Lesson 1: Types, Variables, and Operators in Python

Marcin Kurzyna

Lecture Goals

This lecture introduces the basics of Python programming: variables, basic data types, and operators. By the end, students should be able to:

- Write and run a simple Python script.
- Understand how variables and data types work.
- Use arithmetic and string operations in Python.

1 Python Overview

Python is a high-level, interpreted programming language known for its readability and simplicity. Unlike Java or C++, it does not require compilation — Python code runs directly in an interpreter.

You can run Python code:

- In an interactive shell (REPL).
- As a script file (`.py`).

Example:

```
print("Hello, world!")
```

2 Variables and Data Types

A **variable** is a name that refers to a value stored in memory. In Python, you do not need to declare the type — it is determined automatically.

Type	Example
`bool`	`True`, `False`
`int`	`12`
`float`	`7.86`
`str`	`"Hello World!"`

Example declarations:

```
course = "Programming in Python"
number = 2.11
is_january = True
```

3 Assignment and Expressions

An assignment statement uses the operator =:

```
x = 5
x = x + 2  # now x holds 7
```

The expression on the right is evaluated first, and its value is stored in the variable on the left.

4 Operators and Precedence

Common arithmetic operators:

+, -, *, /, //, %, **

Operator precedence (from highest to lowest):

1. Parentheses ()
2. Exponentiation **
3. Multiplication, division, floor division, modulus
4. Addition, subtraction

Example:

```
result = 1.0 + 2.0 * 3.0
print(result)  # prints 7.0
result = result / 2.0
print(result)  # prints 3.5
```

5 String Operations

Strings can be combined using the + operator or repeated with *:

```
text = "hello" + " world"
text = text + " number " + str(5)
print(text)
# result: "hello world number 5"

repeat = "ha" * 3
print(repeat)  # prints "hahaha"
```

6 Example: Gravity Calculator

Example program to compute the position of a falling object using:

$$x(t) = \frac{1}{2}at^2 + v_i t + x_i$$

```
gravity = -9.81  # Earth's gravity (m/s^2)
initial_velocity = 0.0
falling_time = 10.0
initial_position = 0.0

final_position = 0.5 * gravity * falling_time**2 \
                 + initial_velocity * falling_time \
                 + initial_position

print(f"The object's position after {falling_time} seconds is {
   final_position} m.")
```

Summary

This lecture introduced:

- How to write and run simple Python scripts.
- Variables and data types in Python.
- Basic arithmetic and string operations.

7 Exercises

1. Write a Python script that prints your name and your favorite number on separate lines.
2. Modify the first example to print two lines of output: `"Hello World"` and `"Welcome to Python!"`.
3. Create variables of each basic type (`int`, `float`, `bool`, `str`) and print them.
4. Write a program that computes and prints the sum, difference, product, and quotient of two numbers (for example, 12 and 5).
5. Write a Python script that converts a temperature in Celsius to Fahrenheit using:

$$F = \frac{9}{5}C + 32$$

   Print both the input temperature in Celsius and the result in Fahrenheit.
6. Given two integers, compute and print their average as a `float`. Make sure the result includes a decimal even if both numbers are integers.
7. Demonstrate the difference between integer division and floating-point division:

```
print(5 // 2)
print(5 / 2)
```

8. Modify the Gravity Calculator program to use a different initial velocity (e.g. `5.0`) and falling time (e.g. `20.0`). Observe how the result changes.

9. Create a program that concatenates three strings (for example, your first name, middle name, and last name) and prints the full name.

10. Challenge: Write a program that computes and prints:

$$\frac{(3+4)\times 5}{2}$$

    Then modify the program to use variables `a`, `b`, `c`, and `d` for each number.