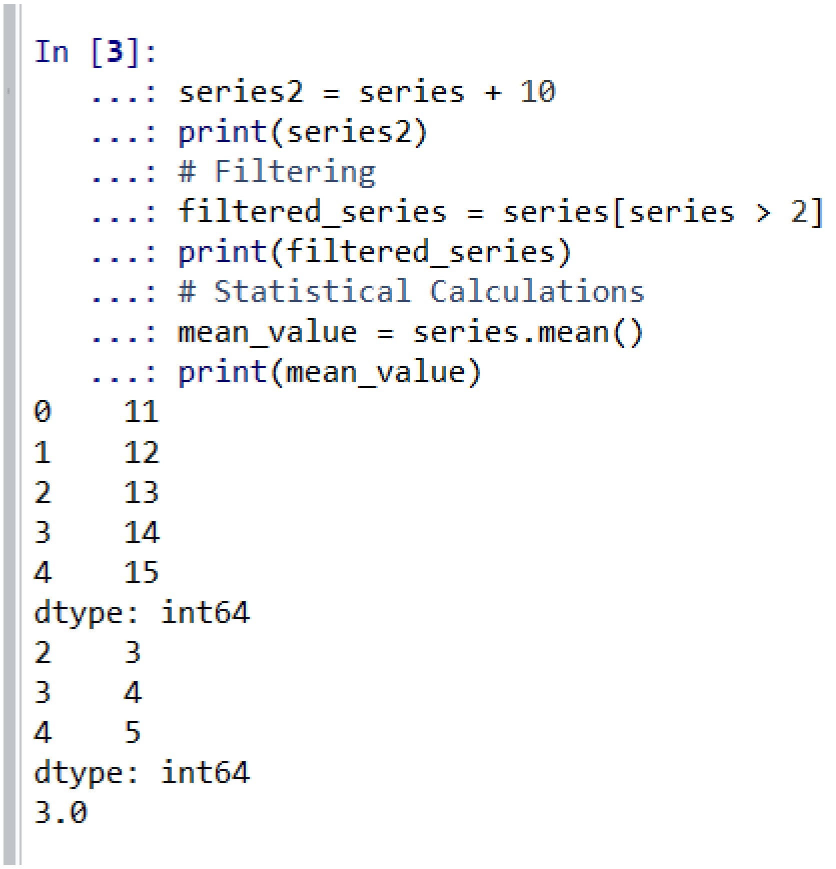
Basic Operations on Series

Perform various operations on Series, such as arithmetic operations, filtering, and statistical calculations.

Example:

```
# Arithmetic Operations
series2 = series + 10
print(series2)
# Filtering
filtered_series = series[series > 2]
print(filtered_series)
# Statistical Calculations
mean_value = series.mean()
print(mean_value)
```

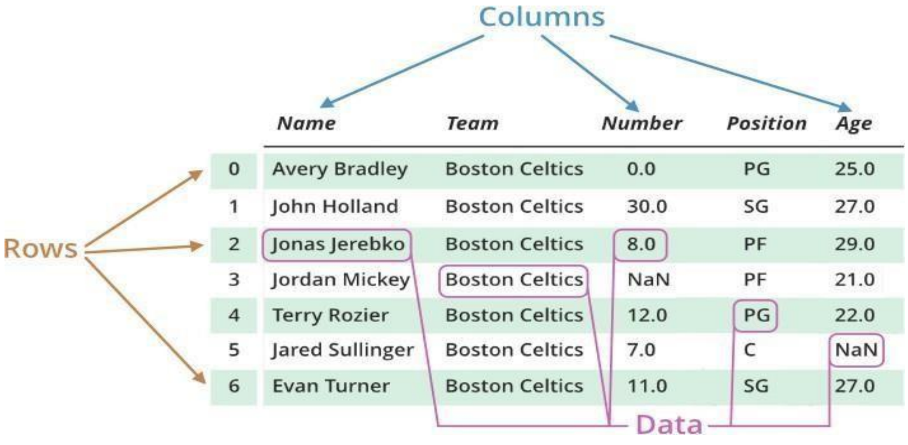
Output



```
In [3]:
   ...: series2 = series + 10
   ...: print(series2)
   ...: # Filtering
   ...: filtered_series = series[series > 2]
   ...: print(filtered_series)
   ...: # Statistical Calculations
   ...: mean_value = series.mean()
   ...: print(mean_value)
0    11
1    12
2    13
3    14
4    15
dtype: int64
2    3
3    4
4    5
dtype: int64
3.0
```

Pandas Dataframe

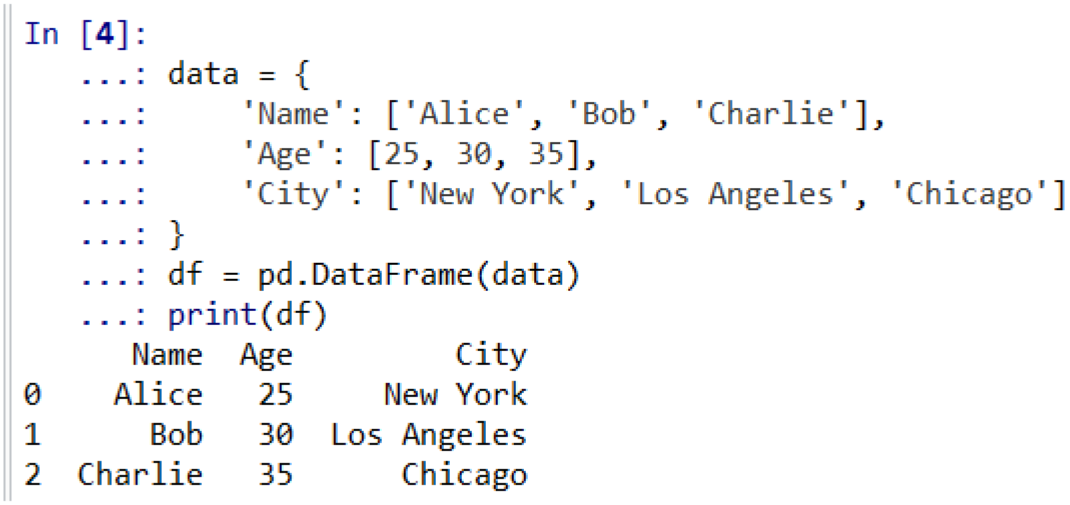
Pandas DataFrame is two-dimensional size-mutable, potentially heterogeneous tabular data structure with labeled axes (rows and columns). A Data frame is a two-dimensional data structure, i.e., data is aligned in a tabular fashion in rows and columns. Pandas DataFrame consists of three principal components, the data, rows, and columns.



