

Distributed Algorithms 2025

8

Local neighborhoods

High-level plan

Algorithm A runs in **T rounds** and solves problem X

→ A is a **mapping from radius- T neighborhoods** to local outputs

Such a mapping cannot solve X correctly

→ Problem X is not solvable in T rounds

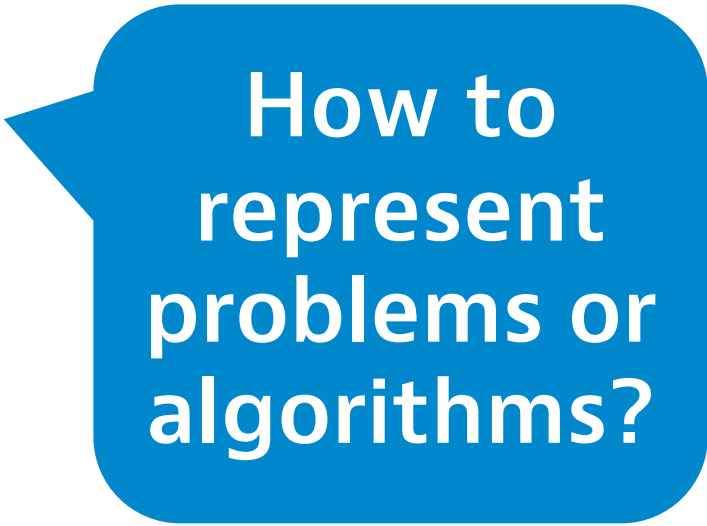
Distributed Algorithms 2025

9 Round elimination

**Can we
automate
our own work?**

Meta-algorithmics

- **Normal algorithms** — example:
 - input: graph G
 - output: coloring of graph G
- **Meta-algorithms** — example:
 - input: **computational problem** P
 - output: **algorithm** for solving P



How to
represent
problems or
algorithms?

This week's plan

- **Topic:** *round elimination*
 - function that maps problem X with complexity T to problem $X' = \text{re}(X)$ with complexity $T - 1$
- **Video:** how to *use* round elimination
 - "re" was a black box
- **Today:** how to *do* round elimination
 - what happens inside the black box and why?

Round elimination

- Basic idea already used by Linial (1987)
 - *"it is not possible to 3-color cycles in $o(\log^* n)$ rounds"*
- Until 2015 it was thought this is an ad-hoc trick that only works for graph coloring
- **Lots** of new applications since 2016
- General idea formalized in 2019

Weak 3-labeling

- **Labels:** 1, 2, 3
- **Active nodes:**
 - degree 3
 - not all labels same
- **Passive nodes:**
 - degree 2
 - both labels same

