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Introduction to Python Programming

Course on Data Structure and Algorithms Using Python

Ankush Saklecha • Lesson 1 • Dec 8, 2023

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Data Structure using Python

By Ankush Saklecha

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Algorithm Procedure

- A **data structure** is a particular way of storing and organizing data so that it can be used effectively.

- A well defined procedure to solve a specific problem is called **Algorithm.**

- **Data Structure + Algorithm = Programming**

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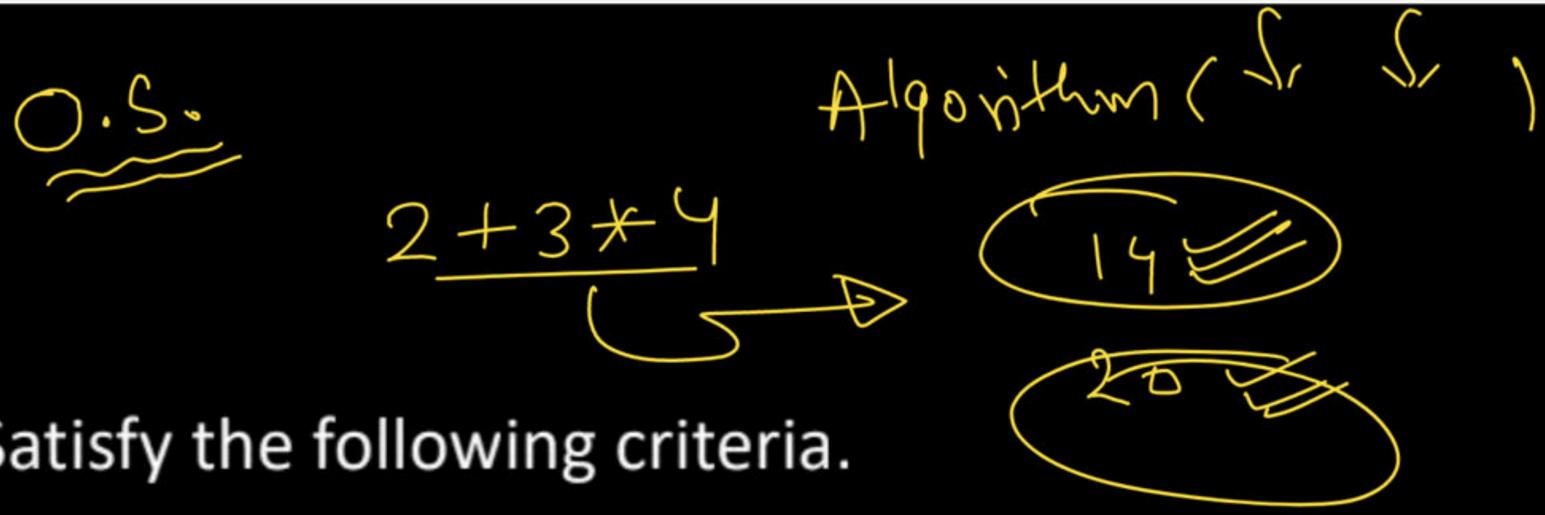
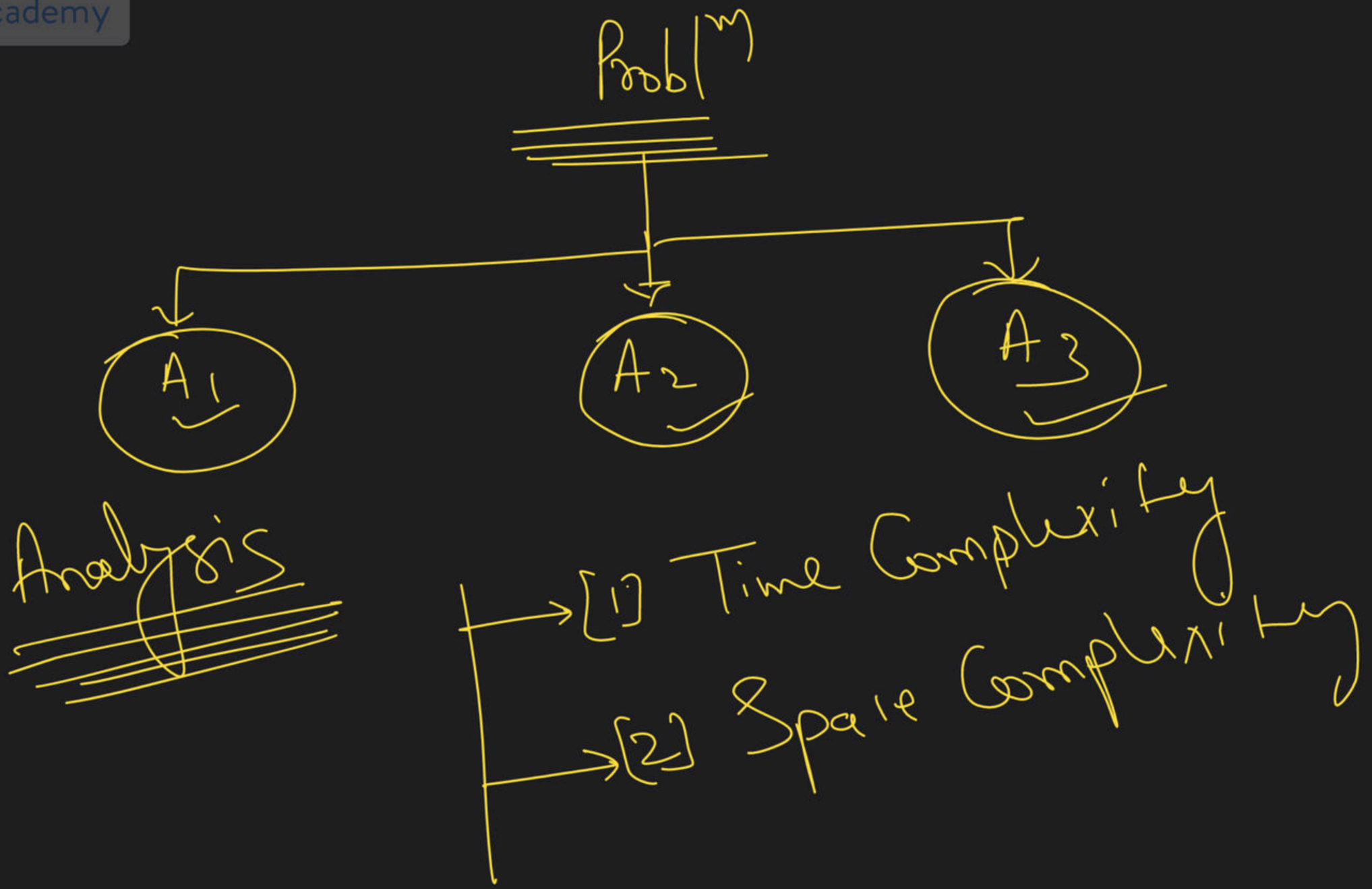
Algorithm



An Algorithm Should Satisfy the following criteria.

- **Input :** Zero or more quantities are externally supplied.
- **Output :** An algorithm should produce at-least one output.
- **Finiteness:** An algorithm should terminate after finite number of steps.
- **Definiteness:** Algorithm should be clear and unambiguous.
- **Effectiveness:** Algorithm must be language independent and easy to implement in any programming language.


Problem
A1
A2
A3
Analysis
[1] Time Complexity
[2] Space Complexity

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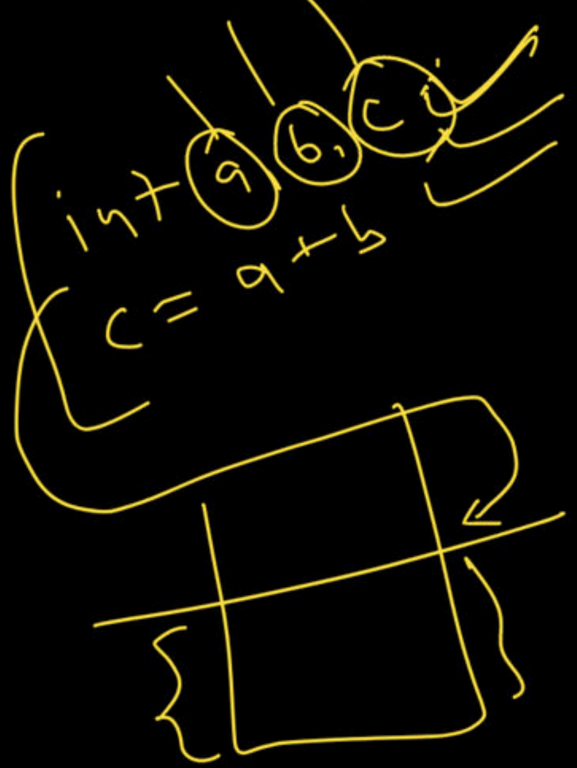
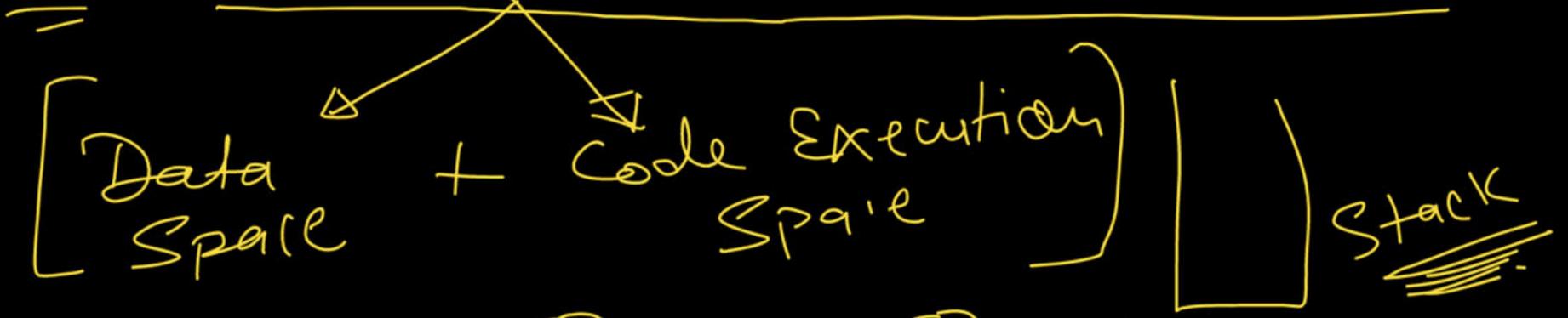
Behavior of algorithm

- Behavior of an algorithm is analyze on the basis of Time and Space.
  - Time complexity : An amount of time required to run an algorithm.
  - Space complexity : An amount of space required to execute the Algorithm.





