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Hello and Welcome to AI Camp

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Python Programming

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Python in AI: A Powerful Partnership

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- Python’s syntax is clear and concise
- The vast array of open-source libraries and frameworks available in Python
- Python has emerged as the preferred programming language for Artificial Intelligence (AI) and Machine Learning (ML)
- Its active community support and continuous development make Python an ideal choice for staying at the forefront of AI advancements.

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Python Fundamentals

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Google colab - Basic usage

- Google Colab is a cloud-based platform that allows you to write and execute Python code in a collaborative environment, directly from your browser.
- It provides free access to GPUs, making it a powerful tool for machine learning and data analysis tasks.
- To get started, go to colab.research.google.com, sign in with your Google account, and create a new Colab notebook.

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Google colab - Basic usage

- The Colab interface consists of cells, each of which can contain either code or text.
- The toolbar at the top allows you to execute cells, add new cells, and manage the runtime.
- To run a cell, you can click the play button in the toolbar, use the keyboard shortcut (Shift + Enter), or select "Runtime" > "Run cell" from the menu.
- The order of execution matters; cells are executed sequentially.

Variables and Data Types

Python is a dynamically-typed language, The interpreter determines the type dynamically.

- **Naming conventions: Start with a letter or underscore, followed by letters, numbers, or underscores.**

+ Code + Text

```
age = 20
name = "islam"
```

Data Types Overview

- Python has several built-in data types:
  - Integer (`int`)
  - Float (`float`)
  - String (`str`)
  - Boolean (`bool`)
- Each data type is used to represent different kinds of information.

Numeric Data Types

- **Integer (`int`):**
  - Represents whole numbers.

```
+ Code   + Text

age = 20
```

- **Float (`float`):**
  - Represents floating-point numbers (decimals)

```
+ Code   + Text

0s  height = 1.75
```

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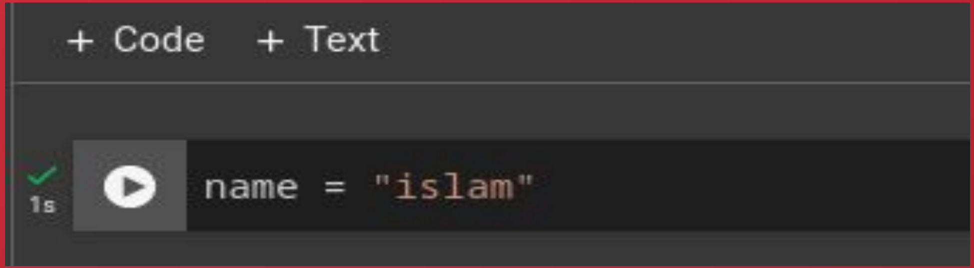
Textual Data Types

- **String (`str`):**
  - Represents text.
  - Created using single or double quotes.



Collections in python

Python offers various collection types to store multiple values:

- Lists (`list`)
- Tuples (`tuple`)
- Dictionaries (`dict`)
- Sets (`set`)

Lists and Tuples

- **List (`list`):**
  - Ordered mutable collection of values

```python
fruits = ["apple","orange","banana"]
```

- **Tuple (`tuple`):**
  - Ordered immutable collection of values

```python
coordinates = (4,5)
```

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Dictionaries and Sets

- **Dictionary (`dict`):**
  - Unordered collection of key-value pairs

```python
person = {"name":"islam", "age": 20}
```

- **Set (`set`):**
  - Unordered unique collection of values

```python
unique_numbers = {1,2,3,4,5}
```

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Type Conversion

- Sometimes, you may need to convert between data types
- Use functions like `int()`, `float()`, `str()`, and `bool()` for type conversion.

```
[30] age = "25"
     age_int = int(age)
```

```
print(type(age))
print(type(age_int))
```

```
<class 'str'>
<class 'int'>
```

Control Structures

- Control structures allow you to manage the flow of your program based on certain conditions and loops.
- They include:

- If-else statements
- for loops
- while loops

If-Else Statements

- Allows you to execute a block of code if a condition is true.

```
age = 25
if age >= 18:
  print("you are an adult.")
```

```
you are an adult.
```

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Elif Statements

- Stands for "else if" and allows you to check multiple conditions.

```python
temperature = 25
if temperature > 30:
    print("It's hot.")
elif temperature > 20:
    print("It's warm.")
else:
    print("It's cool.")
```

```
It's warm.
```

For loop

- Used for iterating over a sequence (e.g., list, tuple, string).

