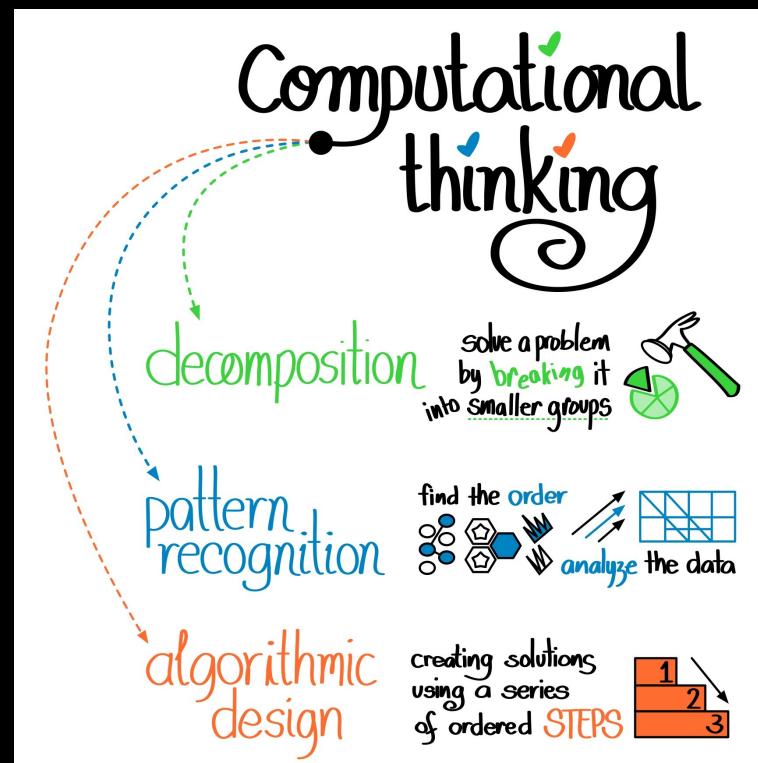


# Computational Thinking

# Computational Thinking



# Il Pensiero Computazionale

... un Processo di Problem-Solving che consiste nel:

1. Formulare Problemi in una forma che ci permetta di usare un computer per risolverli;
2. Organizzare Logicamente e Analizzare Dati;
3. Rappresentare i Dati tramite Astrazioni Modelli e Simulazioni;
4. Automatizzare la Risoluzione dei Problemi tramite il Pensiero Algoritmico;
5. Identificare, Analizzare, Implementare e Testare le possibili Soluzioni con un'efficace ed efficiente combinazione di passi e risorse (avendo come obiettivo la ricerca della soluzione migliore secondo tali criteri);
6. Generalizzare il Processo di Problem-Solving e trasferirlo ad un ampio spettro di altri problemi.

# We have a problem



BigData (2012) = 1 Exabyte =  $10^{18}$  byte

# We Need Tools (for Understanding Data from Reality)



Venice, August 21, 1609

*Galileo presenting telescope potentiality to Venetian Senate from San Marco clock tower*  
(Giuseppe Bertini, 1858, Villa Ponti, Varese)

# Informatica

## (concetti base)

### Il Libro! "Il Ladro dei Numeri"

- |                                |   |
|--------------------------------|---|
| 1. Il Codice Binario           | Arrangiarsi con solo due simboli ...                              |
| 2. Input e Output              | Entrare (e poi uscire!) dal mondo dei bit ...                     |
| 3. Simboli e Codici            | Quando il computer distingue un orologio da una quercia ...       |
| 4. La Memoria o il Magazzino ? | Quando il computer (ri)conosce gli indirizzi ...                  |
| 5. Il "nocciolo" del Computer  | "visitare" caselle contenenti istruzioni ...                      |
| 6. Programmi e Ricette         | Come dare istruzioni al computer "dall'alto verso il basso" ...   |
| 7. La Logica dei Computer      | Parlare usando solo "vero" e "falso" ...                          |
| 8. Azioni, Scelte, Cicli       | il linguaggio dei diagrammi di flusso ...                         |
| 9. Algoritmi                   | Spiegare bene e con parole semplici ...                           |
| 10. I Traduttori               | Dare istruzioni al computer attraverso un "intermediario" ...     |
| 11. Le Reti di Computer        | Le reti di computer: quando bisogna far comunicare i computer ... |

# Computational Thinking Framework

Computational Concepts

Computational Practices

Computational Perspectives

# Computational Thinking Framework

## Computational Concepts

Concept	Description
sequence	identifying a series of steps for a task
loops	running the same sequence multiple times
parallelism	making things happen at the same time
events	one thing causing another thing to happen
conditionals	making decisions based on conditions
operators	support for mathematical and logical expressions
data	storing, retrieving, and updating values

# Computational Thinking Framework

"Scientific Method" e "Problem Solving" ci aiutano a trovare una soluzione.  
Ora dobbiamo passare dal "Computational Thinking" per arrivare a metterla su computer ("Coding")

## Computational Concepts

Concept	Description
sequence	identifying a series of steps for a task
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conditionals	making decisions based on conditions
operators	support for mathematical and logical expressions
data	

In memoria avremo DATI e ISTRUZIONI.

