Python for Data Science and Machine Learning

School Year 2023-2024

IST

Introductions

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Introductions - Icebreaker

- What is your name?
- What grade are you in?
- What operating system do you use at home?
- Have you programmed before?

Course Structure

1	Introduction to Python	OCT 19	OCT 26	NOV 9	NOV 16	NOV 23	NOV 30
2	Introduction to Data Science	DEC 7	DEC 14	DEC 21	JAN 11	JAN 18	
3	Introduction to Machine Learning	JAN 25	FEB 1	FEB 8	FEB 22		
4	Data Science & ML Challenge	FEB 29	MAR 7				

= Core Topics = Optional Topics

Course Objectives

- Learn to code using the **Python programming language**.
- Learn to use **Jupyter Notebooks** to write programs.
- Learn to use **Data Science** libraries to analyse datasets.
- Discover **Machine Learning** fundamentals, applying them to real-world challenges.

What is Coding?

Coding is the process of writing and creating **instructions in a programming language** to instruct a computer to **perform specific tasks** or functions.

What is Data Science?

Data science is the practice of **extracting insights** and knowledge **from data** using statistical methods and data analysis. It involves **data collection, cleaning, and analysis** to inform decision-making.

What is Machine Learning?

Machine learning is a branch of **artificial intelligence** that focuses on **developing algorithms and models** that enable **computers to learn and make predictions** or decisions from data without being explicitly programmed.

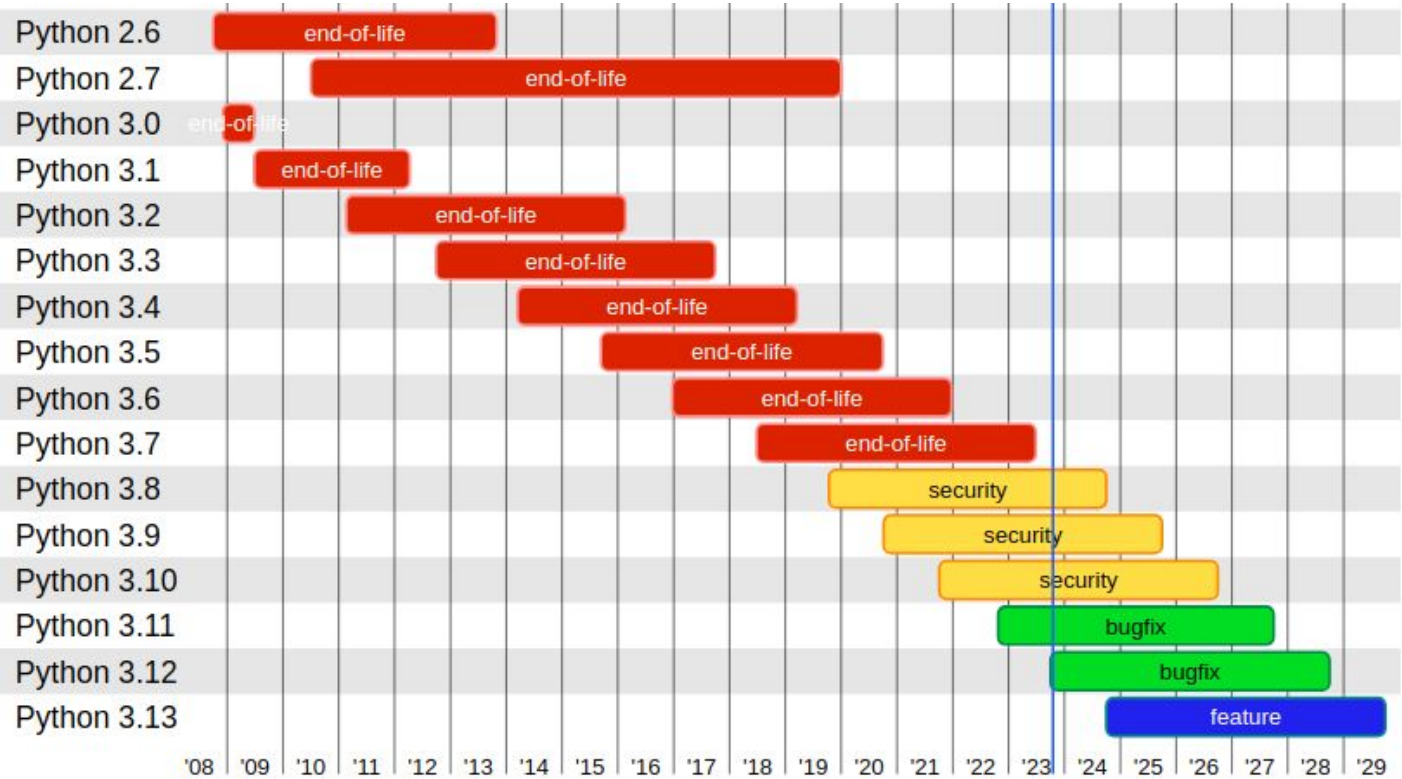
Programming Languages

- Python
- C
- C++
- Java
- PHP
- Javascript
- MATLAB
- Assembly
- … many, many more!

