NoSQL Database

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Problem – What's wrong with RDBMS?

- RDBMS are performance challenged to handle "big data"
  - Scaling
  - Distributed transaction processing
- Cores/servers
- Cloud
- Difficult to develop OO applications for relational DBs
- Multi-Structured/Complex Data

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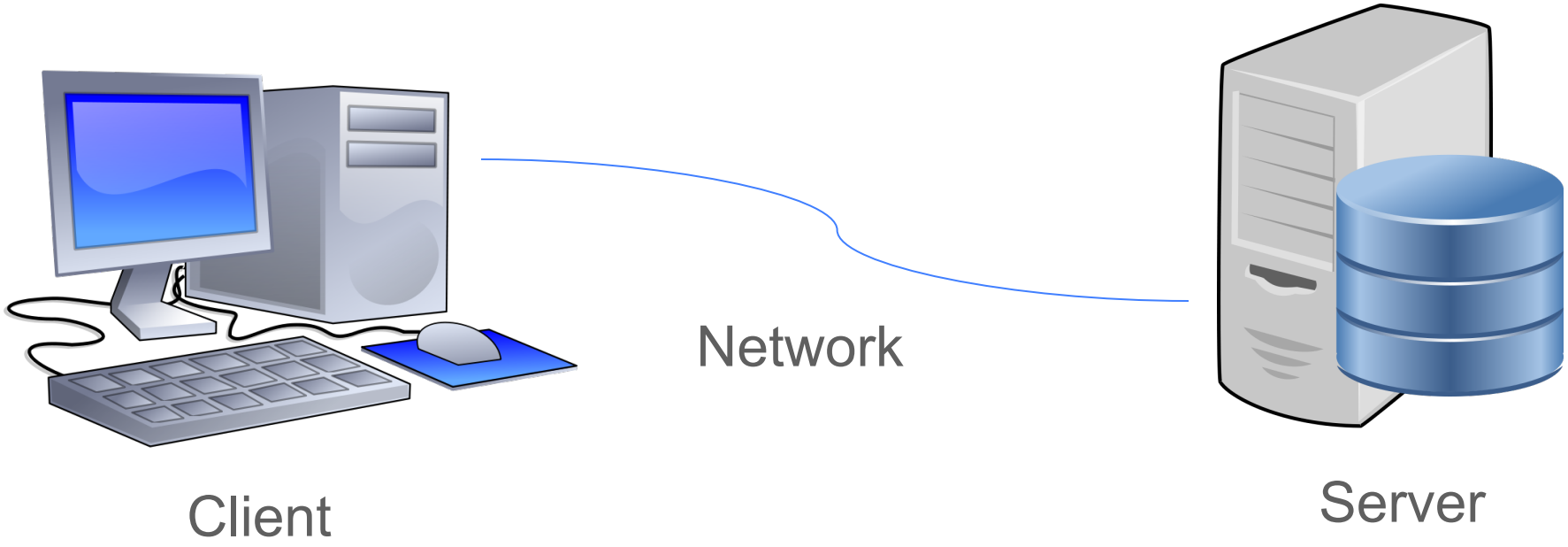
ACID

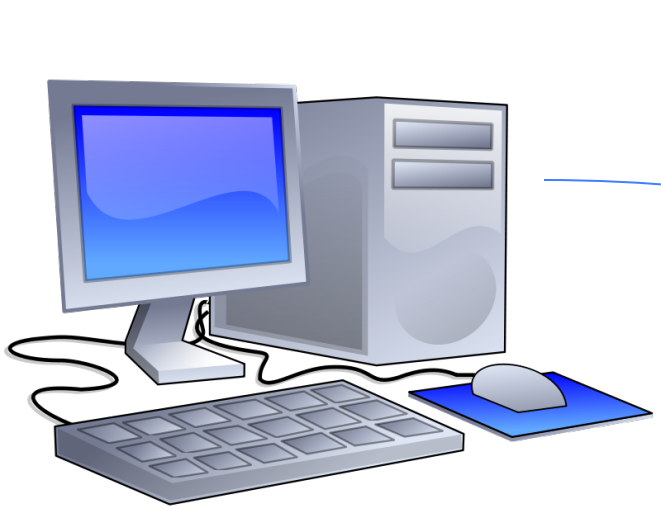
- Atomic
  - Everything in transaction succeeds or everything rollback
- Consistent
  - Transaction cannot leave DB in inconsistent state
- Isolated
  - Transactions cannot interfere with each other
- Durable
  - Completed transactions persist

Transaction Support



Scaling?

