Aalto University

Distributed Algorithms 2020

1 Warm-up

Welcome!

- You should have already done this:
  - register in **Oodi**
  - read instructions in **MyCourses**
  - join our **Slack workspace**
  - watch two **pre-recorded videos**
  - solve this week's **quiz**

This week: extra time to solve the quiz until midnight today!

Our weekly routine

- **Mon:** prerecorded videos
- **Tue:** quiz (noon), lecture (12:15pm)
- **Wed:** 1 exercise (midnight)
- **Thu:** exercise session (10:15am)
- **Fri:** 2 exercises (midnight)

Workload:
10–11 h/week

Quiz

- One quiz per week, in the lecture notes
- Solve by ***Tuesday*** at noon
- Submit your answer in **MyCourses**
  - type the answer in the web form
- ***The answers should be very short***
  - just give the answer, nothing else!
  - no proofs, no explanations!

Exercises

- 5+ exercises per week, in the lecture notes
- Solve 1 by ***Wednesday***, 2 more by ***Friday***
- Submit your answers in **MyCourses**
  - submit the answer as an easy-to-read PDF file
- ***The answers need to be complete***
  - full details, complete proofs
  - e.g. why does your algorithm work correctly?

Challenging exercises

- In the lecture notes, marked with a star ★
- Solve ***at any point*** during the course
- **Email** your answers to the lecturers
  - with full details, as an easy-to-read PDF file
- ***The answers need to be complete***
  - full details, complete proofs
  - e.g. why does your algorithm work correctly?

Grading

- **To pass the course:**
  - you need to pass both ***midterm exams***
- **For a good grade:**
  - you need to ***solve exercises***
  - quiz + exercises = max 96 points in total
  - challenging exercises = 4 extra points each
  - 80 points = grade 5/5

Learning objectives

- Understand models of distributed computing
- Design and analyze efficient distributed algorithms
- Prove impossibility results
- Use standard graph-theoretic concepts

Practiced in exercises

Tested in midterm exams

This is a theory course

- **100% mathematics**
  - definitions
  - theorems
  - proofs …
- **0% practice**
  - programming
  - hardware
  - protocols …

