

## Midterm feedback (thanks)

- **Points to need for more structure/signposting**
  - Will try to start more classes with a few slides
- **Maybe try some other communication tool [poll]**
- **Experiment: try to mitigate “race to answer” with breakout rooms (1–2 times per lecture)**
  - Discuss among yourselves for 1 minute
  - One person reports back in main chat with member SUnet IDs  
E.g., [sunset1,sunset2,sunset3] Answer . . .
  - Jim will read out the best answer(s)
- **A majority finds project discussions helpful**
  - Clarification: fine to meet with me multiple times
  - Will have another round of meetings May 4–15

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## CS244b so far

- **Seen how to transact atomically across systems using 2PC**
  - E.g., lets you shard a database for scalability
- **Seen how to replicate deterministic systems with consensus**
  - Replication provides greater availability and reliability
  - Understand how at least one of {Raft, Paxos} works
- **Seen an example replicated system: zookeeper**
  - Nice, clean abstraction barrier between RSM and consensus (ZAB)
- **Next week: Byzantine failure**

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## Today’s learning goals

- **Add a few more techniques to our arsenal**
  - Primary copy replication, Witnesses
  - “Leases” (even though paper doesn’t use the term)
- **More experience thinking about replication, consistency, logs**
  - Reinforce concepts from multiple angles before doing Byzantine
- **See a real system that is not perfectly clean, faces trade-offs**
  - Violating abstraction barriers (RPC, NFS, replication)
  - Making hardware assumptions (clocks, batteries)
  - Failing to meet expected semantics (atime)

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## Who are the authors?

- **Barbara Liskov**
  - One of Stanford’s most distinguished CS Ph.D.s
  - Co-invented viewstamped replication (published *before* Paxos)
  - Co-invented practical Byzantine fault tolerant replication
  - Other contributions: parametric polymorphism, decentralized information flow control
  - ACM Turing award 2008 for inventing abstract data types  
*If Harp violates abstraction boundaries, probably a good reason!*
- **Sanjay Ghemawat**
  - Highly respected engineer at Google
  - Numerous contributions including map-reduce, GFS, Spanner

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