

The logical
model of
computation

Dr. Giuseppe
Maggiore

Introduction

A
programming
language

Let's start
programming

The logical model of computation

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Course topics

- This course is about *basic programming concepts* (DEV I)
- We will discuss computational concepts
- Computational thinking
- Describing computations clearly

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Course topics

- *How does a programming language work?*
- Memory, variables, conditionals, if-statements, and loops
- These are already enough to implement anything (of course not handily!)

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At the end of the course you will be able to...

- ...describe algorithms clearly
- ...write basic programs in Python
- ...describe the semantics of a basic Python program

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What is programming not about?

- computers
- programming languages
- technology
- programs
- websites
- smartphones
- ...

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What is programming about?

- the encoding of logical thought
- non-ambiguity: there is only one possible mode of execution
- precision: there is no appeal to vagueness or intuition

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What is programming about?

- especially if a machine will eventually run our program
- machines are **dumb as **ck**^a

^arock

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A programming language specifies

- what instructions we have
- what do they perform
- in what order

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The stdNt programming language

- In stdNt we let students perform some actions
- It does not require a machine, but only a white-board and alive (and complying students)

Following instructions¹

```
take 3 steps forward  
sit on the chair  
turn left  
slide 3 steps forward
```

¹The teacher should ask for a volunteer

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The features of stdNt so far

- **Instructions**, in English
- **Order of execution** is left-to-right, top-to-bottom
- **State** made up of a living, breathing student

Following instructions with state (*we need a "volunteer"*)

A	B	C
your age	2	-3

```
take A/4 steps forward  
sit on the chair  
turn left by  $90 * B$  degrees  
slide C steps forward
```

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The features of stdNt so far

- **Instructions**, in English
- **Order of execution** is left-to-right, top-to-bottom
- **State** made up of a living, breathing student plus a bunch of cards with data written on them

What if the state makes no sense? (*we need a “volunteer”*)

A	B	C
your age	“nice day today”	-3

```
take A/4 steps forward  
sit on the chair  
turn left by 90 * B degrees  
slide C steps forward
```

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State comes with big preconditions

- It only contains information that is:
 - used in a way that makes sense with respect to the instructions
 - logically expressed (numbers, strings, etc. rather than emotions or riddles)
 - actually accessible (there is some connection from the executor to the accessed data)

The state may change (*we need a "volunteer"*)

B	C
-1	today's weather

```
make a comment on C
write on C the index of the current day of the week
sit on the chair
turn left by  $90 * B$  degrees
slide C steps forward
```


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The features of stdNt so far

- **Instructions**, in English
- **Order of execution** is left-to-right, top-to-bottom
- **Mutable state** made up of a living, breathing student plus a bunch of cards with data written on them

We can make decisions²

A	B	C	D
shirt colour	-1	2	3

```
sit on the chair
if A is 'black' then
    turn left by 90 * B degrees
otherwise
    turn left by 90 * C degrees
clap D times
```

²Teacher should ask the students to perform the action

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The features of stdNt so far

- **Instructions**, in English
- **Order of execution** is left-to-right, top-to-bottom
- **Mutable state** made up of a living, breathing student plus a bunch of cards with data written on them
- **Decisions** based on elements of the state

We can repeat behavior³

```
while there are green soldiers alive
  AND
  there are brown soldiers alive
  TEAM 1:
    a = pick green soldier
    d = pick brown soldier
    fight(a,d)
  TEAM 2:
    a = pick green soldier
    d = pick brown soldier
    fight(a,d)
```

```
fight(a,d):
  if a = BAZOOKA AND d = GRENADIER then
    both die
  else if a = BAZOOKA then
    d dies
  else if d = GRENADIER then
    a dies
  else if brown team still has leader t
    a dies
  else
    d dies
```

³The teacher should ask for two teams of volunteers

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The features of stdNt so far

- **Instructions**, in English
- **Order of execution** is left-to-right, top-to-bottom
- **Mutable state** made up of a living, breathing student plus a bunch of cards with data written on them
- **Decisions** based on elements of the state
- **Repetition** of code based on elements of the state

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Assignment 1 in groups of four

- Reprogram the game
- Make it so that the positioning of defending soldiers makes a difference (positive or negative)
- *One group will be "randomly selected" to present*

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Assignment 2 in groups of four

- Think about the actions needed for a game concept (at most 10).
- Write them down and put them in the box.
- Pick a sheet at random (if it is the one you wrote pick again).
- Write the implementation of a game using the actions you have.
- A group will be chosen to play the game.

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The best of luck, and thanks for the attention!