Expected: basic knowledge of university-level mathematics

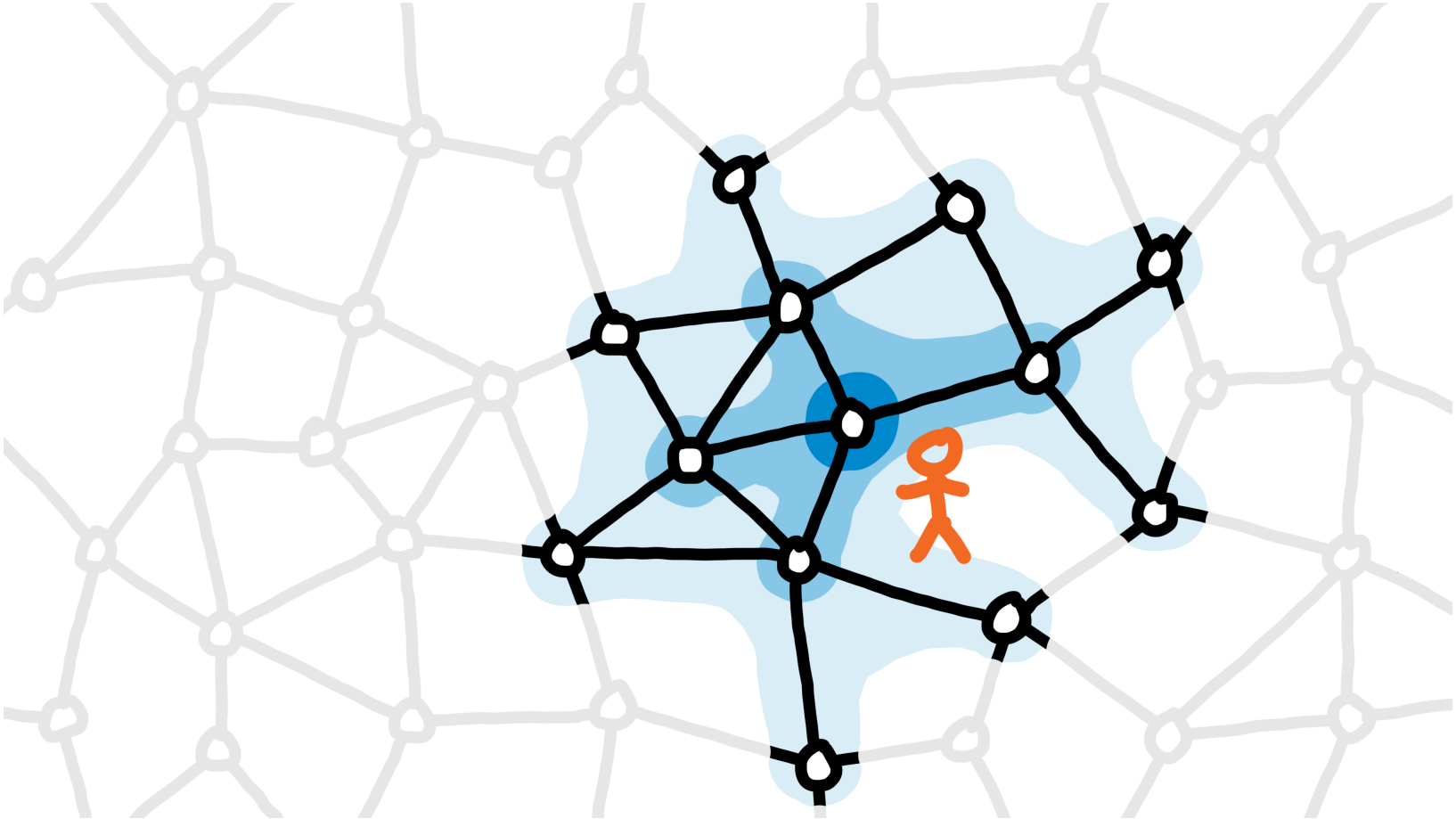
Example: what is a mathematical proof

Course practicalities

- Everything ***100% online***
- Primary tool for communication: **Slack**
- Lectures & exercise sessions: **Zoom**
- Course material, submitting solutions: **MyCourses**

This week's content...

