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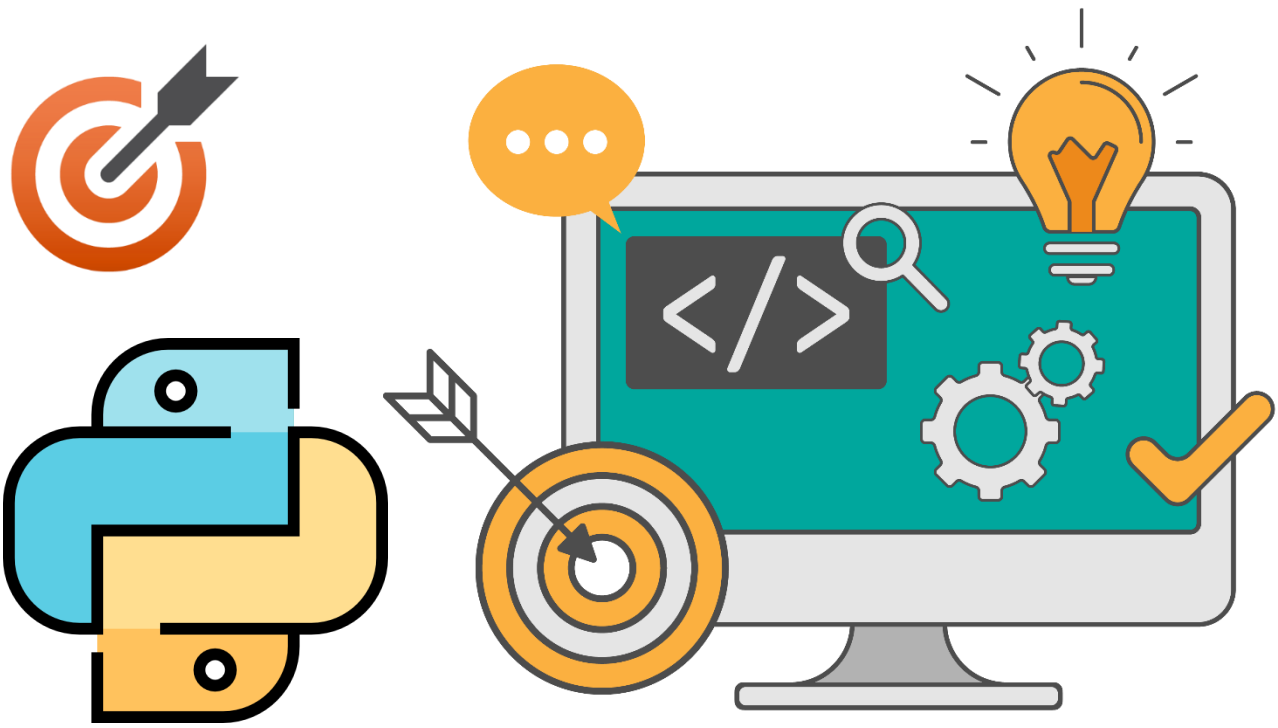
Python for Beginners Notes

by Rishabh Mishra



Rishabh Mishra

7+ Years in Data Analytics

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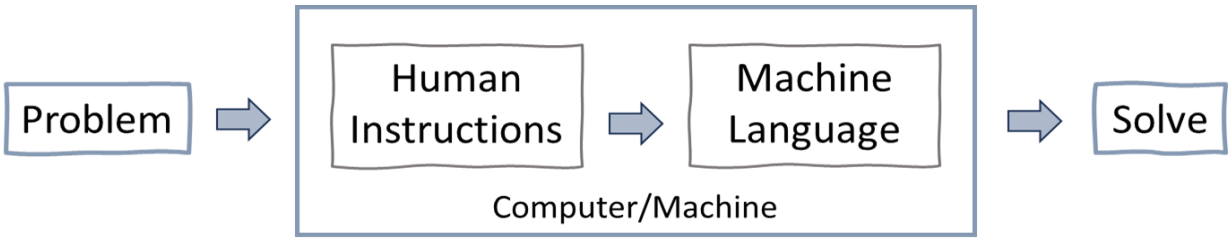
Chapter - 01

Introduction to Python

- What is programming
- What is Python
- Popular programming languages
- Why Python
- Career with Python

What is Programming Language?



Programming is the process of creating sets of instructions that tell a computer how to perform specific tasks. These instructions, known as code, are written in programming languages that computer understand and executes to carry out various operations, such as solving problems, analysing data, or controlling device.

Popular programming languages: Python, C, C++, Java, Go, C#, etc.

What is Python?

Python is a high-level programming language known for its simplicity and readability.

Just like we use Hindi language to communicate and express ourselves,

Python is a language for computers to understand our instructions & perform tasks.

Note: Python was created by Guido van Rossum in 1991.

Popular programming languages

As per statista survey, Python is the most popular programming language.

Why Python?

Python is one of the easiest programming languages to learn and known for its versatility and user-friendly syntax, is a top choice among programmers.

Also, python is an open source (free) programming language and have extensive libraries to make programming easy. Python has massive use across different industries with excellent job opportunities.

Python is Dynamically Typed Example

In Python there is no declaration of a variable, just an assignment statement.

```
x = 8                                  # here x is a integer

x = "Python by Rishabh Mishra"         # here x is a string

print(type(x))                         # you can check the type of x
```

Python - Easy to Read & Write

Ques1: Write a program to print “Hello World”

Python

```
print("Hello World")
```

C#

```
using System;
class Program
{
    static void Main()
    {
        Console.WriteLine("Hello World");
    }
}
```

Java

```
public class HelloWorld
{
    public static void main(String[] args)
    {
        System.out.println("Hello World");
    }
}
```

Ques2: Write a program to print numbers from 1 to 10

Python

```
for i in range(1, 11):
    print(i)
```

C#

```
using System;

class Program
{
    static void Main(string[] args)
    {
        for (int i = 1; i <= 10; i++)
        {
            Console.WriteLine(i);
        }
    }
}
```

In above examples we can see that Python is simple in writing & reading the code.

Careers with Python

Python is not only one of the most popular programming languages in the world, but it also offers great career opportunities. The demand for Python developers is growing every year.

Web Development

Web Developer
Frontend Developer
Backend Developer
Python Developer

Data Science & Analytics

Data Analyst
Data Scientist
Machine Learning Engineer
Artificial intelligence Engineer

Software Development

Game Developer
Software Developer
DevOps Engineer
Software Testing & more

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Chapter - 02

Python Installation & Setup + Visual Studio Code Installation

- Python installation
- Visual Studio Code installation

Install Python

Step 1: Go to website: https://www.python.org/downloads/

Step 2: Click on “Download Python” button

(Download the latest version for Windows or macOS or Linux or other)

Step 3: Run Executable Installer

Step 4: Add Python to Path

Step 5: Verify Python Was Installed on Windows

Open the command prompt and run the following command:

```
python --version
```

Install Python IDE (code editor)

Step 1: Go to website: https://code.visualstudio.com/download

Step 2: Click on “Download” button

(Download the latest version for Windows or mac or Linux or other)

Step 3: Run Executable Installer

Step 4: Click “Add to Path”

Step 5: Finish & launch the app

Popular Python IDE: VS Code, PyCharm, Jupyter Notebook & more

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Chapter - 03

First Python Program

- Print- Hello World!
- Python As a Calculator
- Running the Python code
- Python Execution Steps
- Interpreter v/s Compiler

First Python Program - Hello World

Printing "Hello World" as the first program in Python.

print is a keyword word that has special meaning for Python.

It means, "Display what's inside the parentheses."

```
print("Hello World")

Instructor = "Rishabh Mishra"
print("Python by", Instructor, sep="-")
```

Python As a Calculator

Python can be used as a powerful calculator for performing a wide range of arithmetic operations.

```
2+5           # add two numbers
print(10/5)   # divide two numbers

# print sum of two numbers
a = 2
b = 5
print(a+b)
```

Comments: Comments are used to annotate codes, and they are not interpreted by Python. It starts with the hash character #

Comments are used as notes or short descriptions along with the code to increase its readability.

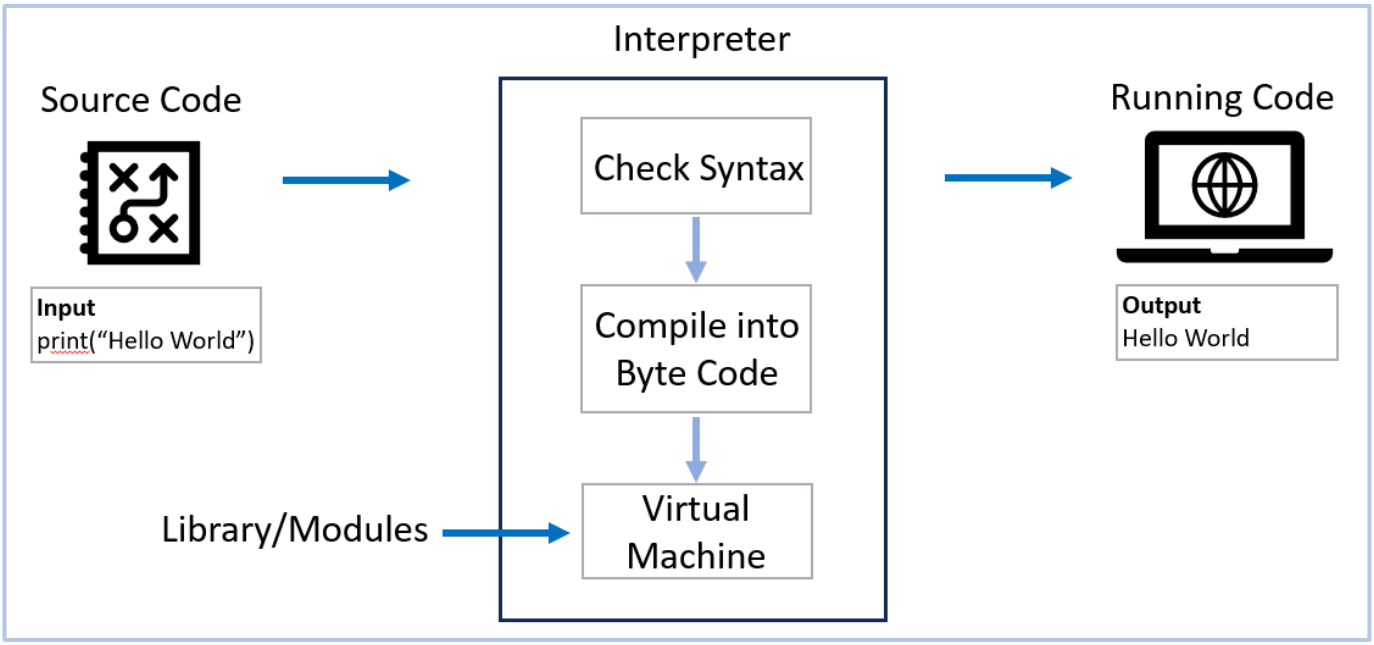
Running the Python Code

- Create a new text file and inside it write – print("Welcome to the Python Course by Rishabh Mishra")
- Save file with extension .py – firstcode.py
- Open command prompt on windows (or Terminal on MacOS)
- Enter the location where firstcode.py file is saved – cd downloads
- Finally run the file as – python firstcode.py

```
C:\Users\hp>cd downloads

C:\Users\hp\Downloads>python firstcode.py
Welcome to the Python Course by Rishabh Mishra
```

Python Execution Flow



Python Code Execution Steps

1. Lexical Analysis: The interpreter breaks down the code into smaller parts called tokens, identifying words, numbers, symbols, and punctuation.
2. Syntax Parsing: It checks the structure of the code to ensure it follows the rules of Python syntax. If there are any errors, like missing parentheses or incorrect indentation, it stops and shows a SyntaxError.
3. Bytecode Generation: Once the code is validated, the interpreter translates it into a simpler set of instructions called bytecode. This bytecode is easier for the computer to understand and execute.
4. Execution by PVM: The Python Virtual Machine (PVM) takes the bytecode and runs it step by step. It follows the instructions and performs calculations, assigns values to variables, and executes functions.
5. Error Handling and Output: If there are any errors during execution, like trying to divide by zero or accessing a variable that doesn't exist, the interpreter raises an exception. If the code runs without errors, it displays any output, such as printed messages or returned values, to the user.

