Pandas

Pandas:-

↳ Wes McKinney in 2008.

↳ Open source library - mainly work with relational/ labeled data easily.

↳ Various data stru work with numeric data & time series.

↳ Fast, high performance & productivity.

↳ Function - Analyzing, cleaning, exploring & manipulating data.

↳ Data cleaning - Delete irrelevant rows / wrong values empty/ NULL values.

Why Pandas:-

↳ Fast & efficient data manipulation & analyzing.

↳ Easy load data.

↳ Flexible reshaping & pivoting data sets.

↳ Time series analysis functionality.

Uses of Pandas:-

↳ Data set cleaning, merging & joining.

↳ Easy handle missing data (NaN).

↳ Easy insert, delete col & records in DF.

↳ Groupby functionality.

↳ Split-apply-combine operations.

↳ Data visualization.

Get Started with Pandas :-

① **Install Pandas** – Use pip command :

```
pip install pandas
```

② **Import Pandas** – Use following import statement :

```
import pandas as pd
```

Data Structures :-

1) Series :-

↳ 1D labeled array hold - int, str, float, object.

↳ Labels must be hashable (immutable) type.

↳ In real world create series from : existing storage, SQL database, CSV file / Excel file.

↳ Can create from - List, dict & scalar values.

```
>>> arr = np.array([10, 15, 20, 25])
>>> sr = pd.series(arr)
```

O/p →

```
0   10
1   15
2   20
3   25
```

- **series** – Just like a column in table / excel sheet.

- **Labels** – Default, index start from 0.
  ↳ Used to access values in series.

- **Create labels for series** – with **index** arg, can give labels to the series.

```
>>> sr = pd.Series(a, index = ['a', 'b'])
```

O/p →
```
a   1
b   2
dtype: int64
```

Len = series len.

- **Key / value object** – create series from Dict.
  - ↳ keys become labels.

```
>>> d = {'a': 10, 'b': 20, 'c': 30}
>>> sr = pd.Series(d)
```

O/p →
```
a   10
b   20
c   30
```

- **Series with selected Dict keys** – Use **index** arg, to specify items to select.

```
>>> d = {'a': 10, 'b': 20, 'c': 30}
>>> sr = pd.Series(d, index = ['a', 'c'])
```

O/p →
```
a   10
c   30
```
→ 'b' is not taken.

- **Series Represented by** –

```
<class 'pandas.core.series.Series'>
```

2) DataFrame :-

↳ 2D size-mutable, heterogeneous tabular data stru. with labeled axis (rows & cols).

↳ cols - Also cla Feature, variable, field, dimension.

↳ rows - Records, values, ~~obje~~ observa^n, index.

- **Applications of DataFrame :**

① Work on data set.
② Analysis
③ Dropping
④ Processing
⑤ cleaning
⑥ Join multiple data(csv, excel file format)
⑦ Create Excel, CSV, JSON, binary files.
⑧ Math & statistical opera^n.
⑨ Use of Groupby.

- **Represented by -**

```
<class 'pandas.core.frame.DataFrame'>
```

- **Creating DataFrame -**

① **From dict with List values -**

```
>>> data = {'a' : [1,2], 'b' : [11,12]}
>>> df = pd.DataFrame(data)
```

O/p →

	a	b
0	1	11
1	2	12

② Same value to all rows:-

```
>>> data = {'name': 'A', 'b': [1,2], 'c': [11,12]}
>>> df = pd.DataFrame(data)
```

O/p →

	name	a	b
0	A	1	11
1	A	2	12

Same value to all the columns.

③ Dict of numpy arrays:-

```
>>> a = np.array([1,2])
>>> b = np.array([11,12])
>>> d = {'a': a, 'b': b}
>>> df = pd.DataFrame(d)
```

O/p →

	a	b
0	1	11
1	2	12

④ List of Lists -

```
>>> lst = [['a','b'], [1,2], [11,12]]
>>> df = pd.DataFrame(dict(zip(lst[0], lst[1:])))
```

O/p →

	a	b
0	1	11
1	2	12

⑤ Named Indexes - Use index argument -

```
>>> df = pd.DataFrame(d, index=['id1', 'id2'])
```

O/p →

	a	b
id1	1	11
id2	2	12

- **Importing & Exporting Dataframes –**

① **CSV File** – comma-separated values.

```
df.to_csv('file.csv')
df = pd.read_csv('file.csv')
```

② **Excel File** –

```
df.to_excel('file.xlsx')
df = pd.read_excel('file.xlsx')
```

③ **JSON** – Same format like Python Dict.

```
df.to_json('file.json')
df = pd.read_json('file.json')
```

④ **HTML** – Export to HTML <table> element.

```
df.to_html('file.html')
df = pd.read_html('file.html')
```

- **DataFrame Functions –**

1) **Checking Size & Index:**

① **size** – Size of DataFrame = rows * cols.