Brief History of Python

- Python was created by Guido van Rossum in the late 1980s.
- It was first released in 1991 as Python 0.9.0.
- Python 3.12 just released this month.

Python versions



Why use Python?

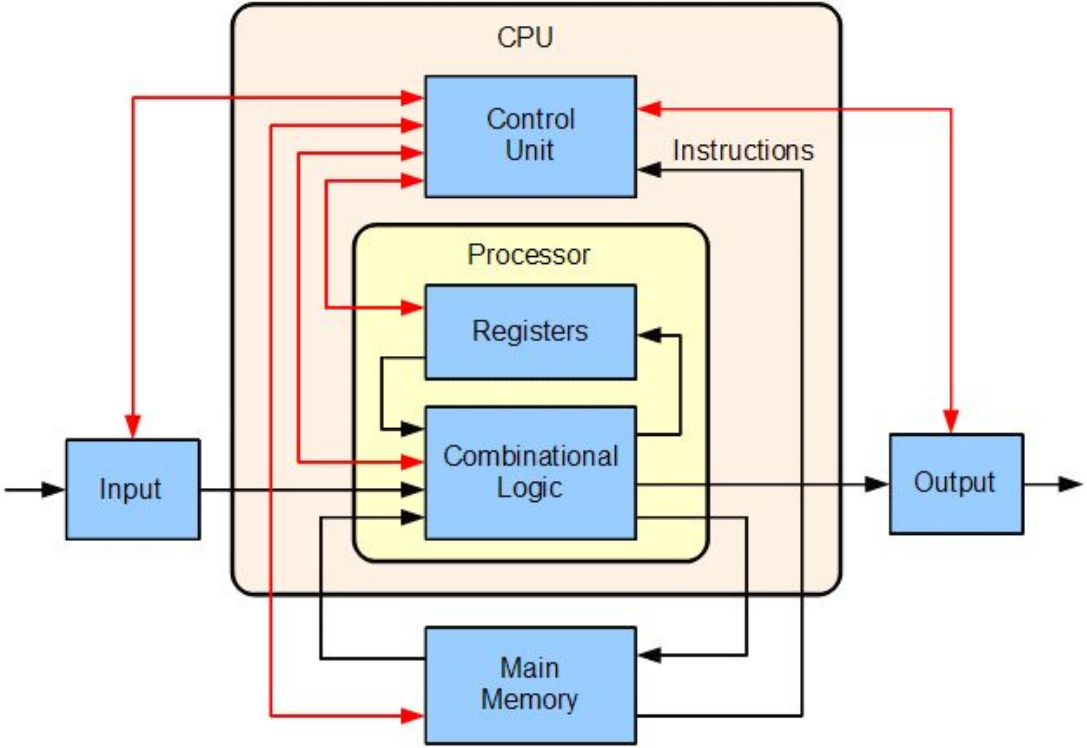
- **Simplicity**: Easy-to-read syntax.
- **Versatility**: Suitable for data analysis, and more.
- **Rich ecosystem**: Vast third party libraries and frameworks.
- **Community support**: Large and active community ensures access to resources and solutions.

What is a Program?

A program is a **set of instructions** or a sequence of code **written in a programming language** to tell a computer how to perform a specific task or solve a particular problem.

These **instructions** are designed to be **executed by the** computer's central processing unit (**CPU**).

Inside a CPU

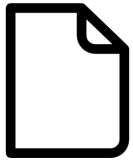

CPU
Control Unit
Instructions
Processor
Registers
Combinational Logic
Input
Output
Main Memory

Machine Instructions (ARM Assembly)

program1.s

```
mov     r0, #42
mov     r1, #10
mov     r2, #5
add     r0, r0, r1
add     r0, r0, r2
```

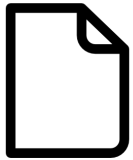
Machine Instructions (ARM Assembly)



program2.s

```
mov     r0, #5
mov     r1, #6
mov     r2, #7
cmp     r1, r2
movlt   r1, r2
cmp     r0, r1
movlt   r0, r1
```