Python Syntax

The syntax of the Python programming language, is the set of rules that defines how a Python program will be written and interpreted (by both the runtime system & by human readers).

```
my_name = "Madhav" ✅
```

```
my_name =  Madhav  ❌
```

```
# Use quotes "" for strings in Python
```

Interpreter vs Compiler

Interpreter	Compiler
An interpreter translates and executes a source code line by line as the code runs.	A compiler translates the entire code into machine code before the program runs.
Execution: Line by line.	**Execution:** Entire program at once.
Speed: Slower execution because it translates each line on the fly.	**Speed:** Faster execution because it translates the entire program at once.
Debugging: Easier to debug as it stops at the first error encountered.	**Debugging:** Harder to debug because errors are reported after the entire code is compiled
Examples: Python, Ruby, JavaScript, and PHP.	**Examples:** C, C++, Java, and Go.

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Chapter - 04

Variables in Python

- What is a Variable
- Variables - examples
- Variable Naming Rules

Variables in Python

A variable in Python is a **symbolic name** that is a reference or pointer to an object.

In simple terms, variables are like **containers** that you can fill in with different types of data values. Once a variable is **assigned** a value, you can use that variable in place of the value.

We assign value to a variable using the **assignment operator** (=).

```
Syntax:  variable_name = value
Example: greeting = "Hello World"
          print(greeting)
```

Variable Examples

Python can be used as a powerful calculator for performing a wide range of arithmetic operations.

```
PythonLevel  = "Beginner"  # pascal case
pythonLevel  = "Beginner"  # camel case
pythonlevel  = "Beginner"  # flat case
python_level = "Beginner"  # Snake case
```

```
x = 10
print(x+1)    # add number to a variable

a, b, c = 1, 2, 3
print(a, b, c)    # assign multiple variables
```

Variable Naming Rules

1. Must start with a letter or an underscore (_).
2. Can contain letters, numbers, and underscores.
3. Case-sensitive (my_name and my_Name are different).
4. Cannot be a reserved keyword (like for, if, while, etc.).

```
_my_name = "Madhav" ✅
 for = 26 ❌
# ‘for’ is a reserved word in Python
```

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Chapter - 05

Data Types in Python

- What are Data types
- Types of data types
- Data types examples

Data Types in Python

In Python, a data type is a **classification** that specifies the **type of value** a variable can hold. We can check data type using type() function.

Examples:

```
1. my_name = "Madhav"
                    >>> type(my_name)
                    O/P: <class 'str'>
2. value  = 101
                    >>> type(value)
                    O/P: <class 'int'>
```

Basic Data Types in Python

Python can be used as a powerful calculator for performing a wide range of arithmetic operations.

1. Numeric: Integer, Float, Complex
2. Sequence: String, List, Tuple
3. Dictionary
4. Set
5. Boolean
6. Binary: Bytes, Bytearray, Memoryview

Data Types in Python

1 Numeric

The data that has a numeric value

int: positive or negative whole numbers

float: real number with a decimal point

complex: number contains an arranged pair, x + iy, (real part) + (imaginary part)i

2 Sequence

Collection of similar or different Python data types

string: Collection of one or more characters put in a quote/quotes.

list: can store objects of multiple data type, and encased inside square sections []. Mutable.

tuple: store objects of multiple data type, and encased inside circle sections (). Immutable.

3 Dictionary

A key-value pair set arranged in any order.

4 Sets

Unordered collection of elements. It is iterable, mutable, and has no duplicate elements

5 Boolean

True and **False** are the two default values

6 Binary

Used to work with binary data. Such as image, audio, mp3 files, etc.

bytes: immutable sequence type to represent sequences of bytes (8-bit values).

bytearray: similar to bytes but can be modified .

Memoryview: Used to create a "view" of memory containing binary data.

Data Types Examples

Numeric

Int	float	complex
26, 101, 108	0.5, 1.5, 101.2	complex(3, 5) -> 3+5i

Sequence

str	list	tuple
"Madhav", "Rishabh", "26"	[1, 26, 101, 108]	(1, 26, 101, 108)

Dictionary

dict
{'name': 'Madhav', 'age': 26, 'city': 'Prayagraj'}

Sets

set
{1, 26, 101, 108}, {"abc", 34, True, 40, "male"}

Boolean

bool
True, False

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Chapter - 06

Type Casting in Python

- What is type casting
- Type Casting examples
- Type Casting - Types

Type Casting

Type casting in Python refers to the process of **converting** a value from **one data type to another**. This can be useful in various situations, such as when you need to perform operations between different types or when you need to format data in a specific way. Also known as **data type conversion**.

Python has several built-in functions for type casting:

`int()`: Converts a value to an integer.

`float()`: Converts a value to a floating-point number.

`str()`: Converts a value to a string.

`list()`, `tuple()`, `set()`, `dict()` and `bool()`

Type Casting Examples

Basic examples of type casting in python:

```
# Converting String to Integer:
str_num = "26"
int_num = int(str_num)
print(int_num)        # Output: 26
print(type(int_num))  # Output: <class 'int'>
```

```
# Converting Float to Integer:
float_num = 108.56
int_num = int(float_num)
print(int_num)         # Output: 108
print(type(int_num))   # Output: <class 'int'>
```

Types of Typecasting

There are two types of type casting in python:

- Implicit type casting
- Explicit type casting

Implicit Type Casting

Also known as coercion, is performed automatically by the Python interpreter. This usually occurs when performing operations between different data types, and Python implicitly converts one data type to another to avoid data loss or errors.

```
# Implicit type casting from integer to float
num_int = 10
num_float = 5.5
result = num_int + num_float  # Integer is automatically converted to float
print(result)              # Output: 15.5
print(type(result))   # Output: <class 'float'>
```

Explicit Type Casting

Also known as **type conversion**, is performed **manually** by the programmer using built-in functions. This is done to ensure the desired type conversion and to avoid unexpected behavior.

```
# Converting String to Integer:
str_num = "26"
```

```
int_num = int(str_num)
print(int_num)    # Output: 26
print(type(int_num))  # Output: <class 'int'>

# Converting a value to boolean:
bool(0)  # Output: False
bool(1)  # Output: True
```

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Chapter - 07

Input Function in Python

- Input Function – Definition
- Input Function – Example
- Handling Different Data Types

Input Function in Python

The input function is an essential feature in Python that allows to take **input from the user**. This is particularly useful when you want to create interactive programs where the user can provide data during execution.

Also known as **user input function**.

How input Function Works:

The input function waits for the user to type something and then press Enter. It reads the input as a string and returns it.

Example:

```
# Prompting the user for their name
name = input("Enter your name: ")
# Displaying the user's input
print("Hello, " + name + "!")
```

Input Function – Add 2 Numbers

A simple program that takes two numbers as input from the user and prints their sum.

```
# Prompting the user for the first and second number
num1 = input("Enter the first number: ")
num2 = input("Enter the second number: ")
```

```
# Since input() returns a string, we need to convert it to an integer
    num1 = int(num1)
    num2 = int(num2)
# Calculating the sum and display the result
    sum = num1 + num2
    print("The sum of", num1, "and", num2, "is:", sum)
```

Multiple Input from User & Handling different Data Types

```
# input from user to add two number and print result
    x = input("Enter first number: ")
    y = input("Enter second number: ")
# casting input numbers to int, to perform sum
    print(f"Sum of {x} & {y} is {int(x) + int(y)}")
```

Home Work – User input and print result

Write a program to input student name and marks of 3 subjects. Print name and percentage in output.

```
# Prompting the user for their name and 3 subject marks
    name = input("Enter your name: ")
    hindi_marks = input("Enter Hindi Marks: ")
    maths_marks = input("Enter Maths Marks: ")
    science_marks = input("Enter Science Marks: ")
# Calculating percentage for 3 subjects
    percentage = ((int(hindi_marks) + int(maths_marks) +
    int(science_marks))/300)*100
# Printing the final results
    print(f"{name}, have {percentage}%. Well done & keep
    working hard!!")
```

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Chapter - 08

Operators in Python

- What are Operators
- Types of Operators
- Operators Examples

Operators in Python

Operators in Python are **special symbols or keywords** used to perform operations on operands (variables and values).

Operators: These are the special symbols/keywords. Eg: + , * , /, etc.

Operand: It is the value on which the operator is applied.

```
# Examples
    Addition operator '+': a + b
    Equal operator '==':   a == b
    and operator 'and':    a > 10 and b < 20
```

Types of Operators

Python supports various types of operators, which can be broadly categorized as:

1. Arithmetic Operators
2. Comparison (Relational) Operators
3. Assignment Operators
4. Logical Operators
5. Bitwise Operators
6. Identity Operators
7. Membership Operators

Operators Cheat Sheet

Operator	Description
()	Parentheses
**	Exponentiation
+, -, ~	Positive, Negative, Bitwise NOT
*, /, //, %	Multiplication, Division, Floor Division, Modulus
+, -	Addition, Subtraction
==, !=, >, >=, <, <=	Comparison operators
is, is not, in, not in	Identity, **Membership** Operators
NOT, AND, OR	Logical NOT, Logical AND, Logical OR
<<, >>	Bitwise Left Shift, Bitwise Right Shift
&, ^, |	Bitwise AND, Bitwise XOR, Bitwise OR

1. Arithmetic Operators

Arithmetic operators are used with numeric values to perform mathematical operations such as addition, subtraction, multiplication, and division.

Operator	Name	Example (a = 5, b = 3)
+	Addition	a + b # o/p: 8
-	Substraction	a – b # o/p: 2
*	Multiplication	a * b # o/p: 15
/	Division	a / b # o/p: 1.6666
%	Modulus (returns remainder)	a % b # o/p: 2
//	Floor division	a // b # o/p: 1
**	Exponentiation	a ** b # o/p: 125

Precedence of **Arithmetic Operators** in Python:

P – Parentheses
E – Exponentiation
M – Multiplication
D – Division
A – Addition
S – Subtraction

2. Comparison (Relational) Operators

Comparison operators are used to compare two values and return a Boolean result (True or False).

