Introduction to Programming with Python

Session 1

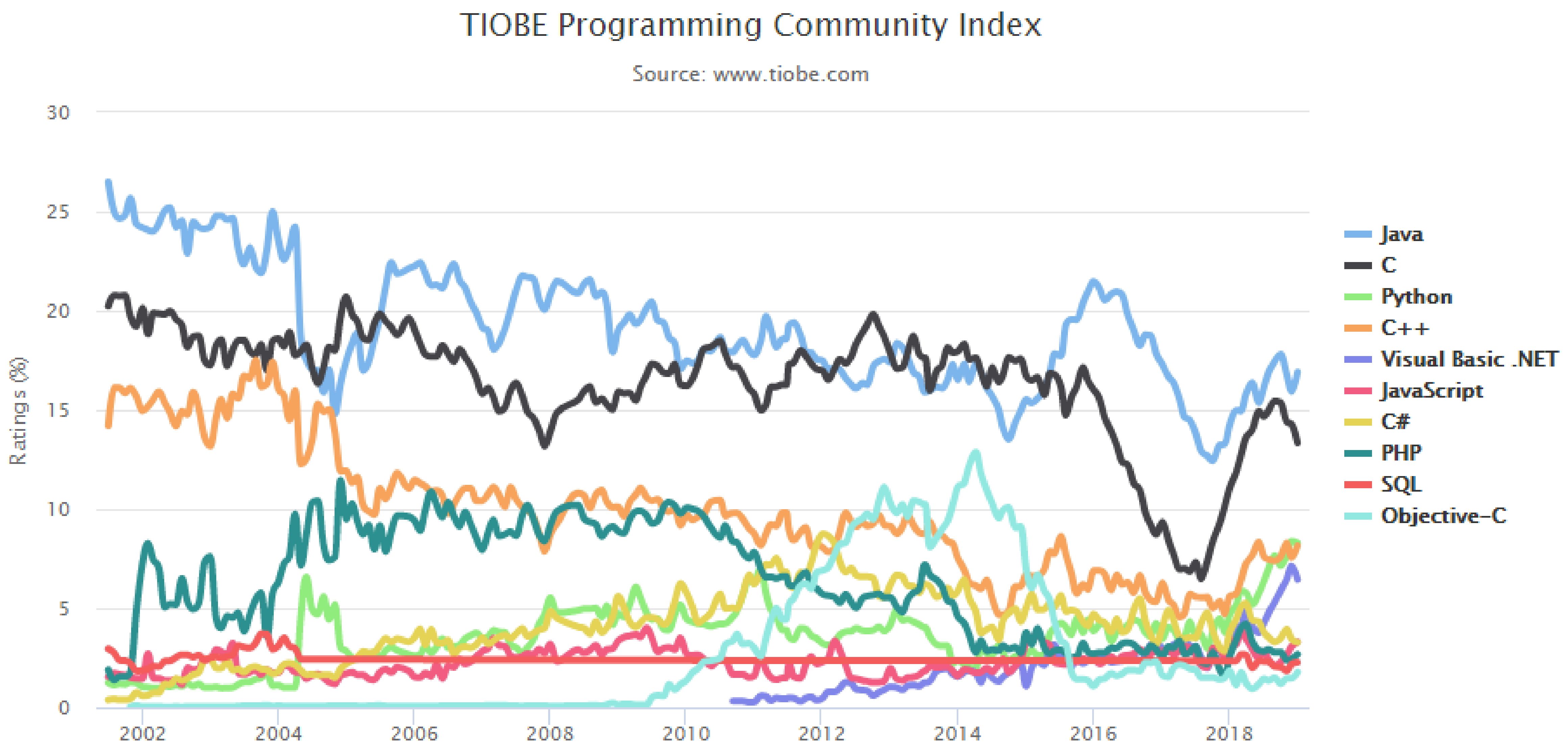
Introduction to computers and Python

Objectives

- To get a brief overview of what Python is
- To understand computer basics and programs
- To understand what statement, variable and expressions are
- To explain the differences between syntax errors, runtime errors, and logic errors.

Python’s popularity

Python was named TIOBE's programming language of the year 2018, as it gained most ranking points if compared to all other languages.



