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Identifying trends in computing science education

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Which methodology is chosen?

Iterative approach:

1) Analysis of the problem
2) Requirements for a solution
3) Design of a prototypical solution
4) Implementation of this prototype
5) Small scale user test
6) Conclusions: “Go” or “Another iteration”

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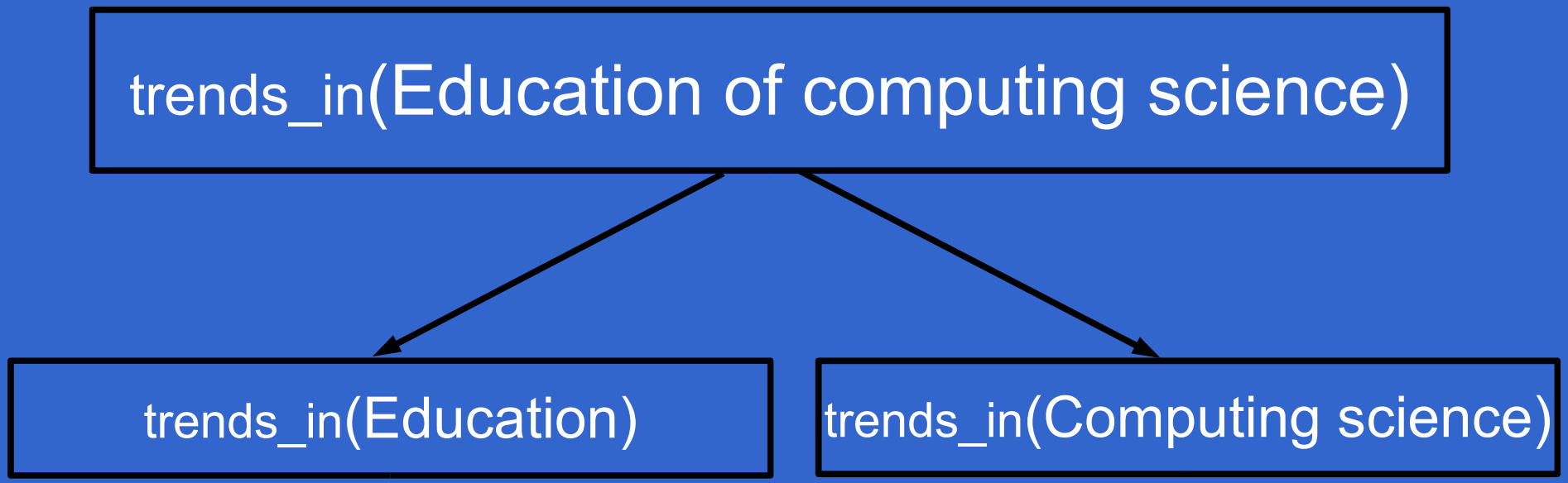
Phase 1 Analysis of the problem (i)

Decomposition of the problem



In case of independency between the components!

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Phase 1 Analysis of the problem (ii)

- Trends in education:
  - More and more pupil orientation
  - Self reliant and collaborative learning
  - Subject integration, including interdisciplinarity
  - Open attitude
  - Internationalisation
  - ICT
  - Competence based
  - Education is becoming 'a complex arrangement of learning experiences'

Phase 1 Analysis of the problem (iii)

- Trends in computing science (including ICT)
  - Wireless (short range -e.g. Bluetooth- as well as long range -e. g. Wimax, UMTS, Edge-)
  - Interconnectivity (e.g. PAN, domotica -digital televisionWMC-) and security
  - Open source and open standards software
  - Interdisciplinarity (e.g. bioinformatics, geographical information systems, visualization, computational physics, entertainment -Pixar-)
  - Grid computing; technologies that provide seamless and scalable access to wide-area distributed resources (e.g. Mersenne primes, LOFAR)

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Phase 2 Requirements of a solution

- Try and meet as much trends in the subdomains Education and Computing Science as possible.
- How? Assumed that our resources are limited, make a priority list of trends to be met.
- We will show that education in computer science is very well on the road with meeting *almost all* of these trends.
- To merge all of these elements a program of development and research on computer science education has to be set up.

