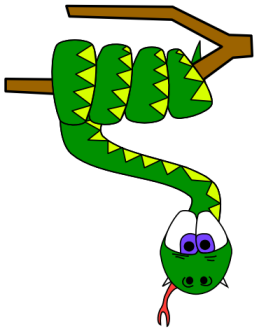


Introduction to Programming with Python

Session-I

Outline

- Why Python
- History
- Features
- Installing Python & Using with Eclipse
- Working With Python interactive shell
- Variables
- Datatypes
- Assignments
- Input/output
- Comments
- Id & type functions

Why Python

World wide Python Users

- Web Development--Yahoo Groups, Google, Shopzilla
- Games--Battlefield 2, The Temple of Elemental Evil, Vampire
- Graphics--Walt Disney Feature Animation, Blender 3D
- Science– National Weather Service, NASA, Environmental System Research Institute
- Who uses Python?
  - Google
  - PBS
  - NASA
  - Library of Congress
  - Instagram
  - Dropbox
  - Pinterest

  ...the list goes on...

Why Python

- **Easy – to – learn**.
- Code is 3-5 times shorter than Java.
- 5-10 times shorter than C++.
- Since it allows you to express very powerful ideas in **very few lines of code** while being very readable.
- Therefore **maintainability is high**.
- **Stepping Stone to Programming universe**.
- Python code is often said to be **almost like pseudocode**.

Facts about Python

- Python's methodologies can be used in a **broad range of applications.**
- Bridging the Gap between abstract computing and real world applications.
- **Rising Demand** for Python Programmers.
- Google, Nokia, Disney, Yahoo, IBM use Python.
- **Not only a Scripting language**, also **supports Web Development** and **Database Connectivity**.

Python v/s Java

A simple Program to print “Hello World”

Java Code	Python Code

public class HelloWorld
{
public static void main(String args [])
{
System.out.println (“Hello World!”)
}
}
	print (“Hello World!”)

Google-Fuchsia

- Google is dumping Linux and the GPL and most likely Java and all the problems they have had with Oracle. The actual operating system will be very different in how Android was designed, but Google worked on Android, therefore many things will also be the same/similar.
- Fuchsia is written in Go, Rust, Dart, C, C++ and ***Python***, unlike Android, which is mainly written in Java.

**https://www.quora.com/How-different-will-Googles-new-OS-Fuchsia-be-from-others

Evolution of Python

- **Guido Van Rossum** developed Python in **early 1990s** at National Research Institute for Mathematics and Computer Science, Netherlands.
- Named after a circus show Monty Python show.
- Derives its features from many languages like **Java, C++, ABC, C, Modula-3, Smalltalk, Algol-68, Unix shell** and other scripting languages.
- Available under the GNU General Public License (GPL) – Free and open-source software.

Python-Releases

- Python 1.0 - January 1994
  - Python 1.5 - December 31, 1997
  - Python 1.6 - September 5, 2000
- Python 2.0 - October 16, 2000
  - Python 2.1 - April 17, 2001
  - Python 2.2 - December 21, 2001
  - Python 2.3 - July 29, 2003
  - Python 2.4 - November 30, 2004
  - Python 2.5 - September 19, 2006
  - Python 2.6 - October 1, 2008
  - Python 2.7 - July 3, 2010
- Python 3.0 - December 3, 2008
  - Python 3.1 - June 27, 2009
  - Python 3.2 - February 20, 2011
  - Python 3.3 - September 29, 2012
  - Python 3.4 - March 16, 2014
  - Python 3.5 - September 13, 2015
  - Python 3.6 - December 23, 2016

