Python Fundamentals - Part 1

INTERVIEW KICKSTART

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Introduction – Emmanuel Awa

- ✔ In AI/ML space since 2016 with a focus on NLP
- ✔ School:
  - Undergrad: Physics with Electronics | Grad: Computer Science
- ✔ Post Graduate Work:
  - Amadeus for ~3 years
  - Microsoft for ~7.5 years
  - Google for a year now
- ✔ Career trajectory:
  - SWE => Big Data Engineer ==> AI Engineer ===> Data & Applied Scientist ====> Technical Solutions Arch - Applied GenAI

amadeus

Welcome to today's class, before we begin, pop into the chat:

Optimize Your Experience

- ✅ Interact with your instructors via Sunday live class.
- ✅ Don’t be shy to speak up and get clarifications !

- ✅ Solve your assignments, MCQs and other assessments and get feedback (Thursday review session)
- ✅ Use your resources! It’s your experience – what you put in is what you’ll get out.

Today's Agenda

1

Intro to Python, Data Types & Strings

Break

2

Conditionals ,Functions, OOPS in Python

Break

3

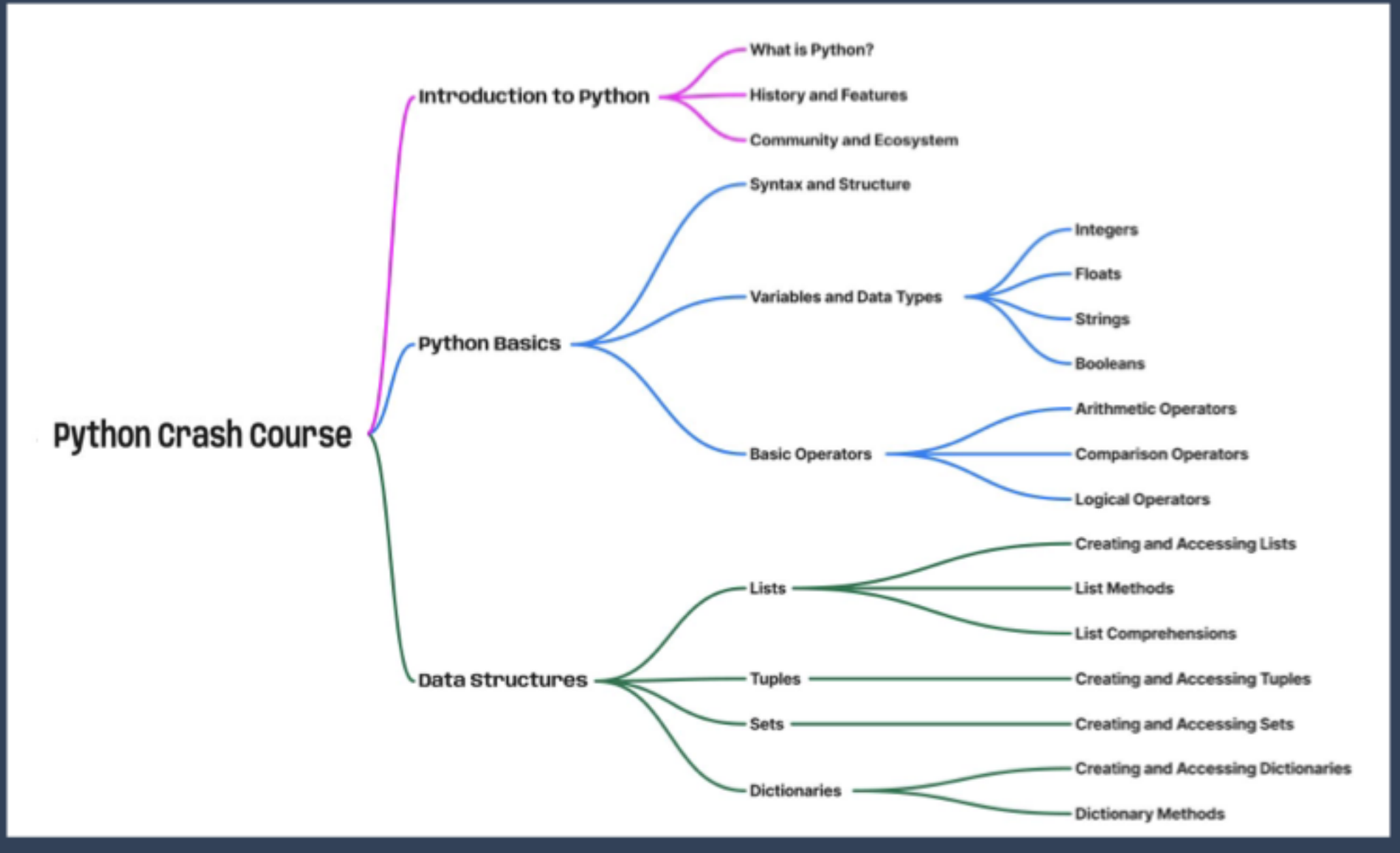
NumPy

Break

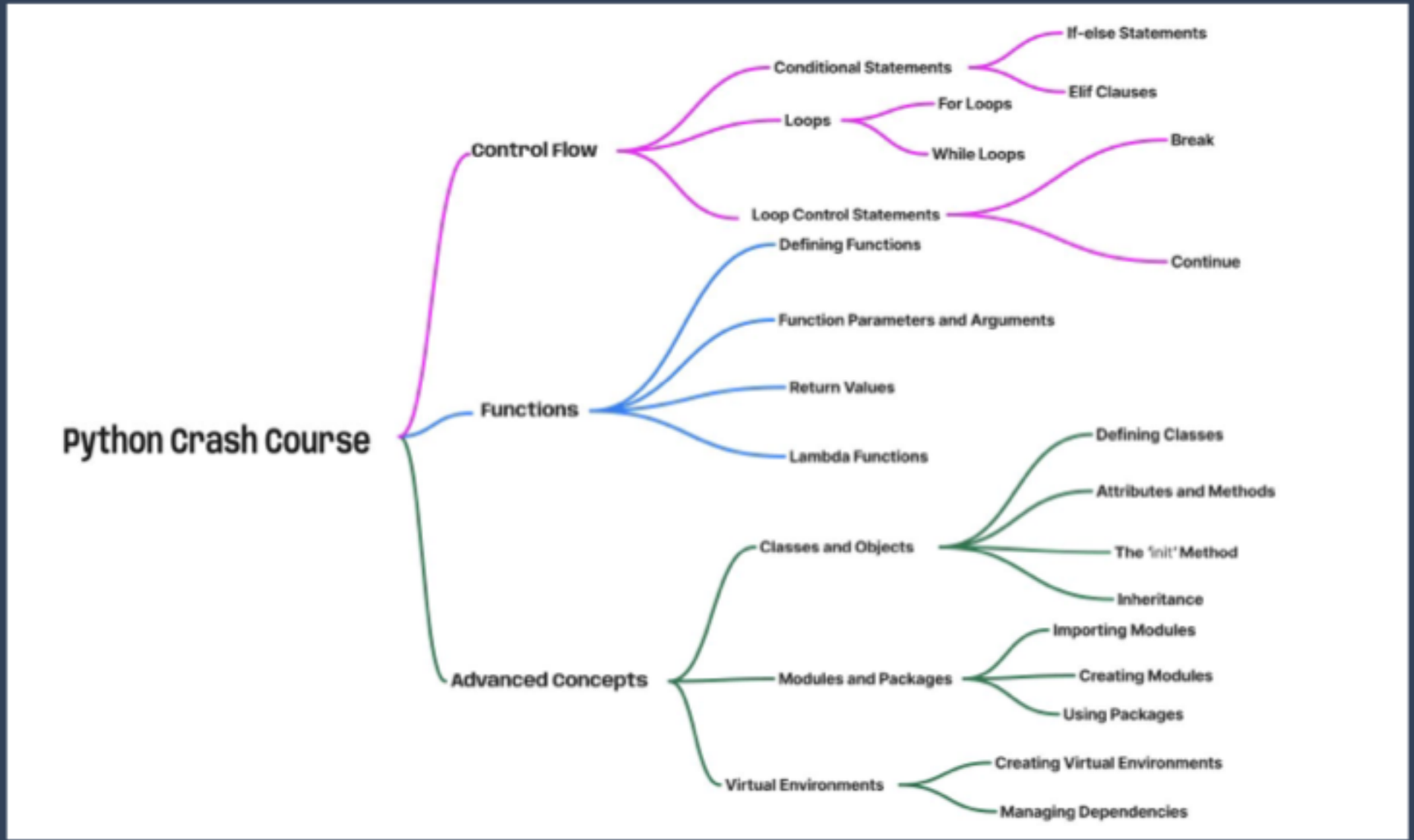
4

Pandas, Dataframe Operations

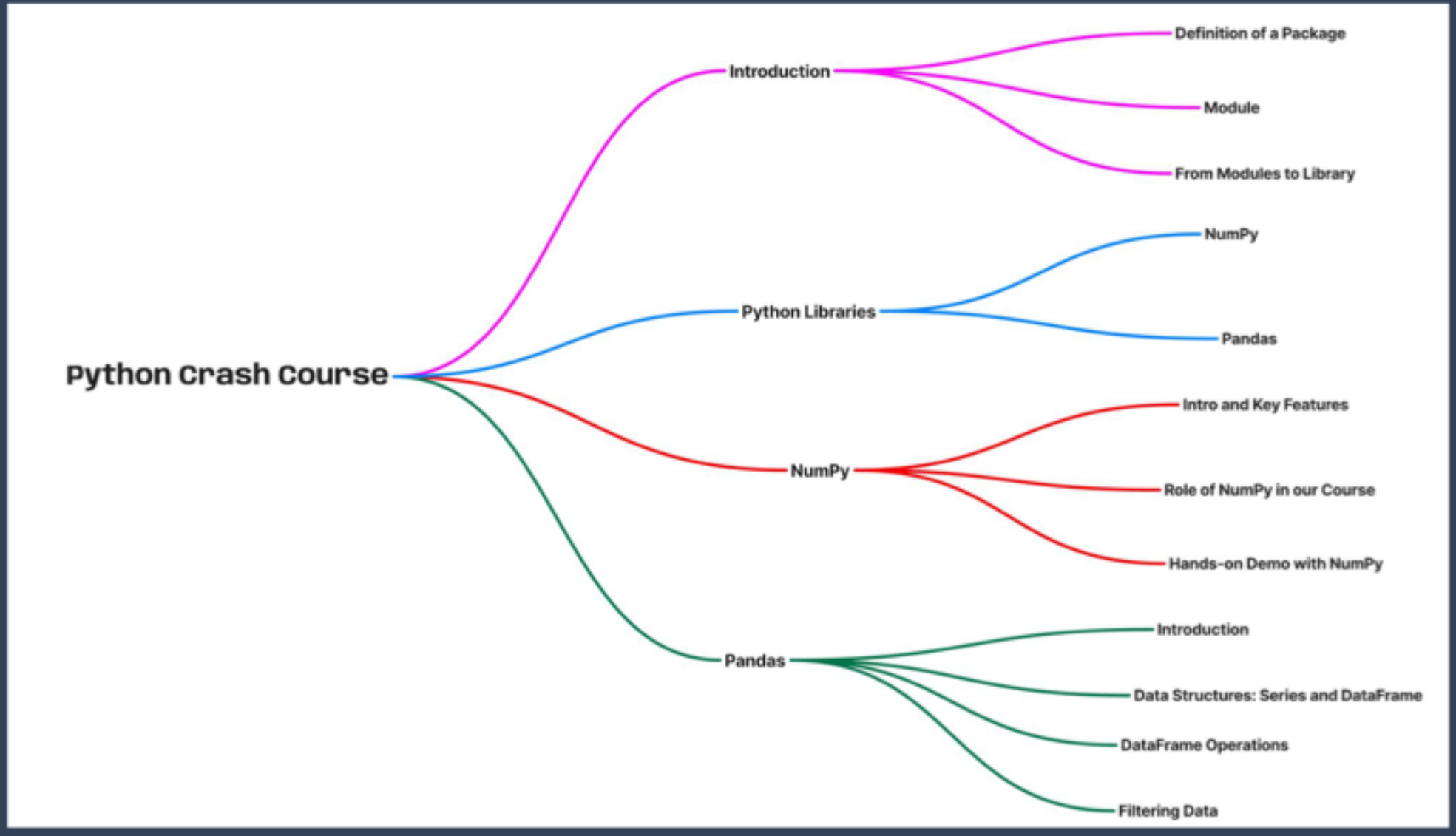
Session Mindmap - Part 1



Session Mindmap - Part 2



Session Mindmap - Part 3



How is Today's Content Relevant to My Job Role?