Anatomy of a Python Program



program1.py

```
x = 42

y = 10

z = 5

x + y + z
```

Python VS Assembly

program1.py

```python
x = 42
y = 10
z = 5
x + y + z
```

VS

program1.s

```asm
mov     r0, #42
mov     r1, #10
mov     r2, #5
add     r0, r0, r1
add     r0, r0, r2
```

Python VS Assembly

program3.py

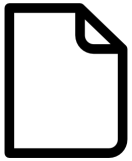
VS

program3.s

```python
print("Hello World!")
```

```
.LC0:
        .ascii  "Hello, World!\000"
main:
        push    {r3, lr}
        movw    r0, #:lower16:.LC0
        movt    r0, #:upper16:.LC0
        bl      puts
        movs    r0, #0
        pop     {r3, pc}
```

Executing a Python Program



file.py

```
python file.py
```

```
$ python file.py
Hello World!
```

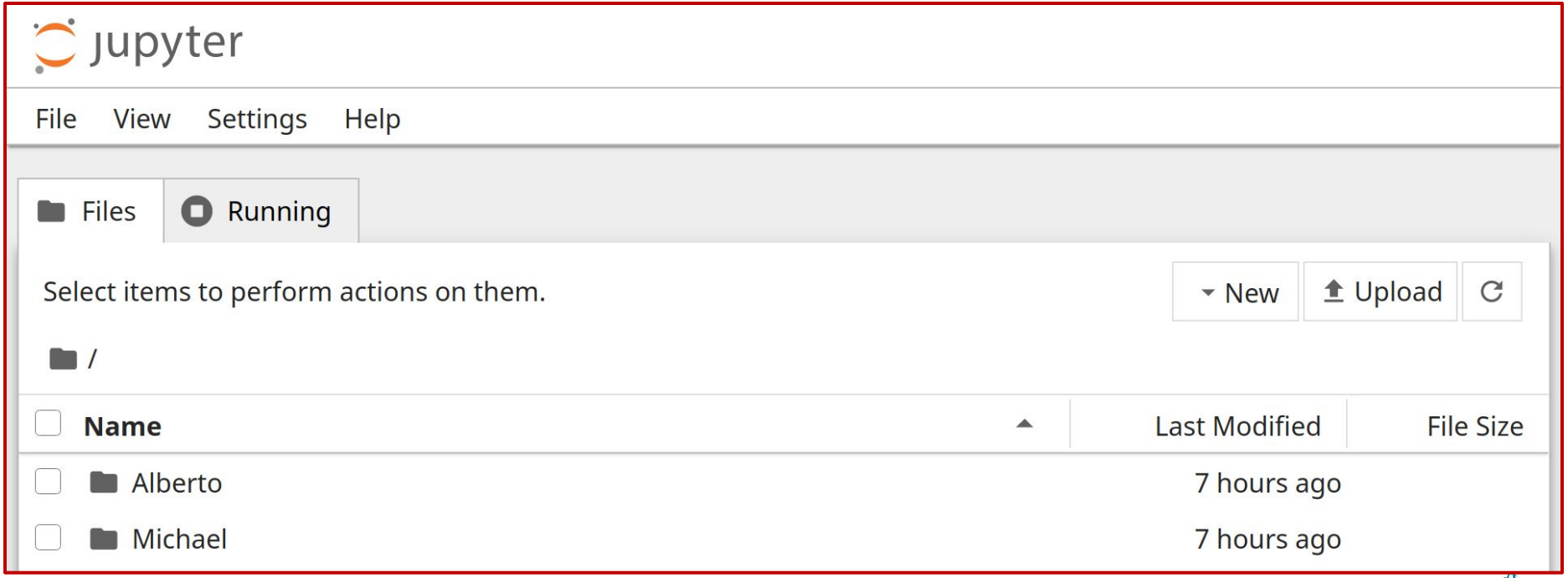
Jupyter Notebook Setup

In a browser:

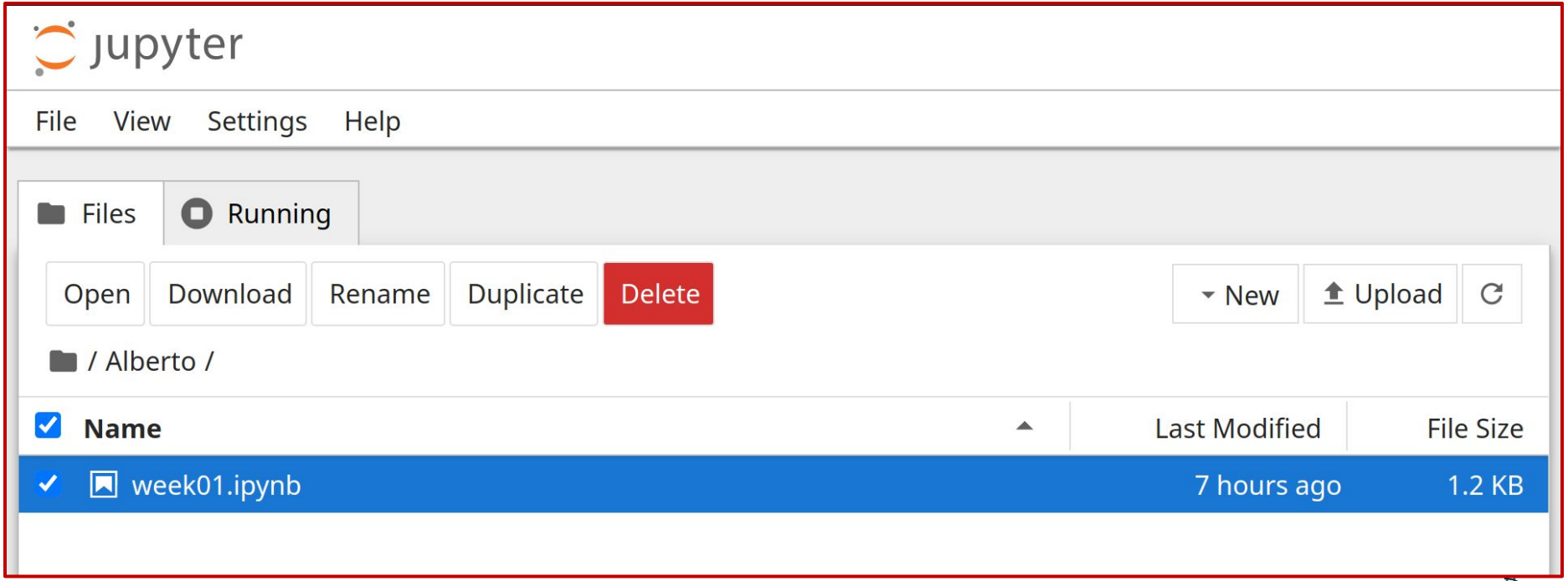
```
192.168.10.4:8888
```

Password: **ist**

Jupyter Notebook Setup



Jupyter Notebook Setup

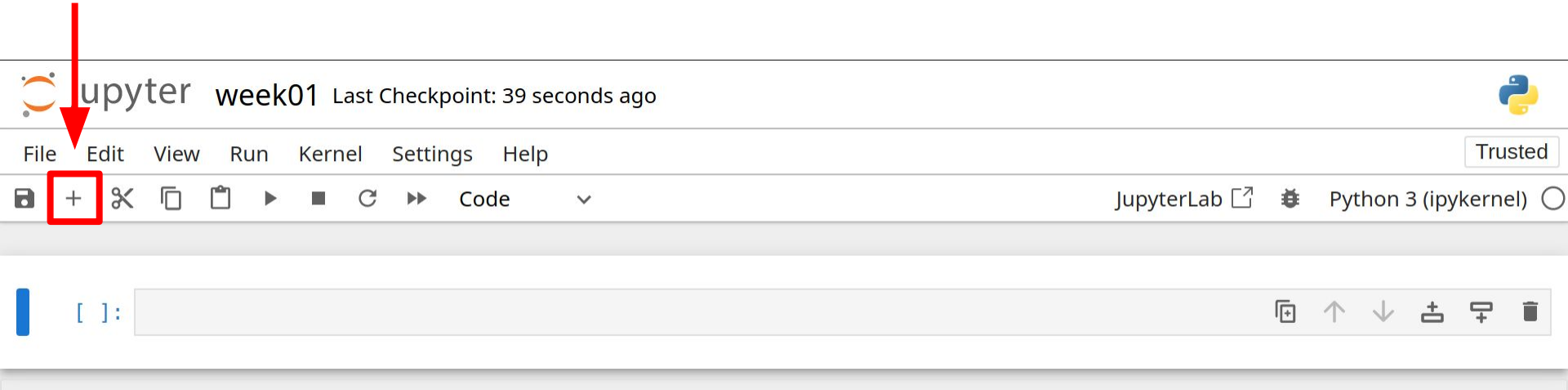


Jupyter Notebook Structure

Code Cell / Editor

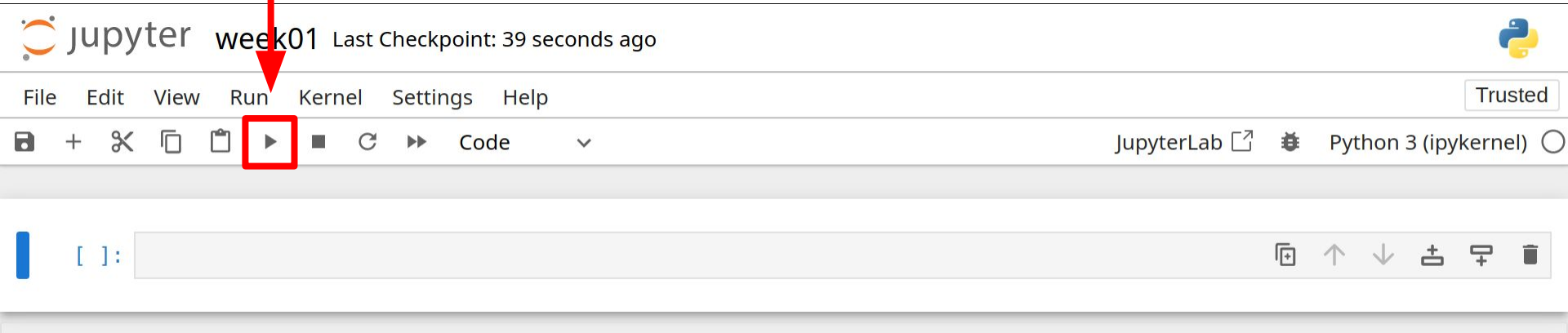
Jupyter Notebook Structure

Add Cell



Jupyter Notebook Structure

Run Cell



Variables

A variable is a named container that stores data or values.

```
x = 42
y = "Hello"
```

Variable declarations must contain a variable name followed by an equals sign (**=**).

```
variable = "I am a variable"
also_valid_variable_name = "I am also a variable"
```

Output

The **print** function can be used to display variables and values

```
print("Hello World!")
print(123)
```

```
x = 42
print(x)
```

```
y = "Hello"
print(y)
```

Data Types

Python has 4 primitive data types:

int `42` `1200` `1_200` `-3`

float `3.14` `0.00001` `-2.1`

str `"Hello"` `"A"` `"I am a full sentence!"`

bool `True` `False`

The `type` function

You can use the **type** function to get the type of a variable

```
print(type(True))

print(type(42))

print(type("Hello"))

print(type(3.14))
```

Notebook TIP!

Jupyter Notebooks will automatically print the return value of the final line in a Notebook cell.

```
[12]: print(type(123))

      <class 'int'>

[13]: type(123)

[13]: int
```

```
[14]: x = 1234
      y = 4567

      x
      y

[14]: 4567
```

Changing the value of variables

You can mutate the value you assign to a variable

```
x = 42
print(x)

x = 200
print(x)

x = "Hello"
print(x)
```

Arithmetic Operations

You can perform arithmetic with variables

