CSE 486/586 Distributed Systems
Wrap-up

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Building a Distributed System

• “The number of people who know how to build really solid distributed systems...is about ten”
  – Scott Shenker, Professor at UC Berkeley

• Are you confident now?

• What were the most interesting topic to you?

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Things We Discussed (Midterm)

• Networking basics (feat. the Internet)
• Failure detection
• Time synchronization
• Logical time & global states
• P2P & DHT
• Reliable multicast
• Consensus basics
• Mutual exclusion & leader election
• RPC

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• PA4 due this Friday (5/8) @ 11:59am
• Final: 5/15, Friday, 11:45am – 2:45pm
  – NSC 201
  – Everything
  – No restroom use (this quickly becomes chaotic)
  – Multiple choices
• Important things about the final week
  – PA4 scores will be posted before the final.
  – No office hours next week
• Final grading
  – ~ 1 week before the posting deadline (Sat, 5/23)
  – I’m shooting for Wednesday (5/20) for posting, Thursday (5/21) for reviewing, and Friday for finalizing.
  – This will change if there’s any delay in grading at the scoring center.

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Things We Discussed

• Transactions & concurrency control
• Replication
• Gossiping
• Distributed file systems
• Paxos
• BFT
• Security

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The Way I See It

• We’ve learned some of the building blocks & fundamental results...
  – Networking basics, failure detection, logical time, reliable multicast, mutual exclusion, leader election, transactions, concurrency control, replication, gossiping, Paxos, BFT, ...
• …and how real systems get built using those...
  – P2P, DHT, Dynamo, ...
• …and also got some experience in building/using the fundamental building blocks...
  – Ordered multicast for messaging, a DHT, and a replicated key-value storage

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Distributed Systems 10 Questions

• Course goal: answering 10 questions on distributed systems
  – At the end of the semester, if you can answer only 10 questions about distributed systems, you’ll probably get an A.
  – Easy enough!
• What are those questions?
  – Organized in 6 themes
  – 1–2 questions in each theme
  – A few (or several) lectures to answer each question

Theme 1: Communications

• Q1: how do you talk to another machine?
  – A: Networking basics
  – Know how to use socket now?
• Q2: how do you talk to multiple machines at once?
  – A: Multicast
  – What is “reliable multicast”?
  – What orderings are there for ordered multicast?
• Q3: can you call a function/method/procedure running in another machine?
  – A: RPC
  – What is a stub compiler (generator)?

Theme 2: Concurrency

• Q4: how do you control access to shared resources?
  – A: Distributed mutual exclusion, leader election, etc.
  – Ring election? Modified ring election? Bully algorithm?
Theme 3: Consensus

- Q5: how do multiple machines reach an agreement?
  - A: it’s impossible! (the FLT result), but algorithms do exist that get around the impossibility (Paxos, BFT, etc.)
  - What are the phases for Paxos?

Theme 4: Storage Management

- Q6: how do you locate where things are and access them?
  - A: DHT, distributed file systems, etc.
  - Consistent hashing?

Theme 5: Non-Byzantine Failures

- Q7: how do you know if a machine has failed?
  - A: Failure detection
  - What is the fundamental limit of a failure detector?
- Q8: how do you program your system to operate continually even under failures?
  - A: Replication, gossiping
  - Linearizability? Sequential consistency? One-copy serializability?
Theme 6: Byzantine Failures

• Q9: how do you deal with attackers?
  – A: Security
  – What is a digital certificate?
• Q10: what if some machines malfunction?
  – A: Byzantine fault tolerance
  – To tolerate f faulty nodes, how many nodes do we need in total?

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