

```
In [1]: import numpy as np
import pandas as pd
```

Create A Series

- Series Is One-Dimensional Array Of Data
- It Can Hold Data Of Any Type: String, Integer, Float, Dict, List, Boolean, ...
- Pandas Series Like A Column In A Table

```
In [3]: data = [1, 2, 3, 4]
series = pd.Series(data)
series
```

```
Out[3]: 0    1
        1    2
        2    3
        3    4
dtype: int64
```

```
In [4]: data = ["Osama", "Mohamed", "Khaled", "Mahmoud"]
series = pd.Series(data)
series
```

```
Out[4]: 0    Osama
        1  Mohamed
        2   Khaled
        3  Mahmoud
dtype: object
```

You Can Specify The Index Of the Rows

```
In [6]: series = pd.Series(data, index=["N1", "N2", "N3", "N4"])
series
```

```
Out[6]: N1    Osama
        N2  Mohamed
        N3   Khaled
        N4  Mahmoud
dtype: object
```

DataFrame

- Pandas DataFrame Is A 2-Dimensional Data Structure
- Like 2 Dimensional Or A Table With Rows And Columns

```
In [8]: data = {
    "Calories": [420, 380, 390],
    "Duration": [50, 40, 45],
}

# Load The Data Into A DataFrame Object
df = pd.DataFrame(data)
df
```

```
Out[8]:
```

	Calories	Duration
0	420	50
1	380	40
2	390	45

```
In [9]: data = [
    [1, 2, 3],
    [4, 5, 6],
    [7, 8, 9],
]

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

```
Out[9]:
```

	0	1	2
0	1	2	3
1	4	5	6
2	7	8	9

Rename DataFrame Columns

```
In [11]: cols = ["Column 1", 'Column 2', "Column 3"]
df.columns = cols
display(df)
```

	Column 1	Column 2	Column 3
0	1	2	3
1	4	5	6
2	7	8	9

Rename DataFrame Index

```
In [13]: index = ["Row 1", 'Row 2', 'Row 3']
df.index = index
df
```

```
Out[13]:
```

	Column 1	Column 2	Column 3
Row 1	1	2	3
Row 2	4	5	6
Row 3	7	8	9

Pandas Dtypes

- Bool: Represents Numerical Datatypes With A True & False Values
- Int: Represents Numerical Datatypes With Integer Values
- Float: Represents Numerical Datatypes With Continuous Values
- Category: Represents categorical Datatypes
- Object: Is A Mix Of Categorical & Numerical Datatypes, Can Carry Any Python Object

Get Datatypes Of All Columns

```
In [16]: df.dtypes
```

```
Out[16]: Column 1    int64
Column 2    int64
Column 3    int64
dtype: object
```

Get Datatype Of One Column

```
In [18]: df['Column 1'].dtype
```

```
Out[18]: dtype('int64')
```

Change Datatype Of Group Of Columns

```
In [20]: columns = ["Column 1", "Column 2", "Column 3"]
df[cols] = df[cols].astype("category")
df.dtypes
```

```
Out[20]: Column 1    category
Column 2    category
Column 3    category
dtype: object
```

Create DataFrame For Testing

```
In [22]: data = np.random.randint(0, 20, (10, 3))
df = pd.DataFrame(data)
df
```

```
Out[22]:
```

	0	1	2
0	10	13	15
1	4	18	2
2	13	17	0
3	5	7	8
4	4	15	8
5	9	5	9
6	15	14	6
7	15	8	17
8	4	7	19
9	8	7	8

Get The First Rows Of DataFrame

- Get The First 5 Rows On The DataFrame

```
In [24]: df.head()
```

```
Out[24]:
```

	0	1	2
0	10	13	15
1	4	18	2
2	13	17	0
3	5	7	8
4	4	15	8

Get The Last Rows Of DataFrame

- Get The Last 5 Rows On The DataFrame