Distributed Transaction Support



Client

Network

Servers

Trade Consistency for Availability can improve performance in Scalability

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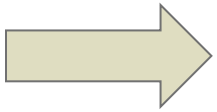
Vertical Scaling

Need 10X more power – buy 10x bigger server



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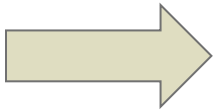
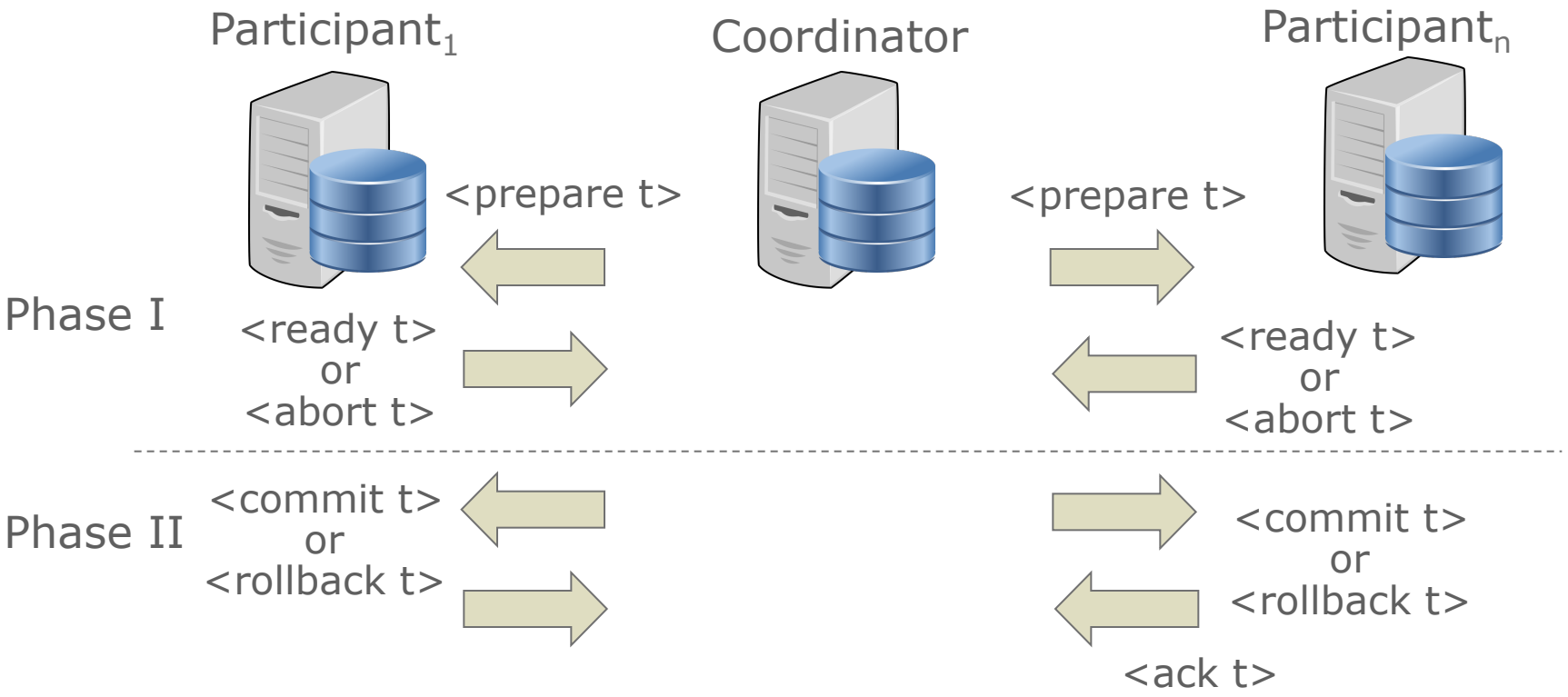
Horizontal Scaling

Need 10X more power – buy 10 more servers



2 Phase Commit



- Voting occurs in Phase I. Coord issues Commit for Phase II
- Not difficult for 2 servers. What about 200 servers?