	Name	Team	Number	Position	Age
0	Avery Bradley	Boston Celtics	0.0	PG	25.0
1	John Holland	Boston Celtics	30.0	SG	27.0
2	Jonas Jerebko	Boston Celtics	8.0	PF	29.0
3	Jordan Mickey	Boston Celtics	NaN	PF	21.0
4	Terry Rozier	Boston Celtics	12.0	PG	22.0
5	Jared Sullinger	Boston Celtics	7.0	C	NaN
6	Evan Turner	Boston Celtics	11.0	SG	27.0

```
# Creating a DataFrame
data = {
   'Name': ['Alice', 'Bob', 'Charlie'],
   'Age': [25, 30, 35],
   'City': ['New York', 'Los Angeles', 'Chicago']
}
df = pd.DataFrame(data)
print(df)
```

Output



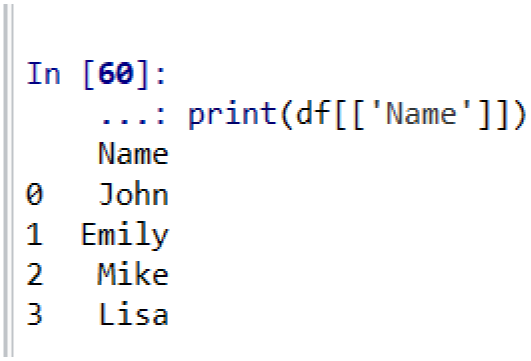
```
In [4]:
   ...: data = {
   ...:     'Name': ['Alice', 'Bob', 'Charlie'],
   ...:     'Age': [25, 30, 35],
   ...:     'City': ['New York', 'Los Angeles', 'Chicago']
   ...: }
   ...: df = pd.DataFrame(data)
   ...: print(df)
      Name  Age         City
0    Alice   25     New York
1      Bob   30  Los Angeles
2  Charlie   35      Chicago
```

Basic Operations on Dataframes

DataFrames support a wide range of operations for data manipulation and analysis.

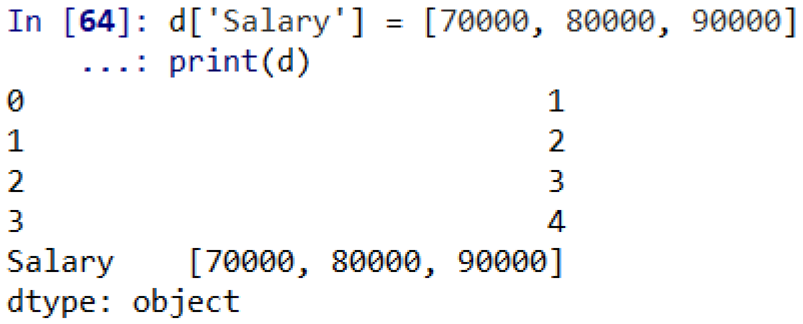
```
# Accessing Columns (# select one column)
print(df[['Name']])
```

Output



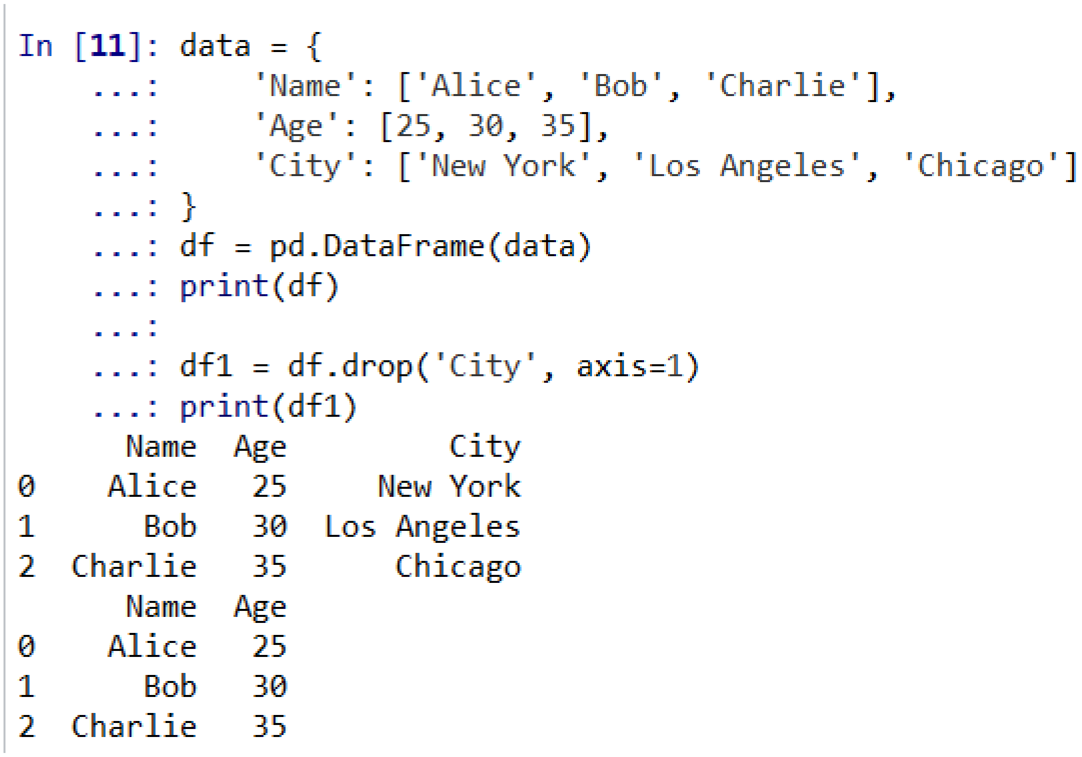
```
In [60]:
    ...: print(df[['Name']])
    Name
0   John
1  Emily
2   Mike
3   Lisa
```

# Adding a New Column
df['Salary'] = [70000, 80000, 90000]
print(df)
Output



```
In [64]: d['Salary'] = [70000, 80000, 90000]
    ...: print(d)
0                             1
1                             2
2                             3
3                             4
Salary    [70000, 80000, 90000]
dtype: object
```

# Dropping a Column
df = df.drop('City', axis=1)
print(df)
Output



```
In [11]: data = {
    ...:     'Name': ['Alice', 'Bob', 'Charlie'],
    ...:     'Age': [25, 30, 35],
    ...:     'City': ['New York', 'Los Angeles', 'Chicago']
    ...: }
    ...: df = pd.DataFrame(data)
    ...: print(df)
    ...:
    ...: df1 = df.drop('City', axis=1)
    ...: print(df1)
      Name  Age         City
0    Alice   25     New York
1      Bob   30  Los Angeles
2  Charlie   35      Chicago
      Name  Age
0    Alice   25
1      Bob   30
2  Charlie   35
```