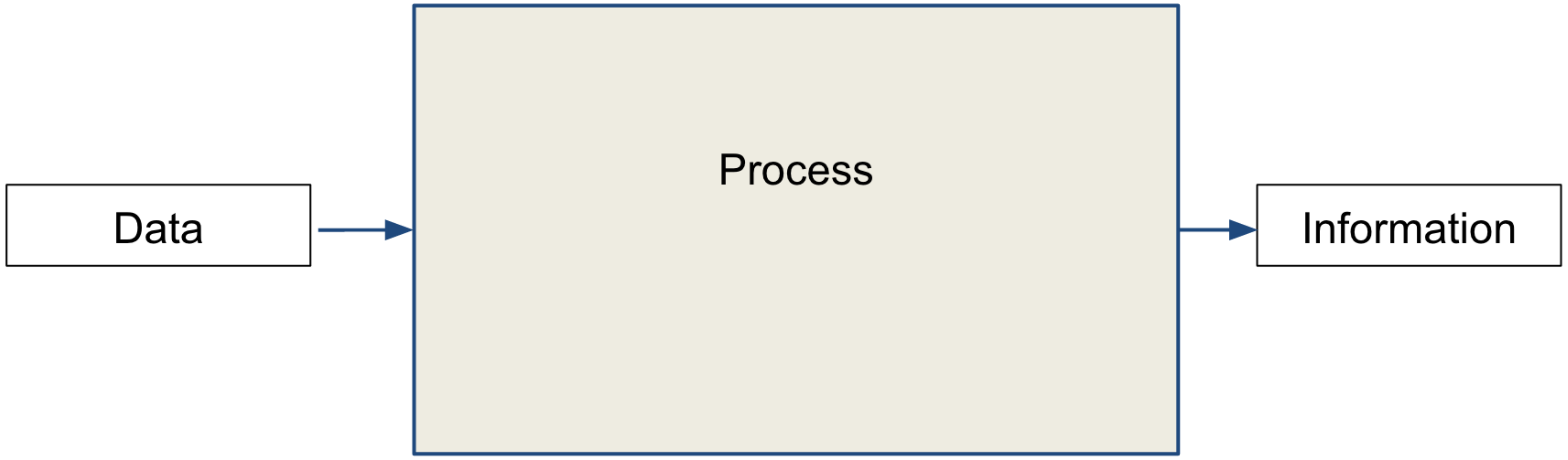
CITY
UNIVERSITY OF LONDON
EST 1894

Who uses Python?

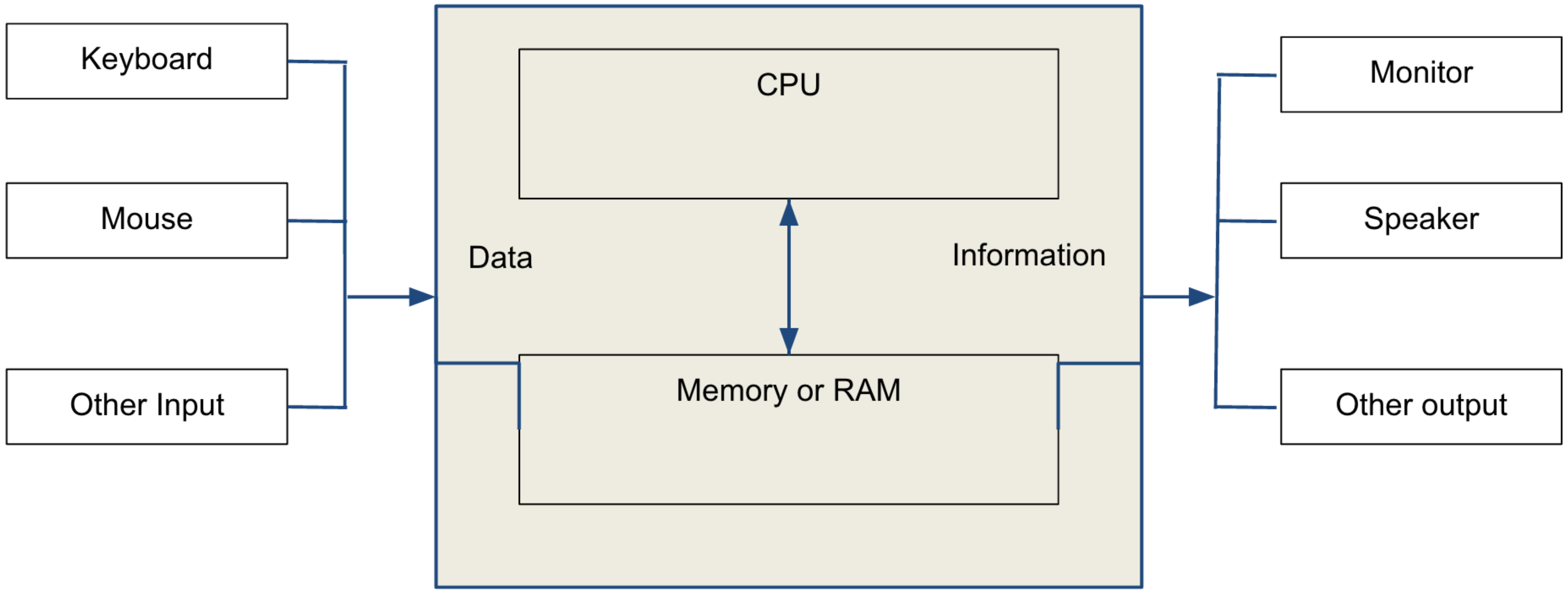
cars.com
Confidence Comes Standard.
Massachusetts Institute of Technology
FreeBSD
NetBSD
NASA
Walt Disney Animation Studios
NOKIA Connecting People
YAHOO!
instagram
redhat
evite.com
Atlassian bitbucket
YouTube
LexisNexis
Consumer Notebook
National Weather Service
CANONICAL
Los Angeles Times
EVE ONLINE
ebay
ableton
mozilla Firefox
Google
bit.ly
AstraZeneca
reddit
Quora
TRUECar Know the Real Price
Dropbox
INDUSTRIAL LIGHT & MAGIC
A LUCASFILM COMPANY

