



Unitedworld Institute of Technology

Data

Science

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Unitedworld Institute of Technology **DATA
OPERATIONS**

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Data Operations

Data Operations refers to the **set of actions** we perform to **understand, analyze, and transform** the data once it is collected and cleaned.



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1. Reading

Reading data means **loading** a dataset from an **external**

source into your Python environment using the pandas library.

We mostly use:

`pd.read_csv()` – for CSV files

`pd.read_excel()` – for Excel files

`pd.read_json()` – for JSON files

`pd.read_html()` – to extract tables from websites



General Codes:

Code 1: Reading a CSV file

```
import pandas as pd
```

```
df = pd.read_csv("students.csv")
print(df.head())
```

NOTE:

Loads the CSV file named students.csv into a DataFrame and displays the first 5 rows using .head().



Unitedworld Institute of Technology **Code 2: Reading an Excel file**

```
df_excel = pd.read_excel("sales_data.xlsx")
print(df_excel.info())
```

NOTE:

Reads an Excel file and shows structure: columns, datatypes, missing values.



Unitedworld Institute of Technology **Code 3: Reading a Dataset from**

URL

```
url = "https://raw.githubusercontent.com/mwaskom/seaborn  
data/master/iris.csv"  
  
df_iris = pd.read_csv(url)  
print(df_iris.head())
```

NOTE:

Fetches a public CSV dataset directly from a URL.



Unitedworld Institute of Technology **Code 4: Reading a JSON file**

```
df_json = pd.read_json("data.json")  
print(df_json.head())
```

NOTE:

Reads a JSON file. JSON is commonly used in APIs.



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How to View Data

.head(),

.tail()

.info()

.shape



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Task to do

Q. What is Custom delimiter ?

Q. Give the Code ?



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2. Selecting

Code 1 : Selecting Columns using df[]

```
df["Student"] # Single column
```

```
df[["Student", "CGPA"]] # Multiple columns
```

NOTE:

df['col'] gives a **Series**

df[['col1', 'col2']] gives a **DataFrame**



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Code 2 : Selecting by Labels with .loc[]

Syntax: df.loc[row_label, column_label]

```
df.loc[2] # Entire row with index 2 df.loc[0:2, "Student"] #
```

Student names from row 0 to 2

```
df.loc[1:3, ["Student", "CGPA"]]
```

Rows 1 to 3 with two columns (include 1,2,3)



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Code 3 : Selecting by Index Numbers with

.iloc[] Syntax: df.iloc[row_index, column_index]

```
df.iloc[2] # Row at position 2
```

```
df.iloc[1:4, [0, 2]] # Rows 1 to 3, columns 0 and 2 or
```

```
print(df.iloc[0:2, 0:2]) # Select first two rows and first two  
columns
```

```
df.iloc[:, 1] # All rows, column 1
```



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Task	Code	Returns
Select one column	df['Name']	Series
Select multiple columns	df[['Name', 'City']]	DataFrame
Select row by label	df.loc[1]	Series
Select row and specific columns	df.loc[0, ['Name', 'City']]	Series

Select rows/cols by label	<code>df.loc[[0, 2], ['Name', 'Age']]</code>	DataFrame
Select row by position	<code>df.iloc[1]</code>	Series
Select value by position	<code>df.iloc[0, 1]</code>	Scalar value
Select range of rows and columns	<code>df.iloc[0:2, 0:2]</code>	DataFrame



3. Data Filtering

Example :

```
import pandas as pd
```

```
data = {'Name': ['Alice', 'Bob', 'Charlie', 'David'],
```

```
'Age': [25, 30, 35, 28],  
'City': ['Delhi', 'Mumbai', 'Chennai', 'Delhi']}  
df = pd.DataFrame(data)  
print(df)
```



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OUTPUT :

	Name	Age	City
0	Alice	25	Delhi
1	Bob	30	Mumbai
2	Charlie	35	Chennai
3	David		



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1. Filter rows based on a single condition

CODE:

```
# Filter where Age > 30  
print(df[df['Age'] > 30])
```

OUTPUT:

Name Age City
2 Charlie 35 Chennai



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2. Filter rows based on multiple

conditions Use & (and), | (or), ~ (not) with parentheses

0

CODE:

```
# Age > 25 AND City is Delhi  
print(df[(df['Age'] > 25) & (df['City'] == 'Delhi')])
```

OUTPUT:

Name Age City

3 David 28 Delhi



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Why use .isin()?

