Objectives of this Lecture

- Course Objectives
- Course Contents
- Course format, grading etc.
- Why distributed systems ?
- Puzzles

Course Objective

- Cover fundamental concepts
- Details of my research interests
- How to do research in dist. systems ?
  - Mathematical tools
- Make friends
  - Instructor: Vijay Garg, ENS 527, 471-9424
  - email: garg@ece.utexas.edu
  - Office Hourse: TTh 3:30 - 5:00
- Have fun - solve puzzles

Course Contents

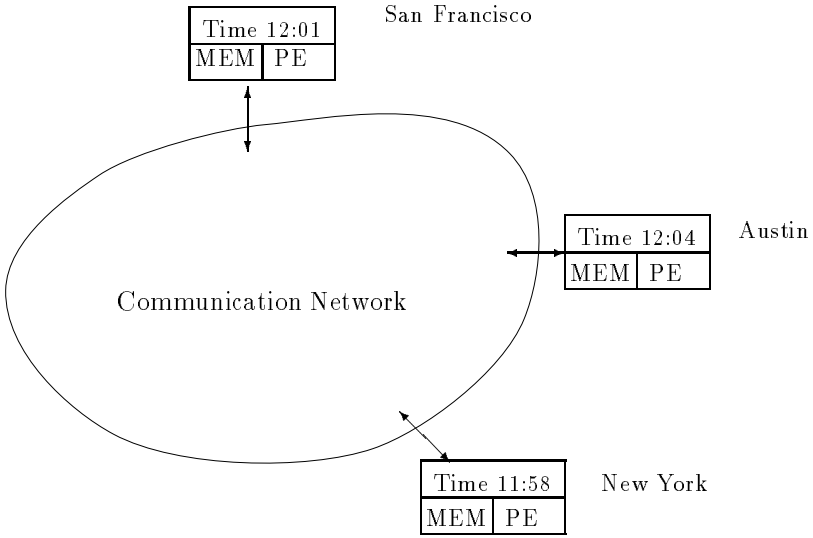
- Global Time
- Global State and Knowledge
- Algorithms: Mutual Exclusion, Causal Ordering
- Fault-tolerance
- Distributed Operating Systems
- Security

Course Format

- Grading
  - 25 % Assignments
  - 20 % Mid-Term Exam
  - 25 % Term Paper
  - 30 % Final
- Lectures
  - Questions
- Feedback

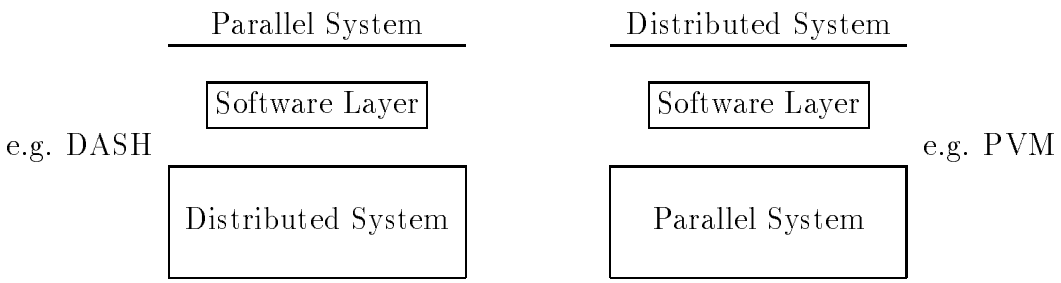
Distributed Systems

- Essential characteristics of distributed systems
  - no shared clock
  - no shared memory



Parallel Systems

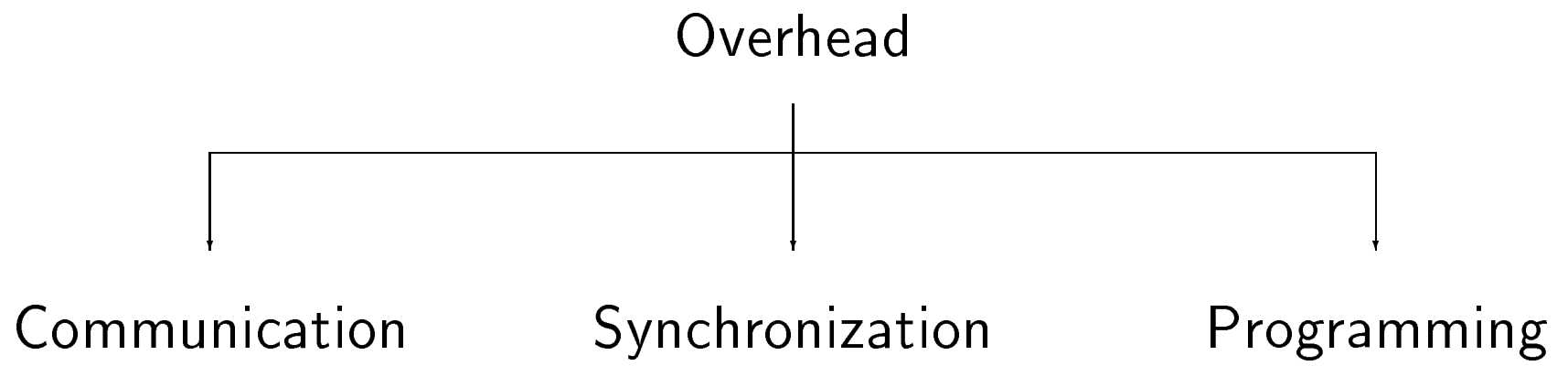
- Distributed systems vs Parallel systems
- Physical vs logical model



