
Introduction to Python

Denis Oluka
Software Developer
Interswitch East Africa (U) Ltd

About the Course

Interactive lectures with real-time coding demonstrations.
Hands-on exercises and coding challenges after each module.
Physical and Virtual classes via Google Meet
Self-paced assignments and projects.

Frequency: 3 days a week - Days and time to be discussed

Module 1:

What is Python?

24th Dec 2024

What is Python

- Python is an interpreted, object oriented, high level programming language with dynamic semantics
- Python is simple easy to learn syntax emphasizes readability and therefore reduces the cost of program maintenance
- Python supports modules and packages which emphasizes program modularity and code reuse.

History

Started by Guido Van Rossum as a hobby
Now widely spread
Open Source! Free!
Versatile



Who Uses Python

On-line games

Web services

Applications

Science

Instrument control

Embedded systems

Who Uses Python

Developed a large and active scientific computing and data analysis community

Now one of the most important languages for

- Data science
- Machine learning
- General software development

Packages: NumPy, pandas, matplotlib, SciPy, scikit-learn, statsmodels

Failures

Coding is all about trial and error.

Don't be afraid of it.

Error messages aren't scary, they are useful.

Demo



Tools

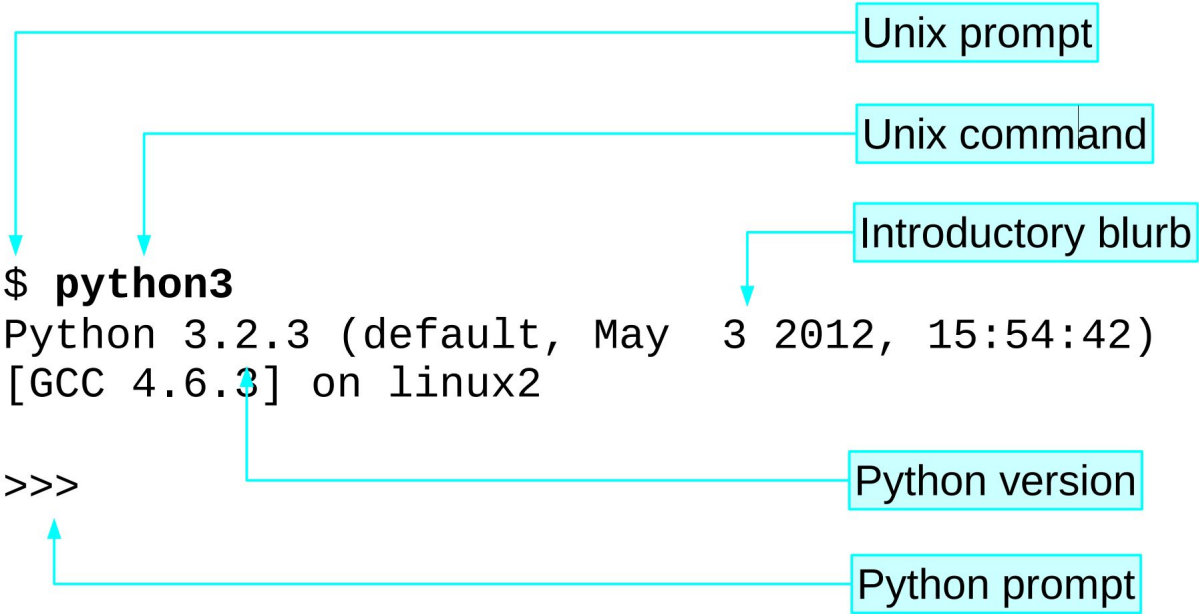
Python3

Command prompt

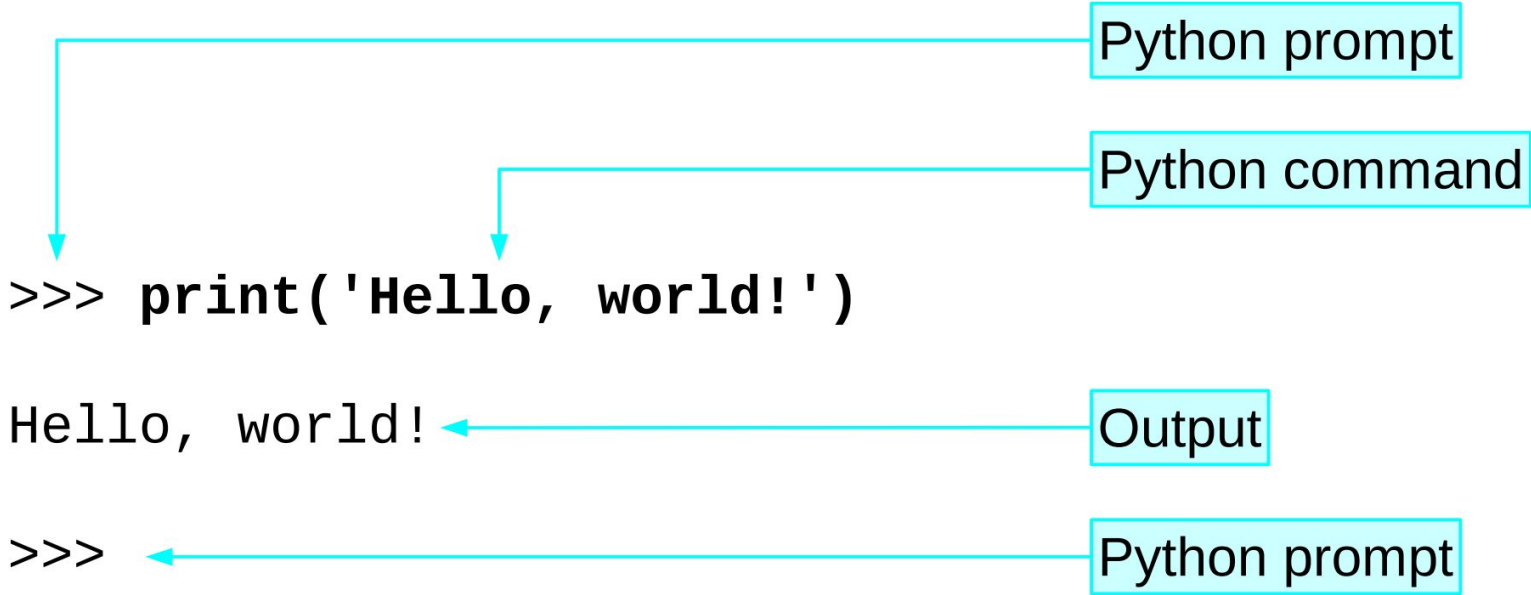
Vs Code

Git - VCS

Running Python



Syntax



Installation

Visit

<https://python.org/>

Select and Download the stable version of python

Install Python

Run python command prompt

Thank you

Module 2:

Python Variables and Data Types

27th Dec 2024

Variables in Python

What is a variable in programming?

A variable is essentially a reserved memory location that stores data values. In Python, variables do not require explicit declaration; they are created the moment a value is assigned to them. This flexibility allows for dynamic typing, meaning the type of a variable can change as needed.

They go on to serve as symbolic names for data stored in memory, allowing programmers to manipulate and reference values throughout their code. Here's a detailed explanation of variables, including their creation, usage, naming conventions, and scope.