- In Pandas, `.isin()` is used to filter rows where a column's value is **in a list or set of multiple values**.

Eg: `df[df['City'].isin(['Delhi', 'Mumbai', 'Chennai'])]`

Without `.isin()`:

- We need to write **multiple OR conditions**, which gets messy:

Eg: `df[(df['City'] == 'Delhi') | (df['City'] == 'Mumbai') | (df['City'] == 'Chennai')]`



Key Benefits of .isin():

Advantage	Explanation
Easy syntax	More readable than writing multiple == and `
Works with lists/sets	You can filter using many values at once
Works with NOT using ~	Like ~df['City'].isin(['Delhi']) to exclude Delhi



3. Filter using string methods

CODE:

```
# Filter where Name starts with 'A'
```

```
print(df[df['Name'].str.startswith('A')])
```

OUTPUT:

Name Age City

0 Alice 25 Delhi



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Quiz

```
import pandas as pd
```

```
data = {'Name': ['Alice', 'Bob', 'Charlie', 'David',
```

```
'Eva'], 'Age': [25, 30, 35, 28, 22],  
'City': ['Delhi', 'Mumbai', 'Chennai', 'Delhi',  
'Kolkata']}  
df = pd.DataFrame(data)
```



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Q1. Filter all rows where the Age is greater than 28

Write the filtering line of code.

Q2. Filter all rows where the City is either Delhi or Kolkata

Use `.isin()` method.



Q3. Filter all rows where Name starts with the letter 'C'

Q4. Filter all rows where Age is NOT 30 or 35

Q5. Filter all rows where City is not Delhi, using the ~ operator.



- **Manipulating data** means **modifying the contents** of a DataFrame — like changing values, adding/removing columns, renaming, replacing, or applying calculations.
- This includes:

- Adding new columns
- Updating existing values
- Replacing missing or incorrect data
- Changing data types
- Applying operations to transform data



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Common Manipulation Operations:

S.No.	Operation	Example
1	Add new column	Add Total or Grade column

2	Modify values	Update names, marks, etc.
3	Apply formula	Convert marks to percentage
4	Replace values	Replace 'NaN' or wrong data
5	Rename columns	Make headers cleaner or standardized



Unitedworld Institute of Technology Example 1: Create a Sample DataFrame

CODE:

```
import pandas as pd
```

```
data = {'Name': ['Alice', 'Bob', 'Charlie'],  
'Marks': [85, 90, 78],  
'City': ['Delhi', 'Mumbai', 'Chennai']}
```

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



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OUTPUT:

	Name	Marks	City
0	Alice	85	Delhi

1 Bob 90 Mumbai

2 Charlie 78 Chennai



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Code1: Add a new column (Let's add a column Grade based on Marks)

CODE:

```
df['Grade'] = ['B', 'A', 'C']  
print(df)
```

OUTPUT:

	Name	Marks	City	Grade
0	Alice	85	Delhi	B
1	Bob	90	Mumbai	A

2 Charlie 78 Chennai C



Unitedworld Institute of Technology Code 2: Update values in a column
(Let's say Bob improved his marks to 95)

CODE:

```
df.loc[df['Name'] == 'Bob', 'Marks'] = 95  
print(df)
```

OUTPUT:

	Name	Marks	City	Grade
0	Alice	85	Delhi	B
1	Bob	95	Mumbai	A
2	Charlie	78	Chennai	C



Code 3: Apply a function to transform data (Let's add 5 bonus marks to each student)

CODE:

```
df['Final_Marks'] = df['Marks'].apply(lambda x: x + 5)
```

OUTPUT:

	Name	Marks	City	Grade	Final_Marks
0	Alice	85	Delhi	B	90
1	Bob	95	Mumbai	A	100
2	Charlie	78	Chennai	C	83



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CODE:

```
def add_bonus(x):  
    return x + 5
```

```
df['Final_Marks'] = df['Marks'].apply(add_bonus)
```

NOTE:

- (1) Lambda is a Short, inline function.
- (2) No need to define a separate named function.



