Python Notes | The Testing Academy | Pramod 

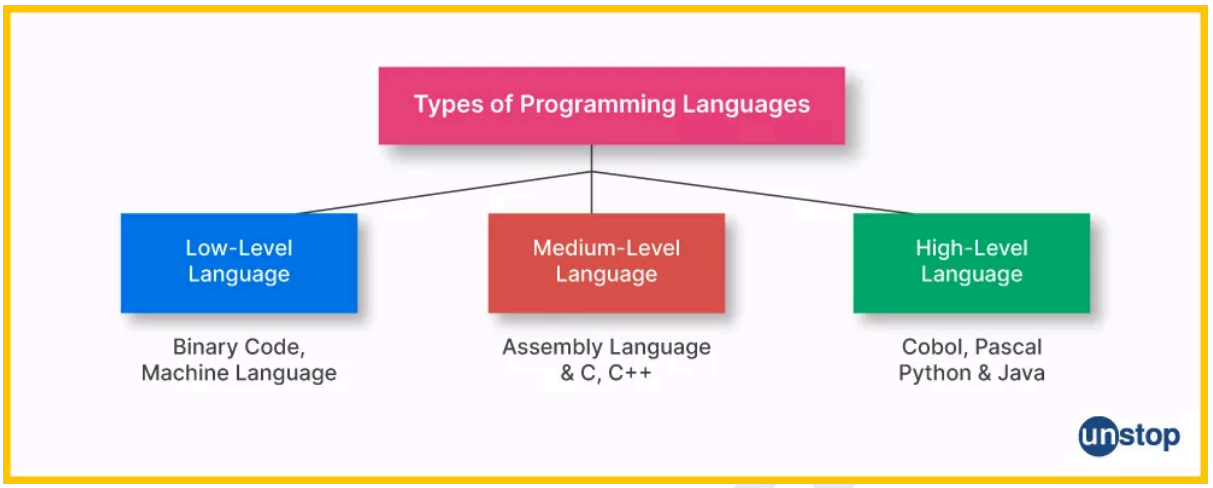
✅ Python Basics

Why should you learn Python?

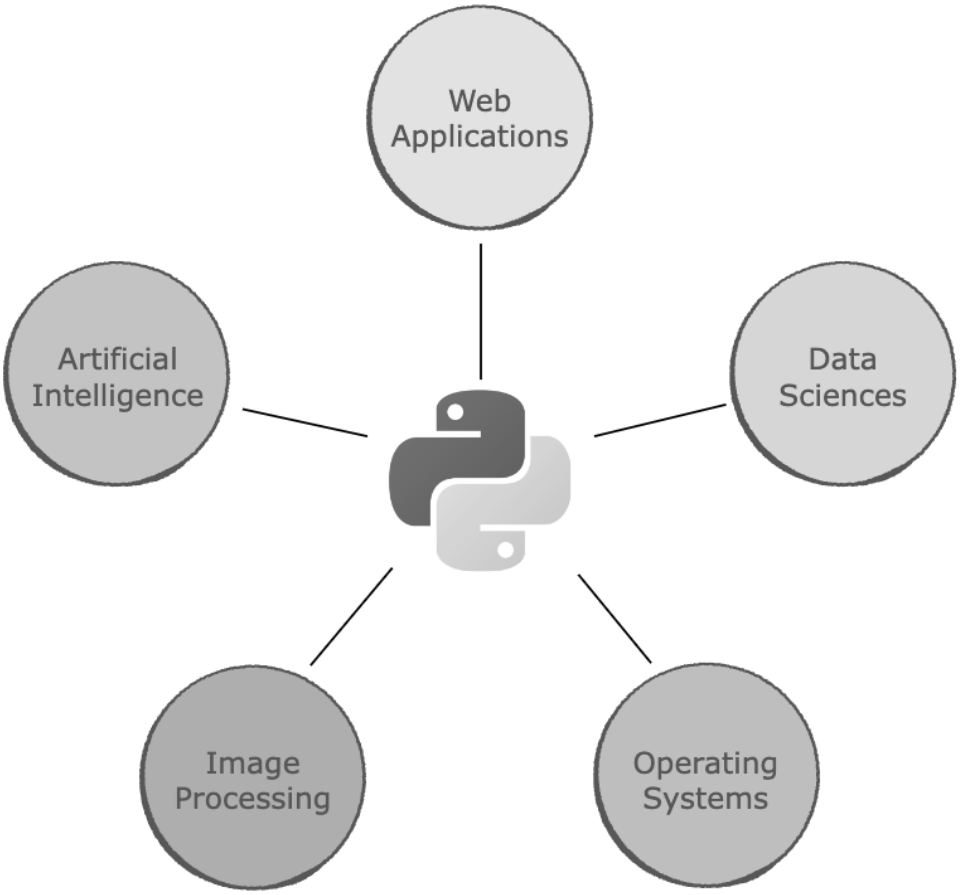
- Easy to learn: Python has a simple and readable syntax
- Large community, massive and supportive community of programmers.
- High demand : Python is in high demand in the job market.

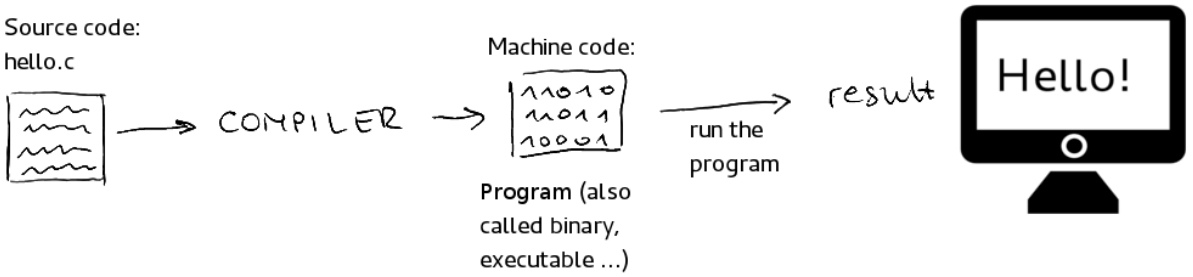
➕What is Python?

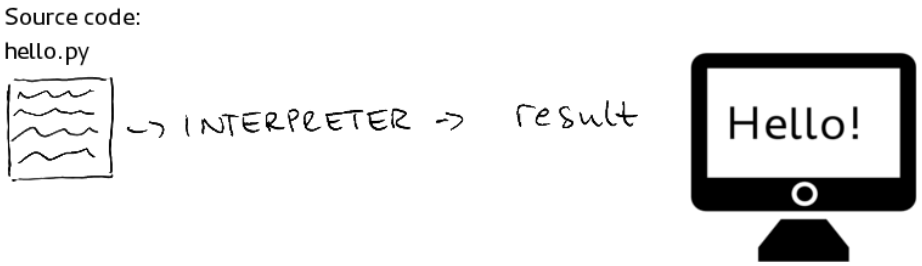
Developed in 1990, Python is one of the most popular general-purpose programming languages in modern times.

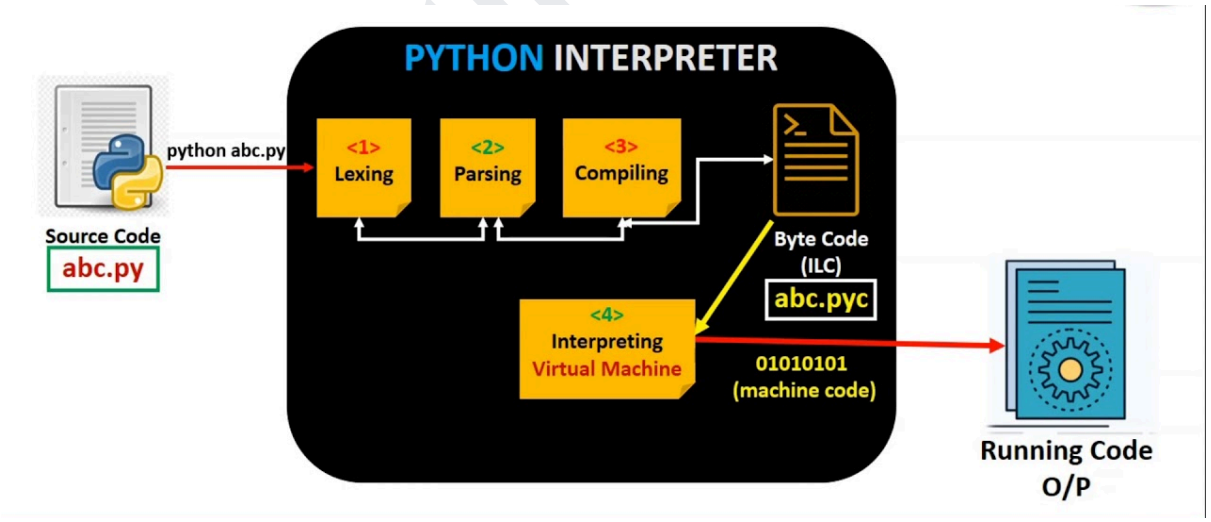


- **High-level programming language**
- General-purpose
- Interpreted
- Object-oriented
- **Dynamically typed**
- Emphasizes readability
- Extensive libraries and frameworks
- Cross-platform compatibility
- Large supportive community
- Popular in web development, data analysis, AI, and more.


Web
Applications
Artificial
Intelligence
Data
Sciences
Image
Processing
Operating
Systems


Source code:
hello.c
COMPILER
Machine code:
run the
program
result
Hello!
Program (also
called binary,
executable ...)


Source code:
hello.py
INTERPRETER
result
Hello!


PYTHON INTERPRETER
python abc.py
<1>
Lexing
<2>
Parsing
<3>
Compiling
Source Code
abc.py
Byte Code
(ILC)
abc.pyc
<4>
Interpreting
Virtual Machine
01010101
(machine code)
Running Code
O/P

```
# Python Case Sensitive
# True  , true
#Indentation in Python

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

✅ Dynamically typed

Python determines the type of a variable during runtime, rather than during compilation.

```
age = 25
# The interpreter automatically determines the type of the variable:
print(type(age))  # Output: <class 'int'>

# You can also reassign a variable to a different type without any issues:
age = "twenty-five"
print(type(age))  # Output: <class 'str'>
```

✅ Python 2.7 Vs 3.x ?

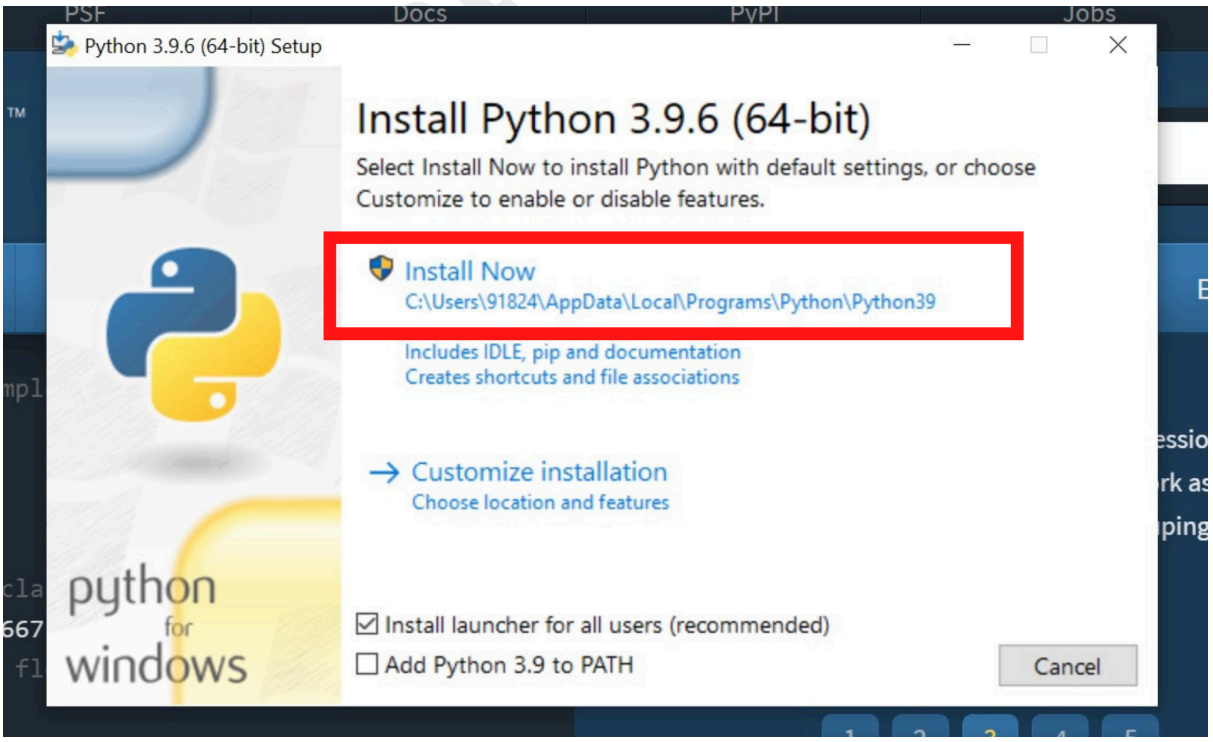
Feature	Python 2.7	Python 3
Release Date	July 3, 2010	December 3, 2008
End of Life	January 1, 2020	Ongoing (latest: 3.10.2)
Print function	`print "Hello, World!"`	`print("Hello, World!")`
Integer Division	`5 / 2 = 2`	`5 / 2 = 2.5`
Unicode support	Limited, using `u"..."`	Native, all strings are Unicode
xrange function	`xrange()`	Replaced by `range()`
Exception Handling	`except Exception, e:`	`except Exception as e:`
Syntax for raising errors	`raise ValueError, "error message"`	`raise ValueError("error message")`
Dict comprehensions	Not built-in	Built-in
Ordering Comparisons	Comparisons like `1 < '2'` allowed	Not allowed, requires explicit type conversion
Round function	`round(0.5) = 1.0`	`round(0.5) = 0`

👉 Highly recommended to use Python 3 for new projects and migrate existing projects to Python 3, if possible.

✅ Installation of Python 3.x?

For Windows:

- Visit the official Python website: https://www.python.org/downloads/
- Click the "Download Python 3.x.x" button (replace 'x' with the latest version number).
- Run the downloaded installer (python-3.x.x.exe).
- In the installer, check the box next to "Add Python 3.x to PATH" to add Python to your system's environment variables.



- Choose the "Customize installation" option if you want to change the installation location or features, or just click "Install Now" for a default installation.
- Wait for the installation to finish.
- Click "Close" once the installation is complete.
- Open the Command Prompt or PowerShell and type python --version to verify the installation. The output should display the installed Python version.

For macOS:

- Visit the official Python website: https://www.python.org/downloads/
- Click the "Download Python 3.x.x" button (replace 'x' with the latest version number).
- Open the downloaded installer (python-3.x.x.pkg).
- Follow the on-screen instructions in the installer.
- Click "Continue" and then "Install" to begin the installation process.
- You might be prompted to enter your macOS user password. Enter it and click "Install Software."
- Wait for the installation to finish.
- Click "Close" once the installation is complete.
- Open **Terminal** and type python –version / python3 --version to verify the installation. The output should display the installed Python version.
- Note that macOS comes with Python 2.x pre-installed, so using the python command will still refer to Python 2.x. Use the python3 command to run Python 3.x.

Writing Our First Code

The print Statement

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

```
print(*objects, sep=' ', end='\n', file=sys.stdout,
flush=False)
```

- ***objects:** This argument represents a variable number of objects to be printed. You can pass any number of objects separated by commas. These objects will be converted to strings using the str() function before being printed.

- **sep:** This is an optional argument that specifies the string that separates multiple objects when printed. The default separator is a space ' '.

- **end:** This is an optional argument that specifies the string that is printed at the end of the line. The default value is a newline character '\n', which causes the output to move to the next line after printing.

- **file:** This is an optional argument that defines where the output is printed. By default, it is set to sys.stdout, which represents the console. You can change this to a file object if you want to print the

output to a file.

- **flush**: This is an optional argument that, when set to True, forces the output to be written immediately. By default, it is set to False. When set to False, the output may be buffered until enough data is available to write or until the file is closed.

Here's an example using all the arguments:

python