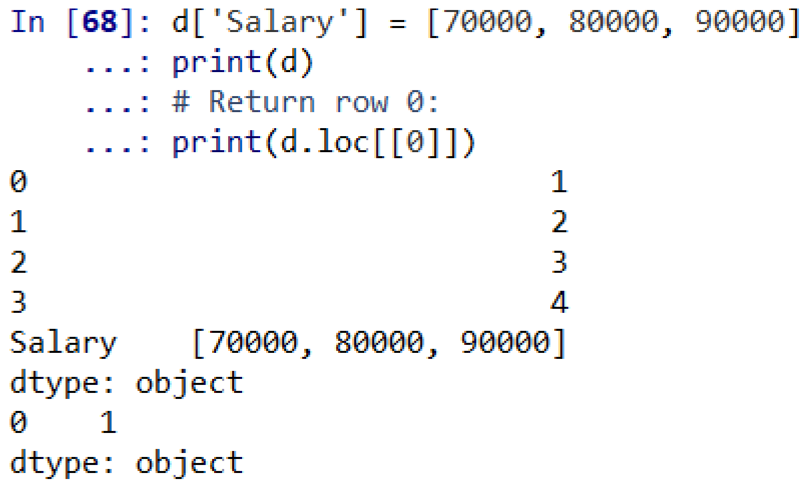
The DataFrame is like a table with rows and columns.

Pandas use the loc attribute to return one or more specified row(s)

# Return row 0:

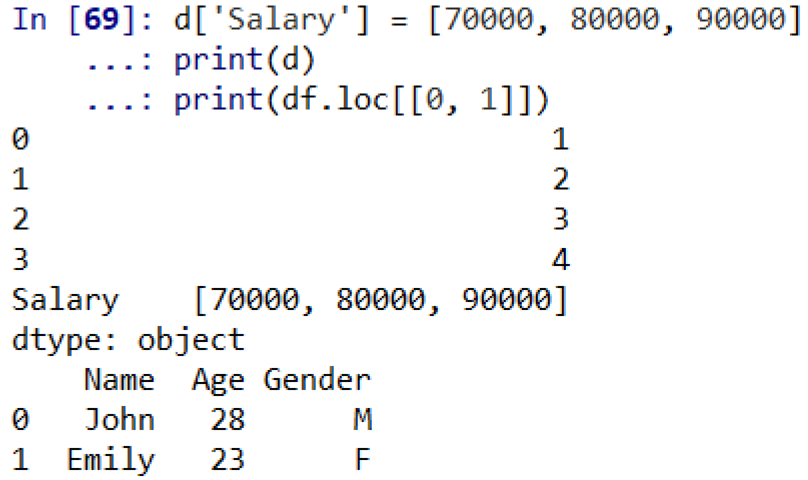
print(df.loc[[0]])

Output



```
In [68]: d['Salary'] = [70000, 80000, 90000]
    ...: print(d)
    ...: # Return row 0:
    ...: print(d.loc[[0]])
0                              1
1                              2
2                              3
3                              4
Salary    [70000, 80000, 90000]
dtype: object
0    1
dtype: object
```

#Return row 0 and 1:
#use a list of indexes:
print(df.loc[[0, 1]])
Output



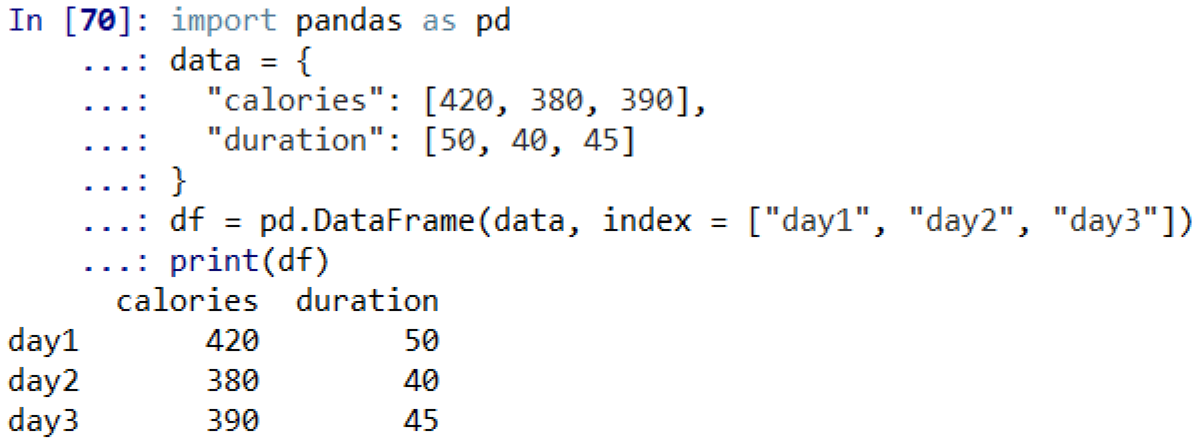
```
In [69]: d['Salary'] = [70000, 80000, 90000]
    ...: print(d)
    ...: print(df.loc[[0, 1]])
0                              1
1                              2
2                              3
3                              4
Salary    [70000, 80000, 90000]
dtype: object
    Name  Age Gender
0   John   28      M
1  Emily   23      F
```

Named Indexes
With the index argument, you can name your own indexes.
Example:

Add a list of names to give each row a name:

```
import pandas as pd
data = {
  "calories": [420, 380, 390],
  "duration": [50, 40, 45]
}
df = pd.DataFrame(data, index = ["day1", "day2", "day3"])
print(df)
```

Output



```
In [70]: import pandas as pd
    ...: data = {
    ...:   "calories": [420, 380, 390],
    ...:   "duration": [50, 40, 45]
    ...: }
    ...: df = pd.DataFrame(data, index = ["day1", "day2", "day3"])
    ...: print(df)
      calories  duration
day1       420        50
day2       380        40
day3       390        45
```