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

```
apple
orange
banana
```

```
fruits = ["apple", "orange", "banana"]
for i in range(len(fruits)):
    print(fruits[i])
```

```
apple
orange
banana
```

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While loop

- Repeats a block of code as long as a condition is true.

```
count = 0
while count < 5:
    print(count)
    count += 1
```

```
0
1
2
3
4
```

Break Statement

- Exits the loop prematurely.

```
for number in range(10):
    if number == 5:
        break
    print(number)
```

```
0
1
2
3
4
```

Functions in Python

- Functions in Python are blocks of reusable code that perform a specific task.
- They help in modularizing code, making it easier to understand, maintain, and reuse.

Writing a Function in Python

- **Function Definition:**
- Start with the `def` keyword, followed by the function name and parameters.

```python
def greet(name):
    print("Hello, " + name + "!")
```

0s

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Writing a Function in Python

- **Function Call:**
- Use the function name followed by parentheses to execute the function.

```python
greet("islam")
```

```
Hello, islam!
```

Writing a Function in Python

- **Return Statement:**
- Use the `return` statement to send a value back from the function.

```
[43] def square(x):
         return x ** 2
```

```
a = 3
print(square(a))
```

```
9
```

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Modules in Python

- Modules are files containing Python code that can be reused in other Python files.
- They allow you to organize code into separate files for better structure

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Modules in Python

- To use a module, you need to import it using the `import` keyword.

```
[45] import math
```

```
a = 9
a_sqrt = math.sqrt(a)
print(a_sqrt)
```

```
3.0
```

Q&A Session

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Introduction to Numpy

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- NumPy is a powerful library for numerical computing in Python.
- It provides support for large, multi-dimensional arrays and matrices, along with a collection of mathematical functions to operate on these arrays.
- NumPy is a fundamental tool for data scientists, researchers, and engineers working with numerical data.

Basics of Numpy Arrays

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Basics of Numpy arrays

Array Creation:

- Create arrays using the `numpy.array()` function.

```
import numpy as np

arr = np.array([1, 2, 3, 4, 5])
```

Basics of Numpy arrays

Array Indexing:

- Access elements of an array using indexing (0-based).

```
print(arr[0])  # Output: 1
```

```
1
```

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Basics of Numpy arrays

Array Slicing:

- Extract subarrays using slicing.

```
sub_arr = arr[1:4]  # Output: [2, 3, 4]
print(sub_arr)
```

```
[2 3 4]
```

Multi-Dimensional Arrays

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Multi-Dimensional Arrays

- NumPy supports multi-dimensional arrays.

```
[54] matrix = np.array([[1, 2, 3], [4, 5, 6]])

print(matrix[1, 2])  # Output: 6

6
```

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Array Operations

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Array Operations

Element-wise Operations:

- NumPy allows for element-wise operations on arrays.

```
[57] result = matrix * 2
     print(result)

[[ 2  4  6]
 [ 8 10 12]]
```

```
result = matrix + 5
print(result)

[[ 6  7  8]
 [ 9 10 11]]
```

Numpy Functions

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Numpy Functions

`np.arange()` - Create an Array with a Range:

- Generates an array with regularly spaced values.
- Syntax: `np.arange(start, stop, step)`

```python
import numpy as np
arr = np.arange(0, 10, 2)
print(arr)
```

```
[0 2 4 6 8]
```

Numpy Functions

`np.zeros()` and `np.ones()` - Create Arrays of Zeros and Ones:

- Generates arrays filled with zeros or ones.
- Syntax: `np.zeros(shape)` and `np.ones(shape)`

```python
zeros_arr = np.zeros((3, 3))
ones_arr = np.ones((2, 4))

print(zeros_arr)
print(ones_arr)
```

```
[[0. 0. 0.]
 [0. 0. 0.]
 [0. 0. 0.]]
[[1. 1. 1. 1.]
 [1. 1. 1. 1.]]
```

Numpy Functions

`np.random.rand()` - Random Values in a Given Shape:

- Generates an array of random values in the [0.0, 1.0) interval with a given shape.
- Syntax: `np.random.rand(d0, d1, ..., dn)`

```
random_values = np.random.rand(2, 3)
print(random_values)
```

```
[[0.98256224 0.08184861 0.29765565]
 [0.29965464 0.39622773 0.85310264]]
```