Advantages of Distributed Systems

- Scalability
- Sharing of resources
- Fault-tolerance
- Ease in programming
- Puzzle-like quality

Disadvantages of Distributed Systems

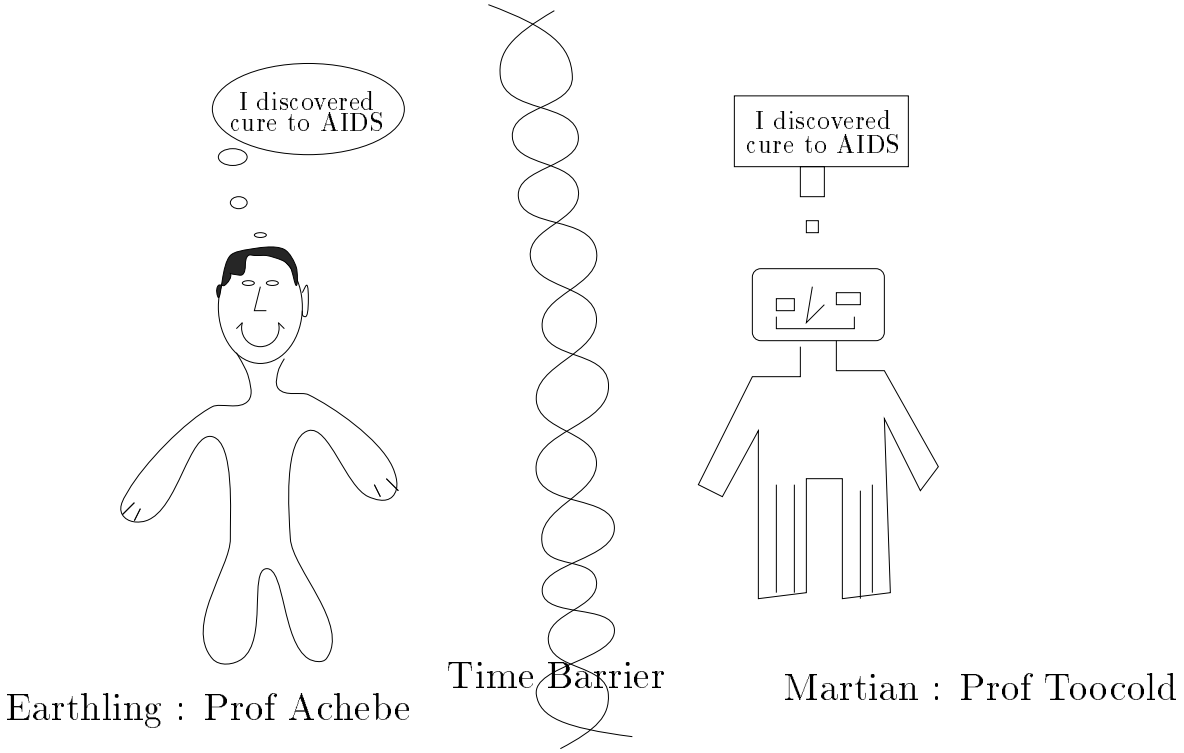


Existing Machines

System Features	Intel Paragon XP/S	nCUBE/2 6480	Parsys Ltd. SuperNode1000	J Machine/MIT
Node Type and Memory	50 MHz i860 XP nodes with 16-128 Mbytes/node	CISC 64-bit CPU with FPU, 14 DMA 1-64 Mbytes/node	multiple T-800 Transputers/node	Message-Driven Processor
Network and I/O	2-D Mesh with SCSI HIPPI, VME, Ethernet custom I/O	13-dimensional Hypercube of 8192 nodes	Reconfigurable interconnect	$8 \times 8 \times 8$ Mesh
OS	4.3 BSD	Vertex/OS or UNIX	IDRIS/OS UNIX compatible	wormhole routing
Application	Sparse Matrices	Scientific and database	Scientific and academic	Academic
Performance	5-300 Gflops peak 64-bit results	27 Gflop, 36 Gbytes/s I/O	200 MIPS to 13 GIPS peak	