Explanation of Key Pandas Functions

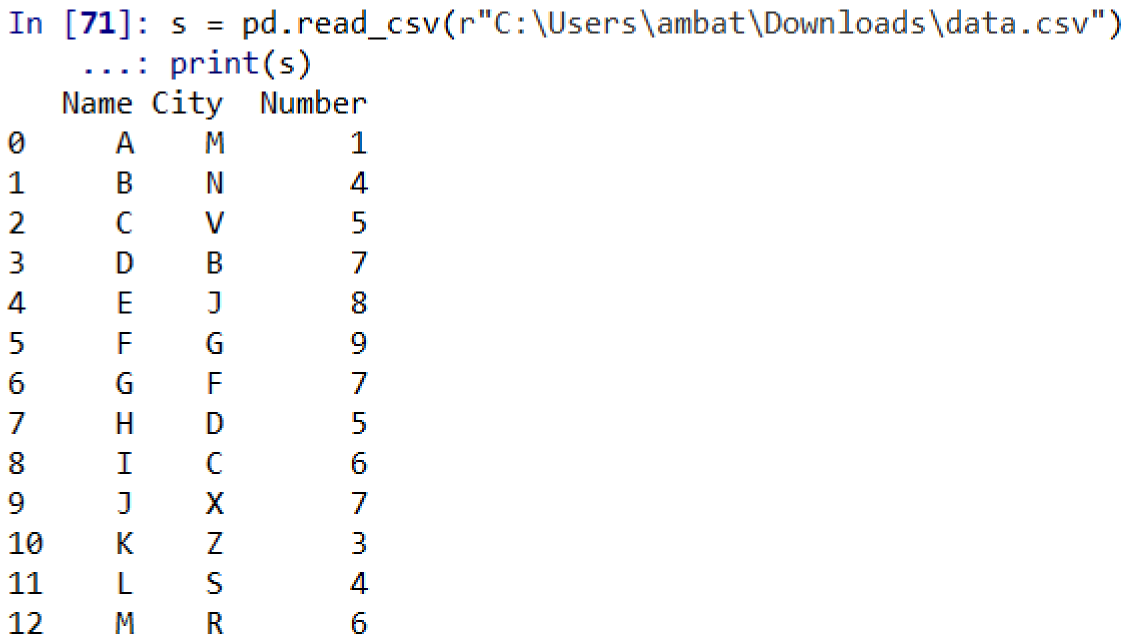
Reading and Writing Data:

Reading Data: Read a CSV file into a DataFrame.

Example:

```
s = pd.read_csv(r"C:\Users\ambat\Downloads\data.csv")
print(s)
```

Output



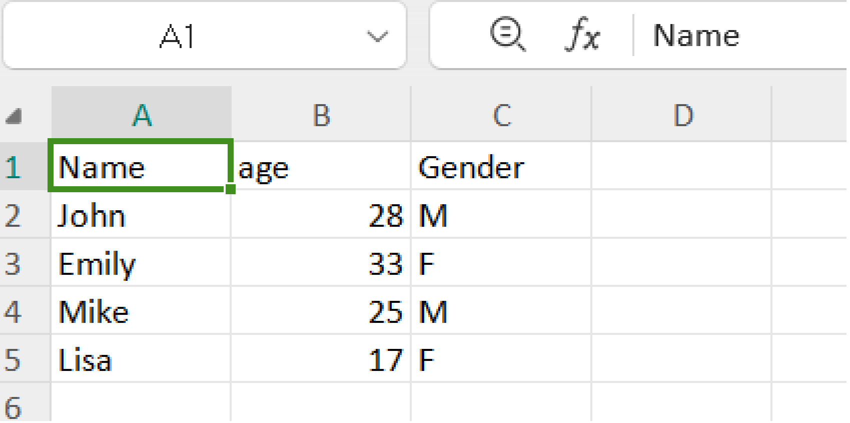
```
In [71]: s = pd.read_csv(r"C:\Users\ambat\Downloads\data.csv")
    ...: print(s)
   Name City  Number
0     A    M       1
1     B    N       4
2     C    V       5
3     D    B       7
4     E    J       8
5     F    G       9
6     G    F       7
7     H    D       5
8     I    C       6
9     J    X       7
10    K    Z       3
11    L    S       4
12    M    R       6
```

Writing Data: Write a DataFrame to a CSV file.
Note: Other Ways to Save Pandas DataFrames (to_excel(), to_json(), to_hdf(), to_sql(), to_pickle())

Example:

```
Biodata = {'Name': ['John', 'Emily', 'Mike', 'Lisa'],
       'Age': [28, 23, 35, 31],
       'Gender': ['M', 'F', 'M', 'F']
       }
df = pd.DataFrame(Biodata)
# Save the dataframe to a CSV file
df.to_csv('Biodata.csv', index=False)
```

Output



	A	B	C	D
1	Name	age	Gender	
2	John	28	M	
3	Emily	33	F	
4	Mike	25	M	
5	Lisa	17	F	
6				

Data Inspection:

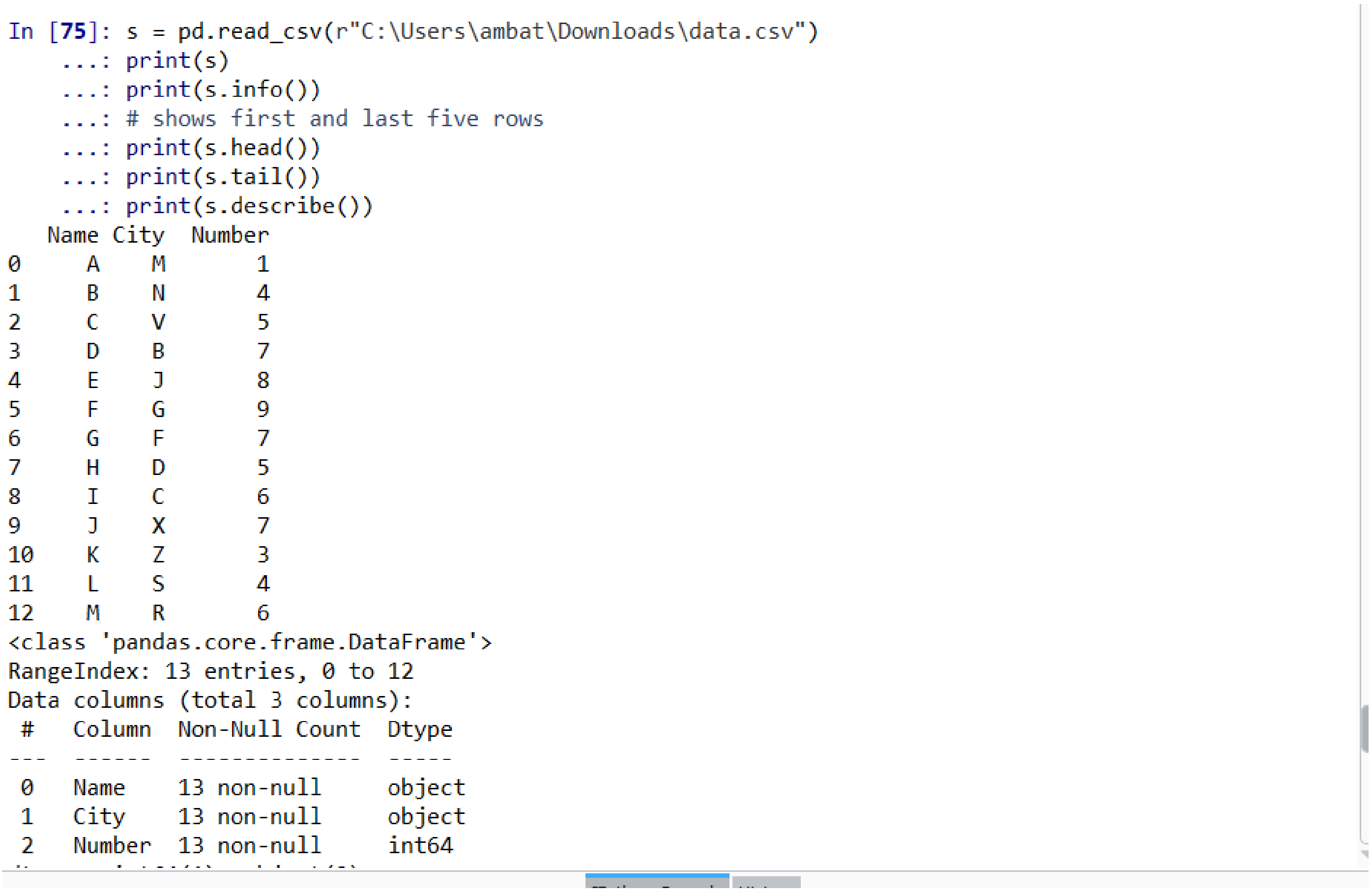
`df.head()`: Display the first few rows of the DataFrame.
`df.tail()`: Display the last few rows of the DataFrame.
`df.info()`: Display a summary of the DataFrame.