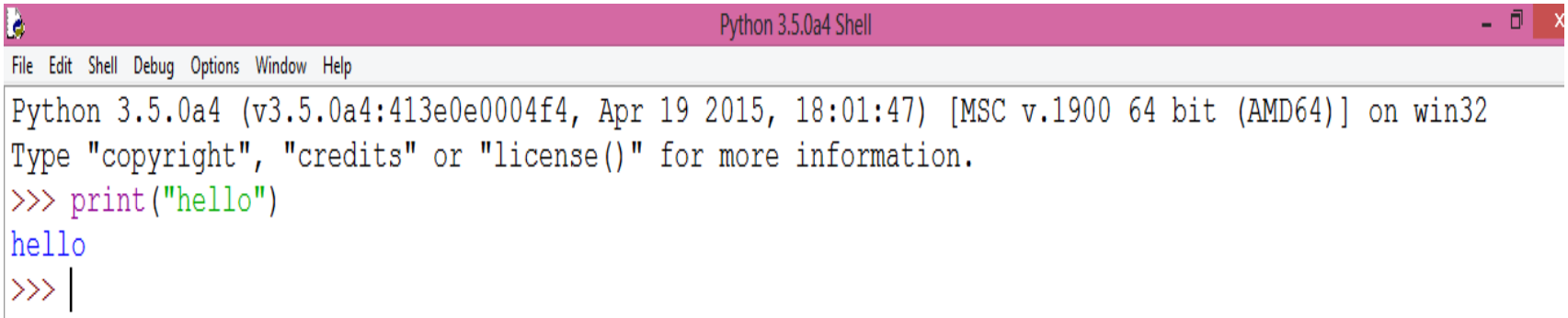
Features

1. Python is a **high-level**, **interpreted**, **Interactive dynamically typed, multi paradigm** programming language**.**
2. Open- Source, **Object - Oriented**, **procedural** and **functional.**
3. Very **rich scientific computing libraries**.
4. Well thought out language, allowing to write **very readable** and **well structured code**: we “code what we think”**.**

Installing Python

- Download Python from www.python.org
- Any version will do for this class
  - By and large they are all mutually compatible
  - Recommended version: 3.x ..latest 3.6 (32 bit or 64 bit)
  - Recommended 64 bit
- Use IDLE or IDE

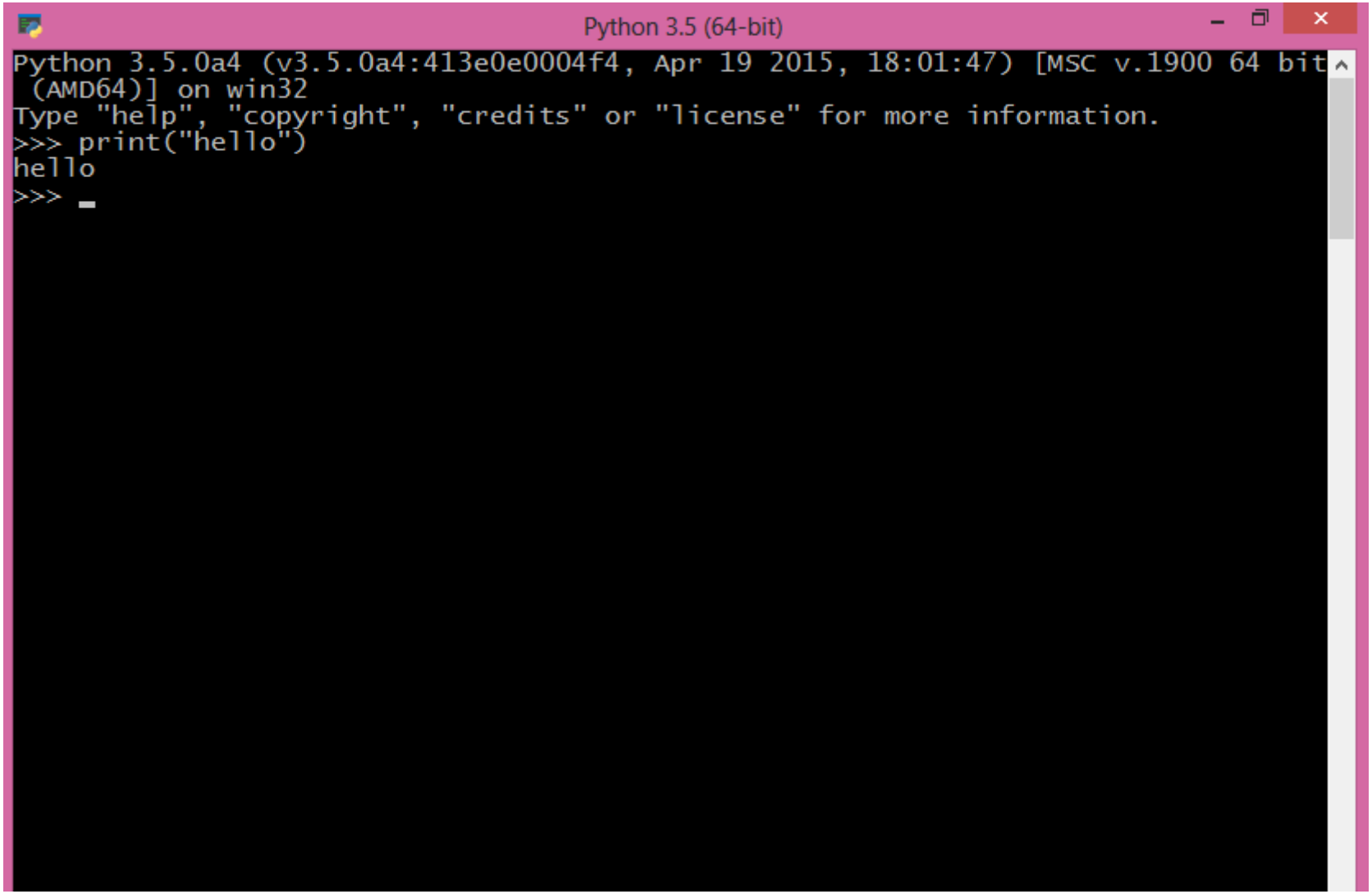
Interactive Shell-Python IDLE (GUI)



