Aalto University

Distributed Algorithms 2023

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

Example: coloring

- **Problem:** find a vertex coloring with the smallest possible number of colors
- **Proof:** *three different approaches!*

Example: coloring

- **Idea 1:** consider a path, ***fix solutions in two neighborhoods***, construct another path

Example: coloring

- **Idea 2:** consider an odd cycle, ***look at a node that outputs "3"***, construct a path

Example: coloring

- **Idea 3:** if we can 2-color paths locally, *then we can also 2-color odd cycles*

What about…

- PN model?
- CONGEST model?
- Randomized algorithms?

Example: leaf distance

- **Graph family:** trees
- **Model:** LOCAL
- **Input:** unique IDs and value of n
- **Output:** distance to the nearest leaf node

Example: is it a forest?

- **Input is a forest:** ***all*** nodes output ***"yes"***,
  otherwise: ***at least one*** node outputs ***"no"***
- **Questions:**
  - is this solvable in PN, and how fast?
  - is this solvable in LOCAL, and how fast?
  - does it help if we know n?

Example: is it a forest?

- PN, n is not known?

Example: is it a forest?

- PN, n is known?

Example: is it a forest?

- LOCAL, n is not known?

Example: is it a forest?

- LOCAL, n is known?