CS315: Database Systems
NoSQL and Big Data Systems

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  - Scalability
  - Flexibility
  - Naturalness
  - Distribution
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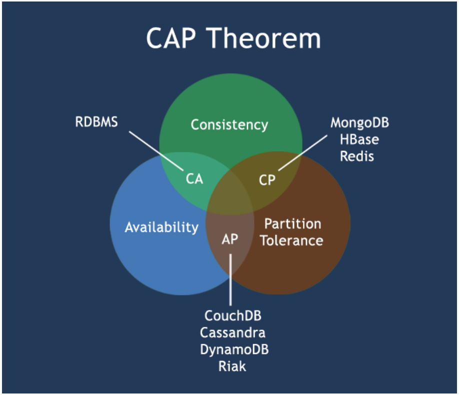
- NewSQL

CAP Theorem



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- CP: what is available is consistent
- AP: everything is available but may not be consistent

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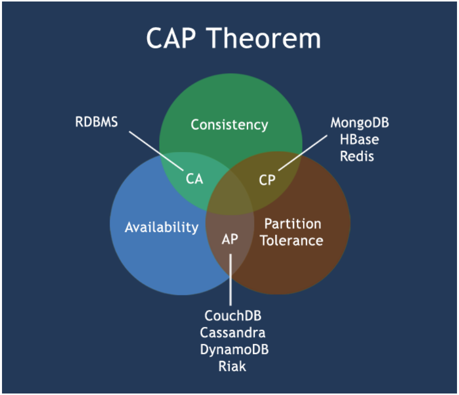

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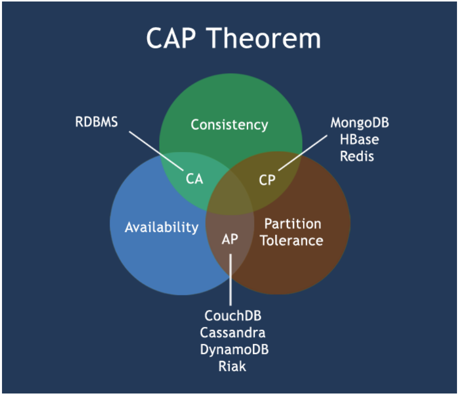

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- More a hypothesis than a theorem

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- Soft state: State of system is soft, i.e., it may change without input to maintain consistency
- Eventual consistency: Data will be eventually consistent without any interim perturbation
  - Sacrifices strong (immediate) consistency

Types

- Main types of NoSQL data stores:
  1. Columnar families
  2. Key-value stores
  3. Bigtable systems
  4. Document databases
  5. Graph databases

Columnar Storage

- Instead of rows being stored together, columns are stored consecutively
- A single disk block (or a set of consecutive blocks) stores a single column family
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- Two main types
  - Columnar relational models
  - Key-value stores and/or big tables

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- Example: MonetDB

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- Example: Cassandra, CouchDB, Tokyo Cabinet, Redis

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- Example: BigTable, HBase, Cassandra, HyperTable, SimpleDB

Document Databases

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- Popular document formats are XML, JSON, BSON, YAML
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- Example: MongoDB, CouchDB

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- Example: Neo4J, HyperGraph, Infinite Graph, Titan, FlockDB

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- NoSQL horizon is shifting rapidly
- Trend is for NoSQL as cloud computing and big data relies on it
- Many NoSQL systems are increasingly using features of RDBMS
- New paradigm of scalability with transaction support is NewSQL

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- When data is bigger than most standard machines can store or most algorithms can handle

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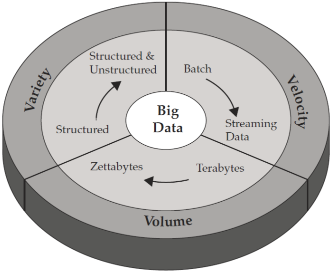
- Allows solving newer problems
  - Can also solve older problems better

Properties of Big Data



- 3 V's: volume, variety, velocity
- Volume: When data is extremely large in size, how to load it, index it or query it
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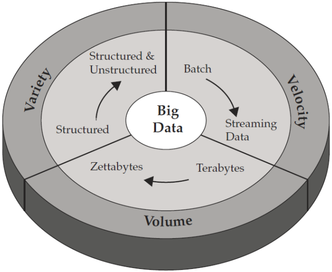

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- Extended V's: veracity, validity, visibility, variability

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- Database: NoSQL
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- Operations: Querying, indexing, analytics
  - Data mining, Information retrieval
  - Machine learning: Mahout on top of Hadoop

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- Databases have become robust and stable