- **PMs:** Learn to identify Python-based AI features for product development.
- **TPMs:** Understand Python's role in implementing AI features and managing projects.
- **SDEs:** Develop Python skills for integrating AI capabilities into applications
- **Engineering Managers:** Discover how to leverage Python for integrating AI in projects.
- **DevOps Engineers:** Understand Python's infrastructure requirements for deploying AI models.

Frequently Asked Question - 1

I don't have to code in my job role, why am I learning Python here? How will it help me?

Don't worry, you don't have to learn Python to the extent of a Python Developer. You only need to be able to comprehend the code that would be used in the upcoming modules in the course.

In GenAI, Python is just a tool! With this Crash Course, you would understand just enough on how to operate the tool and that's all you need!

Frequently Asked Question - 2

I have never coded in Python before. Will I become an expert in Python after completing this module?

This is a Python Crash Course - tailored specifically to equip you with enough knowledge to help you navigate through the Applied GenAI Course smoothly.

Generative AI technologies are implemented through Python, and you will encounter multiple coding demos in Python throughout the course. This Python Crash Course includes just enough details so that the coding demos in the further modules are comprehensible.

If you have never coded in Python before, you may need to refer to external resources too. If you need help with the resources, please contact studentsupport@interviewkickstart.com

If you are already familiar with Python programming, this module may seem like a basic refresher for you - and that's exactly what it's meant to be!

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3

NumPy

Break

4

Pandas, Dataframe Operations

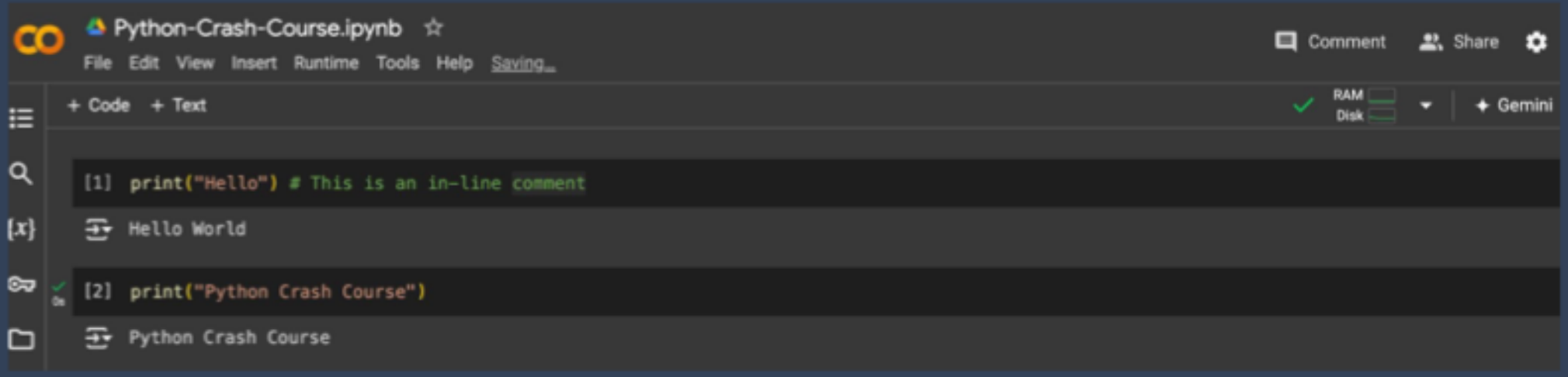
Introduction to Python

Introduction

- Python is a versatile and powerful programming language used in various domains. From web development to data science, Python has become a language of choice for many.
- Python is a high-level, interpreted, and object-oriented programming language.
- Python was created by Guido Van Rossum and released in 1991.
- There are several Integrated Development Environments (IDEs) available for coding in Python, including PyCharm, Visual Studio Code, Spyder, and Jupyter

Why Google Colab?

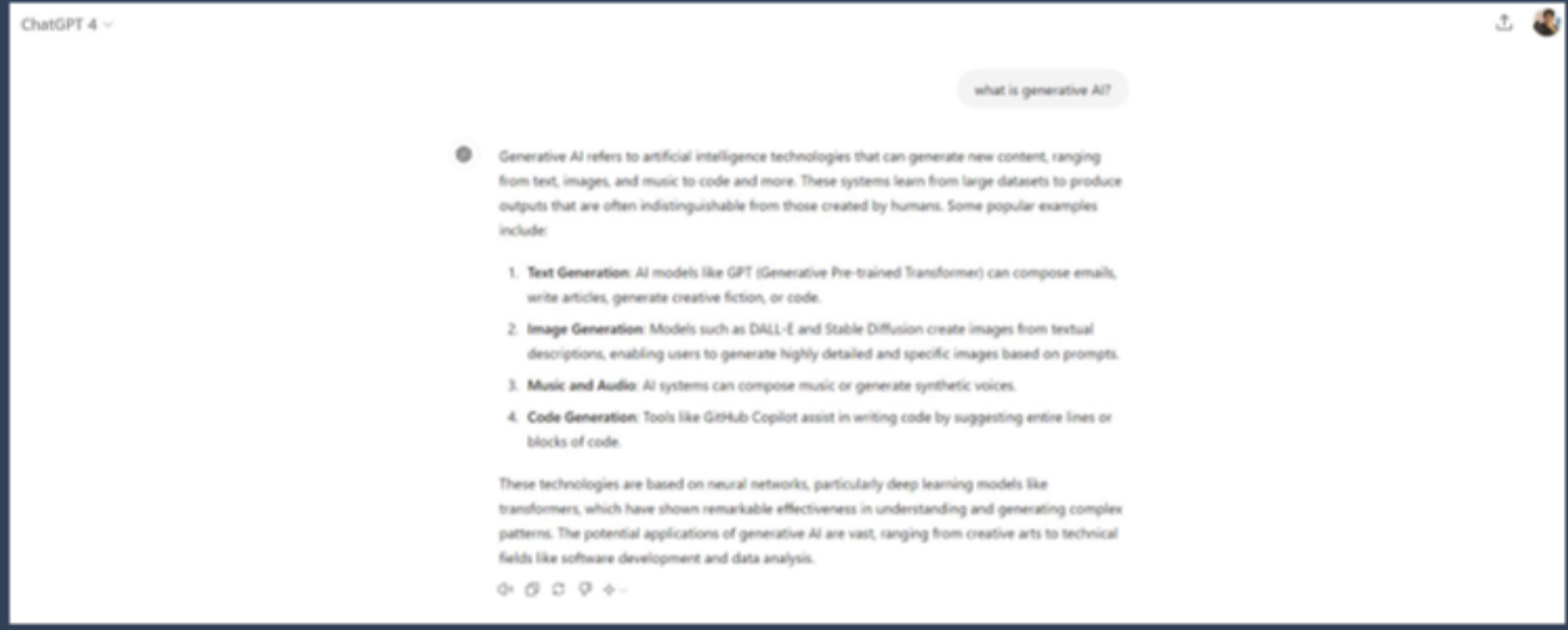
- It allows you to write your code in separate blocks or cells, and you can execute these cells one at a time.



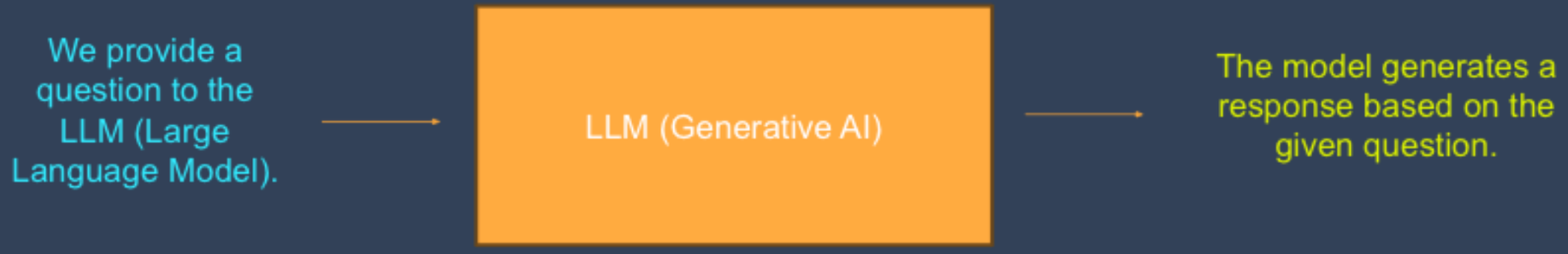
Role of Python in Generative AI

- **Primary Language for AI:** Python's simplicity and readability make it the go-to language for AI development, supported by libraries like TensorFlow, PyTorch, and Keras.
- **Generative Models:** Python is used to implement various generative models such as GANs, VAEs, and Transformers for applications like image, text, and audio generation.
- **Integration and Deployment**: Seamless integration with APIs, web services, and cloud platforms (e.g., AWS, Google Cloud) for scalable deployment of AI models.
- **Extensive Libraries:** Essential libraries like NumPy and Pandas facilitate data manipulation and preprocessing tasks critical for AI development.
- **Vibrant Community:** A large, active community and abundant educational resources support ongoing learning and development in Python for generative AI.

