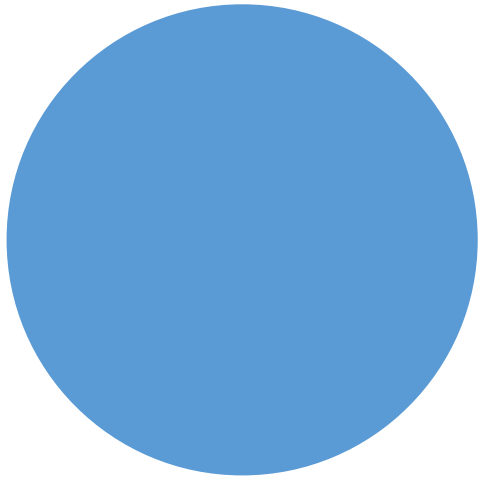
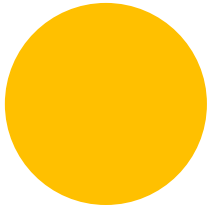



Programming 1

Introduction in programming

Course 1

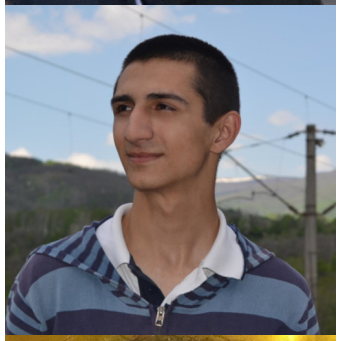
Flavia Micota

Marian Neagul

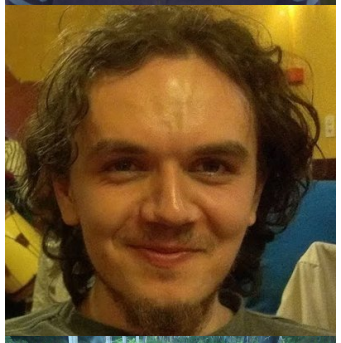
Teodora Selea

Cosmin Bonchiș

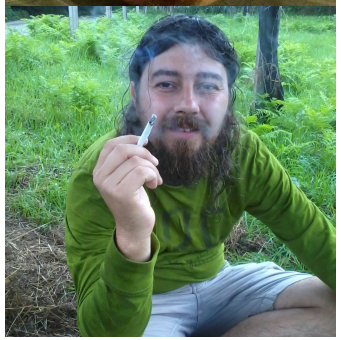
Silviu Panica



Adrian Spătaru



Radu Ciorba



Florin Roșu

What we toke about?

- Course information
  - Class requirements and evaluation
- Basic elements about Python
  - Variables and data types
- Mathematical operations

