

On teaching Informatics

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Where I come from (1)

The 1st year: mostly movies, cards, parties

- Very unmotivated student – not unusual 😊

The 2nd year: I discovered computers as an intern in CNET Lannion

The 3rd year: I started learning CS at the Technion, Haïfa

From my personal statistics (not very large and not very recent)

- Telecom students could work harder
- 2 years rue Barrault suffice
- A good internship is worth a lot
- Travel broadens the mind « Les voyages forment la jeunesse »

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Where I come from (2)

Researcher at INRIA Saclay – not a teaching institution

Teacher at ENS Cachan/Ulm (L3) and Paris 11 (Master)

Previous teaching experiences

- 10 years part time at Ecole Polytechnique; 2 years at Stanford
- Assistant at USC (4 years - PhD) and Technion Haïfa (Master)
- Many other places: USC, Berkeley, ESEAT-Rennes, Mines, Central...

Industry: Xyleme (a start-up) and some consulting (NASA)

Quite some experience in teaching but only occasionally a professor

No specific knowledge about the question that is asked

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The context: informatics

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What topic are we talking about?

Informatics – Sorry but I don't like the word STIC

- « **informatique** »
- Should not be confused with computer science – too restrictive
- CS & communication & automatics & signal processing & robotics & etc.

No clear boundary

Lots of interactions with other sciences

- Bioinformatics
- Computational linguistic
- Applied mathematics
- Even with « sciences de l'ingénieur »

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Informatics is a branch of mathematics

It is about artificial worlds/models

France has a strong asset in maths

- The “classe préparatoires” give a solid background
- Excellent research school – tradition

Build on this asset

- Formal approach to informatics vs. hacking
- Teach relevant mathematics they don't know yet: graph theory, mathematical logic, finite model theory, etc.
- Teach them theoretical computer science

What they should learn: ***informatics requires the same rigor as mathematics***

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Informatics is a branch of mathematics

It is more and more so

You can hack a quick sort program

You don't hack a P2P system

- because of size
- because of parallelism
- how about a space shuttle, a medical robot...

What they should learn: ***informatics requires the same rigor as mathematics***

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Informatics is an applied science

French students have a handicap on that

- Little computer science in high school
- Little programming experience

They are good so they can catch up fast

- Make them program heavily
- Serious projects & long programming internships

What they should all learn: ***how to design and implement a real application using existing tools***

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Informatics is both maths & applied science

Privilege courses that combine theory and practice

- Each course in informatics should ideally do so
- This is typically not the case

It is often possible – e.g., databases

- Database theory: First-order logic, complexity
- Database systems: optimization, implementation
- They should be part of the same course

What they should learn: ***informatics is not about hacking but about nice mathematical models used to solve real problems***

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Informatics is about changing society

Encourage creativity and innovation

Convince them that there are great opportunities in startups

Encourage real projects such as junior enterprise

Encourage gap years to see something else

- NGOs, social economy, startups
- Works in high-tech industry

Encourage projects crossing to other domains

- Bioinformatics, sustainable growth, physics...

What they should learn: ***R&D in informatics is as fun as financial analysis or management***

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The students

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Where they come from

Diversity

- If I am correct, more diversity than it used to be. Great!
- We should bring the best students from the world

Very heterogeneous background

- Some are hackers
- Some never wrote a program & hardly touched a computer

Very heterogeneous motivation

- For some, learn informatics
- For others, use informatics possibly in specific areas
- For many, don't care
- We have to convince them, this is as fun as mathematics and as useful as anything else

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Where they go

R&D in informatics

- R&d in research labs and university
- r&D in industry
- **Not enough of those in my opinion**

Future managers, engineers in other areas, etc.

- Informatics is likely to be a key component in their future work
- They have to grasp it to become better manager, to be able to talk to their IT department, to take advantage of IT.
- Warning: I am not talking here about learning Matlab, Word or Excel

Difficulty: Heterogeneous needs – Consider different profiles

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Why do they choose informatics or not?

Some dream of some aspects informatics

- Web, video games, special effects, robots, etc.
- Start-ups
- **What they find is often not what they dream**
- Help them realize their dreams

Some have other dreams

- Human genome, understand life/death, ecology and other big challenges
- Help them realize their dreams
- Show how informatics is crucial for their interest

Some are just here because they are good in math and don't have any idea about what they want to do

- Help them discover their dream/talent

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The content?



Core in CS (not informatics) for non computer scientists (1)

Problem: some students have 0 exposure to computer science

- They don't understand the basic notions
- Most learn tricks in CS courses but still don't understand

Convince them this is no magic no mystery

Make them understand the basic notions, e.g. for the Web

- A Web page is a file stored somewhere (what is a **file**)
- A Web page is coded in the HTML language (what is a **code**)
- A Web page may be in a cache (what is a **cache**)
- A Web page is indexed by Google (what is an **index**)
- Try this on your neighbor who is a top manager at SNCF

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Core in CS for non computer scientists (2)

Some of what we do for computer scientists - LARGE

Algorithmic and programming

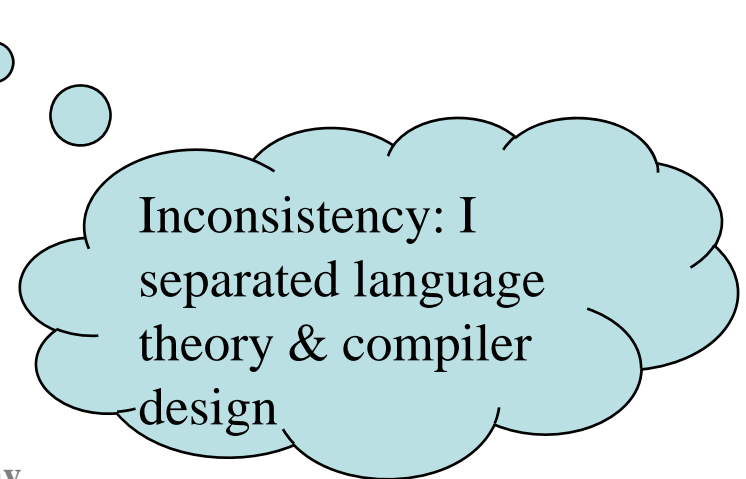
- Data structures and fundamental algorithms
- Programming; modules, objects, usage of libraries, debugging, version control, software engineering
- The issue of programming language tend to focus the passions; not the main one – do something standard like Java or Caml

Theory

- Automata, Languages
- Computability and complexity

Systems

- Machine and system architecture
- Databases and compilers



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Informatics

Informatics is too wide to be taught in such a small number of years

- May be not desirable to teach all

Choose the telecom bias based on the school tradition

- Web and internet: information, database, communication
- Media: video, games, music

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Some principles

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Not specific to informatics

Make them work **harder**

Make them be **more independent**

- Teach them how to learn by themselves

Teach them how to **present/market** their works

Teach them to be **more creative**

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More particular to informatics

- Train them how to **analyze/model** and not only solve
- Train them to work on **insufficiently specified problems**
- Train them to apply their **mathematical rigor** in CS
- Train them to work in **groups**
 - Projects
 - In particular, decomposition of a problem between several groups and integration phase

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Desegregate

Between engineering schools and university

Let them follow courses in masters

Encourage them to do PhDs

- PhDs are not (only) for becoming professors
- PhDs are about learning and improving skills
- The rest of the world knows about PhDs
- Bac+5 is not sufficient to become a top computer scientist

Between France and the world

- Make them bilingual (I mean English fluent)
- Make them travel

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Last but most important – Political

We should teach computer science very early (kindergarten?)

Warning: computer science and not computer usage (word)

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