Before going more into details... What is a computer? (1/2)

An electronic device that is receiving data input; storing data (in RAM); processing data (in CPU); and producing information as output.



What is a computer? (2/2)



What is a program?

- Computer programs, known as software, are *instructions to the computer.*
- You tell a computer what to do through programs. Without programs, a computer is an empty machine. Computers do not understand human languages, so you need to use computer languages to communicate with them.
- Programs are written using programming languages.

Different types of Programming Languages

- **Machine language** is a set of primitive instructions built into every computer. The instructions are in the form of binary code. The programs in machine language are very difficult to read and modify. For example, to add two numbers, you might write an instruction in binary like this:

  1101101010011010

- **High-level languages** mostly use keywords taken from, or inspired by, the English vocabulary and are easy to learn. For example, the following is a high-level language statement that multiplies two numbers:

Computers work using binary logic.

- It is extremely difficult for humans to program in binary.
- Computer languages have to be translated to binary logic for the computer to understand.
- Two types of translation:
  - Compilation
  - Interpretation

Compilation (1/2)

- The compiler translates the entire source code into a program for the target machine (object code).
- The object code is then loaded onto the target machine and executed.
- Translation and execution are separate activities.

Compilation (2/2)

- Advantages:
    - Programs are only translated once, and the execution can be remote from the target machine.
    - Execution is fast, because it is not interleaved with translation.
    - The source code does not have to be available.
- Disadvantages:
    - Run-time checks are more difficult, and are usually not performed.
    - Compilers tend to be large complex programs.