```
with open("output.txt", "w") as file:
    print("Hello", "World", sep="-", end="!", file=file,
flush=True)
```

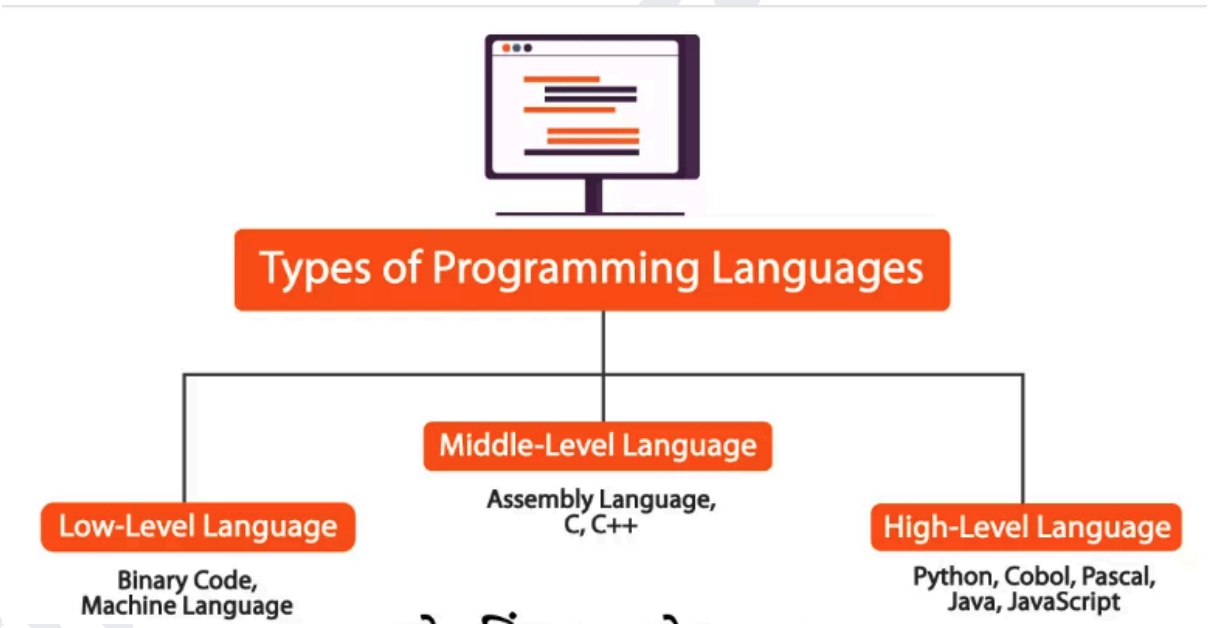
In this example, we print "Hello" and "World" with a dash separator, followed by an exclamation mark at the end.

The output is written to a file named "output.txt" instead of the console. The flush=True argument ensures the output is written immediately to the file.

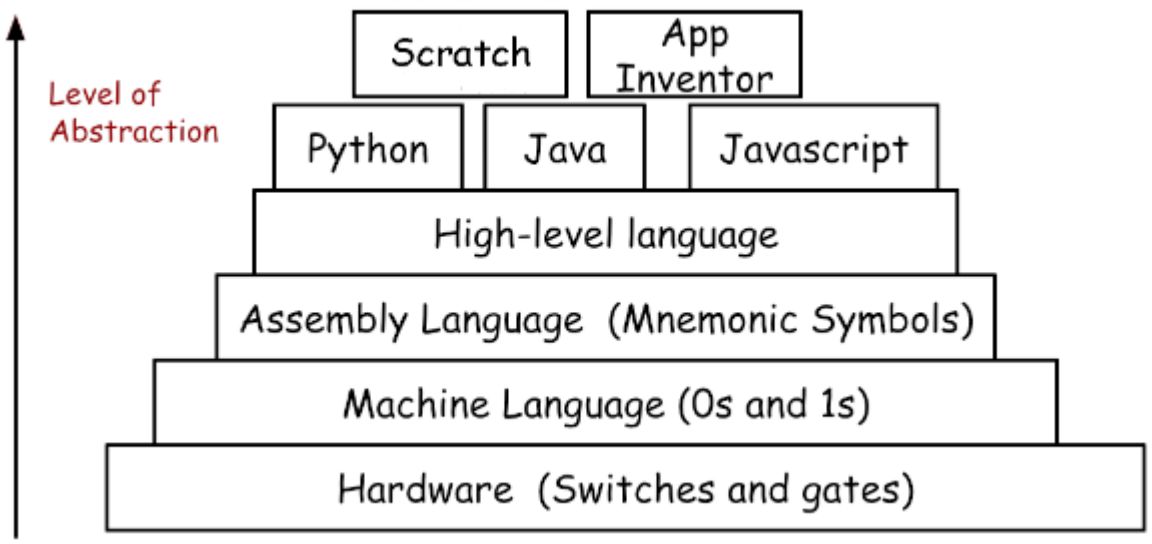
```
print(50, 1000, 3.142, "Hello World")
```

Python is Interpreted Language

Aspect	Interpreted Language	Compiled Language
Execution	Code is executed line-by-line by interpreter	Code is compiled to machine code/executable before running
Example Languages	Python, JavaScript, Ruby	C, C++, Java, Rust
Performance	Generally slower due to runtime interpretation	Generally faster due to pre-compiled machine code



Check the Languages, with the Level of Abstraction



Comments in Python

```
print(99)  # This line prints 99
print("Hello World")  # This line prints Hello World
```

```
# This is just a comment hanging out on its own!

# For multi-line comments, we must
# add the hashtag symbol
# each time
```

Multiple lines

```
""" Docstrings are pretty coofor writing longer comments or notes about the code"""
```

⚠️ What is Source Code?

Human understandable code written using High Level Programming language is called as Source Code. (NameOfFile.py)

📕 Keywords & Identifiers

- Keywords are also called Reserved Words.
- All the keywords can be in Lower Case or Upper Case.
- We cannot use a keyword as a variable name, function name or any other identifier.
- They are used to define the syntax and structure of the Python language. In Python, keywords are case-sensitive.

```python
False      await      else       import     pass
None       break      except     in         raise
True       class      finally    is         return
and        continue   for        lambda     try
as         def        from       nonlocal   while
assert     del        global     not        with
async      elif       if         or         yield
```

```
import keyword
print(keyword.kwlist)
```

Lab005.py

```
2
3   import keyword
4   print(keyword.kwlist)
5
```

```
PROBLEMS   OUTPUT   DEBUG CONSOLE   TERMINAL

/Library/Frameworks/Python.framework/Versions/3.9/bin/python3 /Users/pramod/Documents/Code/PyTuts/PyBasics/Lab005.py
➜  PyTuts /Library/Frameworks/Python.framework/Versions/3.9/bin/python3 /Users/pramod/Documents/Code/PyTuts/PyBasics/Lab005.py
['False', 'None', 'True', '__peg_parser__', 'and', 'as', 'assert', 'async', 'await', 'break', 'class', 'continue', 'def', 'del', 'elif', 'else', 'except', 'finally', 'for', 'from', 'global', 'if', 'import', 'in', 'is', 'lambda', 'nonlocal', 'not', 'or', 'pass', 'raise', 'return', 'try', 'while', 'with', 'yield']
➜  PyTuts
```


Identifiers

Identifiers are the names used to identify a variable, function, class, module, or other objects.

- They start with a letter (A-Z or a-z) or an underscore (_) followed by zero or more letters, underscores, and digits (0-9).
- Python is case-sensitive, so myVariable and myvariable are two different identifiers.

Rules for writing identifiers:

Identifiers can be a combination of letters in lowercase (a to z) or uppercase (A to Z) or digits (0 to 9) or an underscore (_).

- An identifier cannot start with a digit.
- Keywords cannot be used as identifiers.
- We cannot use special symbols like !, @, #, $, %, etc. in our identifier.
- An identifier can be of any length.

Examples of valid identifiers: myVar, var1, _var, _1_var

Examples of invalid identifiers: 1var, my-var, my@, my var, break

(break is a keyword)

Task # 1

1. Finish the Git Course, so that you can too upload your code, I can review.
2. https://sdet.live/git

Task 2

- Take a input from a user and print the table
-

n = 2 & print

- 2 x 1 = 2
- 2 x 2 = 4
- 2 x 3 = 6
- 2 x 4 = 8
- 2 x 5 = 10

- 2 x 6 = 12
- 2 x 7 = 14
- 2 x 8 = 16
- 2 x 9 = 18
- 2 x 10 = 20

Task 3 :

1. List the all the functions avaiable for the String Data Type.
2. e.g len()

Please upload your answers to github.com and share that link.

✅ Variables and Data Types

Variables

- A variable is a container (storage area) used to hold data.
- Each variable should be given a unique name (identifier).

- Variables are created on demand whenever a value is assigned to them using the equals sign = which is known as the assignment operator.
- Value of the variable can be changed any number of times during the program execution

```
x = 5        # x is an integer
pi = 3.14    # pi is a floating point number
name = "Python" # name is a string
x,y,z = 0,1,2
```

Three main Types of Variables

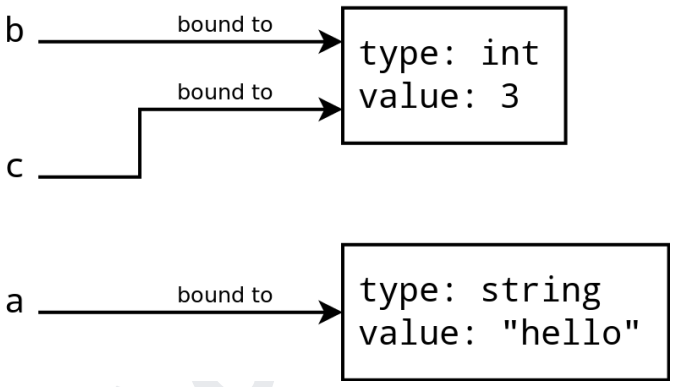
There are two types of variables based on data type used to declare the variable.

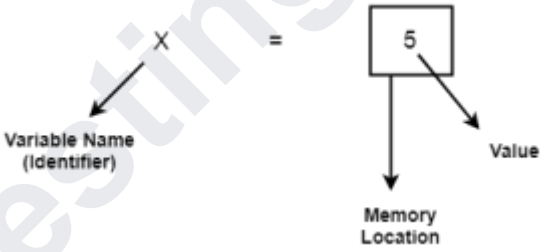
1. Numbers
2. Strings
3. Booleans

Executed Code:
Variable Assignment

```
a = 3
b = a
c = a
a = "hello"
```

Variables **Values in Memory**





Naming Conventions

1. Variables: Use lowercase letters and separate words with underscores (snake_case). For example: user_name, count.

2. Constants: Use uppercase letters and separate words with underscores. For example: PI, MAX_SIZE.

3. Functions: Use lowercase letters and separate words with underscores (snake_case). For example: calculate_sum, read_file.

4. Classes: Use PascalCase (or CamelCase) for class names, capitalizing the first letter of each word. For example: MyClass, Person.

5. Modules: Use lowercase letters and separate words with underscores (snake_case). For example: my_module, file_handler.

6. Packages: Use lowercase letters and avoid underscores if possible. For example: mypackage, utilities.

7. Protected instance variables: Start with a single underscore followed by lowercase letters and underscores (snake_case). For example: _protected_variable.

8. Private instance variables: Start with two underscores followed by lowercase letters and underscores (snake_case). For example: __private_variable.

9. Methods: Use lowercase letters and separate words with underscores (snake_case). For example: get_name, set_value.

10. Avoid using single character names: Do not use single character names like i, x, etc., except in specific cases like loop counters. Use descriptive names that provide context.

Data Types

Numbers

1. Integers - Positive and negative whole numbers.
2. Floating Points Numbers
3. Complex Numbers
4. Strings, Lists, Tuples, Dictionaries, Booleans
5. Sets

There are different types of data types in Python. Some built-in Python data types are:

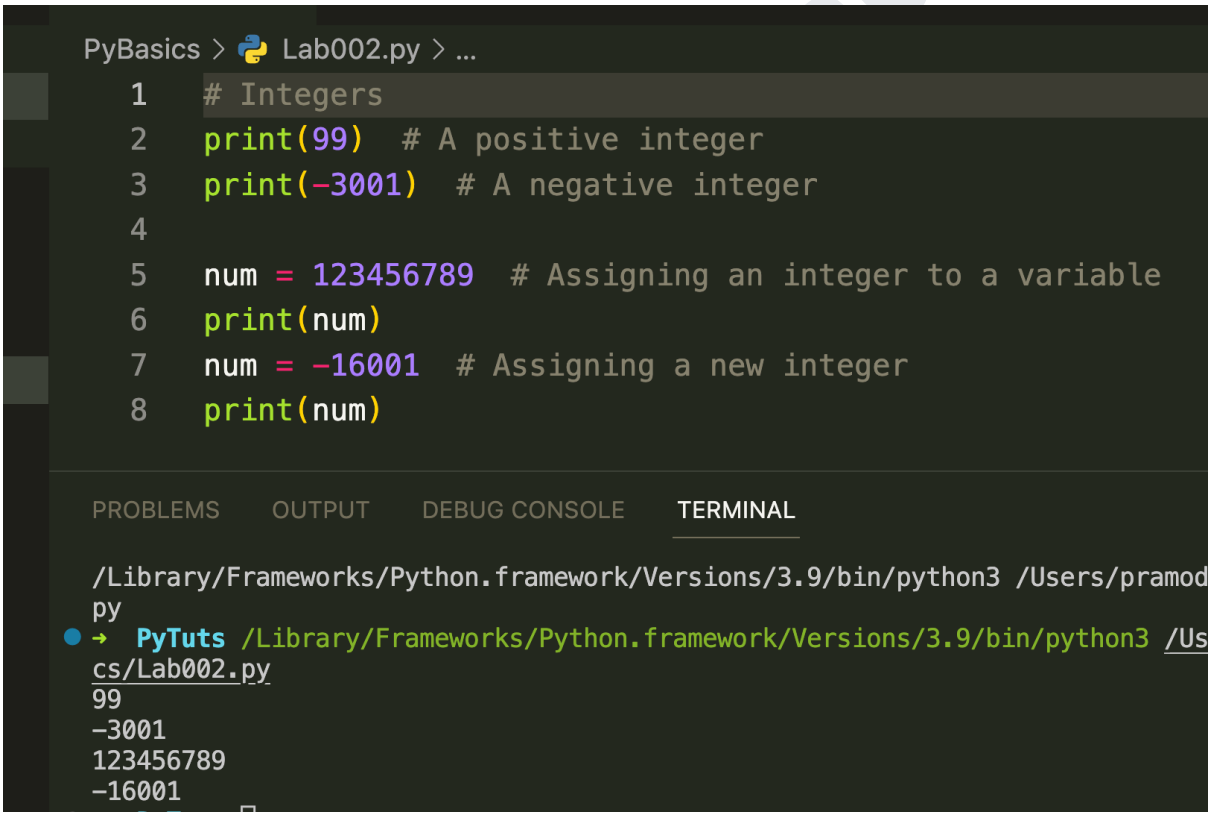
- **Numeric data types**: *int, float, complex*
- **String data types**: *str*
- **Sequence types**: *list, tuple, range*
- **Binary types**: *bytes, bytearray, memoryview*
- **Mapping data type**: *dict*
- **Boolean type**: *bool*
- **Set data types**: *set, frozenset*

Ref

[Python Data Types (With Complete List) | DigitalOcean]

Integers

0 will take up 24 bytes whereas 1 would occupy 28 bytes

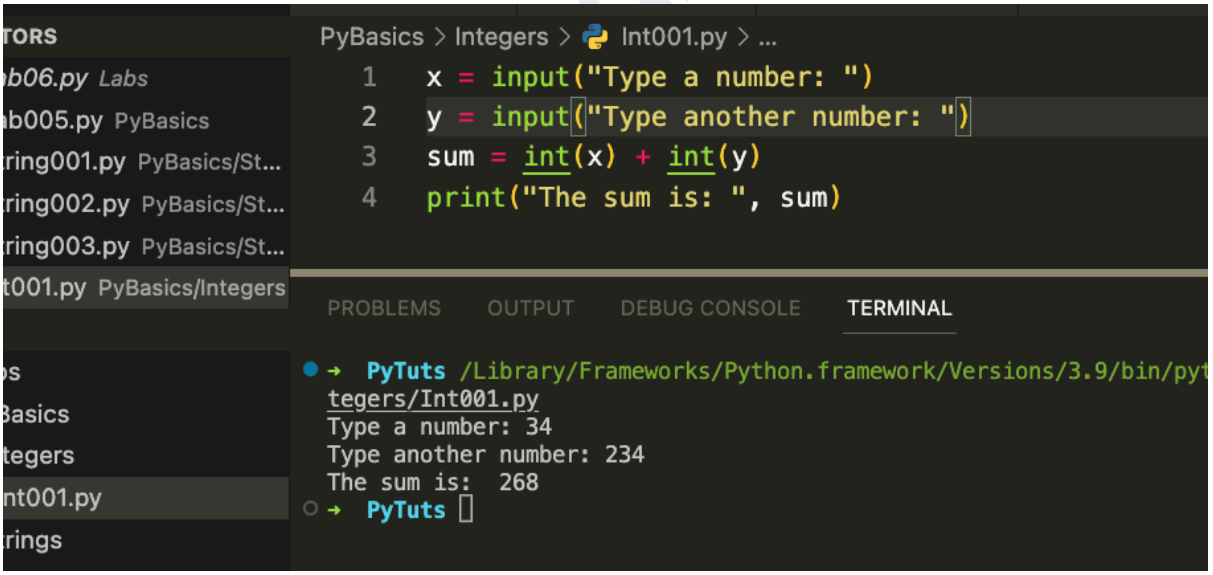


Add Two Numbers with User Input

In Python, the input() function is used to take user input. By default, the input() function returns data as a string.

To get a numerical input from a user, you should convert it to an integer or float using the int() or float() function, respectively.

