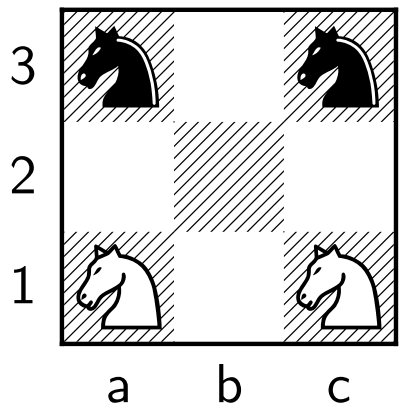
Programmazione dei Calcolatori con Laboratorio

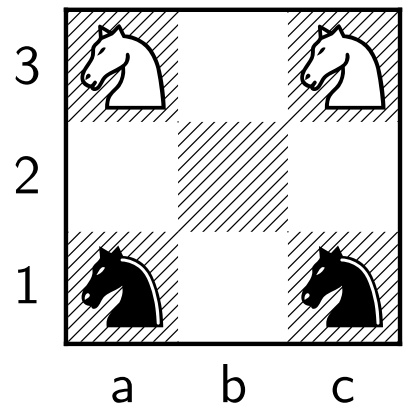
Gianluca Rossi

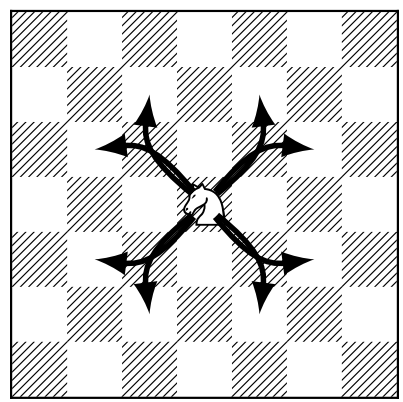
gianluca.rossi@uniroma2.it

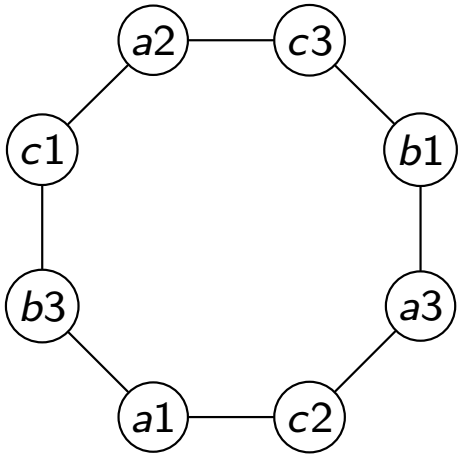
TOR VERGATA
UNIVERSITÀ DEGLI STUDI DI ROMA

