Web Service and Revision

Web Service: Three Tiers

A loose design paradigm:

1. Stateless web servers
2. Application logic, high-level storage (i.e. BigTable)
3. Durable storage: Google File System, Lustre

Starbucks Example

Starbucks lets gift card holders transfer funds between cards online.

- **Tier 1** Route requests to Tier 2, render pages.
- **Tier 2** Logic sharded by user. Ensure sufficient funds exist and decrement/increment balances of their users. Commits changes to Tier 3.
- **Tier 3** Filesystem. Transfer records are appended to files and replicated across machines.

State in Tier 1

Tier 1 machines are generally stateless.

Caching pages and even user information is OK.
Example: Google doodles on home page have a canned query, probably cached in Tier 1.

Loosely Defined Tier 1 and 2

Starbucks credit moves from one user to another.

Tier 1 server could coordinate transaction with two Tier 2 machines.

Or Tier 2 server for sender contacts Tier 2 for receiver.

Combine Tier 2 and 3?

Why doesn't the machine responsible for a user also store the final copy?

Fine for one application, but in general there are multiple applications sharing one filesystem.

Example Exam Questions

Setting the Scene

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a) Does the current Starbucks system guarantee linearisible consistency? [1 mark]

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a) Does the current Starbucks system guarantee linearisible consistency? [1 mark]

No.

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Evaluating Technology

b) Would BigTable's consistency model solve the problem? Why? [2 marks]

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Evaluating Technology

b) Would BigTable's consistency model solve the problem? Why? [2 marks]

No, because it can't do transactions across rows.

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- Tier 1 is presentation with front-line web servers. These contact the Tier 2 machine for the user from whom funds will be transferred.
- Tier 2 has machines responsible for shards of users, using Chord to assign responsibility. These machines ensure sufficient funds exist and decrement/increment balances of their users. The Tier 2 machine contacts the machine responsible for the destination to send funds. Agreement is done by two-phase commit (coordinated by Tier 1).

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- Tier 3 is the backing store (filesystem) where Tier 2 ensures transaction records are committed.

Revision

Key Words in Questions

Name	Usually a single word will do
Why?	1 or 2 sentences
Explain	1 or 2 sentences
Design	Long answer

How does that impact marks?

Won't take marks off for longer answers.

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. . . We do take off if you say something wrong.

No multiple guessing

If the question says “name two” and you name three, we’ll mark the first two.

Pick 2 Questions of 3

The exam has three questions: 1, 2, and 3 (each of which has parts).
Choose exactly two and indicate this on the front.
If you do all three questions, we will only mark 1 and 2.
. . . unless, in our judgment, one is obviously incomplete.
This is the short version of school policy.

Difference from Last Year

Exams before academic year 2015–2016 are from a different instructor.

Less scatterbrain than last year.

Emphasis on solving problems

Design a system to store YouTube videos.
You're Twitter. Make a low-latency feed system.
Show the most frequently visited pages. Live.

Reason About a Problem

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More fun: how will this system fail?

Bag of Tricks

- Sharding aka partitioning: divide the work across machines
- Replication for speed and fault tolerance
- “Cold” large read-only store, “hot” small mutable store
- Approximations: Bloom filters, streaming counts, resevoir sampling

Systems

MapReduce	Parallel batch processing
BitTorrent	File sharing
HDFS	File storage
Chord	Divide responsibility as machines join and leave
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Given a problem, name a system and apply it.
Take inspiration from the design of these systems.

Linearisable versus Sequential

Alice and Bob write checks to each other for the same amount.

Alice's Statement

-10	Check Alice $\rightarrow$ Bob
0	Check Bob $\rightarrow$ Alice

Bob's Statement

-10	Check Bob $\rightarrow$ Alice
0	Check Alice $\rightarrow$ Bob

Both overdraft.

✓ Sequential: each client sees a consistent order

✗ Linearizable: no globally linear story