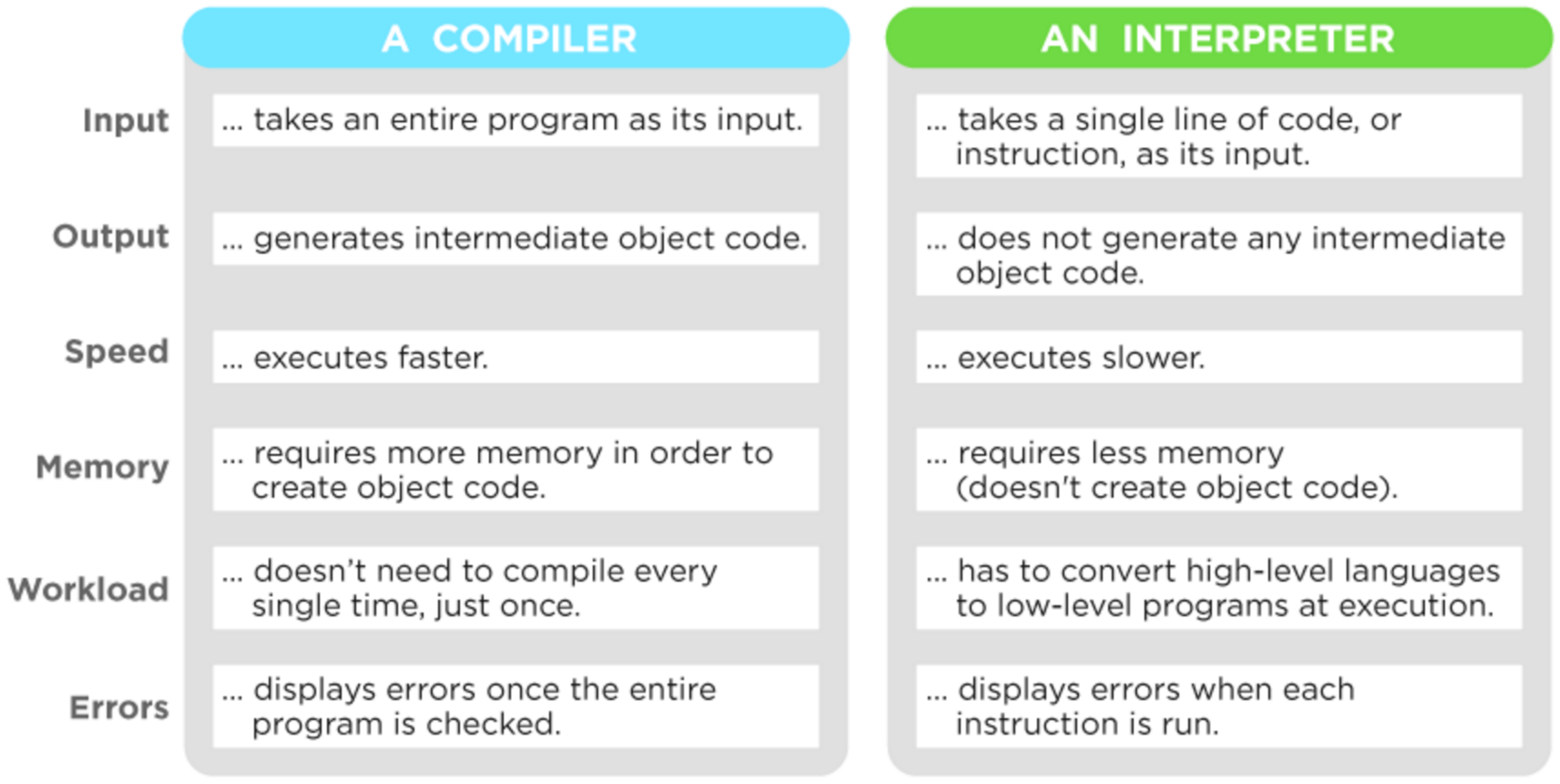
Interpretation (1/2)

- A software that translates each statement of a source code and executes it to the target machine's language.
- Cycle of actions:
  - Read one statement from the source code.
  - Translate it into one or more statements in the target machine's language.
  - Execute those statements on the target machine.
- Translation and execution are interleaved.

Interpretation (2/2)

- Advantages:
  - At run-time, the interpreter knows the current situation on the target machine, and it is therefore easier to perform runtime checks.
  - Interpreters are usually small programs.
- Disadvantages:
  - The interleaving of translation and execution means that programs are translated each time they are executed, and execution is therefore slow.
  - The source code has to be made available.

Comparison of interpreted vs compiled



	A COMPILER	AN INTERPRETER
Input	… takes an entire program as its input.	… takes a single line of code, or instruction, as its input.
Output	… generates intermediate object code.	… does not generate any intermediate object code.
Speed	… executes faster.	… executes slower.
Memory	… requires more memory in order to create object code.	… requires less memory (doesn't create object code).
Workload	… doesn't need to compile every single time, just once.	… has to convert high-level languages to low-level programs at execution.
Errors	… displays errors once the entire program is checked.	… displays errors when each instruction is run.

