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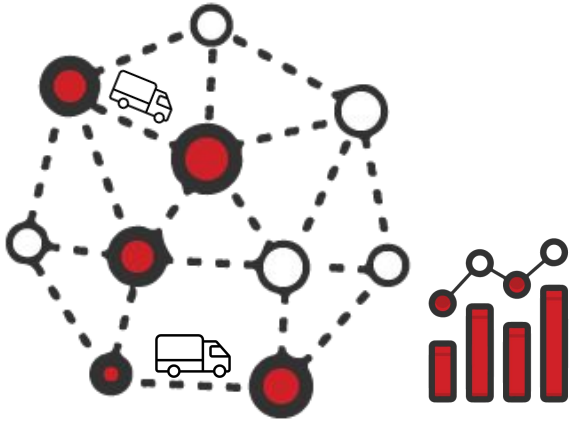

OPTIMIZING LOGISTICS DISTRIBUTION ROUTES: A GRAPH THEORY APPROACH

Date: 20 - 22 Juni 2023

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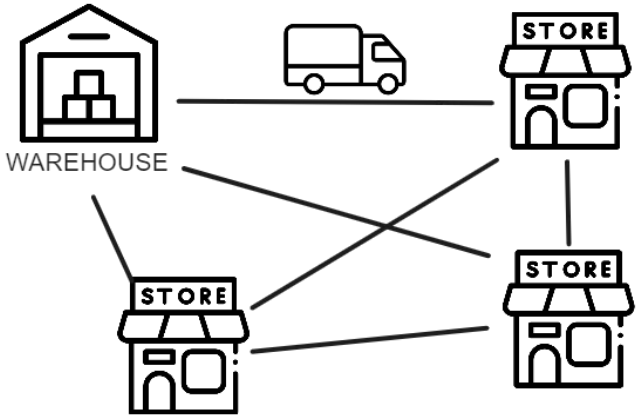
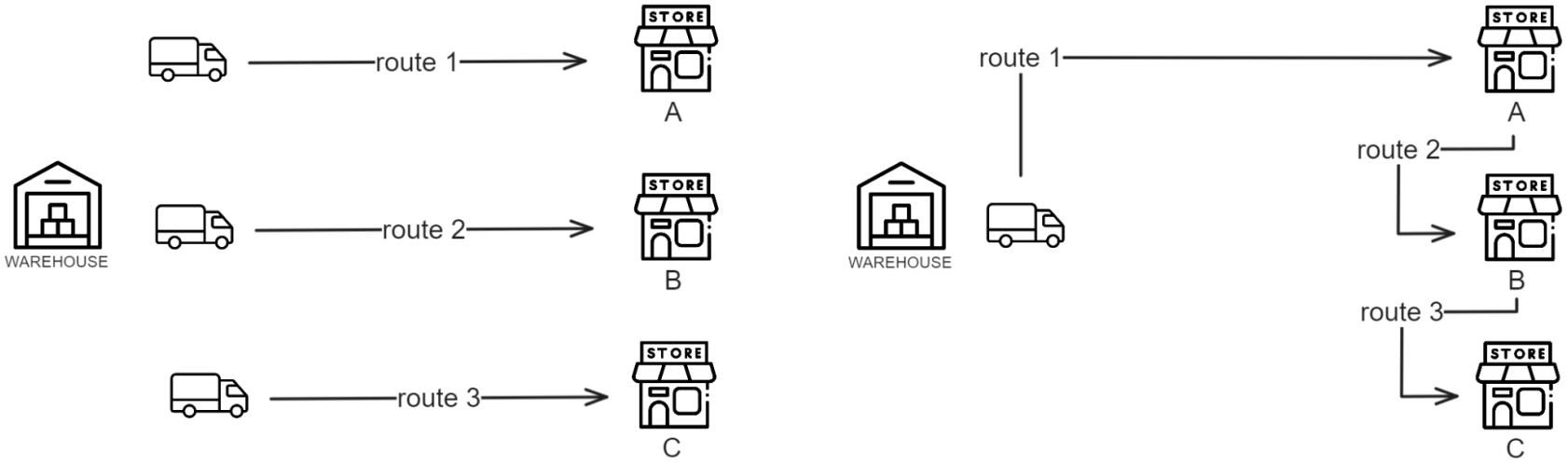
Introduction

What is Logistics Distribution Routes?