	A1	A2
Time complexity ⇒		
Space complexity		

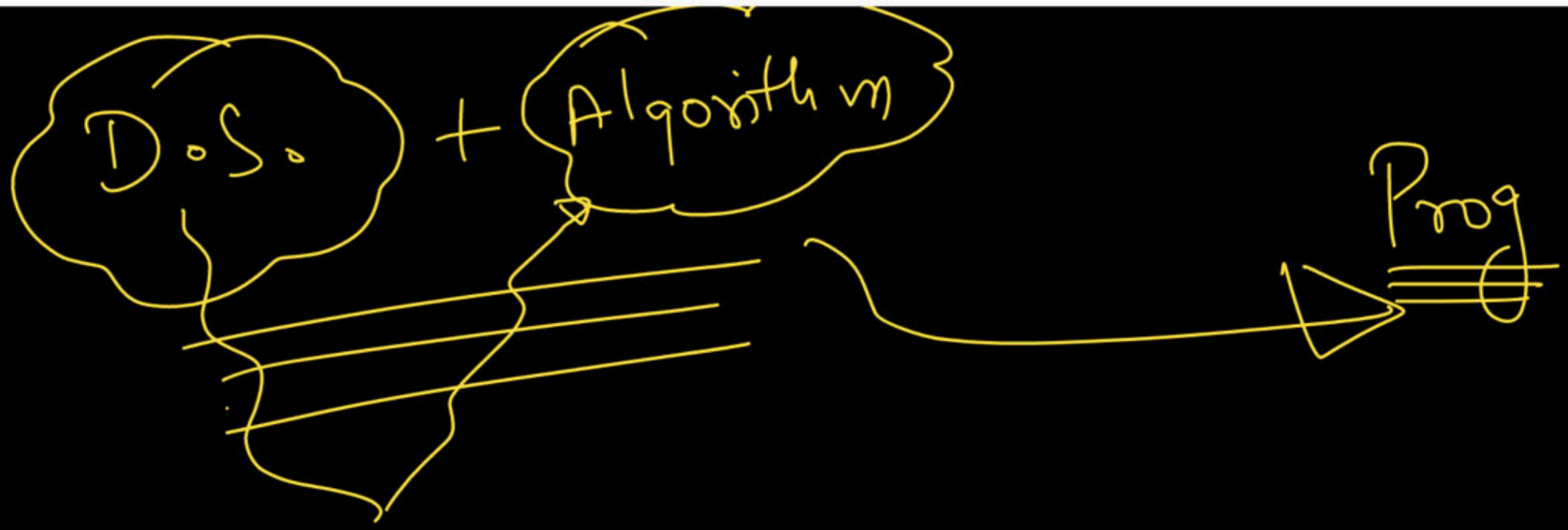
Best

Best

Which algorithm is best A1 or A2?

Time complexity	A1	A2
Best case		
Worst case		
Average Case		

Lower bound <= Running time <= upper bound



Python Programming Language

About Python

- Python is created in 1991 by Guido van Rossum.
- It is high level and interpreted language.
- It is an object oriented programming.

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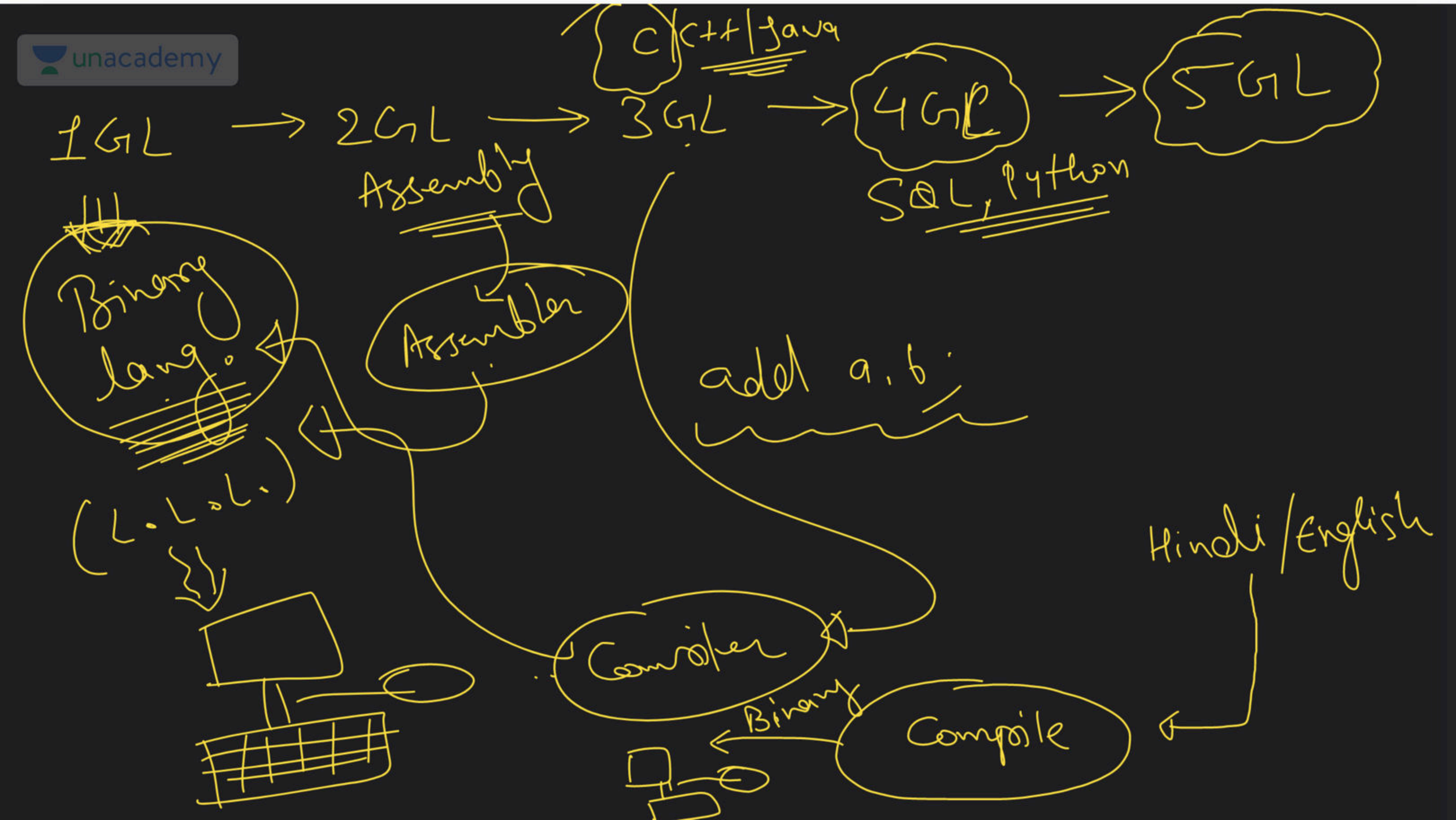
Why Python?

- Python allows solving of mathematical and scientific problems.
- It has feature to deal with high volume and diverse data sets.
- It support development of artificial intelligence based software.
- It also offers implementation of neural network, deep and machine learning algorithms.
- It support development of Internet of Things (IoT) based applications.
- It offers web development.

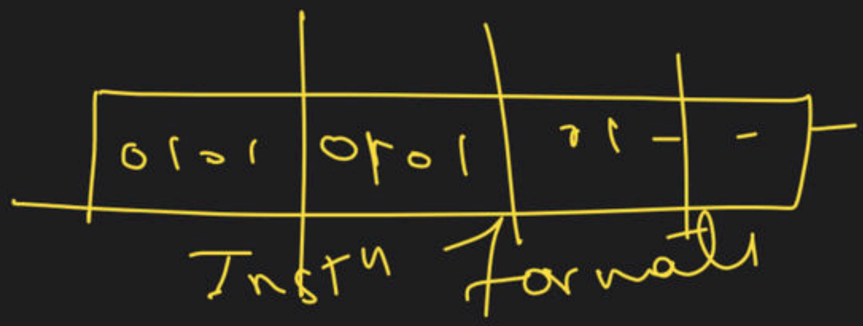

1GL
2GL
Assembly
3GL
C/C++/Java
4GL
SQL, Python
5GL
Binary lang.
(1.1.1.1)
Assembler
add a, b
Compiler
Binary
Compile
Hindi/English

