Deterministic Distributed Algorithms

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Intensive course 10-21 May 2010

\[ G = (V, E) \]

\[ H = (V', E') \]
DDA 2010, lecture 0:
About the course

• What and for whom
What?

- Distributed algorithms
  - several computers, communication links
- Restrictive models of distributed computing
  - everything is deterministic: no randomness
  - as little extra information as possible
- Graph problems
  - e.g., graph colouring
What?

• Fast algorithms for extremely large networks
  • time = number of communication rounds
  • worst-case analysis
• Sending information across the network takes much more time than running these algorithms!
  • i.e., running time $\ll$ diameter of the network
• How is this even possible...?
What?

• Emphasis on theoretical aspects

• Upper-bound results:
  • e.g., there exists an algorithm that is so-and-so fast

• Lower-bound results:
  • e.g., no algorithm is so-and-so fast

• When possible, matching upper and lower bounds:
  • e.g., this is the fastest possible algorithm
What?

• Not only classical results but also recent research
  • you’ll be up-to-date and well prepared if you’d like to write an MSc thesis in this area

• Mathematical tools
  • in particular, Ramsey’s theorem
  • useful in other areas of computer science, too
  • nice result, too few computer science students know it
Objectives

• Good understanding of the models that we study
  • what is easy, what is possible, what is impossible
  • what kinds of techniques work, what doesn’t
  • what is not yet known

• You know how to program computers, here you’ll learn how to program networks
  • entirely different way of thinking, new bag of tricks
For whom?

• Advanced course, so you are expected to have BSc in computer science (or equivalent)
  
  • No specific courses required, basic knowledge of discrete mathematics is enough
  
  • If you don’t know proof by induction, you’ll be in trouble
  
  • If you don’t know the basic concepts of graph theory, you’ll need to do some extra reading on your own
  
  • If you have never heard of distributed algorithms, don’t worry, I’ll explain everything
Practicalities

- **Read the web page!**
  - Don’t assume anything, this isn’t a typical lecture course

- 7 lectures, 2 exercise session, final report
  - 3 credits, no exam, pass/fail

- Ask if anything is unclear — emails are welcome
  - If you use IRC, you can try to join #dda-2010 on IRCnet
How much...?

• 3 credits \(\approx 2\) weeks of full-time study!
  • e.g., 2 hours of lectures + 6 hours of self-study each day

• Exercises are open-ended, calibrate it yourself!
  • doing more: solve by yourself first, then look it up, then take part in discussions, then revise your solution, then write it up nicely, solve some optional exercises …
  • doing less: don’t worry if you can’t solve everything before the exercise session, don’t try to give the best possible answer but something that is easy to prove, …
Final report

• The final report should demonstrate that
  • you understand the basic concepts
  • you have done your quota of self-study

• I can tell the difference between a 2-week report and a 1-night report

• Remember: this time you can use sources, but you must use appropriate citations
  • see the web page for links to some sources I have used