Logistics Distribution Routes

Logistics Distribution refers to the process of delivering goods from one place to another. Such us warehouse to customers store.

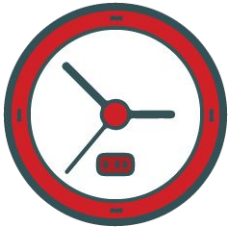


Routing in Logistics Distribution is the process of mapping specific routes that drivers will take to make deliveries to customers

Why transportation routing is crucial

Cost Efficiency

Effective routing helps optimize the use of resources



Time Optimization

Effective routing ensures timely delivery of goods

Customer Satisfaction

Timely and reliable delivery essential for customer satisfaction

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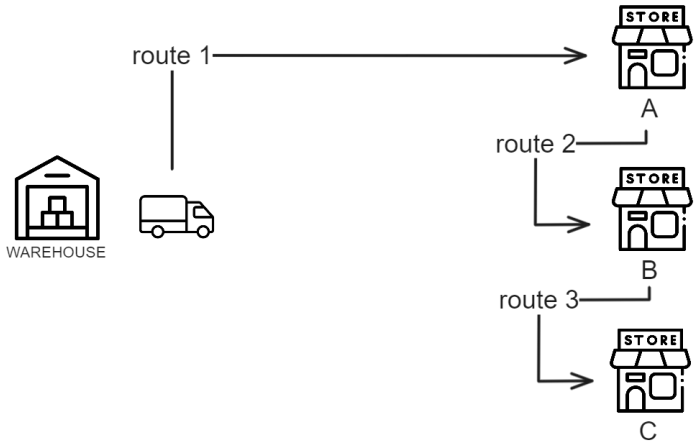
How to Analyze Logistics Distribution Routes?

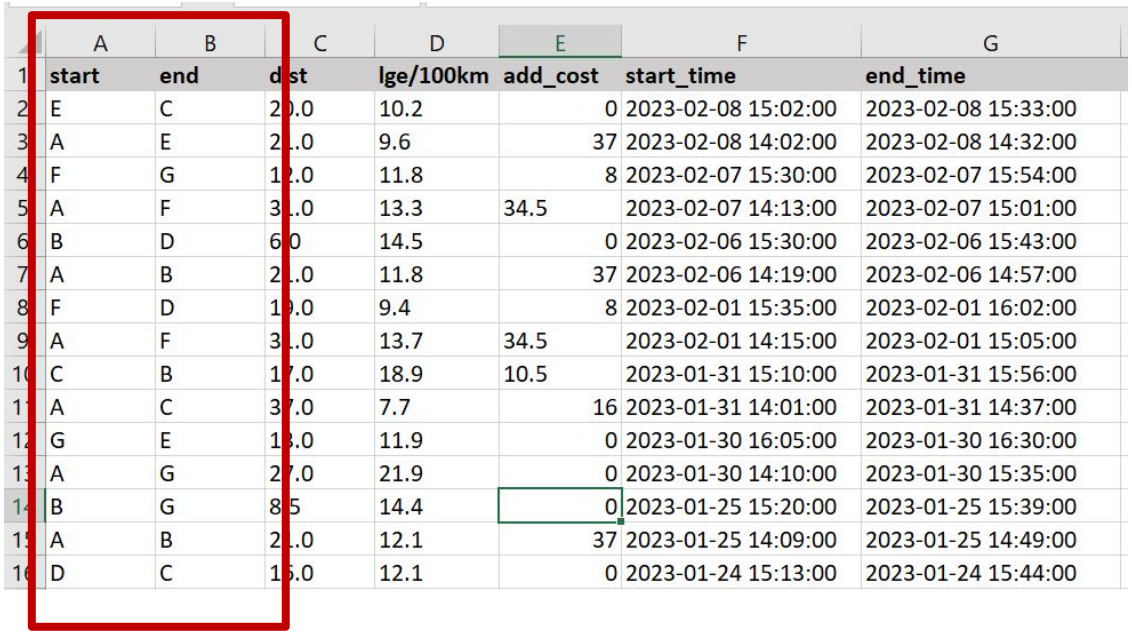
Analyze route

We want to analyze the connection between store and warehouse.

Then **how to analyze** this **connection** (warehouse and store)?