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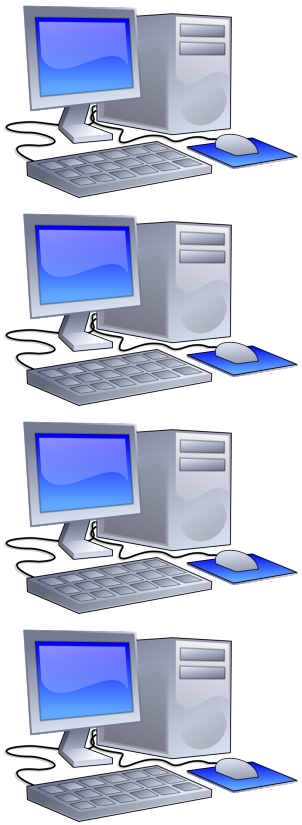
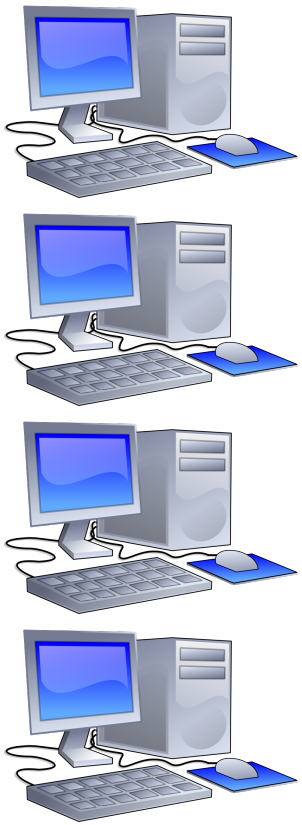
Scalability

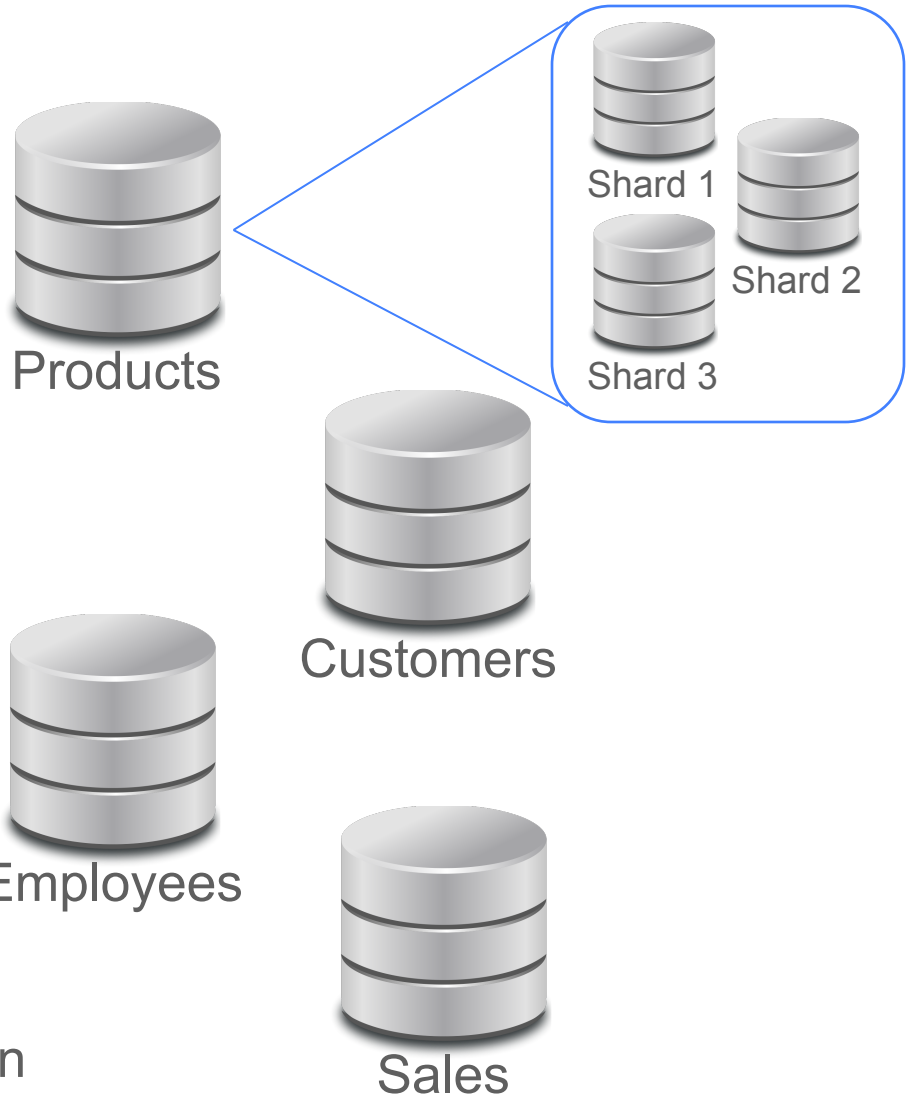
- Vertical – Move to larger computers
  - Expensive
  - Out grow largest computer
  - Vendor lock
  - Clustering – adds layer to stack
- Horizontal – partitions data across multiple DBs (2 dimensions)
  - Flexible
  - More complex
  - Easily scaled