Source: Advanced Computer Arch. by Kai Hwang and 1993 IEEE

Time



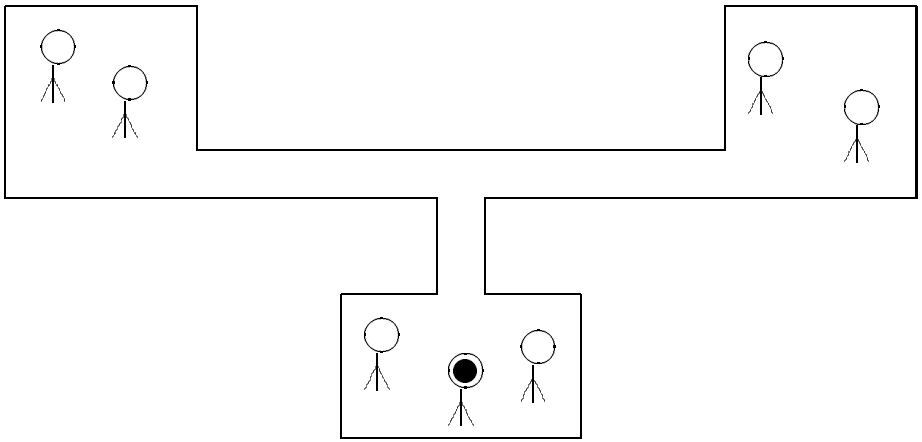
- clocks not synchronized
- How to define happed before

Time considered dangerous : replaced by causality

Reference: Lamport 79

State

- Taking picture of sky
- Taking census in a country
- Counting number of tokens in a distributed system

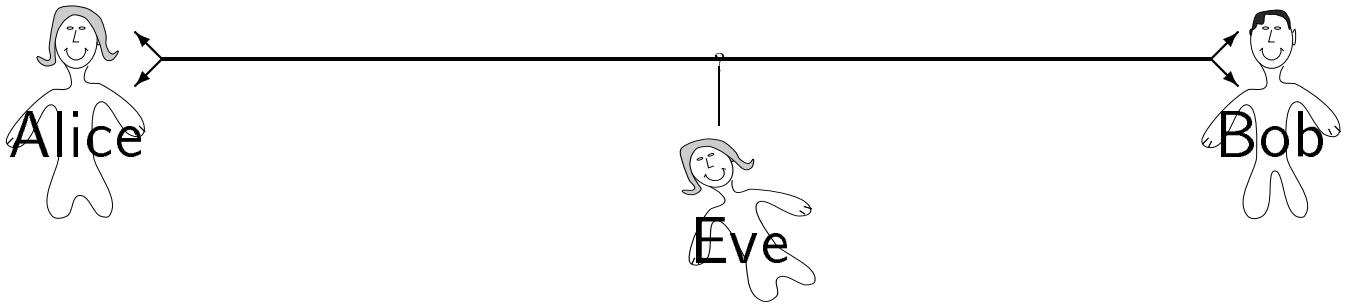


Notion of physical state replaced by consistent state

Reference: Chandy and Lamport 85

Secrets

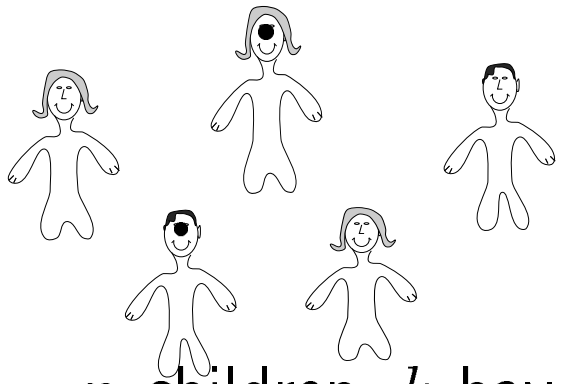
- Alice calls up Bob.
- Alice and Bob do not share any private information.
- How can Alice transmit a secret ?
- How to sign your email messages ?



Reference: Rivest, Shamir and Adleman 78

Knowledge

- Father: at least one of you have mud on your forhead
- He repeatedly asks the question: Do you know if you have mud on your forhead ?
- What happens ?



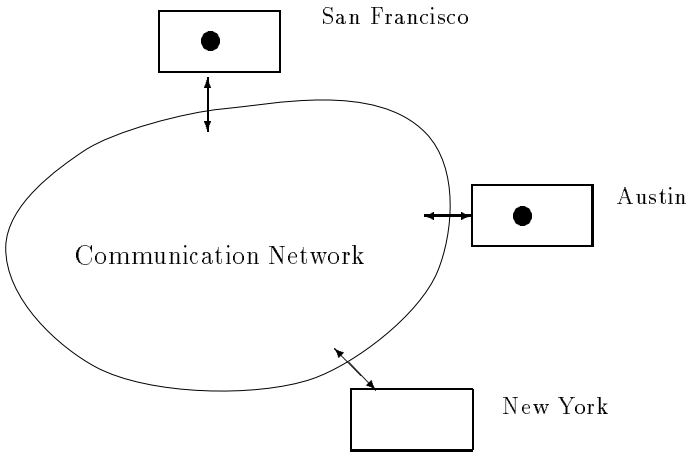
n children, k have mud

Knowing is different from knowing what is known

Reference: Hailpern and Moses 84

How to check violation of Mutual Exclusion

- A company buys a single copy of your program.
- can run the program on multiple machines
  - so long as there is a single copy of the program at any time.
- How will you detect any violation of the agreement
  - allowed access to a single computer at any time ?



Reference: Garg and Waldecker 94

This course will not deal with..

- Hardware issues
- Networking issues
- Parallel Algorithms
- Numerical Methods