A Code Sample (in IDLE)

```
x = 34 - 23                 # A comment.
y = “Hello”                 # Another one.
z = 3.45
if z == 3.45 or y == “Hello”:
    x = x + 1
    y = y + “ World”        # String
        concat.
print x
print y
```

Interactive Shell-Python Command Line



Data Type/variables/Assignment

Dynamic Typing-

- **Java: *statically typed***
  - Variables are declared to refer to objects of a given type
  - Methods use type signatures to enforce contracts
- **Python**
  - Variables come into existence when first assigned to
  - A variable can refer to an object of any type
  - All types are (almost) treated the same way
  - *Main drawback*: type errors are only caught at runtime

Assignment

- ***Binding a variable*** **in Python means setting a *name* to hold a *reference* to some *object*.**
  - *Assignment creates references, not copies (like Java)*
- **A variable is created *the first time* it appears on the left side of an assignment expression:**

```
x = 3
```

- **An object is deleted (by the garbage collector).**
- ***Names in Python do not have an intrinsic type. Objects have types.***
  - Python determines the type of the reference automatically based on what data is assigned to it.

(Multiple Assignment)

- You can also assign to multiple names at the same time.

```
>>> x, y = 2, 3
>>> x  2
>>> y
3
```

Variables

- **variable**: A named piece of memory that can store a value.
  - Usage:
    - Compute an expression's result,
    - store that result into a variable,
    - and use that variable later in the program.

- **assignment statement**: Stores a value into a variable.
  - Syntax:

    name `=` ***value***

  - Examples:

```
x = 5
gpa = 3.14
```

  - A variable that has been given a value can be used in expressions.

    `x + 4` is `9`

- **Exercise:** Evaluate the quadratic equation for a given *a*, *b*, and *c*.

Naming Rules

- Names are case sensitive and cannot start with a number. They can contain letters, numbers, and underscores.

```
bob   Bob   _bob   _2_bob_   bob_2   BoB
```

- There are some reserved words:

```
and, assert, break, class, continue, def, del,
elif, else, except, exec, finally, for, from,
global, if, import, in, is, lambda, not, or, pass,
print, raise, return, try, while
```

Everything is an object

- Everything means everything, including functions and classes (more on this later!)
- Data type is a property of the object and not of the variable

```
>>> x = 7
>>> x
7
>>> x = 'hello'
>>> x
'hello'
>>>
```