Course Information

- An introductive course

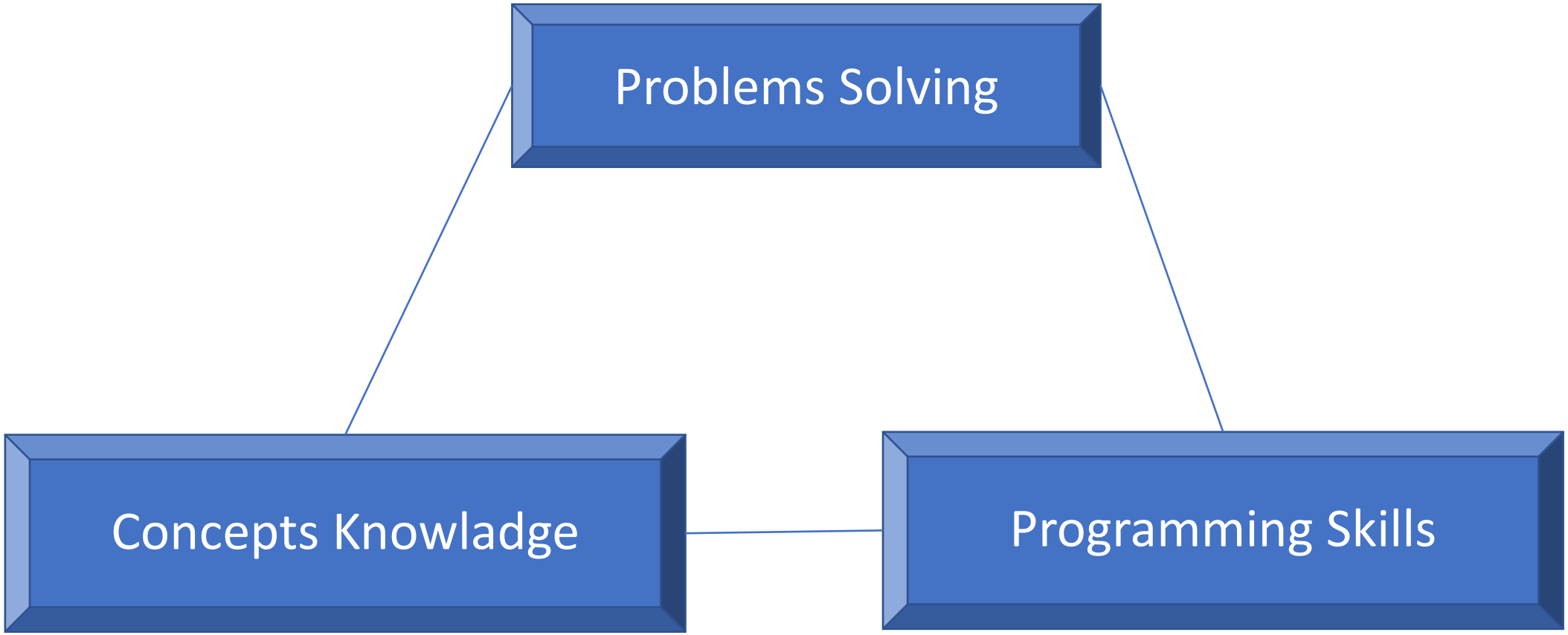
- For beginners
  - ➢You cannot learn programming in a passive way
  - ➢Do not be afraid of Python. Failure is an opportunity to learn
  - ➢Download our materials for course and laboratory
  - ➢Use any additional learning source that is suitable for your needs
  - ➢Exercise

Evaluation

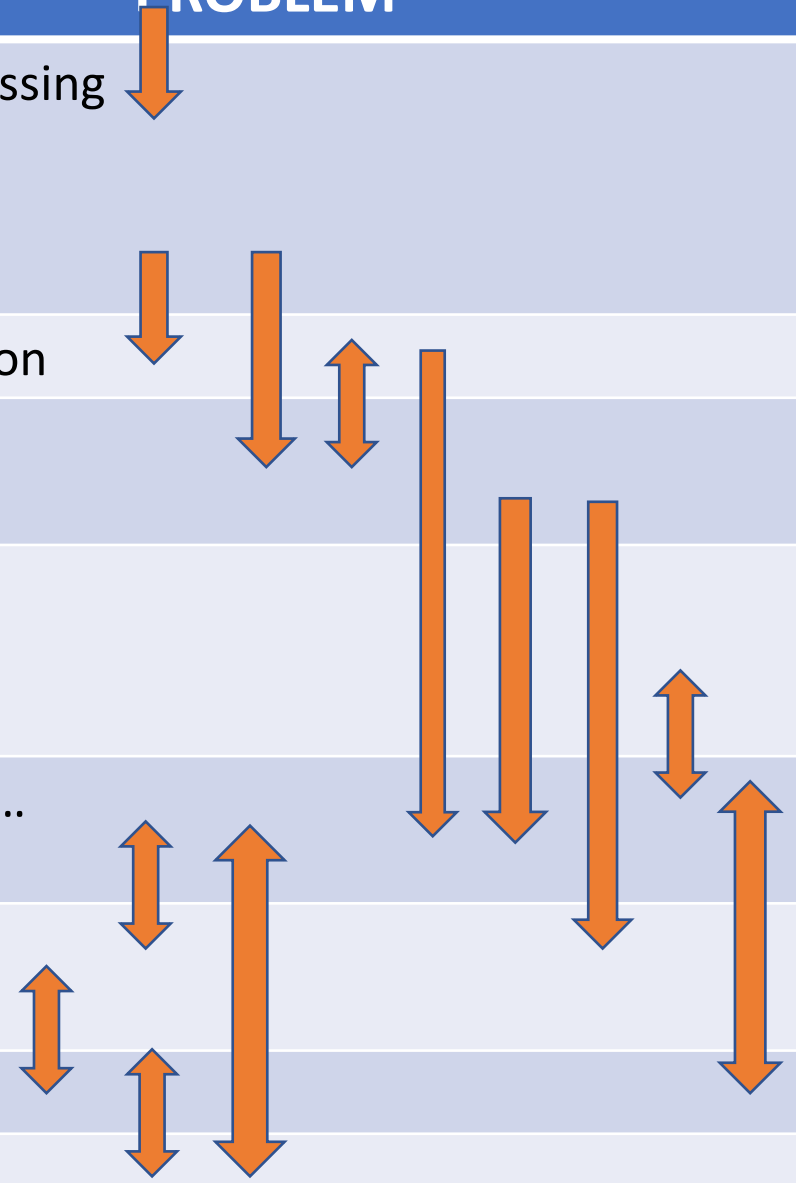
- 40% Examen
- 40% Laboratory (4 Tests)
- 20% Course Activity