Operator	Name	Example
==	Equal	a == b
!=	Not equal	a != b
>	Greater than	a > b
<	Less than	a < b
>=	Greater than or equal to	a >= b
<=	Less than or equal to	a <= b

3. Assignment Operators

Assignment operators are used to assign values to variables.

Operator	Eaample	Also written As
=	a = 5	a = 5
+=	a += 3	a = a + 3
-=	a -= 3	a = a - 3
*=	a *= 3	a = a * 3
/=	a /= 3	a = a / 3
%=	a %= 3	a = a % 3
//=	a //= 3	a = a // 3
**=	a **= 3	a = a ** 3
&=	a &= 3	a = a & 3 ... etc

4. Logical Operators

Logical operators are used to combine conditional statements.

Operator	Decription	Eaample
and	Returns True if both statements are true	a > 2 and a < 5
or	Returns True if one of the statements is true	a > 5 or a < 10
not	Reverse the result, returns False if the result is true	not(a > 2 and a < 10)

5. Identity & Membership Operators

Identity operators are used to compare the memory locations of two objects, not just equal but if they are the same objects.

Membership operators checks whether a given value is a member of a sequence (such as strings, lists, and tuples) or not.

Tbpe	Operator	Eaample	Also written As
Identity	is	Returns True if both variables are the same object	a is b
Identity	is not	Returns True if both variables are not the same object	a is not b
Membership	in	Returns True if a sequence with the specified value is present in the object	a in b
Membership	not in	Returns True if a sequence with the specified value is not present in the object	a not in b

6. Bitwise Operators

Bitwise operators perform operations on binary numbers.

Operator	Name	Description	Also written As
&	AND	Sets each bit to 1 if both bits are 1	a & b
|	OR	Sets each bit to 1 if one of two bits is 1	a | b
^	XOR	Sets each bit to 1 if only one of two bits is 1	a ^ b
~	NOT	Inverts all the bits	~a
<<	Zero fill left shift	Shift left by pushing zeros in from the right and let the leftmost bits fall off	a << 2
>>	Signed right shift	Shift right by pushing copies of the leftmost bit in from the left, and let the rightmost bits fall off	a >> 2

Bitwise Operators Example:

```
# Compare each bit in these numbers.
0101  (This is 5 in binary)
0011  (This is 3 in binary)
-------
0001  (This is the result of 5 & 3)

# Rules: 0 - False, 1 - True
True + True = True
True + False = False
False + False = False
```

```
Eg:1
a = 5           # 0101
b = 3           # 0011
print(a & b)
# Output: 1     # 0001

Eg:2
a = 5           # 0101
b = 8           # 1000
print(a & b)
# Output: 0     # 0000
```

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Chapter - 09

Conditional Statements in Python

- Conditional Statement definition
- Types of Conditional Statement
- Conditional Statement examples

Conditional Statements in Python

Conditional statements allow you to execute code based on **condition** evaluates to True or False. They are essential for **controlling the flow** of a program and making decisions based on different inputs or conditions.

```
# Examples

            a = 26
            b = 108
            if b > a:
                print("b is greater than a")

# Indentation - whitespace at the beginning of a line
```

Types of Conditional Statements

There are 5 types of conditional statements in Python:

1. `'if'` Statement
2. `'if-else'` statement
3. `'if-elif-else'` statement
4. Nested `'if else'` statement
5. Conditional Expressions (Ternary Operator)

1. 'if' Conditional Statement

The `if` statement is used to test a condition and execute a block of code **only if the condition is true**.

Syntax:

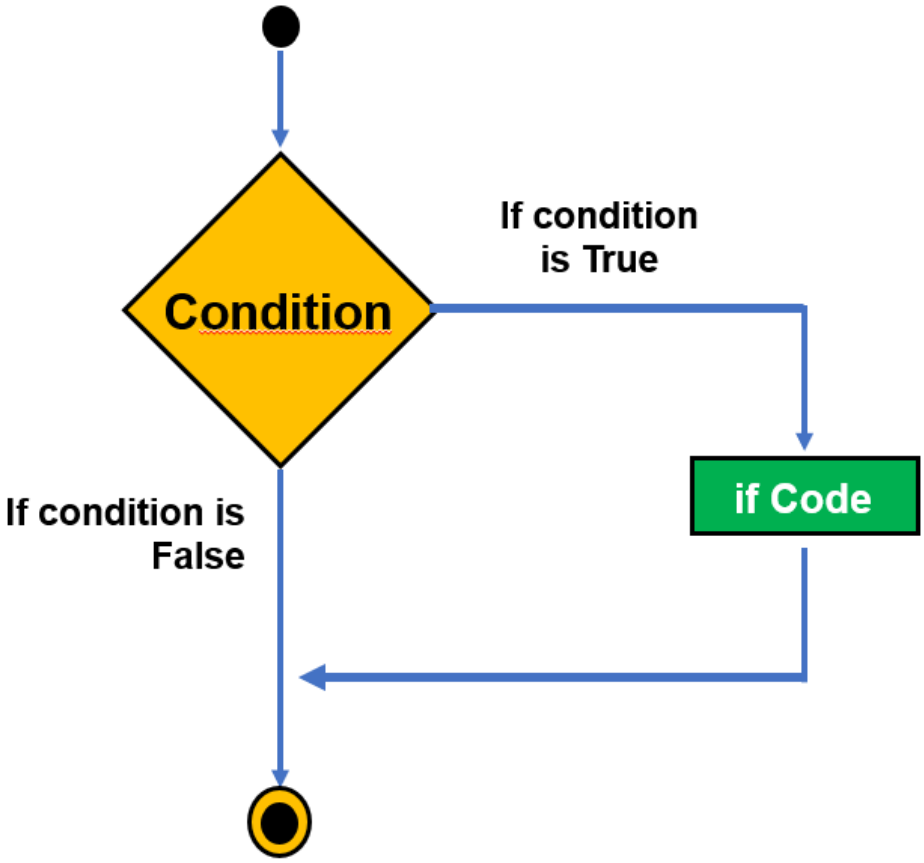
```
if condition:
    # Code to execute if the condition is true
```

Example:

```
age = 26

if age > 19:
    print("You are an adult")
```

'if' statement flow diagram:



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2. 'if-else' Conditional Statement

The `if-else` statement provides an alternative block of code to execute if the condition is **false**.

Syntax:

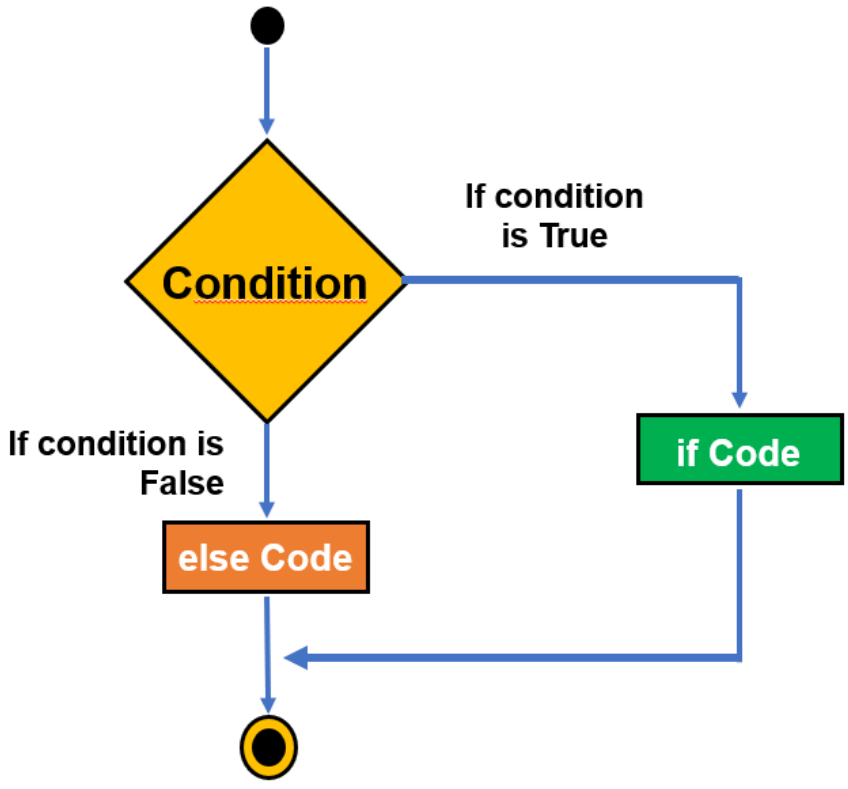
```
if condition:
    # Code to execute if the condition is true
else:
    # Code to execute if the condition is false
```

Example:

```
temperature = 30

if temperature > 25:
    print("It's a hot day.")
else:
    print("It's a cool day.")
```

'if-else' statement flow diagram:



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3. 'if-elif-else' Conditional Statement

The `if-elif-else` statement allows to check **multiple conditions** and execute different blocks of code based on which condition is true.

Syntax:

```
if condition1:
    # Code to execute if condition1 is true
elif condition2:
    # Code to execute if condition2 is true
else:
    # Code to execute if none of the above conditions are true
```

Example:

Grading system: Let's write a code to classify the student's grade based on their total marks (out of hundred).

```
score = 85
if score >= 90:
    print("Grade - A")
elif score >= 80:
    print("Grade - B")
elif score >= 70:
    print("Grade - C")
else:
    print("Grade - D")
```

4. Nested 'if-else' Conditional Statement

A `nested if-else` statement in Python involves placing an if-else statement **inside** another if-else statement. This allows for more complex decision-making by checking **multiple conditions that depend on each other**.

Syntax:

```
if condition1:
    # Code block for condition1 being True
    if condition2:
        # Code block for condition2 being True
    else:
        # Code block for condition2 being False
else:
    # Code block for condition1 being False
... ..
```

Example:

Number Classification: Let's say you want to classify a number as positive, negative, or zero and further classify positive numbers as even or odd.

```
number = 10
if number > 0:  # First check if the number is positive
    if number % 2 == 0:
        print("The number is positive and even.")
    else:
        print("The number is positive and odd.")
else:  # The number is not positive
    if number == 0:
        print("The number is zero.")
    else:
        print("The number is negative.")
```

5. Conditional Expressions

Conditional expressions provide a shorthand way to write simple if-else statements. Also known as Ternary Operator.

Syntax:

```
value_if_true if condition else value_if_false
```

Example:

```
age = 16

status = "Adult" if age >= 18 else "Minor"
print(status)
```

Conditional Statements- HW

Q1: what is expected output and reason?

```
value = None

if value:
    print("Value is True")
else:
    print("Value is False")
```

Q2: write a simple program to determine if a given year is a leap year using user input.

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Chapter - 10

Functions in Python

- Functions definition
- Types of Functions
- Function examples

Functions in Python

A function is a block of code that **performs a specific task**. You can use it whenever you want by calling its name, which saves you from writing the same code multiple times.