Python Syntax

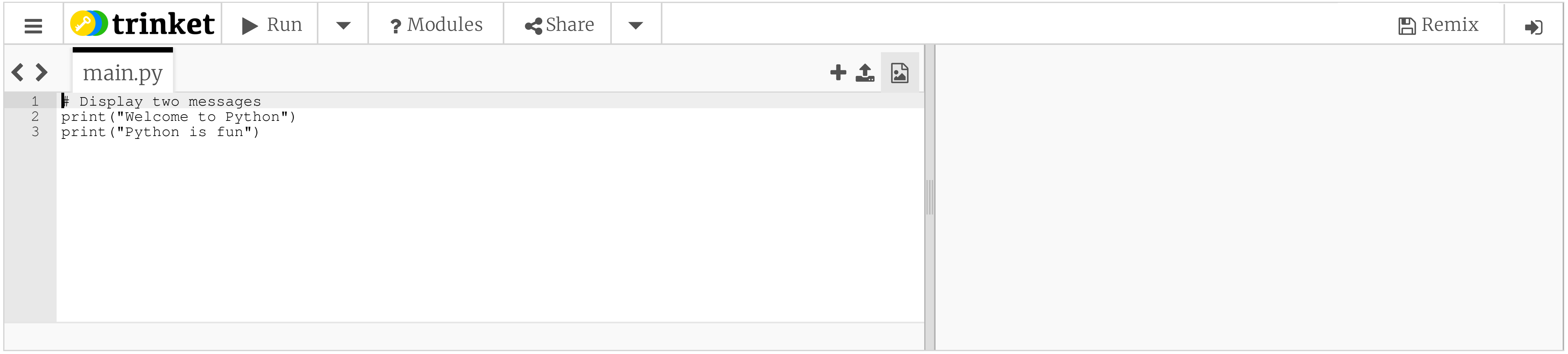
- Statement
- Variable
- Expression
- Indentation
- Comments

Python Syntax - Statement

A statement represents an action or a sequence of actions. It **does something**.

To display the greeting "Welcome to Python", we use the **print** statement:

```
print("Welcome to Python")
```



```
# Display two messages
print("Welcome to Python")
print("Python is fun")
```

Python Syntax - Expression

It represents something, like a number or a string.
Expressions are nothing but values, except they can have operations like addition or subtraction.

```
1 # is an expression
2 + 3 # is also an expression
"hello" # as well
```

Variable 1

It is a space created in memory (in RAM) where we can temporarily store values or data. We use the sign **'='** for assigning a value to a variable.

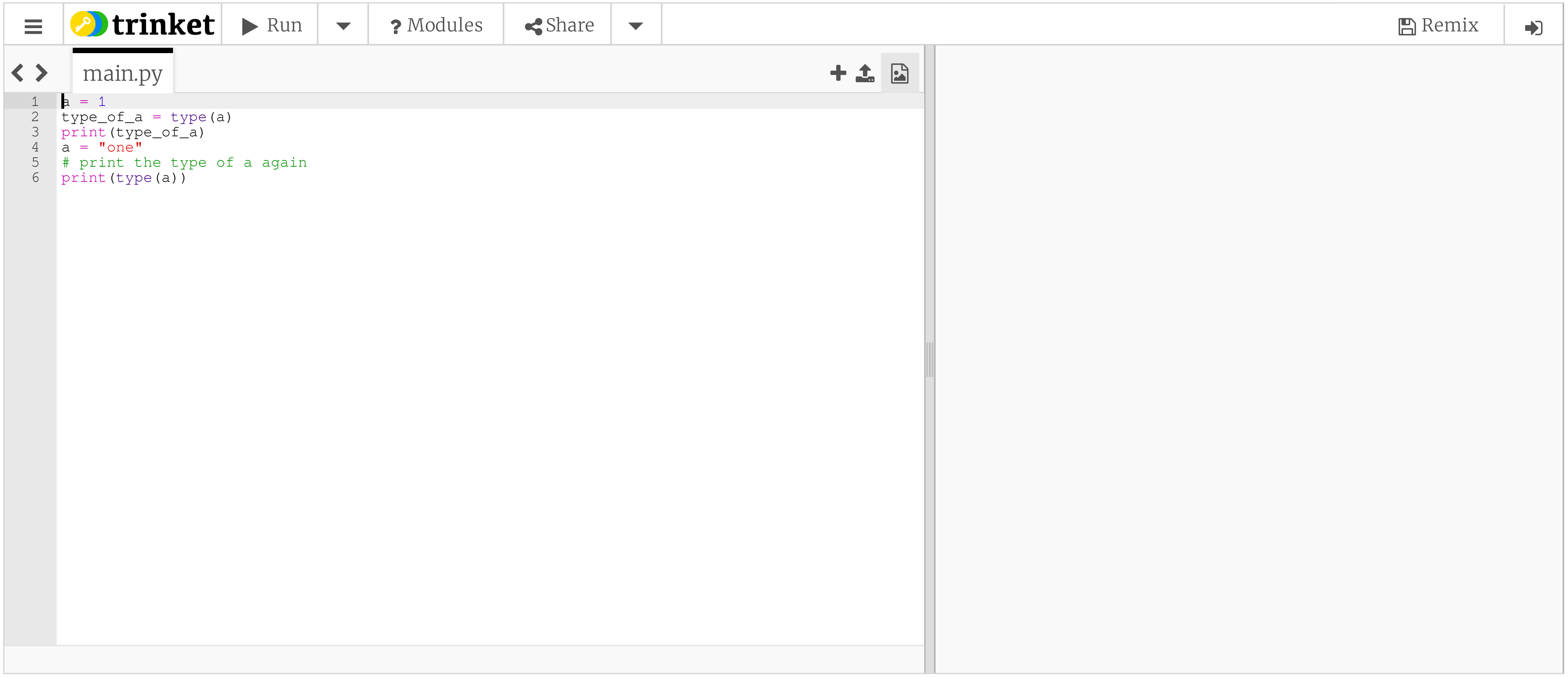
You can think of it like a box. For example, we store the value (or expression) 1 in the box (i.e the variable) **a**.