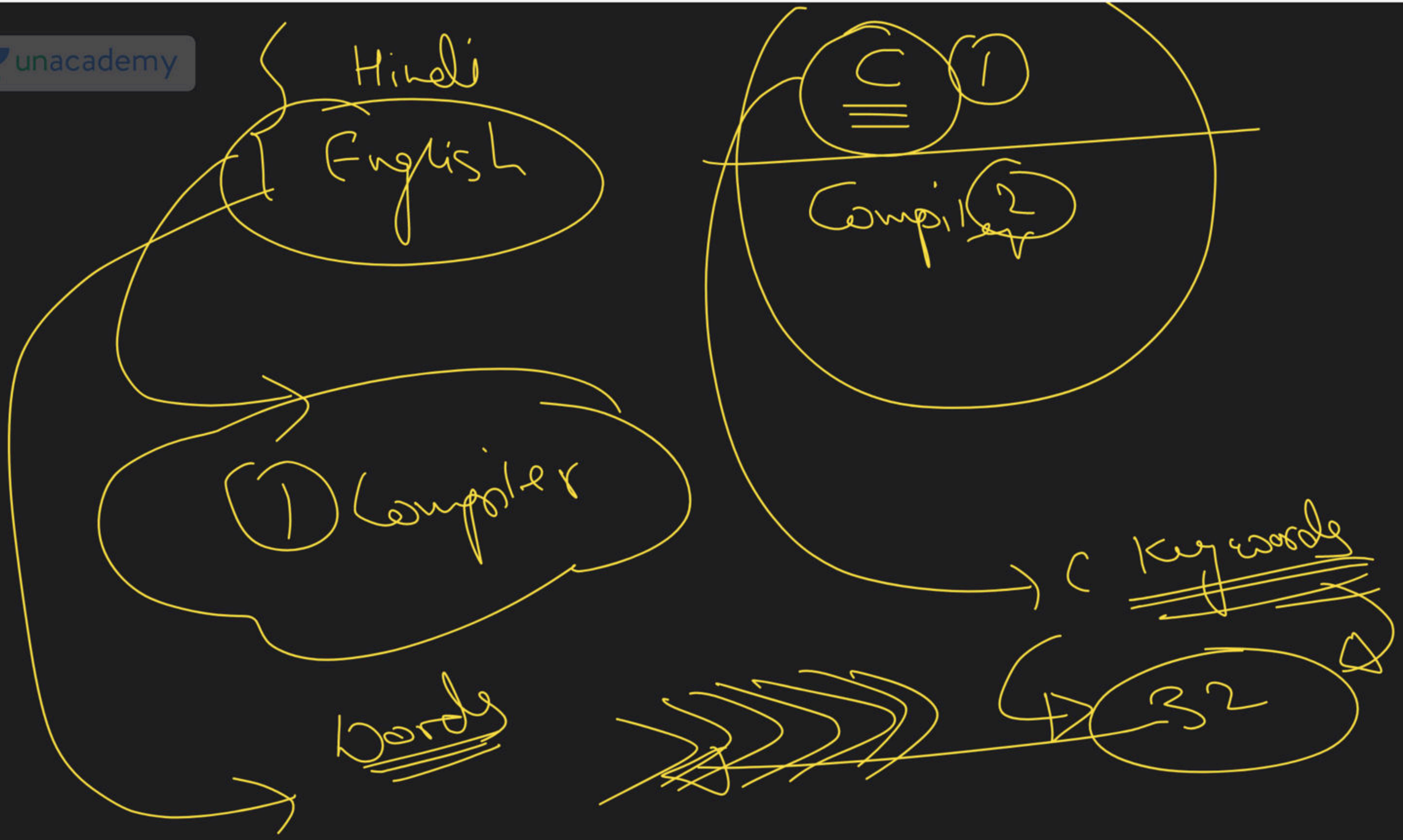
C

C

B.

byte code





Python Vs Other Programming

- Python is dynamically typed language.
- It is free and open source language.
- Python has collections of list, set, tuple and dictionary.
- Python does not support increment and decrement operator.

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Python Programming Language

- Python is a high-level, general-purpose and a very popular programming language.
- Python programming language (latest Python 3) is being used in web development, Machine Learning applications, along with all cutting edge technology in Software Industry.
- Python Programming Language is very well suited for Beginners, also for experienced programmers with other programming languages like C++ and Java.

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Facts of Python Programming

- Python is currently the most widely used multi-purpose, high-level programming language.
- Python allows programming in Object-Oriented and Procedural paradigms.
- Python programs generally are smaller than other programming languages like Java. Programmers have to type relatively less and indentation requirement of the language, makes them readable all the time.
- It is case sensitive.

main ( )

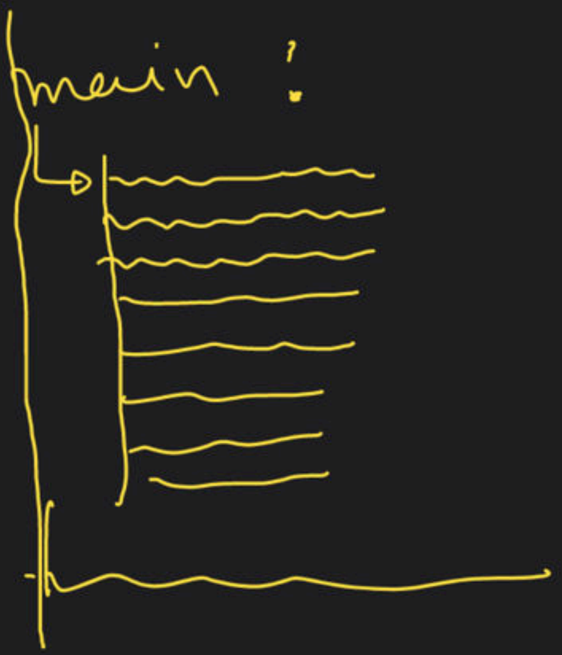
{

;

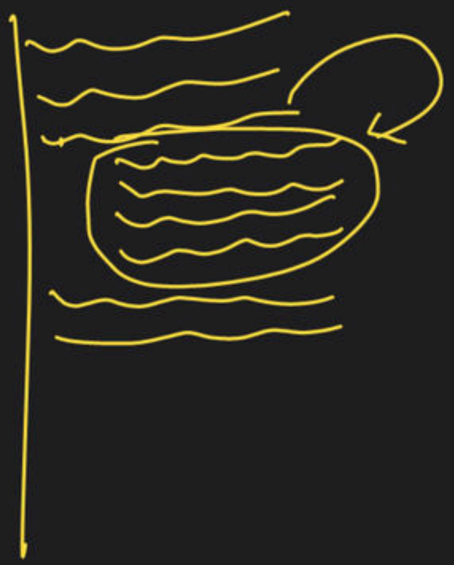
;

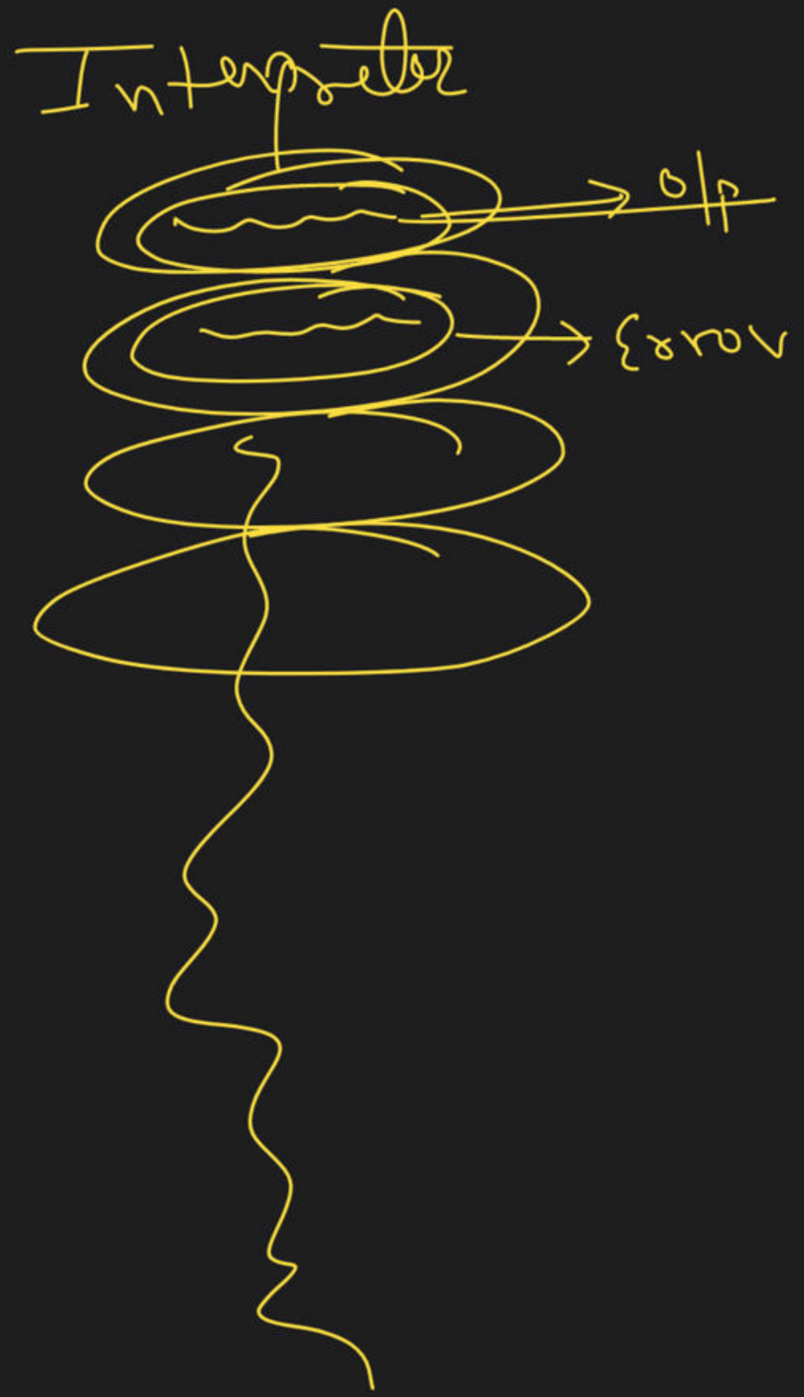
;

}



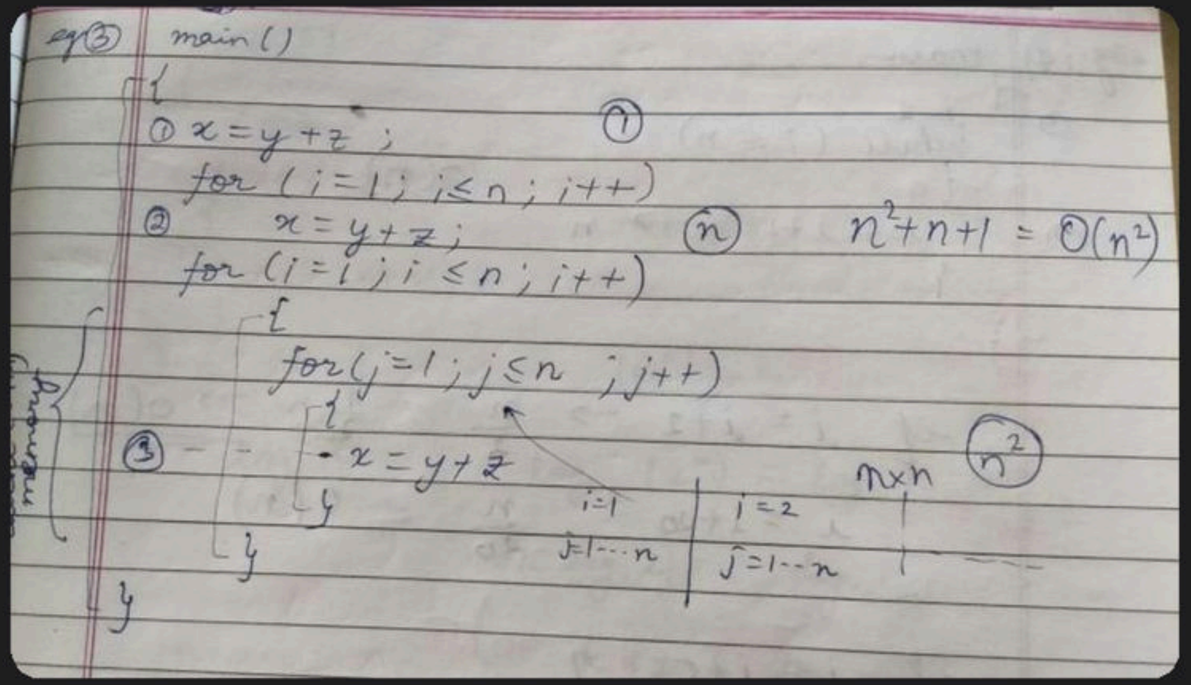
main :