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Code 4: Replace values (Let's change City = 'Chennai' to 'Madras')

CODE:

```
df['City'] = df['City'].replace('Chennai', 'Madras')
print(df)
```

OUTPUT:

	Name	Marks	City	Grade	Final_Marks
0	Alice	85	Delhi	B	90
1	Bob	95	Mumbai	A	100
2	Charlie	78	Madras	C	83



Unitedworld Institute of Technology Code 5: Change Data Type (Change Marks from int to float) **CODE:**

```
df['Marks'] = df['Marks'].astype(float)
print(df.dtypes)
```

OUTPUT:

Name object

Marks float64

City object

Grade object

Final_Marks int64

dtype: object



Unitedworld Institute of Technology Summary

Task	Code
Add new column	<code>df['NewCol'] = [...]</code>
Update cell value	<code>df.loc[row, 'Col'] = new_value</code>

Apply function to column	<code>df['Col'].apply(func)</code>
Replace values	<code>df['Col'].replace(old, new)</code>
Change data type	<code>df['Col'].astype(new_type)</code>



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Special Cases

Ex1: Change a specific value in between (e.g., add 5 to only the second row)

- Modify a specific cell (or row/column) using `.loc[]` or `.iloc[]`.

CODE: Add 5 to the Marks of the second student (index 1): `df.loc[1, 'Marks'] = df.loc[1, 'Marks'] + 5`

OR

```
df.iloc[1, 1] = df.iloc[1, 1] + 5
```

(It's the 2nd row and 2nd column — index 1 and 1):



Unitedworld Institute of Technology Ex 2: Check marks in float

```
print(df)
```

OUTPUT:

	Name	Marks	City	Grade
--	------	-------	------	-------

0	Alice	85.0	Delhi	B
---	-------	------	-------	---

1	Bob	100.0	Mumbai	A
---	-----	-------	--------	---

2	Charlie	88.0	Madras	C
---	---------	------	--------	---



Unitedworld Institute of Technology **5. Data Sorting :**

Sorting in Pandas means arranging your DataFrame based on the values of one or more columns.

It includes:

- Sort by column values (like Marks, Name, etc.)
- Sort by index
- Sort in ascending or descending order
- Sort multiple columns (e.g., by Subject, then Marks)

CODE:

```
df.sort_values(by='column_name', ascending=True/False)
```



Unitedworld Institute of Technology Ex: Create a Data Set

```
import pandas as pd
```

```
data = {'Name': ['Alice', 'Bob', 'Charlie', 'David',  
'Eva'], 'Marks': [85, 95, 78, 88, 95],  
'Subject': ['Math', 'Physics', 'Chemistry', 'Math',  
'Physics']}
```

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



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	Name	Marks	Subject
0	Alice	85	Math
1	Bob	95	Physics
2	Charlie	78	Chemistry

3 David 88 Math

4 Eva 95 Physics



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Code1. Sort by a single column

(ascending) Sort students by Marks in ascending order:

CODE:

```
df_sorted = df.sort_values(by='Marks')  
print(df_sorted)
```



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Name Marks Subject

2 Charlie 78 Chemistry

0 Alice 85 Math

3 David 88 Math

1 Bob 95 Physics

4 Eva 95 Physics

Code 2. Sort by a single column (descending)

```
df.sort_values(by='Marks', ascending=False)
```



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Code 2. Sort by multiple columns

Sort first by Subject, then by Marks in descending order: CODE:

```
df.sort_values(by=['Subject', 'Marks'], ascending=[True, False])
```

OUTPUT:

Name	Marks	Subject
2 Charlie	78	Chemistry
0 Alice	85	Math
3 David	88	Math
1 Bob	95	Physics
4 Eva	95	Physics



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Code 3. Sort by index

CODE:

```
import pandas as pd
```

```
data = {  
    'Name': ['Alice', 'Bob', 'Charlie'],  
    'Marks': [85, 95, 78]  
}  
  
df = pd.DataFrame(data, index=[2, 0, 1])  
  
print("Original DataFrame:")  
  
print(df)
```



Unitedworld Institute of Technology OUTPUT:

Name Marks

2 Alice 85

0 Bob 95

1 Charlie 78



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Now shuffle the data

CODE:

```
df_sorted = df.sort_index()  
print("Sorted by index:")  
print(df_sorted)
```

OUTPUT:

Name Marks

0 Bob 95

1 Charlie 78

2 Alice 85



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General Syntax

```
df.sort_index(ascending=True) # Ascending (default)
```

```
df.sort_index(ascending=False) # Descending
```



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6. Data Grouping :

Grouping means **splitting** your data into groups based on some category and then applying a **function** (like sum, mean, count) to each group.