Video 1a: introduction



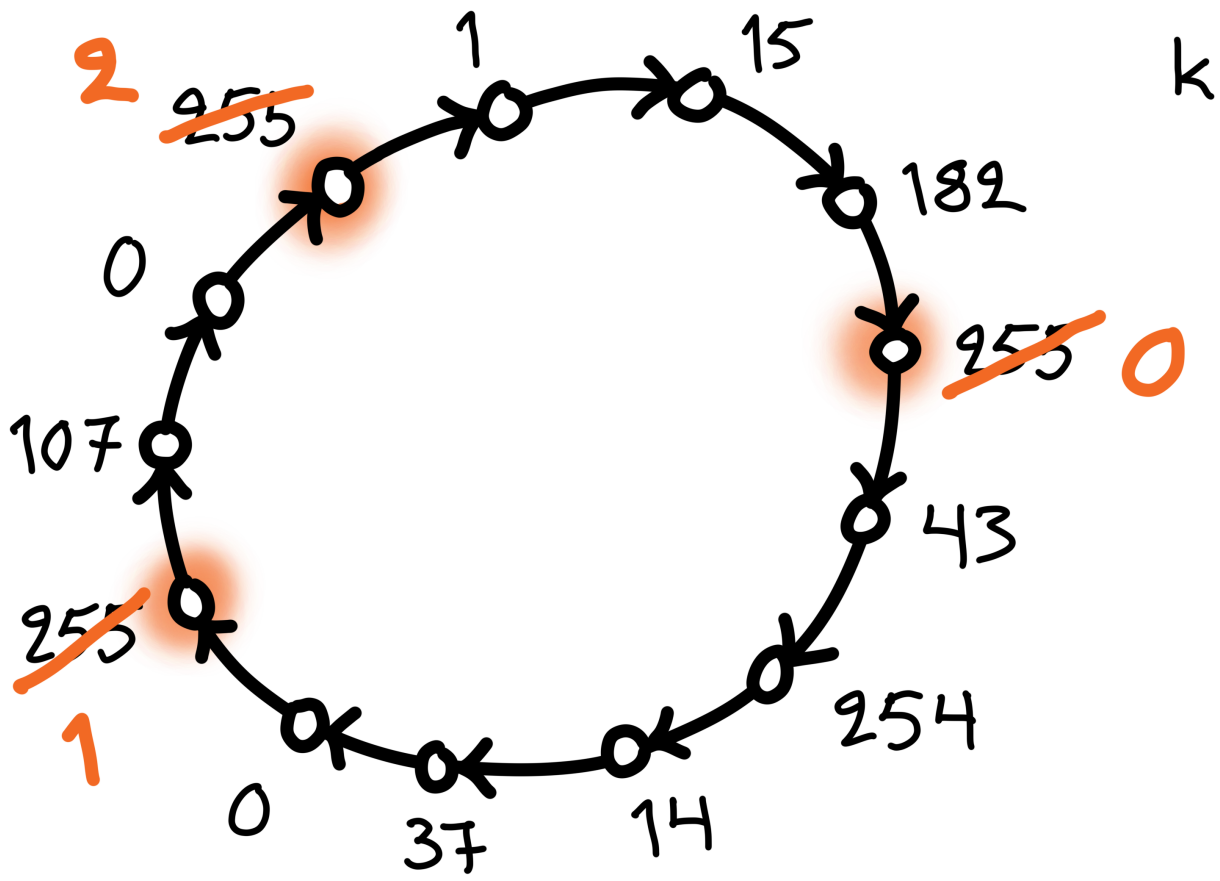
Quick question to all

What was the key new thing to you in the first video?

Or were you already familiar with the distributed perspective?

Please answer in Slack with one sentence under this thread!