Analyze route

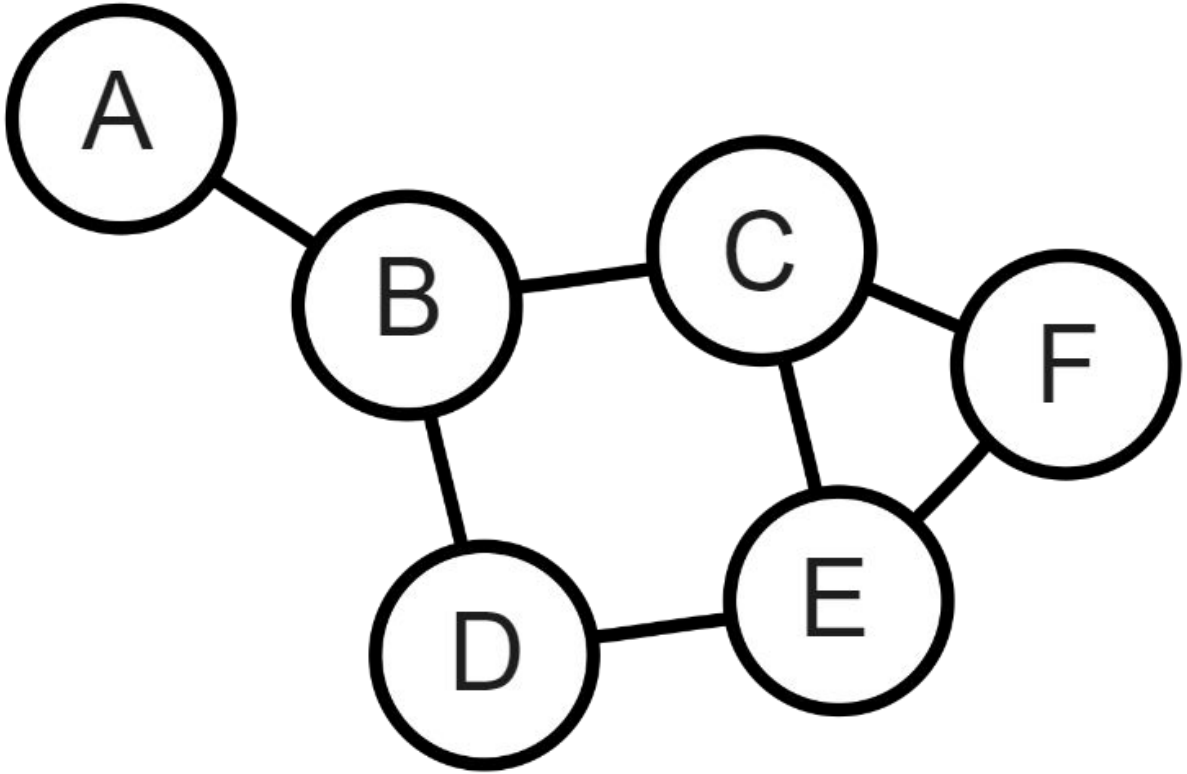


	A	B	C	D	E	F	G
1	start	end	dist	lge/100km	add_cost	start_time	end_time
2	E	C	20.0	10.2	0	2023-02-08 15:02:00	2023-02-08 15:33:00
3	A	E	21.0	9.6	37	2023-02-08 14:02:00	2023-02-08 14:32:00
4	F	G	12.0	11.8	8	2023-02-07 15:30:00	2023-02-07 15:54:00
5	A	F	31.0	13.3	34.5	2023-02-07 14:13:00	2023-02-07 15:01:00
6	B	D	60	14.5	0	2023-02-06 15:30:00	2023-02-06 15:43:00
7	A	B	21.0	11.8	37	2023-02-06 14:19:00	2023-02-06 14:57:00
8	F	D	19.0	9.4	8	2023-02-01 15:35:00	2023-02-01 16:02:00
9	A	F	31.0	13.7	34.5	2023-02-01 14:15:00	2023-02-01 15:05:00
10	C	B	17.0	18.9	10.5	2023-01-31 15:10:00	2023-01-31 15:56:00
11	A	C	37.0	7.7	16	2023-01-31 14:01:00	2023-01-31 14:37:00
12	G	E	13.0	11.9	0	2023-01-30 16:05:00	2023-01-30 16:30:00
13	A	G	27.0	21.9	0	2023-01-30 14:10:00	2023-01-30 15:35:00
14	B	G	85	14.4	0	2023-01-25 15:20:00	2023-01-25 15:39:00
15	A	B	21.0	12.1	37	2023-01-25 14:09:00	2023-01-25 14:49:00
16	D	C	16.0	12.1	0	2023-01-24 15:13:00	2023-01-24 15:44:00