Functional Scaling (1st Dimension)

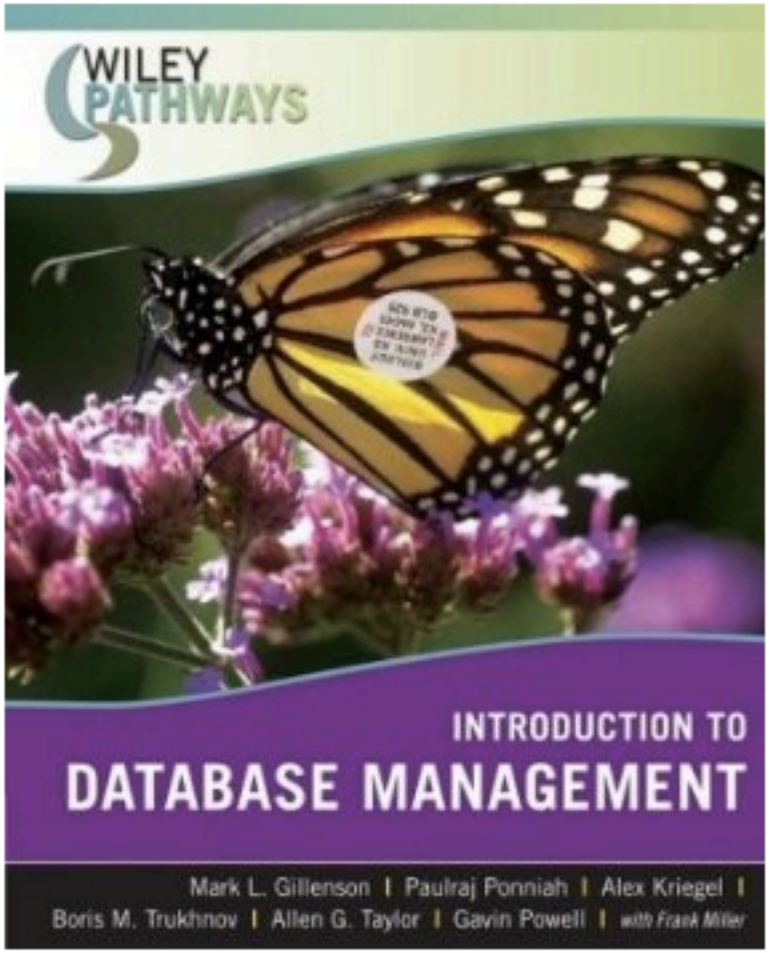


Functional Scaling (2nd Dimension)





Shard – Horizontal DB partition



Wiley Pathways Introduction to Database M

Mark L. Gillenson (Author), Paulraj Ponniah (Author), Alex Krieg
Powell (Author), Frank Miller (Author)