`df.describe()`: Provide descriptive statistics for numerical columns. (count: the number of non-null entries, mean: the mean value, std: the standard deviation, min: the minimum value, 25%, 50%, 75%: the lower, median, and upper quartiles, max: the maximum value)

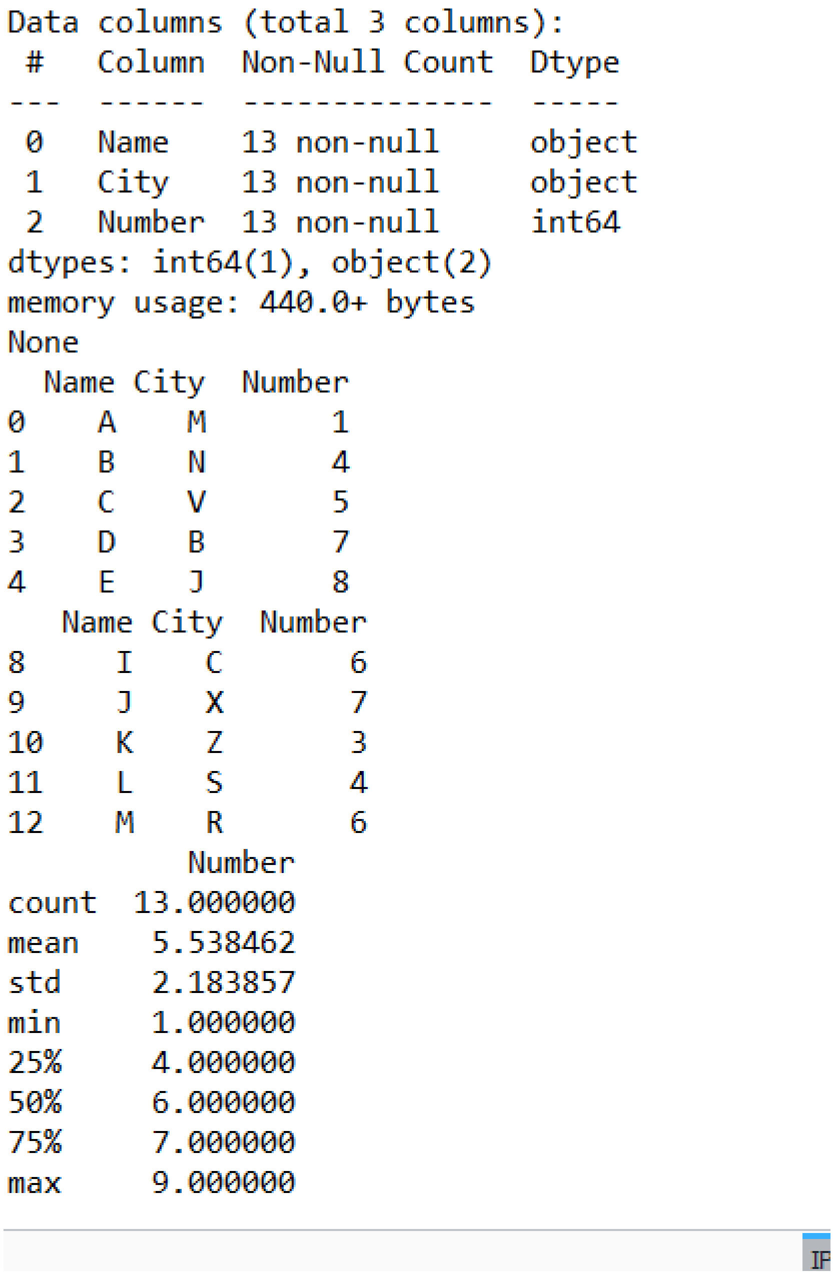
Example:

```
dat = pd.read_csv("data.csv")
print(dat.info())
# shows first and last five rows
print(dat.head())
print(dat.tail())
print(dat.describe())
```

Output



```
In [75]: s = pd.read_csv(r"C:\Users\ambat\Downloads\data.csv")
    ...: print(s)
    ...: print(s.info())
    ...: # shows first and last five rows
    ...: print(s.head())
    ...: print(s.tail())
    ...: print(s.describe())
   Name City  Number
0     A    M       1
1     B    N       4
2     C    V       5
3     D    B       7
4     E    J       8
5     F    G       9
6     G    F       7
7     H    D       5
8     I    C       6
9     J    X       7
10    K    Z       3
11    L    S       4
12    M    R       6
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 13 entries, 0 to 12
Data columns (total 3 columns):
 #   Column  Non-Null Count  Dtype 
---  ------  --------------  ----- 
 0   Name    13 non-null     object
 1   City    13 non-null     object
 2   Number  13 non-null     int64 
```



```
Data columns (total 3 columns):
 #   Column  Non-Null Count  Dtype
---  ------  --------------  -----
 0   Name    13 non-null     object
 1   City    13 non-null     object
 2   Number  13 non-null     int64
dtypes: int64(1), object(2)
memory usage: 440.0+ bytes
None
  Name City  Number
0    A    M       1
1    B    N       4
2    C    V       5
3    D    B       7
4    E    J       8
   Name City  Number
8     I    C       6
9     J    X       7
10    K    Z       3
11    L    S       4
12    M    R       6
          Number
count  13.000000
mean    5.538462
std     2.183857
min     1.000000
25%     4.000000
50%     6.000000
75%     7.000000
max     9.000000
```