```
x = input("Type a number: ")

y = input("Type another number: ")

sum = int(x) + int(y)

print("The sum is: ", sum)
```



Floating Point Numbers

Python allows us to create decimals up to a very high decimal place.

This ensures accurate computations for precise values.

A float occupies 24 bytes of memory.

9 is considered to be an integer while 9.0 is a float.

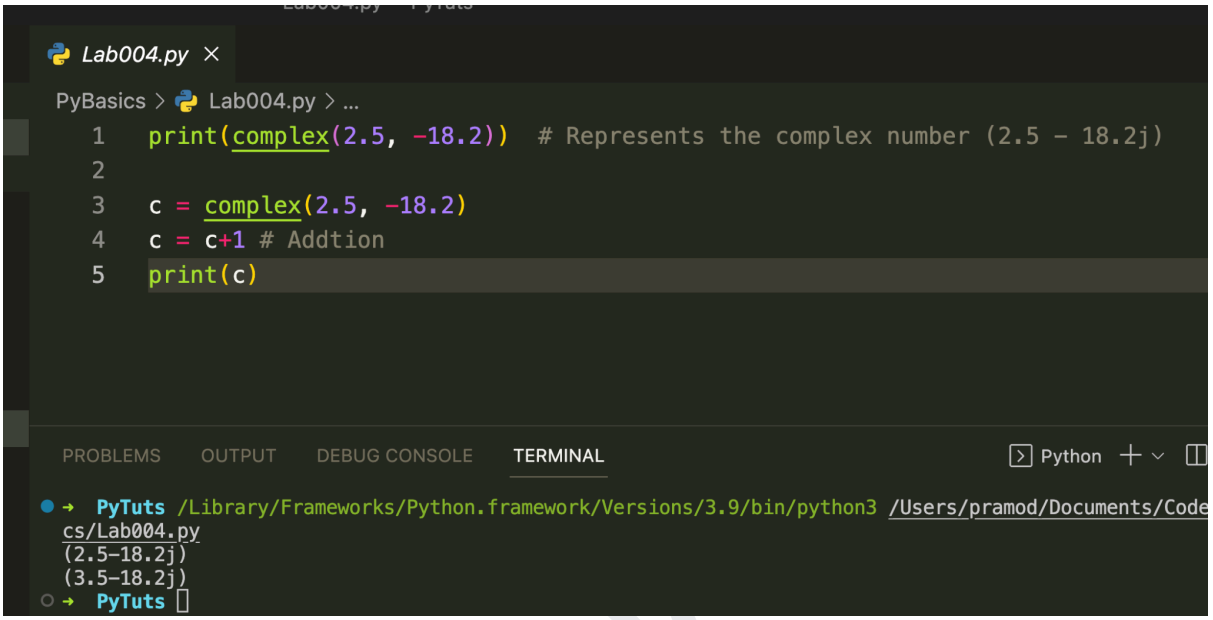
Complex Numbers -

Complex numbers are useful for modelling physics and electrical engineering models in Python.

Here's the template for making a complex number:

complex(real, imaginary)

```
print(complex(2.5, -18.2))  # Represents the complex number (2.5 - 18.2j)
```



Strings

Strings are sequences of characters. In Python, you can define strings using either single quotes ('), double quotes ("") or triple quotes ''' or """) for multiline strings.

```
s = "Hello, world!"
```

raw strings

print('C:\some\name') # - `C:\some ame`

Proper - `print(r'C:\some\name')`

Length of a String

```
random_string = "I am Batman"  # 11 characters
print(len(random_string))
```

Indexing and Reverse Indexing

A string in Python is indexed from 0 to n-1 where n is its length.

```
batman = "Bruce Wayne"
first = batman[0]  # Accessing the first character
print(first)
space = batman[5]  # Accessing the empty space in
the string
print(space)
last = batman[len(batman) - 1]
print(last)
# The following will produce an error since the
index is out of bounds
# err = batman[len(batman)]
```

```
batman = "Bruce Wayne"
print(batman[-1])  # Corresponds to batman[10]
print(batman[-5])  # Corresponds to batman[6]
```

String Immutability

```
string = "I am Immutable"
string[0] = '0' # Will give error
```

How to verify that String are immutable in python?

With ID method

```
str1 = "Pramod"
print(id(str1))
str1 = "Dutta"
print(id(str1))
```

NoneType

We can assign None to any variable, but we can not create other NoneType variables.

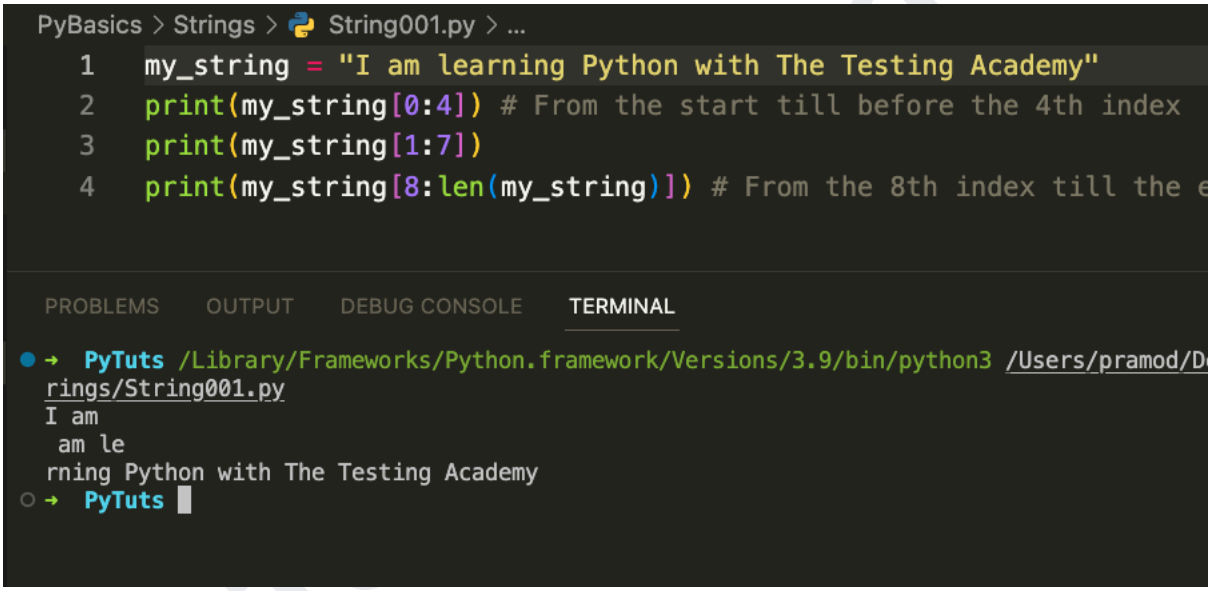
- None is not a default value for the variable that has not yet been assigned a value.
- None is not the same as False.
- None is not an empty string.
- None is not 0.

```
val = None
print(val) # prints "None" and returns None
print (type(val))
```

String Slicing

Slicing is the process of obtaining a portion (substring) of a string by using its indices.

string[start:end]



Slicing with a Step

The default step is 1.Python 3 also allows us to slice a string by defining a step through which we can skip characters in the string.

String002.py

Reverse Slicing

```
# Reverse Slice
my_string = "This is Pramod!"
print(my_string[13:2:-1]) # Take 1 step back each
time
print(my_string[17:0:-2]) # Take 2 steps back. The
opposite of what happens in the slide above
```

Partial Slicing

```
my_string = "This is MY string!"
print(my_string[:8])  # All the characters before
'M'
print(my_string[8:])  # All the characters
starting from 'M'
print(my_string[:])  # The whole string
print(my_string[::-1])  # The whole string in
reverse (step is -1)
```

How to Reverse a String in Python

```
txt = "Hello World"[::-1]
print(txt)
```

String Functions

https://gist.github.com/PramodDutta/d0744a067417b82d36d352ae907e4a16

Lists

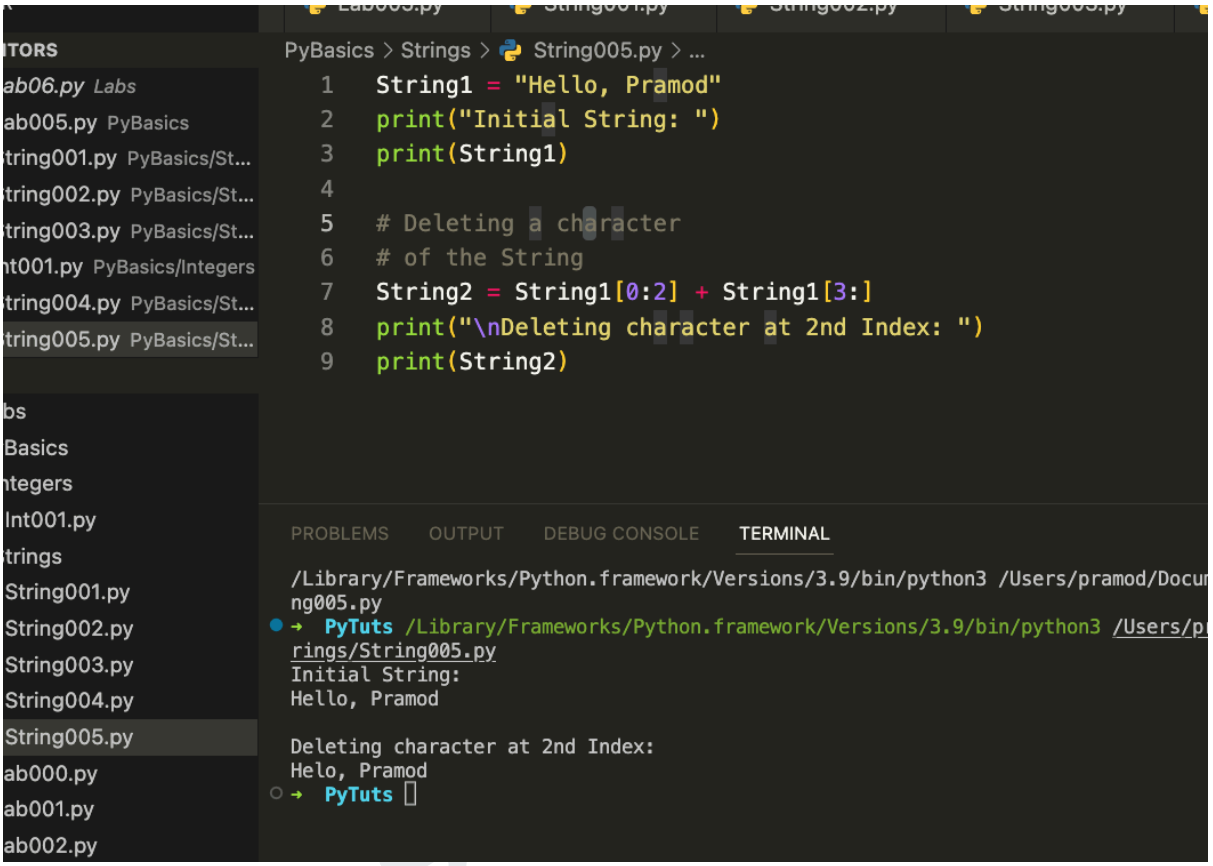
A list in Python is a collection of items which can be of different types. The items are enclosed within brackets [] and separated by commas.

```
my_list = [1, 2, 3, 'four', 5.0]
```

Deleting/Updating from a String

```
String1 = "Hello, I'm a Pramod"
list1 = list(String1)
print(list1)
list1[2] = 'p'
String2 = ''.join(list1)
print(String2)
```

Deletion of a character (String005.py)



Delete String

```
del String1
```

Escape Sequence

Escape sequences in Python are special combinations of characters that have a meaning other than the literal characters

```
print("\nEscaping Backslashes: ")
```

```
print("This is a backslash \\")
print("She said: \"Hello, world!\"")
print("This is a new line \nThis is the second
line")
print("This is a tab\tThis is after the tab")
```

In Python, if you don't want escape sequences to be interpreted, you can use raw strings by prefixing the string literal with an r or R. For example:

```
print(r"This is a backslash \\")
#output
// This is a backslash \\
```

String Formatting

String formatting means substituting values into a string. Following are some use cases of string formatting:

- Inserting strings within a string
- Inserting integers within a string
- Inserting floats within a string

```
string1 = "I like %s" % "Python"
print(string1) # 'I like Python'

temp = "Pramod"
string2 = "I like %s" % temp
print(string2) # 'I like TTA'

string3 = "I like %s and %s" % ("Python", temp)
print(string3)  # 'I like Python and TTA'
```

```
my_string = "%i + %i = %i" % (1,2,3)
print(my_string) # '1 + 2 = 3
```

```
string1 = "%f" % (1.11)
print(string1) # '1.110000'

string2 = "%.2f" % (1.11)
print(string2) # '1.11'

string3 = "%.2f" % (1.117)
print(string3) # '1.12'
```

Booleans

The Boolean data type can have two values: True or False. It is used to represent the truth values of expressions.

```
is_true = True
is_false = False
```

Sets

A set is an unordered collection of unique items. Sets are defined within braces {}.

```
my_set = {1, 2, 3, 4, 4, 5}  # Duplicates will be
removed, so this is equivalent to {1, 2, 3, 4, 5}
```

You can use the type() function to find out the type of a variable:

```
x = 5
print(type(x))  # Outputs: <class 'int'>
```

UNICODE Characters

- UNICODE stands for UNIversal CODE.
- Every character will have UNICODE value.
- UNICODE Notation
- Syntax:
    - \uXXXX - X will be hexadecimal digit
- Starts with \u followed by four hexadecimal digits.
- UNICODE Range
- \u0000 (0) to \uFFFF (65535)

Character	ASCII	OCTAL	UNICODE	Character	ASCII	OCTAL	UNICODE
A	65	101	\u0041	a	97	141	\u0061
B	66	102	\u0042	b	98	142	\u0062
C	67	103	\u0043	c	99	143	\u0063
D	68	104	\u0044	d	100	144	\u0064
E	69	105	\u0045	e	101	145	\u0065
F	70	106	\u0046	f	102	146	\u0066
G	71	107	\u0047	g	103	147	\u0067
H	72	110	\u0048	h	104	150	\u0068
I	73	111	\u0049	i	105	151	\u0069
J	74	112	\u004A	j	106	152	\u006A
K	75	113	\u004B	k	107	153	\u006B
L	76	114	\u004C	l	108	154	\u006C
M	77	115	\u004D	m	109	155	\u006D
N	78	116	\u004E	n	110	156	\u006E
O	79	117	\u004F	o	111	157	\u006F
P	80	120	\u0050	p	112	160	\u0070
Q	81	121	\u0051	q	113	161	\u0071
R	82	122	\u0052	r	114	162	\u0072
S	83	123	\u0053	s	115	163	\u0073
T	84	124	\u0054	t	116	164	\u0074
U	85	125	\u0055	u	117	165	\u0075
V	86	126	\u0056	v	118	166	\u0076
W	87	127	\u0057	w	119	167	\u0077
X	88	130	\u0058	x	120	170	\u0078
Y	89	131	\u0059	y	121	171	\u0079
Z	90	132	\u005A	z	122	172	\u007A

✅ Literals

- Literals are the actual values assigned
- Literals can be Numeric and Non Numeric.

Literal Type	Description
Integer literals	Whole numbers without decimal points, such as 42 or -123

Floating-point literals	Numbers with decimal points, such as 3.14 or -0.0025
Character literals	A single character enclosed in single quotes, such as 'a'
Boolean literals	A value of either true or false
String literals	A sequence of characters enclosed in double quotes, such as "hello world"
None literals	A special literal that represents None

Types of Literals

1) Boolean Literals - true, false

2) Character Literals -

3) String Literals

4) Integral Literals

5) Floating Literals

6) None Literal

1. Boolean Literals

There are two boolean literals 1) True 2) False

2. Character Literals

A char type variable can hold following:

- Single character enclosed in single quotation marks
- Escape Sequence
- ASCII Value
- UNICODE Character
- Octal Character

Escape Sequence - Task_12.java

Escape Sequence	Description
\t	Tab Space.
\b	Backspace.
\n	Newline.
\r	Carriage return.
\f	Formfeed.
\'	Single quote character.
\"	Double quote character.
\\	Backslash character.

ASCII stands for American Standard Code for Information Interchange.

- Every character enclosed in single quotation marks will have an integer equivalent value
- called as ASCII value.
- ASCII Value Range is 0 – 255.
- ASCII Value can be assigned to a char type variable

Octal Value as char type (0)

061 -> 49

$061 = (0 \times 8^2) + (6 \times 8^1) + (1 \times 8^0) = 49$

https://www.rapidtables.com/convert/number/octal-to-decimal.html

Character	ASCII	OCTAL	UNICODE	Character	ASCII	OCTAL	UNICODE
0	48	060	\u0030	5	53	065	\u0035
1	49	061	\u0031	6	54	066	\u0036
2	50	062	\u0032	7	55	067	\u0037
3	51	063	\u0033	8	56	070	\u0038
4	52	064	\u0034	9	57	071	\u0039

Character	ASCII	OCTAL	UNICODE	Character	ASCII	OCTAL	UNICODE
A	65	101	\u0041	a	97	141	\u0061
B	66	102	\u0042	b	98	142	\u0062
C	67	103	\u0043	c	99	143	\u0063
D	68	104	\u0044	d	100	144	\u0064
E	69	105	\u0045	e	101	145	\u0065
F	70	106	\u0046	f	102	146	\u0066
G	71	107	\u0047	g	103	147	\u0067
H	72	110	\u0048	h	104	150	\u0068
I	73	111	\u0049	i	105	151	\u0069
J	74	112	\u004A	j	106	152	\u006A
K	75	113	\u004B	k	107	153	\u006B
L	76	114	\u004C	l	108	154	\u006C
M	77	115	\u004D	m	109	155	\u006D
N	78	116	\u004E	n	110	156	\u006E
O	79	117	\u004F	o	111	157	\u006F
P	80	120	\u0050	p	112	160	\u0070
Q	81	121	\u0051	q	113	161	\u0071
R	82	122	\u0052	r	114	162	\u0072
S	83	123	\u0053	s	115	163	\u0073
T	84	124	\u0054	t	116	164	\u0074
U	85	125	\u0055	u	117	165	\u0075
V	86	126	\u0056	v	118	166	\u0076
W	87	127	\u0057	w	119	167	\u0077
X	88	130	\u0058	x	120	170	\u0078
Y	89	131	\u0059	y	121	171	\u0079
Z	90	132	\u005A	z	122	172	\u007A

Syntax: \DDD - D will be octal digit

OCTAL Range Range in Decimal 0 - 255 Range in Octal \0 - \377

In Python, a literal refers to any number or text that appears directly in your code. In other words, literals are data given in a variable or constant. Python supports various types of literals, including:

1. **Numeric Literals**: Numeric Literals are immutable. There are three types of Numeric literals:

   - **Integer**: It consists of a set of all positive and negative integers without a fractional component. For example, 123, -786, 0, 777.

   - **Float**: Float literals comprise integer and fractional components. For example, 12.23, -97.56, 0.123.

   - **Complex**: Complex literals are in the form a+bj, where a forms the real part, and b forms the imaginary part of complex number. For example, 3.14j, 4+3.14j.

2. **String Literals**: String literals can be formed by enclosing a text in the quotes. We can use both single as well as double quotes to create a string.

For example, "Hello", 'World'. A string in Python can be multi-line if it's enclosed in triple quotes: """..."""" or '''...'''.

3. **Boolean Literals**: A Boolean literal can have any of the two values: True or False.

4. **Special Literals**: Python contains one special literal i.e., None. 'None' is used to specify that a field is not created.

5. **Literal Collections**: There are four types of literal collection: List literals, Tuple literals, Dict literals, and Set literals.

- **List literals**: Lists are enclosed in square brackets [ ] and each item is separated by a comma. For example, [1, 2, "a", "b"]

- **Tuple literals**: Tuples are enclosed in parentheses ( ) and each item is separated by a comma. For example, (1, 2, "a", "b")

- **Dict literals**: Dictionaries are enclosed in curly brackets { } and values are assigned by key-value pairs. Each key is separated from its value by a colon (:). For example, {"name": "John", "age": 30}

- **Set literals**: Sets are unordered collection of unique items. Set is defined by values separated by comma inside braces { }. For example, {1, 2, 3}

6. **None Literal**: None is a special constant in Python that represents the absence of a value or a null value. It is an object of its own datatype, the NoneType.

For example:

```
# Numeric literals
a = 0b1010 #Binary Literals
b = 100 #Decimal Literal
c = 0o310 #Octal Literal
d = 0x12c #Hexadecimal Literal

# Floating Point Literal
float_1 = 10.5
float_2 = 1.5e2

# Complex Literal
x = 3.14j

print(a, b, c, d)
print(float_1, float_2)
print(x, x.imag, x.real)

# String literals
char = "hello world"
multiline_str = """This is a multiline
```

```
string with more than one
line code."""
unicode = u"\u00dcnic\u00f6de"
raw_str = r"raw \n string"

print(char)
print(multiline_str)
print(unicode)
print(raw_str)

# Boolean literals
x = (1 == True)
y = (1 == False)
a = True + 4
b = False + 10

print("x is", x)
print("y is", y)
print("a:", a)


print("b:", b)

# Special literal
drink = "Available"
food = None

def menu(x):
    if x == drink:
        print(drink)
    else:
```

```
        print(food)

menu(drink)
menu(food)

# Literal Collections
fruits = ["apple", "mango", "orange"] #list
numbers = (1, 2, 3) #tuple
alphabets = {'a':'apple', 'b':'ball', 'c':'cat'}
#dictionary
vowels = {'a', 'e', 'i' , 'o', 'u'} #set

print(fruits)
print(numbers)
print(alphabets)
print(vowels)
```


Question	Answer

What is a literal?	A literal is a fixed value that is directly used in a program without needing to be computed or evaluated.
How many types of literals are available?	There are six types of literals available in programming languages: numeric literals, character literals, boolean literals, string literals, array literals, and null literals.
How many boolean literals are available?	There are only two boolean literals available, which are true and false.
What will happen when I assign 1 to boolean type variable?	When you assign the value 1 to a boolean type variable, it will be interpreted as true because any non-zero value is considered as true in boolean expressions.

Can we store empty character in char type variable?	No, you cannot store an empty character in a char type variable because it requires at least one character.
How to store single quote in char variable?	To store a single quote in a char variable, you need to use the escape sequence ' because the single quote is a reserved character in programming languages.
What is Escape Sequence?	An escape sequence is a combination of characters used to represent special characters or non-printable characters in a string literal. It usually starts with a backslash () character.
What will be displayed when UNICODE value is found in String Literal?	The string "UNICODE of A is A" will be displayed because \u0041 represents the Unicode value of the letter A.

String str="UNICODE of A is \u0041";	
What will be displayed when Octal representation is found in String Literal? String str="Octal of A is \101";	The string "Octal of A is A" will be displayed because \101 represents the octal value of the letter A.
What will happen when Escape Sequence is found in String Literal? String str="Hello\nGuys";	The string "Hello" will be displayed on the first line, and "Guys" will be displayed on the next line because \n represents the newline character.

Integer Literals

- Decimal Literals -
- Octal Literals - int b=0101;
- Hexadecimal Literals - int c=0Xface; // base 16 rather than base 10
- Binary Literals () - int b2 = 0b101;

✅ Operators

Operators are used to perform operations by using operands.

There are three types of operator depending on the number of operands required.

- 1) Unary Operator
    - Only one operand is required.
- 2) Binary Operator
    - Two operands are required.

Unary Operator:

Unary operators operate on just one operand. An example in Python would be the negative sign in front of a number, which flips the sign of the number, or the "not" operator, which inverts a boolean value.

```
n = 7
print(-n)  # Prints: -7
flag = True
print(not flag)  # Prints: False
```

In Python, unary operators are operators that operate on a single operand. Here are the common unary operators:

1. **Unary Plus** (+)**: This operator doesn't really do anything. It's more for clarity and symmetry in your code.

```
a = 5
print(-a)  # Prints: -5
```

2. **Unary Minus** (-)**: This operator negates the value of the operand.

```
a = 5
print(-a)  # Prints: -5
```

3. **Logical Negation (not)**: This operator returns `True` if the operand is `False`, and `False` if the operand is `True`.

```
a = True
print(not a)  # Prints: False
```

4. **Bitwise Not (~)**: This operator returns the bitwise complement of the operand. In other words, it switches each 1 for a 0 and each 0 for a 1. It's equivalent to `-x - 1`.

```
a = 5  # binary: 101
print(~a)  # Prints: -6, binary: -110
```

5. **Identity Operators (is, is not)**: These are used to check if two variables are located on the same part of the memory. Two variables that are equal does not imply that they are identical.

```
a = 5
b = 5
print(a is b)  # Prints: True

list1 = [1, 2, 3]
list2 = [1, 2, 3]
print(list1 is list2)  # Prints: False

print(a is not b)  # Prints: False
print(list1 is not list2)  # Prints: True
```

Even though `list1` and `list2` contain the same elements, they are not the same object, so `list1 is list2` is `False`.

Remember, it's important to know that `is` and `==` are different operators: `is` checks for identity, while `==` checks for equality.

Binary Arithmetic Operators

Binary operators operate on two operands. Common examples include arithmetic operators like +, -, *, /, and logical operators like and, or

Operator	Description
+	Addition (SUM)
-	Subtraction (DIFFERENCE)
*	Multiplication (PRODUCT)
/	Division (QUOTIENT)
%	Modulus (REMAINDER)

```
x = 10
y = 20

print(x + y)  # Prints: 30
print(x < y)  # Prints: True

# Logical Operators
a = True
b = False

print(a and b)  # Prints: False
print(a or b)  # Prints: True
```

AND Truth Table

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

OR Truth Table

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

XOR Truth Table

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

NOT Truth Table

A	B
0	1
1	0

Ternary Operator:

The ternary operator is a more concise way of writing an if-else statement. It allows to quickly test a condition instead of a multiline if-else statement.

```
x = 10
y = 20
# "a if condition else b" - if the condition is true, it returns a, else it returns b.
print("x is greater" if x > y else "y is greater")  # Prints: "y is greater"
```

String Concatenation Operator (+)

+ operator can be used for two purposes:

```
str1 = "Hello, "
str2 = "World!"
str3 = str1 + str2
print(str3)  # Prints: Hello, World!
```

If you try to concatenate a string with a non-string, you will get a TypeError

```
str1 = "Hello, "
num = 7
str3 = str1 + num  # This will raise a TypeError
```

```
# Fixed  - str3 = str1 + str(num)
```

Python also supports string concatenation using the += operator:

```
greeting = "Hello, "
greeting += "World!"
print(greeting)  # Prints: Hello, World!
```

Operator	Description
+=	Add right operand to left operand and assign the result to left operand.
-=	Subtract right operand from left operand and assign the result to left operand.
*=	Multiply right operand to left operand and assign the result to left operand.
/=	Divide right operand to left operand and assign the result to left operand.
%=	Calculate modulus using two operands and assign the result to left operand.

Increment (++) / Decrement (--) Operators

```
# Increment
x = 5
x += 1  # This is equivalent to x = x + 1
print(x)  # Prints: 6

# Decrement
y = 10
```

```
y -= 1  # This is equivalent to y = y - 1
print(y)  # Prints: 9
```

Relational Operators

Operator	Description	Example
`>`	Greater than: True if left operand is greater than the right	`x = 10; y = 3; print(x > y) # Prints: True`
`<`	Less than: True if left operand is less than the right	`x = 10; y = 3; print(x < y) # Prints: False`
`==`	Equal to: True if both operands are equal	`x = 10; y = 10; print(x == y) # Prints: True`
`!=`	Not equal to: True if operands are not equal	`x = 10; y = 3; print(x != y) # Prints: True`
`>=`	Greater than or equal to: True if left operand is greater than or equal to the right	`x = 10; y = 10; print(x >= y) # Prints: True`
`<=`	Less than or equal to: True if left operand is less than or equal to the right	`x = 10; y = 20; print(x <= y) # Prints: True`

Logical Operators

Logical OR and Logical AND

Here's a truth table that illustrates these operators:

A	B	A and B	A or B	not A
True	True	True	True	False
True	False	False	True	False
False	True	False	True	True
False	False	False	False	True

Bitwise Operators

Operator	Description
~	Bitwise NOT
&	Bitwise AND
|	Bitwise OR
^	Exclusive OR (XOR)
<<	Left Shift
>>	Right Shift

Bitwise operators in Python operate on binary representations of integers. Here are the main bitwise operators:

1. **AND (&)**: Takes two numbers as operands and does AND on every bit of two numbers. The result of AND is 1 only if both bits are 1.

```
a = 10  # 1010 in binary
b = 4   # 0100 in binary
```

```
print(a & b)  # Prints: 0 (0000 in binary)
```

2. **OR (|)**: Takes two numbers as operands and does OR on every bit of two numbers. The result of OR is 1 if any of the two bits is 1.

```
a = 10  # 1010 in binary
b = 4   # 0100 in binary

print(a | b)  # Prints: 14 (1110 in binary)
```

3. **NOT (~)**: Takes one number and inverts all bits of it.

```
a = 10  # 1010 in binary

print(~a)  # Prints: -11 (Inverts all bits and adds
```

```
one due to two's complement)
```

4. **XOR (^)**: Takes two numbers as operands and does XOR on every bit of two numbers. The result of XOR is 1 if the two bits are different.

```
a = 10  # 1010 in binary
b = 4   # 0100 in binary

print(a ^ b)  # Prints: 14 (1110 in binary)
```

5. **Right Shift (>>)**: The right shift operator shifts the bits of the number to the right and fills 0 on voids left as a result. Similar effect as of dividing the number with some power of two.

```
a = 10  # 1010 in binary
```

```
   print(a >> 1)  # Prints: 5 (Shifts all bits to the
right, 0101 in binary)
```

6. **Left Shift (<<)**: The left shift operator shifts the bits of the number to the left and fills 0 on voids right as a result. Similar effect as of multiplying the number with some power of two.

```
   a = 10  # 1010 in binary

   print(a << 1)  # Prints: 20 (Shifts all bits to the
left, 10100 in binary)
```

https://bit-calculator.com/bit-shift-calculator

Task #1

1. Explain the difference between the = operator and the == operator in Python.
2. What does the ** operator do in Python, and how is it used?

3. What does the ^ operator do in Python, and in what context is it commonly used?

Task #2

- Write a Python program to calculate the area of a circle given its radius using the formula area=$\pi \times r$^2 (Take pie as 3.14)
- Create a program that takes two numbers as input and prints whether the first number is greater than, less than, or equal to the second number.
- Use the ternary operator to find the maximum of three numbers entered by the user.
- Develop a Python script that calculates the square and cube of a given number.

✅ Conditions and Loop

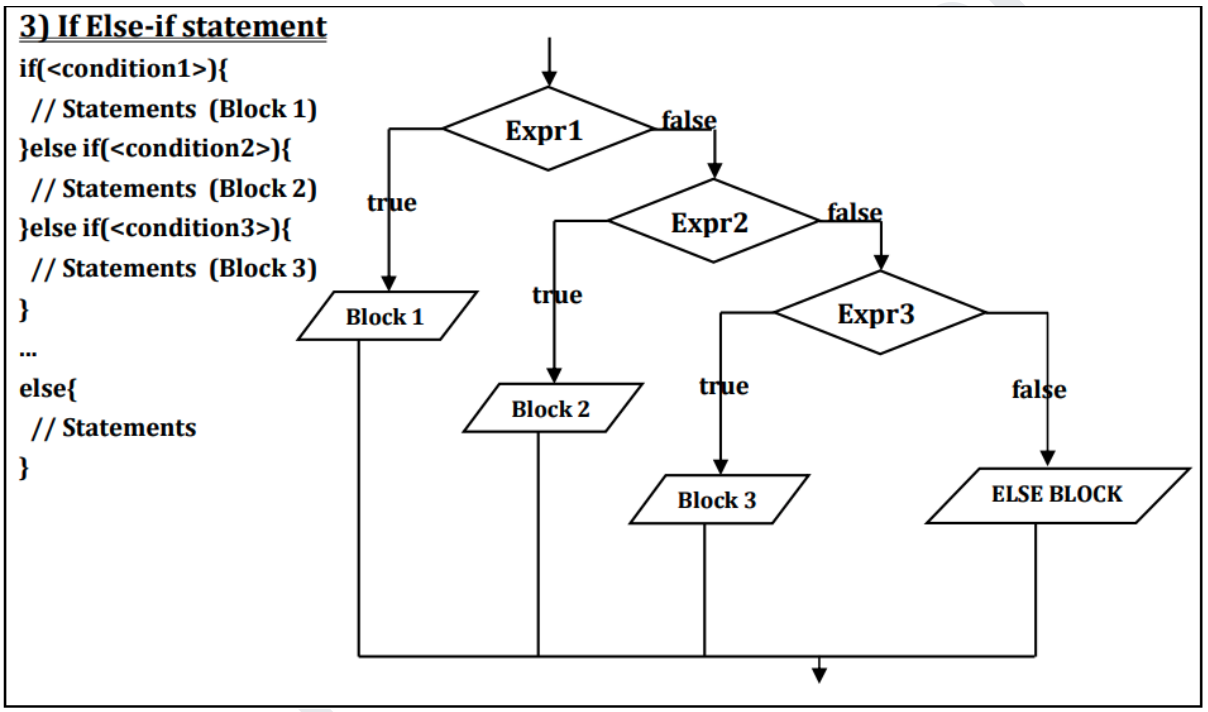
If Else