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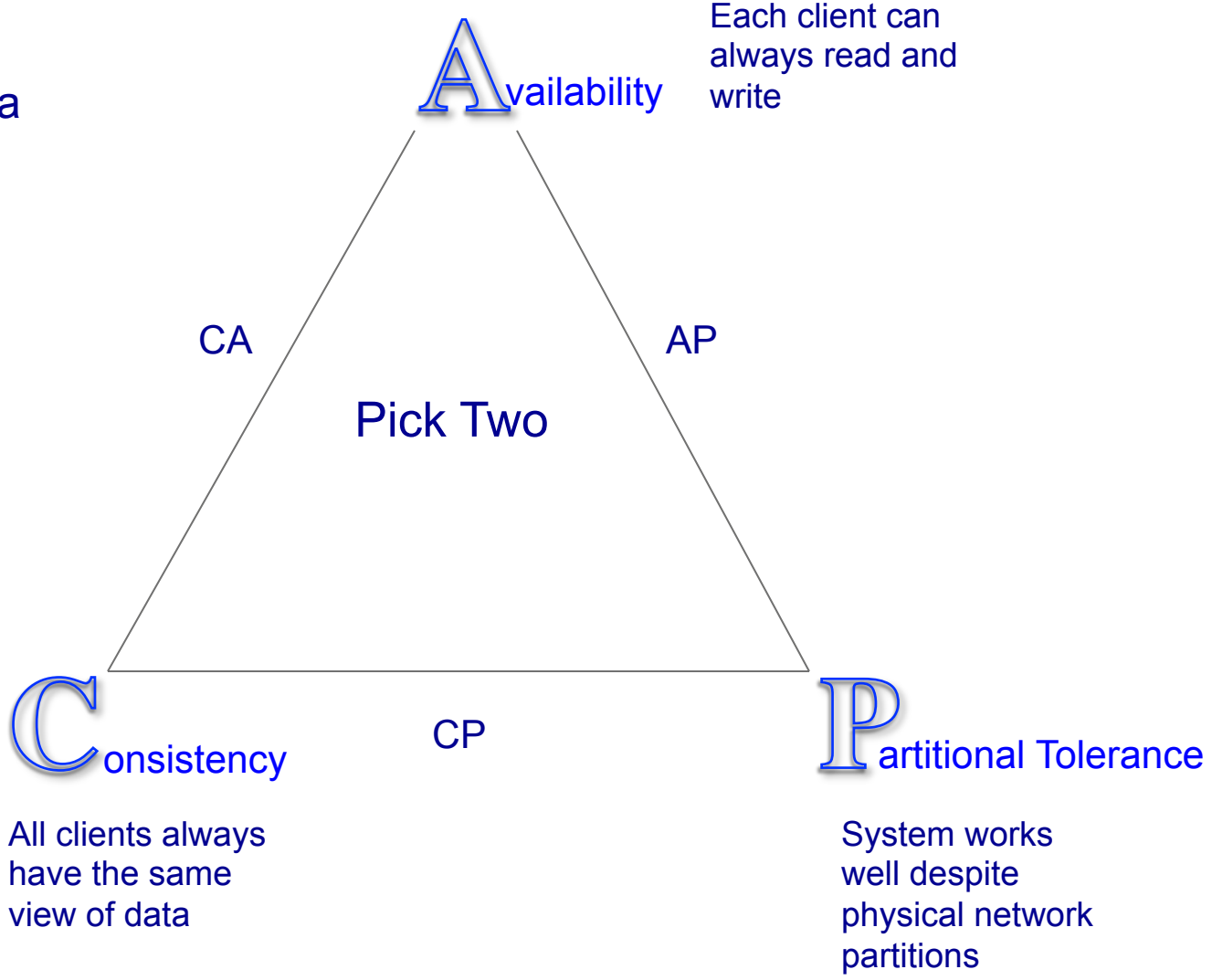
BASE

- *B*asic *A*vailability – System guarantees availability[1]
- *S*oft-state – State may change over time even without input
- *E*ventual consistency – System will become consistent over time, given the system doesn't receive input during that time

[1] CAP Theorem

CAP Theorem

- 3 desirable properties of a distributed system
- Can only embrace 2 of the 3



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Definition

- NoSQL
  - Currently “Not Only SQL”
  - could have been NoRel for no relational
- Non-relational
- Distributed
- Open-Source (mostly)
- Horizontally Scalable

