

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

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**

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)

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