Variables

Creating Variables

To create a variable in Python, you use the assignment operator (`=`) to assign a value to a name. The syntax is straightforward:

`variable_name = value`

```
x = 5          # x is an integer
y = "Hello"    # y is a string
z = 3.14       # z is a float
```

Variables

Dynamic Typing

Python automatically determines the data type of a variable based on the value assigned to it.

For instance, if you assign an integer to a variable and later assign a string to the same variable, Python will adjust its type accordingly:

```
x = 4          # x is of type int  
x = "Sally"    # x is now of type str
```

Variables Rules

- Must start with a letter or underscore (_), not a number.
- Can't contain spaces or special characters.
- Are case-sensitive (e.g., Name and name are different).

Valid naming

```
my_name = "Denis"  
height = 30
```

Invalid naming

```
1user = "Invalid"  
user-name = "Invalid"
```

Data Types

Data types in Python are attributes that tell a computer how to interpret a piece of data. They help identify the type of data, its size, and the functions associated with it.

Python has a rich set of built-in data types that are used to store, manipulate, and process data efficiently, these data types are stored in containers called variables

The data types are categorised as numeric data types, sequence data types, mapping, sets, booleans, binaries and none types as explained below.

Numeric Data Types

int (Integer)

Description: Represents whole numbers without decimal points.

Example: 20, 10, -2, -100, 1000

Use: Counting, indexing, and mathematical operations that don't require fractional values.

float (Floating Point)

Description: Represents numbers with decimal points.

Example: 3.14, -0.5, 2.0, 0.021

Use: Precise calculations, scientific computations, and measurements.

Text Data Types

str (String)

Description: Represents a sequence of characters (text data).

Example: “hello”, ‘python’, “How are you!”

Use: Storing and manipulating textual information such as names, messages, or paragraphs

Sequence Data Types

list

Description: Represents an ordered, mutable collection of elements (can be of different types).