▲ 1 • Asked by Siddharth

Sir can you plz share demo of conversion of this C program into Python



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Facts of Python Programming

- Python language is being used by almost all tech-giant companies like – Google, Amazon, Facebook, Instagram, Dropbox, Uber… etc.
- The biggest strength of Python is huge collection of standard library which can be used for the following:
  - Machine Learning
  - GUI Applications (like Kivy, Tkinter, PyQt etc.)
  - Web frameworks like Django (used by YouTube, Instagram, Dropbox)
  - Image processing (like OpenCV, Pillow)
  - Web scraping (like Scrapy, BeautifulSoup, Selenium)
  - Test frameworks
  - Multimedia
  - Scientific computing
  - Text processing and many more..

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Importance of Python

- Python works on different platforms (Windows, Mac, Linux, Raspberry Pi, etc).
- Python has a simple syntax similar to the English language.
- Python has syntax that allows developers to write programs with fewer lines than some other programming languages.
- Python runs on an interpreter system, meaning that code can be executed as soon as it is written. This means that prototyping can be very quick.
- Python can be treated in a procedural way, an object-oriented way or a functional way.

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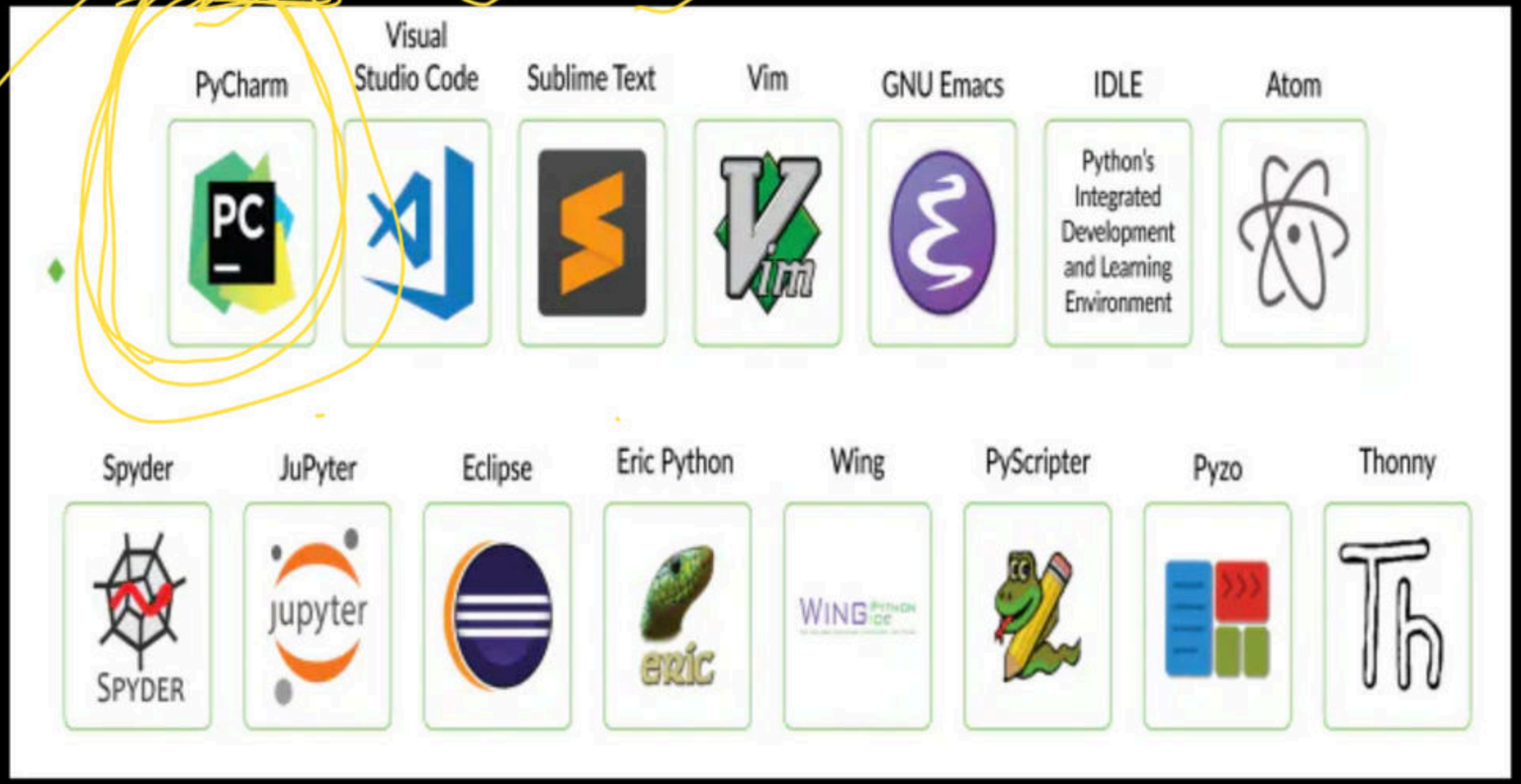
Importance of Python

- Python was designed for readability, and has some similarities to the English language with influence from mathematics.
- Python uses new lines to complete a command, as opposed to other programming languages which often use semicolons or parentheses.
- Python relies on indentation, using whitespace, to define scope; such as the scope of loops, functions and classes. Other programming languages often use curly-brackets for this purpose.

Python IDEs

- Offline IDEs



- Online IDEs

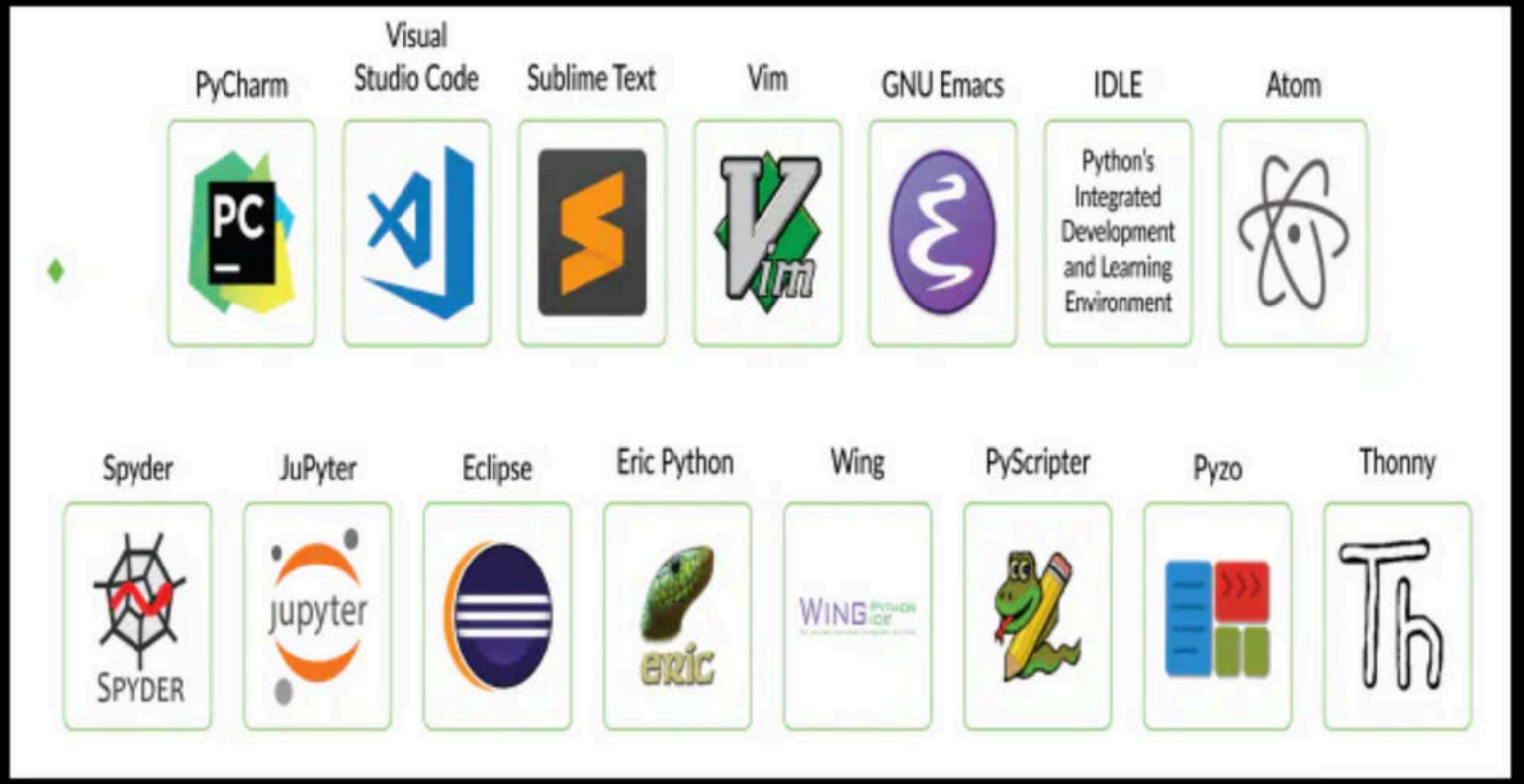
Google colab

replit

programiz

Python IDEs

- Offline IDEs



- Online IDEs

Google colab

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Program Structure

Python Program Structure
Comment Section(Optional)
Functions Definition Section (Optional)
General Statement Section

Python Program Example
First Python Program print('Welcome to Python')

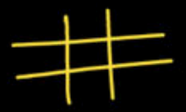
print('Welcome to Python')

C Program Structure
Comment Section(Optional)
Function Declaration Section (Optional)
Preprocessor Section (Optional)
Main Function Section (Mandatory)
Functions Definition Section (Optional)

C Program Example
// First C Program #include<stdio.h> void main(){ printf("Welcome to C"); }

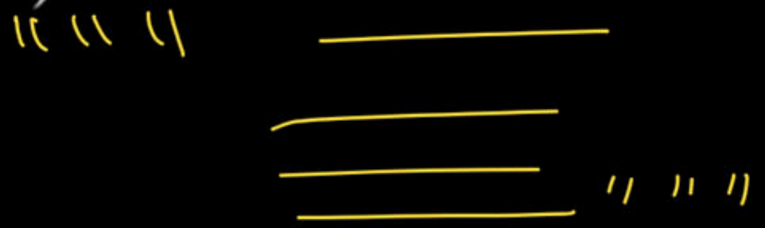
Python Comment

A comment is useful for programmer which help to understand and debug the code.