Ex. [545 rows * 13 columns]

7085

② **index** – Range of index from start to end.

O/p – RangeIndex (start=0, stop=544, step=1)

2) Get columns of DF -

① **columns** - Get names of columns.

O/p - Index ([.....], dtype = 'object')

List of columns.

② **axes** - Range of index & names of columns.

O/p - [RangeIndex (start=0, stop=544, step=1),

Index ([.....], dtype = 'object')]

⊙ Getting DF Information:

① **df.info()** - Get info of overall DF.

```
>>> df.info()
```

O/p → <class 'pandas.core.frame.DataFrame'>

RangeIndex: 545 entries, 0 to 544

Data columns (total ___ columns):

#	Column	Non-Null count	Dtype

dtypes: int64(), object(), ...

Memory usage: 55.5+ KB

None

② df.describe() – Return all stat fun^ values, of numeric cols only.

↳ Not work for str(object) type.

```
>>> df.describe()
```

O/P →

	col names	____	____	____
count	-			
mean	-			
std	-			
min	-			
25%	-			
50%	-			
75%	-			
max	-			

③ max_rows – Define num of rows returned.

↳ Found at: pd.options.display.max_rows.

↳ Default value is 60.

↳ So, for DF with rows > 60, when print() return header, 1st & last 5 rows.

- Change value –

```
pd.options.display.max_rows = gggg
```

Set other value.

Viewing Data from DF :-

① df.to_string() — Print entire DF.

② df.head() — Return top columns.

↳ Default 5, but can give num.

df.head() ⟶ 5 rows

df.head(10) ⟶ 10 rows

③ df.tail() — Return bottom columns.

↳ Default 5, but can give num.

df.tail() ⟶ 5 rows

df.tail(10) ⟶ 10 rows

④ df.isna() — Show all NULL values in the DF.

↳ Return DF with bools:

- True : NULL values
- False : Non-NULL values

```
>>> df -
    a   b
0   10  15
1   20  np.nan
```

```
>>> df.isna()
O/p →
    a   b
0   T   T
1   T   F
```

```
>>> df.isna().sum()
O/p →
a   0
b   1
dtype : int64
```

} Return count of null values in each columns.

- **Transpose of DataFrame –**

↳ convert rows to cols & cols to rows.

```
>>> df.transpose()
>>> df.T
```

} Both serve same.

	a	b
0	1	11
1	2	12

(Transpose) ⟹

	0	1
a	1	2
b	11	12

- **dropna() Method:–**

```
df.dropna(axis=0, how='any',
          thresh=None, subset=None,
          inplace=False)
```

- axis – 0 ('index') / 1 ('columns').
- how – 'any' – Drop if any 1 null present.
  'all' – Drop only if all null present.
- thresh – Min count of non-null values.
- subset – Limit to passed list of rows/cols.
- inplace – Permanent to original, if True.

```
>>> df.dropna(axis=0)   ⇒ Drop na rows.
>>> df.dropna(axis=1)   ⇒ Drop na columns.
```

```
>>> subset = ['col_1', 'col_2']
```

⇒ consider na of these columns only.

>>> thresh = 3 : Drop rows with less than 3 non-null values.

Non-null values should be greater than thresh values, otherwise drop.

- fillna() method – Replace the null with other values.

```
df.fillna(value, method, axis, limit,
                    downcast, inplace=False)
```

- value – Value to replace with – num, str, dict, Series, DataFrame.
- method – Method to use when replacing. backfill, bfill, pad, ffill, None.
- axis – 0('index') / 1('columns')
- inplace – True - Permanent to original DF.
- limit – Max. num. of null values to fill.
- downcast – Dict of values to fill for specific data types.

- Example –

```
df['col-1'].fillna(value, inplace=True)
```

• Accessing DataFrame :-

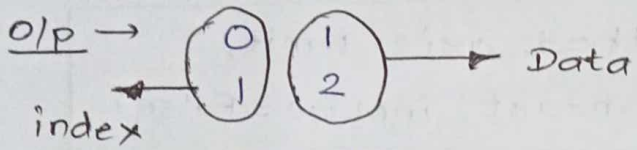
① By Column Name –

```
df.col_name
df['col_name']
```

} Return whole col data.