Example: [1, 19, 2, 90], ['Denis', 34, 12.9]

Use: Storing and organizing a collection of items that may need to change.

Sequence Data Types cont'd

tuple

Description: Represents an ordered, immutable collection of elements.

Example: (1, 19, 2, 90), ('Denis', 34, 12.9)

Use: Storing a fixed collection items, and the elements can be of mixed types.

Mapping data types

These do allow for the storage of data in key value pairs

dict (Dictionary)

Description: Represents a collection of key-value pairs.

Example: {'name': 'Alice', 'age': 25}

Use: Storing and retrieving data via keys, such as configurations or JSON-like structures

Set Data Types

set

Description: Represents an unordered collection of unique items.

Example: {1, 2, 3}, {'apple', 'banana' }

Use: Eliminating duplicates, performing set operations like union and intersection.

bool (Boolean Data type)

Description: Represents True or False values

Example: True, False

Use: Logic and control flow in decision-making statements

Binary Data Types

Binary data types are used for handling binary data.

bytes

These are immutable sequences majorly used for binary data such as file streams or network data.

Example: `b"Hello"`

None

The special type or none value represent the absence of a null value or 'no value' in python programming.

Casting Data Types

Casting is the operation of converting a variable from one data type to another.

Example

```
x = 10  
y = "20"  
x + int(y)
```

Castings include; `int()`, `float()`, `str()`, `bool()`, `dict()`, `list()`, `tuple()`, `set()`

Python Operators

Python operators are special symbols that perform operations on variables and values.

They can be categorized into several types, including arithmetic, assignment, comparison, logical, bitwise, membership, and identity operators.

Arithmetic Operators

Arithmetic operators are used to perform mathematical operations.

Order of precedence is the same as in Mathematics.

Operator	Operation	Example
<code>`+`</code>	Addition	<code>`5 + 2 = 7`</code>
<code>`-`</code>	Subtraction	<code>`4 - 2 = 2`</code>
<code>`*`</code>	Multiplication	<code>`2 * 3 = 6`</code>
<code>`/`</code>	Division	<code>`4 / 2 = 2.0`</code>
<code>`//`</code>	Floor Division	<code>`10 // 3 = 3`</code>
<code>`%`</code>	Modulo	<code>`5 % 2 = 1`</code>
<code>`**`</code>	Exponentiation	<code>`4 ** 2 = 16`</code>

Assignment Operators

Assignment operators assign values to variables and can also perform operations during assignment.

Operator	Description	Example
<code>=</code>	Assignment	<code>a = 10</code>
<code>+=</code>	Addition Assignment	<code>a += 5 # a = a + 5</code>
<code>-=</code>	Subtraction Assignment	<code>a -= 3 # a = a - 3</code>
<code>*=</code>	Multiplication Assignment	<code>a *= 4 # a = a * 4</code>
<code>/=</code>	Division Assignment	<code>a /= 3 # a = a / 3</code>
<code>%=</code>	Modulus Assignment	<code>a %= 10 # a = a % 10</code>
<code>**=</code>	Exponent Assignment	<code>a **= 2 # a = a ** 2</code>
<code>//=</code>	Floor Division Assignment	<code>a //= 3 # a = a // 3</code>

Comparison Operators

Comparison operators compare two values and return Boolean results (True or False)

Operator	Description	Example
<code>`==`</code>	Equal to	<code>`5 == 5` (True)</code>
<code>`!=`</code>	Not equal to	<code>`5 != 4` (True)</code>
<code>`>`</code>	Greater than	<code>`5 > 4` (True)</code>
<code>`<`</code>	Less than	<code>`5 < 6` (True)</code>
<code>`>=`</code>	Greater than or equal to	<code>`5 >= 5` (True)</code>
<code>`<=`</code>	Less than or equal to	<code>`5 <= 6` (True)</code>

Logical Operators

Logical operators are used to combine conditional statements.

Operator	Description
<code>`and`</code>	Returns True if both statements are true
<code>`or`</code>	Returns True if at least one statement is true
<code>`not`</code>	Reverses the logical state of its operand

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Membership Operators

Membership operators test for membership in sequences such as lists, tuples, or strings.

Operator	Description
<code>`in`</code>	Returns True if the value is found in the sequence
<code>`not in`</code>	Returns True if the value is not found in the sequence

Operator Precedence

When a calculation has multiple operators, each operator is evaluated in order of **precedence**

Operator	Meaning
()	Parentheses
**	Exponentiation (right associative)
*, /, //, %	Multiplication, division, floor division, modulo
+, -	Addition, subtraction
<, <=, >, >=, ==, !=	Comparison operators

Math Module

Importing a Module

A **module** is previously written code that can be imported in a program. The **import statement** defines a variable for accessing code in a module. Import statements often appear at the beginning of a program.