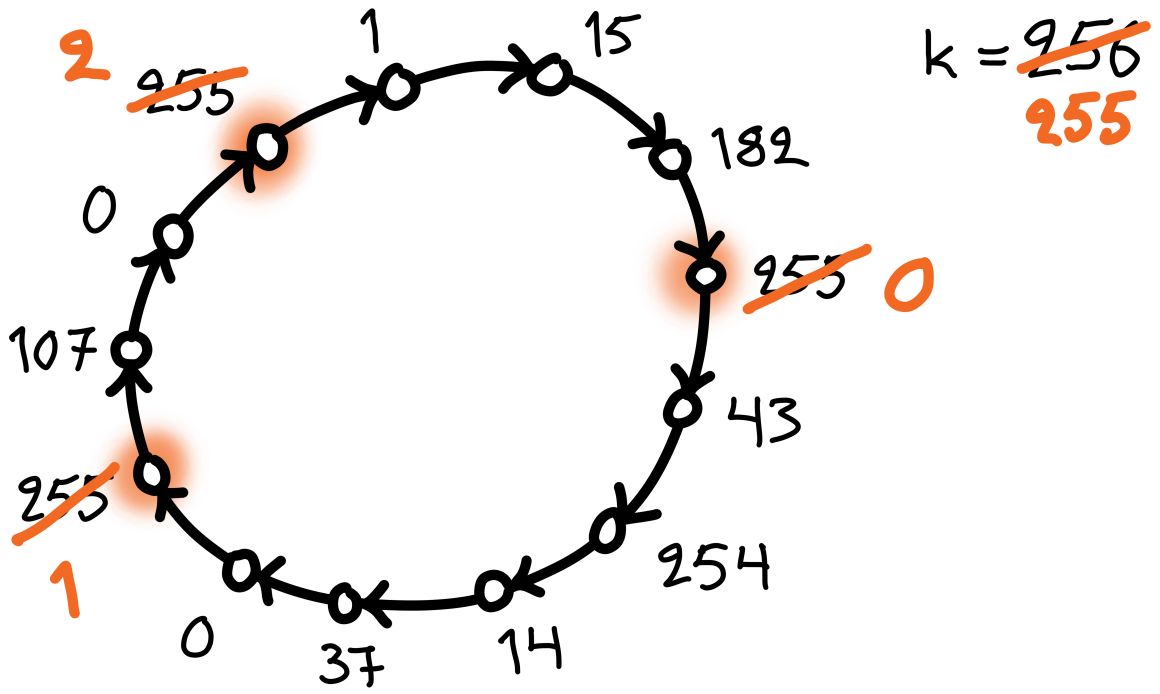
Video 1b: coloring



$k = \cancel{256}$
255

Slow color reduction

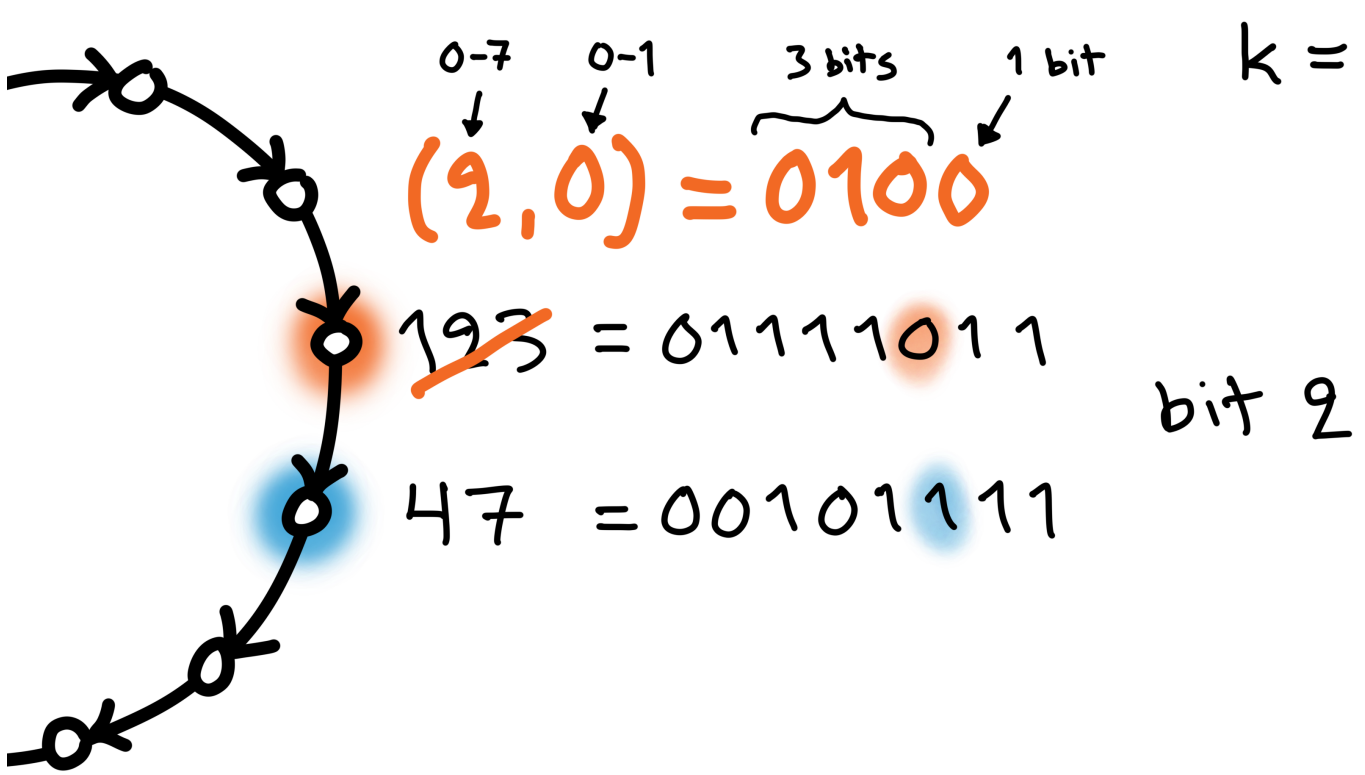
- Algorithm idea:
  - all nodes with the **largest color** are active
  - active nodes pick the ***smallest color that is not used by their neighbors***



