



# **Artificial Intelligence (Machine Learning & Deep Learning) [Course]**

**Week 3 – Numpy & Pandas**

**[See examples / code in GitHub code repository]**

**It is not about Theory, it is 20% Theory and 80% Practical –  
Technical/Development/Programming [Mostly Python based]**

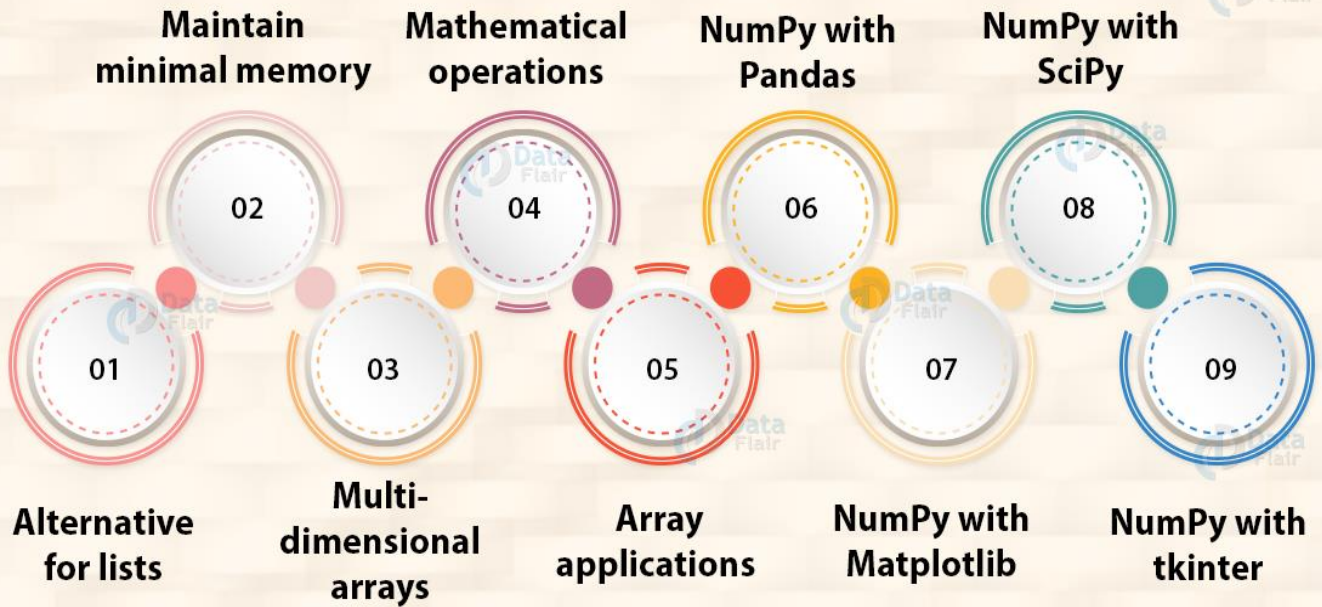
# Numpy - Overview



NumPy is a Python library.  
NumPy is used for working with arrays.  
NumPy is short for "Numerical Python".



## Applications of NumPy



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# Numpy – Overview 2



Application-specific

cesium PyChrono MDAnalysis eht-imaging iris  
khmer PsychoPy Qiime2 FiPy deepchem  
nibabel mne-python yellowbrick scikit-HEP  
PyWavelets librosa SunPy QuTIP yt

Domain-specific

Astropy Astronomy Biopython Biology  
QuantEcon Economics cantera Chemistry  
NLTK Linguistics  
simpeg Geophysics

Technique-specific

scikit-learn Machine learning  
pandas, statsmodels Statistics  
scikit-image Image processing  
NetworkX Network analysis

Foundation

SciPy Algorithms  
Matplotlib Plots

Python Language  
NumPy Arrays  
IPython / Jupyter Interactive environments

New array implementations

NumPy API — Array Protocols - - -



# python

## PYTHON FOR DATA SCIENCE CHEAT SHEET

### Python NumPy

#### What Is NumPy?

A library consisting of multidimensional array objects and a collection of routines for processing those arrays.

