Computing Education Research
Datavetenskapens didaktik

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Today's lecture, a brief introduction (maybe a shorter lecture?)

- What is Computer Science Education Research about?
- Course content, an overview
- Course formalities

An example:

- Why do students hand in incorrect assignments?

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What is Computer Science Education Research?

From the web-page of Uppsala Computing Education Research Group, UpCERG:

- Aim: Study the learning, development, and improvement of undergraduate education in computing through the use of rigorous research methods.
- The goals are pragmatic:
  - Learning of CS should become enhanced
  - Interest in CS encouraged
  - The recruitment and the retention increased
  - The universities becoming better at teaching and composing educational programs.

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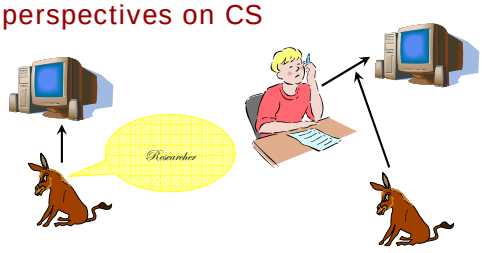
CS Education is about research methodology. It offers new perspectives on CS



A researcher in CS studies computing

A researcher in CS Education study how students understand computing

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CS Education research is a cross-disciplinary field

- It draws on
  - Computer science
  - Pedagogy
  - Sociology
  - Psychology
  - Educational Technology
  - … etc

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What is the course about?

- Introduction to the field.
- Particular emphasis on research.
  - The issue of researchability delimits what we can know about the learning of computer science.
- A discussion about the nature of insights that can be gained from different research perspectives.
  - What can a computer scientist learn from these ways of thinking?

Computer Science Education content

- **Part 1. Introduction.**
  - Introduction to Computer Science Education (CSEd) Research and Computer Science Didactics
  - Classifying CSEd Research, 1
  - Researching students' learning of computer science
  - Classifying CSEd Research, 2
  - Lab. How do students understand 'object' and 'class'.
  - Discussion seminars, learning computer science.
- **Part 2. Hot topics in Computer Science Education (prel. list).**
  - **Topic: Introductory programming.**
  - **Topic: Learning Technology.** Using computers to teach CS
  - **Topic: Pedagogy.** Teaching CS
  - **Topic: The CS teacher.** Computer Science teachers as amateurs, students and researchers. Given over link from University Technology Sydney
  - **Topic: Gender Issues.** Gender issues in CSEd
  - **Topic: Values in CS Eduction Research.** A critical perspective on research
  - Discussion seminars, researching computer science education
- **Part 3. Projects**

Good reasons to take the course

- The course offers a different perspective on research in computer science, since it focuses is on how others (students) understand the CS.
- It offers ways of thinking that could be useful for those who will teach, talk about, or discuss computer science with non-computer scientists.
- It discusses the latest learning technologies the field of computer science.
- It presents the research front in computer science education.
- It can be "customized". Projects can be tailored to meet individual requests.
- It will be a fun and different learning experience.

Computer Science Education, course formalities

- Advanced level, 7,5 credits in Computer Science
- SP 1 and 2.
- No written exam. Instead reflections, assigments, seminars and a project.
- Responsible teacher: Anders Berglund, Anders.Berglund@it.uu.se
- Organised by the Uppsala Computing Education Research Group.
- The guests are internationally recognized researchers within the field.

Projects

- Selected in dialogue with us.
- Limitations set by relevance and supervision.

Examples:

- Preparation of computer supported teaching
- Construction of a computer-supported teaching tool.
- Lab development
- A discussion on lab supervision
- A study concerning cultural aspects of CS.

- Particularly good projects will be encouraged to further develop their reports and submit to international research conferences.

Literature

- Fincher, S., & Petre, M. (2004). Computer Science Education Research: Routledge Falmer
- Articles, normally distributed over www.

Assessment

Components:

- Reflections
- Active participation in seminars
- An essay
- A project (with project presentation)
- Presence at 75% or more of guest lectures

Grade:

- 3,4,5,U

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Example: Why do students hand in incorrect assignments?

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Discussion

- What is learning?
- What is learning of CS?

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What does it mean to learn something?

- General case:
  A "meaningless" question
- It all depends on
  "what you mean by learning"
  or "how you see things"

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A research approach/methodology/ framework

- Offers a way to perform research in learning.
- Organizes "ways to see things".
- A lens with a certain focus.
- With a specific research approach: Some issues get clearer, others blurred.
- Offers theoretical stand on learning, ways to see possibilities and limitations, opens to communicate with other researchers etc.