Numbers: Integers

- Integer – the equivalent of a C long
- Long Integer – an unbounded integer value.

```
>>> 132224
132224
>>> 132323 **
2
17509376329L
>>>
```

Numbers: Floating Point

- int(x) converts x to an integer
- float(x) converts x to a floating point
- The interpreter shows a lot of digits

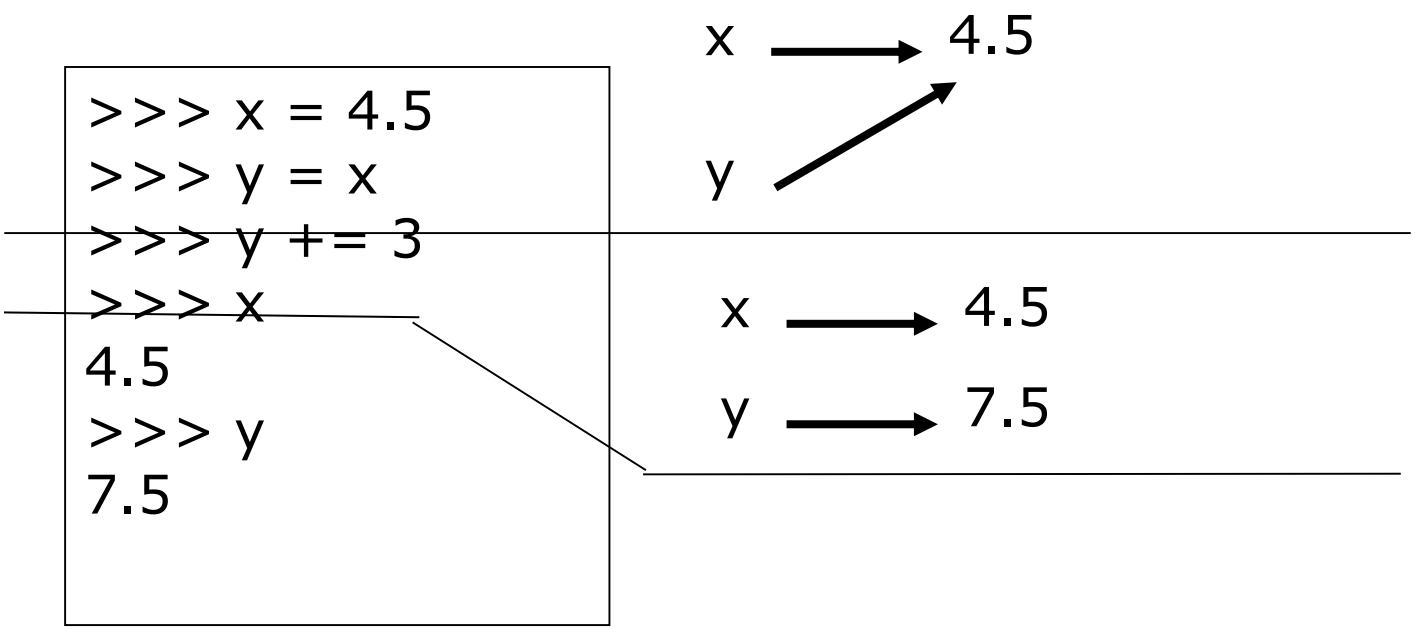
```
>>> 1.23232
1.2323200000000001
>>> print 1.23232
1.23232
>>> 1.3E7
13000000.0
>>> int(2.0)
2
>>> float(2)
2.0
```

Numbers: Complex

- Built into Python
- Same operations are supported as integer and float

```
>>> x = 3 + 2j
>>> y = -1j
>>> x + y
(3+1j)
>>> x * y
(2-3j)
```

Numbers are *immutable*



String Literals

- Strings are *immutable*
- There is no char type like in C++ or Java
- + is overloaded to do concatenation

```
>>> x = 'hello'
>>> x = x + ' there'
>>> x
'hello there'
```

String Literals: Many Kinds

- Can use single or double quotes, and three double quotes for a multi-line string

```
>>> 'I am a string'
'I am a string'
>>> "So am I!"
'So am I!'
>>> s = """And me too!
though I am much longer
than the others :)"""
'And me too!\nthough I am much longer\nthan the
others :)`
>>> print s
And me too!
though I am much longer
than the others :)`
```