#### Why NumPy?

Mathematical and logical operations on arrays can be performed. Also provides high performance.

#### Import Convention

import numpy as np - **import numpy**

#### ND Array

Space efficient multi-dimensional array, which provides vectorized arithmetic operations.

#### Creating Array

- `a=np.array([1,2,3])`
- `b=np.array([[1,2,3,4],[7,8,9,10]],dtype=int)`

### Saving and Loading

On disk:

- `np.save("new_array",x)`
- `np.load("new_array.npy")`

Text/CSV files:

- `np.loadtxt('New_file.txt')` - From a text file
- `np.genfromtxt('New_file.csv',delimiter=',')` - From a CSV file
- `np.savetxt('New_file.txt',arr,delimiter=',')` - Writes to a text file
- `np.savetxt('New_file.csv',arr,delimiter=',')` - Writes to a CSV file

Properties:

- `array.size` - Returns number of elements in array
- `array.shape` - Returns dimensions of array (rows, columns)
- `array.dtype` - Returns type of elements in array

### Operations

Copying:

- `np.copy(array)` - Copies array to new memory array.
- `view(dtype)` - Creates view of array elements with type dtype

Sorting:

- `array.sort()` - Sorts array
- `array.sort(axis=0)` - Sorts specific axis of array
- `array.reshape(2,3)` - Reshapes array to 2 rows, 3 columns without changing data.

### Array Mathematics

Arithmetic Operations:

- **Addition:** `np.add(a,b)`
- **Subtraction:** `np.subtract(a,b)`
- **Multiplication:** `np.multiply(a,b)`
- **Division:** `np.divide(a,b)`
- **Exponentiation:** `np.exp(a)`
- **Square Root:** `np.sqrt(b)`

Comparison:

- **Element-wise:** `a==b`
- **Array-wise:** `np.array_equal(a,b)`

### Functions

- **Array-wise Sum:** `a.sum()`
- **Array-wise min value:** `a.min()`
- **Array row max value:** `a.max(axis=0)`
- **Mean:** `a.mean()`
- **Median:** `a.median()`

- Learn from industry experts and be sought-after by the industry!

- Learn any technology, show exemplary skills and have an unmatched career!

## Python NumPy Cheat Sheet

<https://intellipaat.com/blog/tutorial/python-tutorial/numpy-cheat-sheet/>

<https://intellipaat.com/blog/wp-content/uploads/2022/10/Python-Numpy-Cheat-Sheet-2022.pdf>

<https://www.datacamp.com/cheat-sheet/numpy-cheat-sheet-data-analysis-in-python>





See code here: <https://github.com/ShahzadSarwar10/Fullstack-WITH-AI-B-3-SAT-SUN-6Months-Explorer/blob/main/Week3/Case3-1-NumPy-Zameencom-property-data-By-Kaggle.py>

You should be able to analyze – each code statement, you should be able to see trace information – at each step of debugging. “DEBUGGING IS BEST STRATEGY TO LEARN A LANGUAGE.” So debug code files, line by line, analyze the values of variable – changing at each code statement. BEST STRATEGY TO LEARN DEEP.

Let's put best efforts.

Thanks.