Benefits of Using Function**:** Increases code **Readability** & **Reusability**.

Basic Concepts:

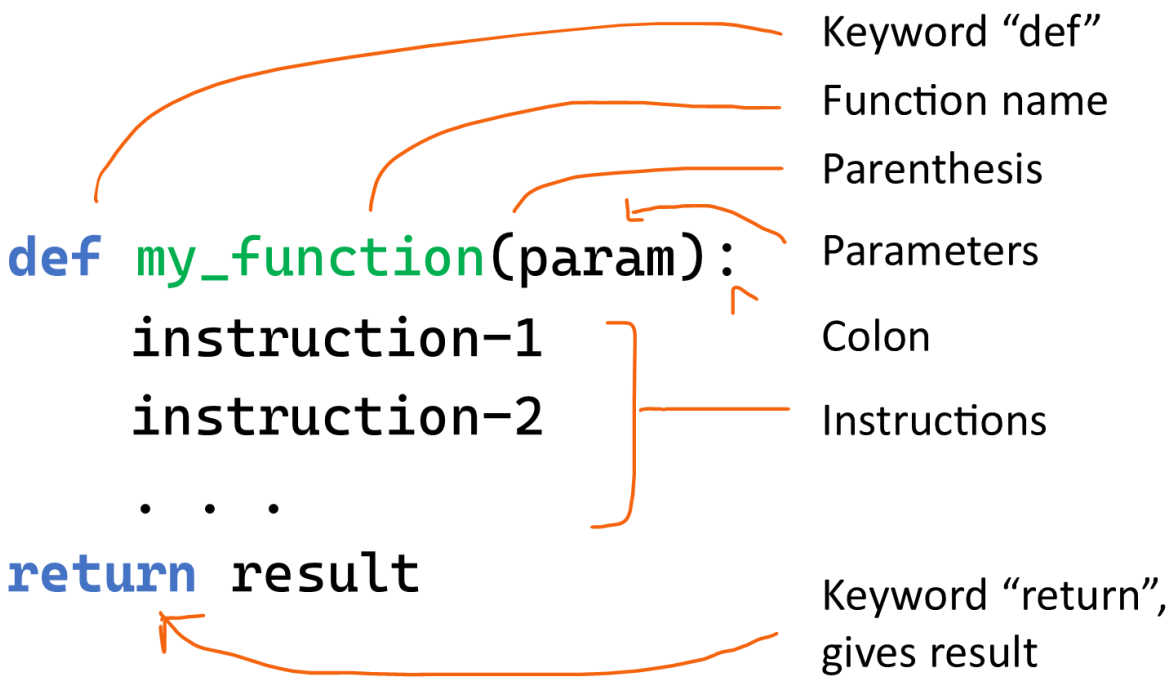
- **Create** function: Use the def keyword to define a function.
- **Call** function: Use the function's name followed by () to run it.
- **Parameter**: The variable listed inside parentheses in function definition.
- **Argument**: The actual value you pass to function when you call it.

Types of Functions

Below are the two types of functions in Python:

1. Built-in library function:
    - These are Standard functions in Python that are available to use.
    - Examples: print(), input(), type(), sum(), max(), etc
2. User-defined function:
    - We can create our own functions based on our requirements.
    - Examples: create your own function :)

Syntax:



*# **return** result is optional, Use if you want the function to give back a value*

Function without Parameters

Example:1

```
# Create or Define Function
def greetings():
  print("Welcome to Python tutorial by Rishabh")

# Use or call this Function
greetings()

# Output: Welcome to Python tutorial by Rishabh
```

Function with Parameters

Example:2

```
# function to adds two numbers & print result.
def add2numbers(a, b):
    result = a + b
    print("The sum is:", result)

# Calling this function with arguments
add2numbers(5, 3)

# Output: The sum is: 8
```

Function with two arguments

The `return` Statement

The return statement is used in a function to **send a result back** to the place where the function was called. When return is executed, the function **stops running** and immediately returns the specified value.

Example:

```
def add(a, b):
    return a + b  # This line sends back sum of a and b
result = add(3, 5)
print(result)

# Output: 8
```

Function with a Return value

Example:3

```
# function to convert Celsius to Fahrenheit
def celsius_to_fahrenheit(celsius):
    fahrenheit = (celsius * 9/5) + 32
    return Fahrenheit

# Calling this function to return a value
temp_f = celsius_to_fahrenheit(25)
print("Temperature in Fahrenheit:", temp_f)

# Output: Temperature in Fahrenheit: 77.0
```

Function with one argument

The `pass` Statement

The pass statement is a placeholder in a function or loop. It **does nothing** and is used when you need to write code that will be added **later** or to define an **empty** function.

Example:

```
def myfunction():
    pass   # This does nothing for now
```

Functions – HW

Write a Python program to create a **calculator** that can perform at least **five** different mathematical operations such as addition, subtraction, multiplication, division and average. Ensure that the program is user-friendly, prompting for input and displaying the results clearly.

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Chapter - 11

Function Arguments in Python

- Function Arguments
- Types of Functions Arguments
- Function Arguments examples

Arguments in Function

Arguments are the values that are passed into a function when it's called. A function must be called with the right number of arguments. If a function has 2 parameters, you must provide 2 arguments when calling it.

Example: function defined using one parameter (variable)

```
def greetings(name):          # name is a parameter
    print("Hello, " + name + "!")

greetings("Madhav")           # Madhav as argument
# Output: Hello, Madhav!
```

Types of Function Arguments

Python supports various types of arguments that can be passed at the time of the function call.

1. Required arguments (Single/Multiple arguments)
2. Default argument
3. Keyword arguments (named arguments)
4. Arbitrary arguments (variable-length arguments *args and **kwargs)

Required Arguments (same as above)

Required arguments are the arguments passed to a function in correct positional order. A function must be called with the right number of arguments. If a function has 2 parameters, you must provide 2 arguments when calling it.

Example: function defined using one parameter (variable)

```
def greetings(name):        # name is a parameter
    print("Hello, " + name + "!")

greetings("Madhav")         # Madhav as argument
# Output: Hello, Madhav!
```

Default Arguments

You can assign **default** values to arguments in a function definition. If a value **isn't** provided when the function is called, the default value is used.

Example: function defined using one parameter & default value

```
def greetings(name = "World"):   # default value
    print("Hello, " + name + "!")

greetings()          # No argument passed
# Output: Hello, World!

greetings("Madhav")     # Madhav as argument
# Output: Hello, Madhav!
```

Keyword Arguments

When calling a function, you can specify arguments by the parameter **name**. These are called **keyword arguments** and can be given in **any order**.

Example: function defined using two parameters

```
def divide(a, b):   # a,b are 2 parameters
    return a / b

result = divide(b=10, a=20) # with keyword arguments
print(result)    # Output: 2
```

```
result = divide(10, 20)      # positional arguments
print(result)    # Output: 0.5
```

Arbitrary Positional Arguments (*args)

If you're unsure how many arguments will be passed, use *args to accept any number of positional arguments.

Purpose: Allows you to pass a variable number of **positional arguments**.

Type: The arguments are stored as a **tuple**.

Usage: Use when you want to pass multiple values that are accessed by position.

Example 1:

```
def add_numbers(*args):
    return sum(args)

# Any number of arguments
result = add_numbers(1, 2, 3, 4)
print(result)# Output: 10
```

Note: Here, *args collects all the passed arguments into a tuple, & sum() function adds them.

Example 2:

```
def greetings(*names):
    for name in names:
        print(f"Hello, {name}!")
greetings("Madhav", "Rishabh", "Visakha")
# Output:
Hello, Madhav!
Hello, Rishabh!
Hello, Visakha!
```

Arbitrary Keyword Arguments (**kwargs)

If you want to pass a variable number of keyword arguments, use **kwargs.

Purpose: Allows you to pass a variable number of **keyword arguments** (arguments with names).

Type: The arguments are stored as a **dictionary**.

Usage: Use when you want to pass multiple values that are accessed by name.

Example 1:

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

print_details(name="Madhav", age=26, city="Delhi")

# Output:
name: Madhav
age: 26
city: Delhi
```

Example 2:

```
def shopping_cart(**products):
    total = 0
    print("Items Purchased:")
    for item, price in products.items():
        print(f"{item}: ₹{price}")
        total += price
    print(f"Total: ₹{total}")

# multiple keyword arguments
shopping_cart(apple=15, orange=12, mango=10)


# Output:
Items Purchased:
apple: ₹15
orange: ₹12
mango: ₹10
Total: ₹37
```

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Chapter - 12

Strings in Python (Part-1)

- Strings and Examples
- Formatted Strings
- Escape Characters
- String Operators

Strings in Python

A string is a sequence of **characters**. In Python, strings are enclosed within single (') or double (") or triple (""") quotation marks.

Examples:

```
print('Hello World!')      # use type() to check data type
print("Won't Give Up!")
print('''"Quotes" and 'single quotes' can be tricky.''')
print("\"Quotes\" and 'single quotes' can be tricky.")
```

Types of Function Arguments

A formatted string in Python is a way to **insert variables** or expressions inside a string. It allows you to format the output in a readable and controlled way.

There are multiple ways to format strings in Python:

1. Old-style formatting (% operator)
2. str.format() method
3. F-strings (formatted string literals)

Formatted String - % Operator

Old-style formatting (% operator)

This approach uses the **%** operator and is similar to string formatting in languages like C.

Syntax: `"string % value"`

Example:

```
name = "Madhav"
age = 16
print("My name is %s and I'm %d." % (name, age))
# %s, %d are placeholders for strings and integers
```

Formatted String - str.format()

str.format() method

In Python 3, the **format**() method is more powerful and flexible than the old-style **%** formatting.

Syntax: `"string {}".format(value)`

Example:

```
name = "Madhav"
age = 16
print("My name is {} and I'm {}.".format(name, age))
# You can also reference the variables by index or keyword:
print("My name is {0} and I'm {1}.".format(name, age))
print("My name is {name} and I'm {age}.".format(name="Madhav",
age=28))
```

Formatted String – F-strings

F-strings (formatted string literals)

In Python 3.6, F-strings are the most concise and efficient way to format strings. You prefix the string with an f or F, and variables or expressions are embedded directly within curly braces **{}**.

Syntax: `f"string {variable}"`

Example:

```
name = "Madhav"
age = 16
print(f"My name is {name} and I'm {age}.")
# You can also perform expressions inside the placeholders:
print(f"In 5 years, I will be {age + 5} years old.")
```

Escape Characters

Escape characters in Python are **special** characters used in strings to represent whitespace, symbols, or control characters that would otherwise be difficult to include. An escape character is a **backslash ** followed by the character you want to insert.

Examples:

```
print('Hello\nWorld!')     # \n for new line
print('Hello\tWorld!')     # \t for tab
print("\"Quotes\" and 'single quotes' can be tricky.") # print single and double quotes
```

String Operators

Operator	Description	Example
+	Concatenation - Adds values on either side of the operator	a + b -- will give HelloPython
*	Repetition - Creates new strings, concatenating multiple copies of the same string	a*2 -- will give HelloHello
[]	Slice - Gives the character from the given index	a[1] -- will give e
[:]	Range Slice - Gives the characters from the given range	a[1:4] -- will give ell
in	Membership - Returns true if a character exists in the given string	H in a -- will give 1
not in	Membership - Returns true if a character does not exist in the given string	M not in a -- will give 1
r/R	Raw String - Suppresses actual meaning of Escape characters.	print(r'\n') -- \n
%	Format - Performs String formatting	% (value)

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Chapter - 13

Strings in Python (Part-2)

- String Indexing
- String Slicing
- String Methods

String Indexing

You can access individual characters in a string using their **index**. Python uses zero-based indexing, meaning the first character has an index of **0**. **Index:** Position of the character.

Syntax:

```
string[Index_Value]
```

Example:

```
name = "MADHAV"
```

	M	A	D	H	A	V
Index →	0	1	2	3	4	5
	name[0] = 'M'	name[1] = 'A'	name[2] = 'D'	name[3] = 'H'	name[4] = 'A'	name[5] = 'V'

String Indexing – Positive & Negative Index

Example:

name = "MADHAV"

M	A	D	H	A	V
0	1	2	3	4	5
-6	-5	-4	-3	-2	-1

Positive Index

Negative Index

name[0] = 'M'	name[1] = 'A'	name[2] = 'D'	name[3] = 'H'	name[4] = 'A'	name[5] = 'V'
name[-6] = 'M'	name[-5] = 'A'	name[-4] = 'D'	name[-3] = 'H'	name[-2] = 'A'	name[-1] = 'V'

String Slicing

Slicing in Python is a feature that enables **accessing parts** of the sequence. String slicing allows you to get subset of characters from a string using a specified **range of indices**.

Syntax:

```
string[start : end : step]
```

- `start` : The index to start slicing (inclusive). Default value is 0.
- `end` : The index to stop slicing (exclusive). Default value is length of string.
- `Step` : How much to increment the index after each character. Default value is 1.

Example:

M	A	D	H	A	V
0	1	2	3	4	5

```
name = "MADHAV"
name[0:2] = 'MA'
name[0:5:2] = 'MDA'
```

String Slicing - Examples

Example:

0	1	2	3	4	5
M	A	D	H	A	V
-6	-5	-4	-3	-2	-1

```
name = "MADHAV"

name[0:1] = name[:1] = 'M'      # first char
name[0:2] = name[:2] = 'MA'     # first 2 chars
name[2:5] = 'DHA'               # third to fifth chars
name[5:] = name[-1:] = 'V'      # last char
name[4:] = name[-2:] = 'AV'     # last 2 chars
name[0:5:2] = name[0::2] = 'MDA'  # every second chars
name[1:-1] = 'ADHA'              # exclude first & last chars
name[:] = name[::] = 'MADHAV'   # all chars
name[::-1] = 'VAHDAM'           # reverse the string
```

String Methods

Methods	Description
len()	returns the length of a string (the number of characters).
upper()	Converts a string into upper case
lower()	Converts a string into lower case
strip()	Removes any leading and trailing whitespace (including spaces, tabs, or newline characters).
count()	Returns the number of times a specified value occurs in a string
find()	Searches the string for a specified value and returns the position of where it was found
title()	Converts the first character of each word to upper case
split()	Splits the string at the specified separator, and returns a list
replace(old, new)	Replaces all occurrences of a substring with a new substring

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Chapter - 14

Loops in Python

- Loops & Types
- While Loop
- For Loop
- Range Function
- Loop Control Statements

Loops in Python

Loops enable you to perform **repetitive tasks** efficiently without writing redundant code. They iterate over a sequence (like a list, tuple, string, or range) or execute a block of code as long as a specific **condition is met**.

Types of Loops in Python

1. While loop
2. For loop
3. Nested loop

While Loop

The while loop **repeatedly** executes a block of code as long as a given condition remains `True`. It checks the condition before each iteration.

Syntax:

```
while condition:
    # Code block to execute
```

Example:

```
Print numbers from 0 to 3
count = 0
while count < 4:        # Condition
    print(count)
    count += 1
# Output: 0  1  2  3
```

While Loop Example

`else Statement:` An else clause can be added to loops. It executes after the loop finishes normally (i.e., not terminated by break). ***Example:***

```
count = 3
while count > 0:        # Condition
    print("Countdown:", count)
    count -= 1
else:
    print("Liftoff!")  # Run after while loop ends
```

For Loop

The `for` loop in Python is used to iterate over a sequence (such as a list, tuple, dictionary, set, or string) and execute a block of code for **each element** in that sequence.

Syntax:

```
for variable in sequence:
    # Code block to execute
```

Example: *iterate over each character in language*

```
language = 'Python'
for x in language:
    print(x)        # Output: P  y  t  h  o  n
```

Using range() Function

To **repeat** a block of code a specified number of times, we use the `range()` function.

The `range()` function returns a sequence of numbers, starting from 0 by default, increments by 1 (by default), and stops before a specified number.

Syntax:

```
range(stop)
range(start, stop)
range(start, stop, step)
```

- `start`: (optional) The beginning of the sequence. Defaults is 0. (inclusive)
- `stop`: The end of the sequence (exclusive).
- `step`: (optional) The difference between each number in the sequence.

  Defaults is 1.

range() Function Example

Example1: *Basic usage with One Argument - Stop*

```
for i in range(5):
    print(i)
# Output: 0  1  2  3  4
```

Example2: *Basic usage with Start, Stop and Step*

```
for i in range(1, 10, 2):
    print(i)
# Output: 1  3  5  7  9
```

For Loop Example

`else Statement:` An else clause can be added to loops. It executes after the loop finishes normally (i.e., not terminated by break).

Example:

```
for i in range(3):
    print(i)
else:
    print("Loop completed")
# Output: 0  1  2  Loop Completed
```

while loop VS for loop

`while loop`

- A while loop keeps running as long as a **condition is true**.
- It is generally used when you **don't know** how many iterations will be needed beforehand, and loop continues based on a condition.

`for loop`

- A for loop **iterates over a sequence** (like a strings, list, tuple, or range) and runs the loop for each item in that sequence.
- It is used when **you know** in advance how many times you want to repeat a block of code.

Loop Control Statements

Loop control statements allow you to **alter** the normal flow of a loop.
Python supports 3 clauses within loops:

- `pass statement`
- `break Statement`
- `continue Statement`

Loop Control - pass Statement

`pass Statement:` The pass statement is used as a **placeholder** (**it does nothing**) for the future code, and runs entire code without causing any syntax error. *(already covered in functions)*

Example:

```
for i in range(5):
    # code to be updated
      pass
```

Above example, the loop **executes** without error using **pass** statement

Loop Control - break Statement

`break Statement:` The break statement terminates the loop entirely, exiting from it immediately.

Example:

```
for i in range(5):
   if i == 3:
       break
   print(i)    # Output: 0  1  2
```

Above example, the loop **terminated** when condition met true for i == 3

Loop Control - continue Statement

`continue Statement:` The continue statement **skips** the current iteration and moves to the next one.

Example:

```
for i in range(5):
    if i == 3:
        continue
    print(i)      # Output: 0  1  2  4
```

Above example, the loop **skips** when condition met true for i == 3

break vs continue Statement

break Statement example

```
# pass statement
count = 5
while count > 0:
    if count == 3:
        pass
    else:
        print(count)
    count -= 1

# Output: 5  4  2  1
```

continue Statement example

```
# continue statement: don't try - infinite loop
count = 5
while count > 0:
    if count == 3:
        # continue
    else:
        print(count)
    count -= 1

# Output: 5  4  3  3…….
```

Validate User Input

```
# validate user input: controlled infinite while loop using break statement

while True:
    user_input = input("Enter 'exit' to STOP: ")
    if user_input == 'exit':
        print("congarts! You guessed it right!")
        break
    print("sorry, you entered: ", user_input)
```

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Chapter - 15

Nested Loops in Python

- Nested Loops Definition
- Nested Loops Examples
- Nested Loops Interview Ques

Nested Loops in Python

Loop inside another loop is nested loop. This means that for every single time the outer loop runs, the inner loop **runs all of its iterations**.

Why Use Nested Loops?

- Handling Multi-Dimensional Data: Such as matrices, grids, or lists of lists.
- Complex Iterations: Operations depend on multiple variables or dimensions.
- Pattern Generation: Creating patterns, such as in graphics or games.

Nested Loop Syntax

Syntax:

```
Outer_loop:
    inner_loop:
        # Code block to execute - inner loop
# Code block to execute - outer loop
```

Nested Loop Example

Example: *Print numbers from 1 to 3, for 3 times using for-for nested loop*

```
for i in range(3): # Outer for loop (runs 3 times)
    for j in range(1,4):
        print(j)
    print()
```

Example: *Print numbers from 1 to 3, for 3 times using while-for nested loop*

```
i = 1
while i < 4:  # Outer while loop (runs 3 times)
    for j in range(1, 4):
        print(j)

    print()
    i += 1
```

Nested Loop Interview Question

Example: *Print prime numbers from 2 to 10*

```
for num in range(2, 10):
    for i in range(2, num):
        if num % i == 0:
            break
    else:
        print(num)
```

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Chapter - 16

List in Python

- What is List
- Create Lists
- Access List: Indexing & Slicing
- Modify List
- List Methods
- Join Lists
- List Comprehensions
- Lists Iteration

List in Python

A **list** in Python is a collection of items (elements) that are **ordered**, **changeable** (mutable), and allow **duplicate** elements.

Lists are one of the most versatile data structures in Python and are used to store multiple items in a single variable.

Example:

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

Create List in Python

You can **create lists** in Python by placing **comma-separated** values between **square brackets []**. Lists can contain elements of different data types, including other lists.

```
Syntax:  list_name = [element1, element2, element3, ...]
# List of strings
colors = ["red", "green", "blue"]
# List of integers
numbers = [1, 2, 3, 4, 5]
# Mixed data types
mixed = [1, "hello", 3.14, True]
# Nested list
nested = [1, [2, 3], [4, 5, 6]]
```

Accessing List Elements - Indexing

You can **access elements** in a list by referring to their **index**. Python uses **zero-based** indexing, meaning the first element has an index of **0**.

Syntax: `list_name[index]`

Example:

```
fruits = ["apple", "orange", "cherry", "apple", "mango"]
```

Index	0	1	2	3	4
	-5	-4	-3	-2	-1

```
# Access first element
print(fruits[0])   # Output: apple
# Access third element
print(fruits[2])   # Output: cherry
# Access last element using negative index
print(fruits[-1])  # Output: mango
```

List Slicing

Slicing allows you to **access a range of elements** in a list. You can specify the **start and stop indices**, and Python returns a new list containing the specified elements.

Syntax: `list_name[start:stop:step]`

Example: `numbers = [10, 20, 30, 40, 50, 60]`

Index	0	1	2	3	4	5
	-6	-5	-4	-3	-2	-1

```
# Slice from index 1 to 3
print(numbers[1:4])  # Output: [20, 30, 40]

# Slice from start to index 2
print(numbers[:3])  # Output: [10, 20, 30]

# Slice all alternate elements
print(numbers[0::2])  # Output: [10, 30, 50]

# Slice with negative indices
print(numbers[-4:-1])  # Output: [30, 40, 50]
```

```
# Reverse list
print(numbers[::-1])  # Output: [60,50,40,30,20,10]
```

Modifying List

Lists are **mutable**, meaning you can change their content after creation. You can **add**, **remove**, or **change** elements in a list.

