

# What is computational thinking?

---

Prof. Enrico Nardelli

Univ. Roma "Tor Vergata"

<http://www.mat.uniroma2.it/~nardelli/>

Lisbon, ECSS, 23 october 2017

# What is computational thinking?

---

- Two (among many possible) answers
- Being able to think like a computer scientist and being able in applying this competence to every field of human endeavour
- The set of mental and cognitive competencies obtained by the study and practice of computer science

# Is a definition really important?

---

- Knuth, discussing computer science: «*the underlying concepts are much more important than the name*»
  - [Computer Science and Its Relation to Mathematics, *The American Mathematical Monthly*, 81(4):323-343, Apr. 1974]

# The concept of CT is important...

---

- ... as a brief explanation of why computer science (or **informatics**, or computing)...
- is a novel and independent scientific subject
- that needs to be taught in schools...
  
- ... as a subject in itself (*fundamental value*)
- ... as a subject for better teaching and learning other subjects (*transversal value*)

# What is computational thinking?

---

- My (for the time being) preferred answer(s)
  - The **conceptual kernel** of informatics
  - The **scientific core** of information technology

# Can you explain what this kernel is?

---

- Knuth, discussing computer science:
- Problem: «find the greatest common right divisor of two  $n \times n$  integer matrices  $A$  and  $B$ »
- Mathematician answer: «*Let  $R$  be the ring of integer matrices ; in this ring the sum of two principal left ideals is principal, so let  $D$  be such that  $R A + R B = R D$ . Then  $D$  is the greatest common right divisor of  $A$  and  $B$* » [ibidem]
- Unsatisfactory for computer scientists (informaticists ?)

# The CS viewpoint

---

- A solution is **provided by a *process* computing an answer** and not by an equation defining the answer
- A *process* is an **algorithm** implemented in a **language** whose executable code is run by an **automaton**
- The three pillars of computing, hence of general informatics education

# Take-home idea

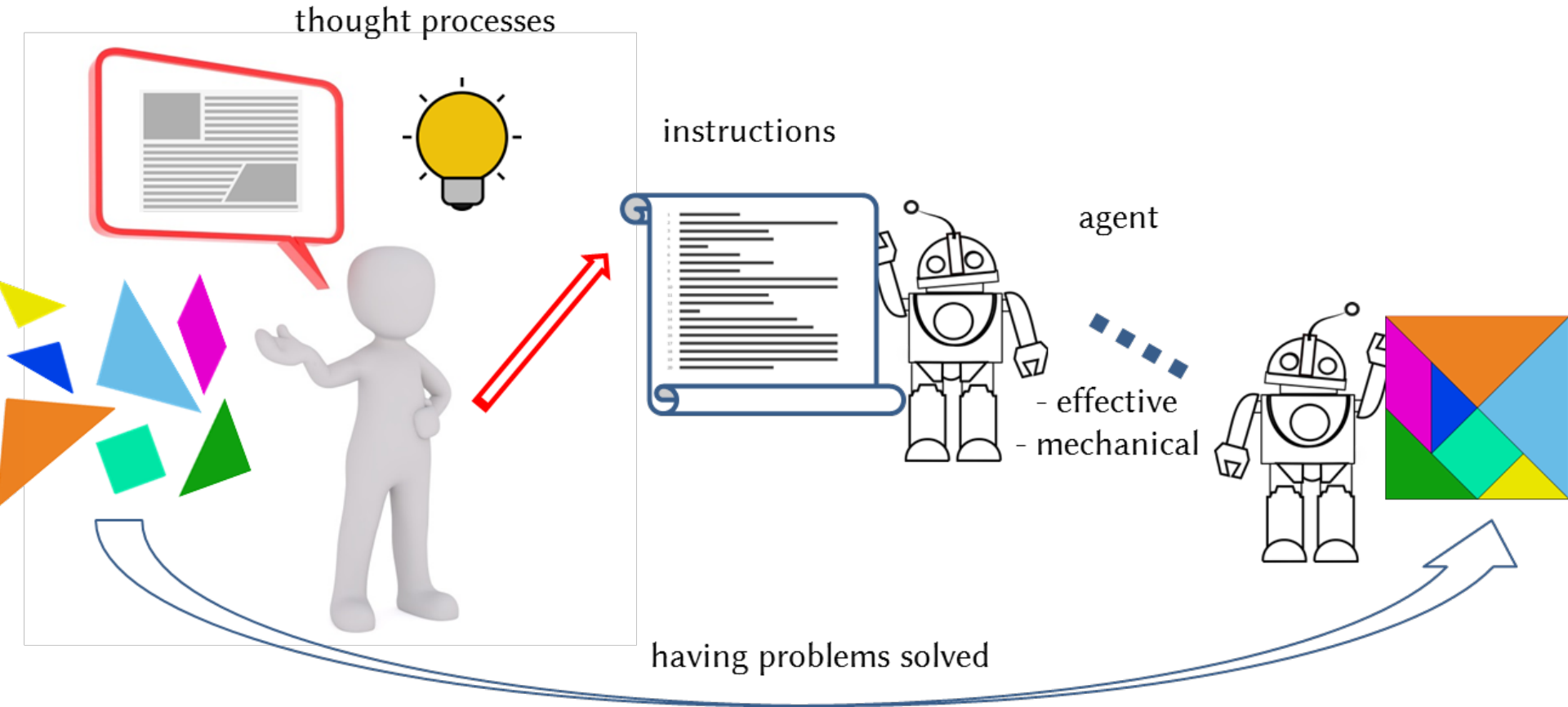
---

- Without the automaton (or machine or agent) characterized by effectiveness and mechanicality there is no informatics but just mathematics
- The *cultural seeds of computing* are in the mathematicians' efforts for unloading the burden of solving problems onto machines:

the shift **from solving problems to having problems solved**



# From solving problems to having problems solved



<http://www.mat.uniroma2.it/~nardelli/publications/Informatica-nella-scuola-Magazine-SeR-aprile-2017.pdf>

# In the long run...

---

- people will arrive at university with some computer science background
- like it happens for mathematics
- But for the time being they are
  - unaware of the science
  - highly exposed to the technology
  - with largely different attitudes

# Challenge for general computing education in first yr university students

---

- Which areas to cover?
- Computational thinking (as described before) is my answer

# Important sub-challenges

---

- What is the:
  - Arithmetics (e.g., 4 operations)
  - Elementary geometry (e.g., circle area formula)
  - Elementary algebra (e.g., solving linear equations)

... of informatics?

# GRAZIE!

---

## Enrico Nardelli

Univ. Roma "Tor Vergata"

<http://www.mat.uniroma2.it/~nardelli/>



@enriconardelli



<http://www.linkedin.com/in/enriconardelli>



<https://www.facebook.com/enrico.nardelli>