Shahzad – Your AI – ML Instructor

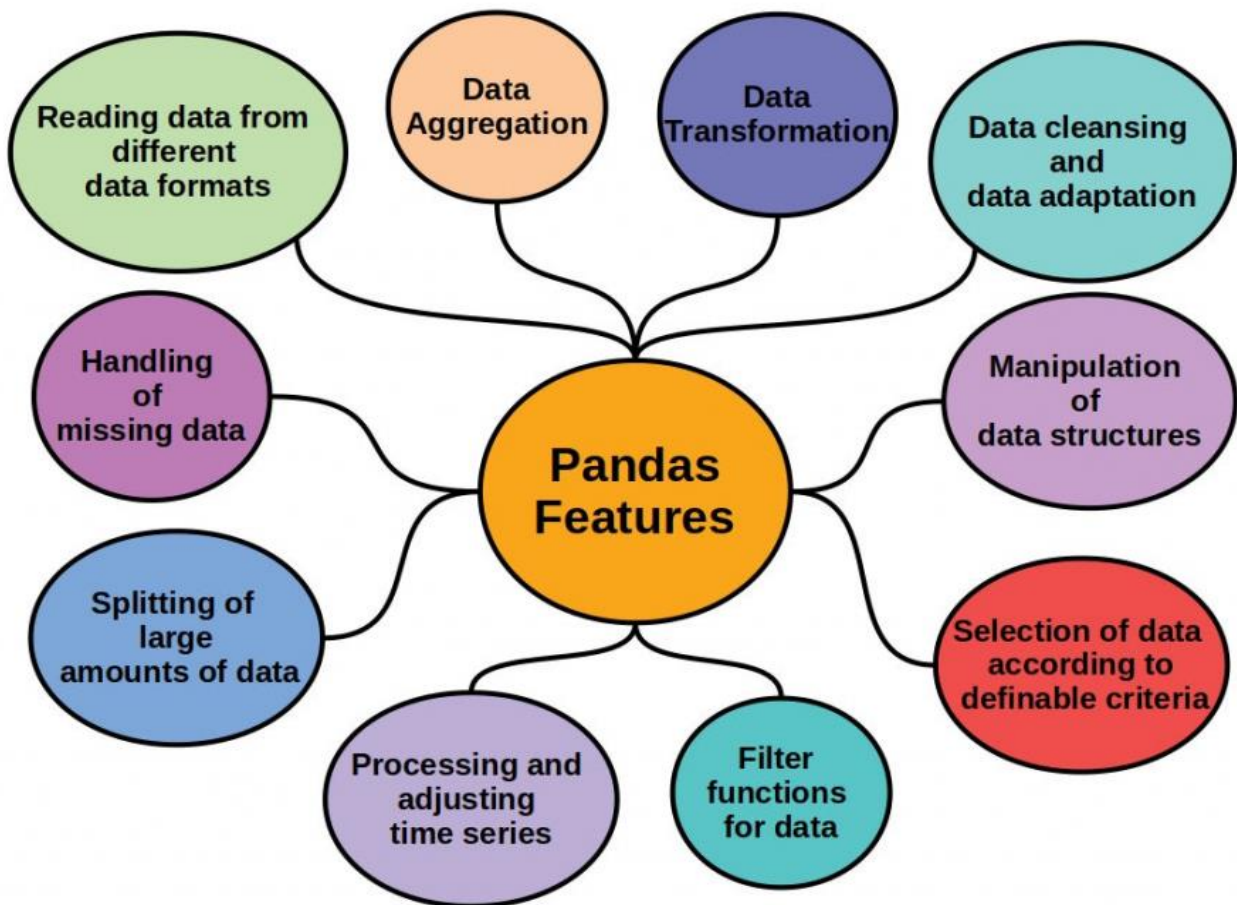
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## Exercises



# python

- ❑ Pandas is a Python library used for working with data sets.
- ❑ It has functions for analyzing, cleaning, exploring, and manipulating data.
- ❑ The name "Pandas" has a reference to both "Panel Data", and "Python Data Analysis" and was created by Wes McKinney in 2008.