- Single line Comment- It is start with # (hash)

  Example- # Python Program



- Multiline Comment- It start and end with three double quotes “””.

  Example- “””Python is high language……

  Python is script language……”””

Python Variable and Constant

- A variable is a memory location where any type of data is stored. Address may be change.
- Variable may be declared using a combination of numbers, letters, and the underscore character.
- An example:

#define Pi = 3.14

```
pi=3.14
name='Jhon'
```

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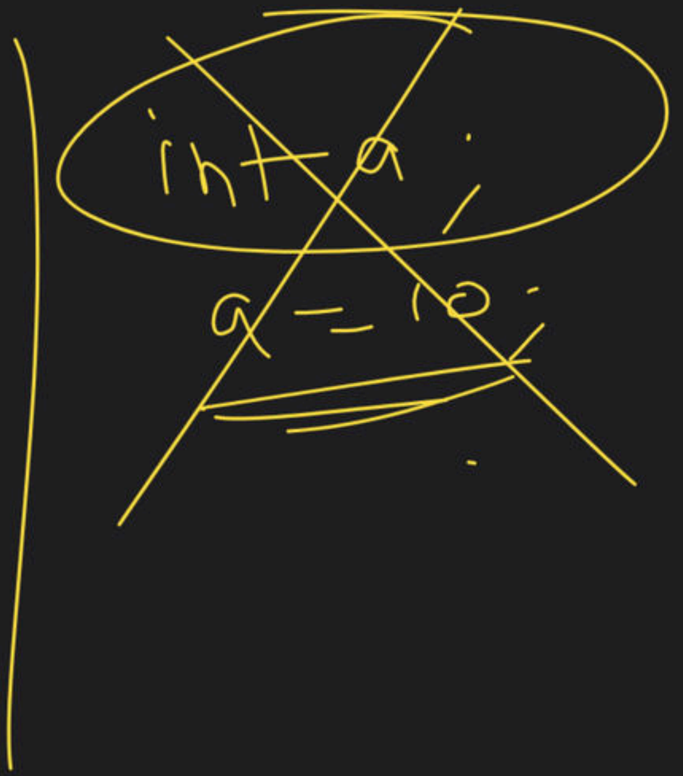
a = 10

b = 10.5

c = "Hello"



Python Variable

An example of C variable:

int a=10;

a= 20;

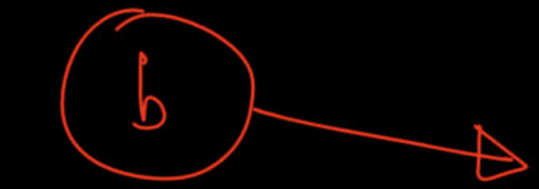
a	
Value	20
Location Address	0x4e5

a = 10
↳ address of a
a = 20
↳ address of a

An example of Python variable:

a=10

a=20

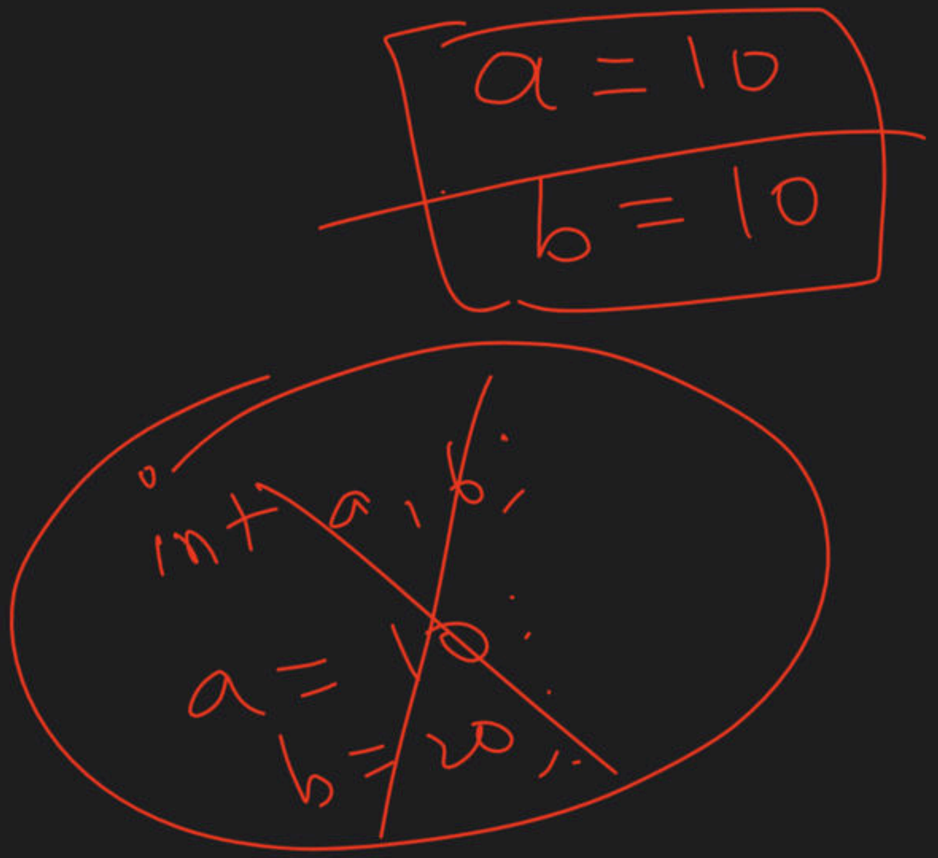


Python Name
a

Pyobject	
Type	Integer
value	10
Address	139653862310416
Refcount	0

Pyobject	
Type	Integer
value	20
Address	139653862324578
Refcount	0


a = 10
b = 10
Py Object



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Python Variables, Data Types, Input Method

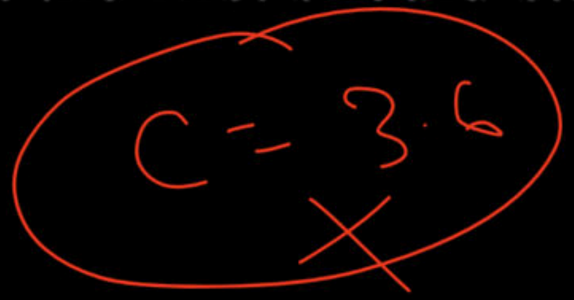
Rules for Variable

- The name of a variable cannot start with a number. It should start with either an alphabet or the underscore character.
- Variable names are always case sensitive and can contain alphanumeric characters and the underscore character.
- Reserved words cannot be used as variable names.
- Python Variables are always assigned using the equal to sign followed by the value of the variable.

Case for Variable Name

- Camel Case- In camel case each word except the first should start with a capital letter.

  Example- circleRaduis=3.6

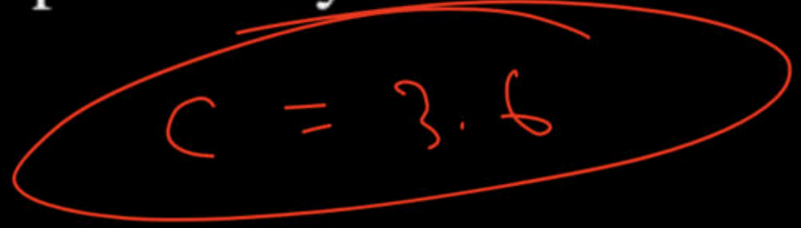


- Pascal Case- In this case each word should start with a capital letter.

  Example- CircleRaduis=3.6

- Snake Case- In this case each word should separated by underscore.

  Example- circle_raduis=3.6



Python Variables

- In Python, variables are created when you assign a value to it:

- Variables in Python:
  - x = 10
  - y = "Hello, Dear“

- Python has no command for declaring a variable.

Python Variables

- In Python, variables are created when you assign a value to it:
- Variables in Python:
  - x = 10
  - y = "Hello, Dear“
- Python has no command for declaring a variable.
- Variables are containers for storing data values.
- Variable names are case-sensitive.

