Administrivia

● Web Quiz due Friday, Oct 27
● HW4 due next Tuesday, Oct 31

● **Midterm next Wednesday, Nov 1**
  ○ Everything before next Wed
  ○ Review session: Friday 5:30-6:20 pm, SMI 205
Query workload types

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

OLAP (Online **Analytic** 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”
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

- 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

- **Extensible Record Stores**
  - "column groups"
  - e.g., BigTable, HBase, Cassandra, PNUTS

- **Graph**
  - E.g. Neo4j
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)
AsterixDB
Installation