Numpy Functions

`np.reshape()` - Reshape an Array:

- Changes the shape of an array without changing its data.
- Syntax: `np.reshape(array, new_shape)`

```python
original_array = np.arange(6)
reshaped_array = np.reshape(original_array, (2, 3))
print(reshaped_array)
```

```
[[0 1 2]
 [3 4 5]]
```

Numpy Functions

`np.sum()`:

- Computes the sum of array elements
- Syntax: `np.sum(array, axis)`

```
arr = np.array([[1,2,3],[4,5,6]])
total_sum = np.sum(arr)
print(total_sum)
```

```
21
```

Introduction to Pandas

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- Pandas is a powerful library for data manipulation and analysis in Python.
- It provides two primary data structures: Series and DataFrame.
- Pandas is widely used in data science, machine learning, and data analysis tasks.

Pandas Series

- **Series Definition:**
  - A one-dimensional labeled array capable of holding any data type.

```python
import pandas as pd

data = [1, 3, 5, 7, 9]
series = pd.Series(data)
print(series)
```

```
0    1
1    3
2    5
3    7
4    9
dtype: int64
```

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Pandas DataFrame

- **DataFrame Definition:**
  - A two-dimensional labeled data structure with columns that can be of different types

```python
import pandas as pd

data = {'Name': ['Alice', 'Bob', 'Charlie'],
        'Age': [25, 30, 22],
        'City': ['New York', 'San Francisco', 'Los Angeles']}

df = pd.DataFrame(data)

print(df)
```

```
      Name  Age           City
0    Alice   25       New York
1      Bob   30  San Francisco
2  Charlie   22    Los Angeles
```

Selecting Data in Pandas

Selecting Columns:

- Use square brackets or dot notation.

```python
ages = df['Age']
print(ages)
```

```
0    25
1    30
2    22
Name: Age, dtype: int64
```

Filtering Data in Pandas

Filtering Rows Based on Conditions:

- Use boolean indexing.

```
young_people = df[df['Age'] < 30]
print(young_people)
```

```
      Name  Age         City
0    Alice   25     New York
2  Charlie   22  Los Angeles
```

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Modifying Data in Pandas

Adding a New Column:

- Simply assign values to a new column.

```
[73] df['Salary'] = [50000, 60000, 45000]
```

```
0s  df['Salary'] = 50000
```

Introduction to Data Visualization with Matplotlib

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- Matplotlib is a widely-used library for creating static, animated, and interactive visualizations in Python.
- It provides a variety of plotting options to help you explore and communicate your data effectively.

Basics of matplotlib

Importing Matplotlib:

- Start by importing the library.

```
import matplotlib.pyplot as plt
```

Creating a Figure and Axes:

- The basic structure for a Matplotlib plot involves creating a figure and one or more axes.

```
fig, ax = plt.subplots()
```

Line Plots with matplotlib

Plotting a Line:

- Use the `plot()` function to create a line plot.

```
x = [1, 2, 3, 4, 5]
y = [2, 4, 6, 8, 10]

ax.plot(x, y, label='Line Plot')
```

Customizing Line Style and Color:

- Customize the appearance of the line.

```
ax.plot(x, y, linestyle='--', color='green', marker='o', label='Customized Line')
```

Scatter Plots with matplotlib

Plotting a scatter points:

- Use the `scatter()` function to create a scatter plot.

```
x = [1, 2, 3, 4, 5]
y = [2, 4, 6, 8, 10]

ax.plot(x, y, label='scatter Plot')
```

Customizing marker Style and Color:

- Customize the appearance of the markers.

```
ax.scatter(x, y, marker='s', color='red', label='Customized Scatter')
```

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Adding Labels and Titles

Adding Labels:

- Use `set_xlabel()` and `set_ylabel()` to add labels to the x and y-axes.

```
ax.set_xlabel('X-axis Label')
ax.set_ylabel('Y-axis Label')
```

Adding a Title:

- Use `set_title()` to add a title to the plot.

```
ax.set_title('Title of the Plot')
```

Continue Your Learning Journey

- Explore the documentations to deepen your understanding of the field.
- Data Science and Machine Learning:
  - **Kaggle**: Participate in competitions and access datasets for hands-on experience.
- Interactive Coding Practice:
  - **HackerRank**
  - **LeetCode**

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Challenge

- a simple programming problem
- mathematical operation to do with numpy
- a tabular dataset to play with

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Thank you for attending

any questions ?