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Phase 3 Design of a prototypical solution: meeting educational requirements 1

- More and more pupil orientation: CSE offers loads of possibilities to base learning activities at intrinsic motivation.
- Self reliant and collaborative learning: individual assignments, project work
- Subject integration, including interdisciplinarity: science of everything
- Open attitude: when i teach CS, every student in the classroom knows more about at least one important thing in the domain than i do. I would be a fool not to benefit from this.
- Internationalisation: as the Internet is one of the main resources from CSE, internationalisation is within everyone's reach

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Phase 3 Design of a prototypical solution: meeting educational requirements 2

- ICT: research results are not very firm yet, but it seems that teachers CS are within their organisation pioneers in implementation of the new possibilities of ICT
- Competence based: MBO ICT and, at short distance, HBO-i are the leading players in competence based curriculum. See Vlasblom (Proceedings NIOC2004)
- Education is becoming 'a complex arrangement of learning experiences': CSE offers a wide range of learning experiences. From 'hard core theoretical' (e.g. Lambda calculus, functional programming) until design of human-computer interaction
- The power of CSE is that even theoretical subjects can profit from practical tools. See f.e. Leijen en Heeren (Proceedings NIOC2004)

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Phase 3 Design of a prototypical solution: meeting scientific requirements

- Wireless: TI Navigator
- Interconnectivity: Baja beach club, MSN on the cell phone, Skype on a PDA, SMS result alert through WLE. Hands on => concepts.
- Security: how to secure a wireless network? Hands on => concepts.
- Open source and open standards software: OpenOffice, Firefox, MySQL/PHP, Sourceforge.net
- Interdisciplinarity:
  - (higher education) flexible bachelors with major and minors,
  - (secondary education) CS is the ideal subject to be combined with in the end thesis (profielwerkstuk)
- Grid computing: use SETI@home, Mersenne primes when teaching this new concept

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Implementation of this prototype

- As we have seen: much has been realised yet in CSE, albeit at a sometimes modest scale.
- Try to upscale, starting with a thorough 'lesson learnt' project
- What about the CS teacher?
- At least at a national level, a community for the development of CSE content and the didactics of CS should be 'realised'; the Ruud de Moor centre could play an important coordinating role; NIOC could have some kind of 'glue function'.
- Participants in this community: MBO-ict, informatica-vo, HBOi, managers of CSE at universities, universities offering a MoSc in CSE.

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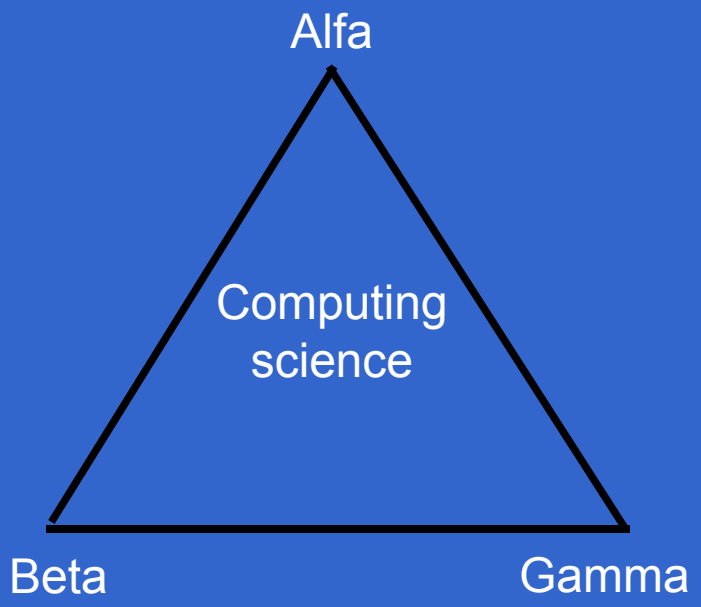
And further?

Mulder (1998) was right when stating:
"... a further development of Computing Science as an independent, integral and powerful discipline in the centre of a alfa-beta-gamma triangle: a new (delta?) discipline, conceptually connected with mathematics physics and engineering, but also with linguistics, philosophy economy, business administration and social sciences in general. A lot of progress should be made."



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Thanks for your attention...

...keep up the good thing!