## Applications of Pandas

### Reference:

<https://data-flair.training/blogs/applications-of-pandas/>

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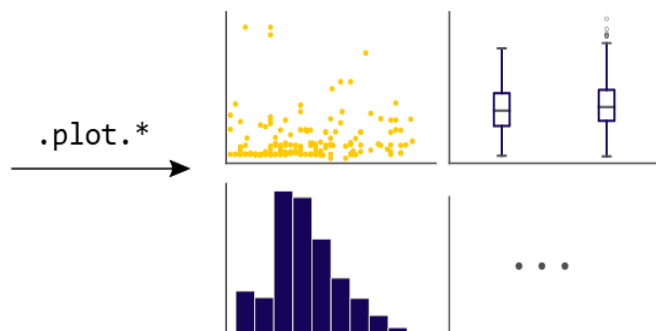
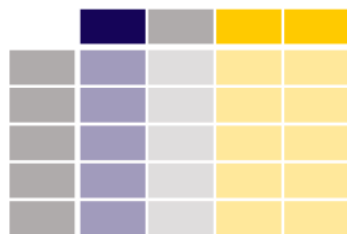
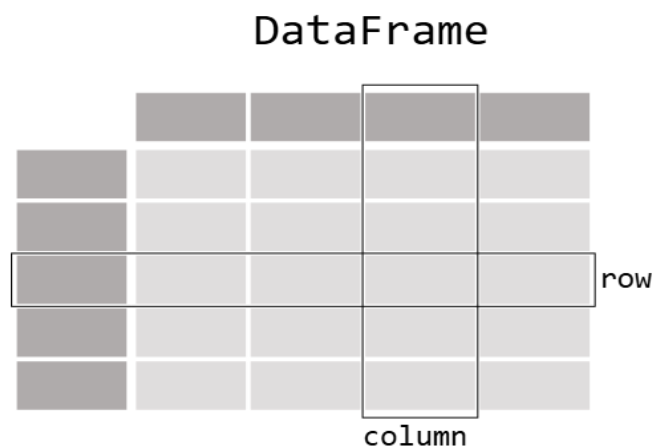


# Pandas – Key Concepts



❑ A data table is called a DataFrame.

❑ Pandas provides plotting your data out of the box, using the power of Matplotlib.



**DATA TYPE**

**STRENGTHS**

**AMOUNT OF DATA  
BEING ANALYZED**

**DATA TYPES**

**MEMORY USAGE**

**SPEED**

pandas

Tabular

Data frame, Series

>500K rows

Can contain dissimilar  
data types

More

Slower

NumPy

Numerical

Arrays

<50K rows

Homogenous  
data types

Less

Faster





# Pandas – Key Concepts

dataframe

x	y
12.3	ace
3	tea
5.01	oil
2.3	tree

matrix

12.3	0.1
3.0	5.2
5.01	3.0
2.3	0.1

list

x	y
12.3	ace
3	tea
5.01	oil
2.3	tree
3	
$Y \sim x - 1$	
some text	

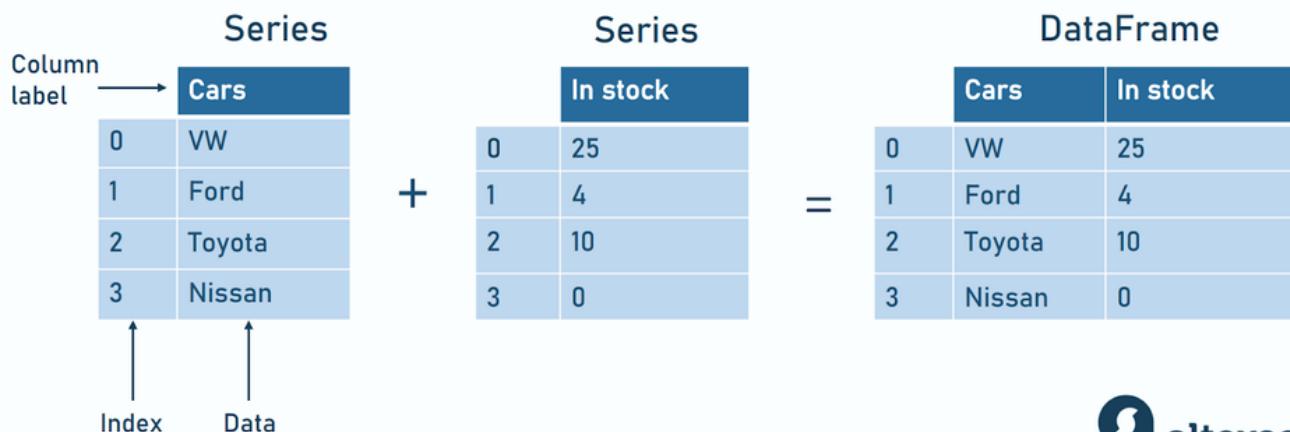
Characteristics	NumPy Array	Pandas Dataframe
Homogeneity	Arrays consist of only homogeneous elements (elements of same data type)	Dataframes have heterogeneous elements.
Mutability	Arrays are mutable	Dataframes are mutable
Access	Array elements can be accessed using integer positions.	Dataframes can be accessed using both integer position as well as index.
Flexibility	Arrays do not have flexibility to deal with dynamic data sequence and mixed data types.	Dataframes have that flexibility.
Data type	Array deals with numerical data.	Dataframes deal with tabular data.



