Python 1

A Self-Learning Guide

Part 2: Core Concepts

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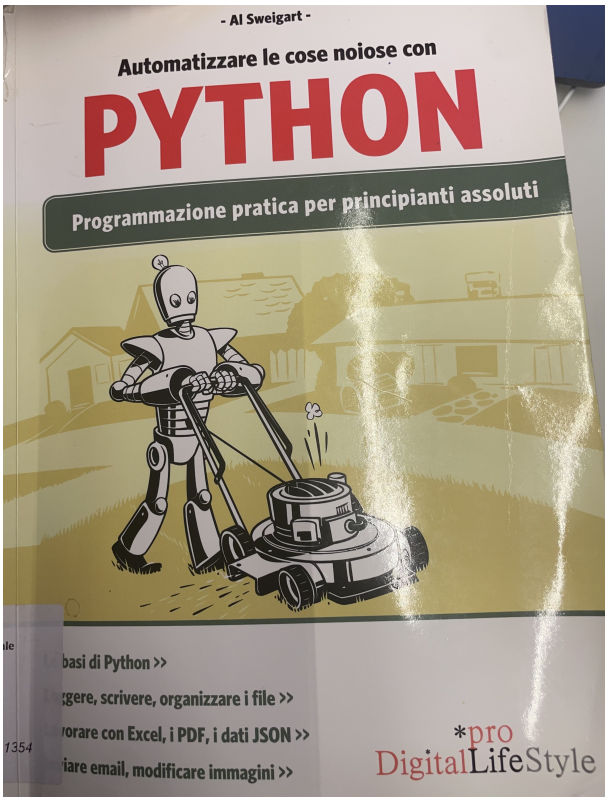

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Abstract

This guide explores fundamental Python programming concepts including functions, lists, dictionaries, and control structures. It provides practical examples and projects to reinforce learning through hands-on practice.

Contents

1 Introduction

Python has emerged as one of the most versatile and accessible programming languages for automation. This guide aims to provide a solid foundation in Python programming while focusing on practical applications that can save time and effort in everyday tasks.

2 Python Fundamentals

2.1 Data Types

In Python, different types of data are used to represent numbers, text, and more complex structures.

2.1.1 Numeric Types

- **Integer (int)**: Whole numbers without decimal points (e.g., `42`, `-10`)
- **Floating-point (float)**: Numbers with decimal points (e.g., `3.14`, `-0.001`)

2.1.2 String Notation

Strings in Python can be defined using several methods:

- **Single quotes**: `'Hello world'`
- **Double quotes**: `"Hello world"`
- **Triple quotes**: For multi-line strings `'''Hello nworld'''` or `"""Hello nworld"""`

2.1.3 String Operations

```
# Concatenation
>>> 'Alice' + 'Bob'
'AliceBob'

# Replication
>>> 'Alice' * 5
'AliceAliceAliceAliceAlice'
```

Listing 1: Basic string operations

2.1.4 Type Conversion

Python allows conversion between different data types:

```
# String to other types
>>> int('42')
42
>>> float('3.14')
3.14

# Numbers to string
>>> str(0)
'0'
>>> str(-3.14)
'-3.14'

# Integer to float and vice versa
>>> int(1.99)
1
>>> float(10)
```

```
10.0
```

Listing 2: Examples of type conversion

2.1.5 Type Equivalence

Even when the string representation of a number matches its numeric value, they are considered different types:

```
# String vs integer comparison
>>> 42 == "42"
False

# Integer vs float comparison
>>> 42 == 42.0
True

# Float formatting doesn't affect values
>>> 42.0 == 0042.000
True
```

Listing 3: Equality comparisons between data types

2.2 Variables

A variable serves as a container in computer memory where a single value can be stored and retrieved later.

2.2.1 Assignment Statement

Variables are assigned using the assignment operator `=`:

```
>>> spam = 40
>>> spam
40
>>> eggs = 2
>>> spam = 1 / eggs
>>> spam
0.5
>>> spam + eggs + spam
3.0
>>> spam = spam + 2
>>> spam
2.5
```

Listing 4: Variable assignment examples

2.2.2 Variable Naming Rules

Python has specific rules for valid variable names:

2.3 Operators

2.3.1 Arithmetic Operators

Python follows the PEMDAS order of operations:

Valid Variable Names	Invalid Variable Names
`balance`	`balance-current` (hyphens are not allowed)
`balanceCurrent`	`balance current` (spaces are not allowed)
`_private`	`4account` (cannot start with a number)
`SPAM`	`42` (cannot be just a number)
`account4`	`total_$` (special characters like $ are not allowed)
`snake_case`	`''` (empty strings are not allowed)

Table 1: Examples of valid and invalid variable names in Python.