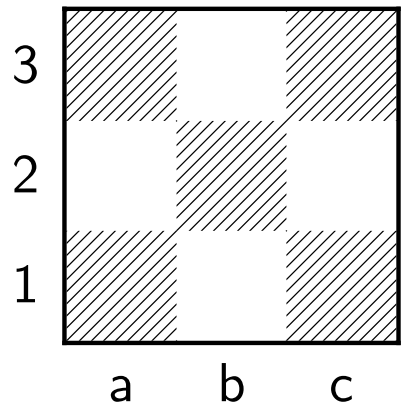


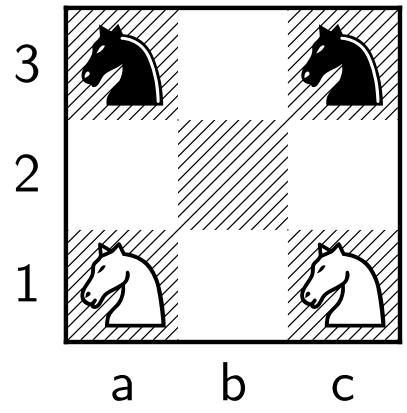
$\Rightarrow$

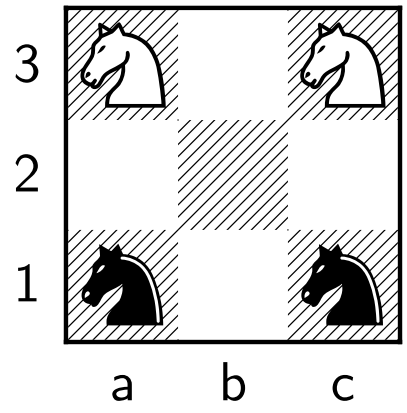




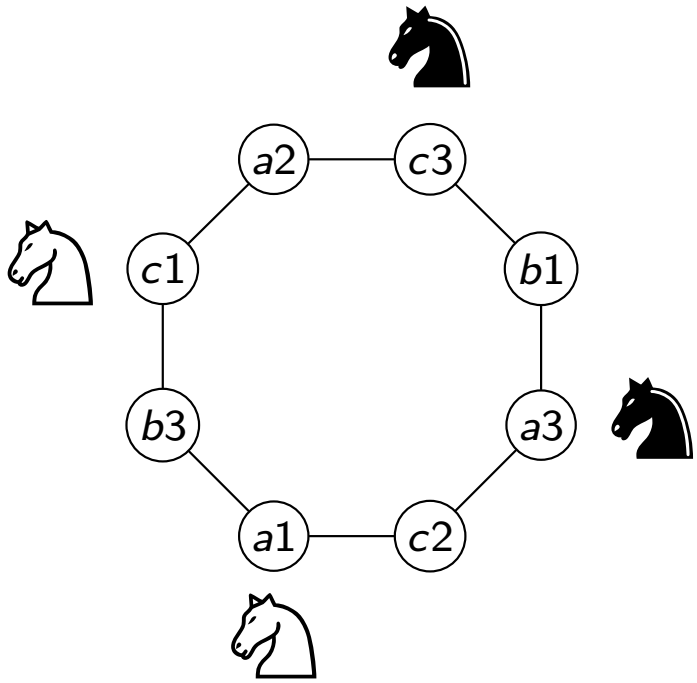


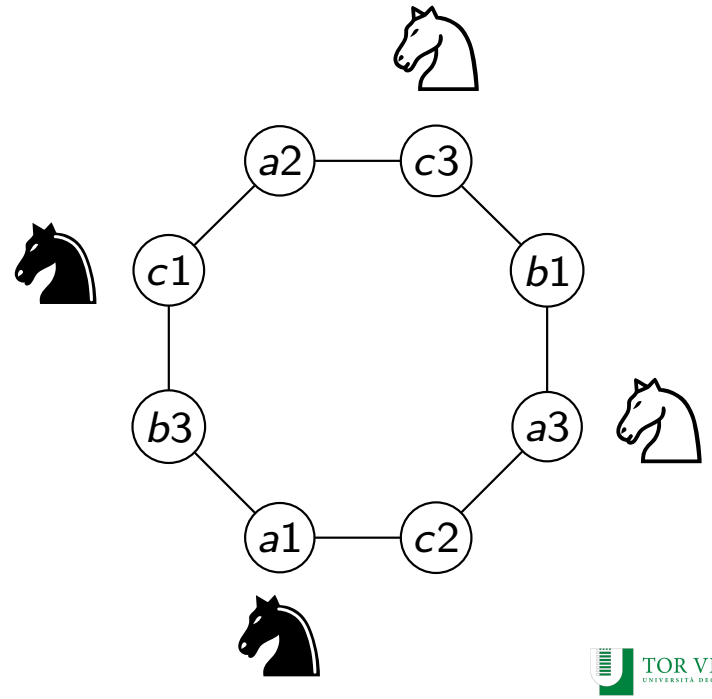


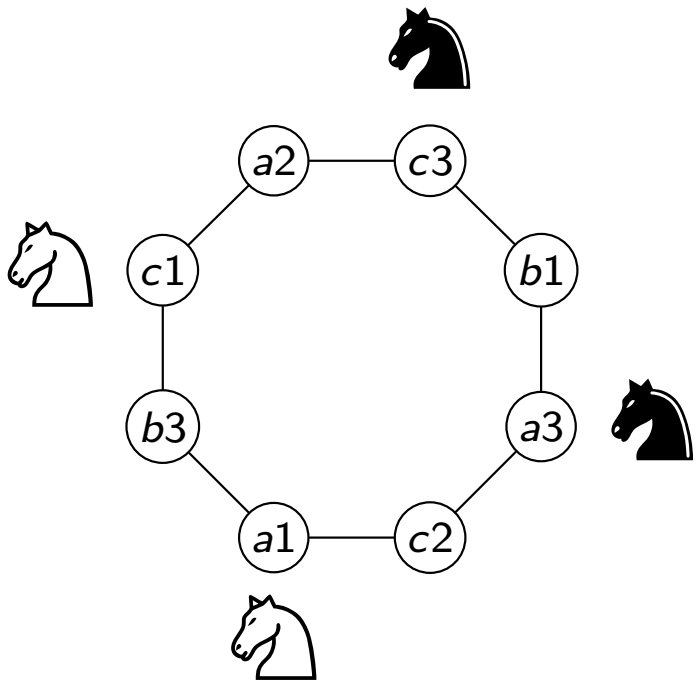


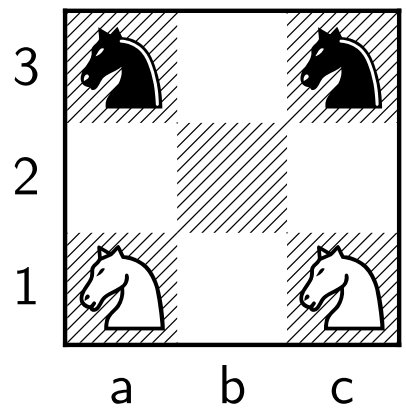


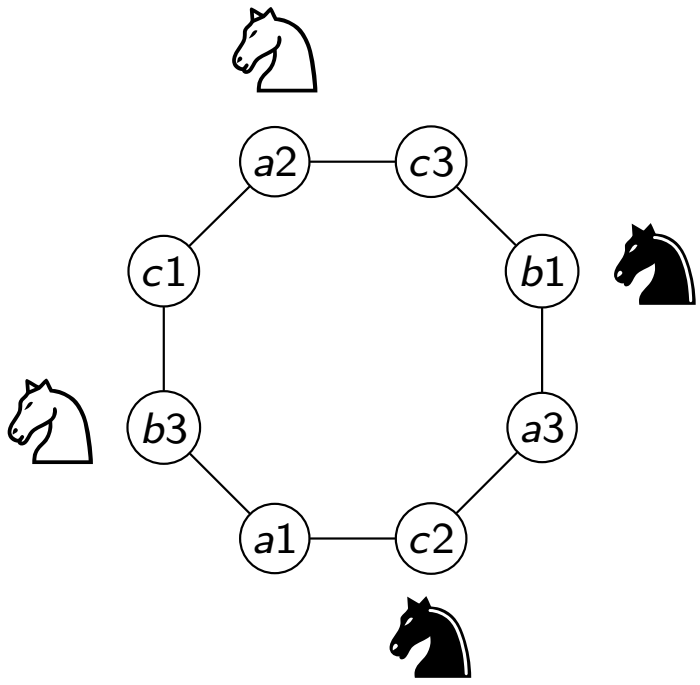
$\Rightarrow$

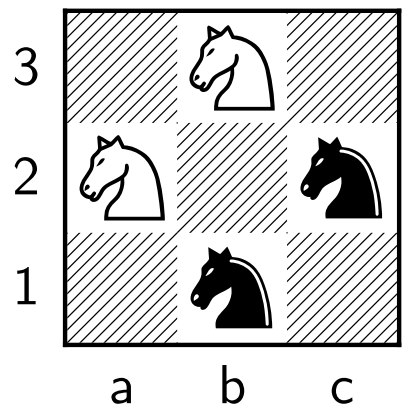