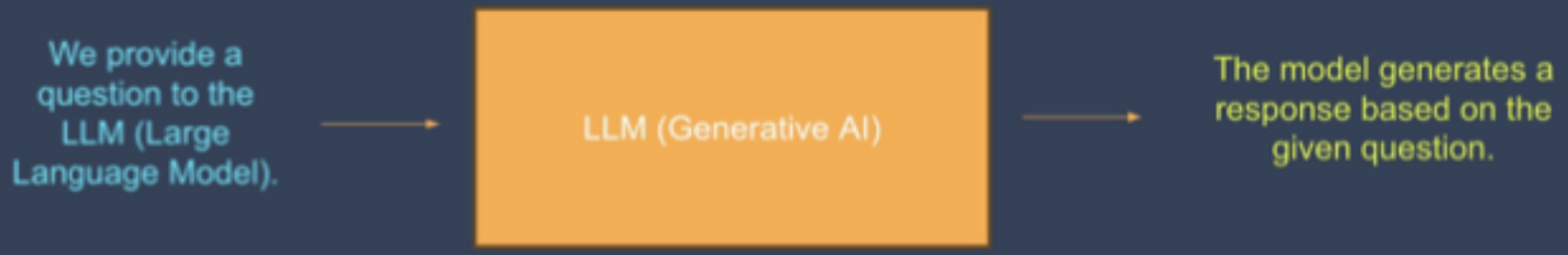
A Problem-Based Learning Approach



A Problem-Based Learning Approach



A Problem-Based Learning Approach




```
# Define the prompt for the AI model, asking it to summarize the provided text
prompt = """
Summarize the following text into a single sentence:
Python is a versatile and powerful programming language used in various domains. From web development
to data science, Python has become a language of choice for many.
Python is a high-level, interpreted, and object-oriented programming language.
Python was created by Guido Van Rossum and released in 1991.
Python's readability and simplicity make it an ideal language for beginners.
It's widely used in industry, making it a valuable skill for future opportunities.
"""


# Generate the summary response by calling LLM
response = call_LLM(prompt)

# Print the generated summary
print(response)
```

Variables and Data Types

Basic Python Programming - Variables and Data Types

- **Variables:**
  - Store values for later use
  - No need to declare data type in advance
- **Data types:**
  - Common types: int, float, str, bool, list, tuple, set and dictionary
  - Automatically assigned based on the value

- **Integer:** Example: a = 10
- **Float:** Example: b = 6.2

String: Example: c = "Matt"

Boolean: Example: d = True

- **List:**
  - An ordered, mutable collection of items enclosed in square brackets []. Items can be of different data types.
  - Example: c = [1, 2, 3, 4, 5]

- **Tuple:**
  - An ordered, immutable collection of items enclosed in parentheses (). Items can be of different data types.
  - Example: d = (1, 2, 3, 4, 5)

- **Set:**
  - An unordered collection of unique items enclosed in curly braces {}.
    Example: c = {1, 2, 3, 4, 5}

- **Dictionary:**
  - A collection of key-value pairs enclosed in curly braces {}, where each key is unique and immutable, and values can be of any data type and are accessed using their keys
  - Example: d = {"name": "Alice", "age": 30}

Operators

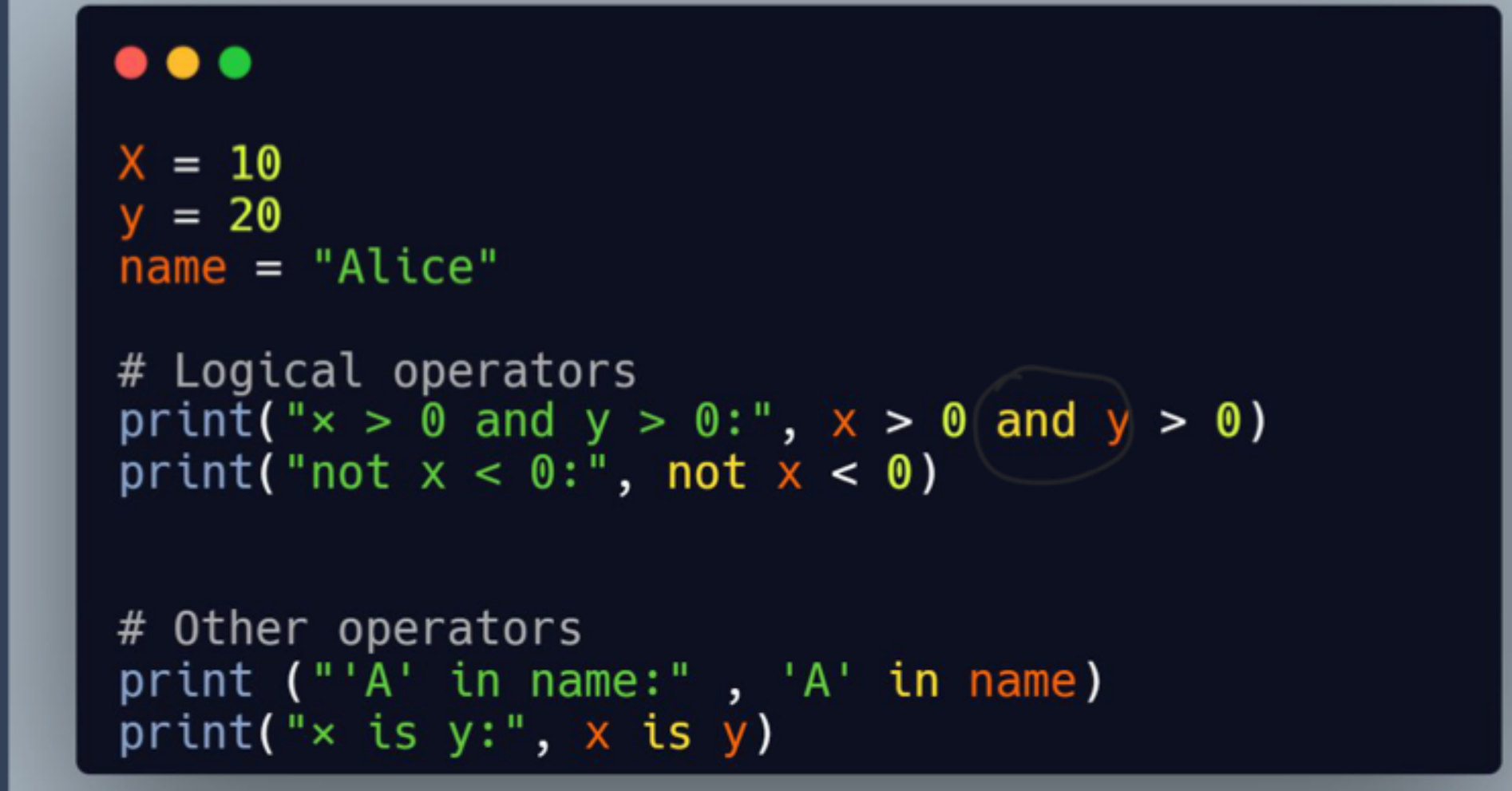
```
In [6]: x = 10

In [7]: y = 3

In [8]: # Arithmetic operators

In [9]: print("x + y =", x + y)
x + y = 13

In [10]: print("x - y =", x - y)
x - y = 7

In [11]: # Comparison operators

In [12]: print("x == y?", x == y)
x == y? False

In [13]: print("x < y?", x < y)
x < y? False
```

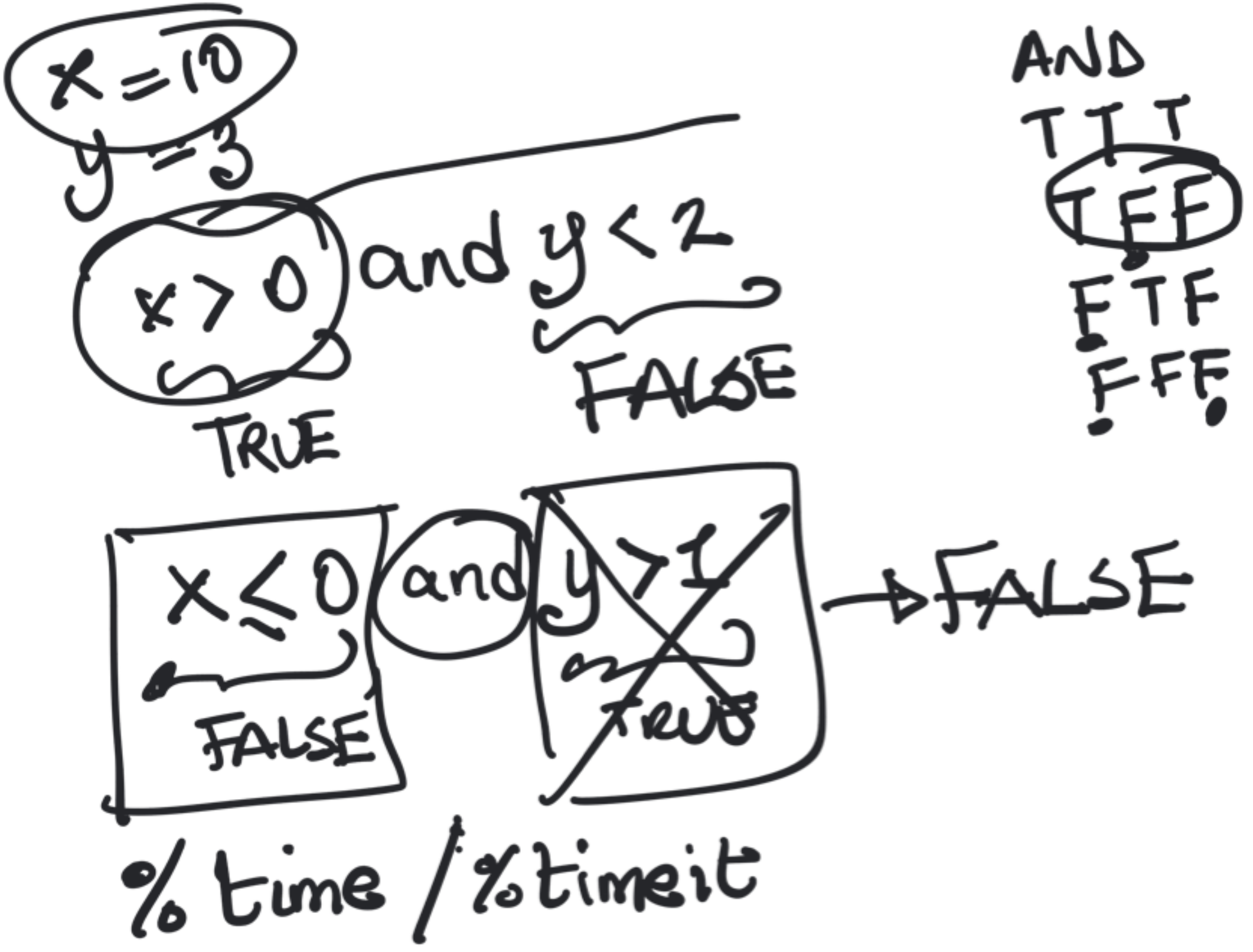
Arithmetic

+, -, /, //, *, %

8//3 = 2

8/3 = 2.667


X = 10
y = 20
name = "Alice"
# Logical operators
print("x > 0 and y > 0:", x > 0 and y > 0)
print("not x < 0:", not x < 0)
# Other operators
print ("'A' in name:" , 'A' in name)
print("x is y:", x is y)


x = 10
y = 3
x > 0
TRUE
and
y < 2
FALSE
AND
T T T
T F F
F T F
F F F
x ≤ 0
FALSE
and
y > 1
TRUE
FALSE
% time / %timeit

Code Review

Variables, Strings and Operators

Lists

Python List - Overview and Basic Operations

- **Definition:**
  - Ordered, mutable collection of items
  - Can contain elements of different data types
  - Created using square brackets []

- **Usage:**
  - Create variable-length and mutable sequences of objects
  - Store objects of any type
  - Store multiple types of objects together

Characteristics of a Python List

The various characteristics of a list are -

- **Ordered:** Lists maintain the order in which the data is inserted.

```
fruits = ["apple", "banana", "cherry"]
print(fruits)  # Output: ['apple', 'banana', 'cherry']
```

- Accessing Items using their index (Zero-based, Negative indexing).

```
first_item = fruits[1]
print(first_item)  # Output: 'banana'
```

- **Dynamic:** List can expand or shrink automatically to accommodate the items accordingly.

