My experience in data management systems and public engagement activities

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Why DBMS!

Users

DBA	APP PROGRAMMERS	END USERS
DB Schema	App Software	Query App Interface

DBMS

Query Processor	Query Evaluation Engine (DDL Interpreter, DML Compiler, Application Object Code)
Storage Manager	Buffer Manager, File Manager, Transaction Manager

Database

Data files, Data Dictionaries, Indices

DBMS Types

	SQL	NoSQL
High Level Model	ER Model	
Representational Model	Hierarchical (IMS), Relational (Oracle, DB2, SQL Server), Network (IDMS, IMAGE)	
Low-Level Model		

DB Architectures

- Centralized DBMS Architecture
- Client-Server Architecture
- Distributed Database Architecture

Schema Types

- Internal Schema
- Conceptual Schema
- External Schema

Glossary on Keys

Key Types

- Super Key
- Candidate Key
- Primary Key
- Secondary Key
- Foreign Key
- Composite Key
- Compound Key (Composite key with foreign key)
- Alternate Key
- Sort/Control Key
- Surrogate key

Overview

1. DBMS
   - MySql, Oracle, Cassandra, HBase, MongoDB
2. Hadoop
   - Hadoop Ecosystem
   - External Data Storages
   - Query Engines
3. Which Data Storage?
4. SQL
   - MySql, Vertica
5. NoSQL
   - Cassandra with solr
   - No one single point of failure
6. Microservices

Hadoop Ecosystem

Query Engines And External data storage

Clustered Computing Platforms (Mapreduce, Spark)