- 1 Bonus point for activity

About the course



PROBLEM	
Abstract models for organizing and processing	<u>Software Engineering</u> Logic Algebra Information Theory
Algorithms for processing data/information	<u>Algorithms</u>
Data structuring	Software Engineering <u>Data Structure</u>
User Interaction	Software Engineering Web Programming Graphical User Interface
Integration services , searching services, …	**<u>Programming Languages</u>** Security
Data Storage and Communication	<u>Data Bases</u> Computer Networks
Resource Management	<u>Operating Systems</u>
Hardware Interactions	Computer Architecture



Course content

- What is a computer and how is functioning
- Knowledge representation using data structures
- Iterative/recursive programming
- Algorithms verification
- System organization using modules, classes and objects
- Guidelines for writing programs
  - Simple principles
  - Refactoring

What does a computer?

- Fundamentally
  - Runs milliards of **computations** per second
  - Stores the result of the computations
    - Uses hundreds of giga of memory
- Computations types?
  - Computations **predefined** in language
  - Computations **defined by us** - programmers
- Computers do/know what we tell them, nothing else

Types of knowledge

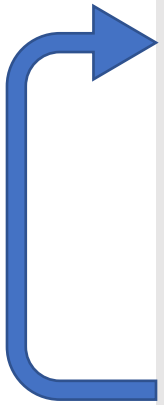
Declarative knowledge

- Assertion regarding facts
- Example
  - $\sqrt{x}$ is defined to be a value y for wich $y^2 = x$ and $y > 0$
- The definition above is axiomatic. But this definition does not help, in general, to find the square it tells how to test a value
- It tells **WHAT** but **NOT**

Imperative Knowledge

- Recipe. A set of rules.
- Tells how to deduce something
- Example: square root

Types of knowledge
Heron of Alexandria Method



```
Choose random a number G


If G*G is close enough to x:
   then stop and the answer is
Otherways:
   guess another G, based on the following
formula G = (G+G/x) / 2
   Repeat
```

- Opposite to declarative knowledge here we have a method that tells what to do in order to solve the problem
- It is Clear!

Types of knowledge
Heron of Alexandria Method

For x=9

g	g*g	x/g	(g+x/g)/2
2	4	4.5	3,25
3,25	10,5625	2,7692	3,0096
3,0096	9,0576	2,9904	3

Fast?

Recipe

1. A sequence of **steps**
2. A mechanism to **manage the control**, that tells when each step must be executed
3. A modality to tell **when to stop**

When all three characteristics are satisfied we can talk about an <u>ALGORITHM</u>