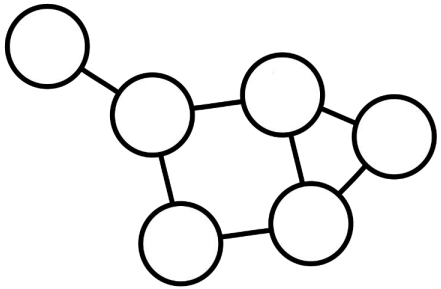
It is difficult to analyze the connection between objects in tabular data.

How to overcome this problem?

Answer: Graph!



What is Graph?



Graph

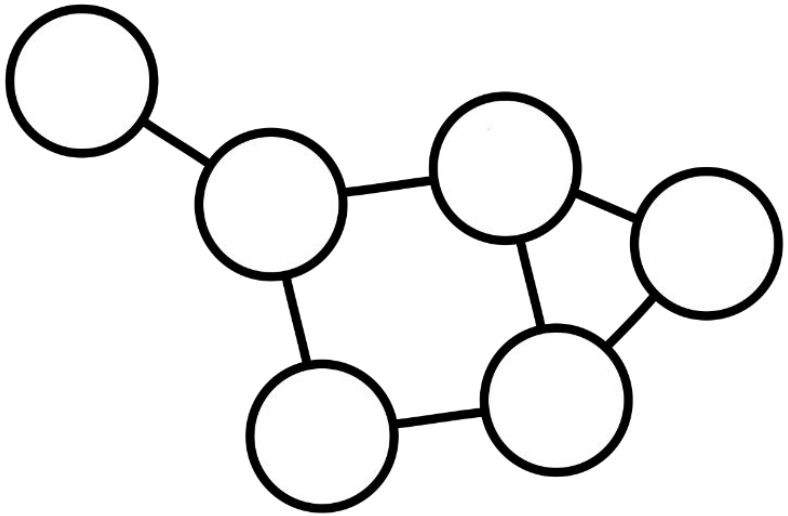
A **graph** is a structure that contains **nodes** and each of the related pairs of nodes is called an **edges**.

Graph theory is branch of mathematics that studies about graph, graph theory explore and analyze different aspects of these networks, it provides methods and algorithms to study properties like how nodes are connected, shortest path and other characteristics.

When to Use Graph?

- When our data **involves relationships** or **connections between nodes** e.g. friendship in a social network, connection between web pages, or logistics distribution routes
- When we need to **analyze connectivity** patterns or **find paths between nodes**, representing the data as a graph is helpful e.g. in logistics, where we want to find the optimum route between locations, a graph representation enables efficient pathfinding and optimization algorithms.

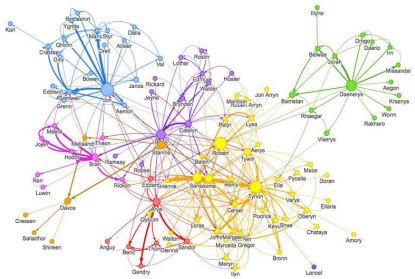
Objective of Graph?



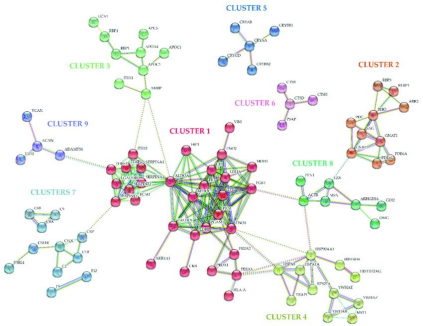
- **Analyze connectivity** pattern
- Find **path between nodes** (optimum path)

