CSE 550: Systems for all

Au 2021

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What is a distributed system?

Separate time domains

• Process have independently clocks
• Impossible to perfectly synchronize all clocks
  • Non-trivial message delays

Separate fault domains

• Processes can fail independently
Challenges of independent time

Event ordering is hard
  • Key to reasoning about system behavior
  • Program logic may depend on ordering -- e.g., Unix make

Consistent snapshot is hard
  • Debugging bad system states – e.g., detect deadlocks
  • Recovery after failures, migration
Two approaches to aligning times

Synchronize physical clocks

Use logical clocks
Synchronizing physical clocks (1/2)

One solution: Time server broadcasts time, clients set their own clocks

Min delay is more reliable
Set clock to received time + min delay

GPS uses a generalization of this idea
• Multiple satellites
• Triangulation yields location too
Synchronizing physical clocks (2/2)

Another solution: Clients interrogate time server, set clock to (server time + RTT/2)

Asymmetric latencies cause problems

NTP uses this idea
- Use multiple time servers
Logical clocks

Physical time is not needed for many tasks

Need ordering and causality, which logical clocks can provide

We read two versions
  • Lamport clocks
  • Vector clocks
Over to Jiarong