```
x = 10
y = 20

if x < y:
    print("x is less than y")
elif x > y:
    print("x is greater than y")
else:
    print("x is equal to y")
```

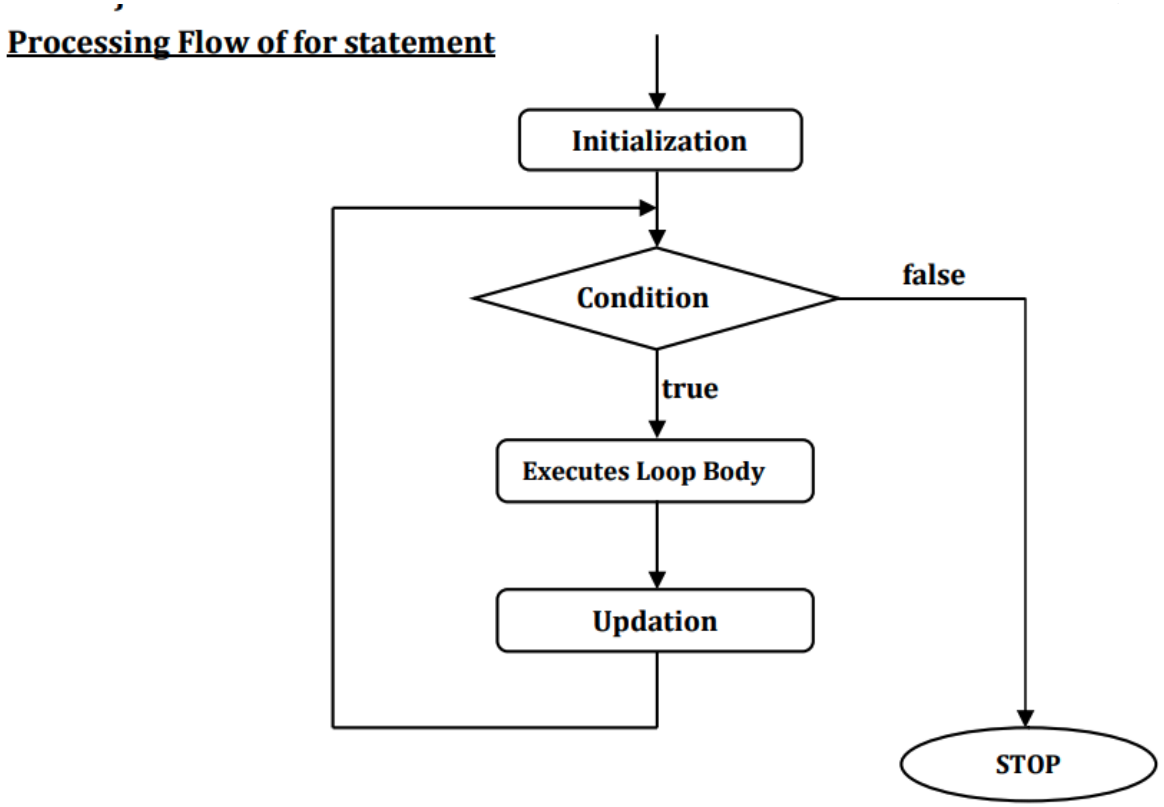
Problem to find the MAX three

```
If a>b and a> c :
 max=a;
else if(b> a and b>c)
 max = b;
else
```

```
 max=c;
System.out.println("Max value is "+max);
```



For



For Loop

A for loop in Python is used to iterate over a sequence (like a list, tuple, string, or range) or other iterable objects. Iterating over a sequence is called traversal.

```
for i in range(5):
    print(i)
```

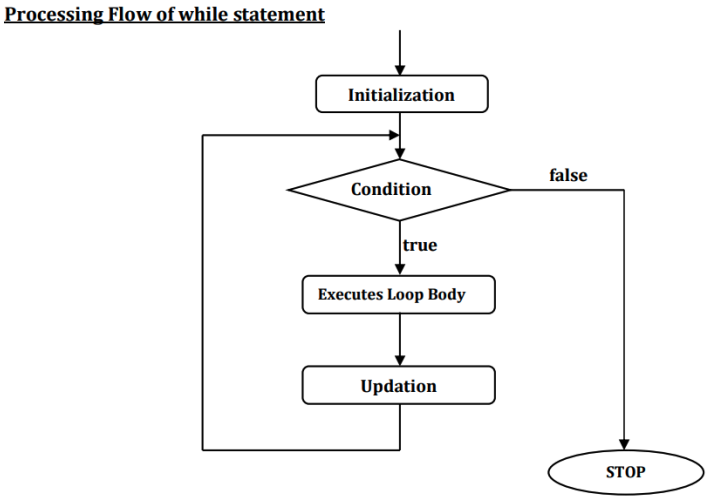
range() and xrange() are both used to generate a sequence of numbers, but they have a key difference: range() returns a list, and xrange() returns an xrange object,

```
# Python 3
for i in range(10):  # Generates each number on-the-fly, more memory-efficient
    print(i)

# If you really need a list for some reason:
numbers = list(range(10))
```

Python 3, xrange() was removed, and range() now behaves like xrange()

While

- condition of while statement is mandatory and must be boolean type




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

Problems

✅ Grade Calculator:

Write a program that calculates and displays the letter grade for a given numerical score (e.g., A, B, C, D, or F) based on the following grading scale:
input- score - 89
output- B
A: 90-100
B: 80-89
C: 70-79
D: 60-69
F: 0-59
If, elif, else
Task #2

✅ Leap Year Checker:

Create a program that determines whether a given year is a leap year.

A leap year is divisible by 4, but not by 100 unless it is also divisible by 400.
Use an if-else statement to make this determination.

Input = 2024
Output = Leap year

✅ Triangle Classifier:

Write a program that classifies a triangle based on its side lengths.

Given three input values representing the lengths of the sides, determine if the triangle is equilateral (all sides are equal), isosceles (exactly two sides are equal), or scalene (no sides are equal).

Use an if-else statement to classify the triangle.

3 Input
side 1, side 2 and side 3
output - Eq, Iso, Scalene -
Eq. = side 1 == side 2 = side 3

Task - Fibonacci series and Factorial

Factorial

n = 5

5! -->5*4*3*2*1 -> 120

3! -> 3*2*1 -> 6

4! -> 4*3*2*1 -> 24

#Fibonaci series

0,0+1, 0+1+1,

n = 7

0, 1, 2, 3, 5, 8, 13

Break

break is used to escape the loop when the condition is not met. Here's a concrete example.

Python does not have a built-in do-while loop structure that you might find in other programming languages like C++ or Java

```
count = 0

while True:
    count += 1
    print(f"This will print at least once. Count = {count}")

    if count >= 5:
        break
```

```
fruits = ['apple', 'banana', 'cherry']

for fruit in fruits:
    print(fruit)
```

Continue

The continue statement, also borrowed from C, continues with the next iteration of the loop:

```
for num in range(2, 10):
    if num % 2 == 0:
        print("Found an even number", num)
        continue
    print("Found an odd number", num)
```

pass Statements

The `pass` statement does nothing. It can be used when a statement is required syntactically but the program requires no action.

Match Statements

- 3.10 Python
- Similar to the Switch Statment
- Mulitple -> If else loops

```
parameter = "Pramoda"

match parameter:
    case "Pramod":
        print("Hi")
    case "PramOD":
        print("2")
    case _:
        print("Default")
```

✅ Functions and Strings

- A function is a reusable set of operations.
- A function in Python is a block of organized, reusable code that is used to perform a specific task.
- Functions are defined in Python using the **def** keyword, followed by the function name and parentheses ().
- They may or may not return something.
- You have to call the function.
- Functions can take parameters, Return Values

```
def greet():
 print("Hello!")
```

greet() # Calls the function and prints "Hello!"

- If you want to repeat a task or delegate a task, reuse code you have to use the functions.

Types of Functions in Python

1. **Built-in functions**
2. **User-defined functions**

💡Built-in functions

len(), min(), and print() are examples of built-in functions.

Function	Description	Example	Result
abs()	Returns the absolute value of a number	abs(-5)	5
bool()	Returns the boolean value of the specified object	bool(0)	False
chr()	Returns a string representing a character at the specified Unicode	chr(97)	'a'
dict()	Creates a dictionary	dict(a=1, b=2)	{'a': 1, 'b': 2}
float()	Returns a floating point number	float(5)	5.0
hex()	Converts a number into a hexadecimal	hex(255)	'0xff'
int()	Returns an integer object from a number or a string	int('10')	10
len()	Returns the number of items in an object	len('Hello')	5
list()	Creates a list	list('Hello')	['H', 'e', 'l', 'l', 'o']
max()	Returns the item with the highest value	max(1, 2, 3)	3
min()	Returns the item with the lowest value	min(1, 2, 3)	1
pow()	Returns the value of x to the power of y	pow(2, 3)	8
round()	Rounds a number	round(5.76543, 2)	5.77
str()	Converts a specified value into a string	str(123)	'123'
sum()	Sums the items of an iterable	sum([1, 2, 3, 4, 5])	15
type()	Returns the type of an object	type(123)	<class 'int'>

More details

https://docs.python.org/3/library/functions.html

round

Built-in Functions

A	**E**	**L**	**R**
abs()	enumerate()	len()	range()
aiter()	eval()	list()	repr()
all()	exec()	locals()	reversed()
any()			round()
anext()	**F**	**M**	
ascii()	filter()	map()	**S**
	float()	max()	set()
B	format()	memoryview()	setattr()
bin()	frozenset()	min()	slice()
bool()			sorted()
breakpoint()	**G**	**N**	staticmethod()
bytearray()	getattr()	next()	str()
bytes()	globals()		sum()
		O	super()
C	**H**	object()	
callable()	hasattr()	oct()	**T**
chr()	hash()	open()	tuple()
classmethod()	help()	ord()	type()
compile()	hex()		
complex()		**P**	**V**
	I	pow()	vars()
D	id()	print()	
delattr()	input()	property()	**Z**
dict()	int()		zip()
dir()	isinstance()		
divmod()	issubclass()		_
	iter()		__import__()

📕 String Built In

1. BO1.py

📕 Components of a Function

How do we actually make a function? In Python, a function can be defined using the **def keyword** in the following format:

The function name is simply the name we'll use to identify the function.

The parameters of a function are the inputs for that function. We can use these inputs within the function. **Parameters are optional.**

```
def minimum(first, second):
    if (first < second):
        print(first)
    else:
        print(second)
```

With Return

```
def minimum(first, second):
    if (first < second):
        return first
    return second
```

📕 Function Scope

1. Normal Data variables
2. Alterdata within (List)

✅ Understanding Decorators in Python

- Decorators in Python are a powerful and flexible tool that allows you to modify the behavior of functions or methods without changing their actual code.
- They are essentially functions that take another function as an argument and extend or alter its behavior.

How Decorators Work

```
def my_decorator(func):
    def wrapper():
        print("Something is happening before the
function is called.")
        func()
        print("Something is happening after the
function is called.")
    return wrapper

@my_decorator
def say_hello():
    print("Hello!")

say_hello()
```

In this example:

- my_decorator is the decorator function.
- wrapper is the inner function that adds behavior before and after calling func.
- The @my_decorator syntax is a shorthand for say_hello = my_decorator(say_hello).

When `say_hello()` is called, the output will be:

```
Something is happening before the function is called.
Hello!
Something is happening after the function is called.
```

Benefits of Using Decorators

1. Code Reusability: Decorators allow you to reuse the same functionality across multiple functions without duplicating code.
2. Separation of Concerns: They help in separating the core logic of functions from auxiliary concerns like logging, access control, etc.
3. Enhanced Readability: Using decorators can make your code more readable and maintainable by clearly separating different aspects of functionality.

Common Use Cases

- Logging: Automatically log function calls and their results.
- Access Control: Check user permissions before executing a function.
- Memoization: Cache the results of expensive function calls to improve performance.
- Timing: Measure the execution time of functions.

```python
import time

def timer_decorator(func):
    def wrapper(*args, **kwargs):
        start_time = time.time()
        result = func(*args, **kwargs)
        end_time = time.time()
        print(f"Function {func.__name__} took
```

```
{end_time - start_time} seconds to execute.")
        return result
    return wrapper

@timer_decorator
def slow_function():
    time.sleep(2)
    print("Function finished.")

slow_function()
```

Popular Python Decorators

Python provides several built-in decorators that are widely used in various applications. Here are some of the most popular ones:

1. @staticmethod

The @staticmethod decorator is used to define a method that does not operate on an instance of the class. It can be called on the class itself.

```
class MyClass:
    @staticmethod
    def static_method():
        print("This is a static method.")
```

```
MyClass.static_method()
```

2. @classmethod

The @classmethod decorator is used to define a method that operates on the class itself rather than an instance of the class. It takes cls as the first parameter.

```
class MyClass:
    class_variable = "Hello"

    @classmethod
    def class_method(cls):
        print(f"Class variable value:
{cls.class_variable}")

MyClass.class_method()
```

3. @property

The @property decorator is used to define a method as a property, allowing you to access it like an attribute. It is commonly used for getters and setters.

```
class MyClass:
    def __init__(self, value):
        self._value = value
```

```
    @property
    def value(self):
        return self._value

    @value.setter
    def value(self, new_value):
        self._value = new_value

obj = MyClass(10)
print(obj.value)  # Getter
obj.value = 20    # Setter
print(obj.value)
```

4. @functools.wraps

The @functools.wraps decorator is used to preserve the original function's metadata when writing custom decorators.

```
import functools

def my_decorator(func):
    @functools.wraps(func)
    def wrapper(*args, **kwargs):
        print("Before the function call")
        result = func(*args, **kwargs)
        print("After the function call")
        return result
    return wrapper
```

```
@my_decorator
def say_hello():
    print("Hello!")

say_hello()
```

All in one

```
class MyClass:
    @staticmethod
    def static_method():
        print("This is a static method.")