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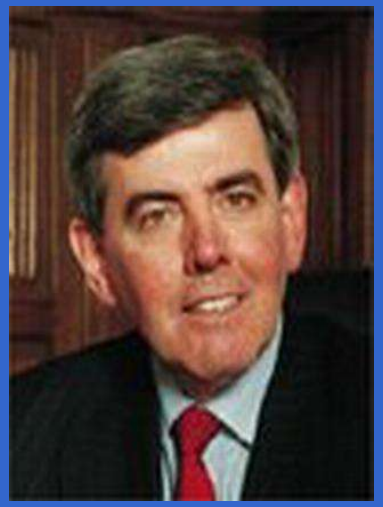
Backgrounds 1

- The teacher in the knowledge society (Coonen, 2005)
  "Teachers (...) are increasingly demanded to invest during their entire career in their own professional development. (...) Teachers should not just be experts at a domain of knowledge, but have to embody advanced design skills and competences for innovation."



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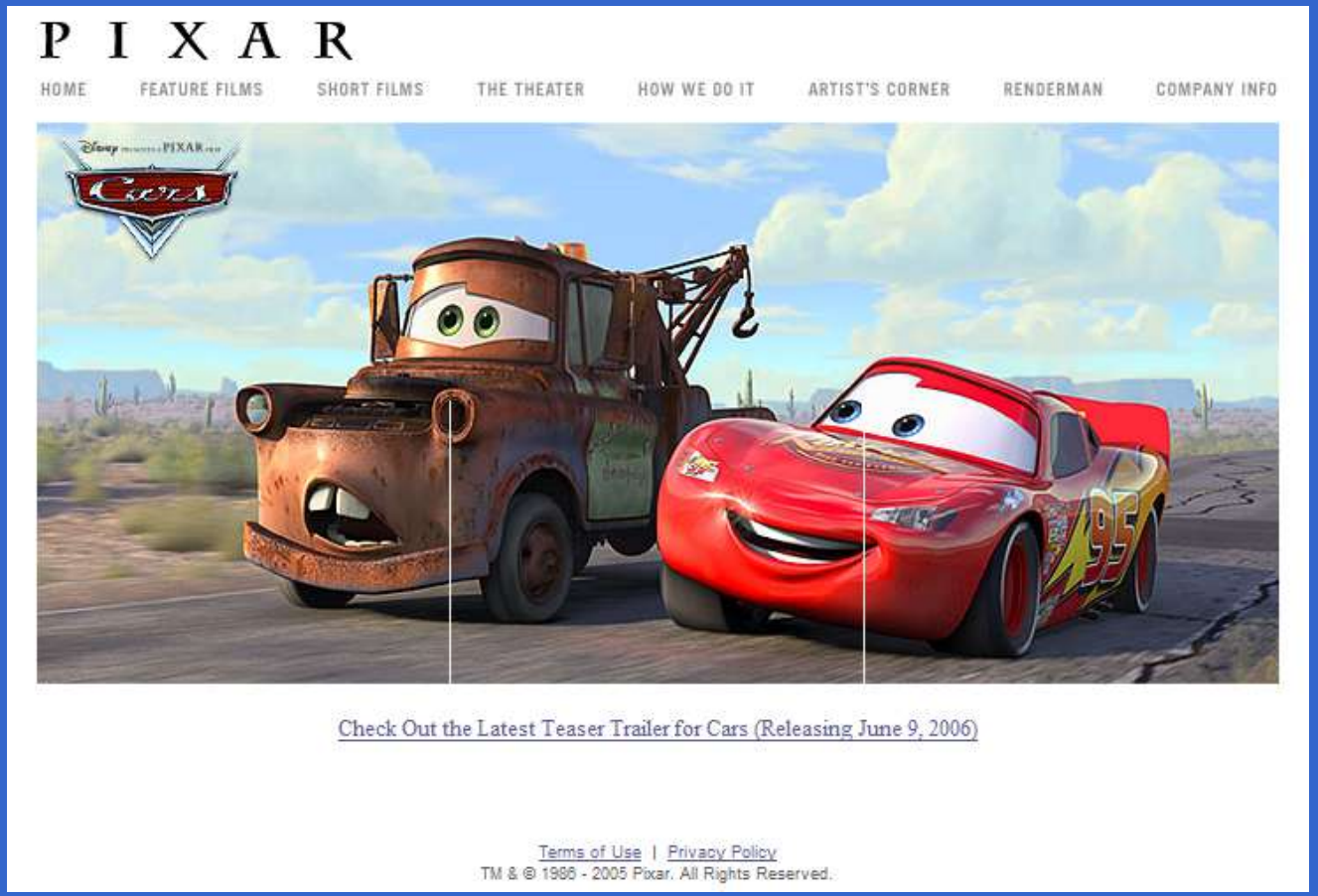
Backgrounds 2