Example of Implementation

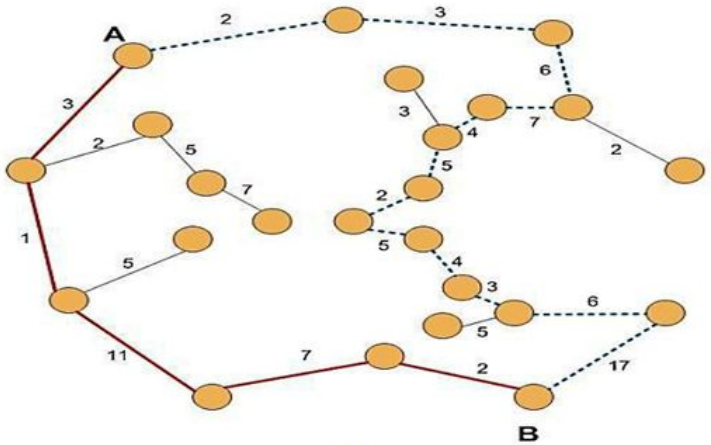
Social Network Analysis



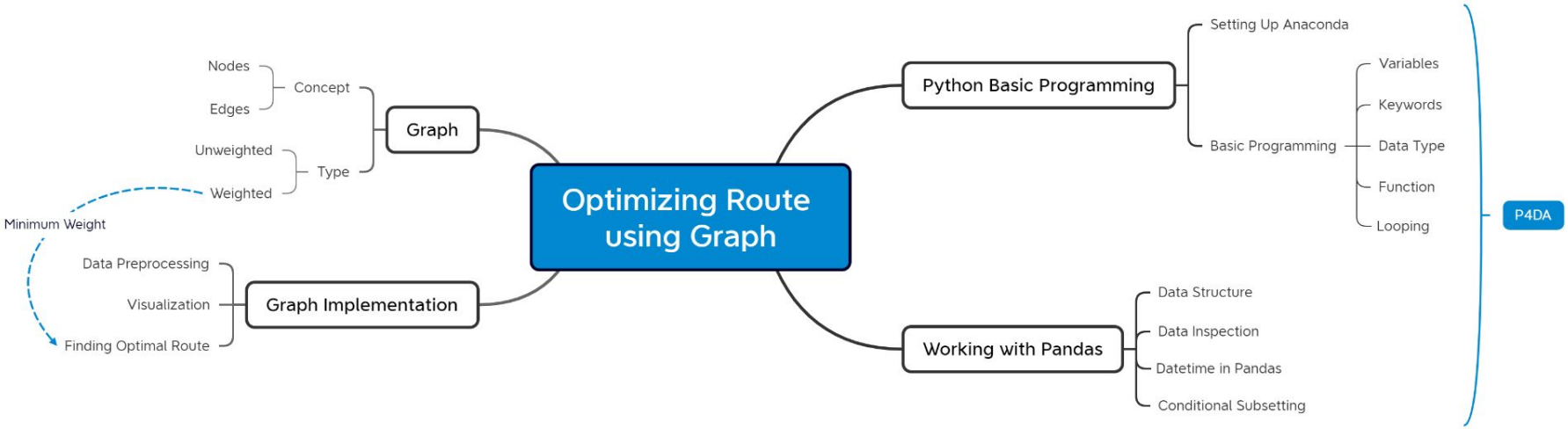
Protein Analysis



Distribution Routes



Mindmap


Optimizing Route using Graph
Graph
Concept
Nodes
Edges
Type
Unweighted
Weighted
Minimum Weight
Graph Implementation
Data Preprocessing
Visualization
Finding Optimal Route
Python Basic Programming
Setting Up Anaconda
Basic Programming
Variables
Keywords
Data Type
Function
Looping
Working with Pandas
Data Structure
Data Inspection
Datetime in Pandas
Conditional Subsetting
P4DA

Objective of Our DSS

1. Work with **Python** and **pandas** for **data cleansing** and **manipulation** processes
2. Understand **graph structure** and **interpretation**
3. Learn and **implement** how **graph** works in python
4. **Apply graph** theory to case studies of **optimizing logistics distribution routes**

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Introduction for Programming in Python