1. **P**arentheses - Expressions inside `(...)` are evaluated first
2. **E**xponents - Powers (e.g., `x**y`) are evaluated next
3. **M**ultiplication and **D**ivision - `*` and `/` are evaluated from left to right
4. **A**ddition and **S**ubtraction - `+` and `-` are evaluated from left to right

Operator	Operation	Example	Result
`**`	Exponentiation	`2 ** 3`	8
`%`	Modulus (Remainder)	`22 % 8`	6
`//`	Floor Division	`22 // 8`	2
`/`	Division	`22 / 8`	2.75
`*`	Multiplication	`3 * 5`	15
`-`	Subtraction	`5 - 2`	3
`+`	Addition	`2 + 2`	4

Table 2: Python arithmetic operators listed in order of precedence.

3 Flow Control

Flow control statements allow for conditional execution and looping in code.

3.1 Boolean Expressions

Boolean expressions evaluate to either `True` or `False` and form the basis for decision-making in code.

3.1.1 Comparison Operators

3.1.2 Boolean Logic Operators

Boolean logic operators combine multiple conditions:

- `and`: Returns `True` if both conditions are `True`
- `or`: Returns `True` if at least one condition is `True`
- `not`: Inverts the value, turning `True` into `False` and vice versa

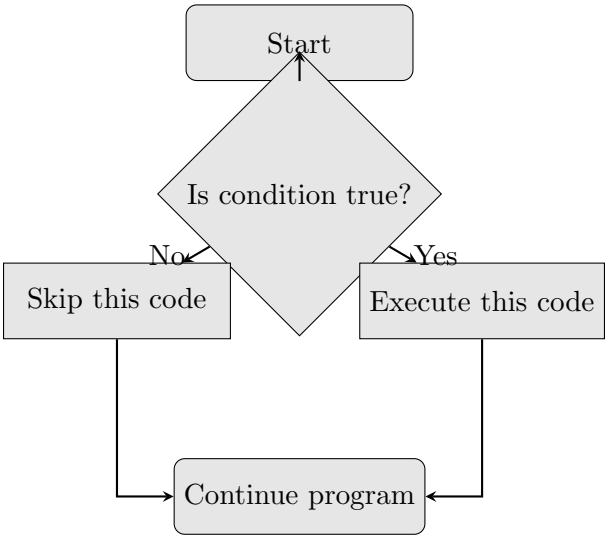

Figure 1: Flowchart demonstrating a basic decision-making process in programming.

Operator	**Meaning**
`==`	Equal to
`!=`	Not equal to
`<`	Less than
`>`	Greater than
`<=`	Less than or equal to
`>=`	Greater than or equal to

Table 3: Python comparison operators.

```
>>> True and True
True
>>> True and False
False
>>> False or False
False
>>> True or False
True
>>> not True
False
>>> not not not not True
True
>>> (4 < 5) and (5 < 6)
True
>>> (4 < 5) and (9 < 6)
False
>>> (1 == 2) or (2 == 2)
True
>>> 2 + 2 == 4 and not 2 + 2 == 5 and 2 * 2 == 2 + 2
True
```

Listing 5: Examples of Boolean operators

3.2 Conditional Statements

3.2.1 If Statements

Conditional execution is performed using `if`, `elif`, and `else` statements.

```
if name == 'Mary':
    print('Hello␣Mary')
    if password == 'swordfish':
        print('Access␣granted.')
    else:
        print('Incorrect␣password.')
```

Listing 6: Basic if-else statement

3.3 Blocks in Python

In Python, code blocks are defined by indentation rather than braces or keywords:

1. Blocks begin when indentation increases
2. Blocks can contain other blocks (nested blocks)
3. A block ends when indentation decreases to match an outer block or the file's base level

4 Loops and Iteration

Loops allow repetitive execution of code blocks.

