

Chapter 0

Introduction

What is Distributed Computing?

- Many processors/nodes active in system at any moment.
- Nodes coordinate or operate without interfering
- Nodes have certain degree of freedom: own hardware, own code, sometimes own independent task
- Nevertheless: there will still be sharing of some common resources and information: coordinating is necessary
- Almost every system today is distributed! Many applications in networking, and distributed systems.
- Basis: graph theory, online algorithms, etc.
- This course: pearls of distributed computing and network algorithms !

Lots of parameters and models (“coupling level” Parallel Computer \Leftrightarrow Internet)

- Synchronous \Leftrightarrow Asynchronous
- Homogeneous \Leftrightarrow Heterogeneous
- Shared Memory \Leftrightarrow Message Passing
- Fast Interconnection Network \Leftrightarrow Best-Effort in Graph
- Global Task \Leftrightarrow Autonomous Agents
- Altruistic \Leftrightarrow Selfish \Leftrightarrow Malicious
- Correct \Leftrightarrow Failures \Leftrightarrow Byzantine
- Concrete models: PRAM \Leftrightarrow Broadcast MP \Leftrightarrow Graph MP

Important issues and paradigms

- Communication: Does not come for free; sometimes dominates local processing and storage (sometimes assumed that local processing is free).
- Incomplete Knowledge: Node does not know what other nodes do. Do nodes know the topology of the network, or just neighbors, and/or just number of nodes in system?
- Failures: Even in the presence of a failure of some nodes, the system as a whole may survive. A major reason to build a distributed system.
- Asynchrony: Synchronous (send, receive, compute); asynchronous: algorithms are event driven; there are models in between. Non-determinism through asynchrony.
- Congestion: Storing the information at one node does not scale.
- Locality: Networks are growing. Global information is not always needed; often sufficient when nodes talk to neighbors. Saves costs, and can be simpler (cf., distance-vector routing).
- (Software/Programming)
- (Security)