NoSQL

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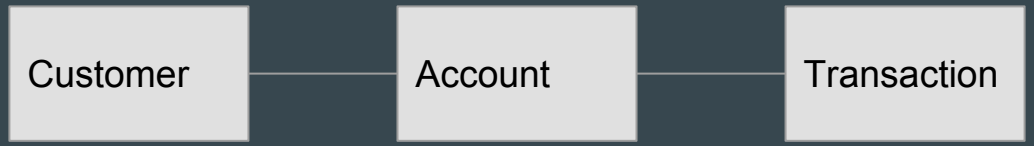
Agenda

1. Agenda
2. The bank case
3. NoSQL databases
4. The bank case revisited
5. Ronald's database wis'dom's
6. Conclusion

The bank case

The 'bank' case




```
SELECT
  SUM(t.Amount)
FROM
  Transaction t
  INNER JOIN Account a ON (a.Id = t.AccountId)
  INNER JOIN Customer c ON (c.Id = a.CustomerId)
WHERE
  c.Id = "13435432"
```

Assumptions

- 6.000.000 customers
- 2 accounts per customer
- 400 transaction each year per account
- 5 year history

24.000.000.000 rows

NoSQL databases

NoSQL databases

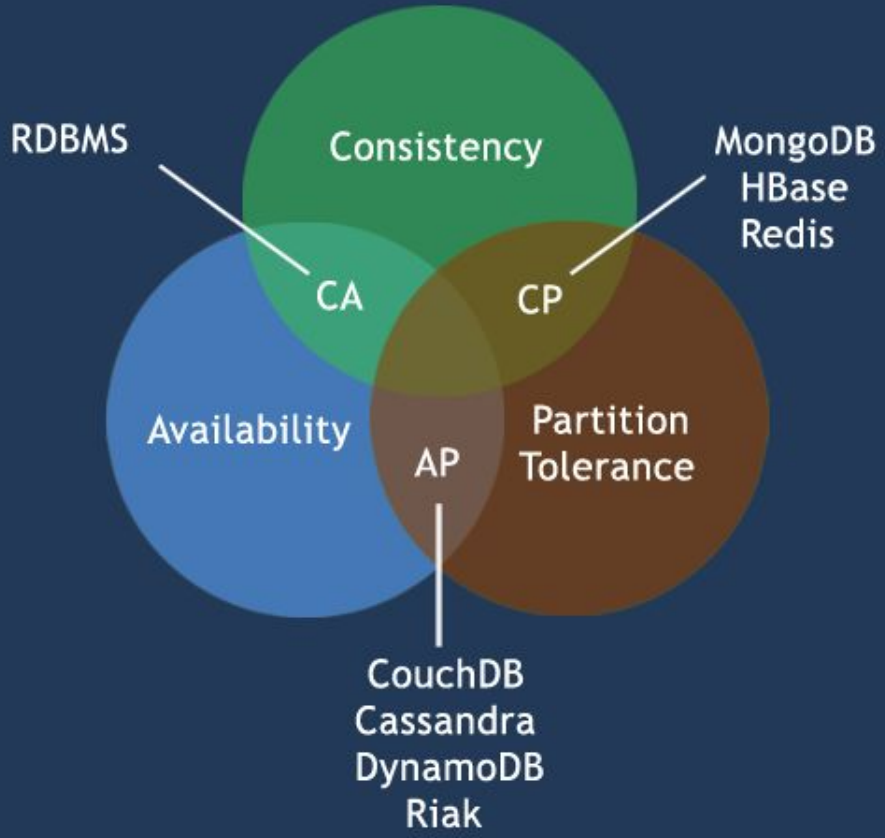
- Not only SQL
- Relaxes on some of the relational properties:
  - Denormalization is the 'norm'
  - Conforming to all the ACID properties not (always) necessary
- Designed to run on many servers

BASE

- Basic Availability ~ The database appears to work most of the time
- Soft-state ~ The state of the system may change over time
- Eventual consistency ~ Stores exhibit consistency at some later point

- Flexible trade-off between consistency and latency, for example using the write/read quorum

CAP Theorem


RDBMS
Consistency
MongoDB
HBase
Redis
CA
CP
Availability
Partition
Tolerance
AP
CouchDB
Cassandra
DynamoDB
Riak

Kinds of NoSQL databases

- Key-Value pair
- Document
- Column family
- Graph

Key-Value pair

- Essential features: Simplicity, Speed & Scalability
- Determine a unique key, for example Customer:13435432:firstname
- Use hashes to determine server
- No to limited (range) searching
- No Standard query language