- Computing science: the science of everything (Adriaans, 2005)
  "The computer has become a model for the processes in nature itself. It has evolved towards a universal modelling machine. "
- This means that the influence of computer science stretches so much further than it's own strict domain, or mathematics or natural sciences. It influences research in social sciences, in linguistic sciences, even in arts.
- This lays a heavy burden on the development of communicational skills of computing scientists.



Renderfarm: 1024 Intel Xeon processors
2 terabyte RAM in a Beowulf Linux cluster

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LOFAR

- LOFAR -low frequency array- telescope
- 10000 radio antenna's spread over an area of about 10^5 km^2: one big wide-area sensor network. The individual signals will be copied 8 times to create in software 8 independent telescopes.
- Grid technology plays a key role in implementing the worlds first multi-user, multi-tasking, on-line software telescope.
- Controle centres at the RuG, MIT, Cam-bridge, US, and the University of Sydney.
- One of the telescopes will be at dispose of the public through the public Internet
- LOFAR

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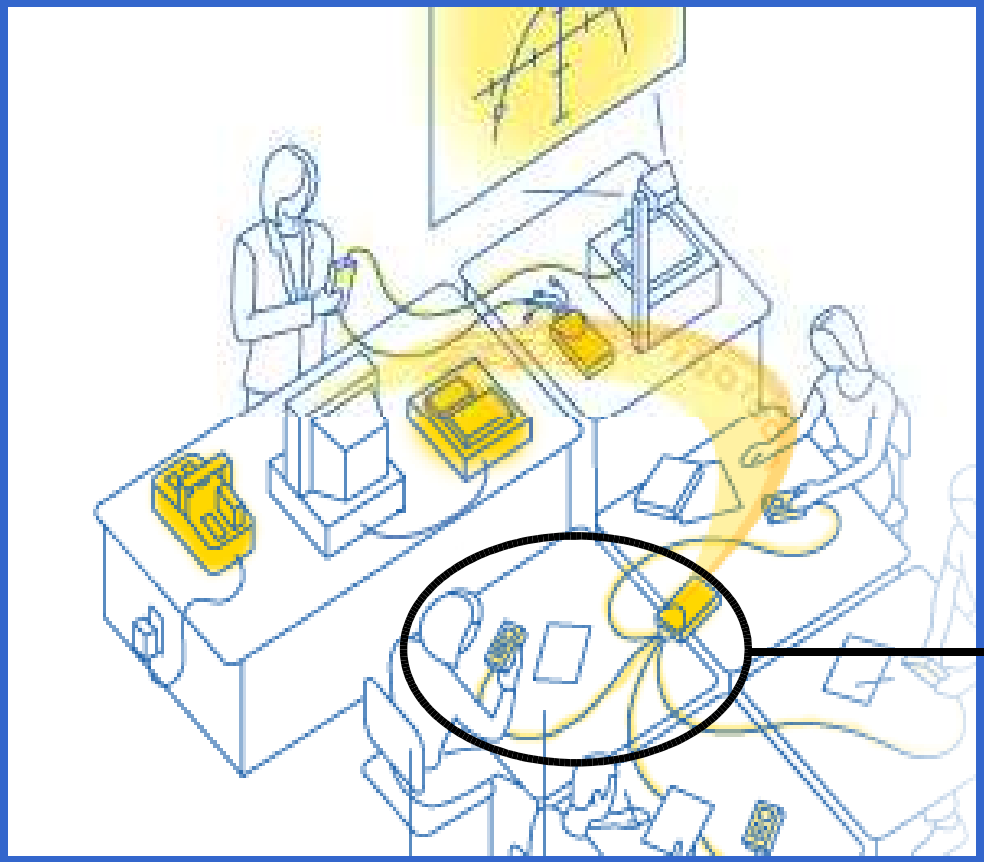
TI Navigator



Wifi based classroom network between teacher's computer and graphical calculators