First computers – Numeric computers with fix programs

- Office calculators
  - Just for arithmetic operations

- Atanasoff–Berry Calculators (1942)
  - Solve linear equations

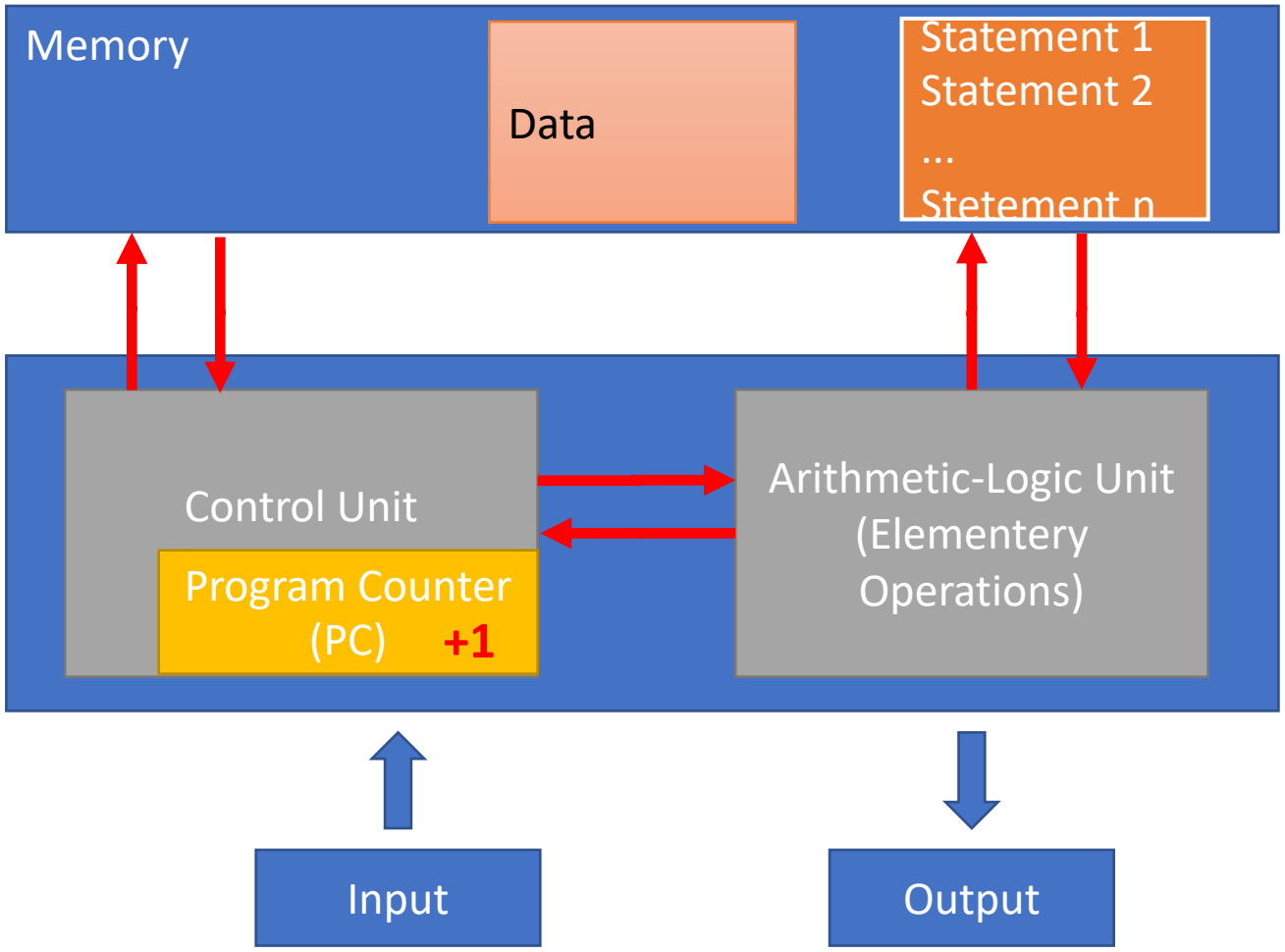
- Turing Machine
  - an electro-mechanical device used to decode Enigma messages, a German device for encoding message in WW2

First computers – Numeric computers with fix programs

- Could we create a computer with a fix program that receives like input a diagram of a circuit of an another computer and configures in such a way it works like it is described in that? 🤔
  - Could it behave like an office calculator or like an Atanasoff-Berry calculator?

Exists! It is the hard of each computer: an *interpreter*.

First Computers – Numeric computers with a stored programs



Elementary architecture

- Some statements can modify PC to go to a specific statement
  - Flux controller

Numeric computers with a stored programs

- A sequence of statements stored into computer memory
  - A predefined set of primitive statements
    - Arithmetic and Logic
    - Simple conditional statements
    - Data copy
- An interpreter (a special program) which executes the statements in an order
  - Uses conditional statements to control the statements flow
  - Stops when it is finishing

What is a program?

A program is a recipe!

- It is formed from a fix set of statements and primitives
  - With this set anything can be
- Which are this primitives?
  - move left, move right, read, write, scan, noop
- In 1936 Alan Turing demonstrated that 6 primitives are enough to describe any program that can be described through a mechanic process

One implication of the previous statement is that a program written into a language can be translated in any other language.

Concept also known like “Turing Compatibility”.

What is a program?