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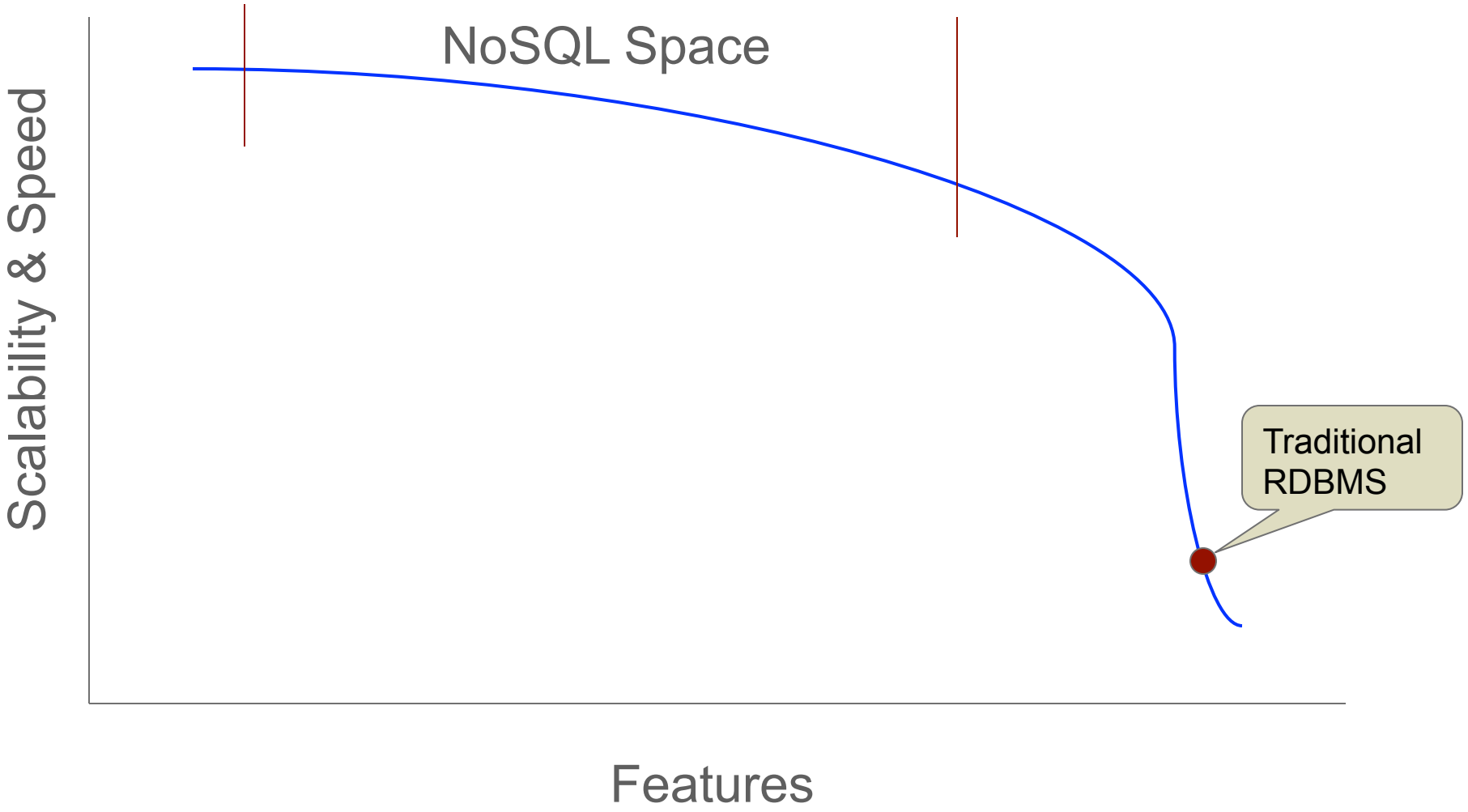
NoSQL DBs



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Hadoop

- Apache project
- Framework that allows distributed processing of large datasets across clusters
- Cassandra
  - Facebook developed 2008