Data Selection and Indexing:

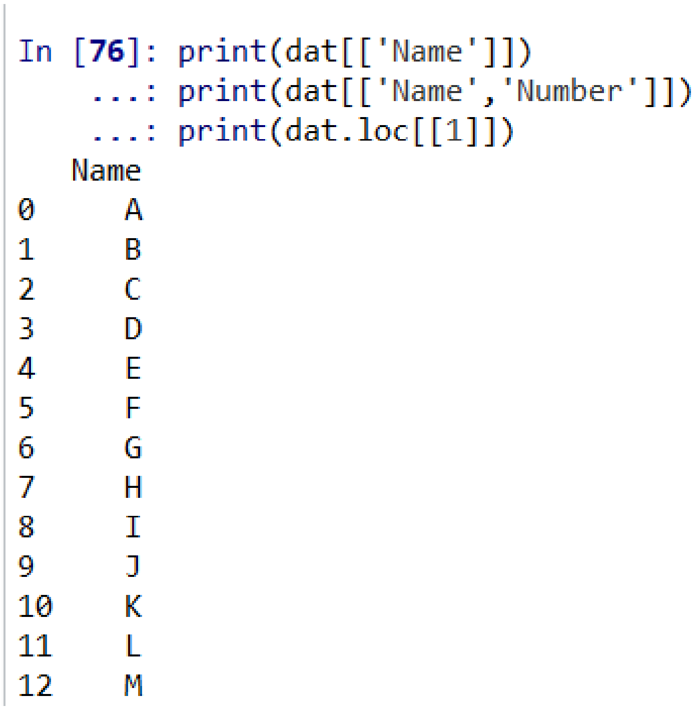
`dat[['A']]`: Select a column.

`dat[['A', 'B']]`: Select multiple columns.

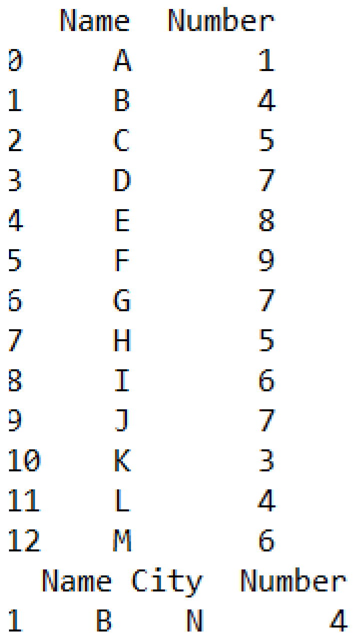
`dat.loc[[0]]`: Select a row by label.

Example:

print(dat[['Name']])
print(dat[['Name','Number']])
print(dat.loc[[1]])
Output



```
In [76]: print(dat[['Name']])
    ...: print(dat[['Name','Number']])
    ...: print(dat.loc[[1]])
   Name
0     A
1     B
2     C
3     D
4     E
5     F
6     G
7     H
8     I
9     J
10    K
11    L
12    M
```



```
   Name  Number
0     A       1
1     B       4
2     C       5
3     D       7
4     E       8
5     F       9
6     G       7
7     H       5
8     I       6
9     J       7
10    K       3
11    L       4
12    M       6
  Name City  Number
1    B    N       4
```

Data Manipulation:

dat['A'] = dat['A'] * 2: Modify a column.

dat['F'] = dat['A'] + dat['B']: Create a new column based on existing columns.

dat.drop(columns=['A']): Drop a column.

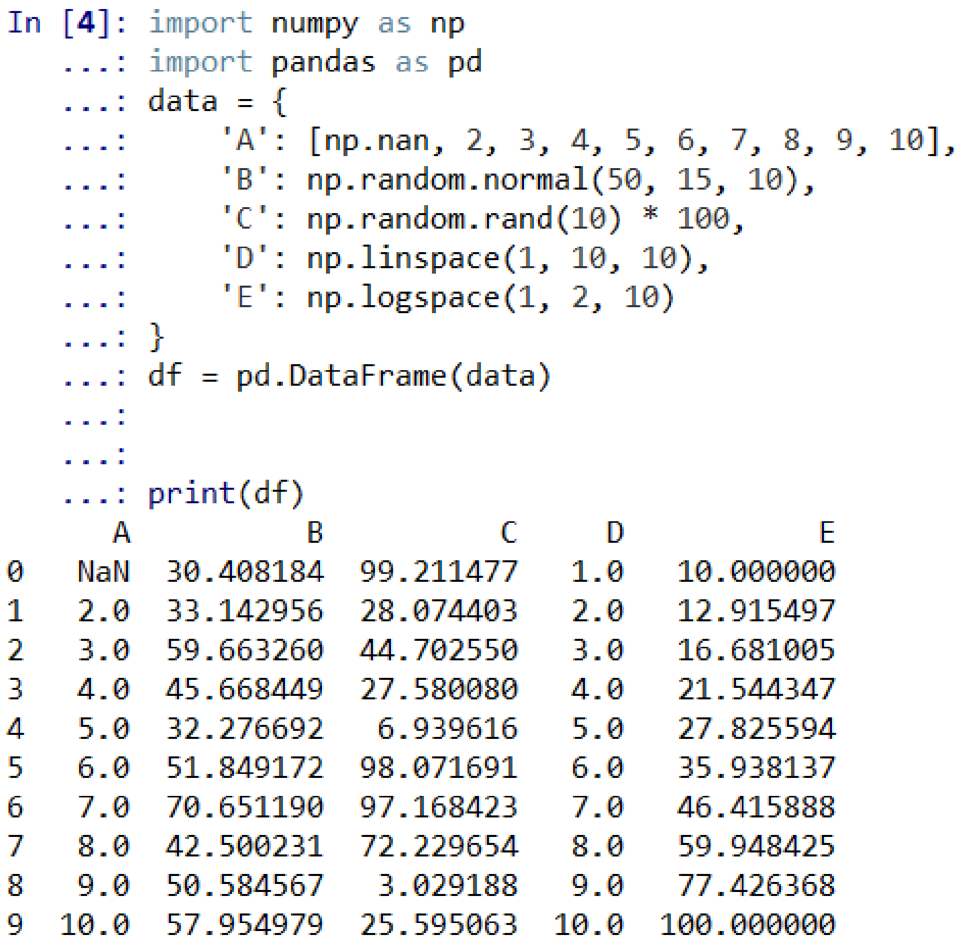
dat.drop(index=[0]): Drop a row.