>>> df.a / df['a']

O/p →



Name : a, Length : 2, dtype : int64

• Give index value in [] –

>>> d.a [1] OR >>> d['a'][1]

- Return value at '1' index of col 'a'.

O/p – 2

② Locate Rows – loc attr return 1/more rows.

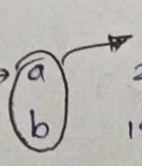
↳ Also access val at index & col.

↳ Can get record at index :

```
df.loc[index]
df.loc[start:end]
df.loc[start:end:step]
```

>>> df.loc[1] → Data at index '1'

O/p →



Name : 1, dtype : int64

>>> df.loc[0:1]

O/p →

	a	b
0	1	11
1	2	12

• loc[] with condition: `df.loc[condition]`

```
>>> df.loc[df['a']%2==0]
```

O/p –

	a	b
[1]	2	12

• loc[] with multiple conditions:

`df.loc[(condi1) & (condi2) & (condi3)]`

condi1 condi2

```
>>> df.loc[(df['a']==2) & (df['b']==12)]
```

	a	b
1	2	12

• Access multiple columns: write column names in list

`df[[col_names_list]]`

```
>>> df[['a', 'b']]
```

③ iloc[] — Pass axes numbers for index & cols.

`df.iloc[row_index, col_index]`

```
>>> df.iloc[1:5, ]
```

1 to 4 rows & all columns.

```
>>> df.iloc[1:5, :3]
```

1 to 4 rows & first 3 cols.

- **Basic Data cleaning :-**

↳ Fixing bad data in the dataset;

① Empty cells

② Wrong format data

③ Wrong data

④ Duplicates

~~1) Empty cells - Have effect, remove some rows large data.~~

~~df.dropna(inplace = True)~~

1) **Empty cells** - Result in wrong analysis.

① **Remove** - Remove some rows in large data sets.

```
df.dropna(inplace = True)
```

② **Fill another value** - May be mean, median, mode.

```
df['col-name'].fillna(val, inplace = True)
```

③ **Replace with mean, median, mode** -

```
df['col'].fillna(df['col'].mean(), inplace = T)
```

2) **Wrong Format data** -

Ex: '2020/12/01', '10 Dec 2020', '2020-12-01'

① **Convert to correct format** -

```
df['date'] = pd.to_datetime(df['date'])
```

convert to: 2020-12-01 format

NaT - Not a Date, for NULL values.

③ Remove NULL Data –

```
df.dropna(subset = ['Date', inplace = True)
```

↳ check for NULL values in 'Date' col only.

3) Fixing wrong Data –

↳ Maby be data not in default range.

↳ Can be outlies.

① Replace with other values –

```
df.loc[index, col] = other_value
```

↳ Replacing one value possible for few values.

② Remove rows –

```
df.drop(index, inplace = True)
```

- For large data set with many values –

```
for i in df.index:
    if df.loc[i, col] (condition) True:
        df.loc[i, col] = other
```

↳ check for condition of wrong data.

OR

```
df.drop(i, inplace = True)
```

4) **Removing Duplicates:** Duplicates just ↑ size of data.

↳ Use `duplicated()` method for duplicate rows.

↳ Return bool for each row -

- True - Duplicate
- False - Original

↳ Remove automatically: `remove_duplicates()`.

```
>>> df.duplicated()
```

O/P →

```
0    False
1    False
2    True
:
n    False
dtype: bool
```

```
df.duplicated(subset, keep)
```

subset → list of cols to consider

keep → 'first', 'last', False (Delete all)

```
>>> df.drop_duplicates(inplace=True)
```

```
df.drop_duplicates(subset, keep,
                   ignore_index, inplace=False)
```

- `subset` - consider these list of cols only.
- `keep` - 'first', 'last', False (delete all).
- `ignore_index` — If True: Return continuous index start from 0.

otherwise return original, may not continuous.

• Apply filter on the Data :

1) **apply() Method** – df.apply() take funⁿ arg & apply to all values in series/col.

```
df.apply( func , convert_dtype = True,
                 args = ())
```

- **func** – Funcⁿ to apply on data in series.
- **convert_dtype** – True, convert type as per operⁿ.
- **args** – Additional args to the funⁿ.

```
>>> d = {
        'name' : ['A', 'B', 'C', 'D', 'E'],
        'Marks': [56, 70, 40, 80, 90]
>>> }
>>> df = pd.DataFrame(d)

>>> def func(num):
>>>     if num>60:
>>>         return 'Pass'
>>>     else:
>>>         return 'Fail'
```

} Funⁿ to apply on the individual data.

```
>>> df['Marks'].apply(func, convert_dtype=True)
```

O/p →

```
0    Fail
1    Pass
2    Fail
3    Pass
4    Pass
```

} convert marks to Pass/Fail strings.