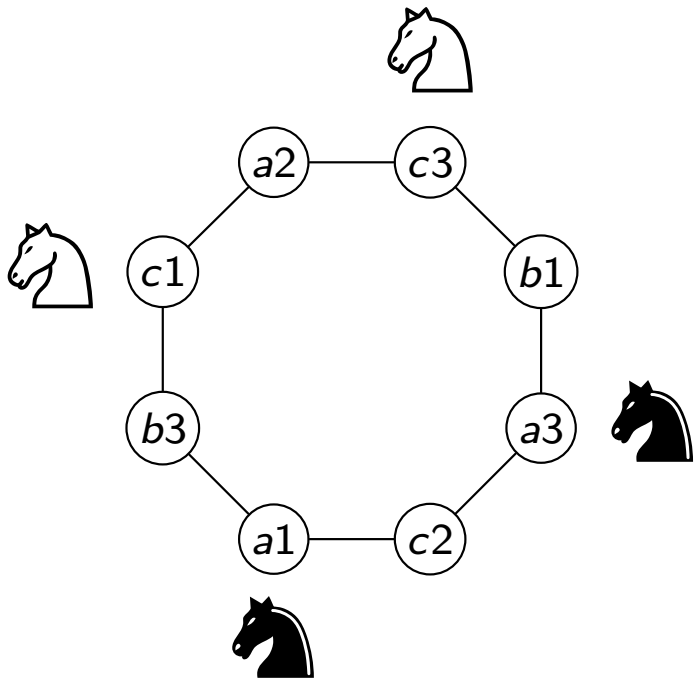


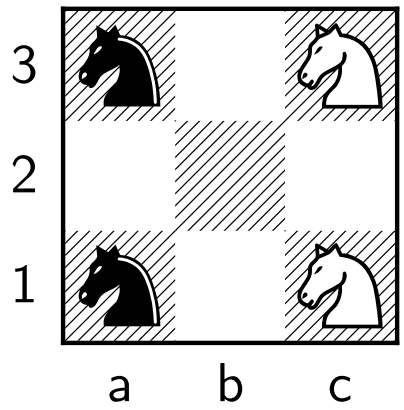


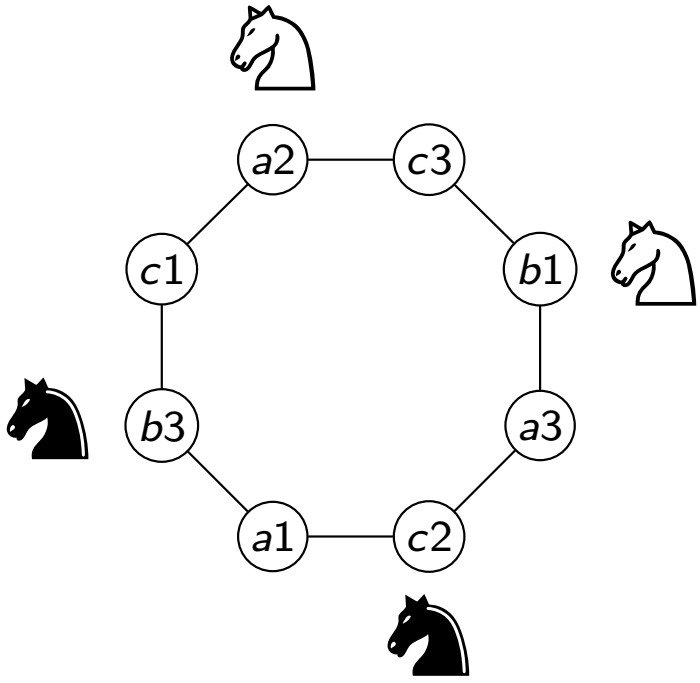


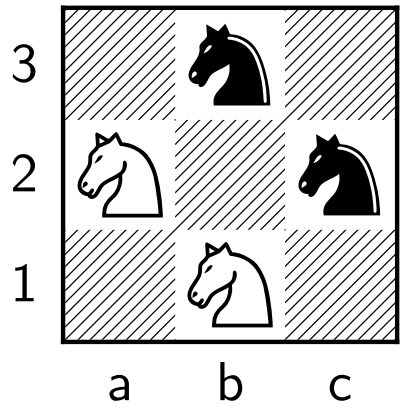


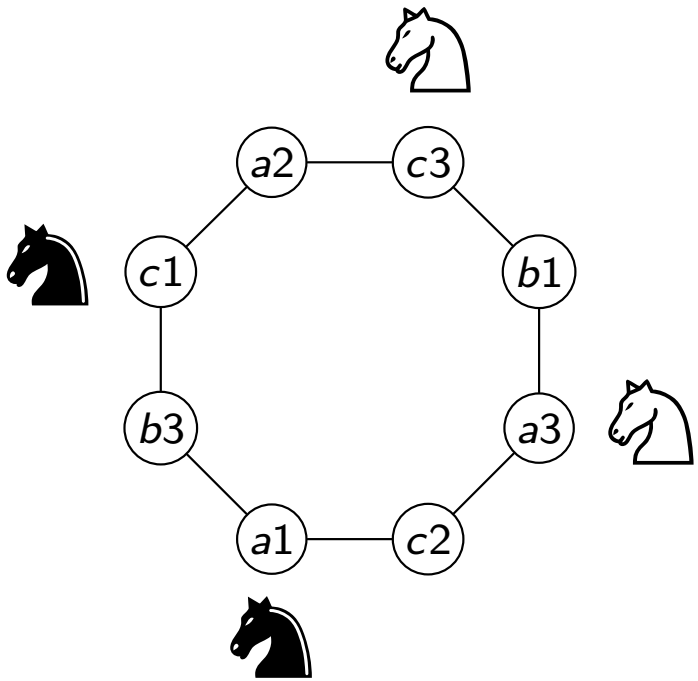


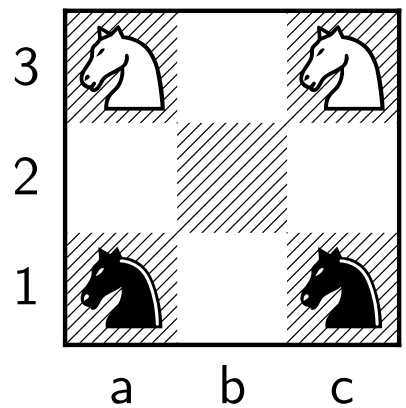












Algorithmic method

1. Problem definition: a stakeholder poses a problem (mathematics, finance, administration, meteorology, betting,...);
2. Find a good mathematical model for the problem;
3. Find a recipe (the algorithm);
4. Code the recipe in a computer programming language:
5. Test the program against syntactical errors (eventually go back 4);
6. Test solutions against semantic errors (eventually go back 2);

A numerical example

Problem: Find $\sqrt{x}$ that is y such that $y^2 = x$

Model: Let $y_0 = g$,

$$\sqrt{x} \approx y_i = \frac{1}{2}\left(y_{i-1} + \frac{x}{y_{i-1}}\right)$$

and $|x - y_{i+1}| \leq |x - y_i|$

Algorithm:

1. Guess a value g;
2. If g^2 is "close" to x stop;
3. Update g with

$$\frac{1}{2}\left(g + \frac{x}{g}\right)$$

4. Repeat from 2

A numerical example

Let $x = 20$

g	g^2	$0.5 \cdot (g + x/g)$
5.0	25.0	4.5
4.5	20.25	4.472
4.472	20.0007	4.4721
4.4721	20.000000007	

What is an algorithm?

- A sequence of simple actions (elementary instructions);
- A flow control mechanism to determine the next instruction;
- Stop conditions.

From algorithm to program

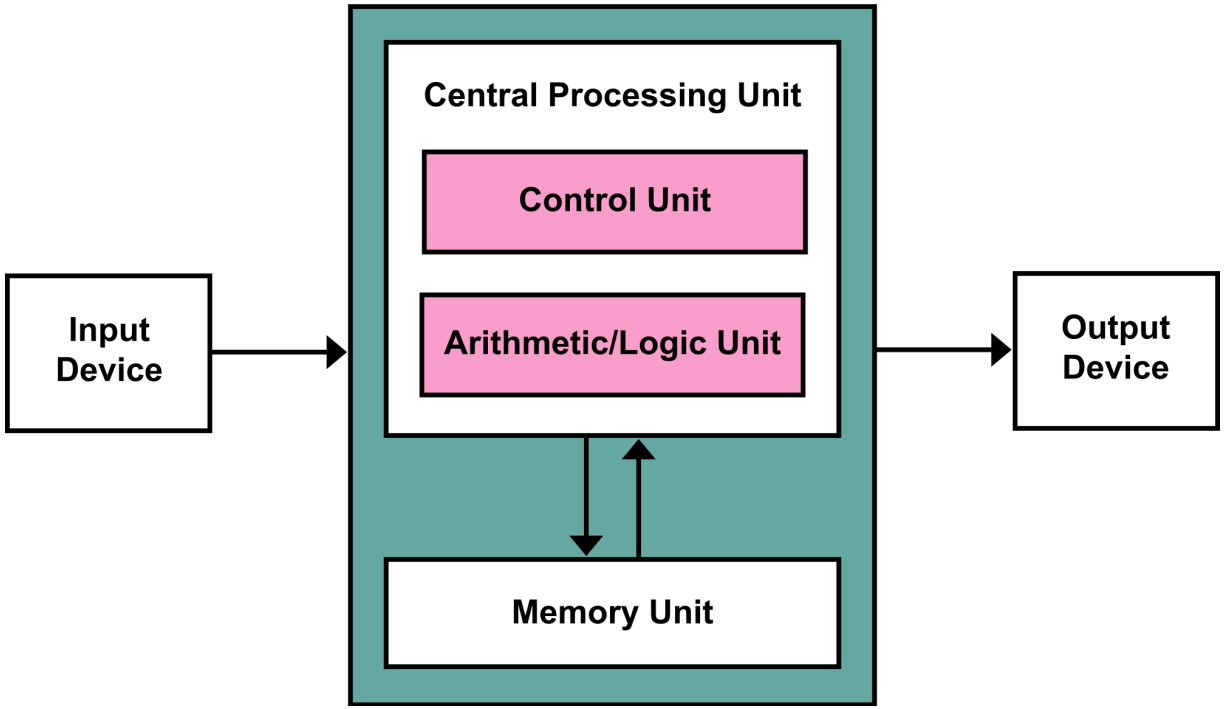
```
x = 20
g = 5.0

while abs(g*g - x) > 0.00001 :
        g = 0.5*(g+x/g)

print(g)
```

- arithmetic and logic instructions;
- test (conditionals) instructions;
- storing instruction

...executed by a special program (interpreter)




```
x = 20
g = 5.0

while abs(g*g - x) > 0.00001 :
        g = 0.5*(g+x/g)

print(g)
```

Programming languages

Symbols: $+$, $=$, $*$,..., `while`, `print`,...

Syntax: Rules that describe how combine symbols to get instruction and programs

Semantic: Meaning of symbols, instructions, and programs