```
In [26]: df.tail()
```

```
Out[26]:
```

5	9	5	9
6	15	14	6
7	15	8	17
8	4	7	19
9	8	7	8

Get Specific N Rows On The Head

```
In [28]: df.head(3)
```

```
Out[28]:
```

	0	1	2
0	10	13	15
1	4	18	2
2	13	17	0

Get Specific N Rows On The Tail

```
In [30]: df.tail(3)
```

```
Out[30]:
```

	0	1	2
7	15	8	17
8	4	7	19
9	8	7	8

Get Statistical Measures About Numerical Columns

- Method Returns Description Of The Data In The DataFrame
- If The DataFrame Contains Numerical Data, The Description Contains These Information For Each Column:
 - Count: The Number Of Non-Empty Values
 - Mean: The Average value
 - Std: The Standard Deviation
 - Min: The Minimum Value
 - 25%: The 25% Percentile*
 - 50%: The 50% Percentile*
 - 75%: The 75% Percentile*
 - Max: The Maximum Value

```
In [32]: df.describe()
```

```
Out[32]:
```

	0	1	2
count	10.000000	10.000000	10.000000
mean	8.700000	11.100000	9.200000
std	4.473378	4.794673	6.160808
min	4.000000	5.000000	0.000000
25%	4.250000	7.000000	6.500000
50%	8.500000	10.500000	8.000000
75%	12.250000	14.750000	13.500000
max	15.000000	18.000000	19.000000

Get DataFrame Rows Names

```
In [34]: df.index
```

```
Out[34]: RangeIndex(start=0, stop=10, step=1)
```

Get DataFrame Columns Names

```
In [36]: df.columns
```

```
Out[36]: RangeIndex(start=0, stop=3, step=1)
```

Get Unique Values

```
In [38]: df[0].unique()
```

```
Out[38]: array([10,  4, 13,  5,  9, 15,  8])
```

Get Unique Values Numbers

```
In [40]: df[0].nunique()
```

```
Out[40]: 7
```

Get Max Value

```
In [42]: df[0].max()
```

```
Out[42]: 15
```

Get Min Values

```
In [44]: df[0].min()
```

```
Out[44]: 4
```

Get Element Whose Value Is Max

- Returns A Series With The Index Of The Maximum Value For Each Column
- Returns A Series With The Index Of The Maximum Value For Each Row

```
In [46]: df.idxmax()
```

```
Out[46]: 0    6
         1    1
         2    8
         dtype: int64
```

Get Element Whose Value Is Min

- Returns A Series With The Index Of Minimum Value For each Column
- By Sepcifying The Column Axis (axis="columns"), The idxmin() Returns A Series With The Index Of The Minimum Value For Each Row
- Syntax: DataFrame.idxmin(axis)

```
In [48]: df.idxmin()
```

```
Out[48]: 0    1
         1    5
         2    2
         dtype: int64
```

Get The DataFrame Basic Information

- Returns A Summary Of The DataFrame
- The Summary Contains The Number Of Columns, Column Lables, Column Data Types, Memory Usage, Range Index, And The Number Of Cells In Each Columns (non-null values)

```
In [50]: df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10 entries, 0 to 9
Data columns (total 3 columns):
#   Column  Non-Null Count  Dtype
---  -
0    0         10 non-null     int32
1    1         10 non-null     int32
2    2         10 non-null     int32
dtypes: int32(3)
memory usage: 252.0 bytes
```

Get Max Value Of All Columns

```
In [52]: df.max()
```

```
Out[52]: 0    15
         1    18
         2    19
         dtype: int32
```

Get The Unique Value Frequency

```
In [54]: d = df[0].value_counts()
         d
```

```
Out[54]: 0
         4    3
         15   2
         10   1
         13   1
          5   1
          9   1
          8   1
         Name: count, dtype: int64
```

Summation