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Why do students hand in incorrect assignments?

Aims

- Two examples of research in CS Education
- An illustration to why this course has an emphasis on research in CS Education
- What kind of results can be obtained?
- What is the role of a theoretical pedagogical framework?

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Why do students hand in incorrect assignments?

- Ben-David Kolikant, Y. (2005). *Students' alternative standards for correctness.* In the proceedings of the ICER '05: Proceedings of the 2005 international workshop on Computing education research, Seattle, WA, USA., 37 - 43.
- Karavirta, V., Korhonen, A., & Malmi, L. (2005). *Different Learners Need Different Resubmission Policies in Automatic Assessment Systems.* In the proceedings of the 5th Annual Finnish/Baltic Sea Conference on Computer Science Education, Koli, Joensuu, Finland, 95 – 102.

Ben-David Kolikant Students' alternative standards for correctness

- What does correctness mean for students?
- Study in Israel
- 40 students, mainly high-school, but also college

How do students test correctness?

(agree, do not agree, otherwise)

A.1 I executed a program I had written **many times** and got valid output, therefore I know that my program is correct.

A.2 I wrote a program that computes a complicated calculation. When I test the program, I sometimes **do not calculate (manually) the expected output**, but rather satisfied if the output displayed looks reasonable.

A.3 There are cases that I am sure that a program I wrote is correct and then **I am satisfied with compiling it** (with no executions).

A.4 When I test a program **I systematically verify that I checked all** the possible input examples.

A.5 There is always the **possibility that there is an input example for which the program does not work** that I did not find

How do students test correctness?

Percentage of those hat say that they are systematically verify that they have checked all the possible input examples.

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Conclusion

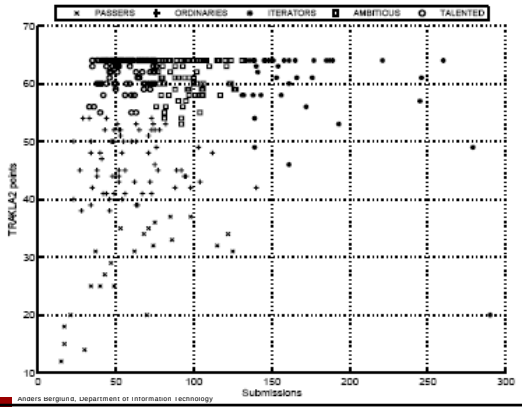
- The students understand correctness differently than a computer scientist.
- Correctness is not a theoretical concepts.
- Correctness is an idea about what the results mean for themselves.
- This is a cultural clash.

Karavirta, V., Korhonen, A., & Malmi, L. (2005). *Different Learners Need Different Resubmission Policies in Automatic Assessment Systems.*

- An automatic assessment system for labs.
- Labs are submitted to the machine, and are corrected immediately.
- Labs concern task such as “Insert these keys one by one into an initially empty AVL-tree: J M R G A B T Z K L”
- Labs can be submitted and then resubmitted, an arbitrary number of times
- New data is generated every time the student restart a lab assignment.

Different Learners Need Different Resubmission Policies in Automatic Assessment Systems.

- A cluster analysis on number of submissions and points the lab score.
- 356 learners.
- Questions:
  - What can we say about the students study strategies?
  - Should we have a limit on the number of submissions?



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Cluster groups

- **PASSERS**
  - Lowest exercise points
  - Do not reiterate much to improve their grade.
  - Aim at passing the course with minimum effort.
- **ORDINARIES**
  - Better results than PASSERS.
  - Do not aim at the best grades
  - satisfied with a reasonably good grade
- **ITERATORS**
  - Use the resubmission feature heavily
  - Good exercise points
- **TALENTED**
  - Fewest iterations
  - Best results.
  - First thin, act only thereafter.
- **AMBITIOUS**
  - Aim at very good exercise points (and overall course grade), which they also achieve.
  - They use considerably fewer resubmissions than ITERATORS.
  - In addition, they use the resubmission feature more than ORDINARIES to get better results.

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Cluster groups

	Number of students	Total score	Minutes per task
PASSERS	24	10.0	9.35
ORDINARIES	72	16.2	8.39
ITERATORS	45	15.9	6.85
AMBITIOUS	98	16.9	8.12
TALENTED	117	20.6	9.60
ALL	356	17.4	8.24

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Discussion
Conclusion

- What are the conclusions of these studies?
- Can they be used to influence teaching of computer science?
- Are they good?