Redis/Amazon DynamoDB

Document

```
{
    "firstName": "John",
    "lastName": "Smith",
    "age": 25,
    "address": {
        "streetAddress": "21 2nd Street",
        "city": "New York",
        "state": "NY",
        "postalCode": "10021"
    },
    "phoneNumber": [
        { "type": "home", "number": "212 555-1234" },
        { "type": "fax", "number": "646 555-4567" }
    ]
}
```

Document

- XML/JSON documents
- Embedded documents
- Use the application queries as a guideline for the design of the documents
- Transactions on a document are atomic
- Range searches supported, the database interprets the xml/json

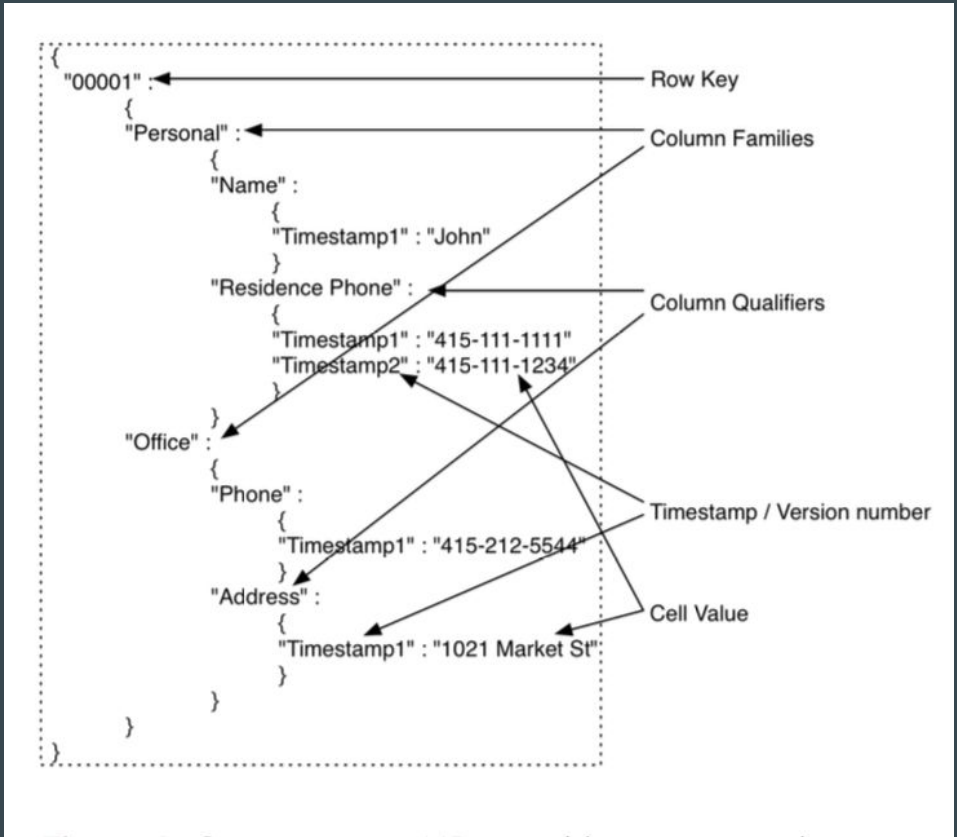
MongoDB query: Db.transaction.find({amount : { "$gte" : 0, "$lt" : 100} })

Document

- Schemaless/Polymorphic schema
  - More flexibility
  - More responsibility for the application
- Related data is stored together in a document:
  - Horizontal partitioning/sharding data is easier
  - Important to determine the right sharding key
  - Developer/Application responsible for avoiding data anomalies

