CSE 414: Section 6 NoSQL, SQL++

November 1st, 2018

Query workload types

[“One Size Fits All”: An Idea Whose Time Has Come and Gone]

OL**T**P (Online **Transactional** Processing)

- Atomic operations (one or multi entities). E-commerce, webapps.
- A small number of records per query - “Latest state”

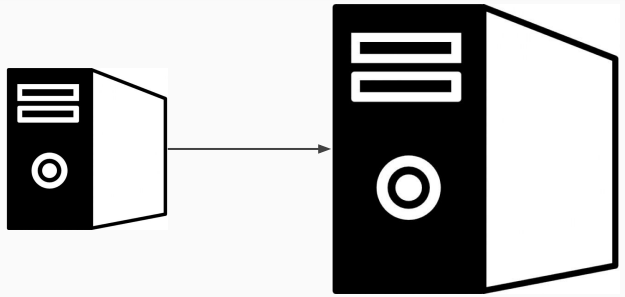
OL**A**P (Online **Analytical** Processing)

- Analytics and data-warehousing. Reporting, decision support.
- Many records per query - “Aggregated stats” on “Bigger data”

Scaling methods

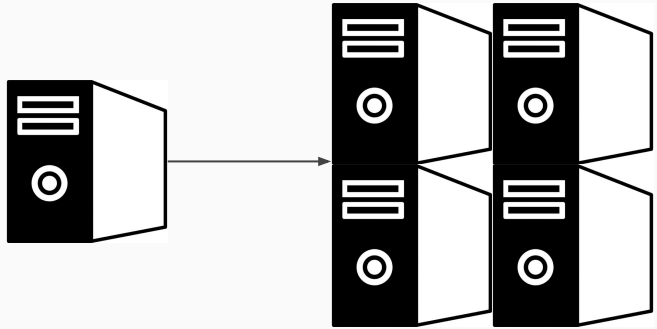
Scale up (vertically)

- Add more power to a single node
- diminishing returns



Scale out (horizontally)

- Cheap commodity hardware
- Management / coordination complexity

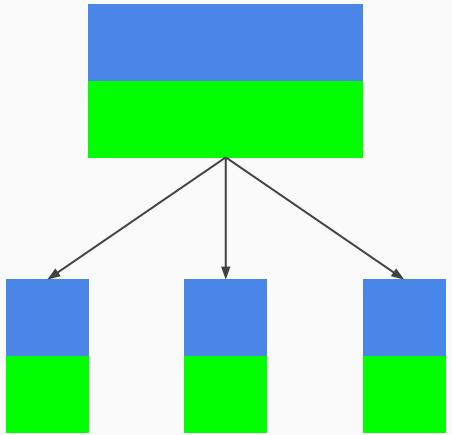


Partitioning & Replication

Partitioning

Or “Sharding”, “Distribution, ”Fragmentation”

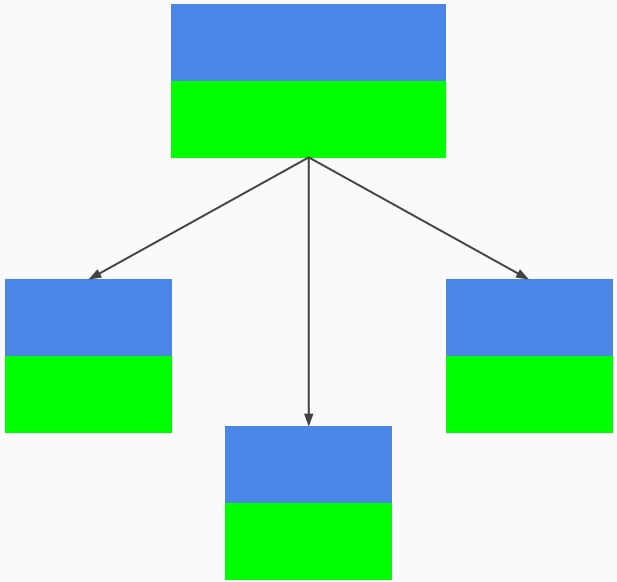
- Motivation:
  - BIG data - need to split up! (e.g. PB-level)
  - Availability: better write (and single-record read) throughput
- Challenge: fair share of requests
  - Choice of partitioning schemes
  - “Justin Bieber Effect” -> “hot spots”



Partitioning & Replication

Replication

- Motivation:
  - Fault-tolerance / durability: power / disk failures
  - Keep data close to the user (geographically)
  - Availability: better read (and potentially write) throughput
- Challenge: keeping data in sync
  - E.g. write to a leader and then propagate
  - Choice of consistency models



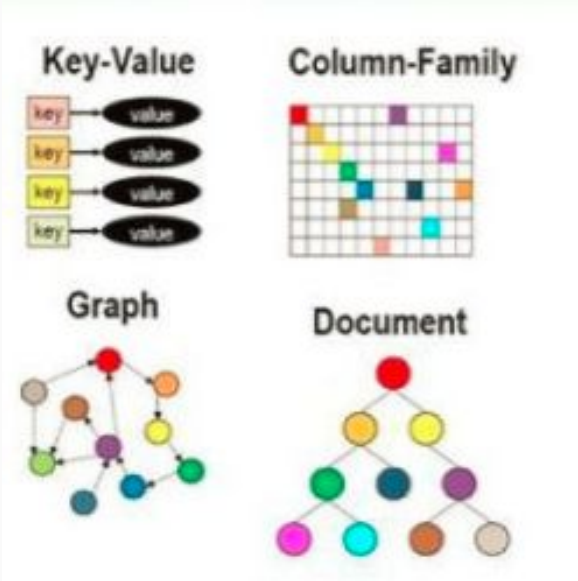
NoSQL

SQL vs. NoSQL Databases: What's the Difference?