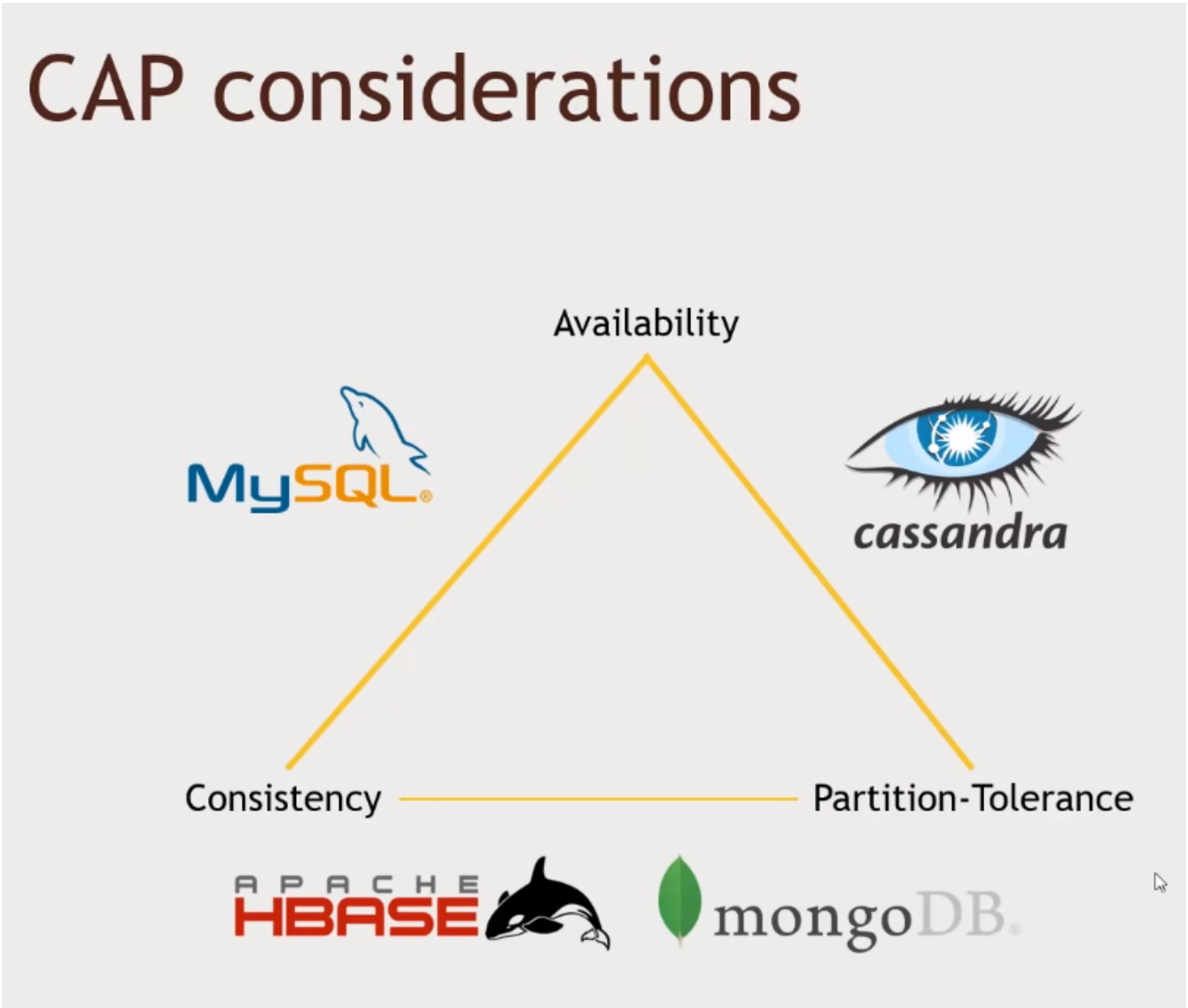
SPARK

- Distributing queries and trend analysis
- Microbatching for historical analysis
- Loading large datasets into memory
- Running queries against large datasets

Pros & Cons of the databases

Hadoop/Mapreduce	Slow for real time analytics
MongoDB	Global write lock performance concerns
Cassandra (w/o solr)	Query Limitations
Cassandra (w/o solr)	No bother about denormalizing, duplication, access pattern data modelling
Solr	Search capabilities, partial text search, facet queries, geospatial, etc.

Which Data Storage?



Vertica for Big Data Engineering

Command Type

1. DDL
2. DML
3. DCL
4. TCL

1. create, alter, drop, truncate, rename
2. select, insert, update, delete
3. grant, revoke
4. commit, rollback

Example (Vertica Code Example)

```
SELECT name, class, date,
RANK() OVER (PARTITION BY class ORDER BY marks desc) AS rank
FROM student
WHERE name IS NOT NULL
AND subject like 'math%'
AND date > '01/01/2007'
ORDER BY class;
```

SQL Glossary

- bandwidth=rate of data transfer
- latency=time of date transfer
- 1NF, NF, 3NF, BCNF
- ACID Properties (atomicity, consistency, isolation, durability)
- Lossless Decomposition
- Data Independence
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-
-
-
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DSE provides integration between Cassandra with Solr

- Storage grid (cassandra) + Search grid(solr)
- Devcenter or cqlsh
- Cassandra cluster handling over 1TB data
- 2 Data Centers
- 3 Servers, with RF of 3
- configure dse.yaml or vassandra.yaml
- Opscenter
- Solr Admin UI gives Solr Index Size
- All Nodes should have solr enabled within DC
- Map collection to dynamic fields
- solr queries have consistency levels

CQL syntax similar to SQL syntax

Example (CQL Code Example)

```
/*create table defining partition, clustering keys*/
CREATE TABLE student (
name text, class text, subject text, date timestamp,
PRIMARY KEY ((name, class), date)
);
```

Primary key is defined as ((partition keys), clustering/sorting keys)

Example (CQL Code Example)

```
SELECT name, class, date, rank FROM student
WHERE name IS NOT NULL
AND subject CONTAINS 'math'
AND date > '01/01/2007'
ORDER BY class
PER PARTITION LIMIT 2;
```

Solr provides full text search, term-search

Example (CQL + Solr Code Example)

```
SELECT name, class, date
FROM student WHERE
solr_query='{"q":"name:[* TO *] AND subject:math*",
            "fq":"date:[2007-01-01T00:00:00Z TO NOW]",
            "facet":{"field":"class"},
            "sort":"class, marks desc",
            "paging":"driver",
            "timeAllowed":30000 }'
ALLOW FILTERING;
```

Clustering columns can be defined in WHERE clauses if ALLOW FILTERING is also used even if a secondary index is not created

Cassandra Glossary

- snitch
- Gossip
- Quorum
- num_tokens
- max_solr_concurrency_per_core = cpu code / num solr cores
- partitioner
- auto_bootstrap
-
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Microservices

Microservices architecture runs on top of STORM/JMS/KAFKA
Storm (handles clustering/distribution)
Kafka (messaging between the grids)

Thank You!