- **Duplicate Elements:** Lists allow us to store duplicate data

- **Heterogenous:** Lists can store elements of various data types.

```
mixed_list = ["apple", 42, 3.14, [1, 2, 3]]
print(mixed_list)  # Output: ['apple', 42, 3.14, [1, 2, 3]]
```

- **Mutable:** In list element(s) are changeable. It means that we can modify the items stored within the list.

```
# Adding an item
fruits.append("date")
print(fruits)  # Output: ['apple', 'banana', 'cherry', 'date']

# Removing an item
fruits.remove("banana")
print(fruits)  # Output: ['apple', 'cherry', 'date']

# Changing an item
fruits[1] = "blueberry"
print(fruits)  # Output: ['apple', 'blueberry', 'date']
```

Slicing in Python

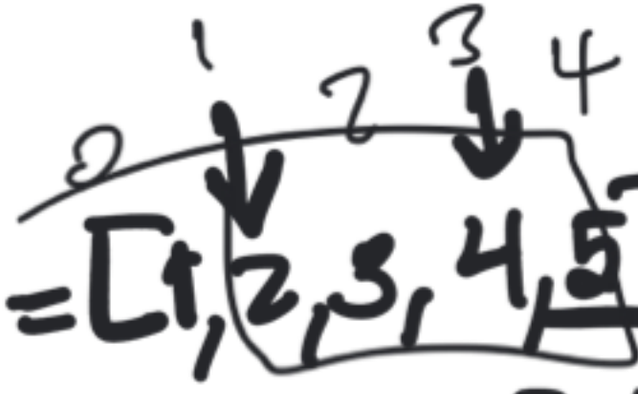
Slicing is a technique in Python used to extract a subset of elements from a sequence (such as a list, tuple, or string) by specifying a range of indices.

```
sequence[start:stop:step]
```

start: The starting index of the slice (inclusive). Defaults to 0 if not specified.
stop: The ending index of the slice (exclusive). The slice includes elements up to, but not including, this index.
step: The step size, or the interval between indices in the slice. Defaults to 1 if not specified.

```python
numbers = [0, 1, 2, 3, 4, 5, 6, 7, 8, 9]

# Slicing from index 2 to 5
subset = numbers[2:6]
print(subset)  # Output: [2, 3, 4, 5]

# Slicing with step size of 2
subset = numbers[1:8:2]
print(subset)  # Output: [1, 3, 5, 7]
```

```python
# Define a string
text = "Hello, World!"

# Slicing from index 7 to the end
substring = text[7:]
print(substring)  # Output: "World!"

# Slicing from the beginning to index 5
substring = text[:5]
print(substring)  # Output: "Hello"
```



Start : Stop : Step

∅ endoflist ↘1

my_list = [1, 2, 3, 4, 5]

sub_list = my_list[1 : 5]

Do you wonder how negative indexing works in Python Slicing?

Python Slicing - Negative Indexing

- Negative indices:
  - Can be used for slicing to refer to elements from the end of the sequence

```
# Create a list of numbers
numbers = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]


# Using negative index to slice the list from the second-to-last element to the fifth-to-last element (exclusive)
slice_negative = numbers[-5:-2]
print("Negative index slice:", slice_negative)  # Output: [6, 7, 8]
```

Tuples

Python Tuple - Overview & Characteristics

The various characteristics of a Tuple are -

- **Ordered Collection**

```
fruits = ("apple", "banana", "cherry")
print(fruits)  # Output: ('apple', 'banana', 'cherry')
```

- Accessing Items using their index (zero-based, negative).

```
first_item = fruits[0]
print(first_item)  # Output: 'apple'
```

- **Immutable Collection**: We can not add, remove or change an item in Tuples.
- **Different Data Types**

```
mixed_tuple = ("apple", 42, 3.14, (1, 2, 3))
print(mixed_tuple)  # Output: ('apple', 42, 3.14, (1, 2, 3))
```

Set

Characteristics of a Python Set

The various characteristics of a set are -

- **Unordered Collection:**

```
fruits_1 = {"apple", "banana", "cherry"}
fruits_2 = {"apple", "cherry", "banana"}
```

- Unique Items::

```
fruits = {"apple", "banana", "cherry", "apple"}
print(fruits)  # Output: {'apple', 'banana', 'cherry'} (duplicates are removed)
```

- **Mutable Collection:**

```
# Adding an item
fruits.add("date")
print(fruits)  # Output: {'apple', 'banana', 'cherry', 'date'}

# Removing an item
fruits.remove("banana")
print(fruits)  # Output: {'apple', 'cherry', 'date'}
```

Characteristics of a Python Set

Different Data Types (Sets cannot contain mutable elements like lists or dictionaries)

```
mixed_set = {"apple", 42, 3.14, (1, 2, 3)}
print(mixed_set)  # Output: {42, 3.14, 'apple', (1, 2, 3)}
```

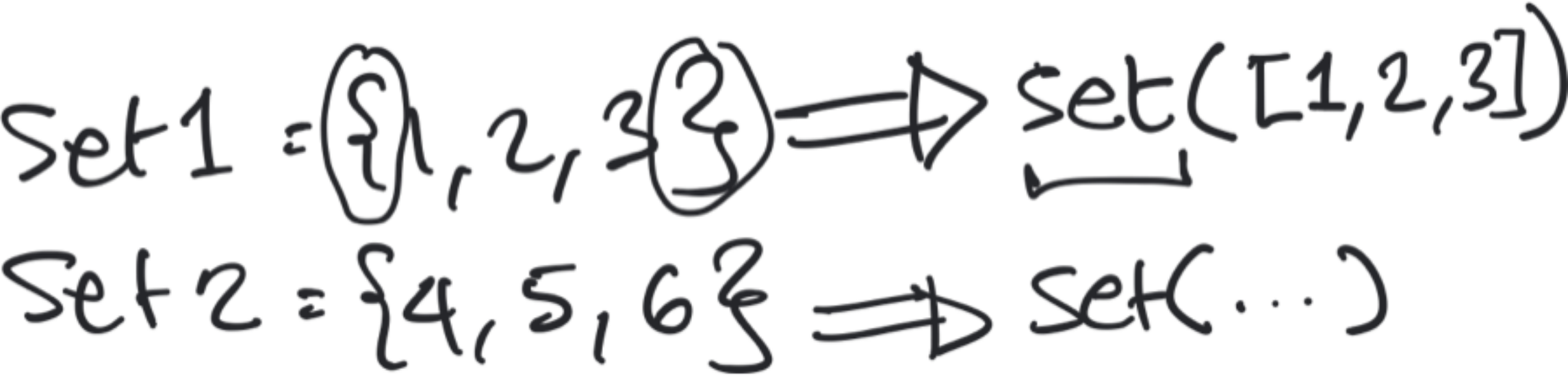
```python
set1 = {1, 2, 3}
set2 = {2, 3, 4}

# Union
union_set = set1 | set2
print(union_set)  # Output: {1, 2, 3, 4}

# Intersection
intersection_set = set1 & set2
print(intersection_set)  # Output: {2, 3}

# Difference
difference_set = set1 - set2
print(difference_set)  # Output: {1}

# Symmetric difference
symmetric_difference_set = set1 ^ set2
print(symmetric_difference_set)  # Output: {1, 4}
```


Set1 = {1, 2, 3} ⟹ set([1,2,3])
Set2 = {4, 5, 6} ⟹ set(...)

Dictionary in Python

Characteristics of Dictionaries in Python

Key-Value Pairs

```
student_ages = {"Alice": 25, "Bob": 22, "Charlie": 23}
print(student_ages)  # Output: {'Alice': 25, 'Bob': 22, 'Charlie': 23}
```

Unique

- If a dictionary contains duplicate keys, the last key-value pair will be used.

```
student_ages = {"Alice": 25, "Bob": 22, "Charlie": 23, "Alice": 26}
print(student_ages)  # Output: {'Alice': 26, 'Bob': 22, 'Charlie': 23}
```

Accessing Values::

```
age_of_alice = student_ages["Alice"]
print(age_of_alice)  # Output: 26
```

age_of_John = student_ages["John"]
↳ KeyError

my_dict.get("key", "default_value")

KEYERROR

my_dict.get("John", 18) → 18

my_dict["John"] = 42

```
my_dict = {"name": "Emmanuel"}
my_dict2 = dict("name"="Emmanuel")
```

Characteristics of Dictionaries in Python

Adding and Modifying Items

```
# Adding a new key-value pair
student_ages["David"] = 24
print(student_ages)  # Output: {'Alice': 26, 'Bob': 22, 'Charlie': 23, 'David': 24}

# Modifying an existing key-value pair
student_ages["Alice"] = 27
print(student_ages)  # Output: {'Alice': 27, 'Bob': 22, 'Charlie': 23, 'David': 24}
```

Different Data Types

- Keys must be immutable (e.g., strings, tuples).
- Values can be of any data type.

```
mixed_dict = {"name": "Alice", "age": 25, "is_student": True, "grades": [85, 90, 92]}
print(mixed_dict)
```

Practical Examples

1. **Storing Data with Different Attributes:** Dictionaries are ideal for storing data with different attributes, such as information about users, products, or any entities with multiple properties.

```
user = {
    'name': 'John Doe',
    'age': 30,
    'email': 'john@example.com',
    'city': 'New York'
}
```

1. **Retrieving Information Efficiently:** Dictionaries offer fast lookups, allowing you to retrieve information quickly using keys.

```
# Accessing user's email
email = user['email']
```

Practical Examples

3. **Mapping Unique IDs to Objects**: Dictionaries are useful for mapping unique identifiers to objects, facilitating efficient retrieval of objects based on their IDs.

```
# Mapping student IDs to their information
students = {
    1001: {'name': 'Alice', 'age': 20},
    1002: {'name': 'Bob', 'age': 22},
    # More students...
}
```

3. **Configuration Settings**: Dictionaries are commonly used to store configuration settings for applications.

```
# Application settings
settings = {
    'debug': True,
    'log_level': 'INFO',
    'timeout': 30
}
```

Code Review

Lists, Sets, Tuples and Dictionaries

Strings

Python String - Defining and Using in Python

- Ordered, immutable sequence of characters
- Enclosed in single or double quotes (" or "")

```
# Using single quotes for a simple string
single_quoted_string = 'Hello, World!'

# Using double quotes for a simple string
double_quoted_string = "Hello, World!"

# Using double quotes to avoid escape character
double_without_escape = "It's a beautiful day."
single_with_escape = 'It\'s a beautiful day.'

# Multi-line string with triple quotes
multi_line_string = """
This is a multi-line string.
It can span multiple lines without needing any escape characters.
"""
```

Important String Methods

```
Converts all characters in the string to lowercase.
str.lower():
Example: "Hello".lower() returns "hello".

Converts all characters in the string to uppercase.
str.upper():
Example: "hello".upper() returns "HELLO".

Capitalizes the first character of the string and lowercases the rest.
str.capitalize():
Example: "hello world".capitalize() returns "Hello world".

Converts the first character of each word to uppercase and the rest to lowercase.
str.title():
Example: "hello world".title() returns "Hello World".

Removes any leading and trailing whitespace
str.strip():
Example: " hello ".strip() returns "hello".

Removes any leading whitespace
str.lstrip():
Removes any leading whitespace.
Example: " hello ".lstrip() returns "hello ".
```

Important String Methods

```
Removes any trailing whitespace
str.rstrip():
Example: " hello ".rstrip() returns " hello".

Splits the string into a list of substrings based on a specified delimiter
str.split():
Example: "hello world".split() returns ["hello", "world"].

Joins a list of strings into a single string with a specified delimiter
str.join():
Example: " ".join(["hello", "world"]) returns "hello world".
```

Advanced String Operations in Python

- **String Concatenation:**
  - Combining multiple strings into one string.

```
# String Concatenation
str1 = "Hello"
str3 = "World"
concatenated_string = str1 + " " + str3
print(concatenated_string)  # Output: Hello World
```

- **String Formatting**
  - f-strings: It provides a concise and readable way to embed expression inside string literals.

```
name = "Alice"
age = 30
formatted_string = f"My name is {name} and I am {age} years old."
print(formatted_string)  # Output: My name is Alice and I am 30 years
old.

formatted_string = "My name is {} and I am {} years old.".format(name, age)
print(formatted_string)  # Output: My name is Alice and I am 30 years old.
```

  - format method: A more versatile way to format strings.

