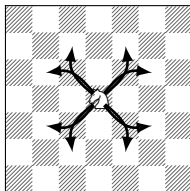
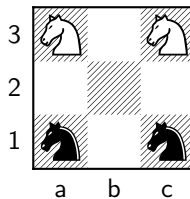
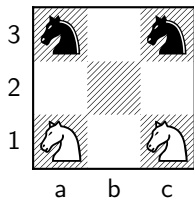
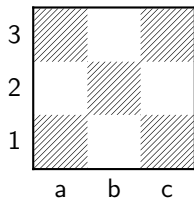
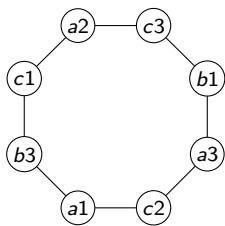


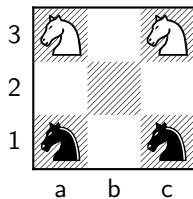
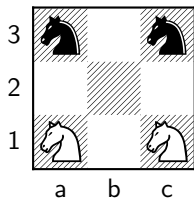
# Programmazione dei Calcolatori con Laboratorio

Gianluca Rossi

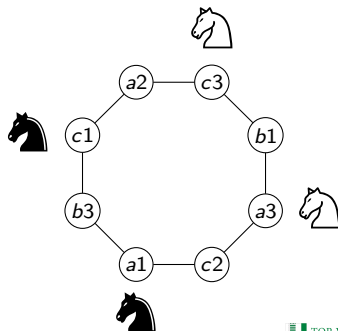
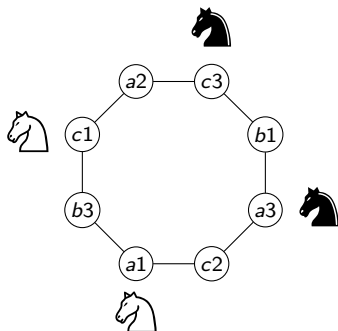
[gianluca.rossi@uniroma2.eu](mailto:gianluca.rossi@uniroma2.eu)

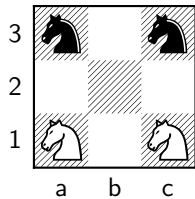
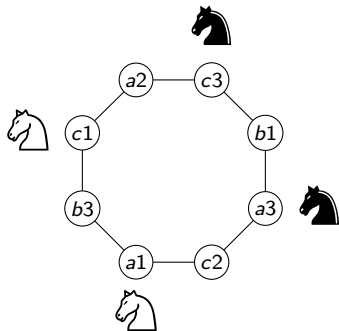


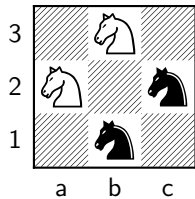
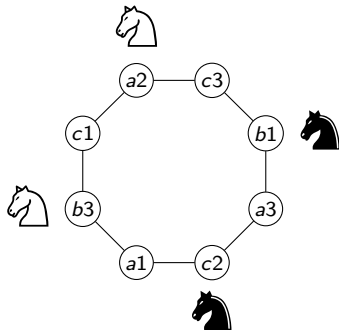


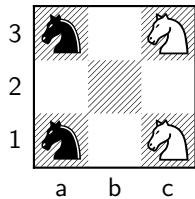
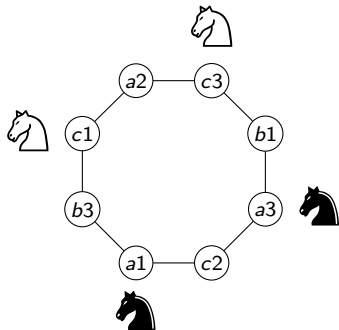


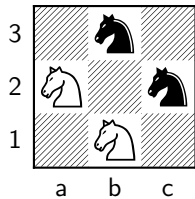
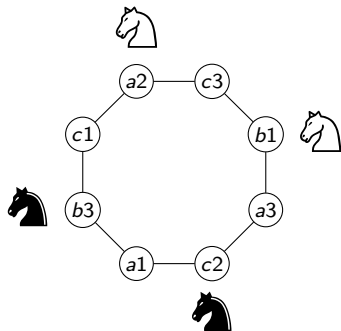
$\Rightarrow$



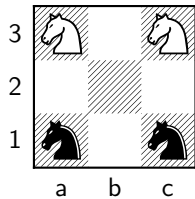
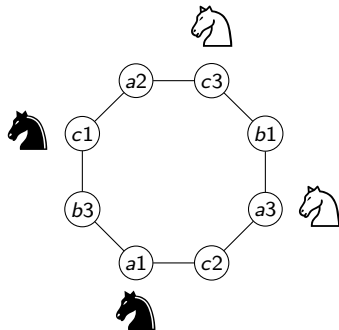












# Algorithmic method

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  $y_0 = g$ ,

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

- 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

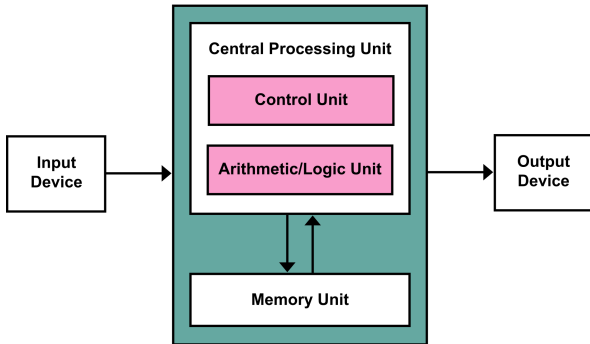
```
x = 20
g = x

while abs(g*g - x) > 0.00001 :
    print(g)
    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 = x
```

```
while abs(g*g - x) > 0.00001 :  
    print(g)  
    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