```
# Initial list:  fruits = ["apple", "banana", "cherry"]

# Changing an element
fruits[1] = "blueberry"
print(fruits)    # Output: ['apple', 'blueberry', 'cherry']

# Adding an element
fruits.append("mango")
print(fruits)    # Output: ['apple', 'blueberry', 'cherry', 'mango']

# Removing an element
fruits.remove("cherry")
print(fruits)    # Output: ['apple', 'blueberry', 'mango']
```

List Methods

Python provides several **built-in methods** to **modify** and **operate** on lists. Eg:

Methods	Description
append()	Adds a single element to the end of the list.
extend()	Adds multiple elements (from another iterable) to the end of the list.
insert()	Inserts an element at a specified position.
remove()	Removes the first occurrence of a specified element.
pop()	Removes and returns an element at a specified index. If no index is specified, it removes and returns the last element.
clear()	Removes all elements from the list, resulting in an empty list.
index()	Returns the index of the first occurrence of a specified element.
count()	Returns the number of occurrences of a specified element.
sort()	Sorts the list in ascending order by default. You can also sort in descending order and specify custom sorting criteria.
reverse()	Reverses the elements of the list in place.
copy()	Returns a shallow copy of the list.

Join Lists

There are several ways to **join**, or **concatenate**, two or more lists in Python.

```
list1 = [1, 2]
list2 = ["a", "b"]

# One of the easiest ways are by using the + operator
list3 = list1 + list2
print(list3) # Output: [1, 2, 'a', 'b']

# using append method
for x in list2:
  list1.append(x)
# appending all the items from list2 into list1, one by one
print(list1) # Output: [1, 2, 'a', 'b']

# using extend method
list1.extend(list2)   # add elements from one list to another list
print(list1) # Output: [1, 2, 'a', 'b']
```

List Comprehensions

List comprehensions provide a **concise way to create lists**. They consist of brackets containing an expression followed by a for clause, and optionally if clauses.

```
# Syntax:
new_list = [expression for item in iterable if condition]

# Creating a list of squares:
squares = [x**2 for x in range(1, 6)]
print(squares)  # Output: [1, 4, 9, 16, 25]

# Filtering even numbers:
even_numbers = [x for x in range(1, 11) if x % 2 == 0]
print(even_numbers)  # Output: [2, 4, 6, 8, 10]

# Applying a function to each element:
fruits = ["apple", "banana", "cherry"]
uppercase_fruits = [fruit.upper() for fruit in fruits]
print(uppercase_fruits)  # Output: ['APPLE', 'BANANA', 'CHERRY']
```

List Comprehensions - Flatten a List

```
Flatten a Nested List - using List Comprehension
    def flatten_list(lst):
        return [item for sublist in lst for item in sublist]
    # Example
    nested_list = [[1, 2], [3, 4], [5, 6]]
    flattened = flatten_list(nested_list)
    print(flattened)
    # Output: [1, 2, 3, 4, 5, 6]
```

Iterating Over Lists

Iterating allows you to traverse each element in a list, typically using loops.

```
#Example: fruits = ["apple", "banana", "cherry"]

# Using for loop
for fruit in fruits:
    print(fruit)

# Using while loop
index = 0
while index < len(fruits):
    print(fruits[index])
    index += 1
```

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Chapter - 17

Tuple in Python

- What is Tuple
- Create Tuples
- Access Tuples: Indexing & Slicing
- Tuple Operations
- Tuple Iteration
- Tuple Methods
- Tuple Functions
- Unpack Tuples
- Modify Tuple

Tuple in Python

A **tuple** is a collection of items in Python that is **ordered**, **unchangeable** (**immutable**) and allow **duplicate** values.

Tuples are used to store multiple items in a single variable.

Note: Ordered – Tuple items have a defined order, but that order will not change.

Example:

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

Create Tuple in Python

There are several ways to create a **tuple** in Python:

```
1. Using Parentheses ()
colors = ("red", "green", "blue")
numbers = (1, 2, 3, 4, 5)
mixed = (1, "hello", 3.14, True)
nested = (1, [2, 3], (4, 5, 6))
```

```
2. Without Parentheses (Comma-Separated)
also_numbers = 1, 2, 3, 4, 5

3. Using the tuple() Constructor
new_tuple = tuple(("apple", "banana", "cherry"))# use doble
brackets
list_items = ["x", "y", "z"]    # Creating a tuple from a list
tuple_items = tuple(list_items)  # ('x', 'y', 'z')

4. Single-Item Tuple
tuplesingle = ("only",)
```

Accessing Tuple Elements - Indexing

You can **access elements** in a tuple by referring to their **index**. Python uses **zero-based** indexing, meaning the first element has an index of **0**.

Syntax: `tuple_name[index]`

Example:

```
fruits = ("apple", "orange", "cherry", "apple", "mango")
```

Index	0	1	2	3	4
	-5	-4	-3	-2	-1

```
# Access first element
print(fruits[0])   # Output: apple

# Access third element
print(fruits[2])   # Output: cherry

# Access last element using negative index
print(fruits[-1])  # Output: mango
```

Tuple Slicing

Slicing allows you to **access a range of elements** in a tuple. You can specify the **start and stop indices**, and Python returns a new tuple containing the specified elements.

Syntax: `tuple_name[start:stop:step]`

Example:

```
numbers = (10, 20, 30, 40, 50, 60)
```

Index	0	1	2	3	4	5
	-6	-5	-4	-3	-2	-1

```
# Slice from index 1 to 3
print(numbers[1:4])  # Output: (20, 30, 40)

# Slice from start to index 2
print(numbers[:3])  # Output: (10, 20, 30)

# Slice all alternate elements
print(numbers[0::2])  # Output: (10, 30, 50)

# Slice with negative indices
print(numbers[-4:-1])  # Output: (30, 40, 50)

# Reverse list
print(numbers[::-1])  # Output: (60,50,40,30,20,10)
```

Tuple Operations

1. Concatenation

```
# You can join two or more tuples using the + operator.
tuple1 = (1, 2, 3)
tuple2 = (4, 5)
combined = tuple1 + tuple2
print(combined)  # Output: (1, 2, 3, 4, 5)
```

2. Repetition

```
# You can repeat a tuple multiple times using the * operator.
tuple3 = ("hello",) * 3
print(tuple3)  # Output: ('hello', 'hello', 'hello')
```

3. Checking for an Item

```
# Use the in keyword to check if an item exists in a tuple.
numbers = (10, 20, 30, 40)
print(20 in numbers)  # Output: True
```

Iterating Over Tuple

Iterating allows you to traverse each element in a tuple, using loops.

```
#Example: fruits = ("apple", "mango", "cherry")

# Using for loop
for fruit in fruits:
    print(fruit)

# Using while loop

i = 0
while i < len(fruits):
    print(fruits[i])
    index += 1
```

Tuple Methods

Python provides two **built-in methods** to use on tuples.

Methods	Description
count()	Returns the number of times a specified value occurs in a tuple.
index()	Searches the tuple for a specified value and returns the position of where it was found.

```
# count
colors = ("red", "green", "blue", "green")
print(colors.count("green"))  # Output: 2

# index
colors = ("red", "green", "blue", "green")
print(colors.index("blue"))  # Output: 2
```

Tuple Functions

Python provides several **built-in functions** to use on tuples.

Methods	Description
len()	Returns the number of items in a tuple.
sorted()	Returns a new sorted **list** from the items in the tuple
sum()	Sums up all the numeric items in the tuple.
min(), max()	Return the smallest and largest items in the tuple, respectively.

```
numbers = (2, 3, 1, 4)

print(len(numbers))  # Output: 4

sorted_num = sorted(numbers)
print(sorted_num)  # Output: [1,2,3,4]

print(sum(numbers))  # Output: 10
print(min(numbers))  # Output: 1
print(max(numbers))  # Output: 4
```

Packing and Unpacking Tuples

a. **Packing** is the process of putting multiple values into a **single** tuple.

```
a = "Madhav"
b = 21
c = "Engineer"
pack_tuple = a,b,c   # Packing values into a tuple
print(pack_tuple)
```

b. **Unpacking** is extracting the values from a tuple into **separate** variables.

```
name, age, profession = person  # Unpacking a tuple
print(name)        # Output: Madhav
print(age)         # Output: 21
print(profession)  # Output: Engineer
```

Modifying Tuple - Immutable

Once a tuple is created, you **cannot** modify its elements. This means you **cannot** add, remove, or change items.

```
# Creating a tuple
numbers = (1, 2, 3)

# Attempting to change an item
numbers[0] = 10
# This will raise an error
```

Modifying Tuple

But there is a **trick**. You can **convert the tuple into a list, change the list, and convert the list back into a tuple.**

```
my_tuple = ("apple", "mango", "cherry")

# type cast tuple to list
y = list(my_tuple)
y.append("orange")

# type cast back list to tuple
my_tuple = tuple(y)
print(my_tuple)
```

Tuple Use Case - Examples

Storing Fixed Data (Immutable Data)

Example: Storing geographic coordinates (latitude, longitude) or RGB color values, where the values shouldn't be changed after assignment.

```
coordinates = (40.7128, -74.0060)  # Latitude and longitude for NYC
rgb_color = (255, 0, 0)  # RGB value for red
```

Using Tuples as Keys in Dictionaries

Since tuples are immutable and hashable, they can be used as keys in dictionaries, unlike lists.

```
location_data = {
    (40.7128, -74.0060): "New York City",
    (34.0522, -118.2437): "Los Angeles"
   }

print(location_data[(40.7128, -74.0060)]) # Output: New York City
```

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Chapter - 18

Set in Python

- What is a Set
- Create Sets
- Set Operations
- Set Methods
- Set Iteration
- Set Comprehensions

Set in Python

A **set** is a collection of **unique items** in Python. Sets **do not** allow **duplicate** items and do not maintain any particular order so it **can't be indexed**.

Characteristics of Sets:

- **Unordered:** Elements have no defined order. You cannot access elements by index.
- **Unique Elements:** No duplicates allowed. Each element must be distinct.
- **Mutable:** You can add or remove elements after creation.
- **Immutable Elements:** individual elements inside a set cannot be modified/replaced

Example:

```
vowels = {'a', 'e', 'i', 'o', 'u'}
```

Create Set in Python

There are two primary ways to create a set in Python:

```
1. Using Curly Braces {}
my_set = {1, 2, 3, 4, 5}
print(my_set)  # Output: {1, 2, 3, 4, 5}

2. Using the set() Constructor
my_set = set([1, 2, 3, 4, 5])
print(my_set)  # Output: {1, 2, 3, 4, 5}
```

Note: An empty set cannot be created using {} as it creates an empty dictionary. Use set() instead.