- To describe/present recipe it is necessary a language. A programming language. This course uses Python like programming language!

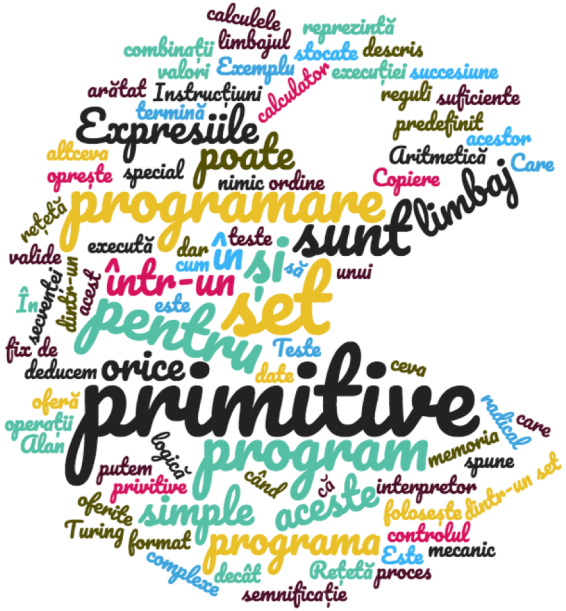
This is not a course about Python Language!

Recipe (algorithm)

- A programming language is formed from a set of primitive operations
- **Expressions** are complex (but valid) combinations of programming language primitives
- The expressions and calculus have values and meaning into a programming language

Languages

- Primitive statements
  - Linguistic: words
  - Programming language: numbers, strings, simple operators



Programming languages

Low/Hight Level ?

- C
- Python
- JavaScript
- Go

For general Usage or Dedicated?

- Matlab
- Python
- JavaScript

Compiled or Interpreted?

- C
- Java
- Python
- JavaScript

Programming languages

- **Syntax**
  - Which expressions are linked to this programming?
  - „Boy a cat in the house” 🤔
- **Semantic**
  - **Static:** tell which program have sense. What expression have sense?
    - „This course is tasty” .
    - Syntactically right?
    - This kind of errors can generate unexpected behavior...
  - **Complete:** what is the expected result? What happens when you execute the program?
    - ✓ **STYLE:** Depends on programmers!
    - ✓ Result: fails, never stops, stops with an unexpected result or stops with an expected result

Objects (in Python)

- Programs use objects

- Objects have a type that tells the programming language what is possible to do with this objects
  - Moris is a dog and can do „hau hau”
  - Pisi is a cat and can do „miau miau”
- Objects can be
  - Scalar values (ex. value 42)
  - Non-scalar (have an internal structure that can be accesed)

Scalar values

- Fundamental data types
  - Numbers
    - `3 – int`
    - `3.14 – float`
  - Booleans
    - `True/False – bool`
  - NoneType
    - Only one value: None
  - Strings
    - ‘Timișoara’ – str
- Usually we talk about the pair (type, value)
- For each data type we have a list of operators
  - For Numbers+ - * / %
  - For Strings: +, *

Can use type() to find an object type:

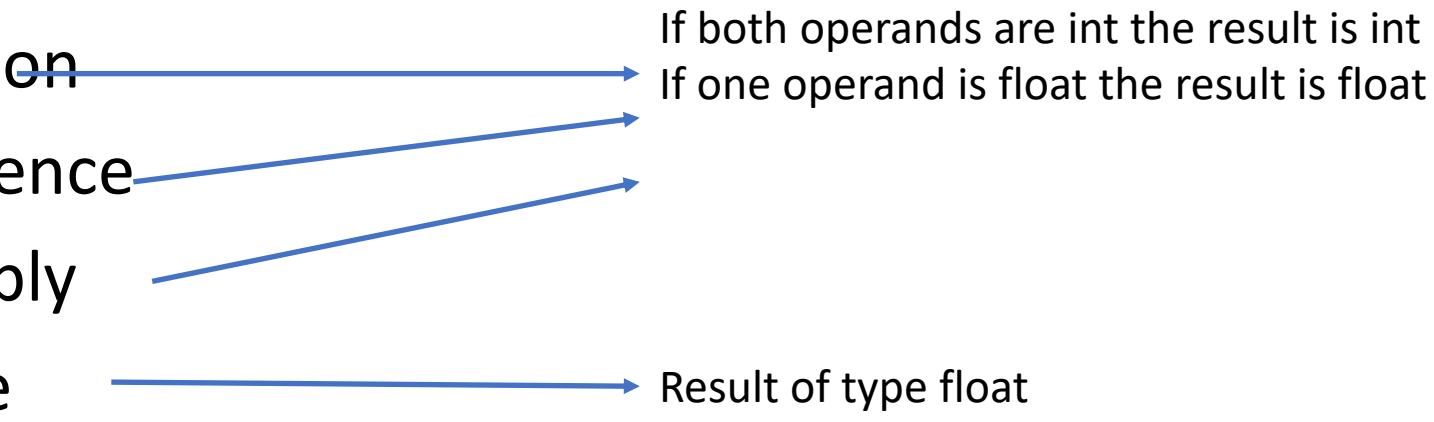
```
>> type(5)
Int
>> type(3.14)
float
```