Cominciamo dai DATI! (le istruzioni le hanno tutti i linguaggi!)

**PRIMO PASSO: QUALI SONO LE STRUTTURE DATI DI CUI HO BISOGNO? QUALI VARIABILI?**

# Computational Thinking Framework

## Computational Practices

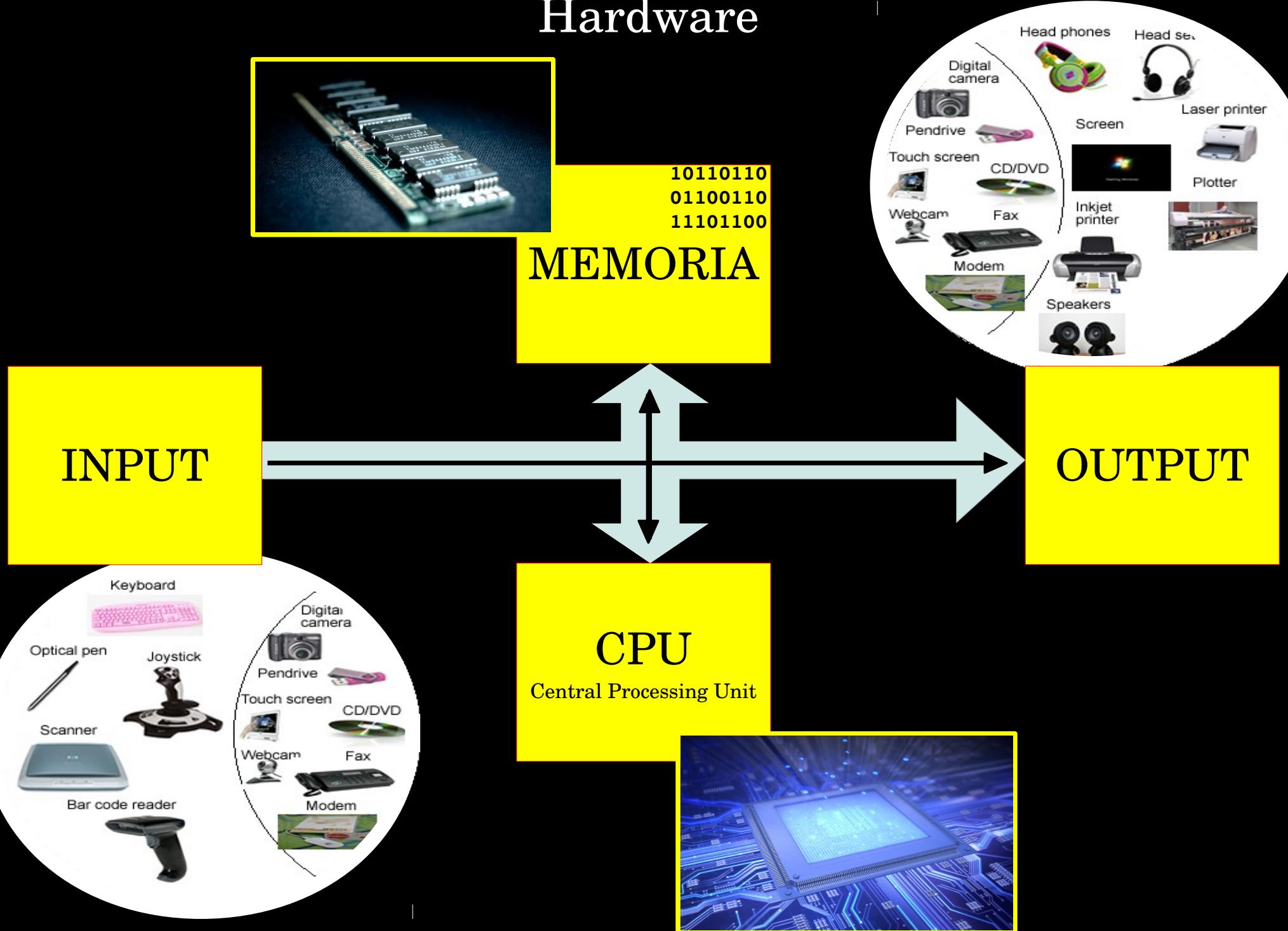
Practice	Description
being iterative and incremental	developing a little bit, then trying it out, then developing some more
testing and debugging	making sure that things work – and finding and fixing mistakes
reusing and remixing	making something by building on what others – or you – have done
abstracting and modularizing	building something large by putting together collections of smaller parts

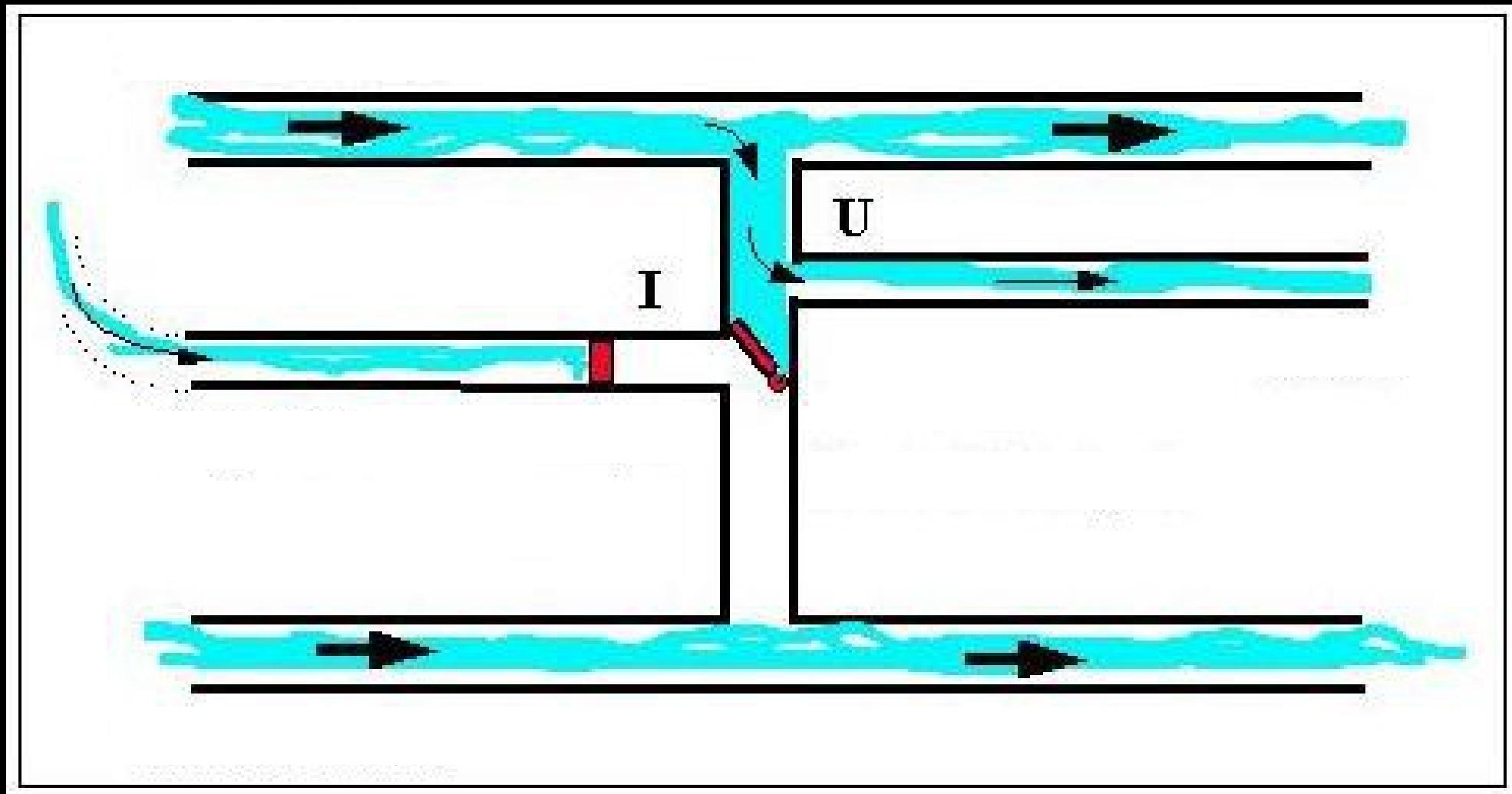
# Computational Thinking Framework

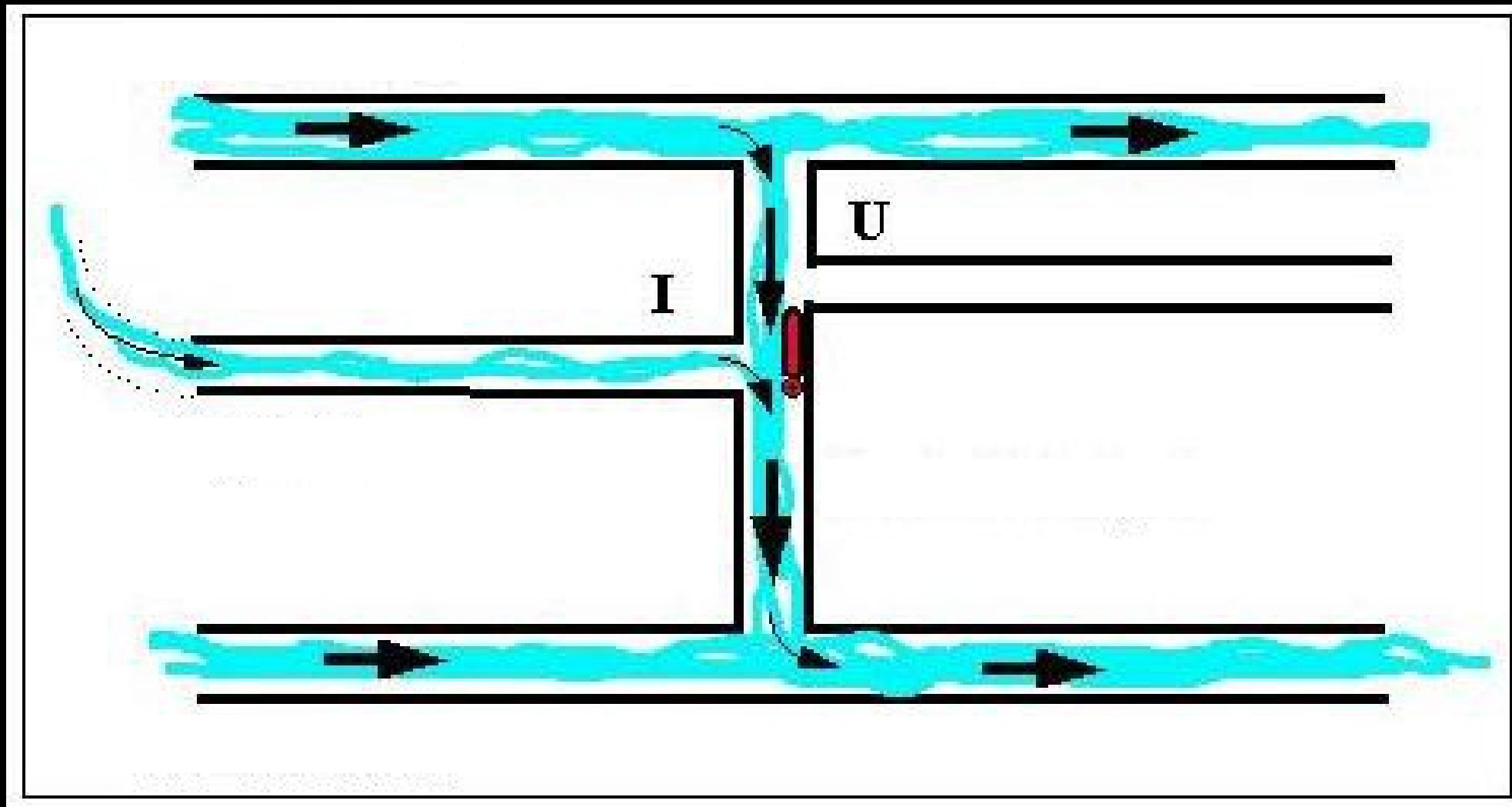
## Computational Perspectives

Perspective	Description
expressing	realizing that computation is a medium of creation “I can create.”
connecting	recognizing the power of creating with and for others “I can do different things when I have access to others.”
questioning	feeling empowered to ask questions about the world “I can (use computation to) ask questions to make sense of (computational things in) the world.”

# Hardware





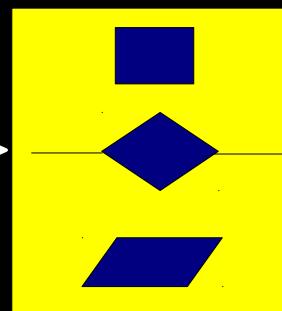


# Software

Algoritmo  
(Flow Chart)



P



Analista

**1. ANALISI**

Programmatrice

**2. FLOW CHART**

Programma  
(espresso con un  
Linguaggio di Programmazione  
es. Pascal, C++, Java, etc.)



```
begin
read (X)
if ( X <= 0)
then goto begin
else Y = SQRT (X)
write (Y)
end
```

Programma

(espresso con un

Linguaggio di Programmazione

es. Pascal, C++, Java, etc.)

Compilatore

01101101  
11001101  
01101111  
11110000

Programma  
ESEGUIBLE  
(espresso in  
BINARIO)

**3. CODING**

**4. TESTING**

**5. SHARING!**

# 1952: 1st Compiler for Computer Languages



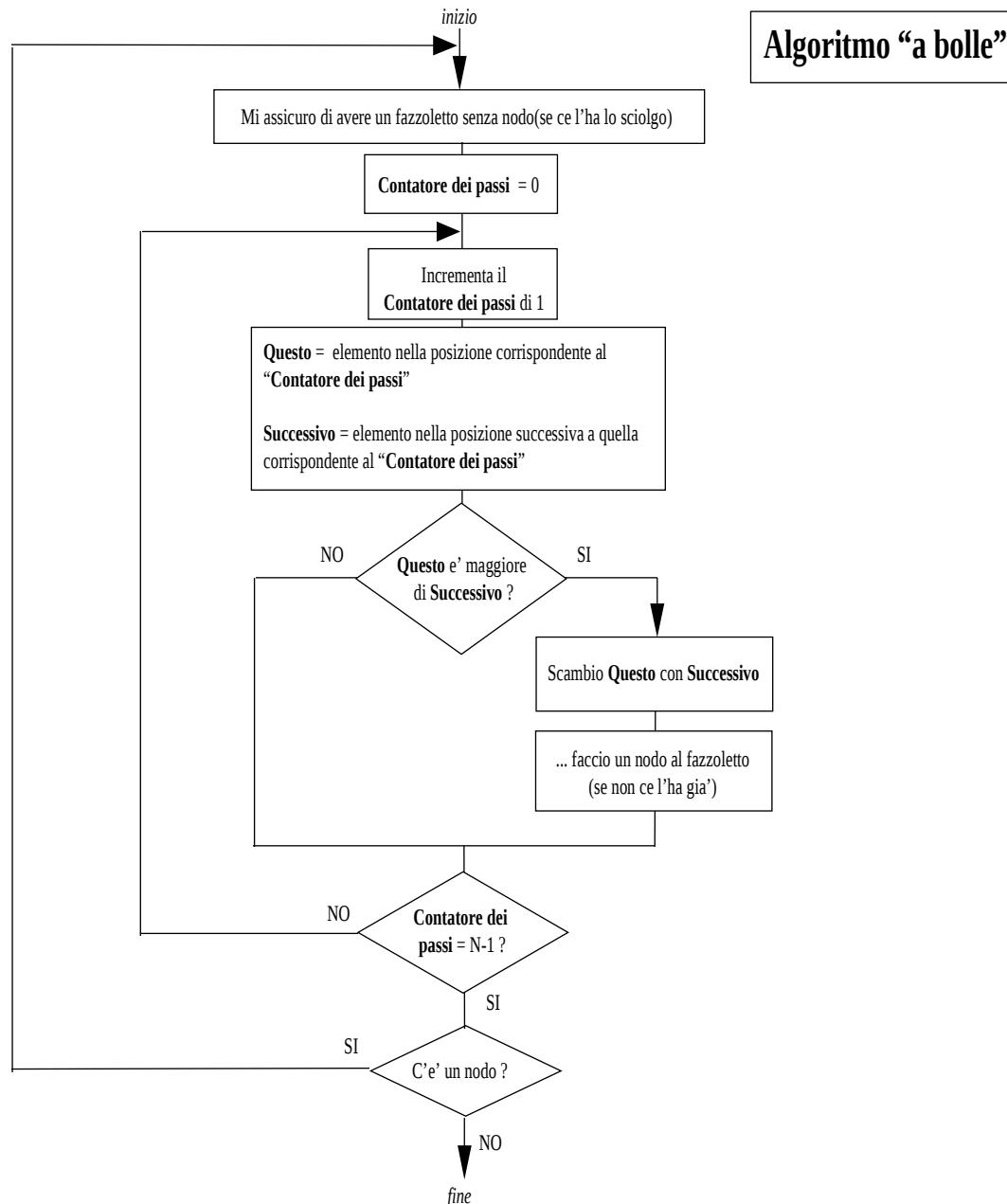
Grace Murray Hopper  
(1906 - 1992)

*"A ship in port is safe;  
but that is not what ships are for  
- sail out to see and do new things."*

Grace Murray Hopper

# Algoritmo

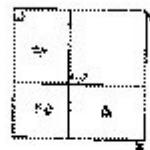
(Al-Khwarizmi, c.825 d.c.)



# Algoritmo

(Al-Khwarizmi, c.825 d.c.)

علي تسعه وعشرين لبم السطح انتظم الذي هو سطح راه خينج  
ذكى كله اربعة وستين فاعينا بحدارها وهو ثمانية وهو واحد  
اللائع السطح انتظم فاما لقى مائه مثل ما زدنا عنه وهو  
خمسة ينوى ذلك وهو سطح انتظم اب الذي هو الماء وهو حدار  
والثالث تسعه وهذه صورته



ولما مائى واحد وعشرون دريداً يعدل عشرة اجدره ذلك  
تحبسه الى مطحنا بربعاً جبارل اتساع وهو سطح آن ثم قسم  
اليه سطحها مساوياً اتساع هرمه مثل واحد اتساع سطح آن وهو  
اضيق من والاسطح رب ضارب اول السطحين جميعاً ضيق جداً  
وكل علمتنا آن طولاً عشرة من العدد آن كن سطح مربع  
مساوي اتساعه والزرايا آن احد المثلثه منسوبها الي واحد حذر  
نهش السطح وفي النصين حذران فلما مائى واحد وعشرين  
يعدل عشرة اجدره علمتنا آن طولاً ضيق جداً بعده عشرة اعداد آن  
اضيق جداً حذر امثال فلسفيها ضيق جداً يعنى عده

*The Book of Algebra*  
by Al-Khwarizmi

$$x^2 + 10x = 39$$

$$x^2 + 10x + 25 = 39 + 25$$

$$(x+5)^2 = 64$$

$$x+5 = 8$$

$$x = 3$$

1

x

5

x

$x^2$

$x5$

2

$$\frac{10}{2} = 5$$

3

"completamento del quadrato"



Abu Ja far Muhammad  
ibn Musa al-Khwarizmi  
(c.780 - 850)

# Algoritmo

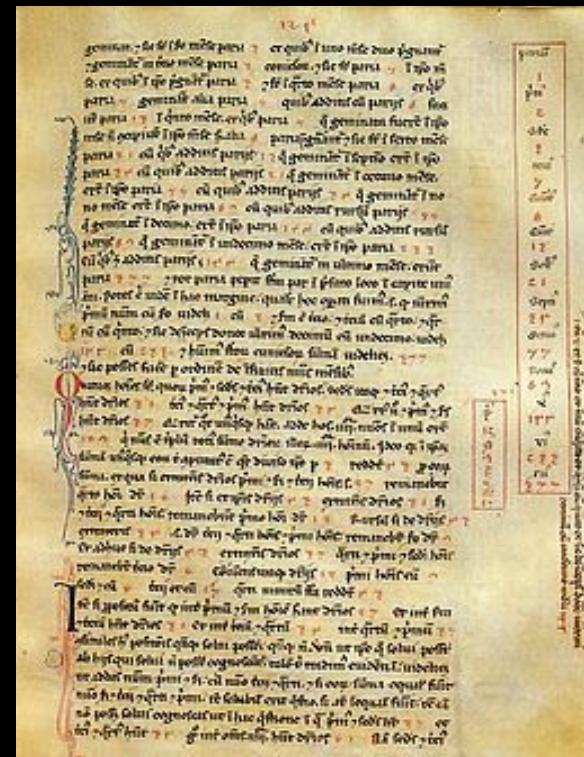
(Al-Khwarizmi, c.825 d.c.)

Adelard of Bath  
(c.1080 - c. 1152)

Robert of Chester  
(c.1100)



Leonardo Pisano  
detto il Fibonacci  
(1175 - 1235)



*Liber Abbaci, 1202*  
Leonardo Fibonacci

## Algoritmo (Medioevo)

Procedimento di calcolo numerico fondato sull'uso delle cifre arabe

# Algoritmo

(Al-Khwarizmi, c.825 d.c.)



Alan Turing  
(1912 - 1954)



Kurt Gödel  
(1906 - 1978)



Alonzo Church  
(1903–1995)

## Algoritmo (1950)

Procedimento esplicito descrivibile con un **numero finito di regole** che conduce al risultato dopo un **numero finito di passi**.

Tutti i **programmi per computer** sono **algoritmi**!

### Caratteristiche di un Algoritmo

#### 1. Neutralita'

rispetto al substrato, la potenza della procedura e' dovuta alla sua struttura logica, non al materiale con cui e' realizzata, puo' essere eseguita con carta e penna oppure da ... un computer!

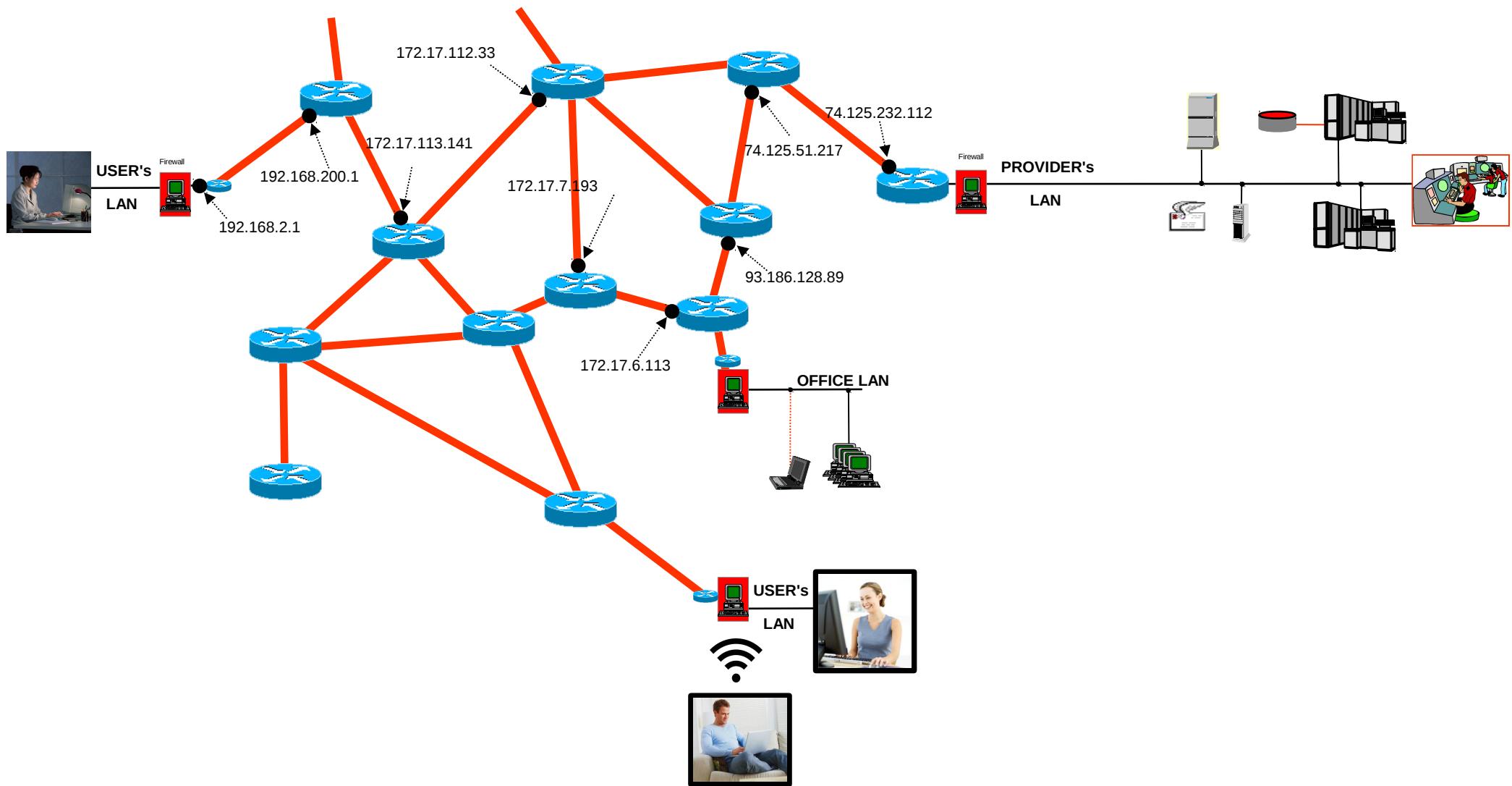
#### 2. Non necessita di una mente

la procedura e' talmente semplice da essere eseguibile da un meccanismo automatico, come una *ricetta per cuochi principianti*!

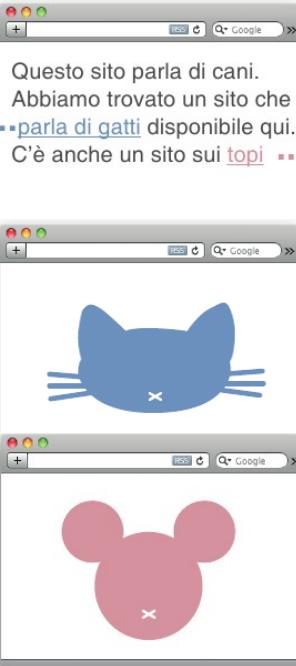
#### 3. I risultati sono garantiti

se lo si esegue senza errori

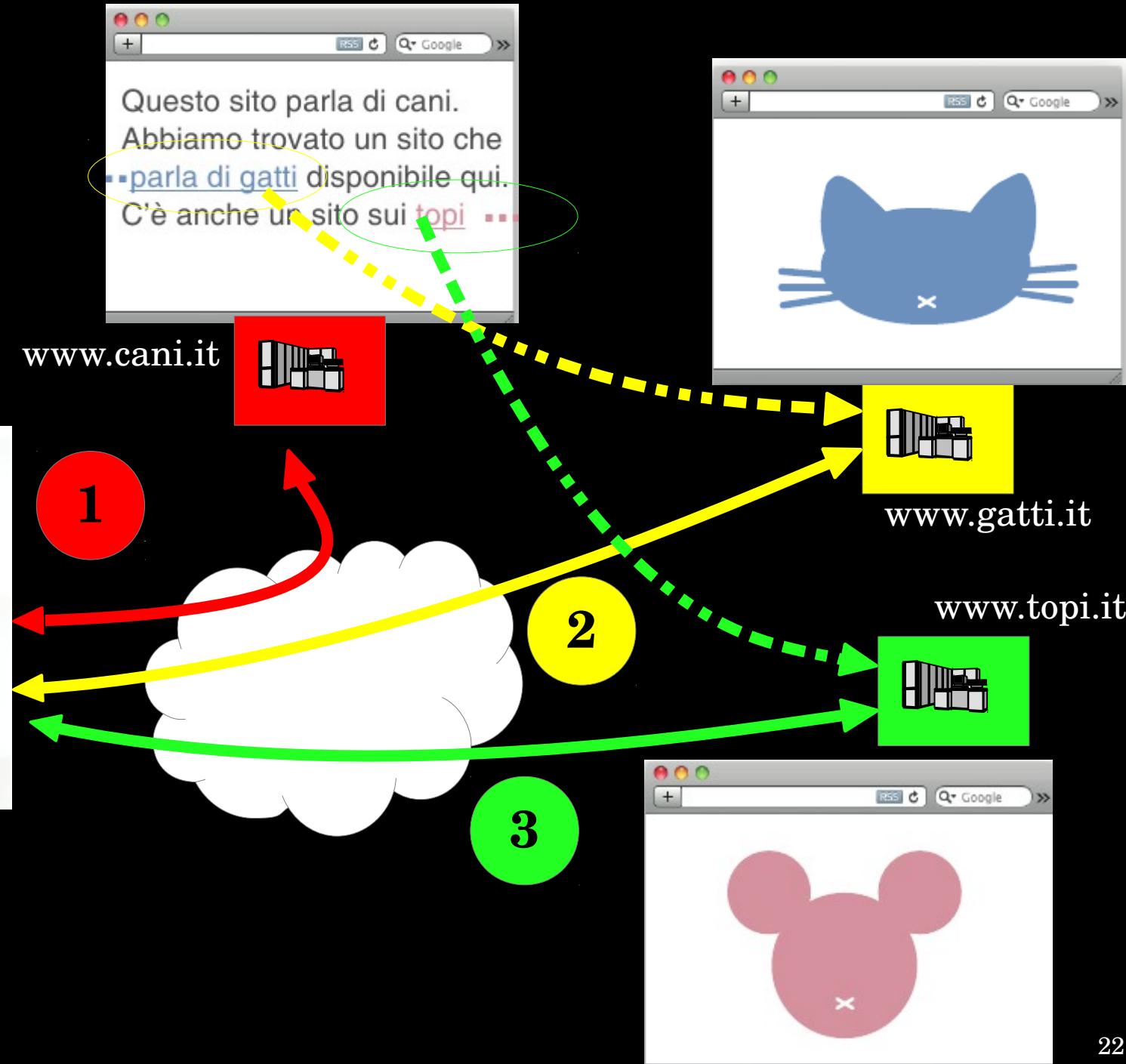
# Internet



# World Wide Web



www.cani.it



# Cloud Computing: Back to the Future