```
empty_set = set()
print(empty_set)  # Output: set()
```

Set Operations

1. Adding Elements : Use the add() method to add a single element to a set.

```
fruits = {'apple', 'banana'}
fruits.add('cherry')
print(fruits)  # Output: {'apple', 'banana', 'cherry'}
```

2. Removing Elements: Use the remove() or discard() methods to remove elements.

- **remove()** raises an error if the element is not found.
- **discard()** does not raise an error if the element is missing.

```
fruits = {'apple', 'banana', 'cherry'}

# Using remove()
fruits.remove('banana')
print(fruits)  # Output: {'apple', 'cherry'}

# Using discard()
fruits.discard('orange')  # No error even if 'orange' is not in the set
print(fruits)  # Output: {'apple', 'cherry'}
```

Set Methods

1. Union: Combines elements from two sets, removing duplicates.

```
set_a = {1, 2, 3}
set_b = {3, 4, 5}
union_set = set_a.union(set_b)
print(union_set)  # Output: {1, 2, 3, 4, 5}
```

Alternative Syntax: `union_set = set_a | set_b`

2. Intersection: Includes only elements present in both sets.

```
set_a = {1, 2, 3}
set_b = {2, 3, 4}
intersection_set = set_a.intersection(set_b)
print(intersection_set)  # Output: {2, 3}
```

Alternative Syntax: `intersection_set = set_a & set_b`

3. Difference: Elements present in the first set but not in the second.

```
set_a = {1, 2, 3, 4}
set_b = {3, 4, 5}
difference_set = set_a.difference(set_b)
print(difference_set)  # Output: {1, 2}
```

Alternative Syntax: `difference_set = set_a - set_b`

4. Symmetric Difference: Elements in either set, but not in both.

```
set_a = {1, 2, 3}
set_b = {3, 4, 5}
sym_diff_set = set_a.symmetric_difference(set_b)
print(sym_diff_set)  # Output: {1, 2, 4, 5}
```

Alternative Syntax: `sym_diff_set = set_a ^ set_b`

Set Iterations – Loop

You can use a **for loop** to go through each element in a set.

```
# Using for loop - Printing each number from a set
numbers = {1, 2, 3, 4, 5}
for number in numbers:
    print(number)
```

```
# Using while loop - first convert set to a list then use while loop because sets do not support indexing.
```

Set Comprehension

Set comprehensions allow concise and readable creation of sets. Similar to list comprehensions but for sets.

```
# Syntax:
new_set = {expression for item in iterable if condition}

# Example:
squares = {x**2 for x in range(1, 6)}
print(squares)  # Output: {1, 4, 9, 16, 25}
```

Set Common Use Cases

- **Removing Duplicates:** Easily eliminate duplicate entries from data.
- **Membership Testing:** Quickly check if an item exists in a collection.
- **Set Operations:** Perform mathematical operations like union, intersection, and difference.
- **Data Analysis:** Useful in scenarios requiring unique items, such as tags, categories, or unique identifiers.

```
# Example:  Removing Duplicates from a List
numbers = [1, 2, 2, 3, 4, 4, 5]
unique_numbers = set(numbers)
print(unique_numbers)  # Output: {1, 2, 3, 4, 5}
```

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Chapter - 19

Dictionary in Python

- What is a Dictionary
- Create Dictionary
- Access Dictionary Values
- Dictionary Methods
- Dictionary – Add, Modify & Remove Items
- Dictionary Iteration
- Nested Dictionary
- Dictionary Comprehensions

Dictionary in Python

A **dictionary** is a data structure in Python that stores data in **key-value pairs**. Dictionary items (key – value pair) are ordered, changeable, and do not allow duplicates.

- **Key:** Must be unique and immutable (strings, numbers, or tuples).
- **Value:** Can be any data type and does not need to be unique.

Example: Simple dictionary with three key-value pairs

```
student = {
      1: "Class-X",
    "name": "Madhav",
    "age": 20
}
```

Create Dictionary in Python

Method-1: We create a dictionary using **curly braces {}** and separating keys and values with a **colon**.

```
# Syntax
my_dict =
{"key1": "value1", "key2": "value2", "key3": "value3", …}
```

```
# Empty dictionary
empty_dict = {}

# Dictionary with data
        cohort = {
            "course": "Python",
            "instructor": "Rishabh Mishra",
            "level": "Beginner"
        }
```

Method-2: Using dict() constructor

Pass key-value pairs as keyword arguments to dict()

```
person = dict(name="Madhav", age=20, city="Mathura")
print(person)

# Output: {'name': 'Madhav', 'age': 20, 'city':
'Mathura'}
```

Method-3: Using a List of Tuples

Pass a list of tuples, where each tuple contains a key-value pair.

```
student = dict([("name", "Madhav"), ("age", 20),
("grade", "A")])
print(student)

# Output: {'name': 'Madhav', 'age': 20, 'grade': 'A'}
```

Access Dictionary Values

Access dictionary values by using the **key** name inside **square brackets**.

Example:

```
        student = {
             1: "Class-X",
            "name": "Madhav",
            "age": 20
        }
```

```
# print value based on respective key-names
print(student["name"])  # Output: Madhav
print(student["age"])  # Output: 20
```

Dictionary Methods

Python provides several **built-in methods** to use on dictionary.

Methods	Description
values()	Returns a list of all values in the dictionary
fromkeys()	Returns a dictionary with specified keys and value
get()	Returns value of the specified key
items()	Returns a list containing a tuple for each key value pair
keys()	Returns a list containing the dictionary's keys
update()	Updates the dictionary with the specified key-value pairs
pop()	Removes the element with the specified key
popitem()	Removes the last inserted key-value pair
clear()	Removes all the elements from the dictionary
copy()	Returns a copy of the dictionary

Here are a few useful methods:

- **.keys():** Returns all keys in the dictionary.
- **.values():** Returns all values in the dictionary.
- **.items():** Returns all key-value pairs.
- **.get():** Returns value for a key (with an optional default if key is missing).

Examples

```
print(student.keys())       # All keys
print(student.values())     # All values
print(student.items())      # All key-value pairs
print(student.get("name")) # Safe way to access a value
```

Dictionary – Add, Modify & Remove Items

1. Add or **Modify Item:** Use **assign-operator '='** to add/modify items in a dictionary.

```
# Adding a new key-value pair
student["email"] = "madhav@example.com"

# Modifying an existing value
student["age"] = 25
```

2. Remove Item: Use **del** or **.pop()** to remove items from a dictionary.

```
# Remove with del
del student["age"]

# Remove with pop() and store the removed value
email = student.pop("email")
print(email)  # Output: madhav@example.com
```

Dictionary Iterations

A dictionary can be iterated using **for loop**. We can loop through dictionaries by keys, values, or both.

```
# Loop through keys
    for key in student:
        print(key)
# Loop through values
    for value in student:
        print(student[value])
# Loop through values: using values() method
    for value in student.values():
        print(value)
# Loop through both keys and values
    for key, value in student.items():
        print(key, value)
```

Nested Dictionary

Dictionaries can contain other dictionaries, which is useful for storing more complex data.

```
# nested dictionaries
    students = {
        "student1": {
            "name": "Madhav",
            "age": 20,
            "grade": "A"
        },
        "student2": {
            "name": "Keshav",
            "age": 21,
            "grade": "B"
        }
    }
    print(students["student1"]["name"])  # Output: Madhav
```

Dictionary Comprehension

A dictionary comprehension allows you to create dictionaries in a concise way.

```
# Syntax:
new_dict =
{key_expression: value_expression for item in iterable if
condition}

# Example: Creating a dictionary with square numbers
squares = {x: x * x for x in range(1, 6)}
print(squares)

# Output: {1: 1, 2: 4, 3: 9, 4: 16, 5: 25}
```

Dictionary Common Use Cases

- **User Profiles in Web Applications:** Store user details like name, email, etc.
- **Product Inventory Management:** Keep track of stock levels for products in an e-commerce system.
- **API Responses**: Parse JSON data returned from APIs (e.g., weather data).
- **Grouping Data:** Organize data into categories. Example: grouped = {"fruits": ["apple", "banana"], "veggies": ["carrot"]}
- **Caching:** Store computed results to reuse and improve performance. Example: cache = {"factorial_5": 120}
- **Switch/Lookup Tables:** Simulate switch-case for decision-making.

```
# Example:
actions = {"start": start_fn, "stop": stop_fn}
actions["start"]()
```

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Chapter - 20

OOPs in Python

- What is OOPs
- Why OOP is required
- Class and Object
- Attributes and Methods
- __init__ Method (Constructor)
- Abstraction
- Encapsulation
- Inheritance
- Polymorphism

OOPs in Python

Two ways of programming in Python:

1) **Procedural** Programming,

2) **OOPs**

OOPs: Object Oriented Programming

A way of organizing code by creating "blueprints" (called **classes**) to represent real-world things like a student, car, or house. These blueprints help you create **objects** (individual examples of those things) and define their behavior.

Class: A class is a blueprint or template for creating objects.

It defines the properties (**attributes**) & actions/behaviors (**methods**) that objects of this type will have.

Object: An object is a specific instance of a class.

It has actual data based on the blueprint defined by the class.

OOPs Example in Python

Example: **Constructing a building**

Class: Blueprint for a floor.

Object: Actual house built from the blueprint. Each house (object) can have different features, like paint color or size, but follows the same blueprint.

Why OOPs?

- **Models Real-World Problems:**
  Mimics real-world entities for easier understanding.
- **Code Reusability:**
  Encourages reusable, modular, and organized code.
- **Easier Maintenance:**
  OOP organizes code into small, manageable parts (classes and objects). Changes in one part don't impact others, making it easier to maintain.
- **Encapsulation:**
  Encapsulation **protects data** integrity and **privacy** by bundling data and methods within objects.
- **Flexibility & Scalability:**
  OOP makes it easier to add new features without affecting existing code.

OOPs – Question

Write a Python program to:

1. Define a Student class with attributes name, grade, percentage, and team.
   - Include an __init__ method to initialize these attributes.
   - Add a method student_details that prints the student's details in the format: "<name> is in <grade> grade with <percentage>%, from team <team>".
2. Create two teams (team1 and team2) as string variables.
3. Create at least two student objects, each belonging to one of the teams.
4. Call the student_details method for each student to display their details.

Class and Object Example

Class: A class is a blueprint or template for creating objects.

Object: An object is a specific instance of a class.

Example

```
class Student:
    pass
# Create an object
student1 = Student()
print(type(student1))
# Output: <class '__main__.Student'>
```

Attributes and Methods

Attributes: Variables that hold data about the object.

Methods: Functions defined inside a class that describe its behavior.

Example

```
class Student:
    def __init__(self, name, grade):
        self.name = name  # Attribute
        self.grade = grade  # Attribute
    def get_grade(self):  # Method
        return f"{self.name} is in grade {self.grade}."
```