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Tools Introduction

ANACONDA®

Studio

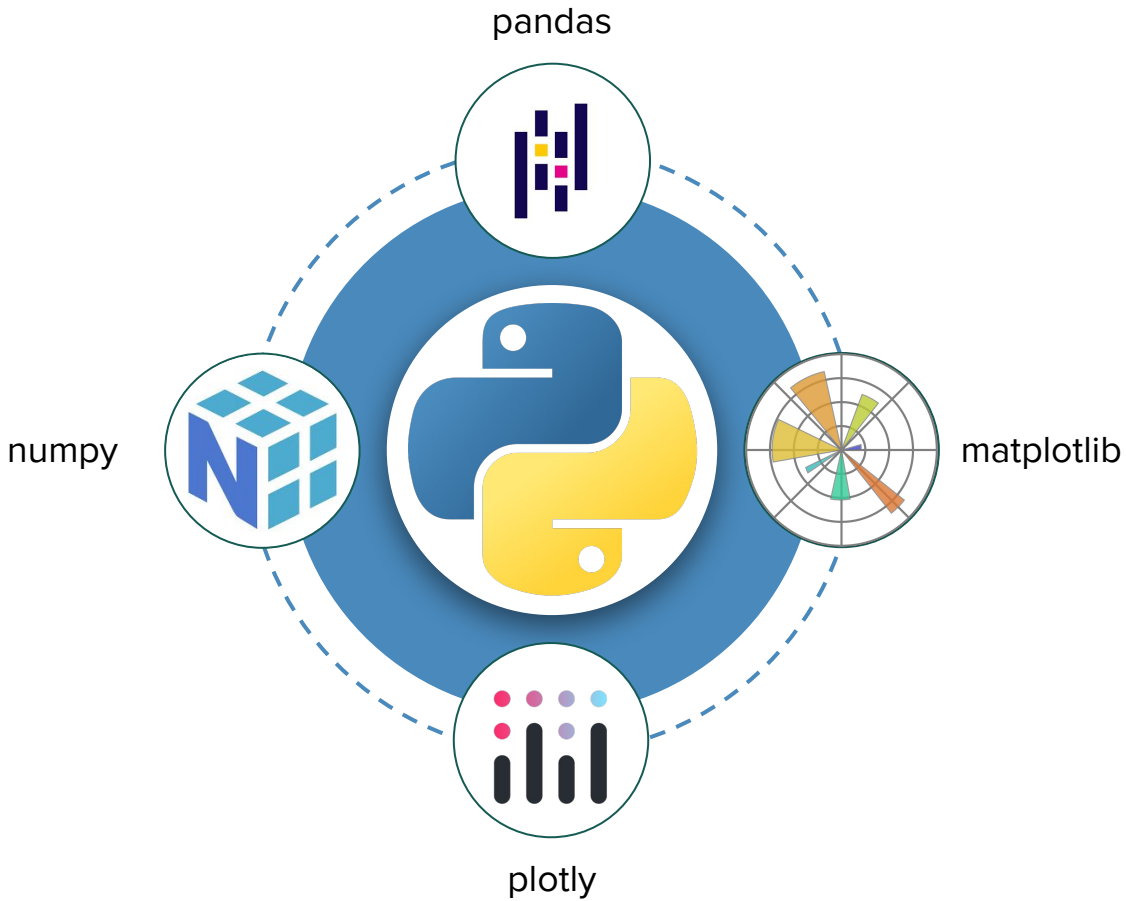
python™

jupyter

Paint

Canvas

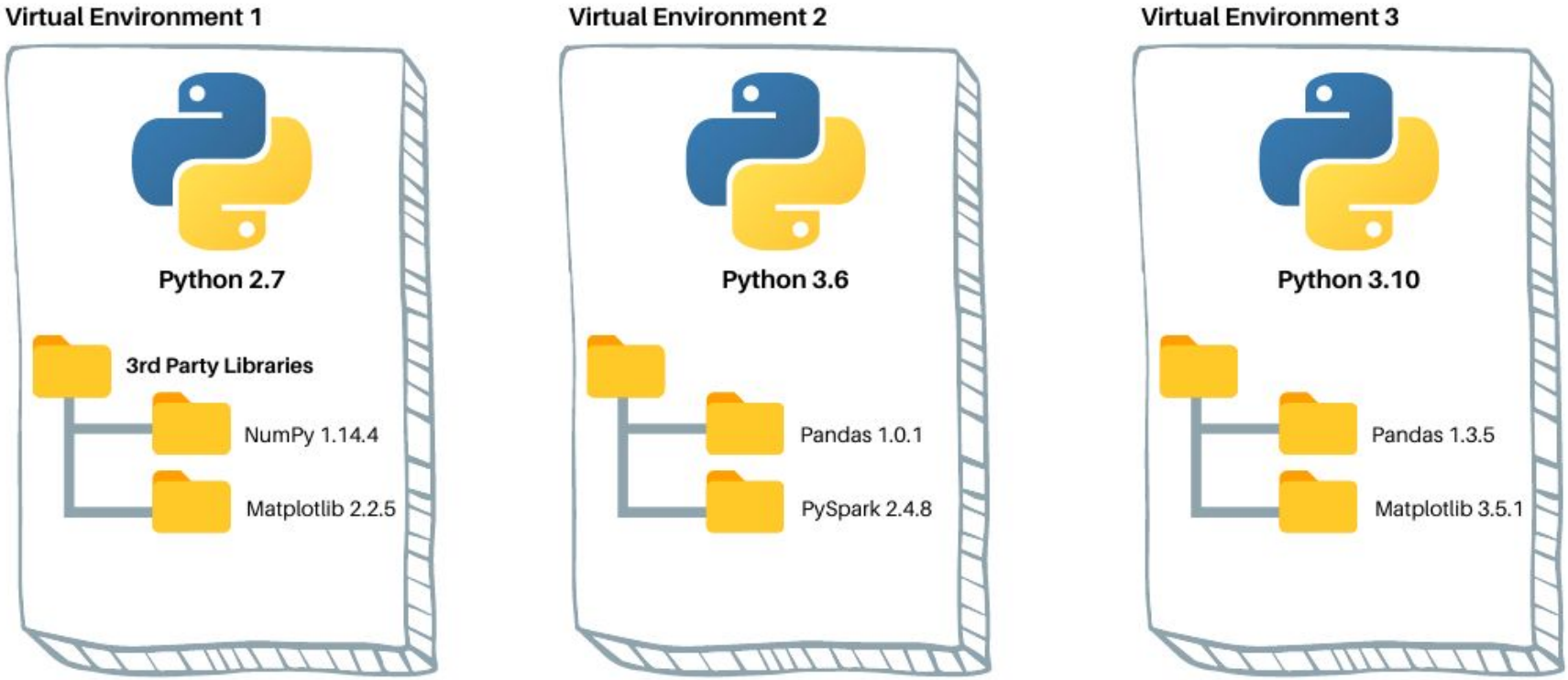
Package / Library



Package / Library

Chef + *Raw Materials* + *Kitchen Set* = *New Food* + *Recipe*

You *Data* *Library* *Product* *Notebook*


Virtual Environment 1
Python 2.7
3rd Party Libraries
NumPy 1.14.4
Matplotlib 2.2.5
Virtual Environment 2
Python 3.6
Pandas 1.0.1
PySpark 2.4.8
Virtual Environment 3
Python 3.10
Pandas 1.3.5
Matplotlib 3.5.1

Why do we need Python environments?

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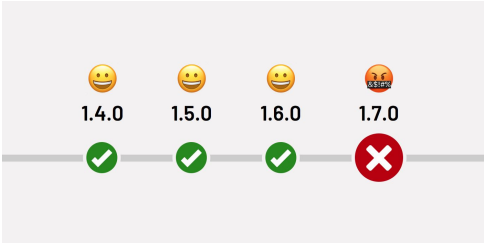
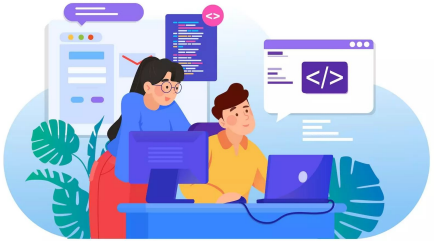
You might ask: *shouldn't I just install the latest Python version?*



Isolate package versions to avoid breaking changes



Sharing virtual environment to enable project collaboration

Publishing or deploying an application requires setting up an environment

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How to Create Virtual Environment

1. Open Anaconda Prompt
2. Create new virtual environment with:
   conda create --name dss_june python=3.10
3. Activate the new virtual environment:
   conda activate dss_june
4. Change your terminal directory to the path where the *requirements.txt* is located. Use cd <PATH>
5. Install packages using:
   pip install -r requirements.txt
6. Install kernel to connect the virtual environment to the Jupyter Notebook.
   pip install ipykernel
   python -m ipykernel install --user --name=dss_june