```
In [56]: df[0].sum()
```

```
Out[56]: 87
```

```
In [57]: df[1].sum()
```

```
Out[57]: 111
```

```
In [58]: df[2].sum()
```

```
Out[58]: 92
```

Convert Pandas Series Into Numpy 1-D Array

```
In [60]: df[0].values
```

```
Out[60]: array([10,  4, 13,  5,  4,  9, 15, 15,  4,  8])
```

```
In [61]: df[1].values
```

```
Out[61]: array([13, 18, 17,  7, 15,  5, 14,  8,  7,  7])
```

Convert Pandas DataFrame Into Numpy 2-D Array

```
In [63]: df.values
```

```
Out[63]: array([[10, 13, 15],
                [ 4, 18,  2],
                [13, 17,  0],
                [ 5,  7,  8],
                [ 4, 15,  8],
                [ 9,  5,  9],
                [15, 14,  6],
                [15,  8, 17],
                [ 4,  7, 19],
                [ 8,  7,  8]])
```

Replace A Single Value

```
In [65]: data = np.arange(20).reshape(5, 4)
         df = pd.DataFrame(data)
         df
```

```
Out[65]:
```

	0	1	2	3
0	0	1	2	3
1	4	5	6	7
2	8	9	10	11
3	12	13	14	15
4	16	17	18	19

```
In [66]: df.replace(0, "Zero")
```

```
Out[66]:
```

	0	1	2	3
0	Zero	1	2	3
1	4	5	6	7
2	8	9	10	11
3	12	13	14	15
4	16	17	18	19

```
In [67]: df.replace(10, "Ten")
```

```
Out[67]:
```

	0	1	2	3
0	0	1	2	3
1	4	5	6	7
2	8	9	Ten	11
3	12	13	14	15
4	16	17	18	19

Replace Multiple Values Using Dictionary

```
In [69]: df.replace({
    0 : "Zero",
    5 : "Five",
    10: "Ten",
})
```

```
Out[69]:
```

	0	1	2	3
0	Zero	1	2	3
1	4	Five	6	7
2	8	9	Ten	11
3	12	13	14	15
4	16	17	18	19

Replace Multiple Values By One Value

```
In [71]: df.replace({0, 1, 2, 3}, "Value")
```

```
Out[71]:
```

	0	1	2	3
0	Value	Value	Value	Value
1	4	5	6	7
2	8	9	10	11
3	12	13	14	15
4	16	17	18	19

Data Manipulating (Mapping)

- Used To Substitute

Data Before Mapping

```
In [74]: cols = ["col1", "col2", "col3", "col4"]
df.columns = cols
df
```

```
Out[74]:
```

	col1	col2	col3	col4
0	0	1	2	3
1	4	5	6	7
2	8	9	10	11
3	12	13	14	15
4	16	17	18	19

Data After mapping

```
In [76]: df.col2 = df.col2.map({5: "Fives", 1: "Ones"})
df
```

```
Out[76]:
```

	col1	col2	col3	col4
0	0	Ones	2	3
1	4	Fives	6	7
2	8	NaN	10	11
3	12	NaN	14	15
4	16	NaN	18	19

Sorting

Ascending Sorting

```
In [79]: # Sort col1 On The DataFrame
sorted_df = df.sort_values(by="col1")
sorted_df
```

```
Out[79]:
```

	col1	col2	col3	col4
0	0	Ones	2	3
1	4	Fives	6	7
2	8	NaN	10	11
3	12	NaN	14	15
4	16	NaN	18	19

```
In [80]: sored_df = df.sort_values(by="col3")
sorted_df
```

```
Out[80]:
```

	col1	col2	col3	col4
0	0	Ones	2	3
1	4	Fives	6	7
2	8	NaN	10	11
3	12	NaN	14	15
4	16	NaN	18	19

Descending Sort

```
In [82]: sorted_df = df.sort_values(by = "col1", ascending=False)
sorted_df
```