Group work 1

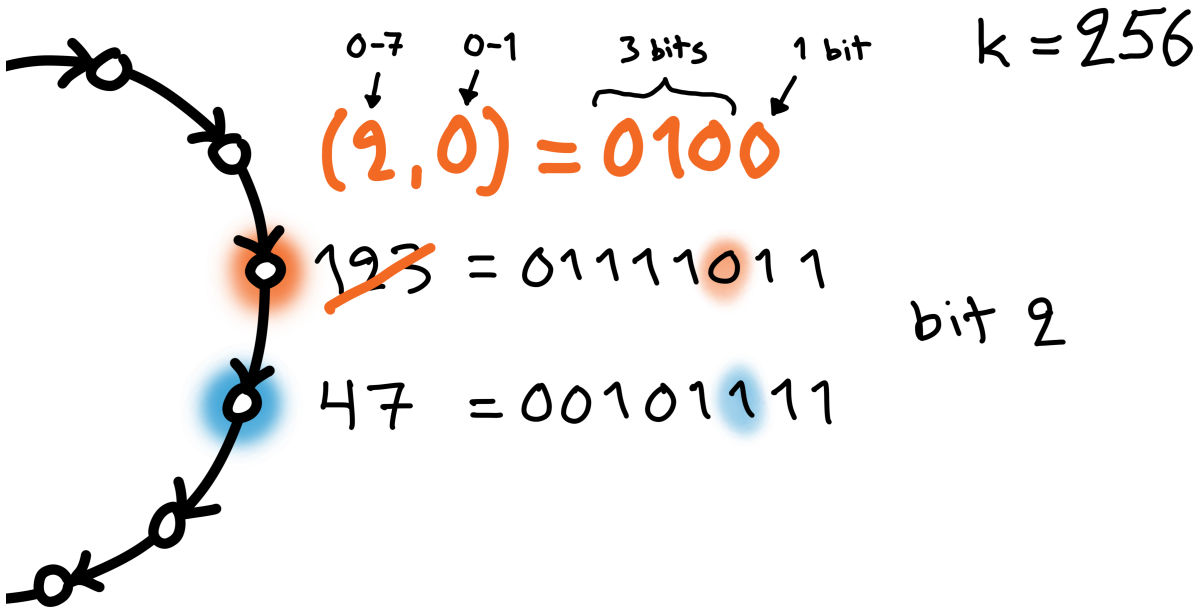
- Consider a simpler algorithm idea:
  - ***all nodes*** pick the smallest color that is not used by their neighbors
- **What would go wrong?**
  - *construct an example in which this algorithm fails!*

Video 1b: coloring fast



Fast color reduction

- Algorithm idea:
  - find the first bit that differs in successor
  - index ***i***, bit value ***b***
  - new color is (***i***, ***b***)



Group work 2

- Algorithm idea:
  - find the first bit that differs in successor
  - index ***i***, bit value ***b***
  - new color is (***i***, ***b***)
- **What would go wrong if the new color was just *b*?**
  - *construct an example in which it fails!*

Group work 3

- Algorithm idea:
  - find the first bit that differs in successor
  - index ***i***, bit value ***b***
  - new color is (***i***, ***b***)
- **What would go wrong if the new color was just *i*?**
  - *construct an example in which it fails!*

Coming next

- **Week 2:** graph theory
- **Weeks 3–6:** models of distributed computing
  - examples of efficient distributed algorithms
- **Weeks 7–11:** proving impossibility results
- **Week 12:** conclusions, recap