Notice that we do not specify the type of the variable, python sees it automatically. This is what we call the "duck typing" or "dynamic typing"

```
a = 1
```

Variable 2

You can use the **type** builtin function to determine the type of a value or variable

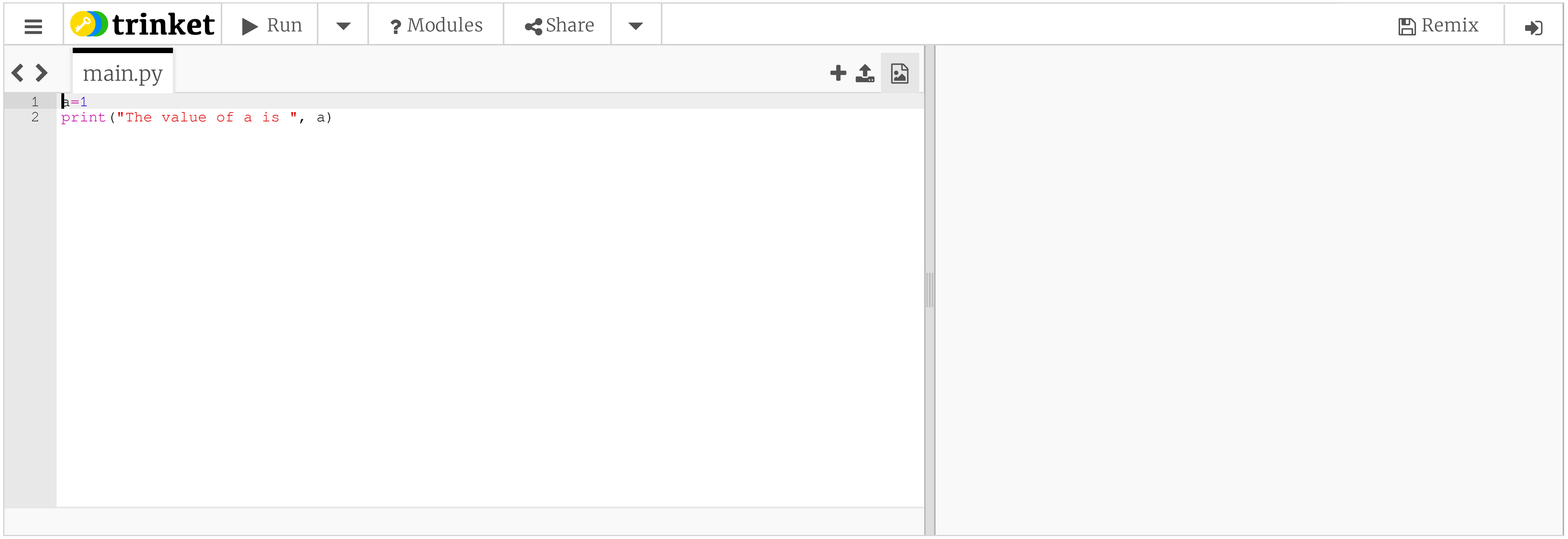


```python
a = 1
type_of_a = type(a)
print(type_of_a)
a = "one"
# print the type of a again
print(type(a))
```