```
x = 9
y = 3
print(x + y)
print(x - y)
print(x * y)
print(x / y)
```

What is the output type of the division operation?

Order of Operations

What is the output of the following expression, and why?

```
x = 6 + 9 / 3 * 10
print(x)
```

Order of Operations

What is the output of the following expression, and why?

```
x = 6 + 9 / 3 * 10
print(x)
```

You can change the order of operations with parentheses:

```
x = (6 + 9) / 3 * 10
print(x)
```

New Operators

What operation is the **%** operator performing?

```
x = 6 % 3
print(x)

y = 12 % 5
print(y)
```

New Operators

What operation is the **%** operator performing?

```
x = 6 % 3
print(x)

y = 12 % 5
print(y)
```

It's the remainder operator (also called **modulo**).

How does the modulo operator behave with floats?

Arithmetic with Strings

What happens if you try to perform arithmetic with strings?

```
x = "Hello"
y = 3
print(x * y)
```

```
x = "Hello"
y = "World"
print(x * y)
```

```
x = "Hello"
y = 3
print(x + y)
```

```
x = "Hello"
y = "World"
print(x + y)
```

Type Casting

You can convert from one type to another

```
x = "123"
y = int(x)
print(y)
print(type(y))
```

```
x = "23.88"
y = float(x)
print(y)
print(type(y))
```

Comparisons

- 5 is larger than 3

```
5 > 3
```

- -5 is larger than 9

```
-5 > 9
```

- 2 is the same as 2

```
2 == 2
```

- 2 is less than 6

```
2 < 6
```

Chaining Comparisons

- not (negation)

```
not True
```

```
not (5 < 3)
```

- and (both must be true)

```
(5 < 6) and (5 < 10)
```

- or (either must be true)

```
(5 < 3) or (5 < 10)
```

End of Class

See you all next week!