```
Out[82]:
```

	col1	col2	col3	col4
4	16	NaN	18	19
3	12	NaN	14	15
2	8	NaN	10	11
1	4	Fives	6	7
0	0	Ones	2	3

Apply Method

```
In [84]: # First Print The DataFrame Before Applying The Method
df
```

```
Out[84]:
```

	col1	col2	col3	col4
0	0	Ones	2	3
1	4	Fives	6	7
2	8	NaN	10	11
3	12	NaN	14	15
4	16	NaN	18	19

```
In [85]: # Then Make Method, And Apply This To The DataFrame Elements
def duplicate(x):
    return x*2
df["col1"].apply(duplicate)
```

```
Out[85]:
```

0	0
1	8
2	16
3	24
4	32

Name: col1, dtype: int64

You Can Use Lambda Function

```
In [87]: df['col1'].apply(lambda x: x*3)
```

```
Out[87]:
```

0	0
1	12
2	24
3	36
4	48

Name: col1, dtype: int64

Indexing & Slicing

Indexing

- Means Accesing One Element In Series Or DataFrame, Using Its Index Or Name
- There Are Two Ways To Apply Indexing
 1. Using The Element's Index
 2. Using The Element's Name

Slicing

- Means Accessing Many Elements In Series Or DataFrame, By Specifying A Range Of Indices Or Name
- There Are Two Ways To Apply Slicing:
 1. Using Range Of Element's Indices
 2. Using Range Of Element's Names

```
In [89]: data = np.arange(20).reshape(10, 2)
df = pd.DataFrame(data)
cols = ["Column1", "Column2"]
df.columns = cols
df
```

Out[89]:

	Column1	Column2
0	0	1
1	2	3
2	4	5
3	6	7
4	8	9
5	10	11
6	12	13
7	14	15
8	16	17
9	18	19

Series Indexing

In [91]: *# Print The Value Of The Given Index*
`df.Column1.iloc[6]`

Out[91]: 12

In [92]: *# Print The Value Of The Given Index*
`df.Column2.iloc[5]`

Out[92]: 11

Matrix Indexing

In [94]: `df.iloc[2, 1]`

Out[94]: 5

Series Slicing

In [96]: `df.Column1.iloc[0:2]`

Out[96]: 0 0
1 2
Name: Column1, dtype: int32

Matrix Slicing

In [98]: *# Get Rows Starting From Index 5 To End, And Get All Columns*
`df.iloc[5:, :]`

Out[98]:

	Column1	Column2
5	10	11
6	12	13
7	14	15
8	16	17
9	18	19

In [99]: *# Get All Rows, And Get First Column*
`df.iloc[:, 0:1]`

```
Out[99]:
```

	Column1
0	0
1	2
2	4
3	6
4	8
5	10
6	12
7	14
8	16
9	18

Indexing & Slicing Using Names

Series Indexing

```
In [102]: df.Column1.loc[3]
```

```
Out[102]: 6
```

Matrix Indexing

```
In [104]: df.loc[2, "Column1"]
```

```
Out[104]: 4
```

Series Slicing

```
In [106]: df.Column1.loc[2:3]
```

```
Out[106]: 2    4
          3    6
          Name: Column1, dtype: int32
```

Matric Slicing

```
In [108]: df.loc[:3, "Column1": "Column2"]
```

```
Out[108]:
```

	Column1	Column2
0	0	1
1	2	3
2	4	5
3	6	7

Inserting & Dropping DataFrame Columns & Rows

Create New DataFrame

```
In [111]: data = np.arange(18).reshape(6, 3)
df = pd.DataFrame(data)
cols = ["col1", "col2", "col3"]
df.columns = cols
df
```

```
Out[111...]
   col1  col2  col3
0      0     1     2
1      3     4     5
2      6     7     8
3      9    10    11
4     12    13    14
5     15    16    17
```

Insert New Column

- Method Allows Us To Insert New Column To An Existing DataFrame
- Syntax: `insert(location, column, value, allow_duplicate)`