Task

Create a DataFrame with 5 numeric columns

```
data = {
   'A': [np.nan, 2, 3, 4, 5, 6, 7, 8, 9, 10],
   'B': np.random.normal(50, 15, 10),
   'C':  np.random.rand(10) * 100,
   'D': np.linspace(1, 10, 10),
   'E': np.logspace(1, 2, 10)
}
df = pd.DataFrame(data)
```

Output

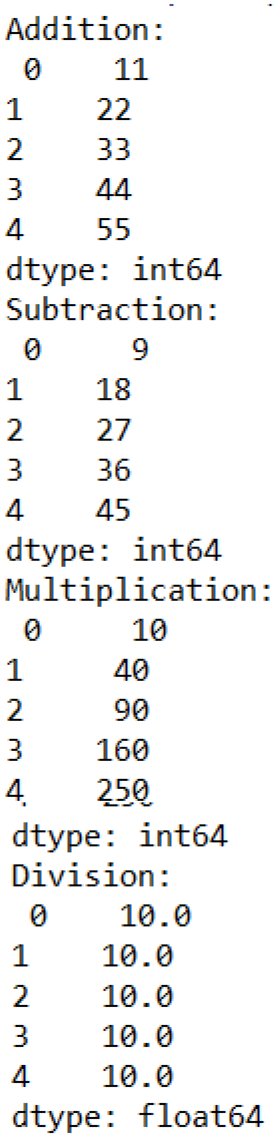


```
In [4]: import numpy as np
   ...: import pandas as pd
   ...: data = {
   ...:     'A': [np.nan, 2, 3, 4, 5, 6, 7, 8, 9, 10],
   ...:     'B': np.random.normal(50, 15, 10),
   ...:     'C': np.random.rand(10) * 100,
   ...:     'D': np.linspace(1, 10, 10),
   ...:     'E': np.logspace(1, 2, 10)
   ...: }
   ...: df = pd.DataFrame(data)
   ...:
   ...:
   ...: print(df)
      A          B          C     D           E
0   NaN  30.408184  99.211477   1.0   10.000000
1   2.0  33.142956  28.074403   2.0   12.915497
2   3.0  59.663260  44.702550   3.0   16.681005
3   4.0  45.668449  27.580080   4.0   21.544347
4   5.0  32.276692   6.939616   5.0   27.825594
5   6.0  51.849172  98.071691   6.0   35.938137
6   7.0  70.651190  97.168423   7.0   46.415888
7   8.0  42.500231  72.229654   8.0   59.948425
8   9.0  50.584567   3.029188   9.0   77.426368
9  10.0  57.954979  25.595063  10.0  100.000000
```

Post Lab Exercise:

a. Write a Pandas program to add, subtract, multiple and divide two Pandas Series.

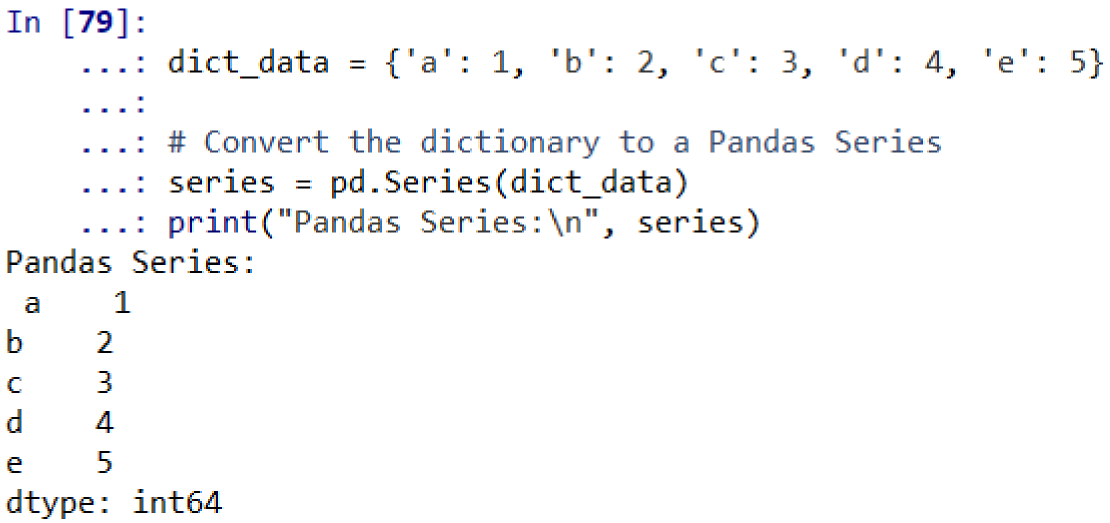
```
import pandas as pd

series1 = pd.Series([10, 20, 30, 40, 50])
series2 = pd.Series([1, 2, 3, 4, 5])

addition = series1 + series2
print("Addition:\n", addition)

subtraction = series1 - series2
print("Subtraction:\n", subtraction)

multiplication = series1 * series2
print("Multiplication:\n", multiplication)

division = series1 / series2
print("Division:\n", division)
```



```
Addition:
 0    11
1    22
2    33
3    44
4    55
dtype: int64
Subtraction:
 0     9
1    18
2    27
3    36
4    45
dtype: int64
Multiplication:
 0     10
1     40
2     90
3    160
4    250
dtype: int64
Division:
 0    10.0
1    10.0
2    10.0
3    10.0
4    10.0
dtype: float64
```

b. Write a Pandas program to convert a dictionary to a Pandas series.