Lists

- Ordered collection of data
- Data can be of different types
- Lists are *mutable*
- Issues with shared references and mutability
- Same subset operations as Strings

```
>>> x = [1,'hello', (3 + 2j)]
>>> x
[1, 'hello', (3+2j)]
>>> x[2]
(3+2j)
>>> x[0:2]
[1, 'hello']
```

Tuples

- Tuples are *immutable* versions of lists
- One strange point is the format to make a tuple with one element:

  ‘,’ is needed to differentiate from the mathematical expression (2)

```
>>> x = (1,2,3)
>>> x[1:]
(2, 3)
>>> y = (2,)
>>> y
(2,)
>>>
```

Dictionaries

- A set of key-value pairs
- Dictionaries are *mutable*

```
>>> d = {1 : 'hello', 'two' : 42, 'blah' :
[1,2,3]}
>>> d
{1: 'hello', 'two': 42, 'blah': [1, 2, 3]}
>>> d['blah']
[1, 2, 3]
```

Data Type Summary

- Lists, Tuples, and Dictionaries can store any type (including other lists, tuples, and dictionaries!)
- Only lists and dictionaries are mutable
- All variables are references

Data Type Summary

- Integers: 2323, 3234L
- Floating Point: 32.3, 3.1E2
- Complex: 3 + 2j, 1j
- Lists: l = [1,2,3]
- Tuples: t = (1,2,3)
- Dictionaries: d = {‘hello’ : ‘there’, 2 : 15}

Input

- The **input**(string) method returns a line of user input as a string
- The parameter is used as a prompt
- The string can be converted by using the conversion methods **int**(string) converts to int, **float**(string) converts to float or **eval**(string) converts and evaluates expressions etc.

Comments

Commenting Style in Python!

Types of Comments:

- A single line comment starts with hash symbol '#' and end as the line ends.
  - These lines are never executed and are ignored by the interpreter.
    - Single → # This is a single line comment

- Multi-line comments starts and ends with triple single quotes ''' or triple """ double quotes
  - Used for documentation
    - Triple → ''' or """

```
"""Contents here can be used for documentation"""
'''An example for multi-line comments with single quotes'''
```

Multiline Statements

Multiline statements

- Python statements always end up with a new line, but it also allows multiline statement using "\" character at the end of line as shown below:

```
result = (8+5)*\
         2+\
         9/5
```

- Statements which have (), [], {} brackets and comma, do not need any multiline character to go to next line.

```
customer_details = [101, 'kevin',
                    '165', 498.24]
```

Expressions

- **expression**: A data value or set of operations to compute a value.

  Examples: `1 + 4 * 3`

  `42`

- Arithmetic operators we will use:

`+ - * /`	addition, subtraction/negation, multiplication, division
`%`	modulus, a.k.a. remainder
`**`	exponentiation

- **precedence**: Order in which operations are computed.
  - `* / % **` have a higher precedence than `+ -`

    `1 + 3 * 4` is `13`

  - Parentheses can be used to force a certain order of evaluation.

    `(1 + 3) * 4` is `16`

Math commands

- Python has useful commands for performing calculations.

Command name	Description
`abs(`***value***`)`	absolute value
`ceil(`***value***`)`	rounds up
`cos(`***value***`)`	cosine, in radians
`floor(`***value***`)`	rounds down
`log(`***value***`)`	logarithm, base *e*
`log10(`***value***`)`	logarithm, base 10
`max(`***value1***`, `***value2***`)`	larger of two values
`min(`***value1***`, `***value2***`)`	smaller of two values
`round(`***value***`)`	nearest whole number
`sin(`***value***`)`	sine, in radians
`sqrt(`***value***`)`	square root

Constant	Description
`e`	2.7182818...
`pi`	3.1415926...

- To use many of these commands, you must write the following at the top of your Python program:

```
from math import *
```

print

- `print` : Produces text output on the console.
- Syntax:

  `print "`***Message***`"`

  `print` ***Expression***

  - Prints the given text message or expression value on the console, and moves the cursor down to the next line.