```
In [113...]
new_col = df.col1 + df.col2
df.insert(3, "new", new_col)
df
```

```
Out[113...]
   col1  col2  col3  new
0      0     1     2     1
1      3     4     5     7
2      6     7     8    13
3      9    10    11    19
4     12    13    14    25
5     15    16    17    31
```

Another Way To Insert New Column

```
In [115...]
df["new_column"] = df.col1 + df.col2
df
```

```
Out[115...]
   col1  col2  col3  new  new_column
0      0     1     2     1           1
1      3     4     5     7           7
2      6     7     8    13          13
3      9    10    11    19          19
4     12    13    14    25          25
5     15    16    17    31          31
```

Drop Column

Drop One Column

```
In [118...]
df.drop('new', axis=1)
```

```
Out[118...]
   col1  col2  col3  new_column
0      0     1     2           1
1      3     4     5           7
2      6     7     8          13
3      9    10    11          19
4     12    13    14          25
5     15    16    17          31
```

Drop Many Columns

```
In [120...]
df.drop(["col1", "col2"], axis=1)
```

Out[120..

	col3	new	new_column
0	2	1	1
1	5	7	7
2	8	13	13
3	11	19	19
4	14	25	25
5	17	31	31

Insert New Rows

- Syntax: `append(other, ignore_index, verify_integrity, sort)`
- `ignore_index`: If True --> The Original Indexes Are Ignored And Will Be Replaced By 0, 1, 2, ..
- `verify_integrity` --> If True You Will Get An Error If You Have Two Or More Rows With The Same Index
- `sort` --> If True Sorts Columns

In [122..

```
new_row = {"col1": 1, "col2": 222, "col3": 333}
new_row2 = {"col1": 10, "col2": 20, "col3": 30, "new": 40, "new_column": 50}
x = df._append(new_row, ignore_index = True)
y = df._append(new_row2, ignore_index = True)
display(x)
```

	col1	col2	col3	new	new_column
0	0	1	2	1.0	1.0
1	3	4	5	7.0	7.0
2	6	7	8	13.0	13.0
3	9	10	11	19.0	19.0
4	12	13	14	25.0	25.0
5	15	16	17	31.0	31.0
6	1	222	333	NaN	NaN

In [123..

```
display(y)
```

	col1	col2	col3	new	new_column
0	0	1	2	1	1
1	3	4	5	7	7
2	6	7	8	13	13
3	9	10	11	19	19
4	12	13	14	25	25
5	15	16	17	31	31
6	10	20	30	40	50

Drop Rows

Drop One Row

In [126..

```
# Drop Row With Index 2
df.drop(2, axis=0)
```

Out[126..

	col1	col2	col3	new	new_column
0	0	1	2	1	1
1	3	4	5	7	7
3	9	10	11	19	19
4	12	13	14	25	25
5	15	16	17	31	31

Drop Many Rows

```
In [128.. df.drop([1, 3], axis=0)
```

```
Out[128..
```

	col1	col2	col3	new	new_column
0	0	1	2	1	1
2	6	7	8	13	13
4	12	13	14	25	25
5	15	16	17	31	31

Null Values

- Null Values Means Missing Values, Which Means That An Element Doesn't Have A Value, Or Have A Value Of None Or Nan
- Null Values Occur Due To Problems During Gathering Data For Example A Client Forget Or To Enter His Age

```
In [130.. # Check For Null Values
null = df.isnull()
pd.DataFrame(null.sum()).T
```

```
Out[130..
```

	col1	col2	col3	new	new_column
0	0	0	0	0	0

Create New DataFrame With A Null (NaN) Values