Syntax of groupby ():

```
df.groupby('column_name')
```

With function:

```
df.groupby('column_name').sum()  
df.groupby('column_name').mean()  
df.groupby('column_name').count()
```



Unitedworld Institute of Technology **Example :**

Name	Subject	Marks
Alice	Math	85
Bob	Math	90
Alice	Science	88
Bob	Science	84
Carol	Math	92



Unitedworld Institute of Technology **CODE:**

```
import pandas as pd
```

```
data = {  
    'Name': ['Alice', 'Bob', 'Alice', 'Bob', 'Carol'],  
    'Subject': ['Math', 'Math', 'Science', 'Science', 'Math'],  
    'Marks': [85, 90, 88, 84, 92]  
}
```

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



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OUTPUT:

Name	Subject	Marks
Alice	Math	85
Bob	Math	90
Alice	Science	88
Bob	Science	84
Carol	Math	92

0 Alice Math 85
1 Bob Math 90
2 Alice Science 88
3 Bob Science 84
4 Carol Math 92



Unitedworld Institute of Technology Code 1. Total Marks by Student

```
df.groupby('Name')['Marks'].sum()
```

OUTPUT:

Name
Alice 173

Bob 174

Carol 92

Name: Marks, dtype: int64



Unitedworld Institute of Technology Code 2. Average Marks per Subject

```
df.groupby('Subject')['Marks'].mean()
```

OUTPUT:

Subject

Math 89.0

Science 86.0

Name: Marks, dtype: float64



Unitedworld Institute of Technology Multiple Grouping Columns

CODE 1 :

```
df.groupby(['Name', 'Subject'])['Marks'].mean()
```

OUTPUT:

Name Subject

Alice Math 85

Science 88

Bob Math 90

Science 84

Carol Math 92

Name: Marks, dtype: int64



Code 2 : For Duplicate values

```
data = {  
    'Name': ['Alice', 'Alice', 'Bob', 'Bob', 'Carol'],  
    'Subject': ['Math', 'Math', 'Math', 'Science', 'Math'],  
    'Marks': [85, 95, 90, 84, 92]  
}
```

```
df = pd.DataFrame(data)  
df.groupby(['Name', 'Subject'])['Marks'].mean()
```

Or



Name Subject

Alice Math 90.0 # $(85+95)/2$

Bob Math 90.0

Science 84.0

Carol Math 92.0

Name: Marks, dtype: float64



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Code 3. Use Unstack: Convert row index → columns

```
grouped = df.groupby(['Name',  
'Subject'])['Marks'].mean() print(grouped)  
print(grouped.unstack())
```

OUTPUT:

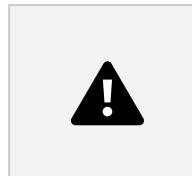
Subject Math Science

Name

Alice 90.0 NaN

Bob 90.0 84.0

Carol 92.0 NaN



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Code 4. Use of reset index

Again back to original data

```
print(grouped.reset_index())
```



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7. Rearranging

Rearranging in Pandas — this includes changing the layout, column orders, or reshaping your DataFrame. It means **changing the order** of:

- Columns
- Rows
- Or even reshaping the structure of your DataFrame.