Let's Try…

Guess Valid/Invalid Variable Name	
1. PI=3.14	Valid
2. _radius=5.5	Valid
3. Student_Name='KUSH'	Valid
4. @Marks=85	Invalid
5. X%=6	Invalid
6. a/b=8	Invalid
7. a/=6	Invalid

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Example

```
x = 10          # x is now of type int
y = "Kush"  # y is now of type str
print(x)
print(y)
```

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x = 3

- If you want to specify the data type of a variable, this can be done with casting.

```
x = str(3)    # x will be '3'
y = int(3)    # y will be 3
z = float(3)  # z will be 3.0
```

x = str(3)

'3'

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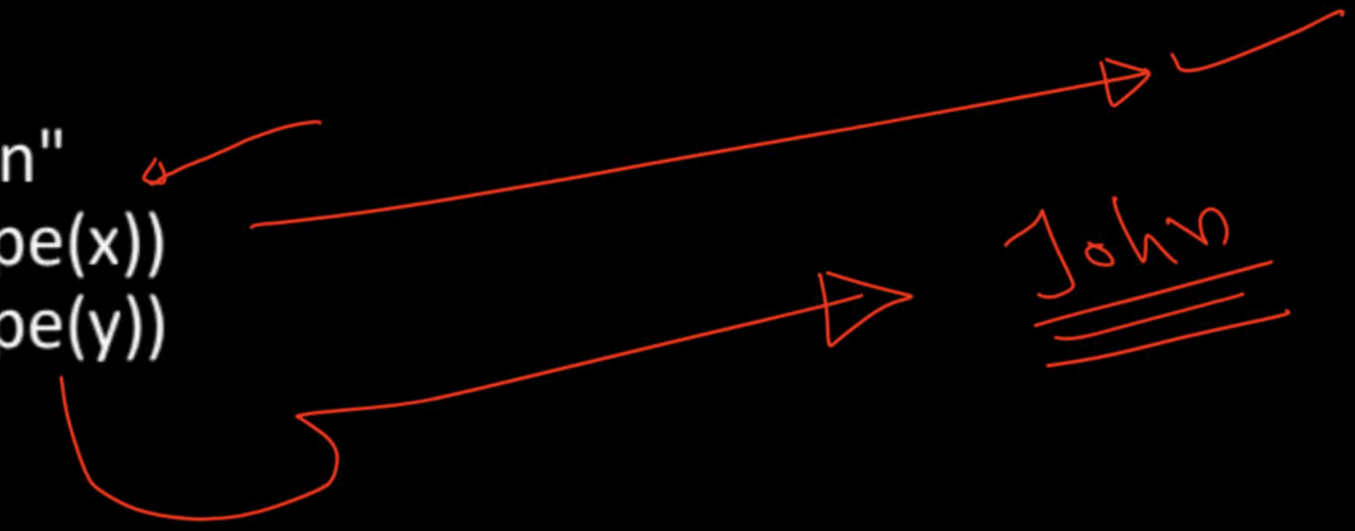
- We can get the data type of a variable with the type() function.

```
x = 5
y = "John"
print(type(x))
print(type(y))
```



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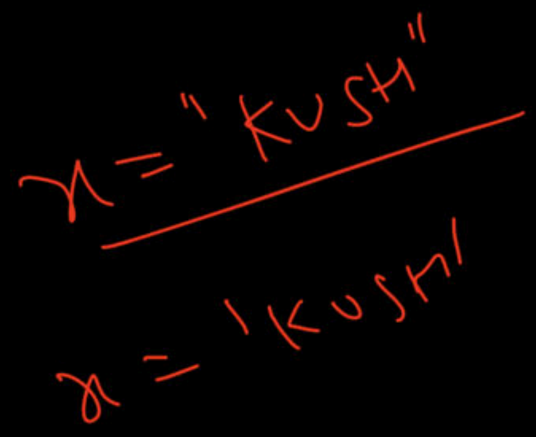
- String variables can be declared either by using single or double quotes:

```
x = “Kush"
# is the same as
x = ‘Kush'
```



- Python allows you to assign values to multiple variables in one line:

```
x, y, z = “Luv", “Kush", “Atharva"
print(x)
print(y)
print(z)
```

- We can assign the *same* value to multiple variables in one line:

```
x = y = z = “Kush”
print(x)
print(y)
print(z)
```

fruits = ["apple", "banana", "cherry"]

→ Name of List

→ List

- If you have a collection of values in a list, tuple etc. Python allows you to extract the values into variables. This is called *unpacking*.

```
fruits = ["apple", "banana", "cherry"]
x, y, z = fruits
print(x)
print(y)
print(z)
```

- In the print() function, you output multiple variables, separated by a comma :

```
x = "Python"
y = "is"
z = "awesome"
print(x, y, z)
```

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Example :

```
x = "Python "
y = "is "
z = "awesome"
print(x + y + z)
```

print (x, y, z)

- Output : Python is awesome

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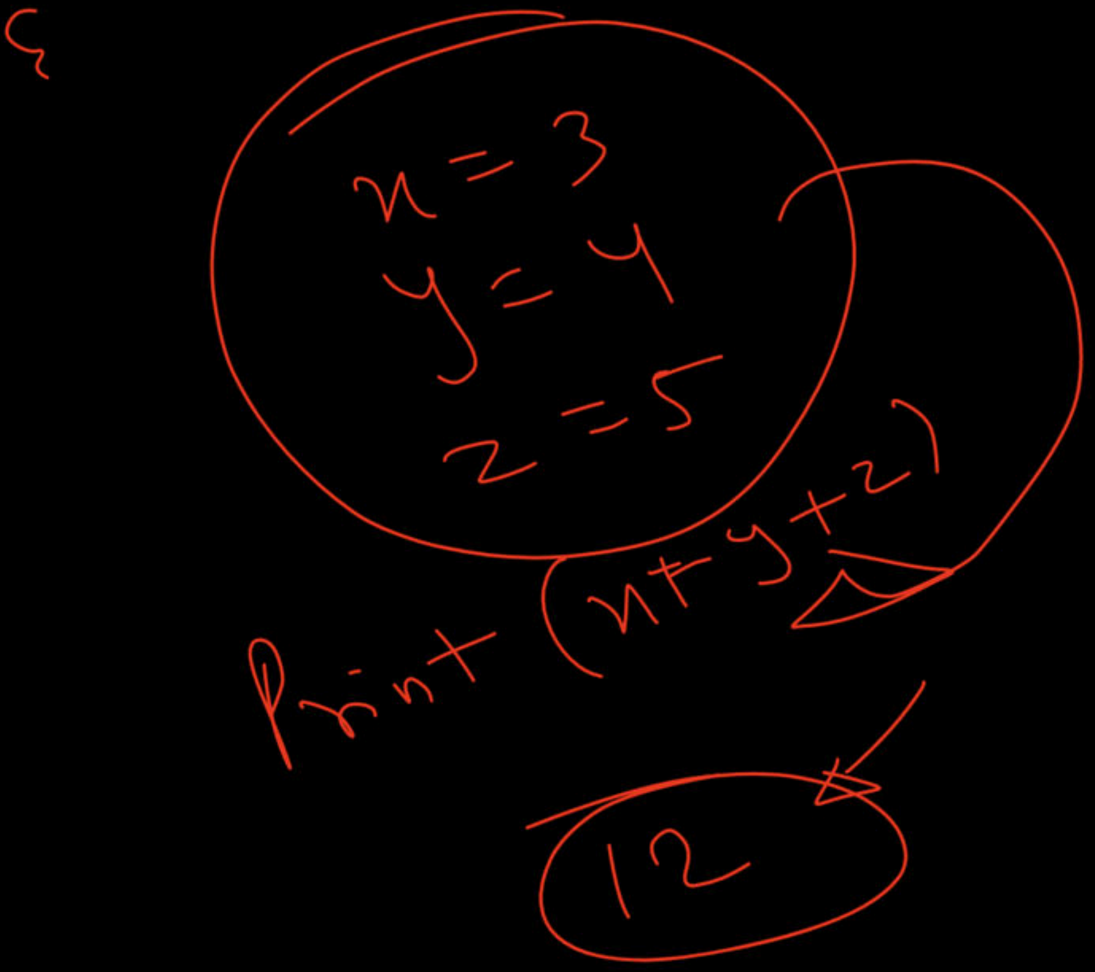
Example :

```
x = "Python "
y = 5
z = "awesome"
print(x + y + z)
```

- Output : Error



print(x, y, z)

3 4 5

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```
x = "3"
y = "4"
z = "5"
print (x + y + z)
```

```
3 4 5
```

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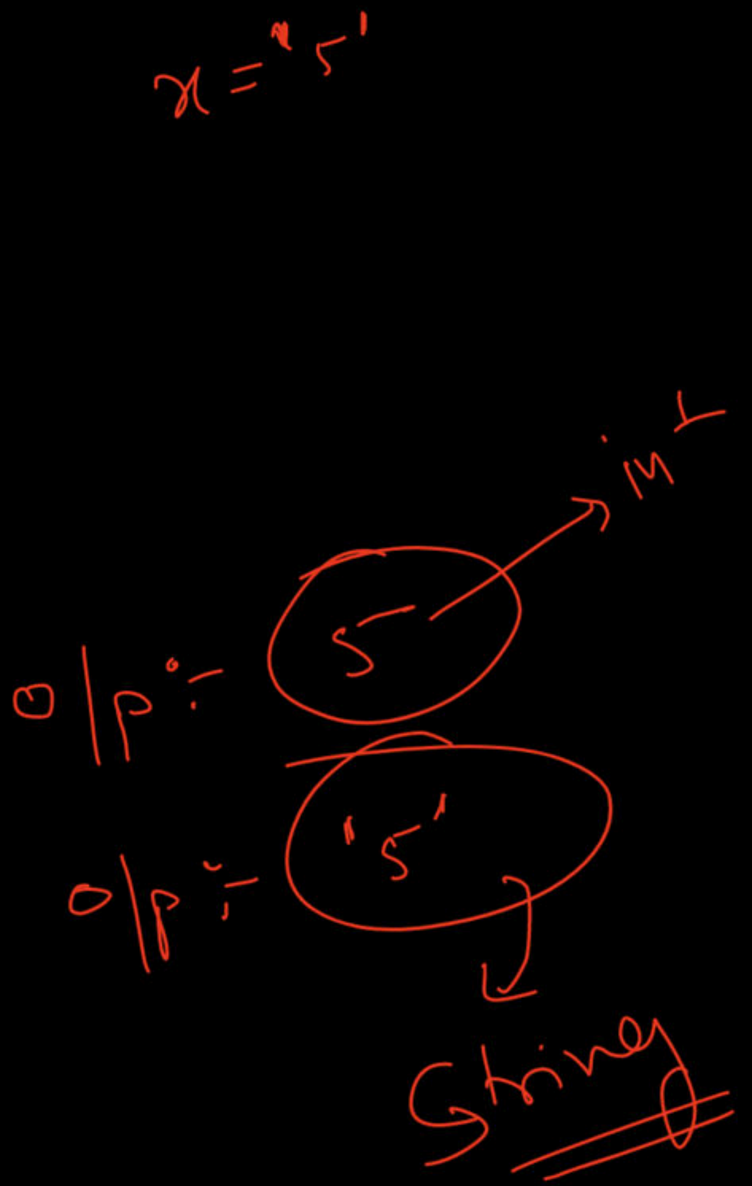
Example :

```
x = "Python "
y = 5
z = "awesome"
print(x , y , z)
```

- Output : Python 5 awesome



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Example :