# Pandas – Key Concepts

Pandas dtype	Python type	NumPy type	Usage
object	str or mixed	string_, unicode_, mixed types	Text or mixed numeric and non-numeric values
int64	int	int_, int8, int16, int32, int64, uint8, uint16, uint32, uint64	Integer numbers
float64	float	float_, float16, float32, float64	Floating point numbers
bool	bool	bool_	True/False values
datetime64	NA	datetime64[ns]	Date and time values
timedelta[ns]	NA	NA	Differences between two datetimes
category	NA	NA	Finite list of text values

## DATA STRUCTURES IN PANDAS



# python

## Creating DataFrames

	a	b	c
1	4	7	10
2	5	8	11
3	6	9	12

```
df = pd.DataFrame(  
    {"a": [4, 5, 6],  
     "b": [7, 8, 9],  
     "c": [10, 11, 12]},  
    index = [1, 2, 3])  
Specify values for each column.
```

```
df = pd.DataFrame(  
    [[4, 7, 10],  
     [5, 8, 11],  
     [6, 9, 12]],  
    index=[1, 2, 3],  
    columns=['a', 'b', 'c'])  
Specify values for each row.
```

	a	b	c
N	v		

## Reshaping Data – Change layout, sorting, reindexing, renaming



`pd.melt(df)`  
Gather columns into rows.



`df.pivot(columns='var', values='val')`  
Spread rows into columns.



`pd.concat([df1, df2])`  
Append rows of DataFrames



`pd.concat([df1, df2], axis=1)`  
Append columns of DataFrames

`df.sort_values('mpg')`  
Order rows by values of a column (low to high).

`df.sort_values('mpg', ascending=False)`  
Order rows by values of a column (high to low).

`df.rename(columns = {'y': 'year'})`  
Rename the columns of a DataFrame

`df.sort_index()`  
Sort the index of a DataFrame

`df.reset_index()`  
Reset index of DataFrame to row numbers, moving index to columns.

`df.drop(columns=['Length', 'Height'])`  
Drop columns from DataFrame

### Subset Observations - rows



### Subset Variables - columns



### Subsets - rows and columns

Use `df.loc[]` and `df.iloc[]` to select only rows, only columns or both.

## Python Pandas Cheat Sheet

<https://www.datasciencecentral.com/data-science-in-python-pandas-cheat-sheet/>

[https://pandas.pydata.org/Pandas\\_Cheat\\_Sheet.pdf](https://pandas.pydata.org/Pandas_Cheat_Sheet.pdf)

<https://www.datacamp.com/cheat-sheet/pandas-cheat-sheet-data-wrangling-in-python>



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Thanks.

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## Exercises







Thank you - for listening and participating

- ☐ Questions / Queries
- ☐ Suggestions/Recommendation
- ☐ Ideas.....?

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