NoSQL Introduction

Lecture 12

Motivation

- Even today, RDBMSs are ubiquitous for small/medium-sized business applications
  - Features: data models, SQL+APIs, ACID, reasonable performance, security, backup, …
- But much of an RDBMS is all-or-nothing, which is to say that many applications (e.g. web) need a smaller/different feature set, with a much different performance profile

NoSQL

- Originally saying "no" to RDBMS…
  - "NoSQLers came to share how they had overthrown the tyranny of slow, expensive relational databases in favor of more efficient and cheaper ways of managing data."
- Now more like "Not Only SQL"
  - Recognize the right tool for the right job
- NoSQL databases focus on semi-structured data, high performance/availability/scalability
  - The movement has also had a positive impact on RBDMSs, motivating them to adapt

NoSQL Characteristics: Performance

- Focus on **horizontal** scaling
- Emphasize availability and fault tolerance, settling for **eventual consistency**
  - Replication: Master-Slave, Master-Master
  - **Sharding** (horizontal partitioning) of data
- High performance data access
  - Hashing and range partitioning

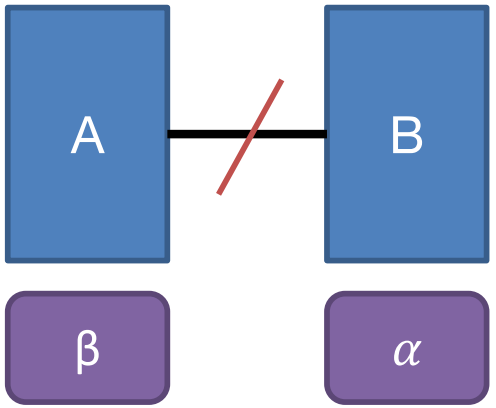
Aside: CAP Theorem

- For any shared-data system…
  - **C**onsistency: all nodes have the same copies of a replicated data item visible for various transactions (note: different from ACID)
  - **A**vailability: every request (to a non-failed node) will result in a response
  - **P**artition tolerance: system still operates despite inability of nodes to communicate

- Commonly stated as “choose 2 of 3”
  - Really: when there is a partition, choose either consistency or availability

Illustrative Example

1. Two nodes: A, B
   – Share data X, initially α
2. Network outage!
   – A can't communicate with B :(
3. User 1 writes X=β on A
4. User 2 reads X from B



Question: what should User 2 receive?

– Consistent: β
  • Must wait for A, and so not available
– Available: α
  • Not consistent

NoSQL Characteristics: Data/Query

- Schema not necessarily required
- Less powerful query languages
  - **(S)CRUD**: Search Create Read Update Delete
  - Often programmers need to manually join
- Built-in versioning of data

Common NoSQL Categories (1)

- Document Stores
  - Commonly JSON, no schema
  - Access by document id or content
  - Example: MongoDB

- Key-Value Stores
  - Associative array: access data via id
  - Basically fast, distributed hash tables
  - Example: DynamoDB, Redis

Common NoSQL Categories (2)

- Graph
  - Stores nodes, columns; graph ops optimized
  - Example: Neo4j

- Others
  - Column-based (horizontal partitioning)
  - Hybrid
  - XML
  - Objects

  …