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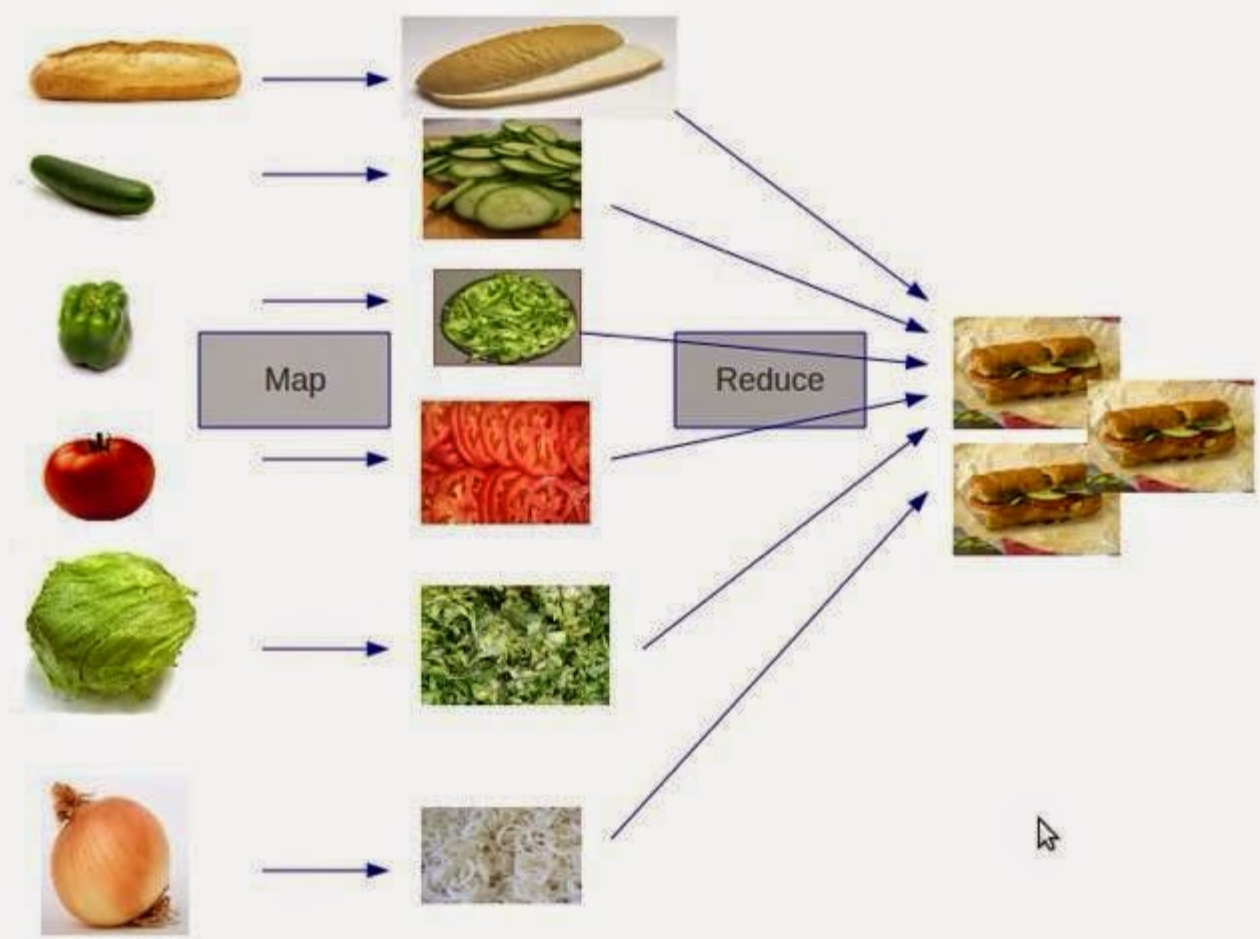
MapReduce



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- Map
  - Filtering and Sorting
- Reduce
  - Summarize or Aggregate