```
# Object creation
student1 = Student("Madhav", 10)
print(student1.get_grade())  # Output: Madhav is in grade 10.
```

The __init__ Method (Constructor)

Whenever we create/construct an object of a class, there is an inbuilt method **__init__** which is automatically called to **initialize** attributes.

The self parameter is a reference to the current instance of the class, and is used to access variables that belong to the class.

Example

```
class Student:
    def __init__(self, name, grade):
        self.name = name
        self.grade = grade
# Initialize object with attributes
student1 = Student("Madhav", 10)
print(student1.name)  # Output: Madhav
```

Abstraction in Python: Hiding unnecessary details

Abstraction hides implementation details and shows only the relevant functionality to the user.

Example

```
class Student:
    def __init__(self, name, grade, percentage):
        self.name = name
        self.grade = grade
        self.percentage = percentage

    def is_honors(self):  # Abstracting the logic
        return self.percentage > 90  # Logic hidden
# Abstract method in use
student1 = Student("Madhav", 10, 98)
print(student1.is_honors())  # Output: True
```

Encapsulation in Python: Restricting direct access to attributes & methods

Encapsulation restricts access to certain attributes or methods to protect the data and enforce controlled access.

Example

```
class Student:
    def __init__(self, name, grade, percentage):
        self.name = name
        self.grade = grade
        self.__percentage = percentage  # Private attribute
(hidden)
    def get_percentage(self):  # Public method to access the
private attribute
        return self.__percentage

# Creating a student object
student1 = Student("Madhav", 10, 98)

# Accessing the private attribute using the public method
print(f"{student1.name}'s percentage is
{student1.get_percentage()}%.")
print(student1.__percentage) # error
```

Inheritance in Python: Reusing Parent's prop & methods

Inheritance (parent-child), allows one class (child) to reuse the properties and methods of another class (parent). This avoids duplication and helps in code reuse.

Example

```
class Student:
    def __init__(self, name, grade, percentage):
        self.name = name
        self.grade = grade
        self.percentage = percentage
    def student_details(self):  # method
        print(f'{self.name} is in {self.grade} grade with
{self.percentage}%')
```

```
class GraduateStudent(Student):  # GraduateStudent inherits from Student

    def __init__(self, name, grade, percentage, stream):
        super().__init__(name, grade, percentage)  # Call parent class initializer
        self.stream = stream  # New attribute specific to GraduateStudent

    def student_details(self):
        super().student_details()
        print(f"Stream: {self.stream}")

# Create a graduate student
grad_student = GraduateStudent("Vishakha", 12, 94, "PCM")
    # Vishakha is in 12 grade with 94%
grad_student.student_details()     # Stream: PCM
```

Polymorphism in Python: Same method but different output

Polymorphism allows methods in different classes to have the same name but behave differently depending on the object.

Example

```
class GraduateStudent(Student):
    def student_details(self):  # Same method as in parent class
        print(f"{self.name} is a graduate student from final year.")

# Polymorphism in action
student1 = Student("Madhav", 10, 98)
grad_student = GraduateStudent("Sudevi", 12, 99, "PCM")
student1.student_details()
# Output: Madhav is in 10 grade with 98%
```

```
grad_student.student_details()
# Output: Sudevi is a graduate student from final year.
```

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Chapter - 21

Modules, Packages & Libraries in Python

- What is Module
- Create & Use a Module
- What is Package
- What is Library
- Python pip
- Most used Libraries

Modules in Python

A module is a single Python file (.py) containing Python code. It can include functions, classes, and variables that you can reuse in other programs.

Why use modules?

- To organize code into smaller, manageable chunks.
- To reuse code across multiple programs.

 # Create a module:

- Save the following as `mymodule.py`

```
def say_hello(name):
    return print(f"Hello, {name}!")
```

 # Use the module:

```
import mymodule
greetings.say_hello("Madhav")
# Output: Hello, Madhav!
```

Packages in Python

A package is a **collection** of modules organized in **directories** (folders) with an __init__.py file. It allows you to structure your Python projects logically.

Why use packages?

- To group related modules together.
- To create larger applications or libraries.

 # Structure Example:

```
my_package/
    __init__.py
    math_utils.py
    string_utils.py
```

 # Use the package:

```
Syntax: from my_package import <package_name>
Example: from my_package import math_utils, string_utils
```

Libraries in Python

A library is a collection of modules and packages that provide pre-written functionality for your program. Libraries are typically larger and more feature-rich than packages or modules.

Why use libraries?

To avoid writing common functionality from scratch.

To leverage powerful tools developed by the community.

Example: Python has many popular libraries, such as:

- Pandas: For data manipulation.
- Matplotlib: For plotting and visualization.

 # Using a library (Pandas):

```
import pandas as pd
```

Python PIP

pip stands for "Pip Installs Packages". It is the package manager for Python that allows you to install, update, and manage Python libraries (packages) from the Python Package Index (PyPI).

Think of pip as an app store for Python libraries. You use it to search, install, and manage Python tools, just like downloading apps on your phone.

When you use pip install <package_name>, it:

- Connects to PyPI (Python Package Index) online.
- Downloads the specified library or package.
- Installs it into your Python environment.

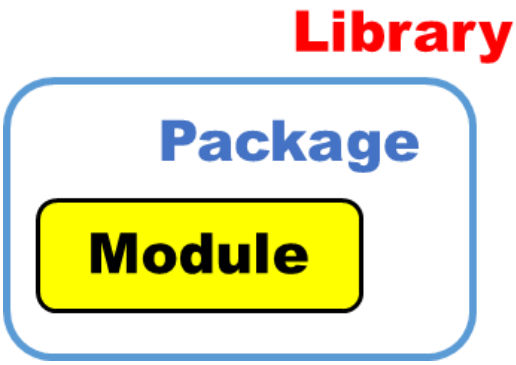
To install packages, we use: `pip install <library_name>`

Example: installing pandas to work on dataframe:

```
pip install pandas
```

Summary: Module, Package and Library

- **Module:** A single page.
- **Package:** A book containing multiple pages.
- **Library:** A book store with many books.



Concept	Key Feature	Example
Module	A single Python file with reusable code.	import math or custom file
Package	A directory of modules with an __init__.py.	from my_package import <*name*>
Library	A collection of modules/packages for functionality.	import pandas

Most Used Python Libraries

Data Analytics, data visualization and ML

Application	Library	Description	Install Command
Data Analytics	**Pandas**	Data manipulation and analysis.	pip install pandas
	NumPy	Numerical computing with array support.	pip install numpy
	SciPy	Scientific computing and technical computing.	pip install scipy
	Statsmodels	Statistical modeling and testing.	pip install statsmodels
	Dask	Parallel computing for large datasets.	pip install dask
Data Visualization	**Matplotlib**	Basic plotting and visualization.	pip install matplotlib
	Seaborn	Statistical data visualization.	pip install seaborn
	Plotly	Interactive graphs and dashboards.	pip install plotly
Machine Learning & Deep Learning	**Scikit-learn**	Classic machine learning algorithms.	pip install scikit-learn
	TensorFlow	Deep learning and ML models.	pip install tensorflow
	PyTorch	Deep learning with dynamic computation.	pip install torch torchvision
	Keras	High-level deep learning API.	pip install keras
	XGBoost	Gradient boosting for structured data.	pip install xgboost

Web Scraping, web development and game development

Application	Library	Description	Install Command
Web Scraping	**BeautifulSoup**	Parsing HTML and XML for data extraction.	pip install beautifulsoup4
	Scrapy	Advanced web scraping framework.	pip install scrapy
	Selenium	Browser automation for scraping dynamic sites.	pip install selenium
	Requests	HTTP library for fetching web pages.	pip install requests
	Lxml	Fast XML and HTML parsing.	pip install lxml
Web Development	**Django**	Full-stack web framework.	pip install django
	Flask	Lightweight web framework.	pip install flask
	FastAPI	High-performance API framework.	pip install fastapi
Game Development	**Pygame**	Game development library.	pip install pygame
	Arcade	Advanced 2D game development library.	pip install arcade
	Panda3D	Real-time 3D rendering and game creation.	pip install panda3d

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Chapter - 22

File Handling in Python

- What is File Handling
- Open & Read a File
- Write & Append to a File
- Create a File
- Close a file
- Work on txt, csv, excel, pdf files

File handling in Python

File handling in Python allows you to read from and write to files. This is important when you want to store data permanently or work with large datasets.

Python provides built-in functions and methods to interact with files.

Steps for File Handling in Python:

- Opening a file
- Reading from a file
- Writing to a file
- Closing the file

Open a File

To perform any operation (read/write) on a file, you first need to open the file using Python's open() function.

Syntax: `file_object = open('filename', 'mode')`

- ***'filename'***: Name of the file (can be relative or absolute path).
- ***'mode'***: Mode in which the file is opened (read, write, append, etc.).

File Modes:

- 'r': Read (default mode). Opens the file for reading.
- 'w': Write. Opens the file for writing (if file doesn't exist, it creates one).
- 'a': Append. Opens the file for appending (if file doesn't exist, it creates one).
- 'rb'/'wb': Read/Write in binary mode.

Example: Opening a file for reading

```
file = open('example.txt', 'r')
```

Read from a File

Once a file is open, you can read from it using the following methods:

- read(): Reads the entire content of the file.
- readline(): Reads one line from the file at a time.
- readlines(): Reads all lines into a list.

```
# Example: Reading the entire file
file = open('example.txt', 'r')
content = file.read()
print(content)
file.close()
```

```
# Example: Reading one line at a time
file = open('example.txt', 'r')
line = file.readline()
print(line)
file.close()
```

Write to a File

To write to a file, you can use the write() or writelines() method:

- write(): Writes a string to the file.
- writelines(): Writes a list of strings.

```
# Example: Writing to a file (overwrites existing content)
file = open('example.txt', 'w')
file.write("Hello, world!")
file.close()
```

*# **Example**: Appending to a file (add line to the end)*

```
file = open('example.txt', 'a')
file.write("\nThis is an appended line.")
file.close()
```

*# **Close a file:***

```
file.close()
```

Close a File

Instead of manually opening and closing a file, you can use the **with** statement, which automatically handles closing the file when the block of code is done.

*# **Example**: Reading with `with` statement*

```
with open('example.txt', 'r') as file:
    content = file.read()
    print(content)
```

In this case, you don't need to call file.close(), because Python automatically closes the file when the block is finished.

*# **Example**: Using **exception handling** to close a file*

```
try:
    open('example.txt', 'r') as file:
    content = file.read()
    print(content)
finally:
    file.close()
```

Working with Difft Format Files

*# **csv** - Using csv module*

```
import csv
file = open('file.csv', mode='r')
reader = csv.reader(file)
```

 # csv - Using pandas library

```
import pandas as pd
df = pd.read_csv('file.csv')
```

 # excel - Using pandas library

```
import pandas as pd
df = pd.read_excel('file.xlsx')
```

 # PDF Using PyPDF2 library:

```
import PyPDF2
file = open('file.pdf', 'b')
pdf_reader = PyPDF2.PdfReader(file)
```

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