Unitedworld Institute of Technology **Code 1. Rearranging**

Columns

(Rearrange columns by simply changing their order)

```
import pandas as pd
df = pd.DataFrame({
    'Name': ['Alice', 'Bob', 'Charlie'],
    'Age': [25, 30, 22],
```

```
'City': ['Delhi', 'Mumbai', 'Chennai']  
})
```

```
# Reorder columns: move 'City' first
```

```
df_rearranged = df[['City', 'Name', 'Age']]  
print(df_rearranged)
```



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OUTPUT:

	City	Name	Age
0	Delhi	Alice	25
1	Mumbai	Bob	30
2	Chennai	Charlie	22



Code2. Rearranging Rows by Index

Reverse the order of rows using slicing like df[::-1].

```
import pandas as pd
```

```
df = pd.DataFrame({  
    'Name': ['Alice', 'Bob', 'Charlie'],  
    'Age': [25, 30, 22],  
    'City': ['Delhi', 'Mumbai', 'Chennai']  
})
```

```
# Reverse row order  
df_reversed = df[::-1]  
print(df_reversed)
```



Unitedworld Institute of Technology OUTPUT:

Name Age City

2 Charlie 22 Chennai

1 Bob 30 Mumbai

0 Alice 25 Delhi



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Code 3. Rearranging Rows Using

.reindex() reorder rows manually

```
# Rearranging rows using custom index
```

```
df_custom = df.reindex([2, 0, 1])
```

```
print(df_custom)
```

OUTPUT:

```
Name Age City  
2 Charlie 22 Chennai  
0 Alice 25 Delhi  
1 Bob 30 Mumbai
```



Unitedworld Institute of Technology Code 4. Transposing the DataFrame with .T # Transpose the DataFrame
print(df.T)

OUTPUT:

```
0 1 2  
Name Alice Bob Charlie
```

Age 25 30 22

City Delhi Mumbai Chennai



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8. Ranking

- In Pandas, `.rank()` is used to assign ranks to data values based on their size — smallest gets rank 1 by default.
- It's often used in grading, competition scores, sales analysis, etc.

Syntax:

```
DataFrame['column'].rank(method='average', ascending=True)
```



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Parameters

Parameter	Description
method	How to assign ranks to equal values: 'average', 'min', 'max', 'dense', 'first'
ascending	True for smallest rank = 1, False for highest = 1
axis	Use 0 for columns, 1 for rows (default is column-wise ranking)



Unitedworld Institute of Technology Code 1. Ranking Exam

Scores

```
import pandas as pd
```

```
df = pd.DataFrame({  
    'Name': ['A', 'B', 'C', 'D', 'E'],  
    'Score': [85, 92, 88, 92, 70]  
})
```

```
df['Rank'] = df['Score'].rank(ascending=False)  
print(df)
```



Unitedworld Institute of Technology OUTPUT:

	Name	Score	Rank
--	------	-------	------

0	A	85	4.0
---	---	----	-----

1	B	92	1.5
---	---	----	-----

2	C	88	3.0
---	---	----	-----

3 D 92 1.5

4 E 70 5.0



Unitedworld Institute of Technology Code 2. Average, min, max, dense

```
import pandas as pd
```

```
df = pd.DataFrame({  
    'Name': ['A', 'B', 'C', 'D', 'E'],  
    'Score': [90, 80, 90, 70, 60]  
})
```



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```
df['Rank_average'] = df['Score'].rank(method='average',  
ascending=False)
```

```
df['Rank_min'] = df['Score'].rank(method='min',  
ascending=False)
```

```
df['Rank_max'] = df['Score'].rank(method='max',  
ascending=False)
```

```
df['Rank_dense'] = df['Score'].rank(method='dense',  
ascending=False)
```

```
print(df)
```



Unitedworld Institute of Technology OUTPUT:

Name	Score	Rank_average	Rank_min	Rank_max	Rank_dense	0
A	90	1.5	1.0	2.0	1.0	1
B	80	3.0	3.0	3.0	2.0	2
C	90	1.5	1.0	2.0	1.0	1
D	70	4.0	4.0	4.0	3.0	4
E	60	5.0	5.0	5.0	5.0	4.0



Unitedworld Institute of Technology Code 3. Axis=1 (Row-wise

Ranking):

```
df2 = pd.DataFrame({  
    'Math': [90, 40, 70],  
    'Science': [80, 60, 75],  
    'English': [85, 55, 65]  
}, index=['Student1', 'Student2', 'Student3'])
```



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Row-wise:

```
rank_rowwise = df2.rank(axis=1,  
ascending=False) print(rank_rowwise)
```

Column-wise:

```
rank_colwise = df2.rank(axis=0,  
ascending=False) print(rank_colwise)
```



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