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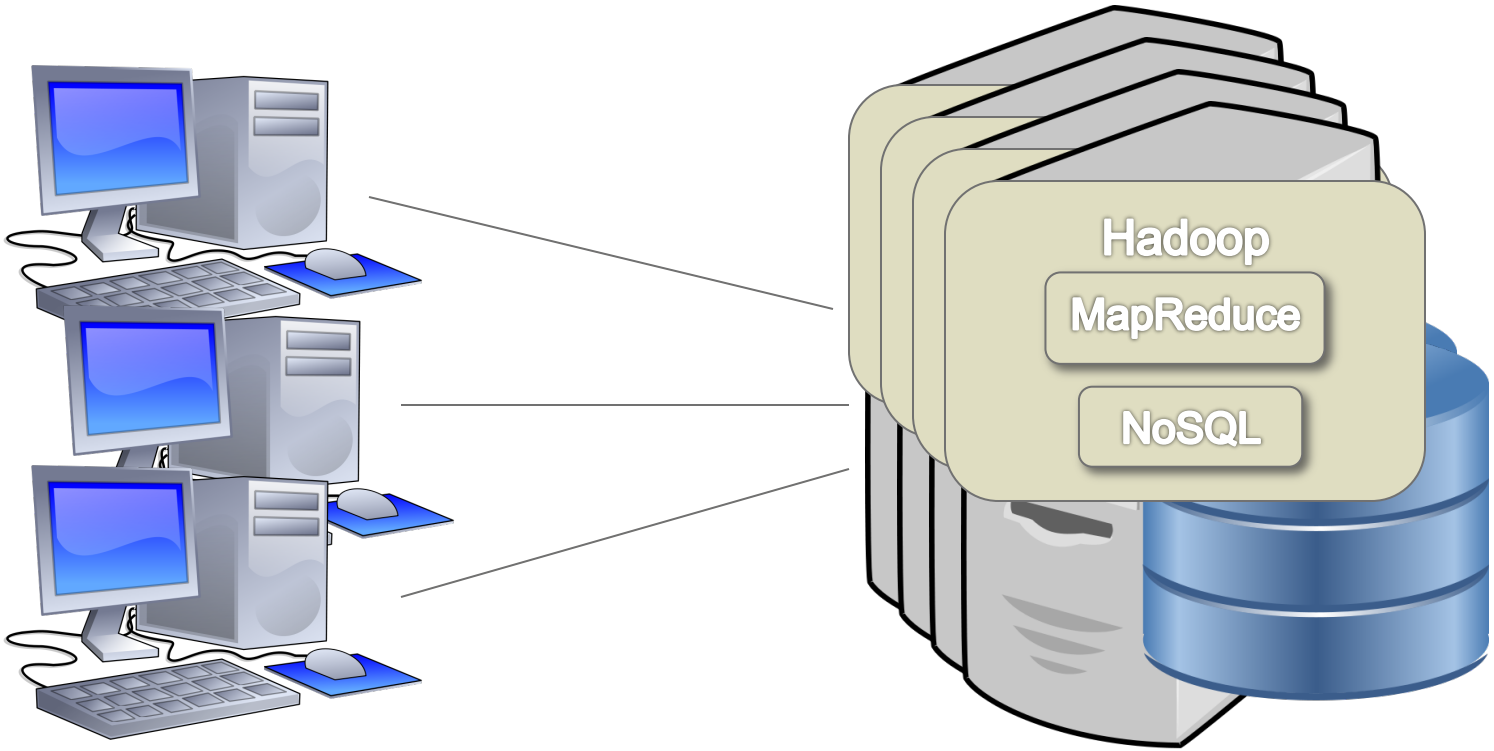
Hadoop Cluster



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MongoDB

- Hu”Mongo”us DB
- Document[1] oriented database
  - Data removed from OO Classes
  - No methods
  - Similar to C struct
- NoSQL DB
- Open Source
- Need for “joins” removed

[1]Documents are semi structured data records. Not Word Documents

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Who Uses Mongo

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JSON/BSON

- JavaScript Object Notation (JSON) – way to represent object style data
- Binary JSON (BSON) – Binary representation of JSON
  - Lightweight – Low overhead
  - Traversable – Key to Mongo
  - Efficient – Encoding/Decoding very fast
- Alternative to XML

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JSON/BSON Data Types

- String
- Numbers
- Booleans
- Null
- Arrays
- Objects/Documents
- Date
- Bin Data
- Object ID

JSON vs Tables

```
{
        "_id" : 123,
        "x" : 3,
        "y" : "hello",
        "z" : [1, 2],
        "nest" : {"q" : 99}
}
```

Table A

_id	x	y
123	3	hello

Table B

_id	z
123	1
123	2

JSON Document

```
{
        "_id" : 1234,
        "name" : "John",
        "age" : 25,
        "address" : {
                "city" : "New York",
                "zcode" : "10021"
        },
        "phones" : [
                {"phone" : "212-555-1234", "type" : "home"},
                {"phone" : "646-555-1234", "type" : "work"}
        ],
        "profile" : {…                                    }
        "active" : true
}
```

Nested

Array of phone numbers

200k of other data. Don't have to scan it if we just want "active".

Mongo Queries

- SQL

```
SELECT *
    FROM  A
    JOIN B USING(_id)
    WHERE _id = 123;
```

- Mongo

```
db.parts.find ({"_id" :
    123})
```

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More Information…

http://nosql-database.org

http://www.mongodb.com

http://www.couchbase.com

http://couchdb.apache.org

Case Study