Data Type Conversion

- Can convert objects of one type into another type
  - `float(3)` → `3.0`
  - `int(3.9)` → `3`

Operators for`int` and `float`

- `i+j` → addition
- `i-j` → difference
- `i*j` → multiply
- `i/j` → divide



- `i%j` → modulo `i` at `j`
- `i**j` → `i` at power `j`

Operators

Operator	Descriere
**	Power
~ + -	Complement, plus și minus unary
* / % //	Multiply, divide, modulo și „floor division”
+ -	Addition și substarction
>> <<	Byte shifting(at right, at left)
&	**AND** on bytes
^ |	**EXCLUSIVE OR** on byte, **OR** on byte
<= < > >=	Reletional operators
<> == !=	Equal operators
= %= /= //= -= += *= **=	Assigment/short operations operators
is is not	Identity operators
in not in	Membership operators
not or and	Logic operators

Variables

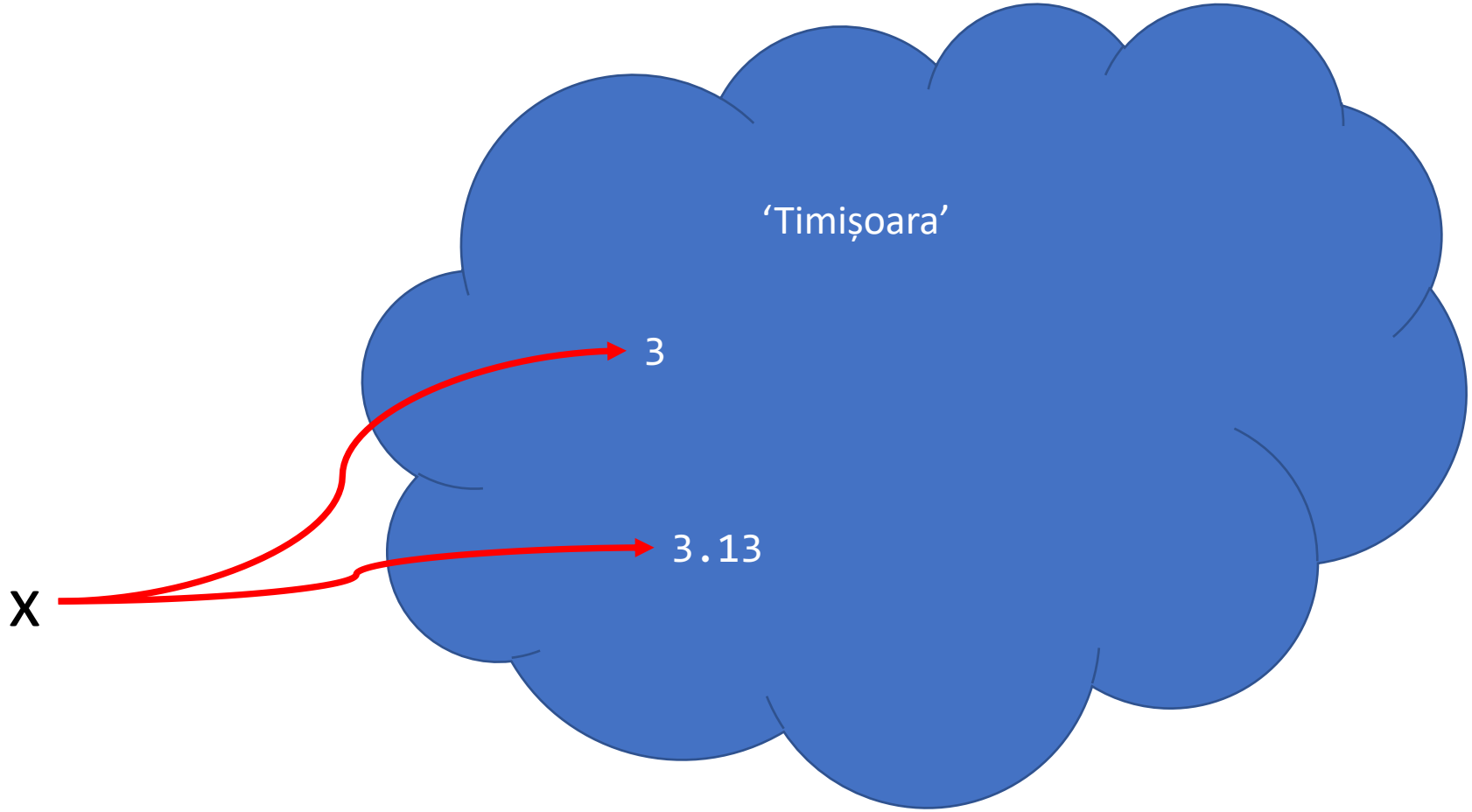
- Creates an association/link between a name and a value
  - Assignment operation: `x=3`,
    - Creates an association/link between value 3 and name x