Advanced String Operations in Python

```
text = """
Python is a versatile and powerful programming language used in various domains. From web development to
data science, Python has become a language of choice for many.
Python is a high-level, interpreted, and object-oriented programming language.
Python was created by Guido Van Rossum and released in 1991.
Python's readability and simplicity make it an ideal language for beginners.
It is widely used in industry, making it a valuable skill for future opportunities.
"""

# Define the prompt for the AI model, asking it to summarize the provided text
prompt = f"""
Summarize the text delimited by triple backticks into a single sentence.
```{text}```
"""



# Generate the summary response by calling LLM
response = call_LLM(prompt)

# Print the generated summary
print(response)
```
```


QUIZ
TIME!

Quiz

How do you access the second element of a list named my_list?

A my_list(1)

B my_list[1]

C my_list.second()

D my_list[2]

Quiz - Solution

How do you access the second element of a list named my_list?

A my_list(1)

B my_list[1]

C my_list.second()

D my_list[2]

Quiz

What is the output of the following code snippet?

```
my_dict = {'a': 1, 'b': 2, 'c': 3}
print(my_dict['d'])
```

A 0

B None

C IndexError: ‘d’

D KeyError: ‘d’

Quiz - Solution

What is the output of the following code snippet?

```
my_dict = {'a': 1, 'b': 2, 'c': 3}
print(my_dict['d'])
```

A 0

B None

C IndexError: ‘d’

D KeyError: ‘d’

Quiz

What is the output of the following code snippet?

```
my_dict = {'a': 1, 'b': 2, 'c': 3}
print(my_dict.get('d'))
```

A 0

B Nothing

C IndexError: ‘d’

D KeyError: ‘d’

Quiz - Solution

What is the output of the following code snippet?

```
my_dict = {'a': 1, 'b': 2, 'c': 3}
print(my_dict.get('d'))
```

A 0

B Nothing

C IndexError: ‘d’

D KeyError: ‘d’

Quiz

What is the output of the following code snippet?

```
my_dict = {'a': 1, 'b': 2, 'c': 3}
print(my_dict.get('d', 4))
```

A 4

B Nothing

C IndexError: ‘d’

D KeyError: ‘d’

Quiz - Solution

What is the output of the following code snippet?

```
my_dict = {'a': 1, 'b': 2, 'c': 3}
print(my_dict.get('d', 4))
```

A 4

B Nothing

C IndexError: ‘d’

D KeyError: ‘d’


Break
Time!

Today's Agenda

Conditionals in Python : If-else statements

Indentation in Python

Indentation in Python is a fundamental aspect of the language's syntax. Unlike many other programming languages that use braces {} to delimit blocks of code, Python uses indentation to define the scope and structure of loops, conditionals, functions, and other control structures.

Consistency is Crucial:

1. All lines of code in a block must be indented the same amount.
2. Python does not enforce a specific number of spaces, but the convention is to use 4 spaces per indentation level

Indentation Levels:

2. Each indentation level indicates a new block of code.
3. Indentation helps to visually distinguish blocks of code that are nested inside other blocks.

Indentation for Control Structures:

1. Indentation is used to define the scope of loops (for, while), conditionals (if, elif, else), functions (def), classes (class), and other constructs.

```
# Correct indentation
if x > 0:
    print("x is positive")
else:
    print("x is negative or zero")

# Incorrect indentation (will cause a syntax error)
if x > 0:
print("x is positive")
```

Conditional Statements in Python

- ✔ The **if statement** checks a condition, and if the condition is True, it executes the block of code that follows.

```
x = 10
if x > 5:
    print("x is greater than 5")
```

- ✔ The **elif statement** checks another condition if the previous if or elif condition was False. It can be used multiple times.

```
x = 10
if x > 15:
    print("x is greater than 15")
elif x > 5:
    print("x is greater than 5 but less than
or equal to 15")
```

- ✔ The **else statement** is executed if none of the preceding if or elif conditions are True.

```
x = 3
if x > 5:
    print("x is greater than 5")
elif x > 2:
    print("x is greater than 2 but less
than or equal to 5")
else:
    print("x is 2 or less")
```

```
if x > 0:
    if x < 10:
        if x == 5 and y == 3:
            print ("values are ....")
```

Python If-Else Statements - Example

```
age = 18

if age >= 18:
  print ("You are eligible to vote.")

else:
  print ("You are not eligible to vote.")
```

Python "match" Statement

✔ Introduced in **Python 3.10** for more concise and readable way to express conditional logic especially for multiple patterns.

```
x = 10

match x:
    case 0:
        print("x is zero")
    case 1:
        print("x is one")
    case _:
        print("x is greater than one")
```

Python >= 3.10

```
x = 10

match x:
    case 0:
        print("x is zero")

    case 1:
        ...

    case n:
        ...

    case _:  <- WILDCARD
        print("default code branch")
```

Loops in Python

Python Loops - Types and Usage

In Python, loops are used to repeatedly execute a block of code as long as a certain condition is true or for a specified number of times.

1. **'for' Loops:** iterate over a sequence (such as a list, tuple, string, or range)

2. **'while' Loops:** used to repeatedly execute a block of code as long as a specified condition is true

Python Loops - Types and Usage

Two types of loops:

- **For loop:** Iterate over a sequence (e.g., list, tuple, string)
- **While loop:** Execute code block while a condition is true

Loops - For

For Loop

Used for iterating over a sequence (such as a list, tuple, dictionary, set, or string).

Syntax

```
for item in sequence:
    # code block to execute for each item
```

Example

```
fruits = ["apple", "banana", "cherry"]
for fruit in fruits:
    print(fruit)
# Output:
# apple
# banana
# cherry
```

Loops - While

Repeatedly execute a block of code as long as a condition is true.

Syntax

```
    while condition:
        # code block to execute as long as the condition is true
```

Example

```
count = 1
while count <= 3:
    print(count)
    count += 1

# Output:
# 1
# 2
# 3
```

Do you know what are loop control statements?

Python Loops - Loop Control

- **Loop control statements:**
  - break: Exit the loop immediately
  - continue: Skip the rest of the loop body and start the next iteration
  - else clause: Executes code if the loop completes normally without being interrupted by "break".

Loop Control : Using the break Statement

What will be the output of this code snippet?

```
for i in range(5):
    if i == 3:
        break
    print(i)
```

0
1
2

Output of the previous code

Else - As Loop Control

```
count = 0
while count < 5:
    user_input = input("Enter a number (or 'quit' to exit):

    if user_input == "quit":
        break

    try:
        number = int(user_input)
        print(f"You entered: {number}")
    except ValueError:
        print("Invalid input. Please enter a number.")

    count += 1

else:
    print("Loop completed without encountering 'quit'.")
```

Nested Loops in Python

- Nested loops:
  - Loops can be placed inside other loops to create complex looping structures

Python Loops - Nested Loops

```python
# List of items
items = ['a', 'b', 'c', 'd']
# List to hold the pairs
pairs = []
# Nested loop to create pairs
for i in items:
    for j in items:
        # Append the pair to the pairs list
        pairs.append((i, j))
# Print the list of pairs
print(pairs)
```

Python Loops - Loop Control and Nested Loops

- Best practices:
  - Keep loop bodies simple and readable
  - Avoid excessive nesting

Functions

What are Functions?

Python Functions - Definition and Syntax

Functions:

- Reusable pieces of code that perform a specific task
- Improve code readability, modularity, and maintainability

Function call:

- Invoke a function by its name, followed by parentheses containing arguments
- Defined using the def keyword.
- Parameters are variables listed inside the parentheses in the function definition.
- They allow you to pass information into functions.
- The return statement is used to exit a function and return a value.

```
def function_name(arguments):
    # function body

    return
```

Here,

- `def` - keyword used to declare a function
- `function_name` - any name given to the function
- `arguments` - any value passed to function
- `return` (optional) - returns value from a function

Let's see an example,

```
def greet():
    print('Hello World!')
```

Function

Syntax

```
def function_name(parameters):
    # code block to execute
    return result
```

```
texts = [
    "Python is a versatile ...
]

summaries = []
for text in texts:
    prompt = f"""
    Summarize the following text into a
single sentence:
    {text}
    """
    summary = call_LLM(prompt)
    summaries.append(summary)
print(summaries)
```

```
texts = [
    "Python is a versatile ...
]

def summarize_texts(texts):
    summaries = []
    for text in texts:
        prompt = f"""
        Summarize the following text into a single
sentence:
        {text}
        """
        summary = call_LLM(prompt)
        summaries.append(summary)
    return summaries

Summary_results  = summarize_texts(texts)
print(Summary_results )
```

What's the difference between arguments and parameters?

??

Python Functions - Parameters and Arguments

- **Parameters vs. arguments:**
  - Parameters: Variables defined in the function's signature
  - Arguments: Values passed to the function when it's called

Function Parameter and Argument

✔ **Positional arguments:**

Positional arguments are the most common type. They are passed to the function in the same order as the parameters are defined

```
def subtract(a, b):
    return a - b

result = subtract(10, 5)
print(result)  # Output: 5
```

✔ **Keyword arguments:**

Keyword arguments are passed to the function by explicitly specifying the parameter name.

```
def greet(name, message):
    print(f"{message}, {name}!")

greet(name="Alice", message="Hello")
greet(message="Hi", name="Bob")
```

✔ **Default parameters:**

Default parameters allow you to specify default values for parameters.
If an argument is not provided, the default value is used.

```
def greet(name, message="Hello"):
    print(f"{message}, {name}!")

greet("Alice")
greet("Bob", "Hi")
```

```
def summarize_text(text: list[str], temperature: float = 0.0):
    ...

    return summary

summarize_text(text)
summarize_text(text, temperature = 0.1)
```

Function Parameter and Argument

✔ **Variable-length arguments:**

i. ***args:**
Allows a function to accept any number of positional arguments and it collects all positional arguments into a tuple

```
def multiply(*args):
    result = 1
    for num in args:
        result *= num
    return result

print(multiply(1, 2, 3, 4))

# Output: 24
```

i. ****kwargs:**
Allows a function to accept any number of keyword arguments. It collects all keyword arguments into a dictionary

```
def print_info(**kwargs):
    for key, value in kwargs.items():
        print(f"{key}: {value}")

print_info(name="Alice", age=30,
city="New York")
```

Function Docstrings

✔ **Docstrings:**
Docstrings are used to document and explain the purpose of a function

```
def greet(name, message):
    """ Greets a person by name. """
    print(f"{message}, {name}!")
```

Code Review

Conditionals, Loops, Break/Continue
and
Functions

Python as an Object-Oriented Programming Language

What are Objects in the Programming World?

- In the real-world, objects are entities that exist - can be felt and touched. For example, a phone. It's an object that exists in the real world.