```
x = 10
y = 5
z = 20
print(x + y + z)
```

- Output : 35

Global Variables

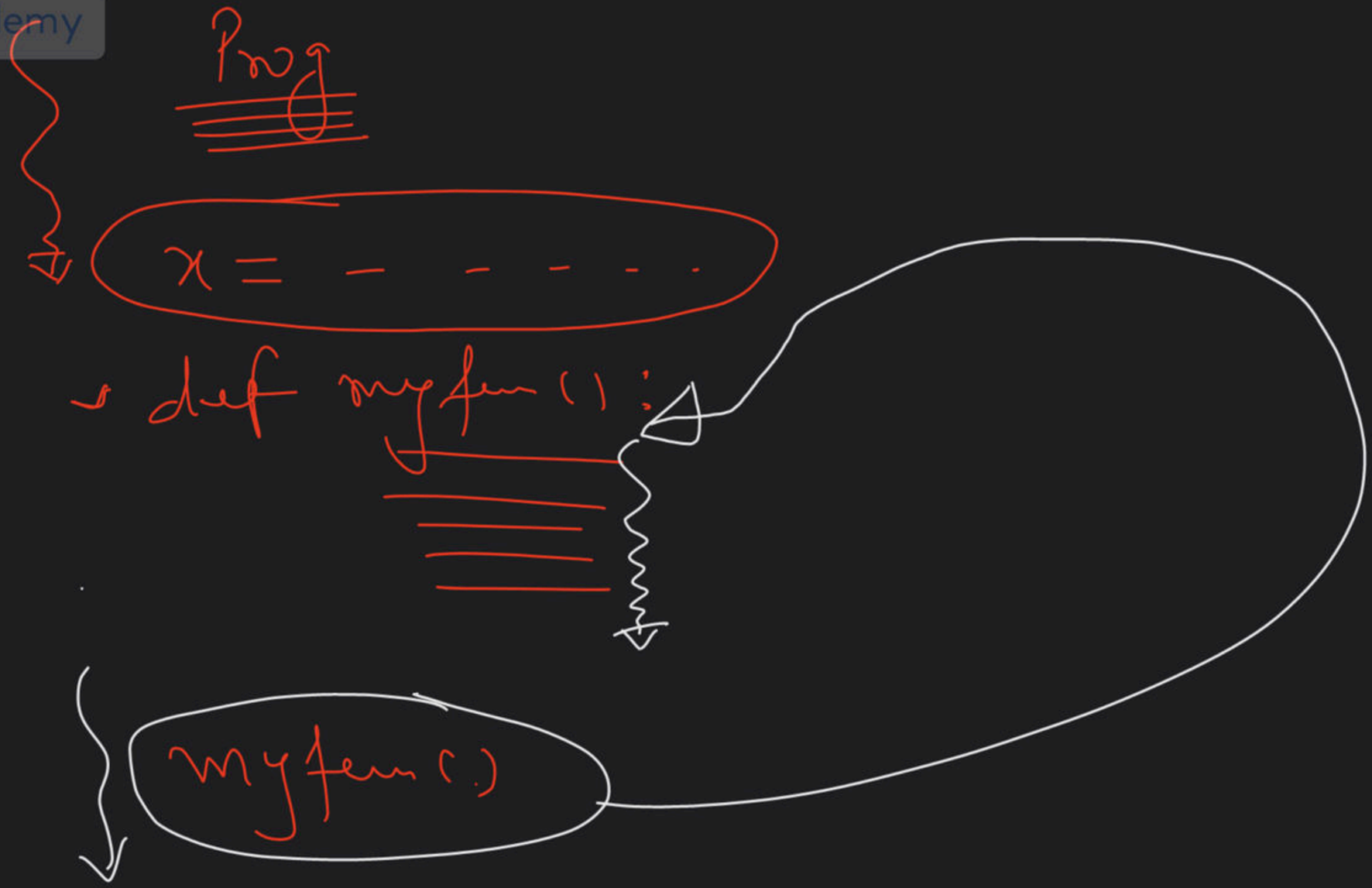
- Variables that are created outside of a function (as in all of the examples above) are known as global variables.
- Global variables can be used by everyone, both inside of functions and outside.

```
x = "animal"

def myfunc():
  print("Lion is " + x)

myfunc()
```

```
def myfunc():
  Print("Lion is" + x)
```



Example

```
x = "awesome"

def myfunc():
  x = "fantastic"
  print("Python is " + x)

myfunc()

print("Python is " + x)
```

Output : Python is fantastic

Python is awesome

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- To create a global variable inside a function, you can use the global keyword.

```
def myfunc():
  global x
  x = "fantastic"

myfunc()

print("Python is " + x)
```

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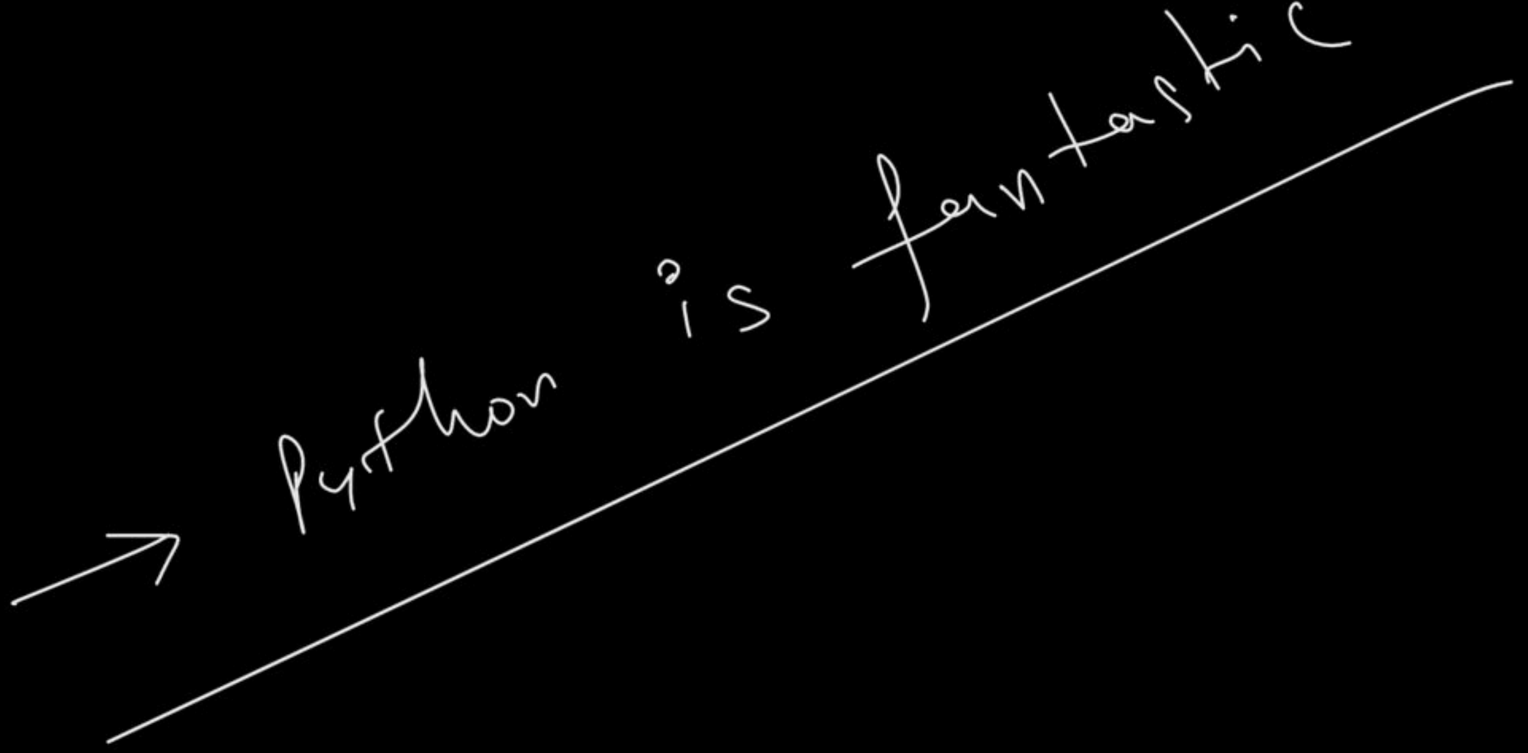
- To change the value of a global variable inside a function, refer to the variable by using the global keyword:
- x = "awesome"

```
def myfunc():
  global x
  x = "fantastic"

myfunc()

print("Python is " + x)
```



Python Data types

- Integer: Integer allows numeric value only. It is immutable.(This means that once you create an integer variable and assign it a value, you cannot change the value of that variable. If you want to update the value of an integer variable, you have to create a new integer object with the desired value and assign it to the variable.)
- Float: It support real number. It is also immutable.
- String- It represent single or group of characters. Immutable
- Boolean- It gives two value either true or false.

a = 10 20

a = 10

a = 20

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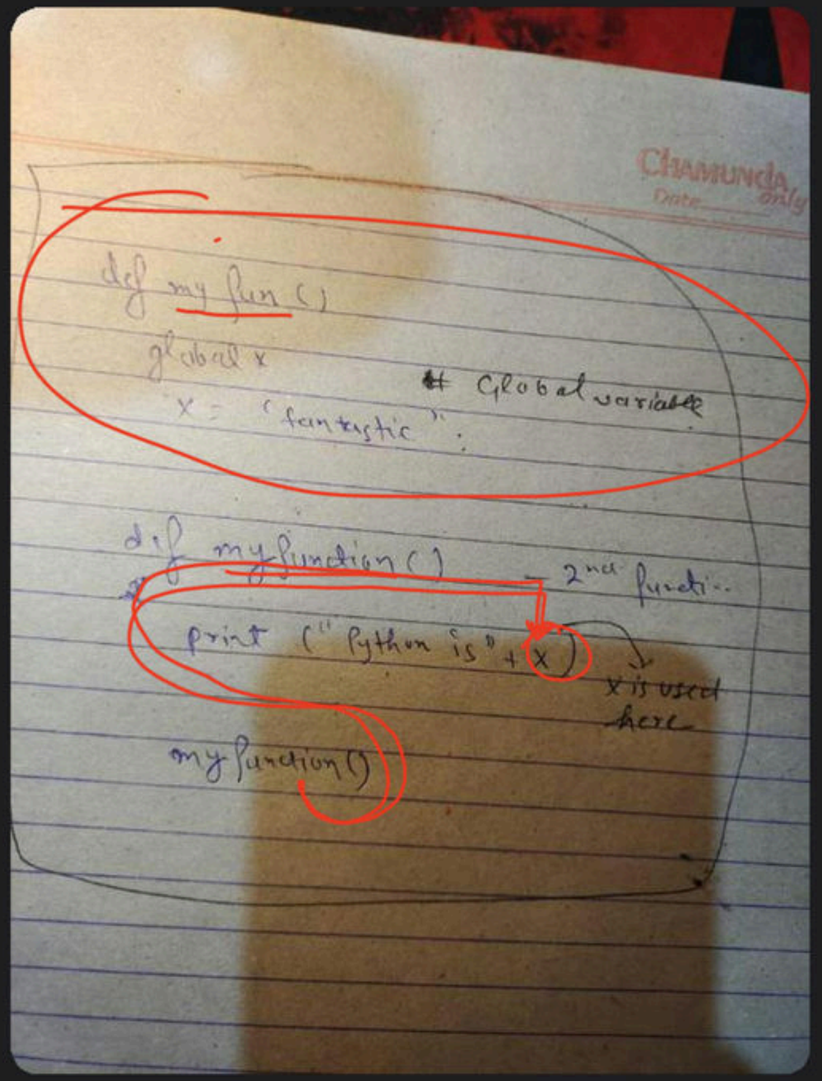
▲ 1 • Asked by Ankit

Sirji ism error aayega kya?



Data types Examples