```
In [154.. # Create New DataFrame With Null Values
data = np.array([
    [np.nan, 2, 3, np.nan],
    [10, 20, 30, np.nan],
    [10, 20, 30, 40],
    [10, 20, 65, 60],
    [10, 80, 100, 60],
    [np.nan, 10, np.nan, np.nan],
])

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

```
Out[154..
```

	0	1	2	3
0	NaN	2.0	3.0	NaN
1	10.0	20.0	30.0	NaN
2	10.0	20.0	30.0	40.0
3	10.0	20.0	65.0	60.0
4	10.0	80.0	100.0	60.0
5	NaN	10.0	NaN	NaN

Check For Null (NaN) Values

```
In [157.. null = df.isnull()
pd.DataFrame(null.sum()).T
```

```
Out[157..
```

	0	1	2	3
0	2	0	1	3

```
In [159.. # Print The Null Values As Boolean Values
null
```

```
Out[159..
```

	0	1	2	3
0	True	False	False	True
1	False	False	False	True
2	False	False	False	False
3	False	False	False	False
4	False	False	False	False
5	True	False	True	True

Handle Null Values

- There Are Three Options To Handle Missing Values:
 1. Drop Rows That Contains Null Values
 2. Drop Columns That Contains Null Values
 3. replace Null Values With Mean, Median, Or Mode

Drop All Rows

Remove ALL Rows With Null Values From The DataFrame

```
In [164... df.dropna()
```

```
Out[164...
   0    1    2    3
2 10.0 20.0 30.0 40.0
3 10.0 20.0 65.0 60.0
4 10.0 80.0 100.0 60.0
```

Drop Rows In Specific Columns

```
In [167... df.dropna(subset=[3])
```

```
Out[167...
   0    1    2    3
2 10.0 20.0 30.0 40.0
3 10.0 20.0 65.0 60.0
4 10.0 80.0 100.0 60.0
```

Drop Columns

```
In [170... df
```

```
Out[170...
   0    1    2    3
0 NaN  2.0  3.0 NaN
1 10.0 20.0 30.0 NaN
2 10.0 20.0 30.0 40.0
3 10.0 20.0 65.0 60.0
4 10.0 80.0 100.0 60.0
5 NaN 10.0  NaN  NaN
```

Drop All Columns That Contains Null Values

```
In [172... df.dropna(axis=1)
```

```
Out[172...
   1
0  2.0
1 20.0
2 20.0
3 20.0
4 80.0
5 10.0
```

Drop Specific Columns

```
In [180... df.drop([0], axis=1)
```

Out[180...

	1	2	3
0	2.0	3.0	NaN
1	20.0	30.0	NaN
2	20.0	30.0	40.0
3	20.0	65.0	60.0
4	80.0	100.0	60.0
5	10.0	NaN	NaN

In [182...

```
df.drop([2], axis=1)
```

Out[182...

	0	1	3
0	NaN	2.0	NaN
1	10.0	20.0	NaN
2	10.0	20.0	40.0
3	10.0	20.0	60.0
4	10.0	80.0	60.0
5	NaN	10.0	NaN

Rename The Columns Name

In [191...

```
cols = ["col1", "col2", "col3", "col4"]
df.columns = cols
df
```

Out[191...

	col1	col2	col3	col4
0	NaN	2.0	3.0	NaN
1	10.0	20.0	30.0	NaN
2	10.0	20.0	30.0	40.0
3	10.0	20.0	65.0	60.0
4	10.0	80.0	100.0	60.0
5	NaN	10.0	NaN	NaN

Replace Rows Null Values

In [194...

```
mean = df.col1.mean()
df.col1 = df.col1.fillna(value=mean)
df
```

Out[194...

	col1	col2	col3	col4
0	10.0	2.0	3.0	NaN
1	10.0	20.0	30.0	NaN
2	10.0	20.0	30.0	40.0
3	10.0	20.0	65.0	60.0
4	10.0	80.0	100.0	60.0
5	10.0	10.0	NaN	NaN

In []: