INF 311

Introduction to programming and computer science

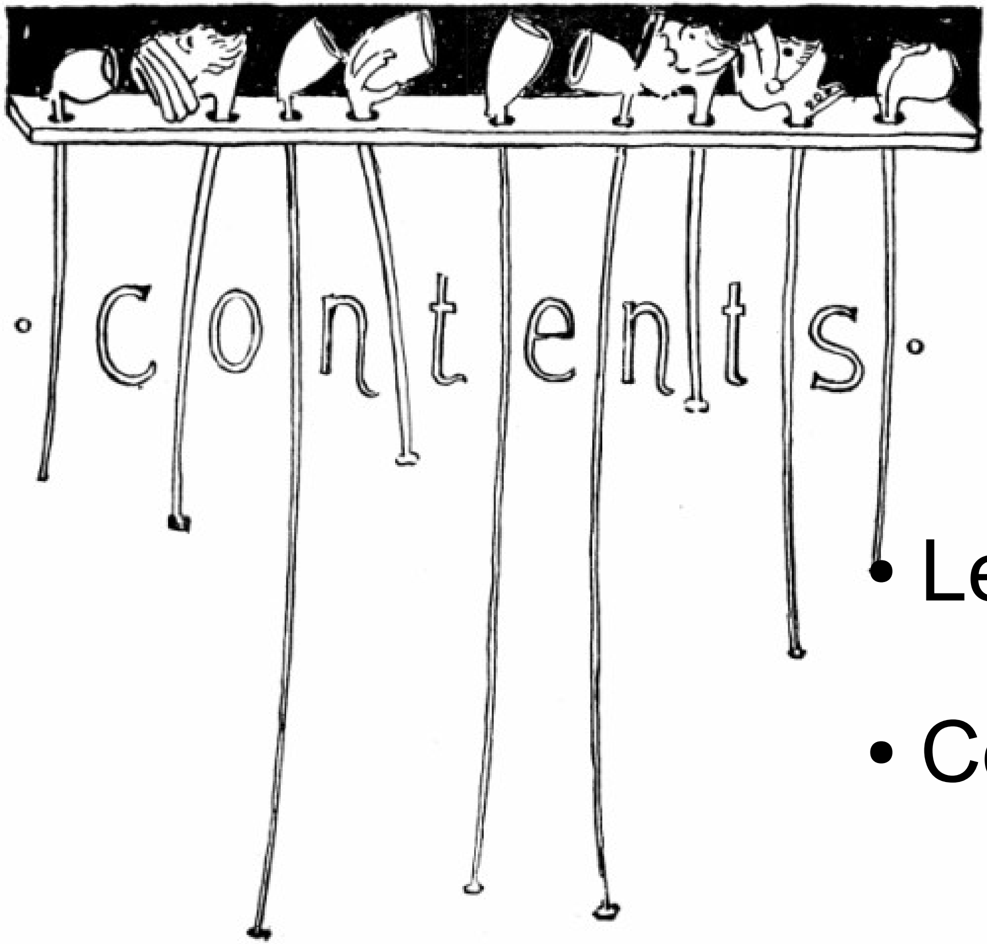
Les bases de l'informatique et de la programmation

Frank NIELSEN

✉ nielsen@lix.polytechnique.fr

Lundi 5 Mai 2008

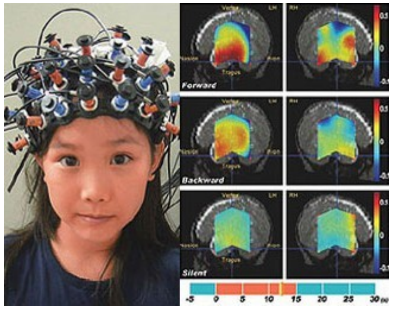
INF311 **Contents**



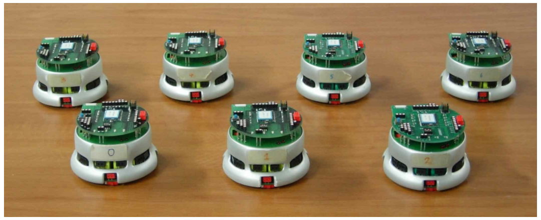
- Learn to **program** with/in Java
- Computing as a science

  (some basic principles)
- Popular (computer) science

HCI



BMI



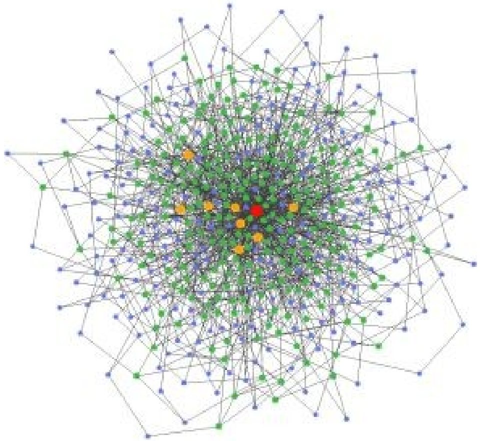
MANET

Jobs & Informatics

Over 35% of Ecole Polytechnique graduates work in CS-related jobs (CS: computer science)

STIC: Sciences et Technologies de l'Information et des Communications

- **Industry**
  - CS Industry
  - Others (information systems)



- **Administration**

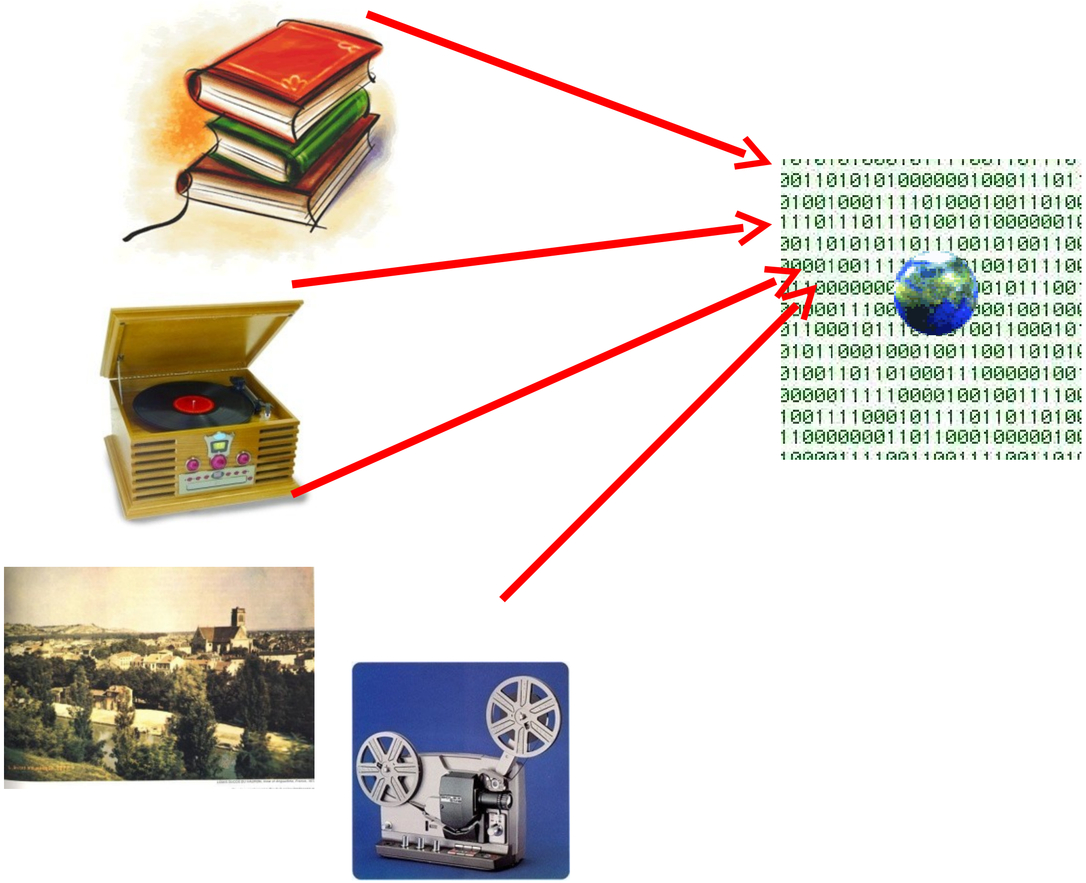
- **Research & Development**

Not feeling fluent with CS today, is like not being able to drive a car !

Digital world

Benefits of the *analog-to-digital* paradigm shift?

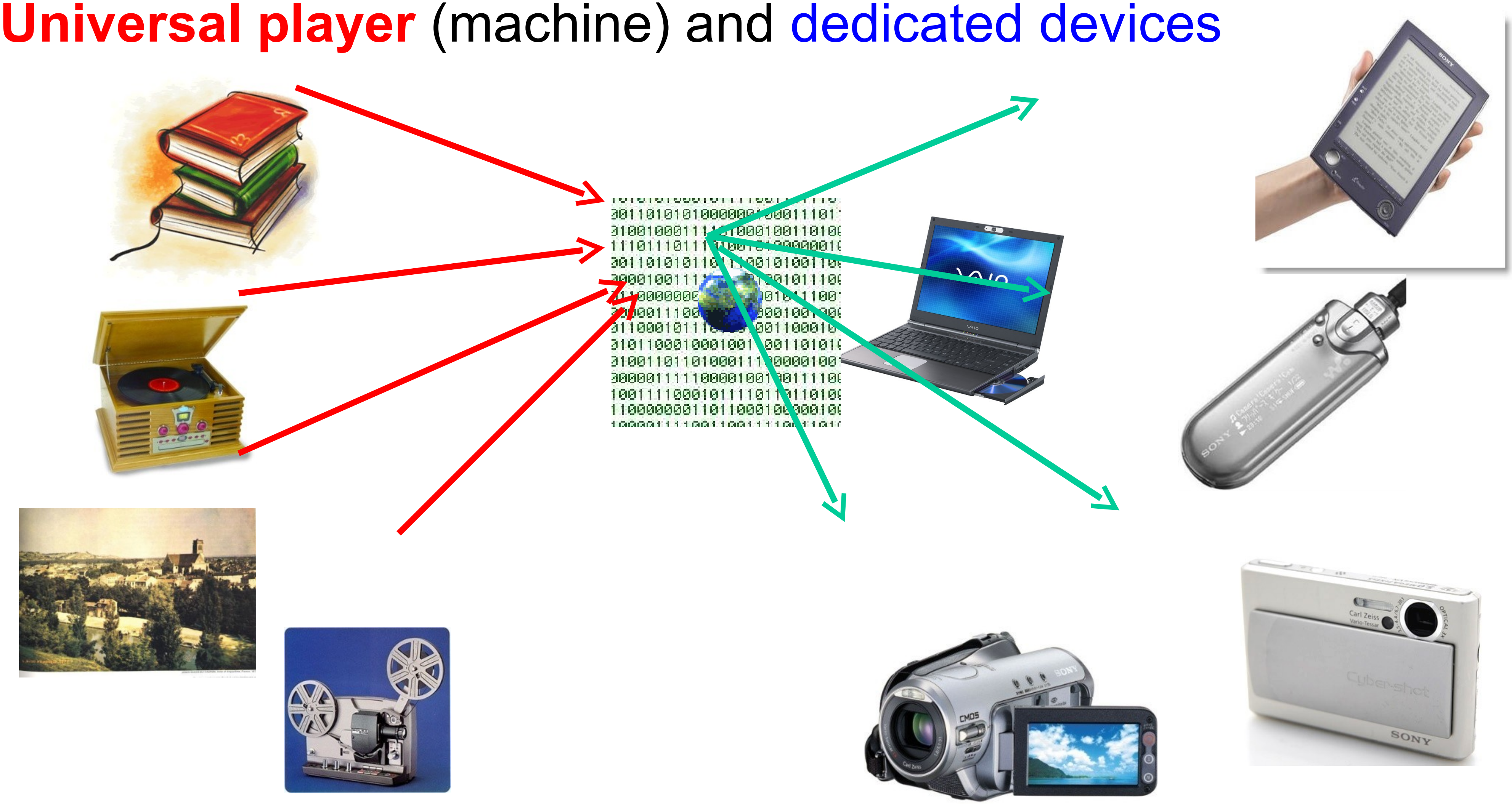
- ***Dissociate* contents from support** : digitize/“binarize”



Contents become mere binary 0/1 strings

Digital world

- **Universal player** (machine) and dedicated devices



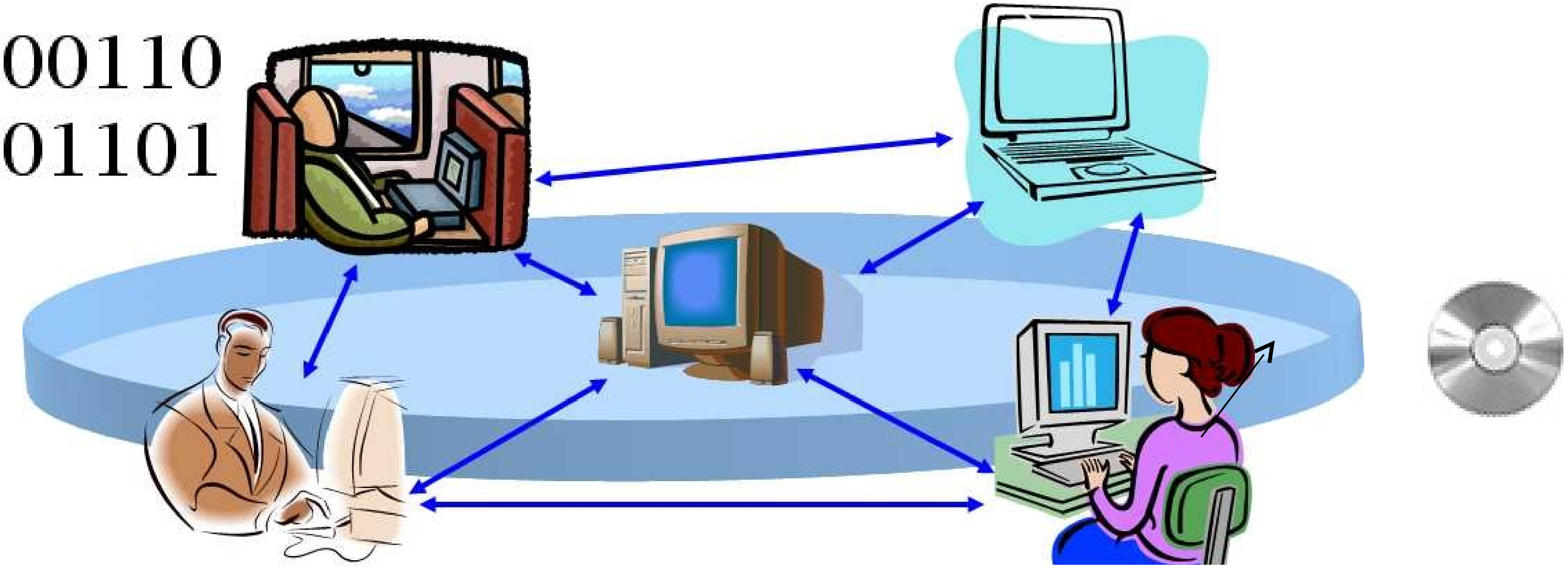
“Multiple 0/1 readers”

Digital world

- **Generic algorithms**:
  copying, compressing, transmitting, archiving, etc.

01101100110
00011101101

- Text
- Music
- Image
- Video
- Data



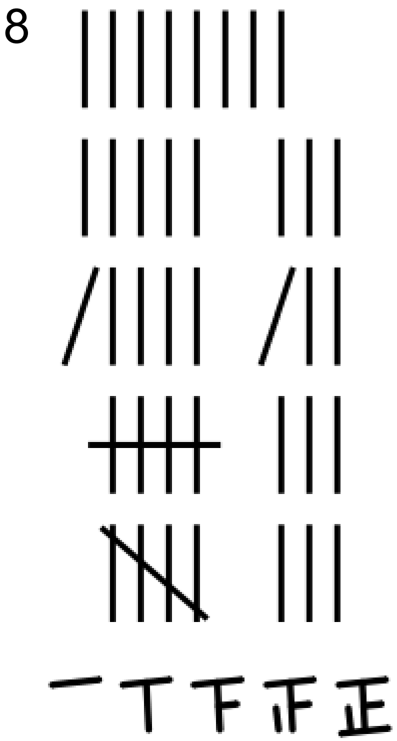
01101100110
00011101101

Raise the question: What is the (digital) information?

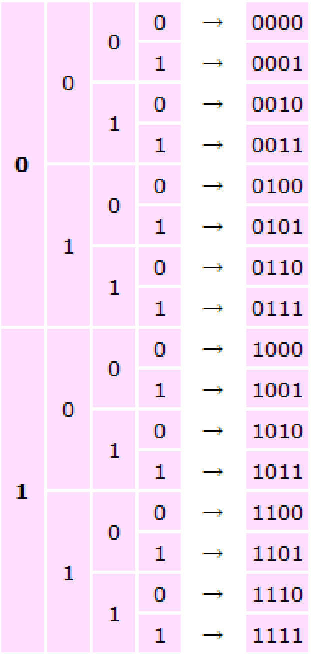
Digital world: Why 0/1 bits?

Information, first needs of counting...

Unary numeral systems:

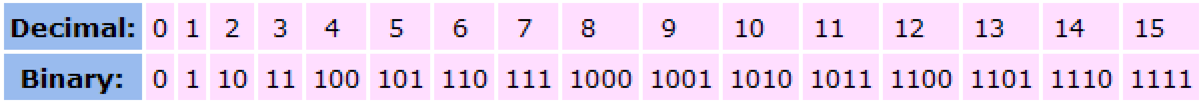


Binary numeral systems:



0	0	0	0	→	0000
			1	→	0001
		1	0	→	0010
			1	→	0011
	1	0	0	→	0100
			1	→	0101
		1	0	→	0110
			1	→	0111
1	0	0	0	→	1000
			1	→	1001
		1	0	→	1010
			1	→	1011
	1	0	0	→	1100
			1	→	1101
		1	0	→	1110
			1	→	1111

4 bits
for counting
0 to 15



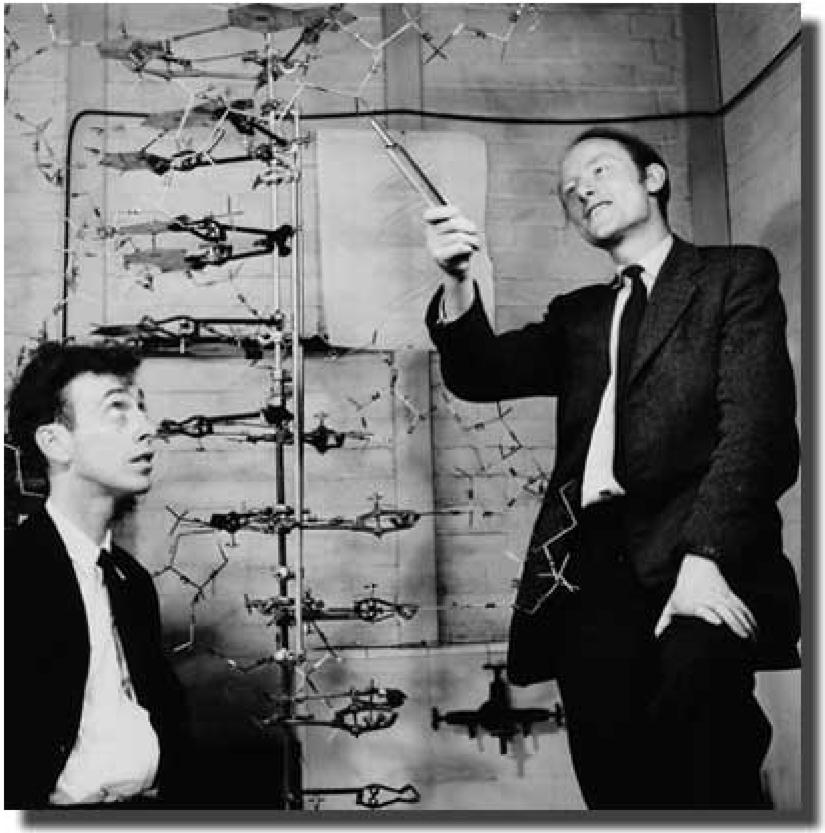
Decimal:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Binary:	0	1	10	11	100	101	110	111	1000	1001	1010	1011	1100	1101	1110	1111

Linear number of bits for counting vs Logarithmic number of bits for counting

Nature of computing?

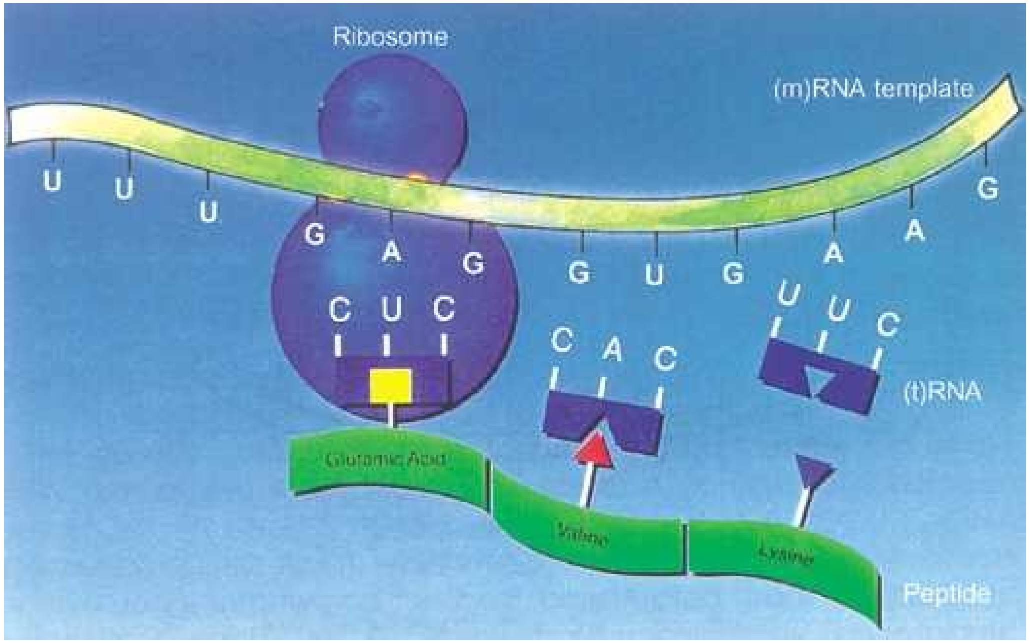
- **Generic algorithms**:

  copying, transmitting... ...genetics...



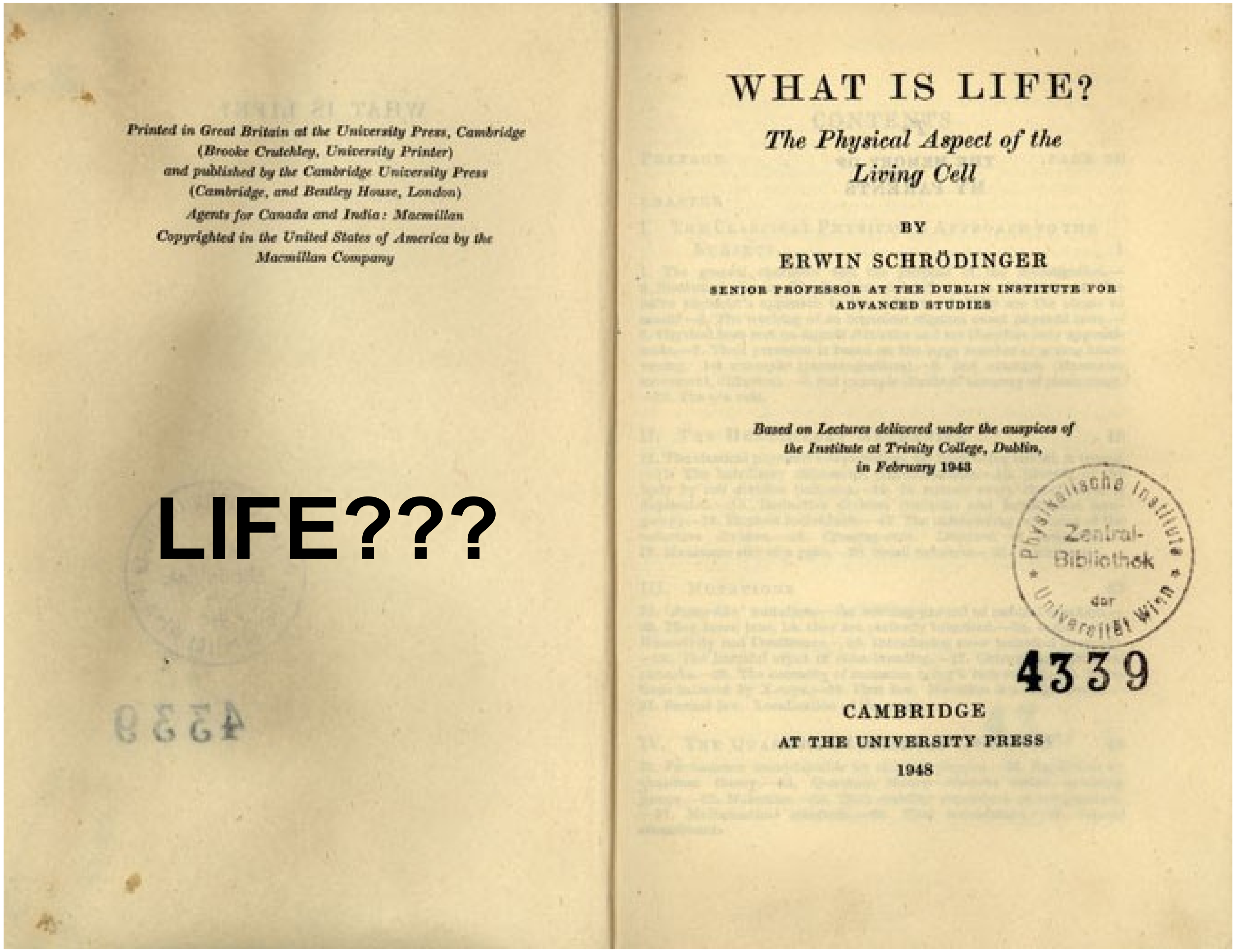
DNA (double-helix structure of DNA)

1953, James Watson and Francis Crick (Nobel prize)



Genetics

Nature of computing?



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LIFE???

WHAT IS LIFE?

The Physical Aspect of the Living Cell

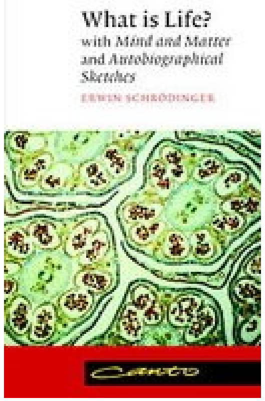
BY

ERWIN SCHRÖDINGER

SENIOR PROFESSOR AT THE DUBLIN INSTITUTE FOR ADVANCED STUDIES

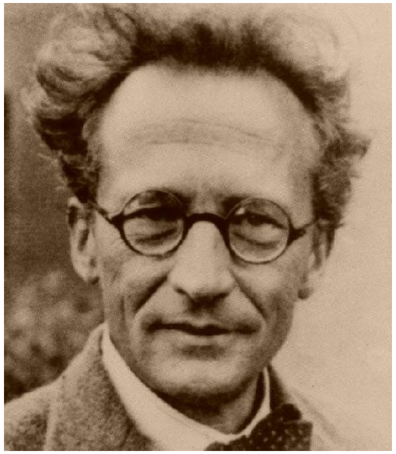
Based on Lectures delivered under the auspices of the Institute at Trinity College, Dublin, in February 1943

CAMBRIDGE
AT THE UNIVERSITY PRESS
1948



What is Life?
with *Mind and Matter*
and *Autobiographical*
Sketches
ERWIN SCHRÖDINGER

Transmit crystals?



Nobel, Physics 1933

First envisioned by Erwin Schroedinger (What is life?, 1944)

Digital world/computing

Ubiquitous computing= computing everywhere

Digital = Binary + Calculations

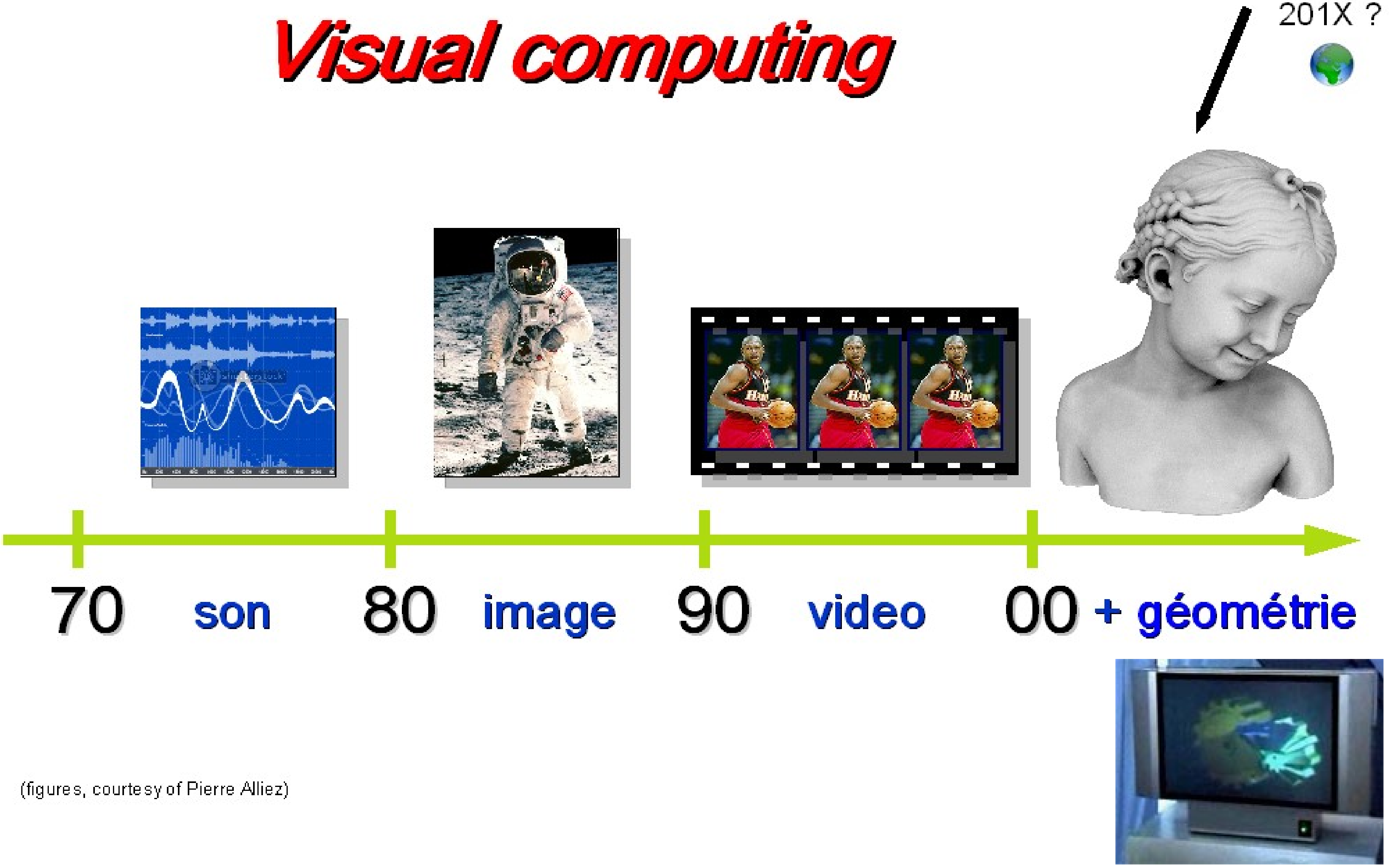
New features

Example: **Computational photography**

Digital world/computing

Sciences de l'Infovisuel :

Visual computing



On est **ici**
3D TV
201X ?

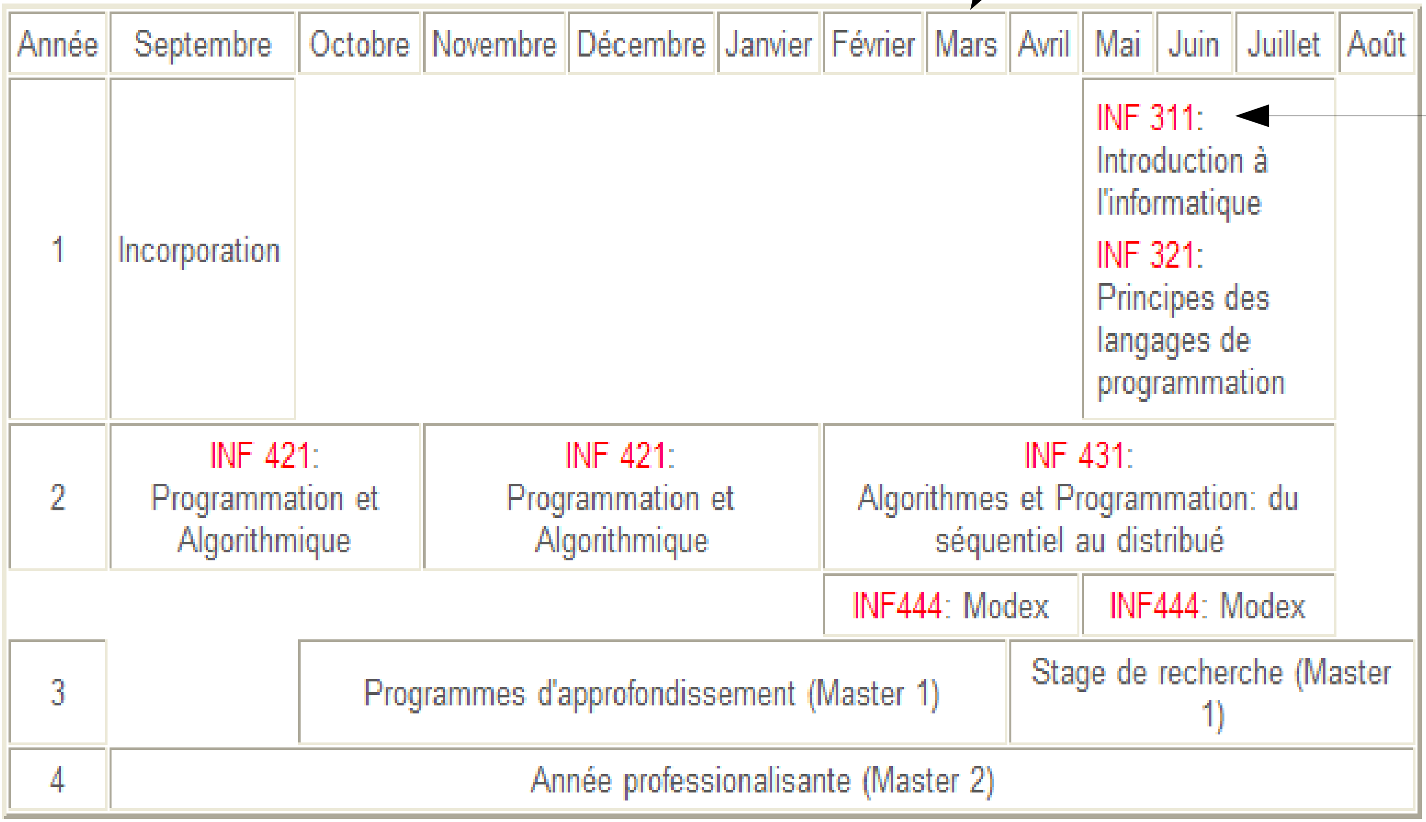
70 son 80 image 90 video 00 + géométrie

(figures, courtesy of Pierre Alliez)

Computer Science at Ecole Polytechnique

http://www.enseignement.polytechnique.fr/informatique/

Semaine de la Science



Année	Septembre	Octobre	Novembre	Décembre	Janvier	Février	Mars	Avril	Mai	Juin	Juillet	Août
1	Incorporation								INF 311: Introduction à l'informatique INF 321: Principes des langages de programmation			
2	INF 421: Programmation et Algorithmique		INF 421: Programmation et Algorithmique		INF 431: Algorithmes et Programmation: du séquentiel au distribué							
					INF444: Modex			INF444: Modex				
3		Programmes d'approfondissement (Master 1)						Stage de recherche (Master 1)				
4	Année professionalisante (Master 2)											

Welcome to INF311

INF 311 versus INF 321?

Theses (Ph. D)

Synopsis of INF311

Welcome to INF311

- 10 lectures (Amphis) x 1h30
- 10 TDs x 2h (12 groups)

- Travail personnel
- Tutorat (x4)

Tutorat:

Jeudi 22 Mai, 13h30-15h30

Jeudi 5 Juin, 13h30-15h30

Jeudi 12 Juin, 13h30-15h30

Jeudi 19 Juin, 13h30-15h30

- Pale machine (TD en Juin)
- Pale finale (HC, Lundi 7 Juillet)

www http://www.enseignement.polytechnique.fr/informatique/INF311/

INF311: Schedule

Irregularities to consider...

Amphi 1, Lundi 5 mai 10h30-12h00, TD1 13h30-15h30 (Gr1-6) et 15h45-17h45 (Gr7-12)

Amphi 2, *Jeudi* 15 mai 10h30-12h00
Amphi 3, Lundi 19 mai 10h30-12h00, TD2 13h30-15h30 (Gr7-12) et 15h45-17h45 (Gr1-6)
Amphi 4, *Mardi* 20 mai *8h30-10h00*
Amphi 5, Lundi 26 mai 10h30-12h00, TD3 13h30-15h30 (Gr1-6) et 15h45-17h45 (Gr7-12)
TD4, Mercredi 28 mai 8h00-10h00 (Gr7-12) et 10h15-12h15 (Gr1-6)

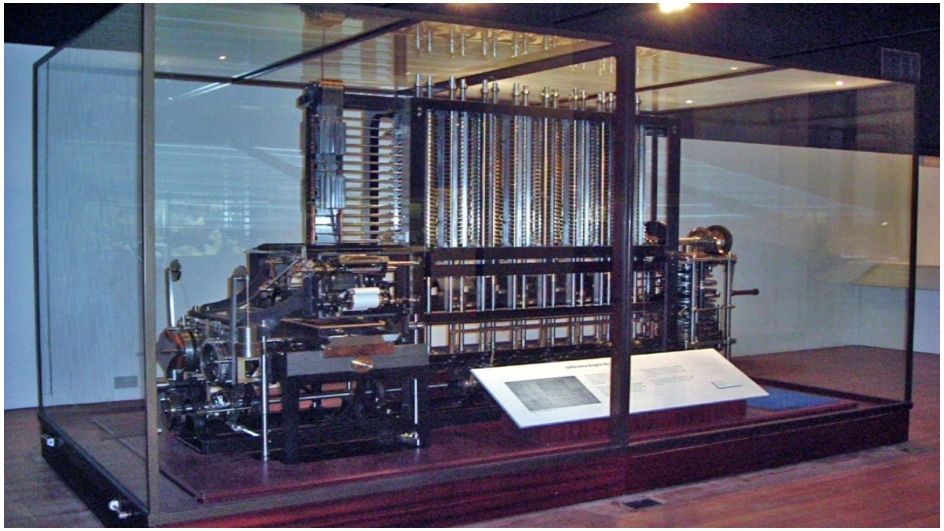
Amphi 6, Lundi 2 juin 10h30-12h00, TD5 13h30-15h30 (Gr7-12) et 15h45-17h45 (Gr1-6)
TD6, Mercredi 4 juin 10h15-12h15 (Gr1-6) et 13h30-15h30 (Gr7-12)

Amphi 7, Lundi 9 juin 10h30-12h00, TD7 13h30-15h30 (Gr1-6) et 15h45-17h45 (Gr7-12)
Amphi 8, Lundi 16 juin 10h30-12h00, TD8 13h30-15h30 (Gr7-12) et 15h45-17h45 (Gr1-6)
Amphi 9, Lundi 23 juin 10h30-12h00, TD9 13h30-15h30 (Gr1-6) et 15h45-17h45 (Gr7-12)
Amphi 10, Lundi 30 juin 10h30-12h00, TD10 13h30-15h30 (Gr7-12) et 15h45-17h45 (Gr1-6)

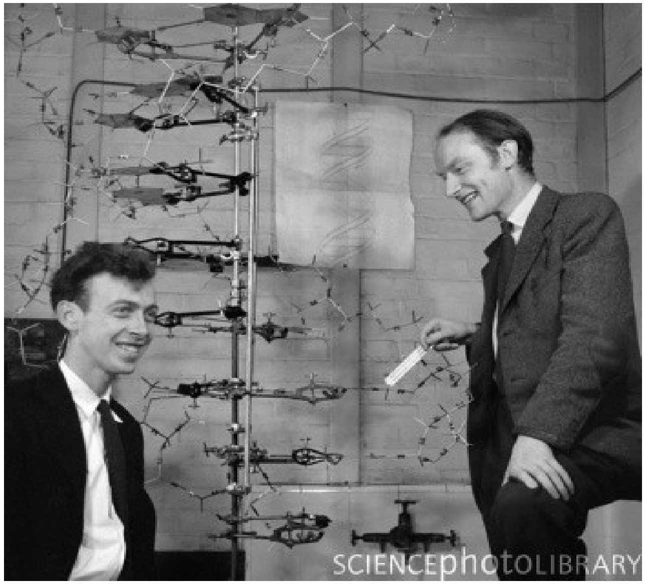
http://www.enseignement.polytechnique.fr/informatique/INF311/

Computer science *is not* programming PCs

Computers
=
computing **machineries**



Difference engine of Charles Babbage
(conceived in 1822 on paper, built much later on)



Computing is a principle of reality (and science)
Watson and Crick 1951 (DNA double helix heredity)

Computing is 21st Century's Science of integration

INFORMATIQUE=INFORmation + autoMATIQUE

Information= Data sets, input (discrete binary sequences of 0/1)
Automatic= *General* recipe that works on *any* input
= **ALGORITHM**

A page from the Kitab al-jabr wa l-muqabala. (Esposito, J.L., editor,Oxford History of Islam.Oxford University Press,Oxford,1999)

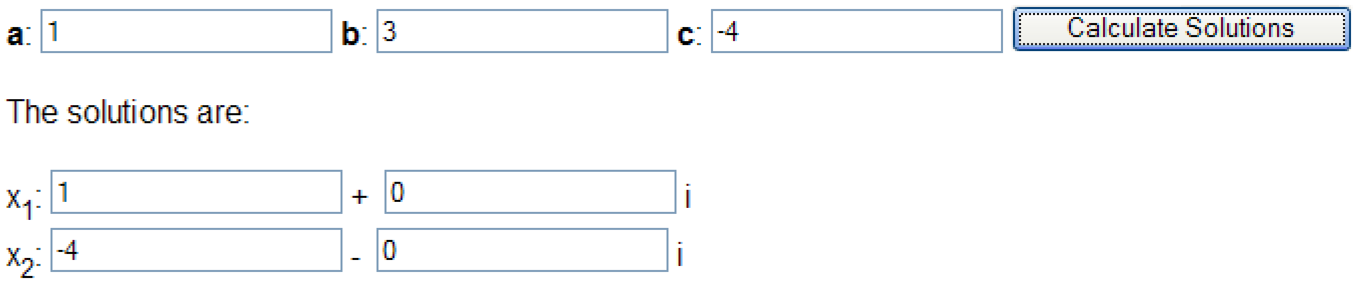
Al-Khwarizmi: Scholar of
scientifically flourishing Bagdad:

- Algorithmi (latinization) -> Algorithm
- Al jabr -> Algebra

Al-Khwarizmi
(790 - 840)

Provide readers a generic ***pipeline*** solution to solve a quadratic equation:

$$\mathbf{a}x^2 + \mathbf{b}x + \mathbf{c} = 0$$



a: 1 b: 3 c: -4

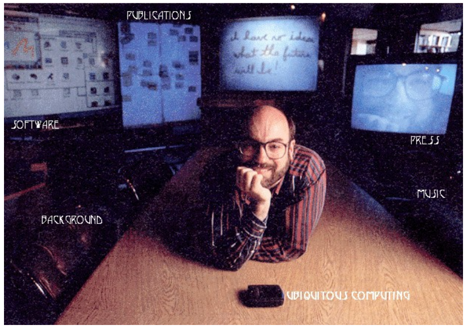
The solutions are:

x_1: 1 + 0 i
x_2: -4 - 0 i

http://www.akiti.ca/Quad2Deg.html

21st century computer science

- Computers (and computing) are **omnipresent** -> **Ubiquitous computing** (Mark Weiser)



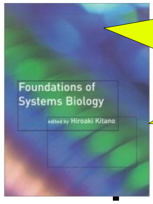
1952-1999
Xerox parc chief scientist

Computers are abundant and versatile:
("pucerons" of Gerard Berry, College de France)

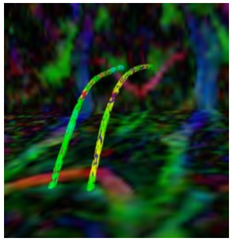
(Many more devices than PCs)

Science of Integration
(complex systems)

- Computing **impacted** all Sciences:
  Computational sciences
  Eg., Biology -> Systems biology
  (simulation-prediction-experience in wet lab)



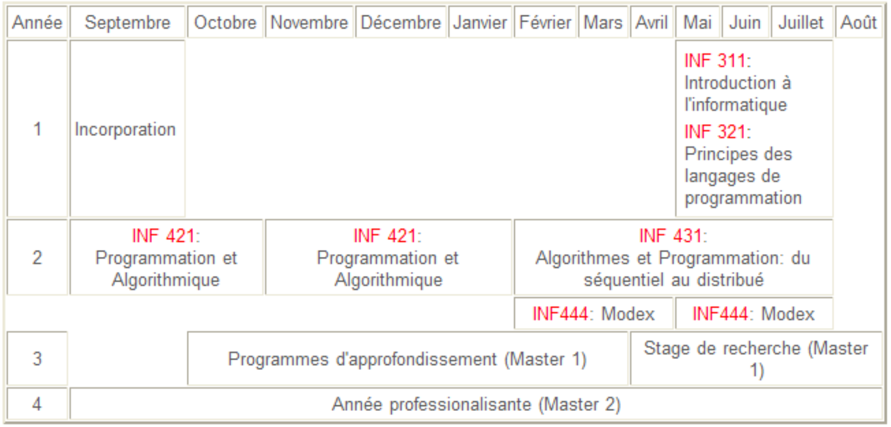
- The Science of computing is Computer Science (CS):
  Deep theoretical questions and important technologies
  (eg., medical imaging such as DT-MRI, economy)



DW-MRI

CS curriculum at Ecole Polytechnique

- INF311+421 allow you to reach **INF431**
- Open doors to MODEXs
- Allow you to go to **Master courses** (International level)



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4	Année professionalisante (Master 2)											

But first, we need to harmonize our background with the *very basics*

(like solfege in music, or ...
studying the theory of driving cars before driving and conceiving them...)

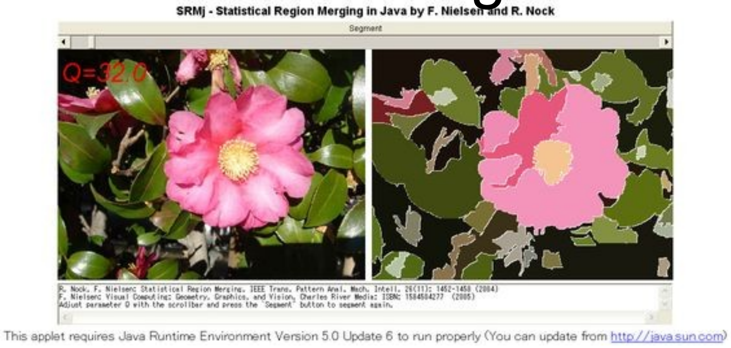
About your instructor...

PhD in computational geometry (1996)
1997- Senior researcher at Sony Computer Science Laboratories
2008- Professor at LIX.

Flavor of my research in computer science

Visual computing:

- Computational geometry,
- Computer vision,
- Computer graphics,
- Machine learning



SRMj - Statistical Region Merging in Java by F. Nielsen and R. Nock

R. Nock, F. Nielsen: Statistical Region Merging. IEEE Trans. Pattern Anal. Mach. Intell. 26(11): 1452-1458 (2004)
F. Nielsen: Visual Computing: Geometry, Graphics, and Vision. Charles River Media: ISBN: 1584504277 (2005)
Adjust parameter Q with the scrollbar and press the 'Segment' button to segment again.

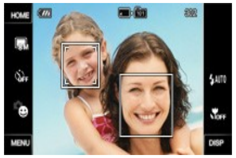
This applet requires Java Runtime Environment Version 5.0 Update 6 to run properly (You can update from http://java.sun.com)

For example, tackling **computational photography**

Reinventing the photography: taking, sharing and experiencing photos...

Analog camera

Digital camera



Smile shutter

Everything has yet to be invented!!!

Beyond 2D pixels
Beyond single flash
etc...

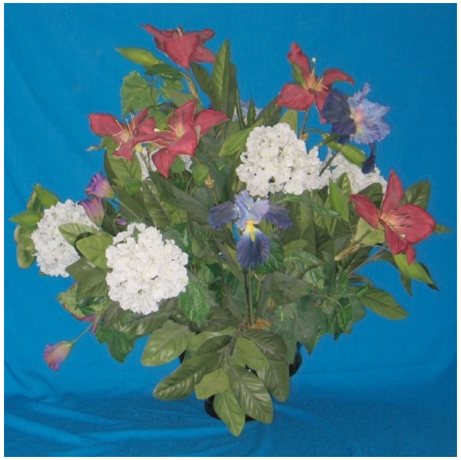
Computer science is (also) for creative minds

Not only the hardcore mathematical problems to solve, but also innovation by unleashing the power of digital calculus for soft problems:

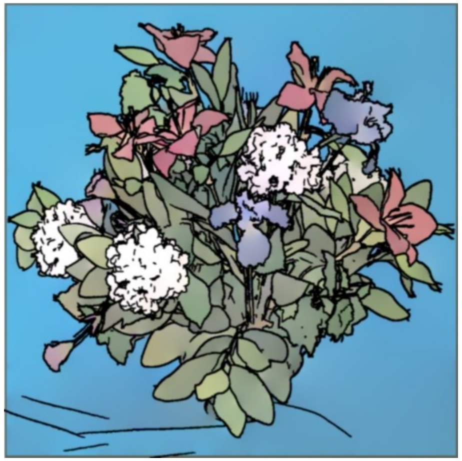
Human Computer Interactions (HCI), design

Example: computational photography project (2004)

Non-photorealistic camera (NPR)

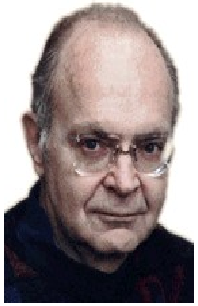


NPR Camera



Algorithms and their performances (resource/complexities)

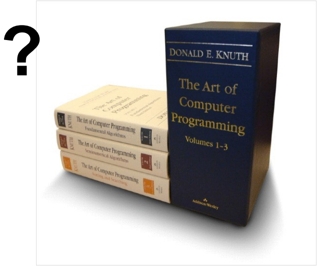
There is usually *not* a single recipe for solving the task:



Eg., compute 5422x2319
(human decimal, machine binary, indian base 60, many tricks, etc.)

Donald Knuth

How to evaluate and compare different algorithms?



Clean framework for *assessing* the use of *ressources*:
- time,
- memory,
- #communications,
- etc.

Judge the *generic* algorithms not for a given instance.

Therefore, analyze:
- Worst-case complexity
- Average-time complexity
- Modern challenges (inplace, i/o bottlenecks & streaming, etc.)
- Etc.

INTRODUCTION
À L'ANALYSE DES
ALGORITHMES

Robert Sedgewick et Philippe Flajolet
Traduction de Cyril Chabaud

Philippe Flajolet, INRIA

Programming algorithms in Java

- Conceived by **Bill Joy** (SUN co-founder) and **James Gosling**

- Started in 1990, for the "next wave in computing"
- On-time for the Internet and WEB (applets are Java applications, Javascript, etc.)
  Cross-platform= runs on various operating systems (Windows, UNIX, Leopard, etc.)
- **Typed language** (a=b, with a and b from different types will generate a compiler error)
- **Object oriented** (OO, ease the conception and modularity of applications)

- Rich set of Applications Programming Interface (API)
- Free Software Development Kit on many platforms (SDK)
- Verbose for catching bugs and debugging applications.

Why programming languages?

Machines are "stupid": they obey you **100%**
-> Need to fully and precisely specify your intentions
(no room for ambiguity, the bug is yours!!!)

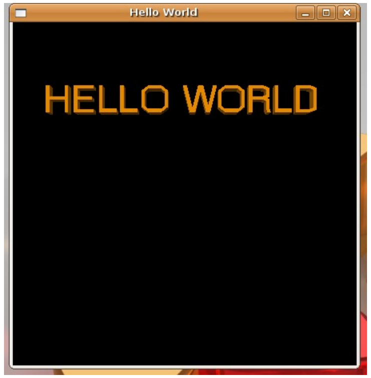
... Machines only "understand" 0/1 binary sequences
(eg., instruction codes of microprocessors)

Machine = Processing + Peripherals (I/O)
... controlled by an Operating System (OS)

But Human masters "natural language"
... and we need to unleash *ease of programming*
ASSEMBLER, FORTRAN, ALGOL, BASIC, ...JAVA

Key principle of CS: **Bootstrapping**!
use existing languages to create more powerful languages:
Python, Ruby, etc.

My first (java) program


Hello World

HELLO WORLD

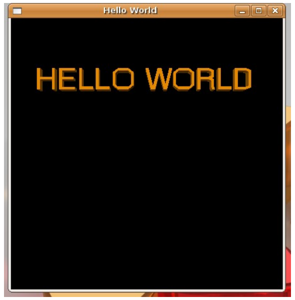
Programmers and CScientists cherrish...
... their “Hello World” programs

```
class FirstProgram{
   public static void main (String[ ] args){
      System.out.println("Hello INF311 !");
   }
}
```

First programs often looks magic!

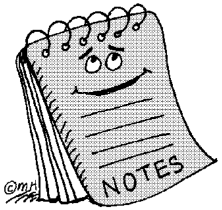
Special function `main`: entry of the program

My first (java) program



HELLO WORLD

- Type this program into a text editor (nedit, notepad)
  Save this “text” as FirstProgram.java

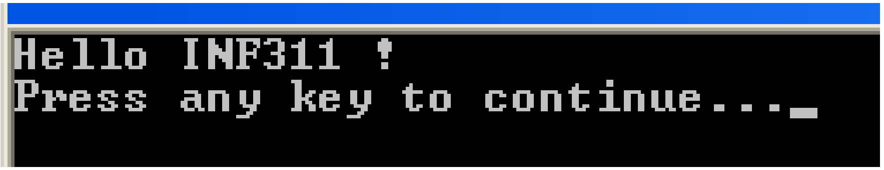


- Compile the program FirstProgram.java

```
prompt% javac FirstProgram.java
```

- Execute the compiled program

```
prompt% java FirstProgram

prompt% Hello INF311 !
```



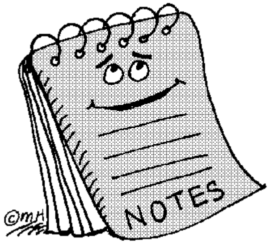
```
Hello INF311 !
Press any key to continue..._
```

My first (java) program

1) EDIT and SAVE

High-level language
concepts/abstraction

```
FirstProgram.java
```



2) COMPILE

```
FirstProgram.class
```

(Java Byte code in .class)

3) EXECUTE

```
java FirstProgram
```

(Java Virtual machine: JVM)
... low-level language
instructions for processors

My first algorithm in Java:
A solver for quadratic equations

In Java

Java
Sun Microsystems
Bienvenue sur Java.com
Offert par Sun Microsystems.
Téléchargement du logiciel Java | Sélectionner une langue | Contact | Aide
Rechercher
Go
Visitez java.com
(site anglais)
(Site en anglais)
JAVA TECHNOLOGY'S HISTORY: THE
Téléchargement gratuit Java

Téléchargement gratuit Java

Téléchargez Java gratuitement pour votre PC dès maintenant !

http://www.java.com/fr/

→ Install the SDK
(you do not have
to do this in room machines)

J2SE v 1.4.2_16 SDK includes the JVM technology

The J2SE Software Development Kit (SDK) supports creating J2SE applications. More info...

Download J2SE SDK
Installation Instructions ReadMe ReleaseNotes
Sun License Third Party Licenses

Input: a, b, c of the quadratic equations

Solution: the at most two real roots

$$ax^2+bx+c=0$$

$$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a},$$

Programming: Solver for quadratic equations

QuadraticEquationSolver.java

```
class QuadraticEquationSolver
{
public static void main(String[] arg)
   {
   double a,b,c;

   a=Math.sqrt(3.0);
   b=2.0;
   c=-3.0;

   double delta=b*b-4.0*a*c;
   double root1, root2;

   root1= (-b-Math.sqrt(delta))/(2.0*a);
   root2= (-b+Math.sqrt(delta))/(2.0*a);

   System.out.println(root1);
   System.out.println(root2);

   System.out.println("Let us check the roots:");
   System.out.println(a*root1*root1+b*root1+c);
   System.out.println(a*root2*root2+b*root2+c);
   }
}
```

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a},$$

Programming simple formula

Variable
(declare)

Assignments

Declare+Assign

```
class QuadraticEquationSolver
{
public static void main(String[] arg)
   {
   double a,b,c;

   a=Math.sqrt(3.0);
   b=2.0;
   c=-3.0;

   double delta=b*b-4.0*a*c;
   double root1, root2;

   root1= (-b-Math.sqrt(delta))/(2.0*a);
   root2= (-b+Math.sqrt(delta))/(2.0*a);

   System.out.println(root1);
   System.out.println(root2);

   System.out.println("Let us check the roots:");
   System.out.println(a*root1*root1+b*root1+c);
   System.out.println(a*root2*root2+b*root2+c);
   }
}
```

Programming simple formula

```
class QuadraticEquationSolver
{
public static void main(String[] arg)
    {
    double a,b,c;

    a=Math.sqrt(3.0);
    b=2.0;
    c=-3.0;

    double delta=b*b-4.0*a*c;
    double root1, root2;

    root1= (-b-Math.sqrt(delta))/(2.0*a);
    root2= (-b+Math.sqrt(delta))/(2.0*a);

    System.out.println(root1);
    System.out.println(root2);

    System.out.println("Let us check the roots:");
    System.out.println(a*root1*root1+b*root1+c);
    System.out.println(a*root2*root2+b*root2+c);
    }
}
```

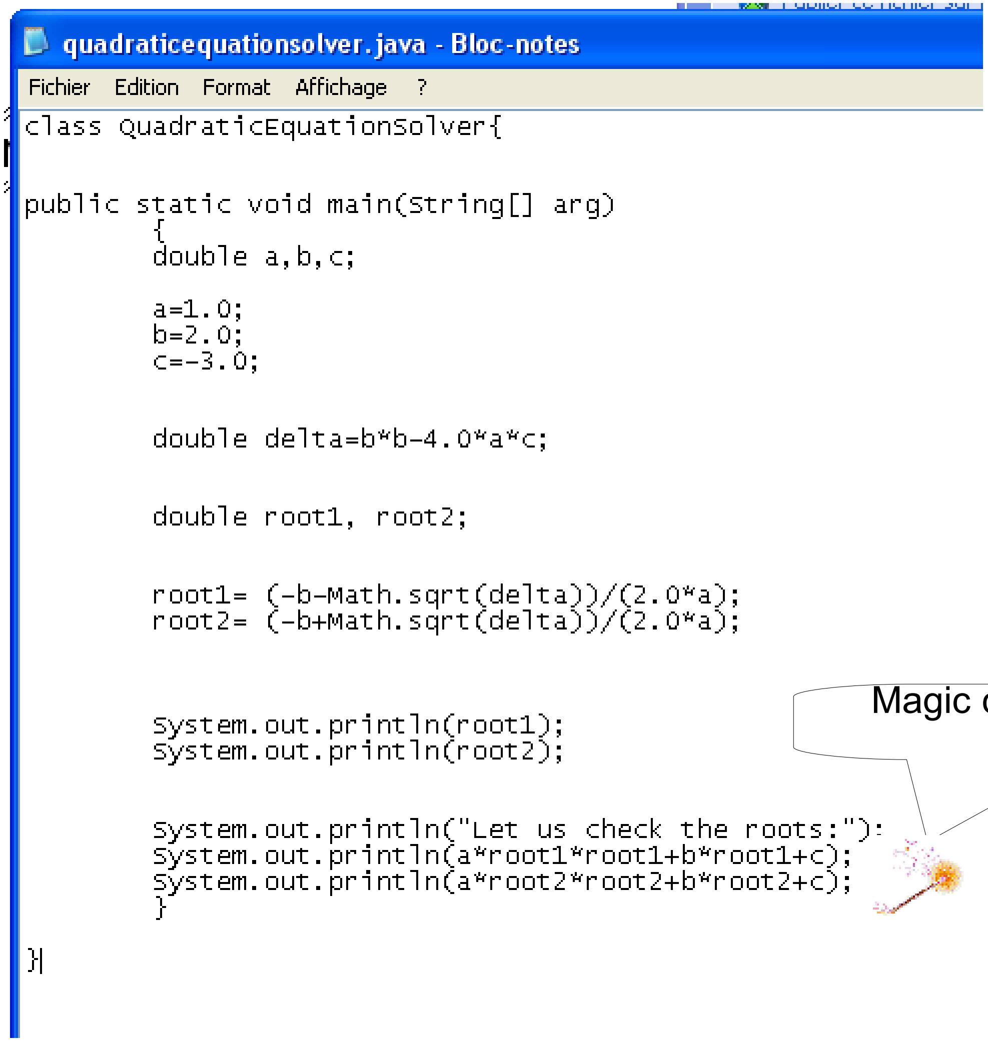
Arithmetic expressions

Display

Programming: Solver for quadratic equations

Use *any* **text editor** to program
(**nedit** in UNIX, **notepad** under windows)

Indentation is up to you
-> helps read programs

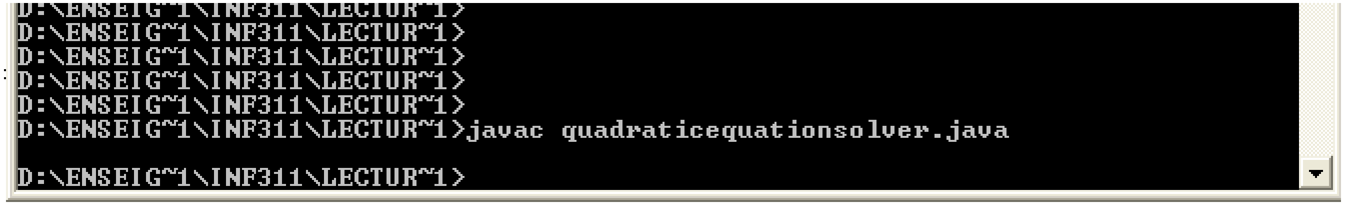

quadraticequationsolver.java - Bloc-notes
Fichier Edition Format Affichage ?

```
class QuadraticEquationSolver{


public static void main(String[] arg)
        {
        double a,b,c;

        a=1.0;
        b=2.0;
        c=-3.0;


        double delta=b*b-4.0*a*c;


        double root1, root2;


        root1= (-b-Math.sqrt(delta))/(2.0*a);
        root2= (-b+Math.sqrt(delta))/(2.0*a);



        System.out.println(root1);
        System.out.println(root2);


        System.out.println("Let us check the roots:");
        System.out.println(a*root1*root1+b*root1+c);
        System.out.println(a*root2*root2+b*root2+c);
        }

}
```

Magic code for printing onto the **console**

Compiling and executing a Java program

```
prompt>javac filename.java
```



```
D:\ENSEIG~1\INF311\LECTUR~1>
D:\ENSEIG~1\INF311\LECTUR~1>
D:\ENSEIG~1\INF311\LECTUR~1>
D:\ENSEIG~1\INF311\LECTUR~1>
D:\ENSEIG~1\INF311\LECTUR~1>
D:\ENSEIG~1\INF311\LECTUR~1>javac quadraticequationsolver.java

D:\ENSEIG~1\INF311\LECTUR~1>
```

If no compile error happens, it produces a file **filename.class**

Then excute the compiled code.

```
prompt>java filename
```

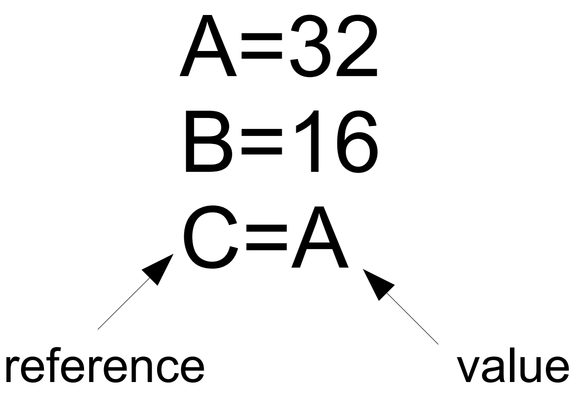
To store output to a file:

```
prompt>java filename  > result.txt
```

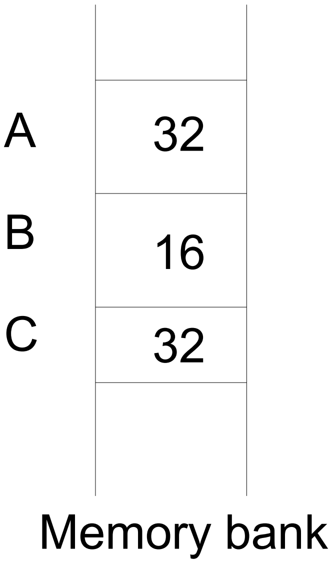
Redirect console to filename result.txt

Fundamentals of Java: Variables

- A variable is *uniquely* named (not a reserved keyword)
- A variable *stores* a value in a memory slot
- The value of a variable *is accessed* by its name
- The value of a variable *can be modified*

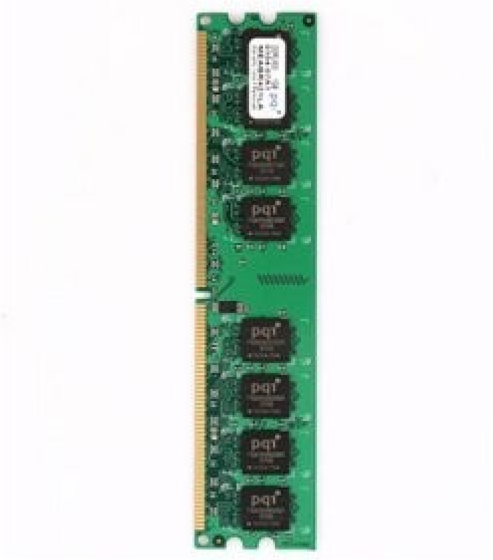


```
A=32
B=16
C=A
```



A	32
B	16
C	32

Memory bank



Left hand side (reference) and right hand side (value) of = means different things

Fundamentals of Java: Expressions

- Formed by variables, operators (+,-,/, x, etc.) and constants (1, Math.PI, etc.)

- Expressions are evaluated and return a result (eventually stored in a variable)

- Operators follow priority rules: 5x3+2 ?
  ...avoid overuse of parenthesis 5x3+2 = (5x3)+2

Few examples of expressions in Java:

```
// Expressions
5+3*x/y
“Hello “+”INF311!”

// Assignment (expressions) terminate with a ;
x=cx + r*Math.cos(theta);
y=cy+ r*Math.sin(theta);
```

Fundamentals of Java: Affectation (sign =)

Var = Expression ;

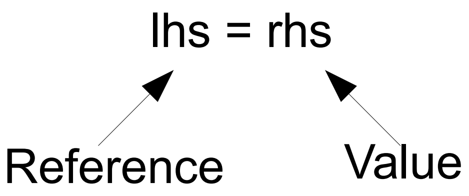
Atomic instruction

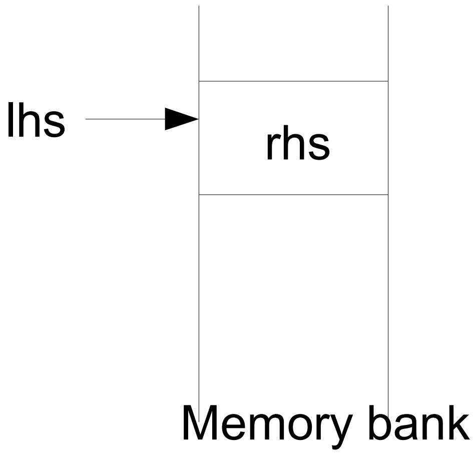
- Var is the name of a variable

- Expression is a well-formed expression

Assignment left hand side=right hand side is decomposed as :

- The Expression is evaluated yielding value v
- The reference (memory slot) of Var is determined
- Value v is stored in the memory slot of Var





Basic types

Type = Domain of values of variables

All variables must be typed in Java

Basic types (=basic data structures):

Integers:

byte	8 bits	
short	16 bits	
int	32 bits	[-2**31,2**31-1]
long	64 bits	[-2**63,2**63-1]

Reals:

float	(single precision, 32 bits)
double	(double precision, 64 bits)

char 16 bits (Unicode, world languages)

boolean true or false

Why do we type variables?

To ensure homogeneous operations

2 🥬 +3 🥬 =5 🥬

3 🥕 +4 🥕 =7 🥕

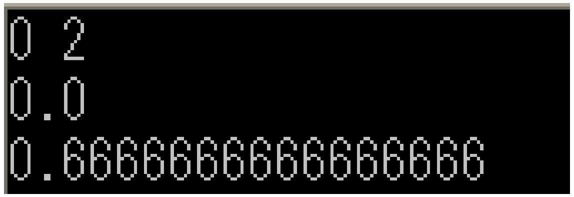
5 🥬 +2 🥕 =???

Basic types: casting expressions

Euclidean (integer) division versus usual (real) division

```
int p=2;
int q=3;
int quotient=p/q;
int reminder=p%q; // modulo

double div=p/q;

double realdiv=(double)p/(double)q;

System.out.print(quotient);
System.out.print(“ “);
System.out.println(reminder);
System.out.println(div);
System.out.println(realdiv);
```

Cast (coercion)



```
0 2
0.0
0.6666666666666666
```

Casting expressions

Implicit casting for assignment

```
x=Expression;
```

Should be of the same type. Casting: Var=(TypeOfVar)Expression;

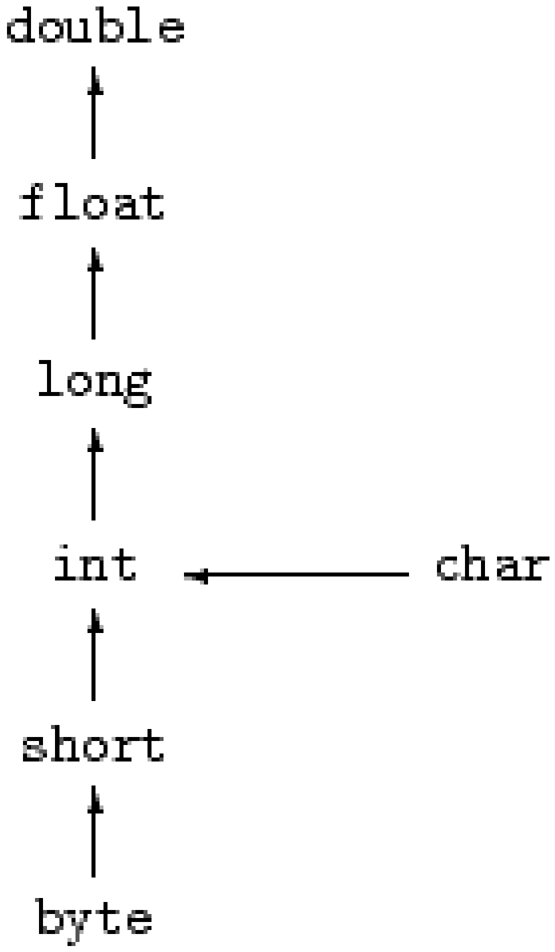
```
double x=2; // implicit casting
double x=(double)2;// explicit
double x=2.0; // same type
```

Typing:

Safeguards for basic bugs in programs

Allows one to perform *static analysis of programs*

Implicit casting



double

float

long

int

char

short

byte

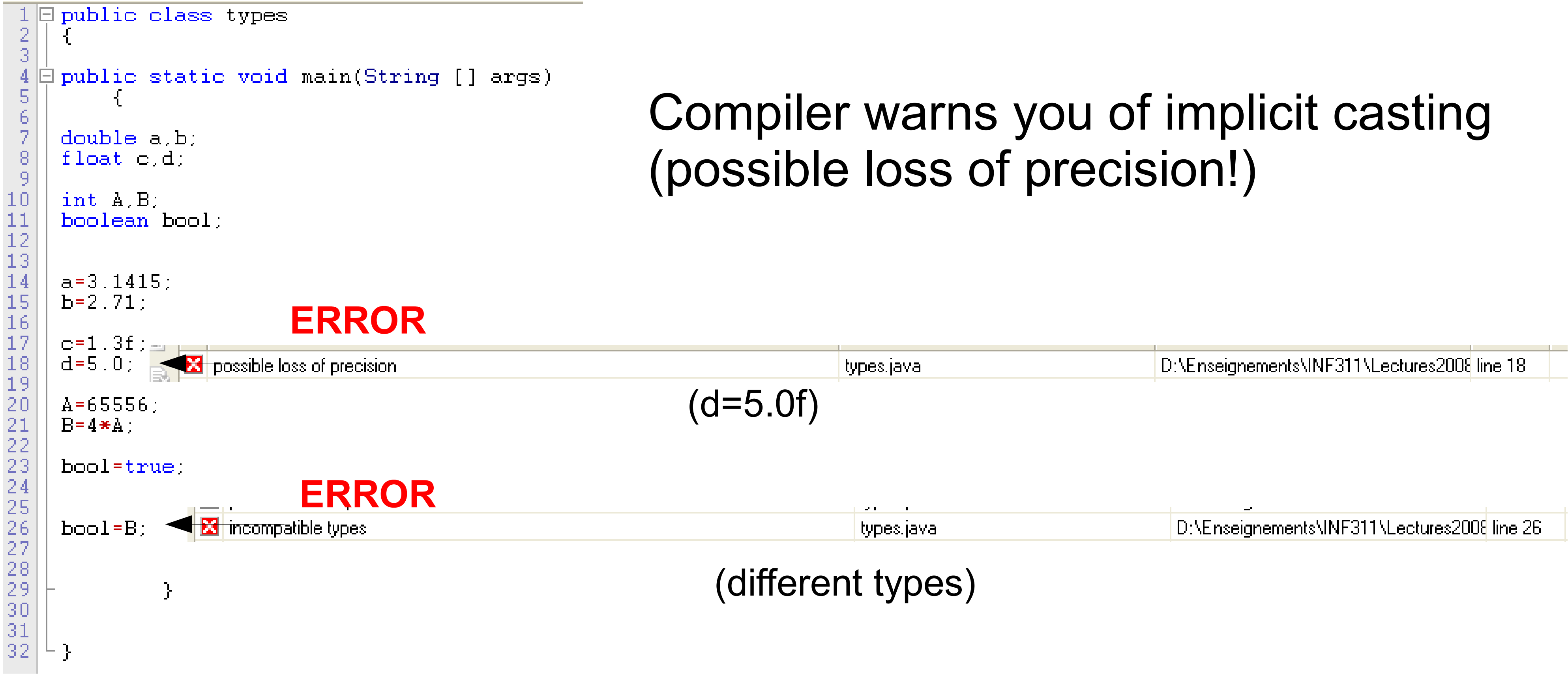
```
char c='X';
int code=c;
System.out.println(code);
```

Answers 88 (ASCII code of X)

Coercions implicites

Fundamentals of Java: Types

- *Everything* is typed (variables, constants, etc.)
- **Require** to declare types of variables
- The result of an expression has a type
- Variable and expression should have the **same type** for assignment



```
 1  public class types
 2  {
 3
 4  public static void main(String [] args)
 5      {
 6
 7  double a,b;
 8  float c,d;
 9
10  int A,B;
11  boolean bool;
12
13
14  a=3.1415;
15  b=2.71;
16
17  c=1.3f;
18  d=5.0;
19
20  A=65556;
21  B=4*A;
22
23  bool=true;
24
25
26  bool=B;
27
28
29          }
30
31
32  }
```

ERROR

```
possible loss of precision    types.java    D:\Enseignements\INF311\Lectures200    line 18
```

(d=5.0f)

ERROR

```
incompatible types    types.java    D:\Enseignements\INF311\Lectures200    line 26
```

(different types)

Compiler warns you of implicit casting (possible loss of precision!)

Recap of simple (formula) programs

Declare variables of basic types: **Type var;**

```
double x;
int n,m; //separate with a comma variables
char c;
```

Assignment: **var=Expression;**

```
x=2.71;
n=2008;
c='X';
```

Arithmetic expression: **Expression1 Operator Expression2**

```
m=300%23;
delta=b*b-4*a*c;
```

Declare+Assign at once (shortcut):

```
int year2secs=365*24*60*60;
```

Incrementing/Decrementing

```
x=x+1;
x=x+step;
// Instructions equivalent to
x+=1;
x+=step;
// Decrement now
x-=3;

i=2;
i++; // equivalent to i=i+1;
++i; // similar, equivalent to i=i+1;
```

Incrementing is useful for loops

Pre- and post-incremention

compare...

```
i=5;
j=i++; // post-incrementation

ii=5;
jj=++ii; // pre-incrementation
```

Var++ returns the value of var and then increment it
++Var *first* increment var and then return its value

Thus j=5 but jj=6

Chopping Programs (Language)

Syntax of programs (postponed, parsing, INF431)

Word	Reserved keywords Variables
Sentence	Instruction I;
Paragraph	Block (of instructions) {I;}
Chapter	Function
Book	Program
Library	Library (API)

Commenting programs

- Adopt conventions

  Eg., class ClassName .... stored in file ClassName.java

- Name variables explicitly (so that you can remember them easily)

- Comment programs (single line // or multiple lines /* */)

```
// Written for INF311

class CommentProgram
{
   /* This is a simple Java program that
    illustrates how to comment source code */


    // Entry of the program

    public static void main(String[ ] args)
    {// it does nothing
    }
}
```

A basic skeleton program in Java

```
// Basic skeleton program for INF311

class Prog
{
   public static void main(String[] arg)
   {
   int x=2008;
   System.out.println(x);
   }
}
```

Name of your program: Prog.java

Magic formula 1

Magic formula 2

```
> javac Prog.java
```

(builds a Prog.class file)

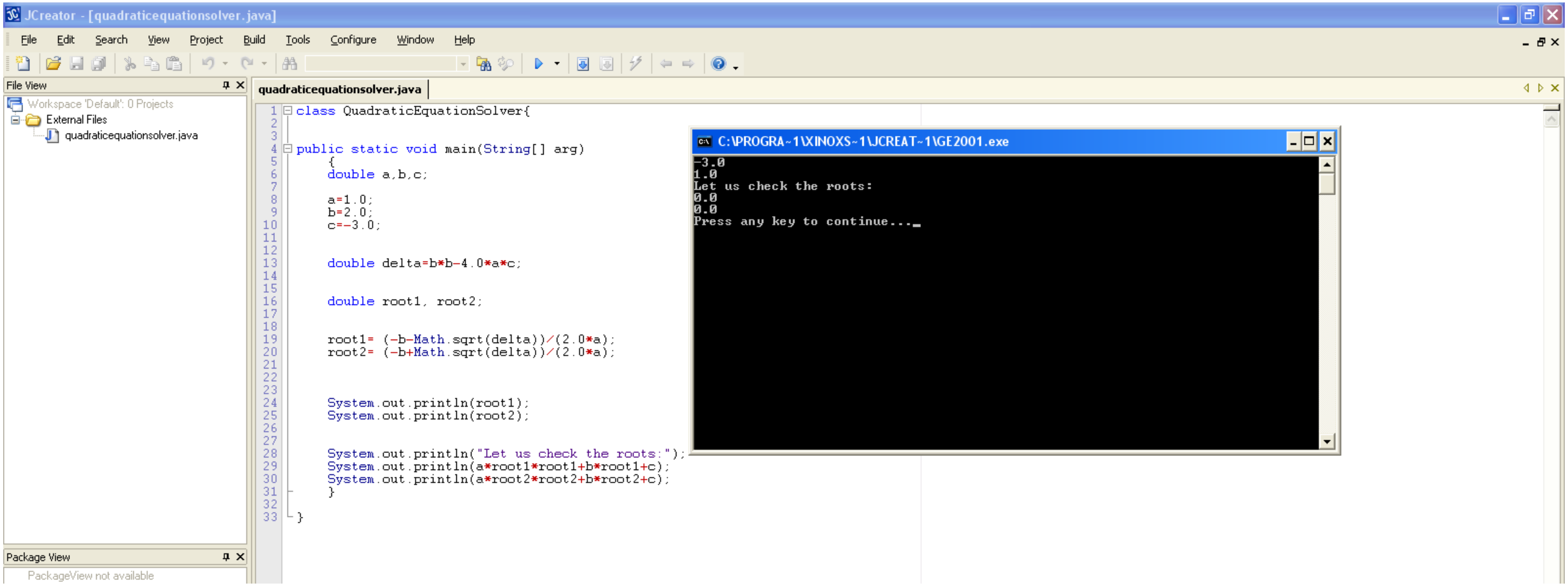
```
> java Prog
```

(execute the program)

```
2008
```

Integrated Development Environment (IDE)

An IDE allows one to create, edit, compile and debug *seamlessly* applications at the tip of mouse clicks.


JCreator - [quadraticequationsolver.java]
File
Edit
Search
View
Project
Build
Tools
Configure
Window
Help
File View
Workspace 'Default': 0 Projects
External Files
quadraticequationsolver.java
Package View
PackageView not available
quadraticequationsolver.java
C:\PROGRA~1\XINOXS~1\JCREAT~1\GE2001.exe

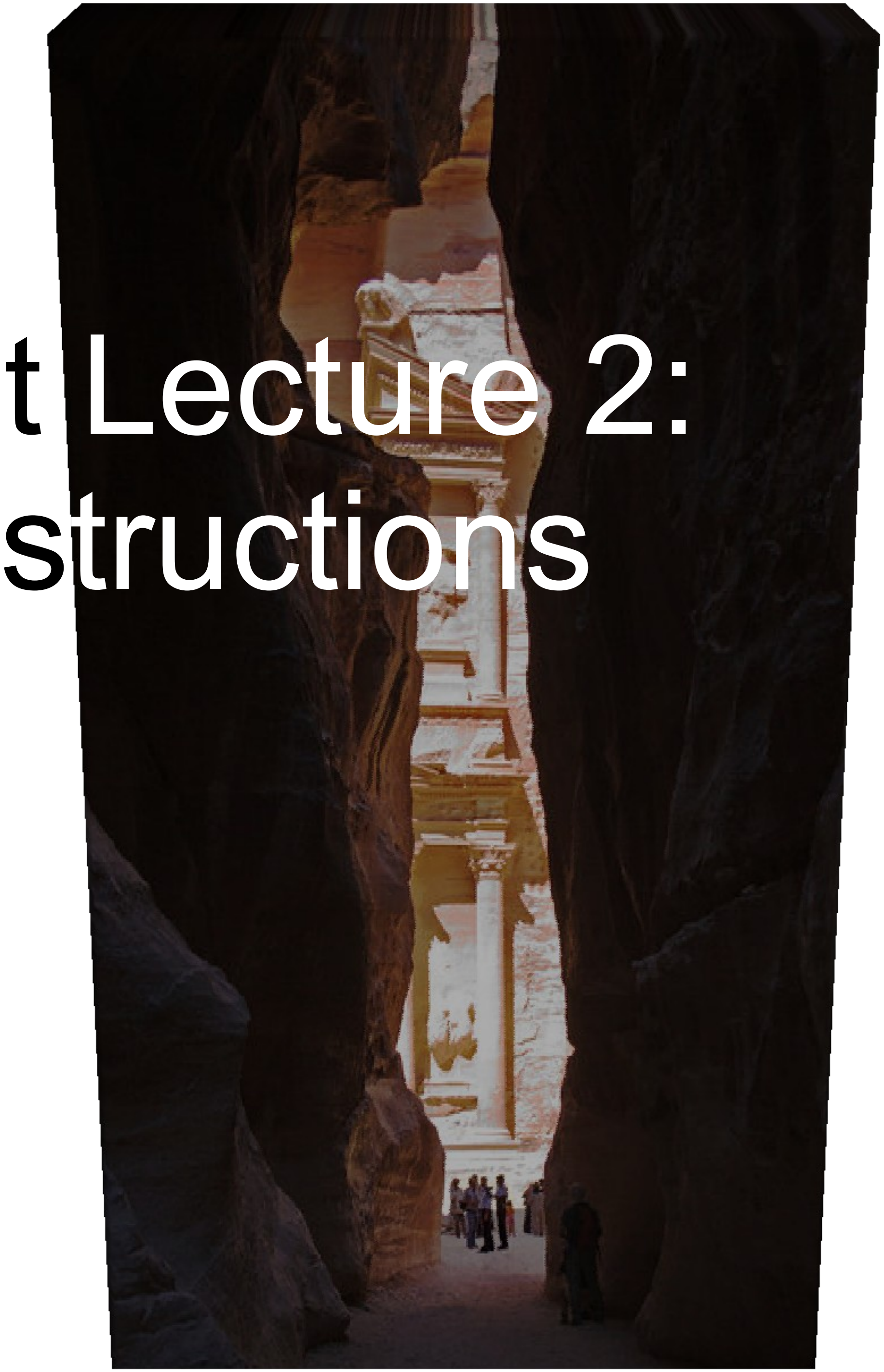
```java
class QuadraticEquationSolver{

public static void main(String[] arg)
    {
    double a,b,c;

    a=1.0;
    b=2.0;
    c=-3.0;


    double delta=b*b-4.0*a*c;


    double root1, root2;


    root1= (-b-Math.sqrt(delta))/(2.0*a);
    root2= (-b+Math.sqrt(delta))/(2.0*a);



    System.out.println(root1);
    System.out.println(root2);


    System.out.println("Let us check the roots:");
    System.out.println(a*root1*root1+b*root1+c);
    System.out.println(a*root2*root2+b*root2+c);
    }

}
```

```
-3.0
1.0
Let us check the roots:
0.0
0.0
Press any key to continue...
```

(Eg., Jcreator, www.jcreator.com/)

Eclipse

eclipse
2.1
THE ECLIPSE PROJECT
(c) Copyright IBM Corp. and others. 2000, 2003. All rights reserved. Java and all Java-related trademarks and logos are trademarks or registered trademarks of Sun Microsystems, Inc. in the U.S., other countries, or both.

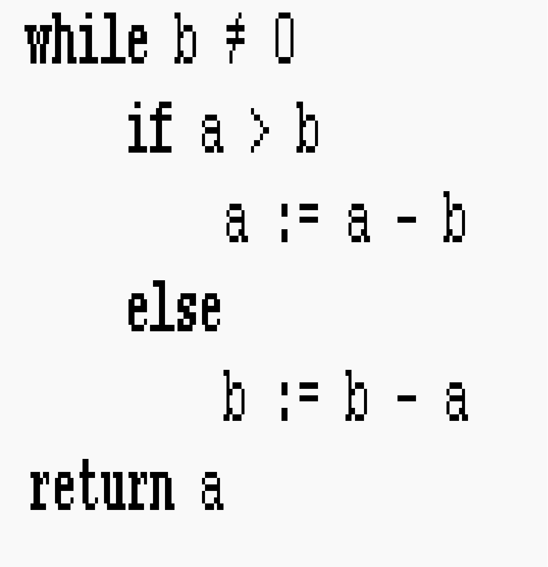


A Glimpse at Lecture 2: Block of instructions

Euclid's Greatest Common Divisor (GCD)

Input: Two numbers **a**,**b**
Output: Find the *greatest common divisors* **c** of **a** and **b**

Euclid's original algorithm



```
while b ≠ 0
    if a > b
        a := a - b
    else
        b := b - a
return a
```

30=2*5*3
105=7*5*3

For example, GCD of (30,105):

Mathematical proof:
GCD(30,105)
=GCD(30,75)
=GCD(30,45)
=GCD(30,15)
=GCD(15,15)
=GCD(15,0)

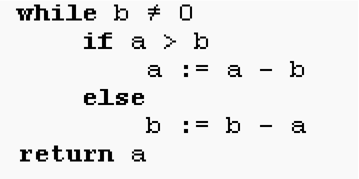
=> GCD(30,105)=15

History, proof, etc http://en.wikipedia.org/wiki/Euclidean_algorithm

Euclid's Greatest Common Divisor (GCD)

Input: Two numbers **a**,**b**
Output: Find the *greatest common divisors* **c** of **a** and **b**

Euclid's original algorithm



```
while b ≠ 0
    if a > b
        a := a − b
    else
        b := b − a
return a
```

```
class GCD {
    public static void main(String[] arg)
    {
        // Parse arguments into integer parameters
        int a= Integer.parseInt(arg[0]);
        int b= Integer.parseInt(arg[1]);

        while (a!=b)
    {
        if (a>b) a=a-b;
            else b=b-a;
    }

        // Display to console
        System.out.println(a);
    }
    }
```

History, proof, etc http://en.wikipedia.org/wiki/Euclidean_algorithm

Euclid's greatest common divisor (GCD)

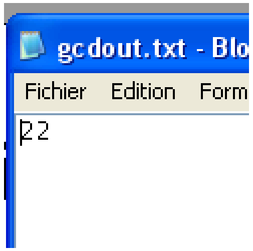
```
> javac  gcd.java
```

(compile in a gcd.class)

arg[0] arg[1]

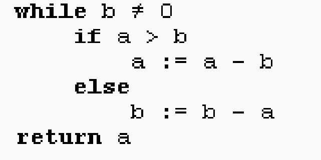
```
> java gcd 234652 3456222    > gcd.txt
```

(execute and store result in gcd.txt)



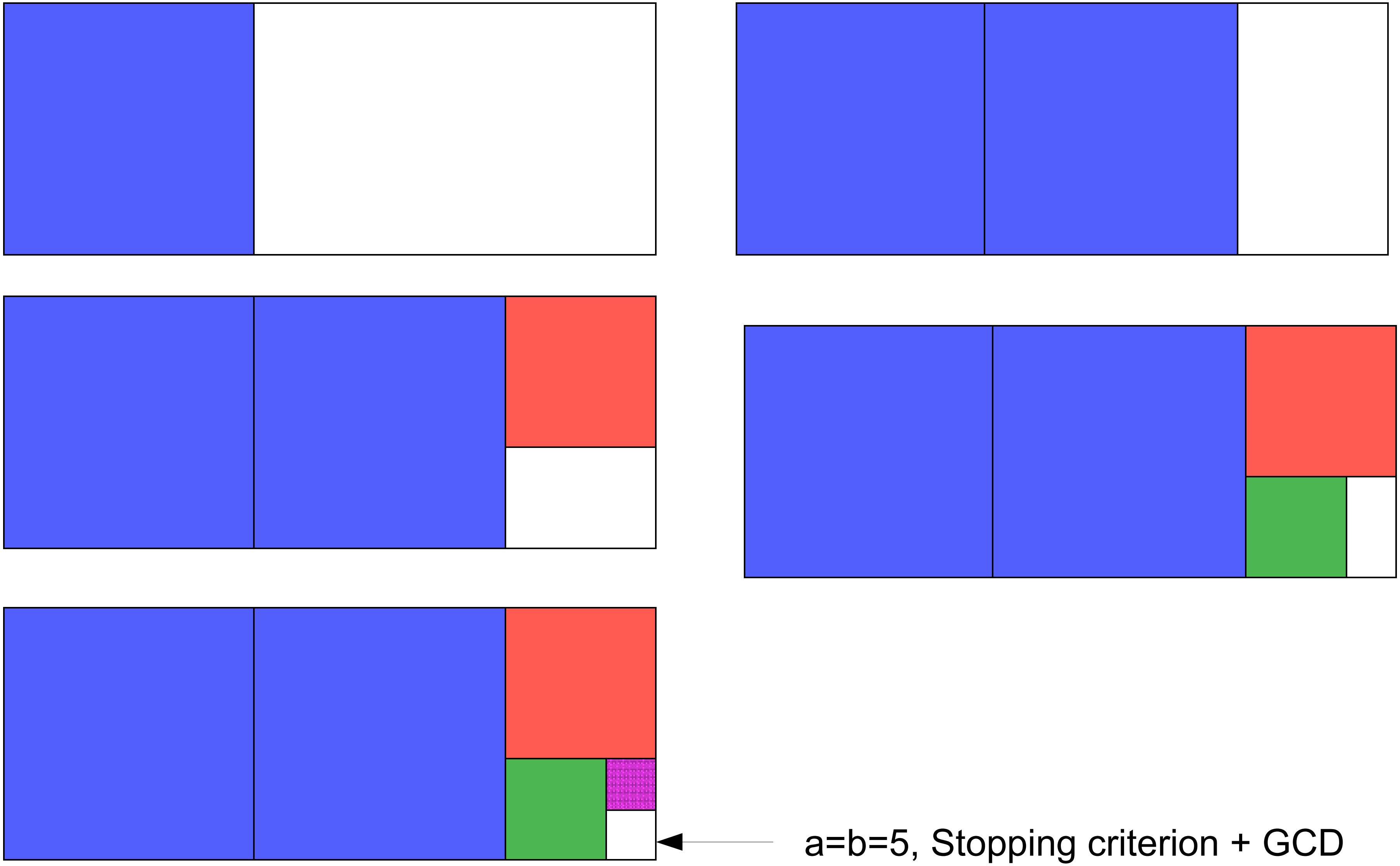
```
22
```

Geometric interpretation of Euclid's GCD



```
while b ≠ 0
    if a > b
        a := a − b
    else
        b := b − a
return a
```

Visualize **a** (65) and **b** (25) on two axes

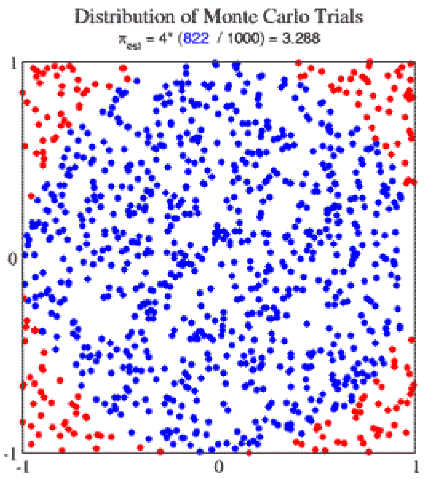


a=b=5, Stopping criterion + GCD

Programming is helpful for simulation

Simulation by Monte Carlo methods:

Eg., approaching PI=3.41592... using simulation



Draw a random point uniformly in a square:
Probability of falling inside a centered unit disk?

$$\frac{\text{Area of Circle}}{\text{Area of Square}} = \frac{\pi \cdot r^2}{(2 \cdot r)^2} = \frac{\pi}{4}$$

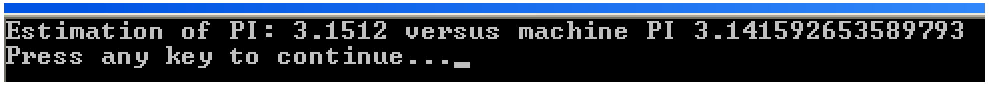
How do we get (pseudo-)random numbers in Java?
Call function random() of class Math

Math.random();

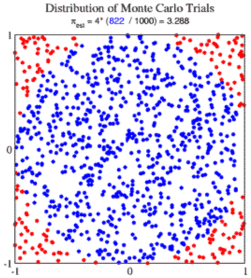
Monte-Carlo sampling extremely used in graphics and financial economy !!!

Monte-Carlo estimation of PI in Java

```
import java.util.*;

class MonteCarloPI
{
    public static void main(String [] args)
    {
        int iter = 10000000; // # iterations
        int hits = 0;

        for (int i = 0; i < iter; i++)
        {
            double rX = 2*Math.random() - 1.0;
            double rY = 2*Math.random() - 1.0;
            double dist = rX*rX + rY*rY;
            if (dist <= 1.0) //  falls inside the disk
                hits++;
        }

        double ratio = (double)hits/iter; // Ratio of areas

        double area = ratio * 4.0;
        System.out.println("Estimation of PI: " + area+ " versus 
machine PI "+Math.PI);
    }
}
```



```
Estimation of PI: 3.1512 versus machine PI 3.141592653589793
Press any key to continue..._
```



Monte-Carlo simulation techniques proved useful in computational sciences

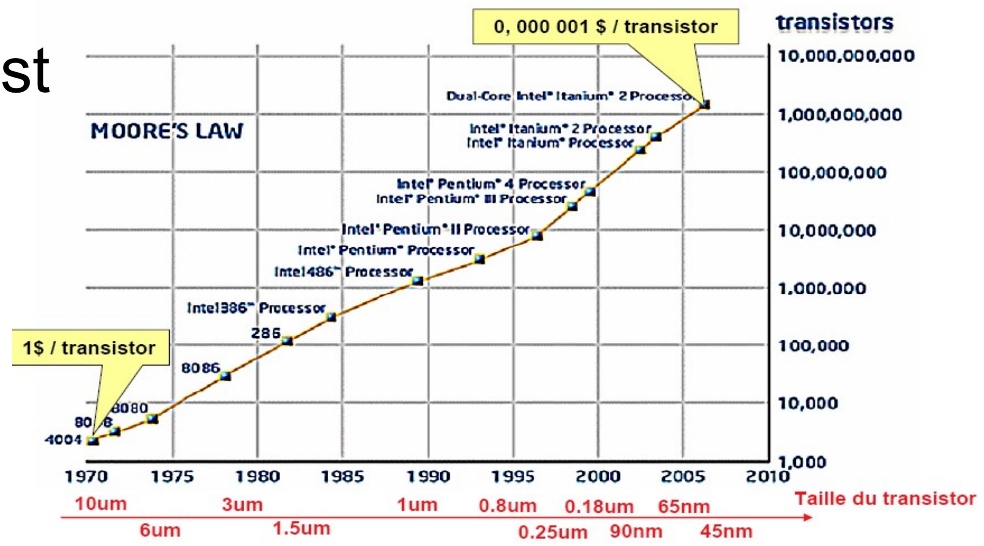
Human versus Machine

#transistors x2 every 18 months

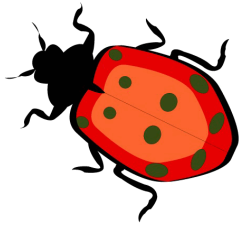
- Machines are dull but *extremely* fast

- Designing software **is difficult**
  (as difficult as building an Airbus)

- Artifical intelligence (AI) is a
  key topic in Computer Science



Bug:

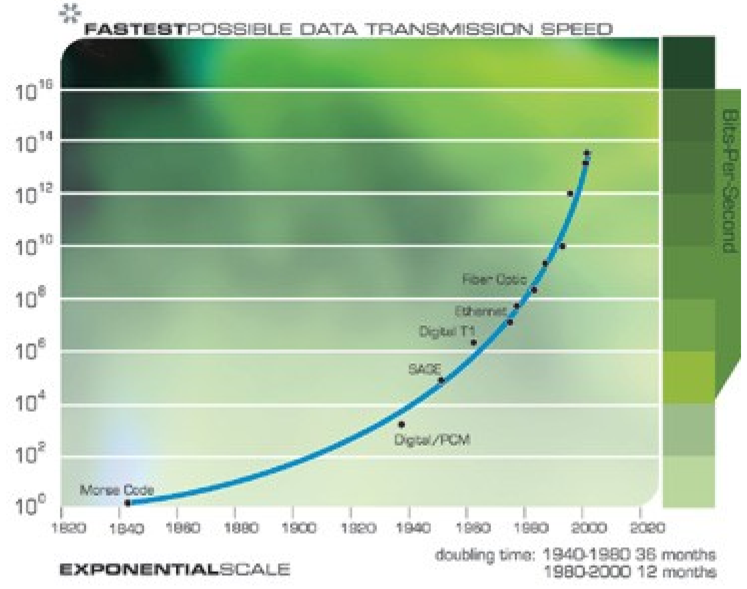


- Abnormality of the system

- Not by the faulty machine but by the programmer!