- In the programming world, an Object is an entity that exists in the memory

In Python, everything is an Object!

- The basic data types - Int, Float, String etc. are also objects and the data structures in Python - List, Set, Tuple, Dictionary are also objects.

- Every object is an instance of its class. We will learn more about classes in the later sections of this module.

Attributes and Behavior of Objects

- All objects have certain properties or characteristics called as Attributes
- For example, a phone object in the real world may have attributes like color, size, width etc.
- In Python, the objects like list have attributes like length - that is its property or attributes that describes it

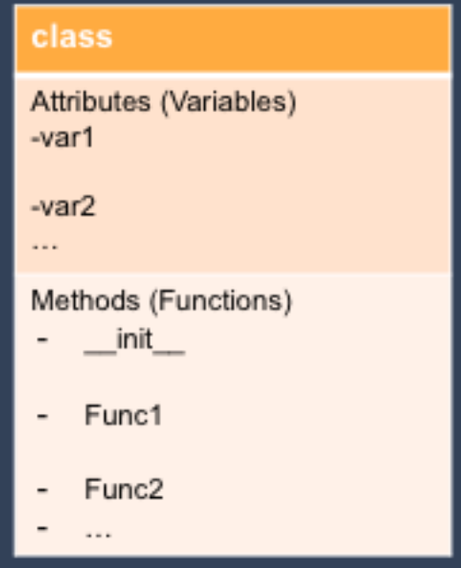
Attributes and Behavior of Objects contd.

- Every object has some functions - it's the tasks that it can perform
- Just like a phone in a real world can perform functions like making calls, clicking pictures etc.
- In Python, the behavior of objects are called as Methods

Class

A class is a blueprint for creating objects. You can think of an object derived from a class as a container that holds some variables (attributes) and functions (methods). These variables and functions might be related to each other.

```
class NameofClass:

    def __init__ (self, var1, var2, ...):
        self.ovar1 = var1
        self.ovar2 = var2
        ....


    def func1(self, ...):
        ...


    def func2(self, ...):
        ...



    def func3(self, ...):

        a = self.ovar1 + self.ovar2
        b = self.func1(a)
        return b


obj1 = NameofClass(var1 = 12, var2 = 14, ...)
```



Inheritance

The ability for one class to inherit attributes and methods from another class.

```python
class Dog:
    def __init__(self, name, breed):
        self.name = name
        self.breed = breed

    def bark(self):
        print("Woof!")

# Create an object of the Dog class
fido = Dog("Fido", "Golden Retriever")

# Access attributes and methods
print(fido.name)  # Output: Fido
fido.bark()  # Output: Woof!
```

```python
class GoldenRetriever(Dog):
    def fetch(self):
        print("Fetching!")

# Create an object of the GoldenRetriever class
buddy = GoldenRetriever("Buddy", "Golden Retriever")

# Buddy inherits attributes and methods from Dog
print(buddy.name)  # Output: Buddy
buddy.bark()  # Output: Woof!
buddy.fetch()  # Output: Fetching!
```

class DogCountry:

class GoldenRetriever(Dog, DogCountry

Polymorphism

The ability of objects of different classes to be treated as if they were objects of the same class.

```
class Cat:
    def meow(self):
        print("Meow!")

def make_sound(animal):
    animal.make_sound()

fido = Dog("Fido", "Golden Retriever")
whiskers = Cat()

make_sound(fido)  # Output: Woof!
make_sound(whiskers)  # Output: Meow!
```

Encapsulation

The practice of bundling data and methods together within a class, protecting data from outside access.

```python
class Animal:
    def __init__(self, name, age):
        self.__name = name
        self.__age = age

    def get_name(self):
        return self.__name

    def get_age(self):
        return self.__age

    def make_sound(self):
        raise NotImplementedError("Subclasses must implement this method")
```

```python
class Dog(Animal):
    def make_sound(self):
        print("Woof!")

class Cat(Animal):
    def make_sound(self):
        print("Meow!")
```

```python
# Create objects
fido = Dog("Fido", 5)
whiskers = Cat("Whiskers", 3)

# Access public methods
print(fido.get_name())  # Output: Fido
print(whiskers.get_age())  # Output: 3

# Make sounds
fido.make_sound()  # Output: Woof!
whiskers.make_sound()  # Output: Meow!

# Attempt to access private attributes directly (will raise an AttributeError)
try:
    print(fido.__name)
except AttributeError as e:
    print(f"Error: {e}")
```

How Does This Help Me?

- As you work with Python for Generative AI, you would be working with different Python objects
- Understanding Attributes and Methods would help you work with the objects better

Code Review

Advanced Concepts - OOP


Break
Time!

Today's Agenda

Modules & Packages

Module

- ✔ A module is a file containing Python code. It can define functions, classes, and variables. You can use it to organize your code into reusable pieces.
- ✔ Think of a module as a library in other languages like Java or C#.

```python
# mymodule.py

def greet(name):
    return f"Hello, {name}!"

def add(a, b):
    return a + b
```

```python
# main.py

import mymodule

print(mymodule.greet("Alice")) # Output: Hello, Alice!
print(mymodule.add(3, 4))      # Output: 7
```

```
python main.py


Hello, Alice!
7
```

Package

- ✔ A package is a collection of modules organized in directories that includes a special __init__.py file.
- ✔ Think of a package as a directory containing multiple related modules or libraries.
- ✔ __init__.py is a special Python file used to indicate that a directory is a Python package. It allows the package's modules to be imported together, providing initialization code for the package if needed.
- ✔ pip is the package installer for Python. It allows you to install and manage additional libraries and dependencies that are not included in the standard library.

```
mypackage/
├── __init__.py
├── module1.py
└── module2.py
```

```
from mypackage import module1,
module2

print(module1.function1())
print(module2.function2())
```

```
python main.py


Hello, Alice!
7
```

Virtual Environment

- ✔ A virtual environment is an isolated Python environment that allows you to manage dependencies for your projects independently of each other.
- ✔ To prevent dependency conflicts between projects and to keep the global Python environment clean.
- ✔ Steps: Create, activate, install dependencies, and verify.
- ✔ If you do not use a virtual environment, all the installed packages will be installed globally, potentially causing conflicts with other projects and cluttering your global Python environment.

```
python -m venv projectA_env
python -m venv projectB_env
```

Python -c

```
projectA_env\Scripts\activate
```

```
(projectA_env) pip install
requests==2.24.0
```

Library

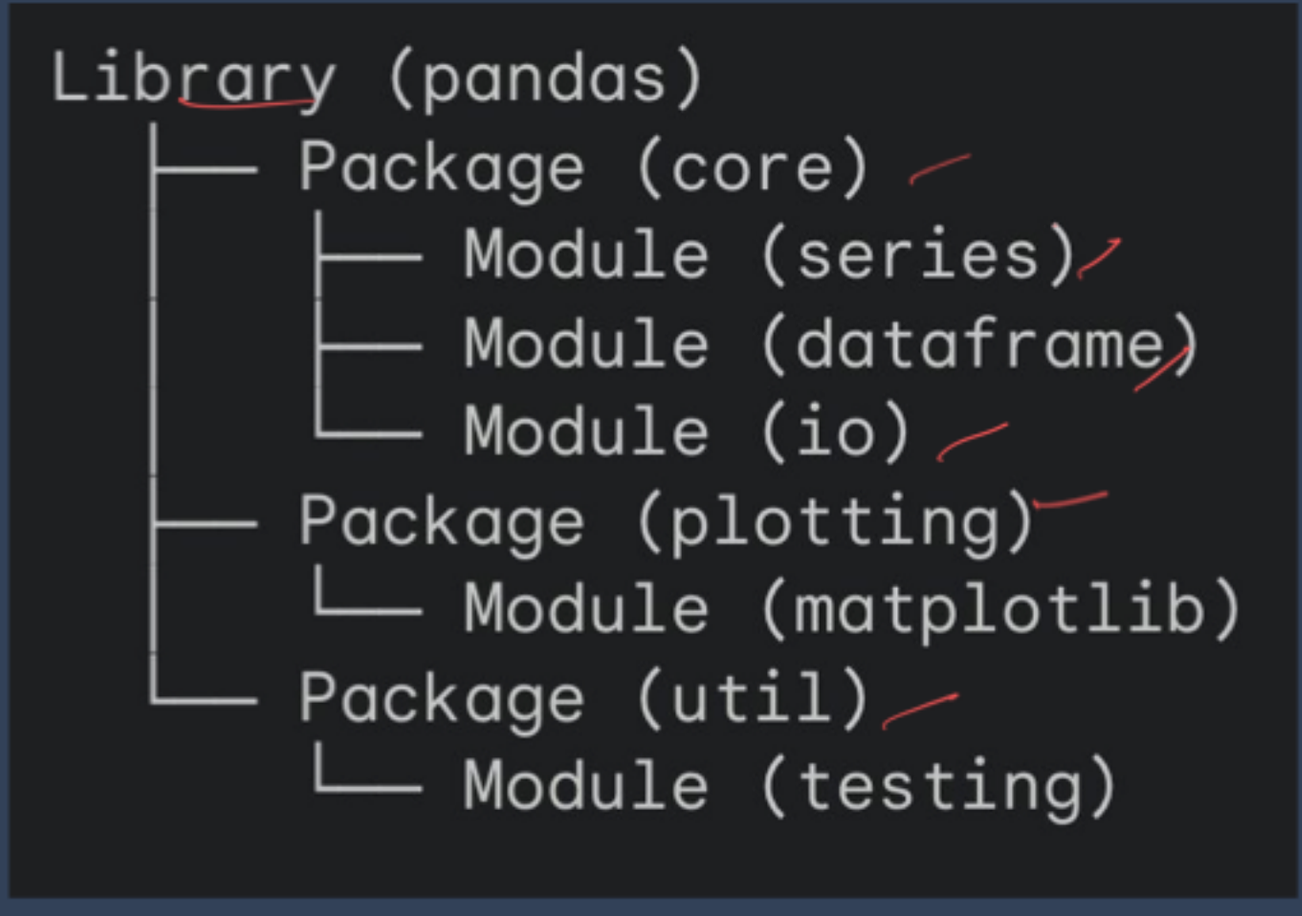
- ✔ A library is a collection of pre-compiled routines that a program can use. These routines are often packaged into a format that can be easily included and used by various programs, facilitating code reuse and modular programming.
- ✔ Libraries can include various functions, classes, and variables that provide specific functionality. For example, a math library might include routines for mathematical operations, while a graphics library might include routines for rendering images.
- ✔ In Python, a library is typically a package that contains multiple modules. These modules can be related to one another and can be imported into your programs as needed.

```
mathlib/
├── __init__.py
├── addition.py
└── subtraction.py
```

```
from .addition import add
from .subtraction import subtract

print(add(5, 3))
print(subtract(5, 3))
```

```
import numpy as np
array = np.array([1, 2, 3])
print(array)
```

Visual Representation



Introduction to NumPy

NumPy

- NumPy stands for Numerical Python and is a foundational package for numerical computing in Python.

- This module will include only hands-on exercises on NumPy. We hope you got a chance to go through the video before attending the class.

Role of NumPy in Applied Generative AI Course

- **Data Handling:** Efficient manipulation of large datasets with ndarray.
- **Mathematical Operations:** Essential for linear algebra and random number generation, crucial for AI model training.
- **Library Integration:** Seamless conversion to tensors in TensorFlow/PyTorch; foundation for Pandas, SciPy, and Matplotlib.
- **Community Support:** Extensive documentation and a vibrant, active community for continuous learning and development.

