TORSTEN HOEFLER

Research Topics in Software Engineering better: Fundamentals of Parallel Computing

Organization: webpage and papers

- **Each student selects one paper from the list at** http://spcl.inf.ethz.ch/Teaching/2015-rtise/
- **Enter your selection (by paper number) in the Doodle**
  - (URL will be published on the webpage right after this lecture at 5pm)
  - Each paper can be selected only once
  - Everybody should select exactly one paper
  - 30 papers are available
- **Set a date when you would like to present from the Doodle**
  - (URL will be published on the webpage right after this lecture at 5pm)
  - Each time can be selected twice (two students present per week)
  - Everybody should select exactly one time

Organization: times and dates

- **Seminar is each Tuesday 1-3pm, CHN D 44**
  - 2/17 (today) introduction
  - 2/44 skip (final deadline for schedule announcement)
  - 3/3, 3/10, 3/17, 3/24, 3/31, 4/14, 4/21, 4/28, 5/5, 5/12, 5/19 seminar talks
- **Deadline for paper and slot selection:**
  - **This Friday** (2/20 – **5pm**)
- **This is an MSc class – attendance is mandatory!**
  - Aims at graduate students and coming (famous) researchers
  - Will thus be tough (complex papers, high presentation standards)
  - Differentiating standards would compromise the teaching goal
    BSc students may stay but will be treated equally to MSc students!

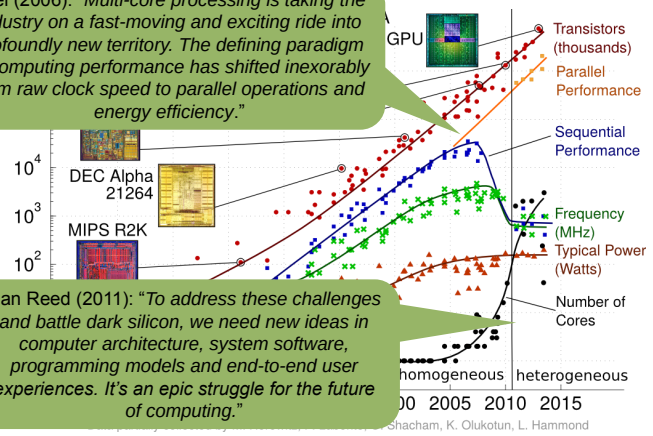
What is this all about?

- **Fundamental techniques in parallel computing!**
  - Most are formalized, a good mathematical understanding is required
- **Papers fall into five categories:**
  - Communication (I/O) complexity
  - Parallel algorithms, models, and bounds
  - Scheduling and work stealing
  - Parallel Graph algorithms
  - Networks, communication, and routing

- **A good book is Leighton: Introduction to Parallel Algorithms and Architectures: Arrays, Trees, Hypercubes**
  - Does not cover all topic but papers have related work

Why do you care about this topic?

Intel (2006): "*Multi-core processing is taking the industry on a fast-moving and exciting ride into profoundly new territory. The defining paradigm in computing performance has shifted inexorably from raw clock speed to parallel operations and energy efficiency.*"

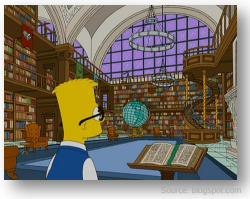


Dan Reed (2011): "*To address these challenges and battle dark silicon, we need new ideas in computer architecture, system software, programming models and end-to-end user experiences. It's an epic struggle for the future of computing.*"

Shacham, K. Olukotun, L. Hammond

What is research? Well, some part of it!

- **Research is about generating new knowledge …**
  and sharing it through either presentations (limited) or publications (long-lasting, wide dissemination).
- **A good researcher or graduate student …**
  - Will spend thousands of hours per year reading
  - Read (on average) a paper a day!



- **So you should start with these:**
  - S. Keshav, How to Read a Paper, ACM SIGCOMM Computer Communication Review, 2007
  - Philip W. L. Fong, Reading a Computer Science Research Paper, SIGCSE 2009
  - Amanda Stent, How to Read a Computer Science Research Paper, Technical Report.

Research papers and books

- **Conference papers**
  - Primary form of dissemination in CS
- **Workshop papers**
  - Hot topics, preliminary results
- **Journal papers**
  - Often later (years after conference version)
  - Longer and usually (hopefully) simpler to understand
  - Can be complete version of conference paper
- **Books/chapters**
  - Much later but much easier to read, often by different authors
- **Dissertations**
  - Around a single complex topic, frequently appear as journal papers

- ***Tip: If you have to understand a conference paper, look for books or journal versions including that topic.***

Why is reading research papers relevant to you?