  `print` ***Item1*`,` *Item2*`,` ...`,` *ItemN***

  - Prints several messages and/or expressions on the same line.

- Examples:

```
print("Hello, world!“)
age = 45
print ("You have", 65 - age, "years until retirement“)
```

Output:

```
Hello, world!
You have 20 years until retirement
```

Operators


Arithmetic Operators
Relational Operators
Assignment Operators
Bitwise Operators
Logical Operators
Membership Operators
Identity Operators

Arithmetic Operators

– Used for performing arithmetic operations

Operators	Description	Example
+	Additive operator (also used for String concatenation)	2 + 3 = 5
-	Subtraction operator	5 – 3 = 2
*	Multiplication operator	5 * 3 = 15
/	Division operator	6 / 2 = 3.0
%	Modulus operator	7 % 2 = 1
//	Truncation division (also known as floor division)	10 // 3 = 3 10.0 // 3 = 3.0
**	Exponentiation	10 ** 3 = 1000

Relational Operators

Operators	Description
==	Equal to
<	Less than
>	Greater than
<=	Lesser than or equal to
>=	Greater than or equal to
!=	Not equal to
<>	Similar to Not equal to

Assignment Operators

Operators	Description	Example	Equivalent
=	Assignment from right side operand to left side	c = 50; c = a;	
+=	Add & assigns result to left operand	c += a	c = c + a
-=	Subtract & assigns result to left operand	c -= a	c = c – a
*=	Multiply & assigns result to left operand	c *= a	c = c * a
/=	Divide & assigns result to left operand	c /= a	c = c / a
%=	Calculates remainder & assigns result to left operand	c %= a	c = c % a
//=	Performs floor division & assigns result to left operand	c //= a	c = c // a
**=	Performs exponential calculation & assigns result to left operand	c **= a	c = c ** a

- **Multiple Assignments** – Same value can be assigned to more than one variable

Ex.1: Students Ram, Sham, John belong to semester 6
Ram = Sham = John = 6

Ex.2: a, b, c = 10, "Hello", 30.66 is same as a = 10, b = "Hello", c = 30.66

Bitwise Operators

Operators	Description
&	Binary AND
|	Binary OR
^	Binary XOR
~	Binary Ones Complement
<<	Binary Left Shift
>>	Binary Right Shift

Logical Operators

- Are based on Boolean Algebra
- Returns result as either True or False

Operator	Meaning
and	Short Circuit-AND
or	Short Circuit-OR
not	Unary NOT

Membership & Identity

- **Membership Operators**
  - Checks for whether the given element is found within a sequence of Strings, Lists, Dictionaries or Tuples

Operators	Description
in	Returns true if given element is found in given sequence else false
not in	Returns true if given element is not found in given sequence else false

- **Identity Operators**
  - Are used to compare memory locations or addresses of 2 objects

Operators	Description
is	Returns true if variables or objects on both sides of operator are referring to same object else false
is not	Returns false if variables or objects on both side of operator are referring to same object else true

id() function

- **Id(object)**
  - Returns identity of an object. It is the address of object in memory
  - It will be unique and constant throughout the lifetime of an object

Example

```
a = 10
b = a
print("Value of a and b before increment")
print("id of a: ",id(a))
print("id of b: ",id(b))
b = a + 1
print("Value of a and b after increment")
print("id of a: ",id(a))
print("id of b: ",id(b))
```

Output:

```
Value of a and b before increment
id of a:  1815592664
id of b:  1815592664
Value of a and b after increment
id of a:  1815592664
id of b:  1815592680
```

Note the change in address of variable 'b' after increment

type() Function

- Used to identify the type of object

Example

```
int_a = 10
print("Type of 'int_a':", type(int_a))
str_b = "Hello"
print("Type of 'str_b':", type(str_b))
list_c = []
print("Type of 'list_c':", type(list_c))
```

Output:

```
Type of 'int_a': <class 'int'>
Type of 'str_b': <class 'str'>
Type of 'list_c': <class 'list'>
```