Time to Code NumPy

Recap Quiz

What distinguishes NumPy arrays from Python lists?

A NumPy arrays do not support operations like element-wise addition or multiplication, which Python lists do.

B Python lists are faster for numerical calculations than NumPy arrays.

C NumPy arrays can only store elements of the same data type, while Python lists can hold elements of different types.

D Python list is designed for efficiency on large arrays of data

Recap Quiz - Solution

What distinguishes NumPy arrays from Python lists?

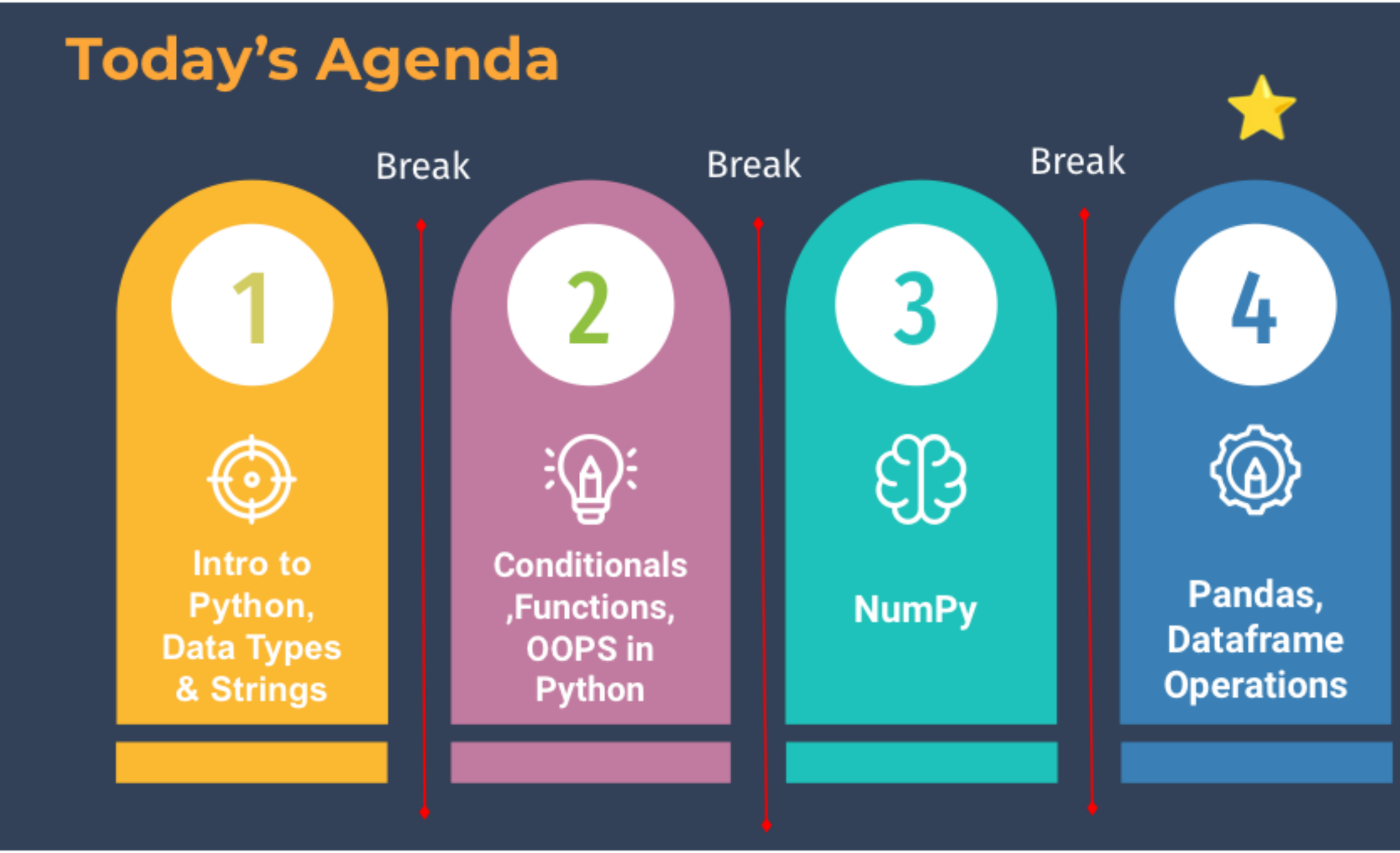
A NumPy arrays do not support operations like element-wise addition or multiplication, which Python lists do.

B Python lists are faster for numerical calculations than NumPy arrays.

C NumPy arrays can only store elements of the same data type, while Python lists can hold elements of different types.

D Python list is designed for efficiency on large arrays of data

Today's Agenda



Introduction to Pandas

Introduction

- Pandas is a powerful Python library widely used for *data manipulation* and *analysis*.

- Pandas offers data structures and functions that simplify working with structured data, making it an essential tool in data science and analysis

Why Pandas?

Using Pandas offers several benefits for data manipulation and data analysis:

- Efficient Data Handling
- Data Alignment
- Handling Missing Data
- Data Integration
- Flexible Data Transformation
- Integration with Other Libraries

Data Structures in Pandas

- Pandas **Series** is a one-dimensional array with axis labels.
- Pandas **DataFrame** is two-dimensional data structure with labeled rows and columns.

Series A

	apples
0	3
1	2
2	0
3	1

+

Series B

	oranges
0	0
1	3
2	7
3	2

=

DataFrame

	apples	oranges
0	3	0
1	2	3
2	0	7
3	1	2

Filtering a DataFrame - Why do we need filtering?

- When we need to remove redundant or unnecessary data for some tasks
- When we want to filter customers based on certain criteria
- When we need to filter out rows or columns have missing values

Filtering a DataFrame

- Filtering with `**loc**` and `**iloc**` methods
- Filtering by Selecting a Subset of Columns
- Filtering by condition(s)

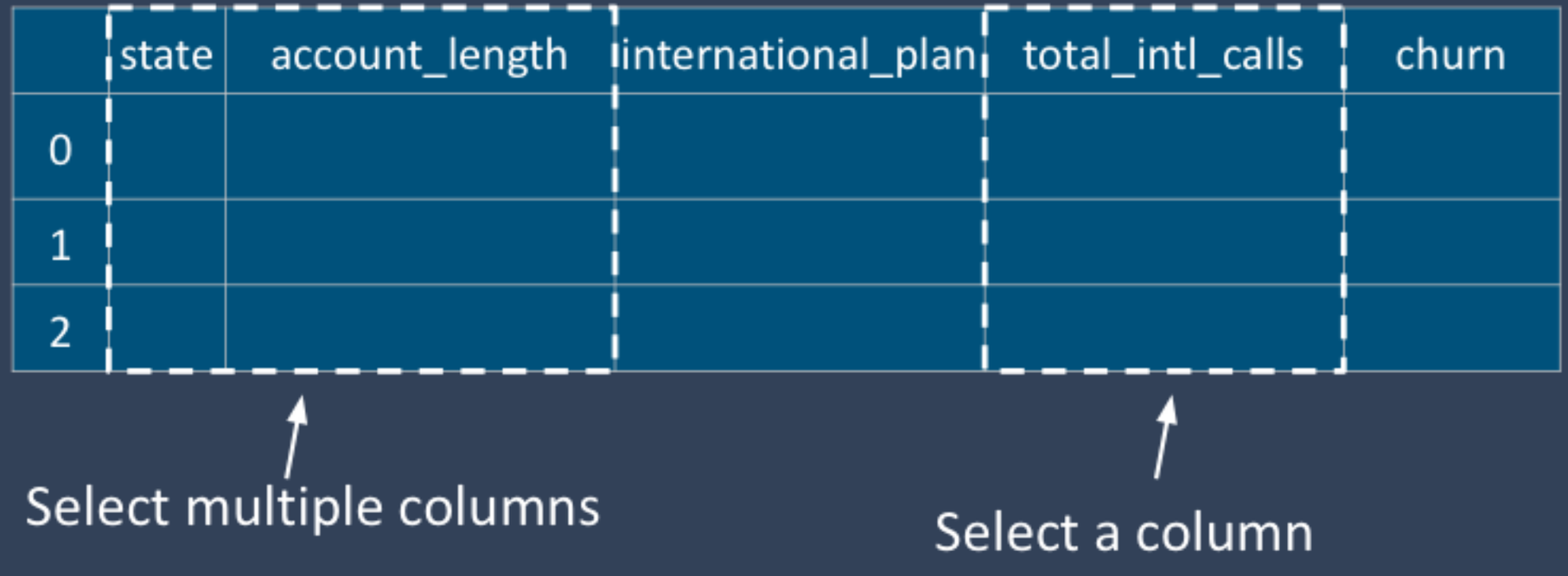
Filtering a DataFrame - `loc` and `iloc` methods

- **loc** uses row and column labels.
- **iloc** uses row and column indexes.

	column index		0	1	2
row index	label		Name	Age	Education
0	March	2			
1	April	3			
2	May	4			
3	June	5			
4	July	6			

Filtering a DataFrame - Selecting a Subset of Columns

- Select a single column
- Select multiple columns



Filtering a DataFrame - Filtering by condition(s)

- Filtering by a condition
- Filtering by multiple conditions

The operators we can use in filtering by condition(s):

- ==: equal
- !=: not equal
- >: greater than
- >=: greater than or equal to
- <: less than
- <=: less than or equal to
- & : and
- | : or

Handling Missing Values with Pandas

- Missing Value Types and Representation
- Finding the Missing Values
- Dropping Rows and Columns with Missing Values
- Replacing the Missing Values

df.isnull()
df.isna()
df.notna()
df.fillna()

Handling Missing Values with Pandas

- Missing values are essentially data we don't have
- NaN : stands for "Not a Number"
  - Python's **None**
  - **np.nan**

Finding the Missing Values

- isna() function: returns **True** to indicate a missing value
- notna() function: returns **False** for missing values

	state	account_length	churn
0	CA	314	yes
1	CO	?	no
2	?	44	yes

Dropping Rows and Columns with Missing Values

- dropna() function:
  - `axis`: 0 (default value, indicates row), 1
  - `how`: “any” (default value), “all”
  - `thresh`: a row or column that at least X non-missing values will be kept, otherwise will be dropped.

	state	account_length	churn
0	CA	314	?
1	CO	?	?
2	?	44	?

Replacing the Missing Values

- Dropping may not be the best option in many cases
- Replace missing values with:
  - the average value of the column
  - the most frequent value in the column
  - a random number
- fillna() function

	state	account_length	churn
0	CA	314	Yes
1	CO	100	Yes
2	CO	44	no

Sorting in a DataFrame

- Sort DataFrames based on their column features
- sort_values() : sort a DataFrame by one or more of its columns
  - First argument: either a column label or a list of column labels
  - `ascending` : ascending (default value), descending

	Name	age
0	David	33
1	Emily	20
2	Emma	44

	Name	age
0	Emily	20
1	David	33
2	Emma	44

Data Manipulation with Pandas

- drop(): Remove rows or columns from a DataFrame
- replace(): Replace values within a DataFrame
- apply(): Applying a given function along an axis of a DataFrame or Series.
- Add a new column from current data

	user_id	account_length	total_orders	total_amt
0	1232as	31	4	156
1	1323wv	0	2	127
2	134pdf	0	3	135
3	342t6ff	23	4	466

Data Manipulation with Pandas

- drop(): Remove rows or columns from a DataFrame
- replace(): Replace values within a DataFrame
- apply(): Applying a given function along an axis of a DataFrame or Series.
- Add a new column from current data

	user_id	account_length	total_orders	total_amt
0	1232as	31	4	156
1	1323wv	0	2	127
2	134pdf	0	3	135
3	342t6ff	23	4	466

How Does This Help Me?