- Small bugs, big consequences!!!
  (Ariane 501, Intel's Pentium division bug, etc.)

- Cost 100 billion$/ years (Dept. of Commerce)



The Law of Accelerating Returns of Ray Kurzweil

http://www.kurzweilai.net/articles/art0134.html?printable=1

Small bugs, big consequences: Numerical errors

Finite precision, roundings of arithmetic operations may cause devastating effects

Predicate

Wrong evaluation of a **predicate**
yields a different path of instructions: Bug!

Branching
instruction

If (a<b)
then

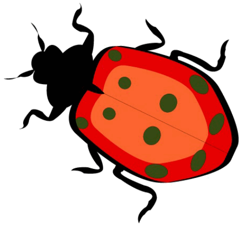
Block 1

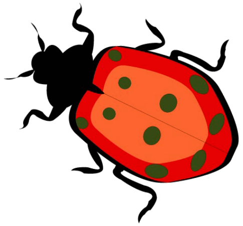
else

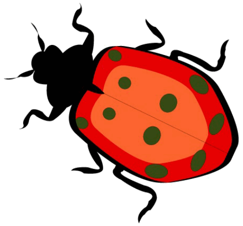
Block 2

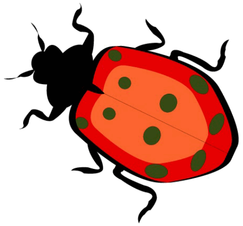
Expressions
lhs=expression(rhs)

Small numerical errors may not be so
capital here.

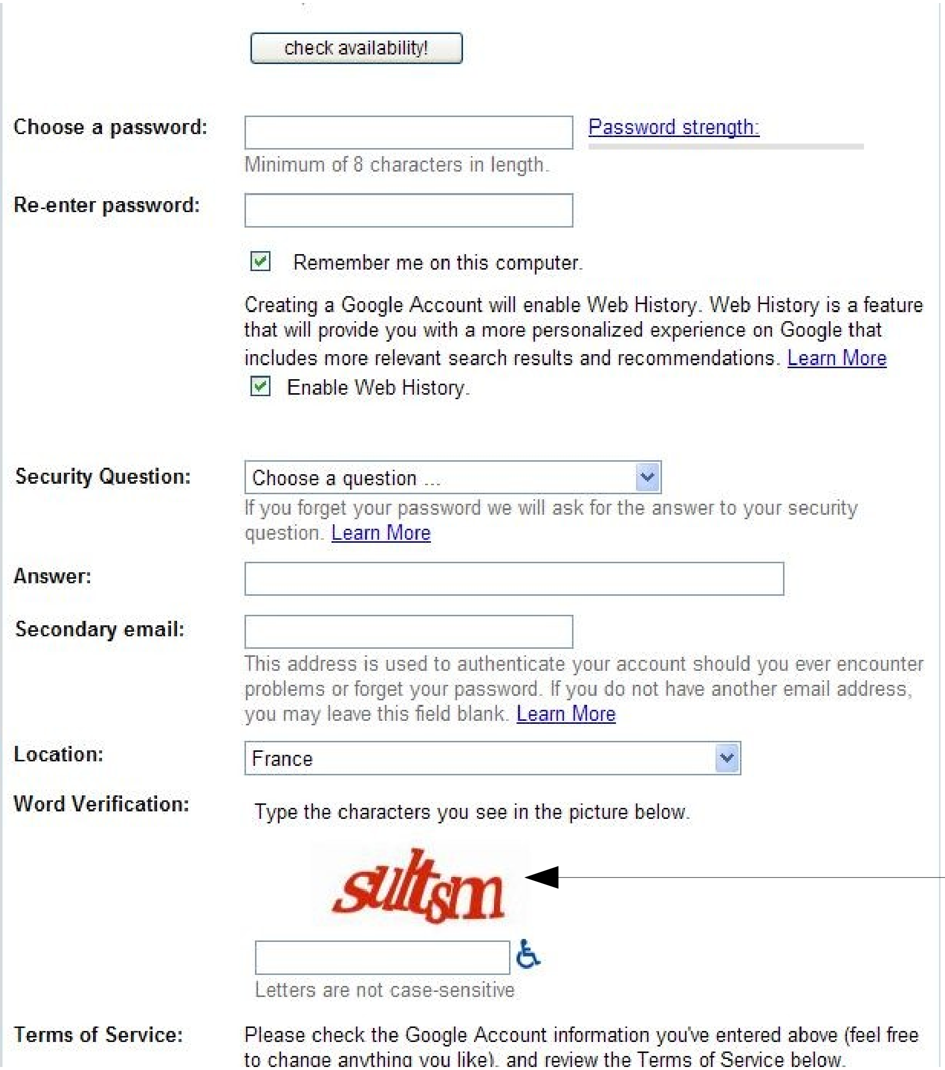








CAPTCHA versus SPAM (Human vs Machine)



Choose a password: Password strength:

Minimum of 8 characters in length.

Re-enter password:

☑ Remember me on this computer.

Creating a Google Account will enable Web History. Web History is a feature that will provide you with a more personalized experience on Google that includes more relevant search results and recommendations. Learn More

☑ Enable Web History.

Security Question: Choose a question ...

If you forget your password we will ask for the answer to your security question. Learn More

Answer:

Secondary email:

This address is used to authenticate your account should you ever encounter problems or forget your password. If you do not have another email address, you may leave this field blank. Learn More

Location: France

Word Verification: Type the characters you see in the picture below.

Letters are not case-sensitive

Terms of Service: Please check the Google Account information you've entered above (feel free to change anything you like), and review the Terms of Service below.

To fight undesirable bulk spam, we need to differentiate whether it is the action of a human or an automated jam program.

Image-recognition CAPTCHAs:
Difficult task (OCR, segmentation, etc.)

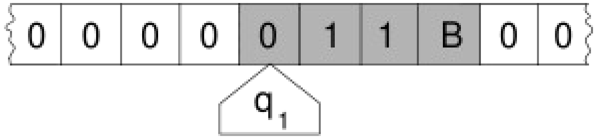
(visual) CAPTCHA

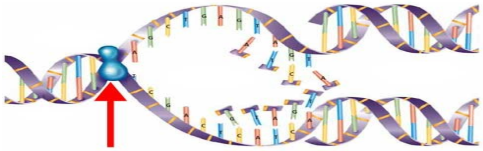
Completely Automated Public Turing test to tell Computers and Humans Apart

Turing test...

Alan Turing, 1912-1954
(41 years old)

Pioneer of modern computer science





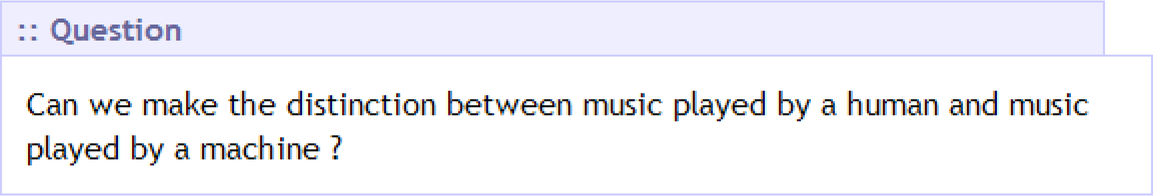
DNA, ribosome

Proposed the "universal" Turing machine:
A *ribbon*, a *head*, a *state* and an *action table* (automaton)

Turing test: proposal for a test of machine's capability to demonstrate intelligence. Originally, for natural language conversation (and processing). Initially, by text-only channel such a teletype machine

Association for computing machinery (ACM)'s Turing Award (250000$)
[Nobel prize in computer science]

Versatility of Turing tests



:: Question

Can we make the distinction between music played by a human and music played by a machine ?

The Continuator of F. Pachet (Sony CSL)

www.csl.sony.fr

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Cet apres-midi, votre premier TD

Philippe Chassignet
Salle 31
Groupes 1 & 7

Olivier Serre
Salle 34
Groupes 4 & 10

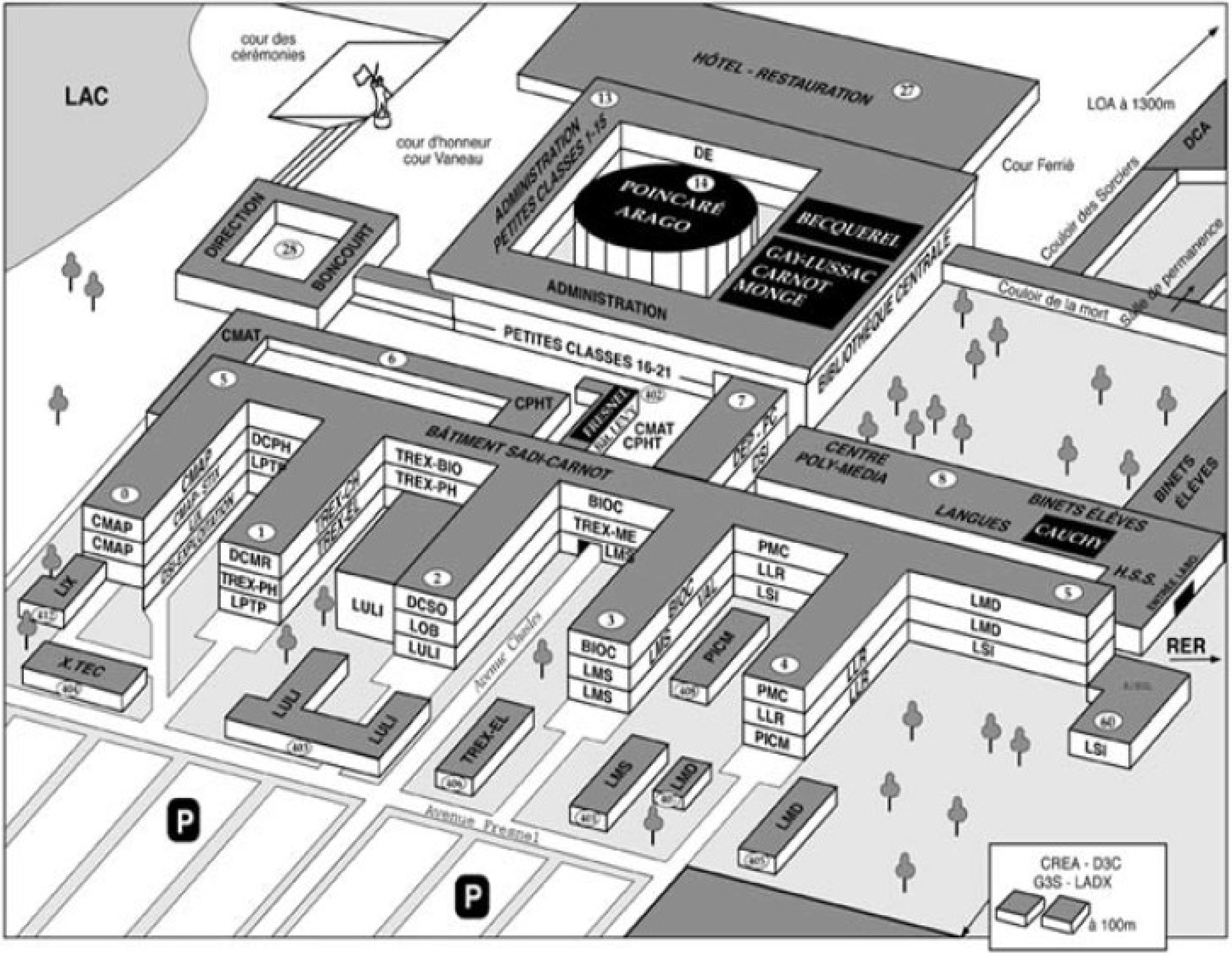
David Monniaux
Salle 32
Groupes 2 & 8

Stephane Redon
Salle 35
Groupes 5 & 11

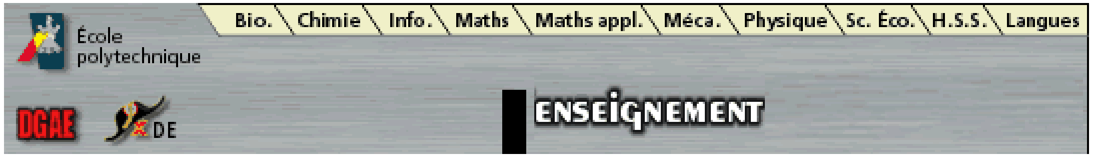
Etienne Duris
Salle 33
Groupes 3 & 9

Yann Hendel
Salle 36
Groupes 6 & 12

How to get to DSI rooms



Questions, comments? nielsen@lix.polytechnique.fr



FIN

TD1 : Les outils indispensables

http://www.enseignement.polytechnique.fr/informatique/INF311/TD_08/index.html

Cours INF311 :

http://www.enseignement.polytechnique.fr/informatique/INF311/

http://www.enseignement.polytechnique.fr/profs/informatique/Francois.Morain/TC/X2003/Poly/www-poly001.html

Envoyez le nom de vos Delegues a:
nielsen@lix.polytechnique.fr

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