Variable 3

```
a = 1
```

The variable has a name so that we can reuse it. When we use a variable, it is for retrieving the value that it is holding.



```
a=1
print("The value of a is ", a)
```

Variables 4: dynamic typing

- Python has strong dynamic typing
  - No need to declare the type of the variable
  - Python recognises the type according to the value of the variable

```
my_variable = 100
print(type(my_variable))  # will print <class 'int'>
my_variable="100"  # notice the quote for a string dat
print(type(my_variable))  # will print <class 'str'>
```

Variables 5: case sensitive

- Python is case sensitive

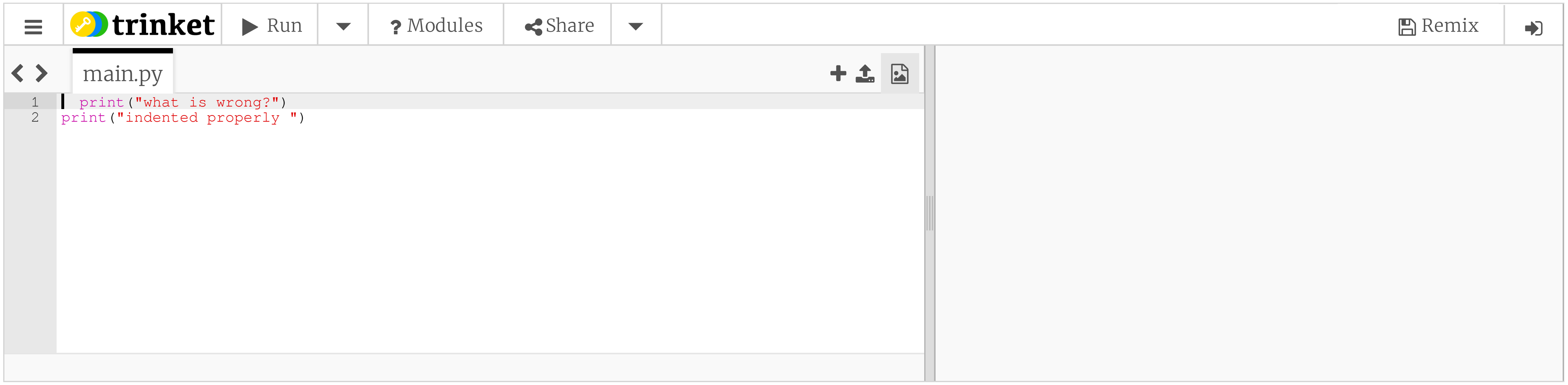
```
My_variable = 100
print(id(my_variable))
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
NameError: name 'my_variable' is not defined
```

Python Syntax - Indentation

The indentation is the increase or decrease of space between the left margin and the first character of the line.

The code need to be properly indented, else python will raise an error.

For example, what is wrong here?