- **Be able to understand the latest developments**
  Before any book covers them!
- **Learn how to write and present ideas**
  Very useful (and hard) skill. Make others believe it's their idea!
- **Start with other people's ideas to feel the process**
  This is what we do here.
- **Read critically**
  Ask the right questions, challenge assumptions!
- **At some point, you will need to write**
  A thesis --- convince your supervisor that you're a genius!
  Maybe research papers (a good MSc thesis typically leads to one)

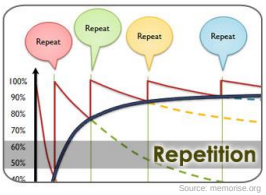
- ***Tip: follow these guidelines to be successful in this class ☺***

Some model questions

- **What is the research problem that the paper addresses?**
  - Is it relevant? Why? What is the impact if it's solved?
- **What are the contributions novel insights?**
  - How do they build on previous work?
    Are the insights deep can they be generalized?
- **What do I learn when reading this?**
  - A good summary of previous work can be worth a lot!
- **How are the results substantiated?**
  - Proofs, experiments, etc.. Is the evaluation thorough?
- **What are the conclusions and broader impact?**
  - What does it mean for others/me? What can we build on top of it? Future work etc.?

- ***Tip: You should be able to answer all these questions before you present the paper.***

Read a paper at least three times



Source: memorise.org

- **First pass: provides a general idea**
  - ~5-10 minutes
  - Read abstract, intro, conclusions, (sub)section headings
  - Briefly check which references you know
- **Second pass: understand the content**
  - ~1 hour
  - Read full paper, ignore details (proofs etc.)
  - Find key points, take notes, check figures carefully to understand them
  - Mark references for further reading
- **Third pass: understand the depth**
  - ~4-5 hours
  - Fully understand everything, attention to detail (read related work)
  - Try to re-implement experiments, make up own examples etc.
  - Question everything!
  - Generate ideas for your work ☺

Read related work

- **If you don't have the required background knowledge then check related work**

- **Find related work, either by (no particular order)**
  - Checking the related work section
  - A search engine with well-chosen keywords
  - Try to find a survey paper of that area (or textbook)
    Will help you to place the work in context
  - Check the author's more recent work
  - Check top-conferences in the field and recent publications!
  - Check later papers that cite the paper (e.g., Google Scholar, ACM DL)
    This can be very helpful!

- ***Tip: The papers we discuss will require to read related work. Not necessarily in all three passes! Pay attention to the conference, you'll learn the good ones as you go.***

Talking about research

- **A good researcher can express his knowledge well**
  - This assumes that you actually have the knowledge!
  - So only advance to this step once you understand the paper ☺

- **Why is talking research useful?**
  - Order your thoughts, think about how to explain them
  - Communication to other researchers
  - Gather feedback
  - Establish relationships
  - Eventually build a career

Simon Peyton Jones [1]: "The greatest ideas are worthless if you keep them to yourself"


Source: microsoft.com

[1]: Jones, Simon L. Peyton, John Hughes, and John Launchbury. "How to give a good research talk." SIGPLAN Notices 28.11 (1993): 9-12. APA

A good research talk

- **Are centered around the audience (NOT you)**
  - Teaches, engages, provokes, and excites listeners
- **Provides intuitions to the audience**
  - "take away messages", surprises, wow effects
- **Should make them want to read the paper**
  - BUT: not because they didn't understand you
- **It does not need to**
  - Tell them every little detail (not possible anyway in the time)
  - Show off how smart you are

- ***Tip: focus on clearly defined goals***
  - Pick your goals carefully
    What do you want to communicate?
    What should people remember?
    How do you achieve this?

Teach (teach) 1. Give lessons 2. To bring understanding to someone, especially through an experience 3.To impart knowledge or skill

Anatomy of a talk

- **Motivation, placement**
  - 20%
- **Key ideas**
  - 70-80%
- **Evaluation/results**
  - 0-10%

Source: criminalbrief.com

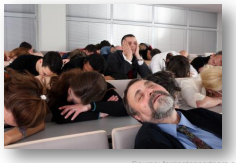
- **Do not present results without an explanation**
  - Again, you need to fully understand what you talk about
  - Don't start with "the authors made SKGSD run 50% faster"
  - Start with "the authors present the nice WIGWAG method with the intuition WAGWIG and that achieves 50% improvement of SKGSD"

The beginning of your talk

- **You have two minutes before your audience dozes off or starts reading emails**
  - USE THEM! Make every second count!
  - Best approach: present an abstract of your talk (one sentence each)
    Problem/Motivation
    Approach/Idea
    Experiments/Results
    Broader Meaning/Impact


Source: presentationmagazine.com

- **Answer these questions within the two minutes**
  - What is the problem?
  - Why is this talk interesting, why should I listen?