2) map() Method:

↳ Transform values in series (col) using specified mapping data/ fun^n.

↳ Replace values from series with other series val/ result of custom fun^n.

↳ map fun^n can take- dict, series/ fun^n.

```
new_sr = old_sr.map(mapping)
```

- old_sr: sr need to be transformed.
- new_sr: Dict/ series/ fun^n defining transform^n.

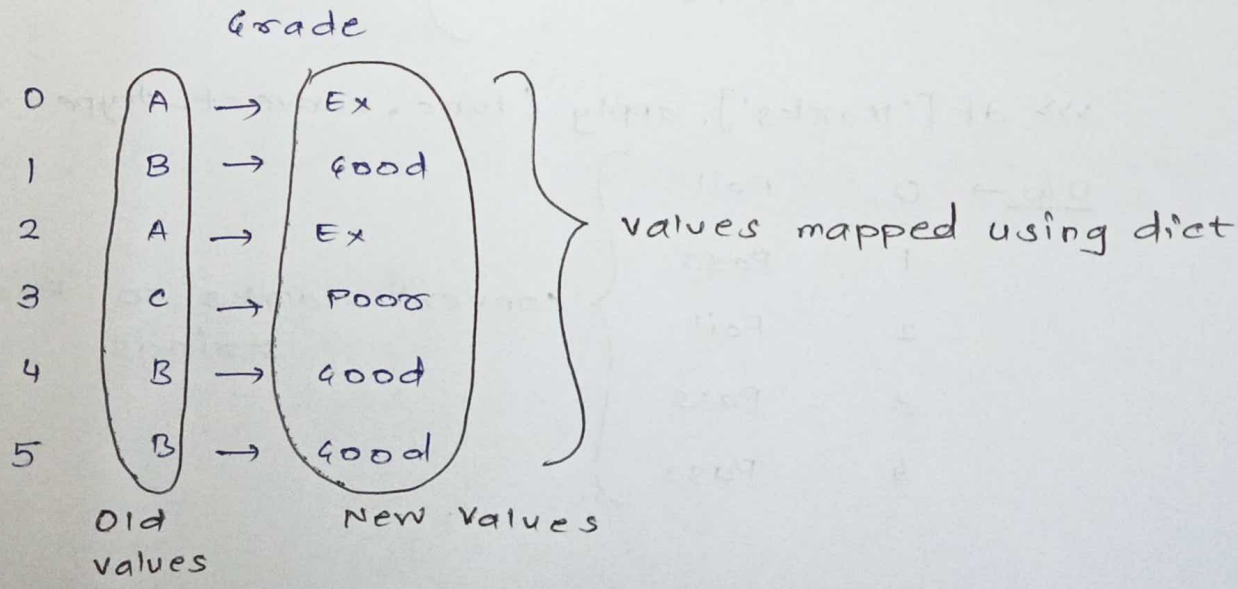
① Using Dict mapping - Use dict to replace the values in series.

```
>>> data = {'Grade' : ['A', 'B', 'A', 'C', 'B', 'B']}
>>> df = pd.DataFrame(data)
>>> grades = {'A' : 'Ex', 'B' : 'Good', 'C' : 'Poor'}
```

corresponding value to change.

Keys define values in old series.

```
>>> df['Grade'] = df['Grade'].map(grades)
```



② Using series Mapping – Use series to transform values.

↳ Pass new values as data.

```
>>> sr = pd.series ( ['Ex', 'Good', 'Poor'],
                     index = ['A', 'B', 'C'])
```

↳ Give old values to index

```
>>> df ['Grade] = d['Grade'].map(sr)
```

O/p →

	Grade
0	A → Ex
1	B → Good
2	A → Ex
3	C → Poor
4	B → Good
5	B → Good

③ Using Function for Mapping – serves same as apply().

↳ Use custom fun^n for transforming values in series.

```
>>> def transform(gr):
>>>     if gr == 'A':
>>>         return 'Ex'
>>>     elif gr == 'B':
>>>         return 'Good'
>>>     elif gr == 'C':
>>>         return 'poor'
```

```
>>> df ['Grade'] = df ['Grade'].map(transform)
```

O/p →

	Grade
0	Ex
1	Good
2	Ex
3	Poor
4	Good
5	Good