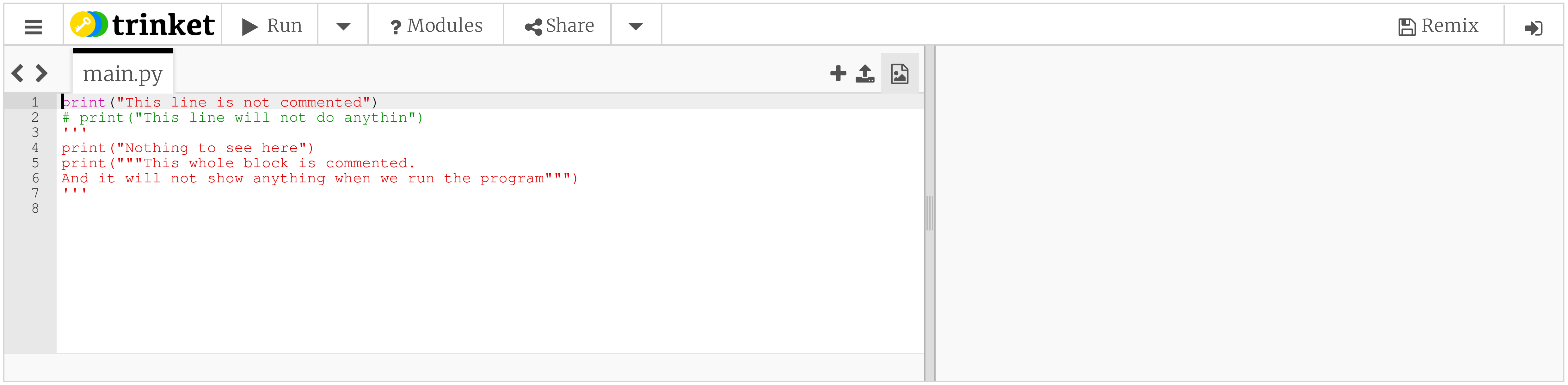
```
 print("what is wrong?")
print("indented properly ")
```

Python Syntax - Comments

If you want to comment a line, you can use the **#** (pound sign) that you place before the commented line

You can also comment multiple lines using ''' (triple quote) before and after the commented paragraph

Example



```python
print("This line is not commented")
# print("This line will not do anythin")
'''
print("Nothing to see here")
print("""This whole block is commented.
And it will not show anything when we run the program""")
'''

```

The IDE (1/2)

- We are going to familiarize ourselves with Pycharm.
  - Pycharm is an IDE (Integrated Development Environment), it helps you to write code with syntax highlighting, auto-completion and a lot of other features.
  - Open the python terminal from Pycharm by going to: View > Tool Windows > Python Console
  - The python terminal is useful for experimenting python code directly, without to run or "launch" a script

The IDE (2/2)

- To run a python script
  - Select the project that you have just created and do a right click and select "New" and "Python file"
  - Notice the extension of the file that you have created, it should be **.py**
  - Write `print("Hello World")` in the file
  - You can then run the file as a python script: in the menu at the top you click on Run and Run

Experimenting with the python shell in the IDE

You can do simple arithmetic operations

```
x = 1                  # Assign 1 to variable x
radius = 1.0           # Assign 1.0 to variable radius

# Assign the value of the expression to x
y = 5 * (3 / 2) + 3 * 2

x = y + 1        # Assign the addition of y and 1 to x
area = radius * radius * 3.14159 # Compute area
```

Exercise 1: run the code as a python script

After having experimented in the python shell (or python interpreter):

- Take the previous script and put it in a **NEW** python file.
- Run the script

Exercise 2:

Add a python file to the project

- Download the python file with this link (right click and save as)
- Run the script in Pycharm
- Change the value of the variable to create your email at city (with the extension @city.ac.uk)
- Can you explain what is the operator "+" for a string?

The different type of errors (1/3)

Syntax Error

For example, when we forget a quote to close a string

```
print("Welcome to Python)
```

The different type of errors (2/3)

Runtime Error

For example a division by zero (which is impossible)

```
print(1/0)
```

The different type of errors (3/3)

Logic error

When a program is not doing what we want it to do.

For instance, a wrong formulae for converting pound in kg

```
pounds = float(input("Enter weight in pound: "))
# convert pound in kilogramme
kilograms = pounds / 0.454
```

It should be:

```
pounds = float(input("Enter weight in pound: "))
# convert pound in kilogramme
kilograms = pounds * 0.454
```

Exercise 3:

Write a program that converts pounds into euros.

- The values can be hard coded for now (it means that the program will not be dynamic)
- Use comments
- Use variables
- Use print

The input function

```
myName = input()
```

The input() function waits for the user to type some text on the keyboard and press ENTER.

Exercise 4:

- Write a program that ask the user what amount is to be converted in euros, convert it and display the result.
- Hint: we are going to need the function **input** and the function **float**

Some simple Data Types in Python

- Numeric: int, float
- String: str

Introspection

Built in functions that enables to introspect your code

- help()
- dir()

Exercise 5

Make a word that a user input in UPPER CASE, i.e. all the letters of the word should be in capital

- Use the input function.
- Put the word in a variable.
- Use a built in function (the help function) to find the method for that.
- Use print