Function	Description	Examples
Number-theoretic		
<code>math.ceil(x)</code>	The ceiling of x: the smallest integer greater than or equal to x.	<code>math.ceil(7.4) → 8</code> <code>math.ceil(-7.4) → -7</code>
<code>math.floor(x)</code>	The floor of x: the largest integer less than or equal to x.	<code>math.floor(7.4) → 7</code> <code>math.floor(-7.4) → -8</code>
Power and logarithmic		
<code>math.log(x)</code>	The natural logarithm of x (to base e).	<code>math.log(math.e) → 1.0</code> <code>math.log(0) → ValueError: math domain error</code>

Math Module

Importing a Module

Example

```
import math

x1 = float(input("Enter x1: "))
y1 = float(input("Enter y1: "))
x2 = float(input("Enter x2: "))
y2 = float(input("Enter y2: "))
distance = math.sqrt((x2-x1)**2 + (y2-y1)**2)
print("The distance is", distance)
```

Module 3:

Control Statements

31st Dec 2024

Control Statements

Control statements are essential in Python programming as they dictate the flow of execution based on certain conditions.

They allow for decision-making, looping, and managing the sequence of operations.

Conditional Statements

If Statement

A **condition** is an expression that evaluates to true or false. An **if statement** is a decision-making structure that contains a condition and a body of statements. If the condition is true, the body is executed. If the condition is false, the body is not executed.

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

Conditional Statements

Elif example

```
hour = 9
if hour < 8:
    print("Too early")
elif hour < 12:
    print("Good morning")
elif hour < 13:
    print("Lunchtime")
elif hour < 17:
    print("Good afternoon")
else:
    print("Too late")
```


Conditional Statements

Chained Decisions (elif)

Sometimes, a complicated decision is based on more than a single condition.

```
if condition:
    # code to execute if condition is true
elif another_condition:
    # code to execute if another_condition is true
else:
    # code to execute if none of the conditions are true
```

Conditional Statements

Loops

A **loop** is a code block that runs a set of statements while a given condition is true. A loop is often used for performing a repeating task.

Two types of loops, **for** loop and **while** loop.

Uses:

Alarms

Sending messages

Conditional Statements

While Loop

A **while loop** is a code construct that runs a set of statements, known as the loop body, when given condition, known as the loop expression, is true. At each iteration, once the loop statement is executed, the loop expression is evaluated again.

- If true, the loop body will execute at least one more time (also called looping or iterating one more time).
- If false, the loop's execution will terminate and the next statement after the loop body will execute.

Conditional Statements

While Loop

Initialization

```
counter = 1
```

While loop condition

```
while counter <= 10:
```

```
    if counter % 2 == 1:
```

```
        print(counter)
```

Counting up and increasing counter's value by 1 in each iteration

```
    counter += 1
```

Conditional Statements

For Loop

. A **for loop** iterates over all elements in a container. Ex: Iterating over a class roster and printing students' names.

```
str_var = "My Name"  
count = 0  
for c in str_var:  
    print(c)  
    count += 1  
print(count)
```

Conditional Statements

Nested Loops

Example 1:

```
for i in range(1, 4):  
    for j in range(4):  
        print(i * j)
```

Conditional Statements

Nested Loops

Example2:

```
numbers = [12, 5, 3]
i = 0
for n in numbers:
    while i < n:
        print(i, end = " ")
        i += 2
    i = 0
    print()
```

Conditional Statements

Break and Continue

Break

A **break** statement is used within a **for** or a **while** loop to allow the program execution to exit the loop once a given condition is triggered. A **break** statement can be used to improve runtime efficiency when further loop execution is not required.

```
user_string = "This is a string."  
for i in range(len(user_string)):  
    if user_string[i] == 'a':  
        print("Found a at index:", i)  
        break
```


Conditional Statements

Break and Continue

Continue

A **continue** statement allows for skipping the execution of the remainder of the loop without exiting the loop entirely. A **continue** statement can be used in a **for** or a **while** loop. After the **continue** statement's execution, the loop expression will be evaluated again and the loop will continue from the loop's expression

```
i = 10
while i >= 0:
    i -= 1
    if i%3 != 0:
        continue
    print(i)
```

Conditional Statements

Loop else

A **loop else** statement runs after the loop's execution is completed without being interrupted by a **break** statement. A loop **else** is used to identify if the loop is terminated normally or the execution is interrupted by a **break** statement.

```
numbers = [2, 5, 7, 11, 12]
for i in numbers:
    if i == 10:
        print("Found 10!")
        break
else:
    print("10 is not in the list.")
```

Module 4: Functions and Modules

7th Jan 2025

Functions and Modules

Python functions and modules are essential components that facilitate code organization, reusability, and maintainability.