Source: farringtonpartners.com

Communicating the key idea

- **Pick a goal for your talk**
  - Plan and make key points in your head
    Organize your whole talk around these key points
    Pick no more than three (better: one)
  - Be explicit, be very explicit
    "If you remember nothing from this talk but this."
  - Repeat, repeat (but don't be annoying)

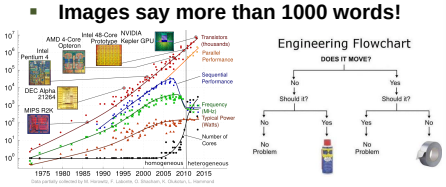
- **Do NOT be shallow, be deep**
  - Avoid overviews at all cost
  - Do NOT ramble, this is really bad
  - Get to the meat quickly

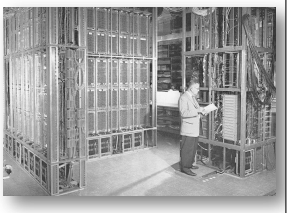

Source: brandonsteiner.com

Examples

- **Are your main weapon**
- **Make your own examples, try to avoid the paper's examples**
- **Ideally have a motivating example at the beginning**
  - Maybe pose a question to get the audience thinking
    "What is the maximum speedup for solving this equation"
- **Illustrate the idea in action**
  - From different perspectives
  - Show corner cases, highlight shortcomings

- **Images say more than 1000 words!**




ILLIAC2 at UIUC, Source: uiuc.org

What to omit

- **Do not present talk outlines**
  - It's a waste of time, has no information, good talks have a storyline
- **Do not present excessive related work**
  - But mention it on your slides (plenty)
  - Give credit, it'll make you look better
- **Do not present too many technicalities**
  - The audience won't follow anyway
  - Equations are a special case
  - Put details in backup slides in case somebody asks!
- **Do not exaggerate with animations**
  - Animations are good but …
- **Do not clutter your slides with graphics**

What to use

- **Use the whiteboard or overhead projector**
  - Can be used to make things “permanent” across slides
  - Explain processes without animations
  - Show depth
  - BE CAREFUL about timing though. Drawing is expensive.
- **Enthusiasm**
  - Be excited, pull the audience with you
  - Move (helps with excitation)
- **Your brain**
  - Review/polish the slides some hours before the talk
  - You need to have your storyline down
  - Focus on key ideas (“what to communicate”)
- **Animations and graphics**
  - They can be very helpful (aesthetically as well as informative)
  - Nice slides make people more receptive

Source: logitech.com

How to present

Source: dreamstime.com

- **Be (or appear) self confident**
  - Don’t forget to breathe ☺
- **Make eye contact**
  - Look around, don’t stare at single people
    Especially not me, I may start shaking my head just for fun!
  - *Tip: identify a nodder (these people always exist). Check back with him every now and then, he’ll give you confirmation.*
- **Watch audience**
  - Sometimes they ask questions, don’t let them interrupt you but serve their questions
  - Questions are wonderful, ask some and answer them
    Nothing is better than involving the audience! BUT watch the time!
- **Finish on time!**
  - Skip slides if necessary, never ask “should I continue” (no polite person would every say “no, thanks” ☺)

Miscellaneous

Source: englishasia.com

- **Standard stuff (not to be forgotten)**
  - Aviod erorrs no sldies
  - Use a presenter carefully (don’t play with it)
  - Face the audience
  - Make jokes but only related ones
  - Check your laptop before!!
- **Practice, practice, practice**
  - Give your talk at least three times before you present it publicly
  - Present to your {boy|girl}friend, your mom, your neighbor, your dog …
- **You’ll attend 22 times more talks then you give here**
  - Engage, help you fellow students (or me)
  - Ask questions, look awake!!

Why do you care?

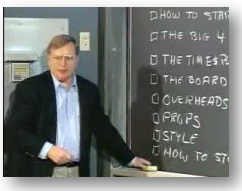
- **Presenting will be most important for your career!**
  - This is the way to convince people to
    Give you good grades
    Give you money/resources
    Think you’re smart
    Like you
    Recommend you
    …

Source: citeworld.com

- **Presentation skills are hard to acquire**
  - Some people are naturals, some not
  - Did I mention practice?

Seven Speaking Tips from Patrick Winston

“Your careers will be determined largely by how well you speak, by how well you write, and by the quality of your ideas… in that order.”

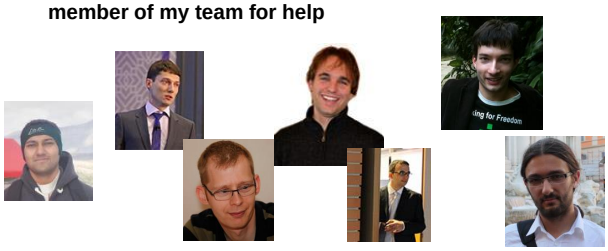


Source: dlugan.com

1. **Use Stories and Analogies**
   - Use it to relate to audience
2. **Open Your Speech Strong**
   - Make promises (what will you learn)
3. **Use Rhetorical Devices**
   - Triads or rhetorical questions
4. **Find Your Style**
5. **Use the Blackboard to Pace Your Delivery**
6. **Salute the Audience Rather than Thanking Them**
7. **Handle the Q&A Skillfully**

Don’t be afraid, we will help - the team

- **If you have questions, we will assign you an experienced member of my team for help**



- **You can also always talk to me but the TAs will be much more accessible**
- **REMEMBER: Deadline for selection is this Friday** (2/20 – **5pm**)

Good luck!

- ***Last Tip: Something original in your talk can make you stronger!***