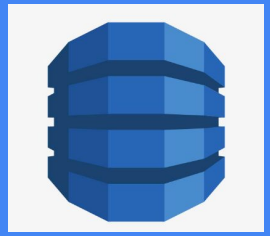
- No clear definition :\
  - Non-relational
  - + **scalability**, + availability, + flexibility
  - - consistency, - OLAP performance
  - Open source implementations
- Motivation
  - The need to scale
  - Lots of web apps mostly **OLTP** queries
    - Read/write intensive
    - but fewer joins & aggregates

Data Models

- Key-value stores
  - Opaque value
  - e.g., Project Voldemort, Memcached
- **Document stores**
  - “key-object”
  - e.g., SimpleDB, CouchDB, MongoDB, AsterixDB
- Extensible Record Stores
  - “column groups”
  - e.g., BigTable, HBase, Cassandra, PNUTS
- Graph
  - E.g. Neo4j



NoSQL: DynamoDB



Document and Key-Value Stores!?

Jeff Bezos wants his shopping carts full

Throughput motivated

NANI?

Dynamo: Amazon's Highly Available Key-value Store

Giuseppe DeCandia, Deniz Hastorun, Madan Jampani, Gunavardhan Kakulapati, Avinash Lakshman, Alex Pilchin, Swaminathan Sivasubramanian, Peter Vosshall and Werner Vogels

Amazon.com

ABSTRACT

Reliability at massive scale is one of the biggest challenges we face at Amazon.com, one of the largest e-commerce operations in

One of the lessons our organization has learned from operating Amazon's platform is that the reliability and scalability of a system is dependent on how its application state is managed.

JSON and Semi-Structured Data

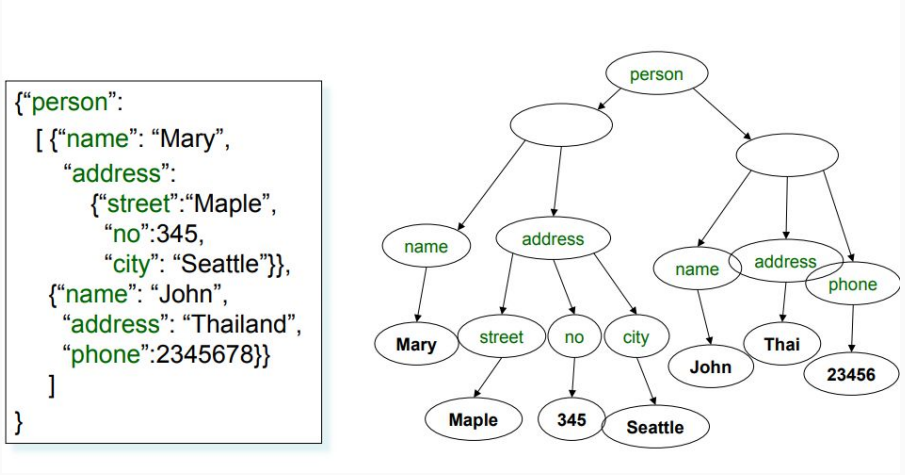
JSON, XML, Protobuf (also an IDL)

Familiar - as your HTTP request/response

- Good for data exchange
- Maps to OOP paradigm

Also - as a database file

- Flexible tree-structured model
- Query langs: XQuery, XPath, etc.



AsterixDB, SQL++

- A semistructured NoSQL style data model (ADM)
- Extends JSON with object database ideas

Know the following:

- DDL: type (open vs. closed), data types (e.g. multiset). Creating an index.
- DML: Heterogenous Collections, Nesting / Unnesting.
- (Asterix stores data as flattened tables behind the scenes)

What is SQL++?

Just like SQL but parsed for processing JSON data

SQL++ has keywords to handle collections of data (i.e. non-flat data)

Motivation for SQL++

Why SQL++? Why not some other query language?

- People are used to/like specifying data through SQL syntax
- SQL-like language enforces idea of physical data independence

Useful Keywords/Syntax for HW

`is_array( … )` -----> checks if value is an array

`split(s, d)` -----> splits string s on delimiter d

`[ … ]` -----> explicitly construct array

`(CASE WHEN … THEN … ELSE … END)` -----> combine with "`is_array(…)`"

`MISSING` -----> reserved keyword like "`NULL`"

`` ` … ` `` -----> backtick needed for accessing keys with names containing "`-`"