```
# Python program to demonstrate Data types
a=10      #integer datatype
pi=3.14     #float datatype
str='A'    #string datatype
print(a)
print(pi)
print(str)
print(type(a))
print(type(pi))
print(type(str))
```

10
3.14
A
int
fl
str

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Taking input in Python

- **input ():** This function first takes the input from the user and converts it into a string.
- The type of the returned object always will be <type 'str'>.
- It does not evaluate the expression it just returns the complete statement as String.
- For example, Python provides a built-in function called input which takes the input from the user.
- When the input function is called it stops the program and waits for the user's input.
- When the user presses enter, the program resumes and returns what the user typed.

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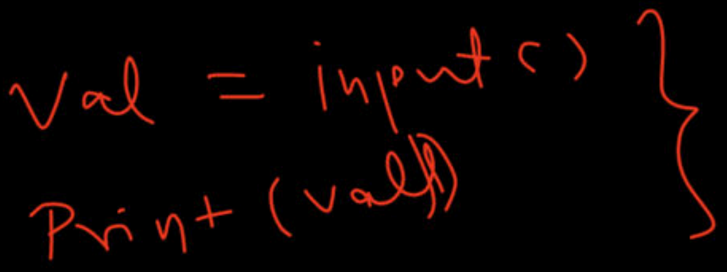
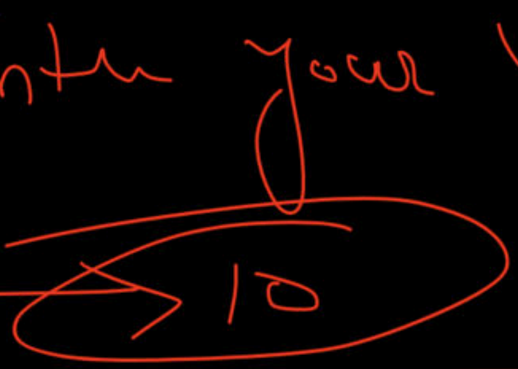
Example



- # Python program showing a use of input()

```
val = input("Enter your value: ")
print(val)
```



- **raw_input():** This function works in older version (like Python 2.x).

Input and Output: Reading Input

There are many ways to assign value or read input for the python variables.

Method-1: Assign value using assignment operator
Example:
diameter=5.8 vehicle='car' pi, a, name=3.14,55, 'David' x=y=z=25

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Input and Output: Reading Input

Method-2: Assign value using input() function
Example:
diameter=float(input('Enter value of diameter')) vehicle=input('Enter name of vehicle') a, b=input('Enter two values').split() x = list(map(int, input("Enter multiple values: ").split()))

10 20 30 40 50

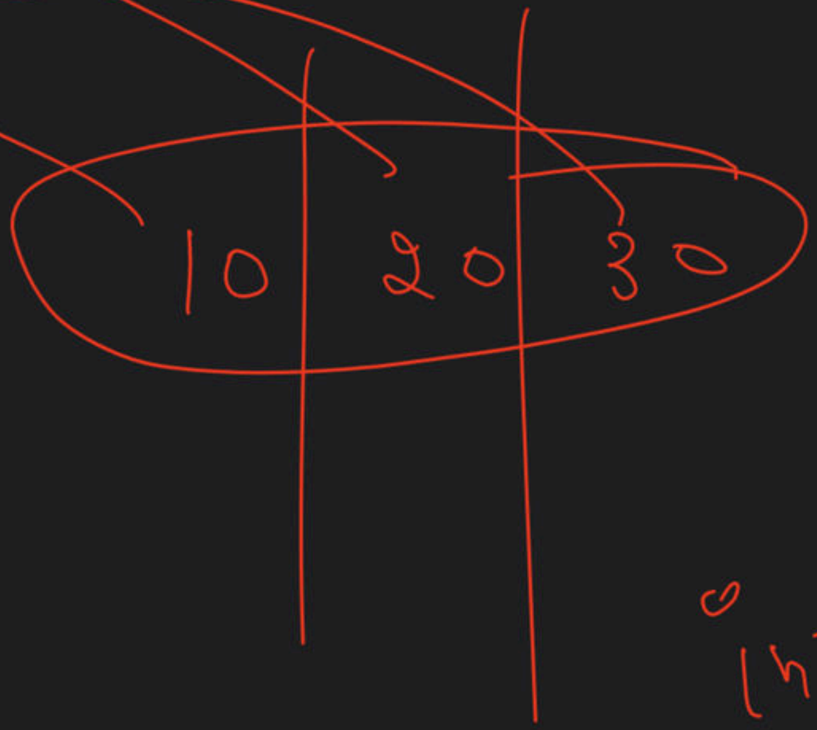
x = [10, 20, 30, 40, 50]

```
x = list(input("Enter multiple values ").split())
print(x)
```

Enter multiple values 10 20 30 40 50

['10', '20', '30', '40', '50']

a, b, c = map(int, input("Enter three value").split())



int( )

float( )

Let's Try…

Guess Output?

Code-1:
```
x, y = input("Enter number of boys and girls: ").split('.')
print("Number of boys: ", x)
print("Number of girls: ", y)
```

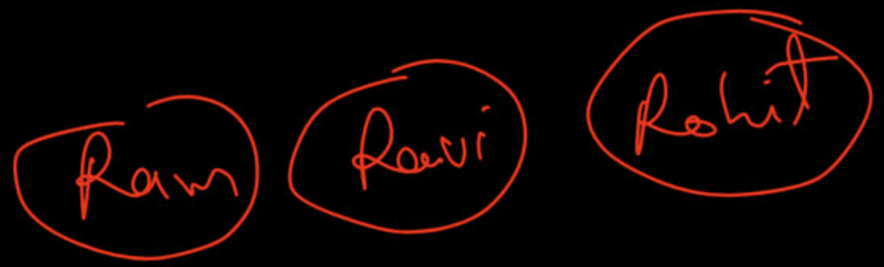
Input- 6 8

Output- **Error**

Code-2:
```
x = list(map(int, input("Enter multiple values: ").split()))
print(x)
```

Input- 6.5 2.4 4.8

Output- **Error**



Let's Try…

Guess Output?

Code-3:
```
x = list(map(int, input("Enter multiple values: ").split()))
print(x+x)
```

Input- 4 8 12

Output- [4, 8, 12, 4, 8, 12]

Code-4:
```
name = "Jony" * 3 * 4
print(name)
```

Output- JonyJonyJonyJonyJonyJonyJonyJonyJonyJonyJonyJony

Input and Output: Displaying Output

In python, print() function is uses to print or display a string or value of variables. A syntax for print() function given below.

Displaying Output: Method-1
Syntax:
print('string',var1,var2....)
Example:
name = "Jenny" print('Name of student is: ', name)

Input and Output: Displaying Output

Displaying Output: Examples

```
print('Welcome \n User')
```

Welcome
User

```
print('Welcome',end=' ')
print('User')
```

Welcome User

```
print("Hello", "how are you?", sep='--')
```

Hello -- how are you?

```
x = float('14.34')
print('%f, %e, %F, %E' % (x, x, x, x))
```

When you run this code, it will format and print the value of x according to the specified format specifiers:
%f: Formats x as a decimal floating-point number.
%e: Formats x in scientific notation (lowercase 'e').
%F: Formats x as a decimal floating-point number with uppercase 'F'.
%E: Formats x in scientific notation with uppercase 'E'.

Output :

14.340000, 1.434000e+01, 14.340000, 1.434000E+01

Let's Try…

Guess Output?

```
x = float('NaN')
print('%f, %e, %F, %E' % (x, x, x, x))
```

nan, nan, NAN, NAN

```
print('%x, %X' % (15, 15))
```

f, F

```
print('%c' % 69)
```

E

```
print('%d %d %.2f' % (11, '22', 11.22))
```

Error : use %s for '22'

```
name = "Jony" * -3  * 4
print(name)
```

Nothing

Input and Output: Output Formatting

With the format () method, print() function display in formatted form. A syntax for print() function with format method() given below.

Displaying Output: Method-2
Syntax:
print(‘UserString{} '.format(‘Otherstring'))
Example:
print('Welcome {}'.format('User')) print('{0} and {1}'.format(‘Hello', ‘World'))

Let's Try…

Guess Output?
print('Best College is {0}, {1}, {other} ' .format('IISC', 'For', other ='M.Tech'))
Best College is IISC, For, M.Tech
print(" No of Circles: {1:d}, Area of each Circle: {0:7.2f}". format(167.34, 6))
No of Circles: 6, Area of each Circle: 167.34
print('@@', '@@', '@@', sep='@@')
@@@@@@@@@@@

Sample Problems

Problem-1:

Write a program that reads sequence of inputs from the user provided on single row and separated by the character ':‘ and display each number.

Example :

Sample Input: 3:12:21:8:4:7

Sample Output: [‘3’, ’12’, ’21’, ‘8’, ‘4’, ‘7’]

Problem-2:

Write a python code to read three heterogeneous data items from the user and display them.

Example

Sample Input- 6 8.9 abc

Sample Output- [‘6’, ‘8.9’,’abc’]

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#Program 1 :

```
x = input("enter multiple value").split(":")
print (x)
```

#Program 2 :

```
x = input("enter multiple value").split()
print (x)
```

Thank You