    @classmethod
    def class_method(cls):
        print(f"This is a class method of {cls}")

    @property
    def name(self):
        return "MyClass"

obj = MyClass()
obj.static_method()
obj.class_method()
```

```
print(obj.name)
```

Chaining Decorators

```
def decorator1(func):
    def wrapper():
        print("Decorator 1")
        func()
    return wrapper

def decorator2(func):
    def wrapper():
        print("Decorator 2")
        func()
    return wrapper

@decorator1
@decorator2
def say_hello():
    print("Hello!")

say_hello()
```

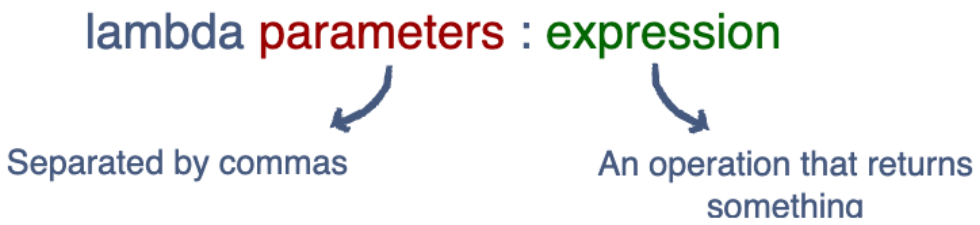
Decorators for Logging

```
def log_decorator(func):
    @functools.wraps(func)
    def wrapper(*args, **kwargs):
        print(f"Calling {func.__name__} with
{args} and {kwargs}")
        result = func(*args, **kwargs)
        print(f"{func.__name__} returned
{result}")
        return result
    return wrapper

@log_decorator
def add(a, b):
    return a + b

add(2, 3)
```

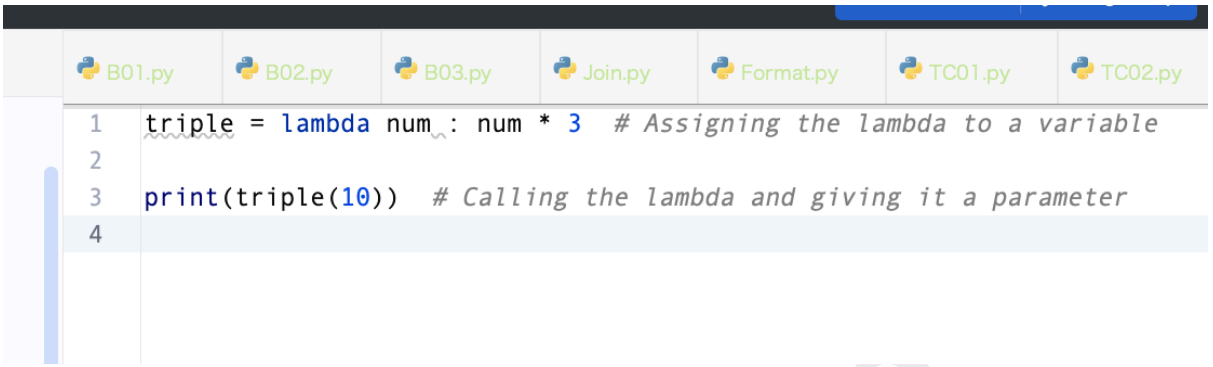
✅ Type Conversions

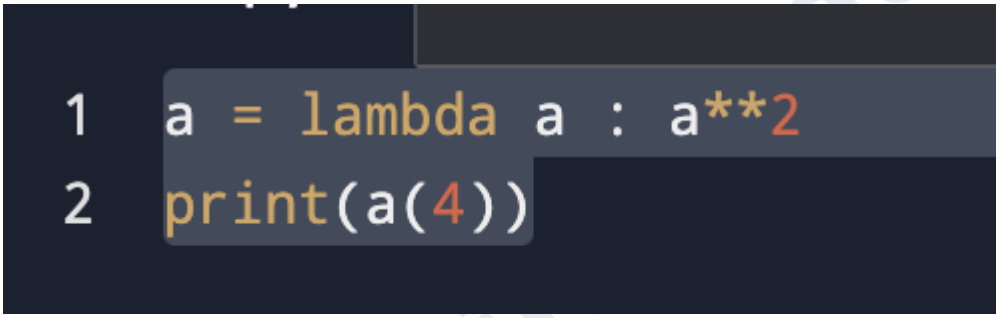
Function	Description	Example	Result
int()	Converts a value to an integer	int('123')	123
float()	Converts a value to a floating point number	float('123.45')	123.45
str()	Converts a value to a string	str(123)	'123'
list()	Converts a value to a list	list('hello')	['h', 'e', 'l', 'l', 'o']
tuple()	Converts a value to a tuple	tuple('hello')	('h', 'e', 'l', 'l', 'o')
set()	Converts a value to a set	set('hello')	{'h', 'e', 'l', 'o'}
dict()	Converts a sequence of tuples to a dictionary	dict([(1,2), (3,4)])	{1: 2, 3: 4}
bool()	Converts a value to a boolean	bool(1)	True
bytes()	Converts a value to bytes	bytes(5)	b'\x00\x00\x00\x00\x00'
complex()	Converts a real number to complex (real+imaginary)	complex(1,2)	(1+2j)

✅ Lambda



- A lambda is an anonymous function that returns some form of data.
- **Syntax:** The syntax to create a lambda function is lambda arguments: expression. The lambda keyword is used to define the anonymous function, followed by a list of arguments, a colon, and an expression.
- **Arguments**: Like a normal function, a lambda function can accept any number of arguments but must have only one expression. The arguments are specified before the colon.
- **Expression**: The expression is executed and the result is returned when the lambda function is called. This expression is written after the colon.
- **Return Value**: A lambda function can have a return value. The expression is evaluated and returned when the function is called.





lambdas are really useful when a function requires another function as its argument.

✅ Map and Filters

Map() Functions

1. Python is a built-in function.
2. Applies a given function to each item of an iterable (such as a list, tuple, or string) and returns an iterator with the results.

3. map() function is often used when you need to transform each element of an iterable using a specific function and collect the results

map(function, iterable)

```
# Define a function to square a number
def square(x):
    return x ** 2

# Apply the square function to a list of numbers using map()
numbers = [1, 2, 3, 4, 5]
squared_numbers = map(square, numbers)

# Convert the map object to a list and print it
# result = list(squared_numbers)
# print(result)  # Output: [1, 4, 9, 16, 25]


# Iterate over the map object and print each result
for result in squared_numbers:
    print(result)

```

main.py

```python
# Define a function to square a number
def square(x):
    return x**2

# Apply the square function to a list of numbers using ma
numbers = [1, 2, 3, 4, 5]
squared_numbers = map(square, numbers)

# Convert the map object to a list
result = list(squared_numbers)
print(result)  # Output: [1, 4, 9, 16, 25]

```

Filter

main.py

```python
numbers = [1, 2, 3, 4, 5]

# Using lambda as an argument to the filter() function
even_numbers = filter(lambda x: x % 2 == 0, numbers)
print(list(even_numbers))  # Output: [2, 4]

```

python Copy code

```python
# Define a function to check if a number is even
def is_even(x):
    return x % 2 == 0

# Filter even numbers from a list using filter()
numbers = [1, 2, 3, 4, 5]
even_numbers = filter(is_even, numbers)

# Convert the filter object to a list
result = list(even_numbers)
print(result)  # Output: [2, 4]
```

Using lambda as argument

python

```python
numbers = [1, 2, 3, 4, 5]

# Filter even numbers from a list using filter() with lambda
even_numbers = filter(lambda x: x % 2 == 0, numbers)

# Convert the filter object to a list
result = list(even_numbers)
print(result)  # Output: [2, 4]
```

Functions as Arguments

1. Using lambda as argument
2. Using map lambda

Using map lambda

```python
numbers = [1, 2, 3, 4, 5]

# Square each number in the list using map() with lambda
squared_numbers = map(lambda x: x ** 2, numbers)

# Convert the map object to a list
result = list(squared_numbers)
print(result)  # Output: [1, 4, 9, 16, 25]
```

Default Parameter

- You can provide default values for parameters, making them optional when calling the function.
- If a caller doesn't provide a value for an optional parameter, the default value is used.

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

greet()          # Output: Hello, World!
greet("Alice")   # Output: Hello, Alice!
```

✅ Recursion

- Recursion is the process in which a function calls itself during its execution.
- Each recursive call takes the program one scope deeper into the function.
- The recursive calls stop at the base case. The base case is a check used to indicate that there should be no further recursion.

main.py

```python
def rec_count(number):
    print(number)
    # Base case
    if number == 0:
        return 0
    rec_count(number - 1)  # A recursive call with a different argument


rec_count(5)

```

python

```python
def fibonacci(n):
    if n <= 1:
        return n
    else:
        return fibonacci(n - 1) + fibonacci(n - 2)

# Calculate the Fibonacci number at index 6
result = fibonacci(6)
print(result)  # Output: 8
```

```python
def factorial(n):
    if n == 0:
        return 1
    else:
        return n * factorial(n - 1)

# Calculate the factorial of 5
result = factorial(5)
print(result)  # Output: 120
```

Sum of List: Calculate the sum of all elements in a list using recursion.

main.py

```python
def sum_list(lst):
    if not lst:
        return 0
    else:
        return lst[0] + sum_list(lst[1:])

# Calculate the sum of [1, 2, 3, 4, 5]
result = sum_list([1, 2, 3, 4, 5])
print(result)  # Output: 15
```


✅ List []

- It allows us to store elements of different data types in one container.
- A list is a collection of items that are ordered and changeable (mutable). It allows duplicate members.
- **Creation**: Lists are created by placing a comma-separated sequence of items inside square brackets [].
    - fruits = ['apple', 'banana', 'cherry']

- **Insert** - aList.insert(index, newElement)
- **Access Items**: You can access items in a list by referring to their index number. Indexes start from 0.
    - print(fruits[0]) # Output: 'apple'
    - fruits[1] = 'blueberry' # change value
    - print(len(fruits)) # Output: 3
    - fruits.append('dragonfruit')
    - fruits.remove('blueberry')
    - mixed_list = ['apple', 1, True]
- nested_list = [[1, 2, 3], [4, 5, 6], [7, 8, 9]]
- List Creation
    - squares = [i**2 for i in range(10)]
    - print(squares) # Output: [0, 1, 4, 9, 16, 25, 36, 49, 64, 81]

- num_seq = range(0, 10) # A sequence from 0 to 9
- num_list = list(num_seq)

Operation	Description	Example	Result
Indexing	Access an item of a list at a specific position.	my_list = [1, 2, 3]; my_list[0]	1
Slicing	Access multiple items of a list.	my_list = [1, 2, 3]; my_list[0:2]	[1, 2]
Changing an element	Modify an existing item of a list using its index position.	my_list = [1, 2, 3]; my_list[1] = 20	my_list becomes [1, 20, 3]
append()	Add an item to the end of a list.	my_list = [1, 2, 3]; my_list.append(4)	my_list becomes [1, 2, 3, 4]
extend()	Add all items of a list to another list.	my_list = [1, 2]; my_list.extend([3,4])	my_list becomes [1, 2, 3, 4]
insert()	Insert an item at a specific position in the list.	my_list = [1, 2]; my_list.insert(1, 'a')	my_list becomes [1, 'a', 2]
remove()	Remove the first occurrence of a specific item from the list.	my_list = [1, 'a', 2]; my_list.remove('a')	my_list becomes [1, 2]
pop()	Remove the item at a specific position, or the last item if no index is specified.	my_list = [1, 2, 3]; my_list.pop(1)	my_list becomes [1, 3] and 2 is returned
clear()	Remove all items from the list.	my_list = [1, 2, 3]; my_list.clear()	my_list becomes []
index()	Return the index of the first occurrence of a specified item.	my_list = ['a', 'b', 'c']; my_list.index('b')	1
count()	Return the number of times a specified item appears in the list.	my_list = [1, 1, 2]; my_list.count(1)	2
sort()	Sort the items in the list in ascending order.	my_list = [3, 1, 2]; my_list.sort()	my_list becomes [1, 2, 3]
reverse()	Reverse the order of the items in the list.	my_list = [1, 2, 3]; my_list.reverse()	my_list becomes [3, 2, 1]

Problems

1. Write a Python program to find the largest number in a list.
2. Write a Python program to find the smallest number in a list.
3. Write a Python program to sum all numbers in a list.
4. Write a Python program to multiply all numbers in a list.

5. Write a Python program to count the number of strings in a list where the string length is 2 or more and the first and last characters are the same.
6. Write a Python program that takes two lists and returns True if they have at least one common member.
7. Write a Python program that prints all the numbers from 0 to 6 except 3 and 6.
8. Write a Python program to get the Fibonacci series between 0 to 50.
9. Write a Python program to find the factorial of a number.
10. Write a Python program to check if a number is a prime number.

✅ Multi-dimensional lists in Python

- Multi-dimensional lists are the lists within lists.
- A dictionary will be the better choice rather than a multi-dimensional list in Python.
- Operations with the Multi Dimensional
    - append
    - extend
    - reverse()

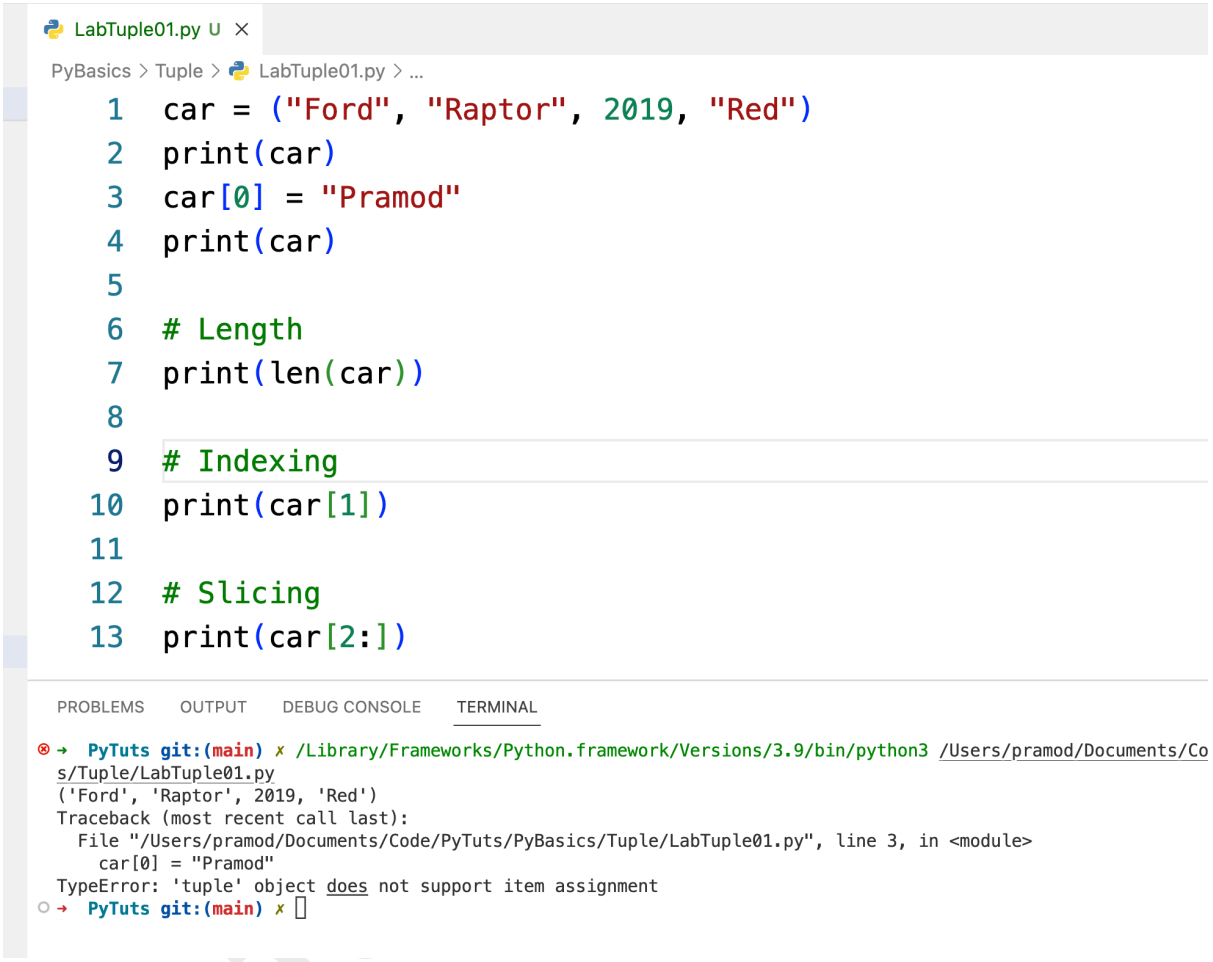
Creating a multidimensional list with all zeros

Practice Question

1. How to check if a list is empty in Python. (if len(lis1) == 0:)
2. Remove duplicates from list.
3. Numbers in a list within a given range.
4. Check if two lists are identical.
5. Check for Sublist in List

✅ Tuple ()

- A tuple is very similar to a list, except for the fact that its contents cannot be changed.
- A tuple is immutable.
- The contents of a tuple are enclosed in parentheses, (). They are also ordered, and hence, follow the linear index notation.



Merging Tuples, Deleting and More Examples.

Here's a bullet-point list of the functions and methods you can use with tuples:

- **Creation of tuple**: Creating a new tuple with parentheses `()`.

- **Accessing Elements**: Accessing tuple elements using an index.

- **len():** Returns the number of elements in the tuple.

- **min()` and `max()`:** Returns the smallest and largest elements in the tuple, respectively.

- index()`: Returns the first index at which a given element appears in the tuple.

- count(): Returns the number of times a specified value occurs in a tuple.

- **Concatenation:** Using the `+` operator to add tuples together.

- **Replication**: Using the `*` operator to repeat the contents of a tuple a given number of times.

- Tuple Unpacking: Extracting the values from a tuple back into variables.

- Membership: Using the `in` keyword to check if an element exists in a tuple.

Tuples VS Lists:

Similarities	Differences
Functions that can be used for both lists and tuples: len(), max(), min(), sum(), any(), all(), sorted()	Methods that cannot be used for tuples: append(), insert(), remove(), pop(), clear(), sort(), reverse()
Methods that can be used for both lists and tuples: count(), Index()	we generally use 'tuples' for heterogeneous (different) data types and 'lists' for homogeneous (similar) data types.
Tuples can be stored in lists.	Iterating through a 'tuple' is faster than in a 'list'.
Lists can be stored in tuples.	'Lists' are mutable whereas 'tuples' are immutable.
Both 'tuples' and 'lists' can be nested.	Tuples that contain immutable elements can be used as a key for a dictionary.

✅ Set ()

a Set is an unordered collection of data types that is iterable, immutable and has no duplicate elements.

- # Creating a Set with a List of Numbers
- # Creating a Set

- # Adding element and tuple to the Set.
- # Access Set
- # Removing elements from Set.
- # Deletion of elements in a Set.
- Frozen sets
    - Python frozen sets are immutable and have methods/operators that don't modify the set.
- Union
- Intersection.
- Diff, SubSet

✅ Dictionary (dict{})

- Key and Value Pair.
- A dictionary stores key-value pairs, where each unique key is an index which holds the value associated with it.
- Dictionaries are unordered because the entries are not stored in a linear structure.