- What is the type of a variable?
  - For Python: the type is inherited (identified) from the value liked to the variable. The variable does not have a type, the value referred by it has
  - The variable type is dynamic, it changes based on the referred value
  - Advice: do not change randomly the variables data type

- Variables names: it is important to have a since!
  - Do not use reserved words

Variabiles

```
x = 3
```



Expressions

- Way to name an expression?
  - To reuse the name later!

- Can change the code easily later

```
pi = 3.14159
radius = 2.2
area = pi * (radius ** 2)
```

Strings

- Letters, numbers, special characters, spaces
- Defined using the symbols" or '

```
hi = 'salut’
```

- Concatenation

```
name =  'ion'
salut = hi + name
```

- Other operations

```
test = hi + " " + name * 2
```

Input/Outpu: `print`

- Used to display at standard output
- print keyword

```
x = 1
print(x)
x_str = str(x)
print (”A number is",  x, ".", "x=", x)
print (”A number is" +  x_str + ". " +  "x= " + x_str)
```

Input/output: `input("")`

- Displays what it receives like argument (what is specified between quotation marks)
- Reads what the user is typing until it encounters the key ENTER
- Returns a value that is associated/linked to a variable

```
text = input(”Type something: ")
print(5*text)
```

🤔

- `input` returns an string that has to be converted at desired data type

```
num = int(input(”Type an integer number"))
print(5*num)
```

Comparing operator for `int, float, str data type`

- `i` and `j` variables names
- All below comparation are evaluated to boolean values

`i > j`

`i >= j`

`i < j`

`i <= j`

`i == j` → equal operator, `True` if the value i is equal with the value of j

`i != j` → different operator, `True` if the value of i is different from the value of j

`i is j` → identity operator, `True` if i is the same with j

Logic operators

- a and b are boolean variables

```
not a      →    True if a is False
                False if a is True
a and b    →    True if a and b are True
a or b     →    True if anya and b is True
```

A	B	A and B	A or B
True	True	True	True
True	False	False	True
False	True	False	True
False	False	False	False

Conditional statement

```
if <condition>:
        < expression >
        < expression >
        ...
```

```
if < condition >:
        < expression >
        < expression >
        ...
else:
        < expression >
        < expression >
        ...
```

```
if < condition >:
        < expression >
        < expression >
        ...
elif < condition >:
        < expression >
        < expression >
        ...
else:
        < expression >
        < expression >
        ...
```

- <conditie> an expresion that evaluates to a boolean value True or False

Alignment

- VERY important in Python
- Used to identify blocks of code

```
x = float(input("x="))
y = float(input("y="))
if x == y:
        print("x and y are equal")
        if y != 0:
                print (”so, x/y is", x/y)
elif x<y:
        print ("x is smaller")
else:
        print("y is smaller")
print (”END PROGRAM")
```

Bibliography

- https://youtu.be/0jljZRnHwOI?t=1020
- John Zelle, **Python Programming: An Introduction to Computer Science (chapter 1)**