# Putting it all together – Final Review

*CS 475: Concurrent & Distributed Systems (Fall 2021)*

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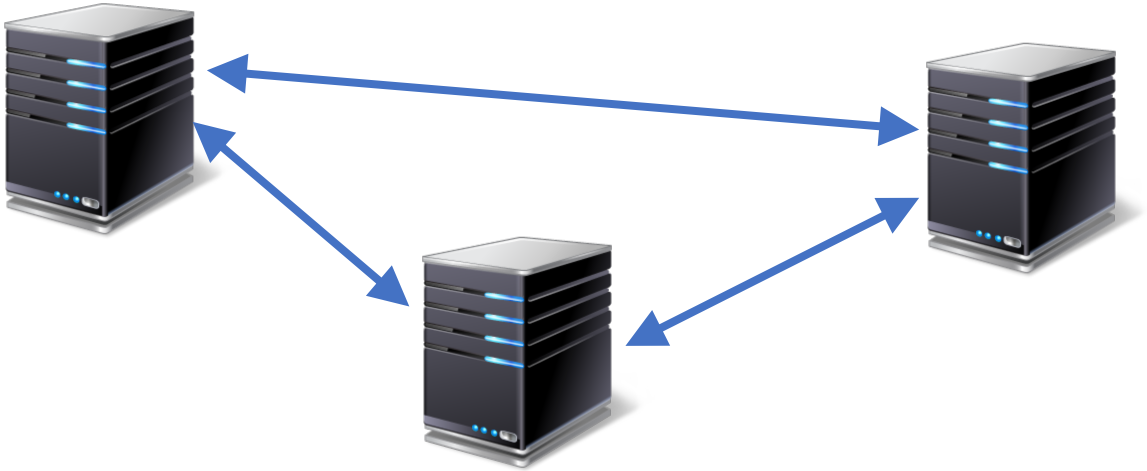
# Back in Lec-1…

# Distributed systems: What?



- Multiple cooperating computers
  - Connected by a network
  - Doing something together

- Lots of critical infrastructure are distributed

# Distributed systems: Why?

- Or, why not 1 computer to rule them all?

- Failure

- Limited computation/storage

- Physical location

# Distributed systems: Why?

- Or, why not 1 computer to rule them all?

- Failure ➢Fault tolerance

- Limited computation/storage ➢Scalability

- Physical location ➢Availability, low latency

# Goals of "distributed systems"

- Service with higher-level abstractions/interface
  - E.g., key-value store, programming model, …
- High complexity
  - Scalable (scale-out)
  - Reliable (fault-tolerant)
  - Well-defined semantics (consistent)
- Do "**heavy lifting**" so app developers don't need to

# Theme

- Fundamental building blocks

- Abstractions and programming models

- Production system designs

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# Fundamental building blocks

- Remote procedure calls (RPCs)

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- Time & clocks

$vc(1) < vc(2)$

$vc(1) \not< vc(2)$

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- Remote procedure calls (RPCs)
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- Consensus algorithms
- Replication, sharding, transactions unit of Work.

# Fundamental building blocks

- Remote procedure calls (RPCs)
- Time & clocks
  - **Vector clocks**
- Consensus algorithms
  - **Raft**
- Replication, sharding, transactions
  - **Serializability**

ACID.

I ↑

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# Theme

- Fundamental building blocks

- Abstractions and programming models

- Production system designs

# Programming models

- MapReduce

- Spark

# Programming models

- MapReduce

- **Spark**

# Resilient Distributed Datasets & Spark

- Transformations and actions

- persist()
  - Not an action nor a transformation – tell which RDDs should materialize

- PageRank example

  links. ranks.

  - How iterative PR algorithm works
  - Q Where to place persist() in iterative PR

  flag → save to disk.

# Theme

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- Production system designs

# Production system designs

- Amazon Dynamo

- Facebook memcache

# Production system designs

- Amazon Dynamo

- **Facebook memcache**

# Facebook memcache

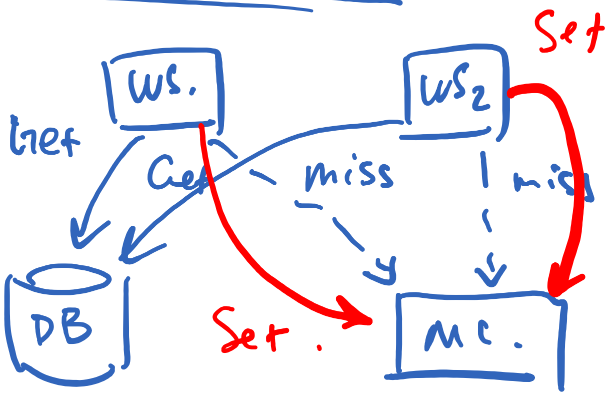
- Memcache as a demand-filled, look-aside cache
  - `Read()` and `write()`

Fig. 1 paper.

- Interesting problems solved in FB's production-scale memcache deployments

WW race!   W-R race!   R marker

1. Stale set: a single region vs. geographically distributed
2. Thundering herds
3. Incast congestion
4. Incorporating McSqueal for what?



# Final exam

- Thursday, Dec 09th, 7:30 – 10:00am
  - 150 minutes
  - Open-book, open-notes (you may use class notes, papers, and lab materials; you may read them on your laptop, **but you are not allowed to use any network**)
  - Let me know if you need testing center accommodation ASAP (**no guarantee if you send me the form one day before the final exam**)

- Covering (selected) topics from lec-1 to lec-17
  - High-level design questions
  - **30%** before midterm **70%** after midterm

# Topics

1. Vector clocks

Basic Building Blocks.

2. Raft
3. Transactions Serializability
4. Spark → Abs. programming models.
5. Facebook memcache → Production System

# Don’t forget to fill out the course evaluation form

**Good luck! ☺**