1. Creating a Dictionary.
2. Accessing Values.
3. Adding/Updating Entries.

4. Removing Entries.
5. Length of a Dictionary.
6. Checking Key Existence.
7. Copying Contents

✅ OOPs : Object Oriented Programming

Objects are the main building blocks of OOPS i.e your applications will be divided into multiple objects.

A class with

Data members

Methods -

OOPs concepts apply now.

o Abstraction

o Encapsulation

o Inheritance

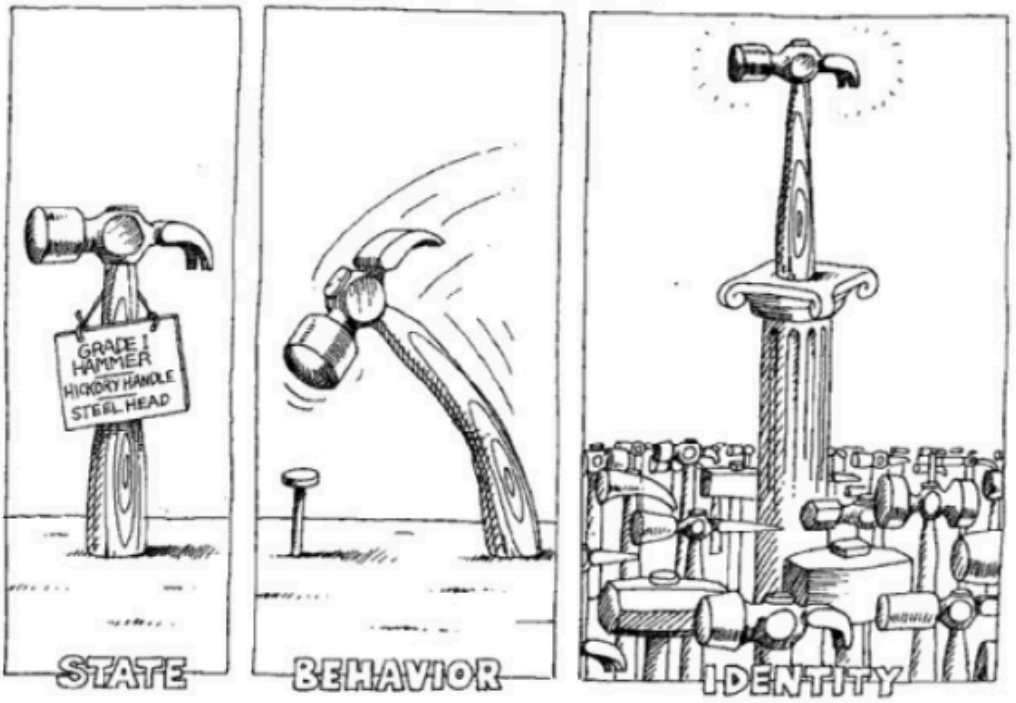
o Polymorphism

Everything in the world is an object.

OOPs vs POP or PPL (Procedural oriented programming)

Object vs Functional.

- **Grady Booch - Father of OOPS defined the object as follows:**



An object has state, exhibits some weii-defined behavior, and has a unique identity.

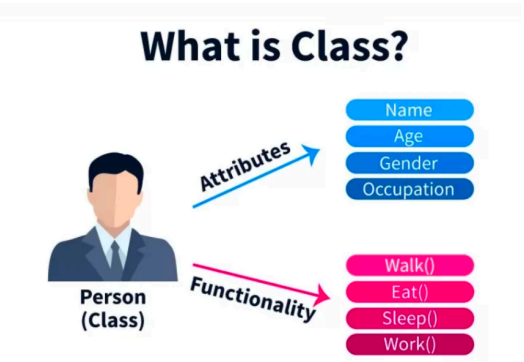
Objects are a collection of data and their behaviors.

A class can be thought of as a blueprint for creating objects.

Procedural Programming Language	Object Oriented Programming Language
1. Program is divided into functions.	1. Program is divide into classes and objects..
2. The emphasis is on doing things.	2. The emphasis on data.
3. Poor modeling to real world problems.	3. Strong modeling to real world problems.
4. It is not easy to maintain project if it is too complex.	4. It is easy to maintain project even if it is too complex.
5. Provides poor data security.	5. Provides strong data Security.
6. It is not extensible programming language.	6. It is highly extensible programming language.
7. Productivity is low.	7. Productivity is high.
8. Do not provide any support for new data types.	8. Provide support to new Data types.
9. Unit of programming is function.	9. Unit of programming is class.
10. Ex. Pascal , C , Basic , Fortran.	10. Ex. C++ , Java , Oracle.

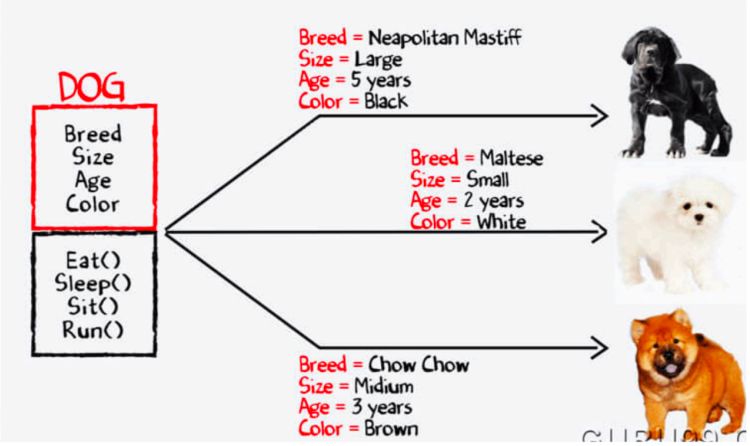
Class

A class is a group of objects which have common properties. A class can have some properties and functions (called methods).
The class we have used is Main.



When a class is created, no memory is allocated

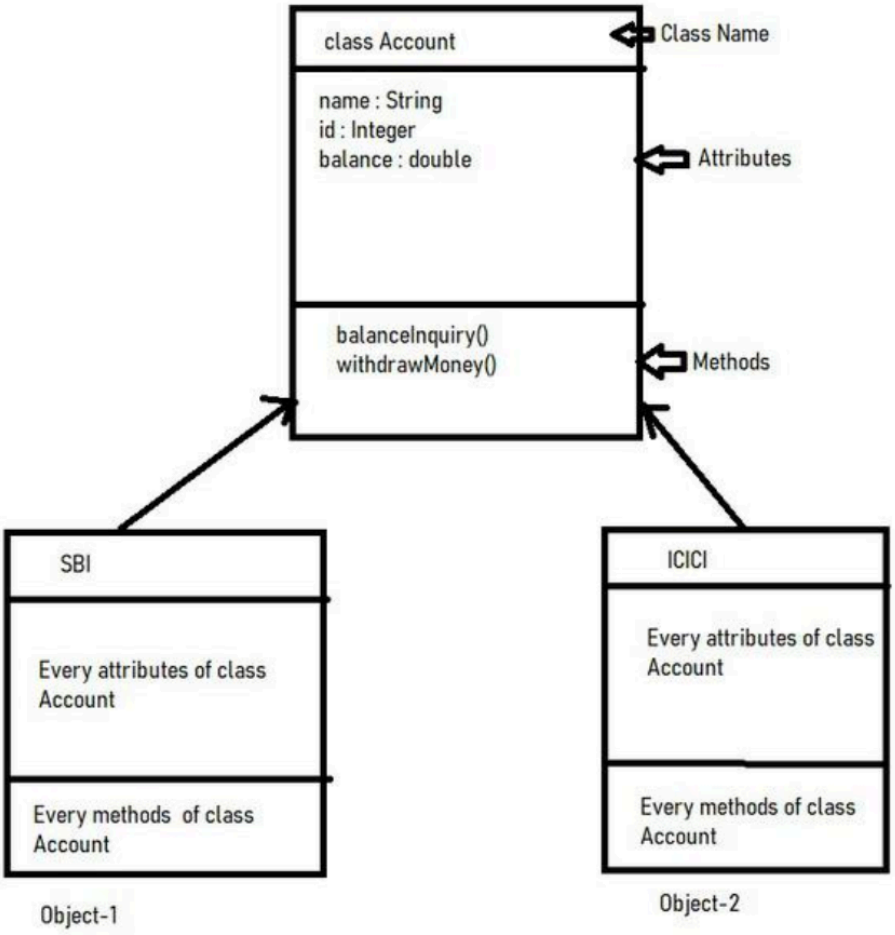
Objects



Object is an instance of a class. All data members and member functions of the class can be accessed with the help of objects

Objects are allocated memory space whenever they are created.

Class & Objects



How to Use Oops to Build Any Modern-Day Software

Consider this scenario: We are developing an Automation Tester Batch System.

1. Identify the objects
    a. Like Student, Course, Payment.
2. Describe those with details
    a. Data - Student -> name, id, age, address, email, course taken
    b. Operations -> addStudent, deleteStudent
    c. Bind them with Encapsulation (Class)
3. Establish the relationship with each other
    a. Student -> payment, Student -> Course, Course -> Payment
4. Now implement it via Class and Objects.

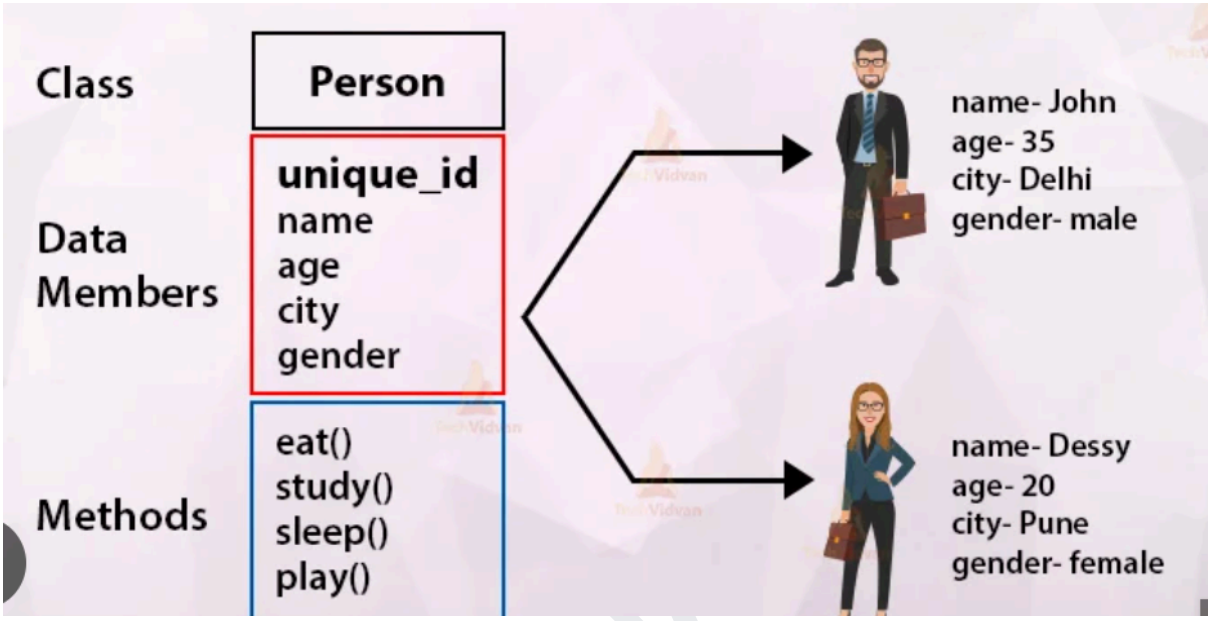
Class and Objects

a class is a blueprint or template that defines the attributes (variables) and behaviors (methods) that objects of that class will have.

An object is an instance of a class, created using the class as a template.

Objects have their own unique state and can access the attributes and behaviors defined in the class.

Classes provide a way to organize and structure code, enabling code reusability and modular design.




```
class Car:
    def __init__(self, brand, color):
        self.brand = brand
        self.color = color

    def start_engine(self):
        print("Engine started!")

    def drive(self):
        print(f"Driving the {self.color}
{self.brand} car.")

my_car = Car("Toyota", "blue")
my_car.start_engine()
```

```
my_car.drive()
```

Constructor

- a constructor is a special method that is automatically called when an object is created from a class.
- It is used to initialize the object's attributes or perform any necessary setup tasks.
- The constructor method in Python is called __init__().

```
class Person:
    def __init__(self, name, age):
        self.name = name
        self.age = age
def display(self):
        print(f"Name: {self.name}, Age:
{self.age}")

# Creating objects and invoking the constructor
person1 = Person("Alice", 25)
person2 = Person("Bob", 30)

# Accessing object attributes
print(person1.name)  # Output: Alice
print(person2.age)   # Output: 30

# Invoking object method
```

```
person1.display()  # Output: Name: Alice, Age: 25
person2.display()  # Output: Name: Bob, Age: 30
```

Encapsulation

- Refers to the bundling of data and methods that operate on that data within a single unit, or object.
- Encapsulation helps to promote the principle of "data hiding".
- This is achieved by declaring the object's data fields as private and providing public getter and setter methods to access and modify the data.

```
class BankAccount:
    def __init__(self):
        self.balance = 0  # Public attribute

    def deposit(self, amount):
        self.balance += amount

    def _withdraw(self, amount):
        self.balance -= amount  # Protected attribute

    def __show_balance(self):
        print(f"Account balance: {self.balance}")  #
Private attribute

account = BankAccount()
account.deposit(1000)
account._withdraw(500)  # Protected attribute accessed
```

```
account.__show_balance()  # Error: private attribute not accessible
```

Polymorphism

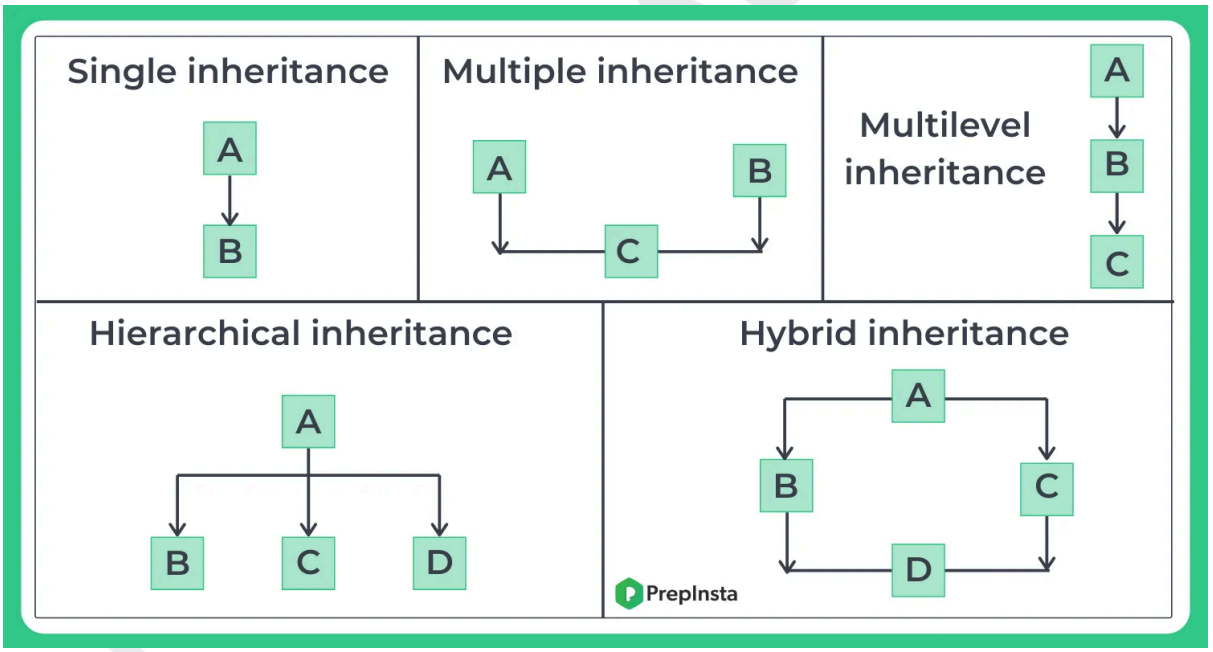
Polymorphism allows objects of different classes to be treated as objects of a common superclass.

It enables flexibility and dynamic behavior based on the actual object type. Here's an example:

```
class Shape:
    def area(self):
        pass

class Rectangle(Shape):
    def __init__(self, length, width):
        self.length = length
        self.width = width

    def area(self):
        return self.length * self.width

class Circle(Shape):
```

```
    def __init__(self, radius):
        self.radius = radius

    def area(self):
        return 3.14 * self.radius * self.radius

shapes = [Rectangle(4, 5), Circle(3)]
for shape in shapes:
    print(shape.area())
```

Inheritance



In Python, the different types of inheritance include:

1. **Single Inheritance**: A class inherits from a single base class.