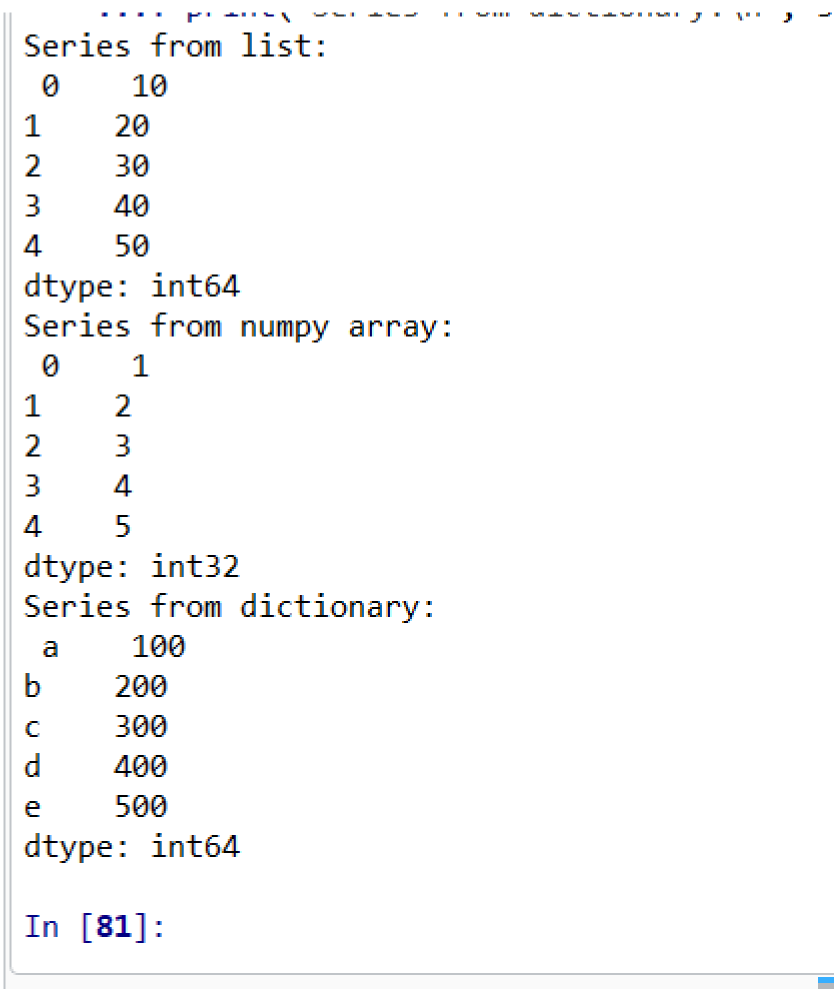
```
dict_data = {'a': 1, 'b': 2, 'c': 3, 'd': 4, 'e': 5}

series = pd.Series(dict_data)
print("Pandas Series:\n", series)
```



```
In [79]:
    ...: dict_data = {'a': 1, 'b': 2, 'c': 3, 'd': 4, 'e': 5}
    ...:
    ...: # Convert the dictionary to a Pandas Series
    ...: series = pd.Series(dict_data)
    ...: print("Pandas Series:\n", series)
Pandas Series:
 a    1
b    2
c    3
d    4
e    5
dtype: int64
```

c. Write a Pandas program to create a series from a list, numpy array and dict

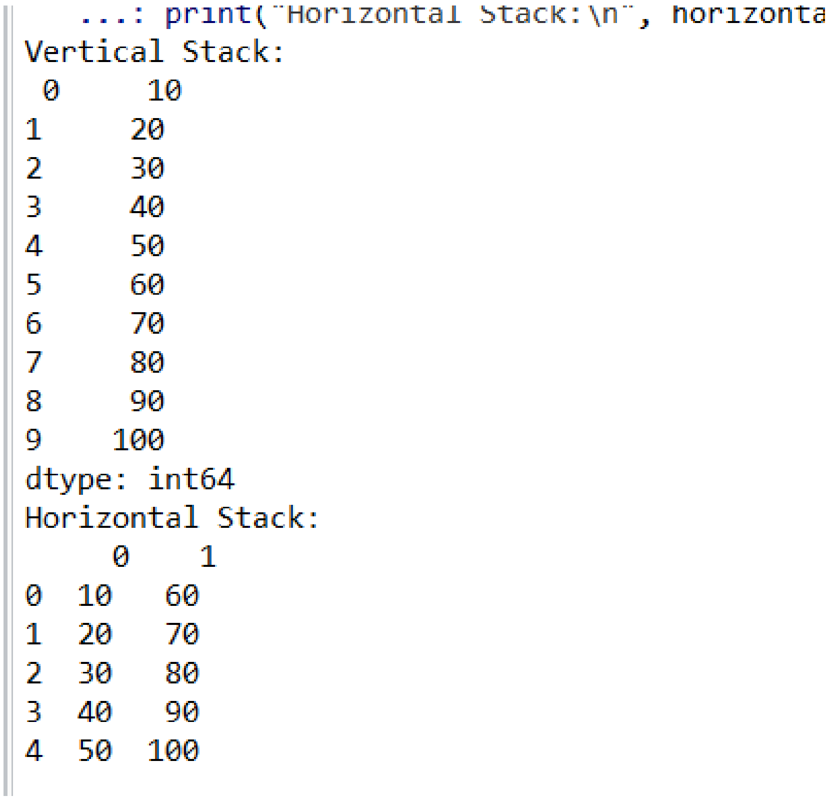
```
import numpy as np

list_data = [10, 20, 30, 40, 50]
np_array = np.array([1, 2, 3, 4, 5])

dict_data = {'a': 100, 'b': 200, 'c': 300, 'd': 400, 'e': 500}

series_from_list = pd.Series(list_data)
print("Series from list:\n", series_from_list)

series_from_array = pd.Series(np_array)
print("Series from numpy array:\n", series_from_array)

series_from_dict = pd.Series(dict_data)
print("Series from dictionary:\n", series_from_dict)
```



```
   ...: print("Series from dictionary:\n", s
Series from list:
 0    10
1    20
2    30
3    40
4    50
dtype: int64
Series from numpy array:
 0    1
1    2
2    3
3    4
4    5
dtype: int32
Series from dictionary:
 a    100
b    200
c    300
d    400
e    500
dtype: int64

In [81]:
```

d. Write a Pandas program to stack two series vertically and horizontally

```
import pandas as pd

series1 = pd.Series([10, 20, 30, 40, 50])
series2 = pd.Series([60, 70, 80, 90, 100])

vertical_stack = pd.concat([series1, series2], ignore_index=True)
print("Vertical Stack:\n", vertical_stack)

horizontal_stack = pd.concat([series1, series2], axis=1)
print("Horizontal Stack:\n", horizontal_stack)
```



```
   ...: print("Horizontal Stack:\n", horizonta
Vertical Stack:
 0     10
1     20
2     30
3     40
4     50
5     60
6     70
7     80
8     90
9    100
dtype: int64
Horizontal Stack:
    0    1
0  10   60
1  20   70
2  30   80
3  40   90
4  50  100
```

Github link: https://github.com/JenishDesai5115/PWP_postlabs