4.1 While Loops

A `while` loop executes as long as its condition remains `True`:

```
spam = 0
while spam < 5:
    print('Hello, world.')
    spam = spam + 1
```

Listing 7: Basic while loop example

4.2 For Loops and range()

The `for` loop iterates over a sequence, often generated by the `range()` function:

```
print('My name is')
for i in range(5):
    print('Jimmy Five Times (' + str(i) + ')')
```

Listing 8: For loop with range() function

range() Call	Equivalent Sequence	Description
`range(5)`	`[0, 1, 2, 3, 4]`	Start at 0, end before 5
`range(1, 5)`	`[1, 2, 3, 4]`	Start at 1, end before 5
`range(0, 10, 2)`	`[0, 2, 4, 6, 8]`	Start at 0, increment by 2, end before 10
`range(5, 0, -1)`	`[5, 4, 3, 2, 1]`	Count down from 5 to 1

Table 4: Common uses of the range() function.

4.3 Loop Control Statements

Python provides several ways to control loop execution:

4.3.1 Break Statement

The `break` statement exits a loop immediately:

```
while True:
    print('Please enter your name.')
    name = input()
    if name == 'your name':
        break
    print('Thank you')
```

Listing 9: Using break to exit a loop early

4.3.2 Continue Statement

The `continue` statement skips the rest of the current iteration and jumps to the next iteration:

```
while True:
    print('Who are you?')
    name = input()
    if name != 'Joe':
        continue
```

```
    print('Hello, Joe. What is your password? (Hint: It\'s a type of
        fish.)')
    password = input()
    if password == 'swordfish':
        break
print('Access granted.')
```

Listing 10: Using continue to skip iterations

4.3.3 Terminating a Program

The `sys.exit()` function terminates a program completely:

```
import sys
while True:
    user_input = input("Enter 'exit' to stop the loop: ")
    if user_input.lower() == "exit":
        print("Exiting the program...")
        sys.exit()  # Terminates the script immediately
    print(f"You entered: {user_input}")
```

Listing 11: Using sys.exit() to terminate a program

5 Python Built-in Functions

Python provides many built-in functions for common operations.

5.1 Input and Output

- `print()`: Displays text or variables on the screen
- `input()`: Accepts user input as a string

5.2 String Manipulation

- `len()`: Returns the length of a string
- `str()`: Converts a value to its string representation

6 Comments in Python

Comments are used to document code and make it more understandable:

```
# Different ways to use comments in Python
print("Hello, World")  # This is an inline comment

# This is a full line comment

# print("This line won't run because it's commented out")

"""
This is a multi-line comment (technically a string literal)
It can span multiple lines
And is often used for docstrings
"""

```

```
# Comments can explain what code does
name = "Alice"  # Store user name
print(f"Hello, {name}")  # Greet the user

# Comments can explain why we do something
x = x + 1  # Increment to account for zero-indexing
```

Listing 12: Different ways to use comments in Python

7 Development Environment

Understanding your development environment is crucial for efficient Python programming.

Program Editor

```
# Python Program
def hello():
  print("Hello world")
name = input("Enter
name: ")
print(f"Hello, {name}")
for i in range(5):
  print(i)
```

Python Shell (REPL)

```
>>> name = "Python"
>>> print(f"Hello,
{name}")
Hello, Python
>>> 2 + 2
4
>>> for i in range(3):
... print(i)
...
0
1
2
>>>
```

Figure 2: Python development environment showing shell (REPL) on the right and program editor on left.

8 Advanced Topics

8.1 Exception Handling

Python provides mechanisms to handle errors gracefully:

```
try:
    age = int(input("Enter your age: "))
    years_to_100 = 100 - age
    print(f"You will be 100 in {years_to_100} years")
except ValueError:
    print("That's not a valid age")
except:
    print("An unexpected error occurred")
finally:
    print("Thank you for using this program")
```

Listing 13: Basic exception handling

8.2 File Operations

Python makes working with files straightforward:

```
# Reading a file
with open('data.txt', 'r') as file:
    content = file.read()
    print(content)

# Writing to a file
with open('output.txt', 'w') as file:
    file.write('Hello, world!\n')
    file.write('This is a test file.')
```

Listing 14: Basic file operations