

## 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)