2. **Multiple Inheritance**: A class inherits from multiple base classes.

3. **Multilevel Inheritance**: A class inherits from a derived class, forming a hierarchy of inheritance.

4. **Hierarchical Inheritance**: Multiple derived classes inherit from a single base class.

5. **Hybrid Inheritance**: A combination of multiple inheritance and multilevel inheritance.

6. **Abstract Base Classes (ABCs)**: Classes that define abstract methods and serve as a blueprint for derived classes.

7. **Method Resolution Order (MRO)**: The order in which base classes are searched for a particular attribute or method.

Single Inheritance:

Single inheritance involves a class inheriting from a single base class.

```
class Animal:
    def speak(self):
        print("Animal speaks!")

class Dog(Animal):
    def bark(self):
        print("Woof!")

my_dog = Dog()
```

```
my_dog.speak()  # Inherited from Animal
my_dog.bark()  # Specific to Dog
```

Multiple Inheritance:

Multiple inheritance allows a class to inherit from multiple base classes.

```
class A:
    def method_a(self):
        print("Method A")

class B:
    def method_b(self):
        print("Method B")

class C(A, B):
    def method_c(self):
        print("Method C")

my_object = C()
```

```
my_object.method_a()  # Inherited from A
my_object.method_b()  # Inherited from B
my_object.method_c()  # Specific to C
```

MRO - Handle Case -

```
class A:
    def greet(self):
        print("Hello from class A")

class B:
    def greet(self):
        print("Hello from class B")

class C(A, B):
    pass

class D(B, A):
    pass

obj1 = C()
obj1.greet()

obj2 = D()
obj2.greet()

print(C.mro())
print(D.mro())
```

Multilevel Inheritance

Multilevel inheritance involves a class inheriting from a derived class.

```
class Vehicle:
    def start_engine(self):
        print("Engine started!")

class Car(Vehicle):
    def drive(self):
        print("Driving the car!")

class SportsCar(Car):
    def race(self):
        print("Racing the sports car!")

my_car = SportsCar()
my_car.start_engine()  # Inherited from Vehicle
my_car.drive()         # Inherited from Car
my_car.race()          # Specific to SportsCar
```

Hierarchical Inheritance

Hierarchical inheritance involves multiple derived classes inheriting from a single base class.

```
class Animal:
    def speak(self):
        print("Animal speaks!")

class Dog(Animal):
    def bark(self):
        print("Woof!")

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

my_dog = Dog()
my_dog.speak()  # Inherited from Animal
my_dog.bark()  # Specific to Dog

my_cat = Cat()
my_cat.speak()  # Inherited from Animal
my_cat.meow()  # Specific to Cat
```

Abstraction

Abstraction is a fundamental concept in object-oriented programming (OOP) that allows us to represent complex systems by simplifying and hiding unnecessary details

Abstract Base Class (ABC):

- An abstract base class is a class that cannot be instantiated and is meant to be subclassed.
- It serves as a blueprint for derived classes and defines a common interface or set of methods that derived classes must implement.
- In Python, ABCs are created using the ABC metaclass from the abc module.

Abstract Method

An abstract method is a method declared within an abstract base class that does not have an implementation.

It serves as a placeholder for the derived classes to provide their own implementation.

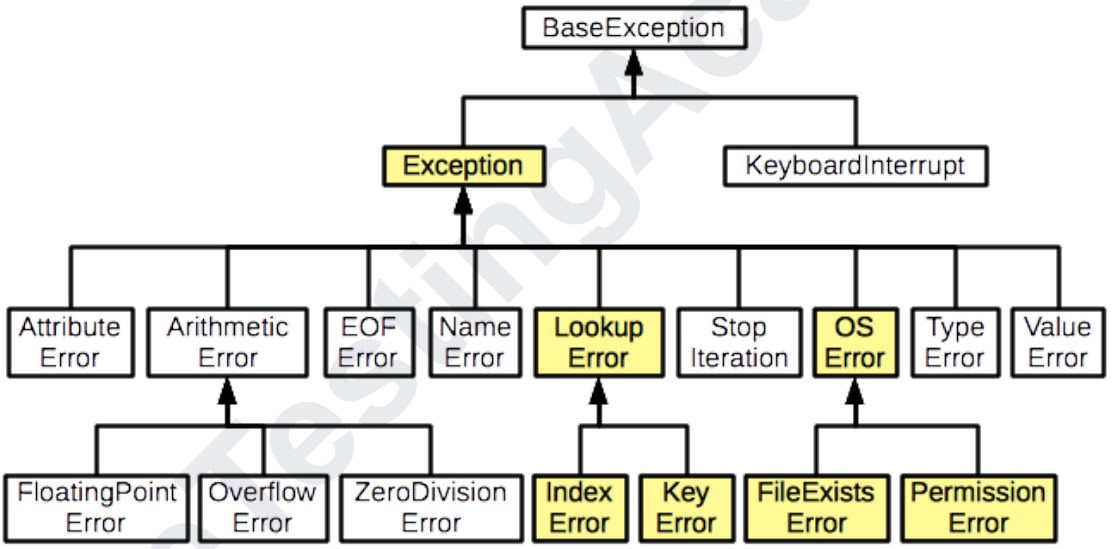
Abstract methods are defined using the @abstractmethod decorator.

```
from abc import ABC, abstractmethod
```

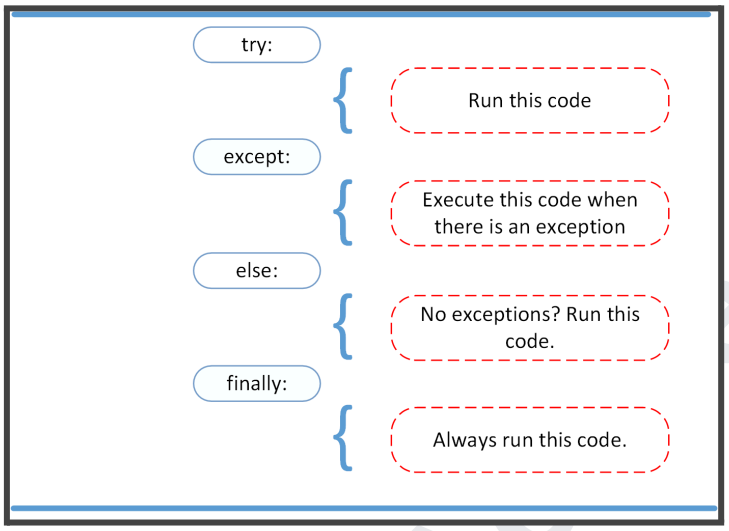
```
class Shape(ABC):
    @abstractmethod
    def area(self):
        pass

    @abstractmethod
    def perimeter(self):
        pass

class Rectangle(Shape):
    def __init__(self, length, width):
        self.length = length
        self.width = width

    def area(self):
        return self.length * self.width

    def perimeter(self):
        return 2 * (self.length + self.width)

class Circle(Shape):
    def __init__(self, radius):
        self.radius = radius

    def area(self):
        return 3.14 * self.radius * self.radius
```

```
    def perimeter(self):
        return 2 * 3.14 * self.radius

rect = Rectangle(4, 5)
print(rect.area())      # Output: 20
print(rect.perimeter()) # Output: 18

circle = Circle(3)
print(circle.area())      # Output: 28.26
print(circle.perimeter()) # Output: 18.84
```

📕 Exceptions



An exception is an event that occurs during the execution of a program that disrupts the normal flow of instructions.

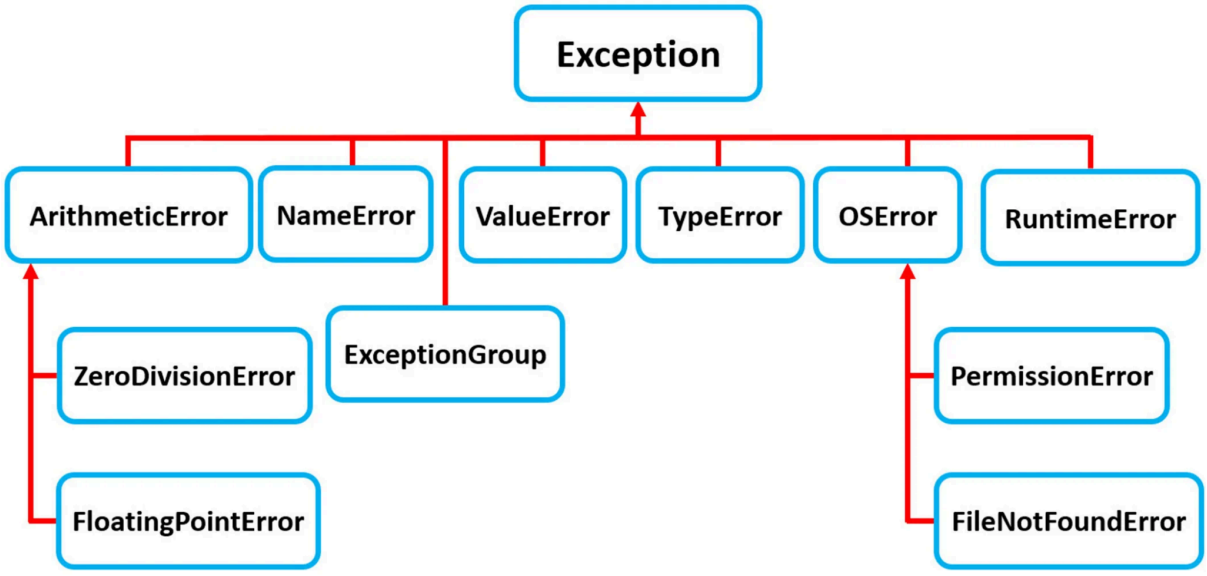



```
# Example 1: Division by zero exception
try:
    result = 10 / 0  # Attempting to divide by zero
except ZeroDivisionError as error:
    print("Error:", error)
```

there are several built-in exception classes available to handle different types of errors or exceptional situations that may occur during program execution.

- **Exception:** The base class for all built-in exceptions.
- **SyntaxError:** Raised when there is a syntax error in the code.
- **IndentationError:** Raised when there is an indentation-related error, such as incorrect or inconsistent indentation.

- **NameError:** Raised when a local or global name is not found.
- **TypeError:** Raised when an operation or function is performed on an object of an inappropriate type.
- **ValueError:** Raised when a function receives an argument of the correct type but an invalid value.
- **ZeroDivisionError:** Raised when division or modulo by zero is encountered.
- **IndexError:** Raised when a sequence subscript is out of range.
- **KeyError:** Raised when a dictionary key is not found.
- **FileNotFoundError:** Raised when a file or directory is requested but cannot be found.
- **IOError:** Raised when an input/output operation fails.
- **ImportError:** Raised when an import statement fails to find and load a module.
- **AttributeError:** Raised when an attribute reference or assignment fails.
- **RuntimeError:** Raised when an error occurs that doesn't belong to any specific category.



StopIteration: Raised by iterator objects to signal the end of iteration.

KeyboardInterrupt: Raised when the user interrupts the execution of the program by pressing Ctrl+C.


```
try:
    # Code that may raise an exception
    # ...
except ExceptionType1:
    # Handler for ExceptionType1
    # ...
except ExceptionType2:
    # Handler for ExceptionType2
    # ...
else:
    # Executed if no exceptions are raised
    # ...
finally:
    # Always executed, whether an exception occurs or not
    # ...
```

✅ OS Module

Here is a comprehensive list of commonly used functions in the Python `os` module, along with examples for each:

1. `os.name` : Returns the name of the operating system dependent module imported.

```
import os
print(os.name)  # Output: 'posix', 'nt', etc.
```

2. `os.getcwd()` : Returns the current working directory.

```
import os

print(os.getcwd())  # Output: Current working directory path
```

3. `os.chdir(path)` : Changes the current working directory to the specified path.

```
import os
```

```
os.chdir('/path/to/directory')
```

4. `os.mkdir(path)` : Creates a new directory at the specified path.

```
import os

os.mkdir('new_directory')
```

5. `os.makedirs(path)` : Creates a directory and all intermediate-level directories needed.

```
import os

os.makedirs('parent/child/grandchild')
```

6. `os.listdir(path)` : Returns a list of the entries in the specified directory.

```
import os

print(os.listdir('.'))  # Output: List of files and directories
```

7. `os.remove(path)` : Deletes the file at the specified path.

```
import os

os.remove('file.txt')
```

8. `os.rmdir(path)` : Removes (deletes) the directory at the specified path.

```
import os

os.rmdir('directory_name')
```

9. `os.rename(src, dst)` : Renames the file or directory from `src` to `dst`.

```
import os

os.rename('old_name.txt', 'new_name.txt')
```

10. `os.path.join(path, *paths)` : Joins one or more path components intelligently.

```
import os

full_path = os.path.join('folder', 'file.txt')
```

11. `os.execvp(file, args)` : Executes a program, replacing the current process.

```
import os

os.execvp('python', ['python', 'script.py'])
```

12. `os.environ` : A mapping representing the string environment.

```
import os

print(os.environ['HOME'])  # Output: Home directory path
```

13. `os.system(command)` : Executes the command in a subshell.

```
import os

os.system('echo Hello World')
```

14. `os.getuid()` : Returns the current process's user ID.

```
import os

print(os.getuid())
```

15. `os.path.exists(path)` : Returns `True` if the path exists, `False` otherwise.

```
import os

print(os.path.exists('file.txt'))
```

16. `os.path.isfile(path)` : Returns `True` if the path is an existing regular file.

```
import os

print(os.path.isfile('file.txt'))
```

17. `os.path.isdir(path)` : Returns `True` if the path is an existing directory.

```
import os

print(os.path.isdir('directory_name'))
```

⚓ Modules in Python

- A module is a file that contains Python code, usually with a specific functionality or set of related functionalities.

- Modules allow you to organize your code into reusable units, making it easier to maintain, share, and reuse code across different projects.
- You can import modules into your Python scripts or interactive sessions to access the functions, classes, and variables defined in them.
- Built In Modules
- Importing Specific Items from a Module

```python
import math

x = 16
sqrt_x = math.sqrt(x)
print(sqrt_x)  # Output: 4.0
```

```
from math import pi, sin

angle = pi / 2
sin_angle = sin(angle)
print(sin_angle)  # Output: 1.0
```

- Custom Modules - my_module.py

python

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

class Person:
    def __init__(self, name):
        self.name = name

    def introduce(self):
        print(f"My name is {self.name}.")
```

```python
import my_module

my_module.greet("Alice")  # Output: Hello, Alice!

person = my_module.Person("Bob")
person.introduce()  # Output: My name is Bob.
```

- Aliasing Modules

```
import numpy as np

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

- Module Packages

  A package is simply a directory containing Python module files and a special __init__.py file.

  The __init__.py file can be empty or can contain initialization code for the package. Packages allow for logical grouping and prevent naming conflicts between modules.

  By including an __init__.py file in a package, you ensure that any necessary initialization code is executed when the package is imported

  It Contains

```
VERSION = '1.0.0'
AUTHOR = 'John Doe'
```

```markdown
my_package/
    __init__.py
    module1.py
    module2.py
```

To import modules from a package, you can use the dot notation:

```python
import my_package.module1
from my_package.module2 import some_function

my_package.module1.function1()
some_function()
```

Using Third-Party Modules

```
import requests
```

```
response =
requests.get('https://www.sdet.live/become')
print(response.status_code)  # Output: 200
```

Namespace packages

Namespace packages are useful when a package must be distributed to different places or when multiple teams work on different parts of the package.

```
my_package_part1/
    my_module1.py
    my_module2.py
```

```
my_package_part2/
    my_module3.py
    my_module4.py
```

```
from my_package_part1 import my_module1
from my_package_part2 import my_module3

my_module1.function1()
my_module3.function2()
```

☎️ Collections in Python

Focus on Main Business Logic rather than Low Level Logics

- Counters
- OrderedDict

Counter: A Counter is a dictionary subclass for counting hashable objects. It is an unordered collection where elements are stored as dictionary keys and their counts are stored as dictionary values.

```
from collections import Counter
cnt = Counter()
for word in ['red', 'blue', 'red', 'green', 'blue',
'blue']:
    cnt[word] += 1
print(cnt)  # Output: Counter({'blue': 3, 'red': 2,
'green': 1})
```

OrderedDict: An OrderedDict is a dictionary subclass that remembers the order that keys were first inserted. The only difference between dict and OrderedDict is that:

```
from collections import OrderedDict
d = OrderedDict()
d['a'] = 'A'
d['b'] = 'B'
d['c'] = 'C'
for key, value in d.items():
    print(key, value)
# Output:
# a A
# b B
# c C
```

Regex