- Pandas will help you handle and analyze large datasets.
- Pandas provide data structures and operations for manipulating numerical tables and time series.


```
import pandas as pd

emotions.set_format(type="pandas")
df = emotions["train"][:]
df.head()
```

	text	label
0	i didnt feel humiliated	0
1	i can go from feeling so hopeless to so damned...	0
2	im grabbing a minute to post i feel greedy wrong	3
3	i am ever feeling nostalgic about the fireplac...	2
4	i am feeling grouchy	3

Data Analysis with Pandas

Data Analysis with Pandas

- Data Analysis: The process of inferring insights, discovering useful information, and drawing results from the data
  - groupby(): groups rows of a DataFrame based on one or more columns
  - agg(): aggregate data within groups created by `groupby()`
  - reset_index(): reset the index of a DataFrame
  - rename(): change the labels (names) of rows or columns in a DataFrame
  - idxmax(): Return index of first occurrence of maximum over requested axis

	total_order	age
0	20	33
1	40	20
2	100	44

Decision-Making process

Explore the data before creating ML model

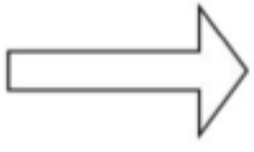
Data Analysis with Pandas - groupby(), agg()

The `groupby` function creates the groups, but they don't provide any information unless we do some aggregations.

DataFrame

product_group	product_code	price
A	1001	9
A	1002	14
B	1101	21
A	1003	12
B	1104	19
C	1201	7
B	1105	25

groupby("product_group")



product_group	product_code	price
A	1001	9
A	1002	14
A	1003	12

product_group	product_code	price
B	1101	21
B	1104	19
B	1105	25

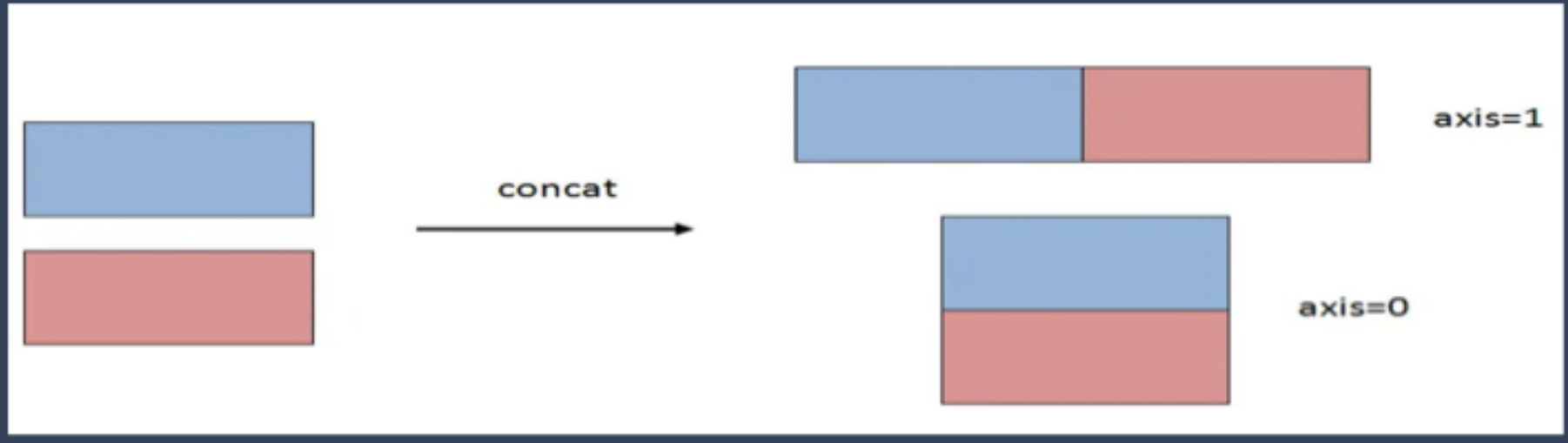
product_group	product_code	price
C	1201	7

concat

- **Purpose:** Concatenates DataFrames along a specified axis (rows or columns).

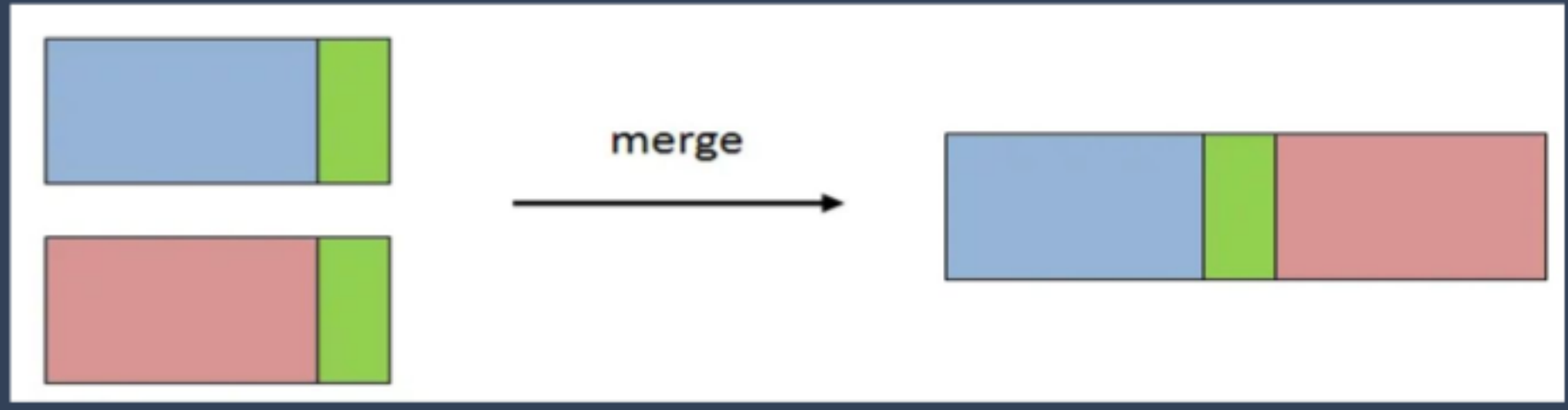
Combining DataFrames with Pandas - The concat function

- Concatenation is the process of combining DataFrames along a particular axis (either vertically or horizontally).
- When you concatenate DataFrames, you're essentially stacking them on top of each other (vertically) or side by side (horizontally).
- The resulting DataFrame maintains the original column names and indexes of the individual DataFrames.



Combining DataFrames with Pandas - The merge function

- Merging is the process of combining DataFrames based on common columns or indexes.
- It is often used to combine DataFrames with related information, similar to how SQL JOIN operation works.
- Merging allows us to specify which columns to use as keys for merging and how to handle overlapping column names.

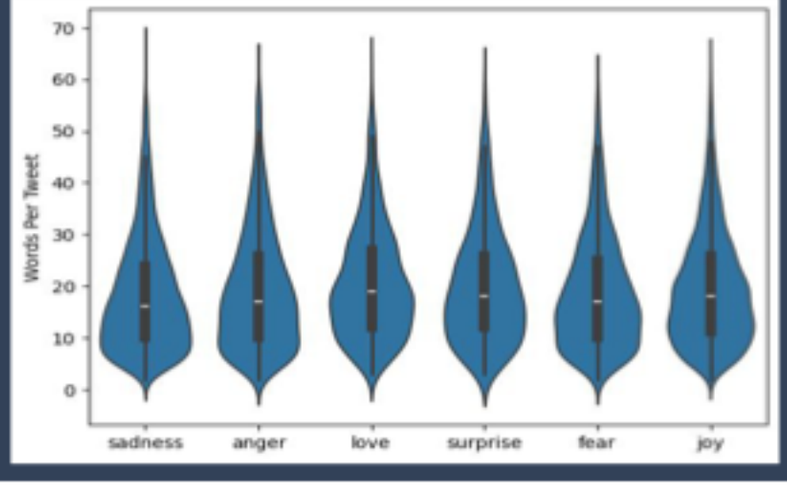


How Does This Help Me?

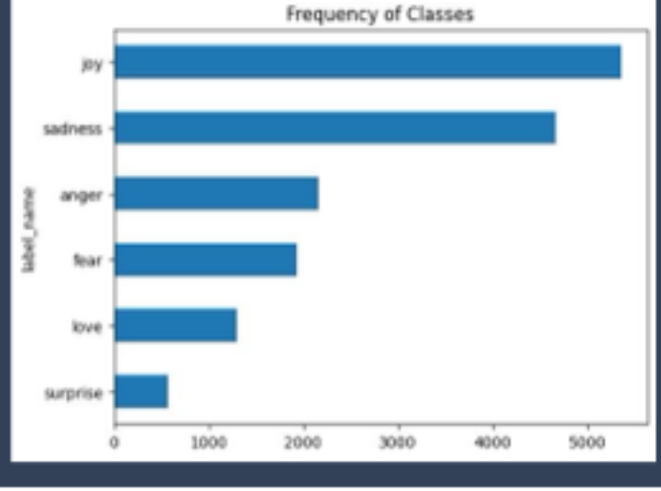
Exploratory Data Analysis (EDA)

- Understands data patterns and relationships, critical for feature selection.
- Identifies key features, outliers, and missing values, ensuring data quality.

```
import seaborn as sns
df["Words Per Tweet"] = df["text"].str.split().apply(len)
sns.violinplot(data=df, x ='label_name', y='Words Per Tweet')
plt.suptitle("")
plt.xlabel("")
plt.show()
```




```
import matplotlib.pyplot as plt

df["label_name"].value_counts(ascending=True).plot.barh()
plt.title("Frequency of Classes")
plt.show()
```



Time to Code - Pandas


QUIZ
TIME!

Quiz

Which function should be used to drop a row by index from a DataFrame?

A df.drop()

B df.delete()

C df.remove()

D df.drop_row()

Quiz

Which function should be used to drop a row by index from a DataFrame?

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Break
Time!

Session Summary

Intro to Python, Variables & Data Types	Overview of Python's syntax and structure	Introduction to integers, floats, strings, and booleans	Understanding how to create and use variables
Strings, List, Tuple, Dictionary	Methods and operations to manipulate string data	Creating and accessing lists and tuples, understanding their differences	Using key-value pairs for efficient data storage and retrieval
If-else, Loops, Functions, Lambda Functions	Implementing conditional statements (if-else) and loops (for, while)	Defining and using functions, understanding parameters and return values	Introduction to anonymous functions for concise operations
Class, Modules, Packages, Virtual Environment	Basics of classes and objects, defining attributes and methods	Organizing code into reusable modules and packages	Setting up and managing isolated Python environments for projects.

Next Steps

- Revise the concepts learnt in today's session through class recording and post-class videos
- Attempt the Assignment & Quiz questions available on Uplevel
- Register for Technical Coaching Session through Xpert Connect option on Uplevel
- Attend the Assignment Review Session to get a walkthrough of the assignment solution


CRM

What's Coming Next in Python Crash Course - Part 2?

Introduction to Python Libraries Essential for Generative AI

- Scikit-Learn
- Deep Learning Background
- Tensors & PyTorch

The scope of this module would be The Foundational Essentials of the most commonly used libraries in the field of Generative AI - enough to help you navigate through the Applied GenAI course!


Thank
you