This section will cover the basics of defining and using functions, as well as creating and importing modules in Python.

Functions and Modules

Functions

A function in Python is a block of reusable code that performs a specific task. Functions can take inputs (arguments) and may return outputs (values).

They help in breaking down complex problems into smaller, manageable parts

In Python there are two types of functions; Built-in and User-defined functions

Functions and Modules

Functions

Types of Functions

Built-in Functions: These are pre-defined functions provided by Python, such as `print()`, `len()`, and `input()`.

User-defined Functions: These are functions created by the user to perform specific tasks. They are defined using the **def** keyword.

Functions and Modules

Functions

Syntax

```
def function_name(parameters):  
    # function body  
    return value # optional
```

Example

```
def add(a, b):  
    return a + b
```

```
result = add(5, 3) # result is 8
```

Functions and Modules

Modules

A module is a file containing Python code (functions, classes, variables) that can be reused in other programs. It allows for better organization of code.

To create a module, save your functions in a `.py` file.

Functions and Modules

Modules

Using Modules

To use a module, you import it using the `import` statement:

```
import mymodule
```

```
mymodule.greeting("Jonathan")    # Output: Hello, Jonathan
```

Functions and Modules

Modules

Importing Specific Elements

You can import specific functions or variables from a module:

```
from mymodule import greeting
```

```
greeting("Alice")    # Output: Hello, Alice
```

Functions and Modules

Modules

Importing with Aliases

You can create an alias for a module to simplify its usage:

```
import mymodule as mx
```

```
mx.greeting("Bob")    # Output: Hello, Bob
```

Functions and Modules

Positional and Keyword Arguments

Positional Arguments

They must be passed to the function in the same order as the parameters are defined in the function signature.

- **Order Matters:** The first positional argument corresponds to the first parameter, the second to the second parameter, and so on.
- **Mandatory:** All positional arguments must be provided when calling a function, unless default values are defined for some parameters.
- **Type Matching:** The types of the arguments should ideally match the expected types of the parameters.

Functions and Modules

Positional and Keyword Arguments

Keyword Arguments

Keyword arguments allow you to pass arguments to a function by explicitly specifying the parameter name along with its value.

- **Order Independence:** When using keyword arguments, you can specify them in any order.
- **Optional Parameters:** Keyword arguments can be used for optional parameters that have default values.
- **Clarity:** Using keyword arguments makes it clear what each argument represents, which is particularly useful in functions with many parameters.

Functions and Modules

Arguments

Variable-Length Arguments in Python (*args)

This allows the function to accept any number of positional arguments.

- **Tuple Storage:** All the extra positional arguments passed to the function are stored in a tuple.
- **Zero or More Arguments:** Functions can accept zero or more arguments when defined with `*args`.
- **Order of Parameters:** A regular positional parameter can precede `*args`, but not follow it. Keyword arguments can be included after `*args`.

Functions and Modules

Built in Modules

The **Python Standard Library** is a collection of built-in functions and modules that support common programming tasks.

Module	Description
calendar	General calendar-related functions.
datetime	Basic date and time types and functions.
email	Generate and process email messages.
math	Mathematical functions and constants.
os	Interact with the operating system.
random	Generate pseudo-random numbers.
statistics	Mathematical statistics functions.
sys	System-specific parameters and functions.
turtle	Educational framework for simple graphics.
zipfile	Read and write ZIP-format archive files.

Functions and Modules

Third-party modules

The **Python Package Index (PyPI)**, available at pypi.org, is the official third party software library for Python.

PyPI allows anyone to develop and share modules with the Python community. Module authors include individuals, large companies, and non-profit organizations. PyPI helps programmers install modules and receive updates

Module	Description
arrow	Convert and format dates, times, and timestamps.
BeautifulSoup	Extract data from HTML and XML documents.
bokeh	Interactive plots and applications in the browser.
matplotlib	Static, animated, and interactive visualizations.
moviepy	Video editing, compositing, and processing.
nltk	Natural language toolkit for human languages.
numpy	Fundamental package for numerical computing.
pandas	Data analysis, time series, and statistics library.
pillow	Image processing for jpg, png, and other formats.

Thank you