MongoDB/CouchDB

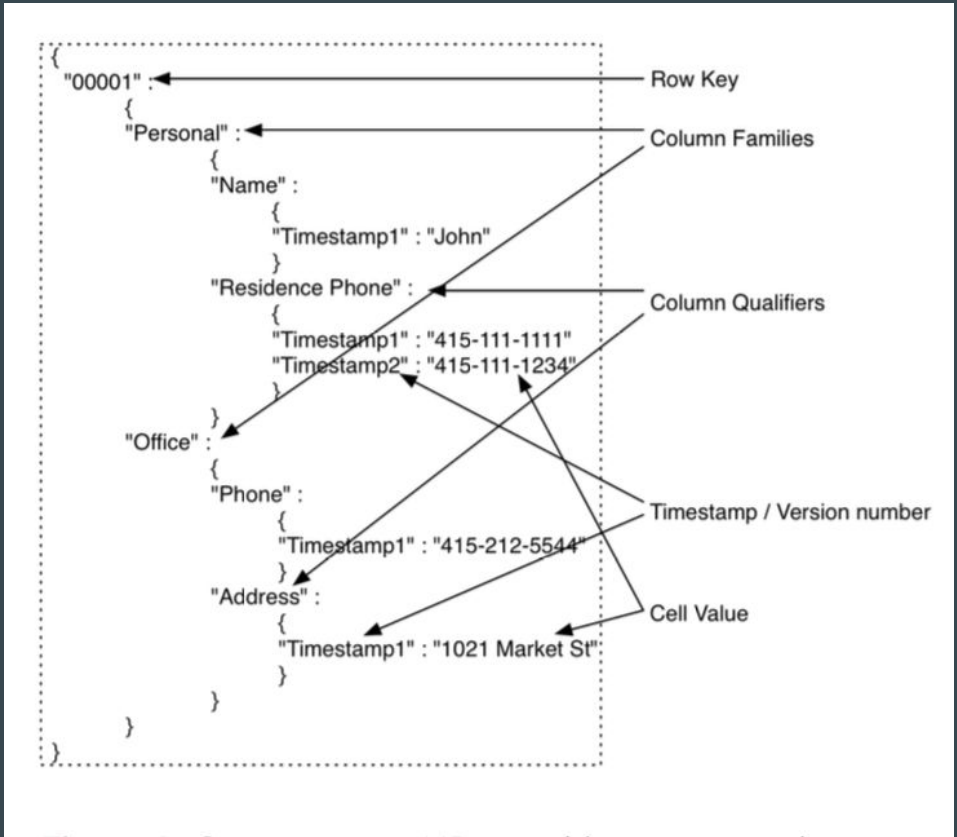
Column family



Column family

- Row key determines the server
- Column family determines the file on the disk
- Data in a column family is stored on disk ordered by row

Column family



Column family

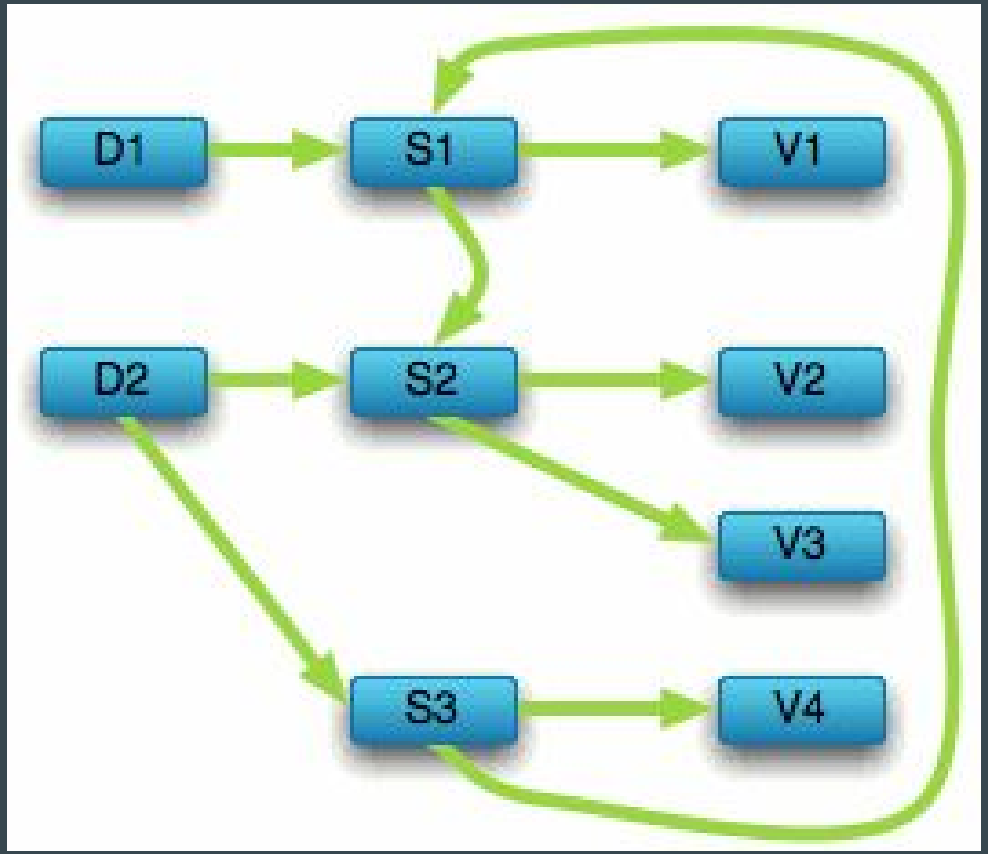
- A column belongs to a column family
- A column name can contain 'data'
- Columns can vary from row to row
- Columns are grouped in column families
- When a value is stored usually also the timestamp of the insert/update is stored

Column family

- Generally read-writes are atomic on the row level
- Peer to peer replication is used
- To reduce the number of internal messages a gossip protocol is used
- Anti-entropy algorithm is used to find and eliminate inconsistencies

- Cassandra/Hadoop/Google BigTable

Graph



Graph

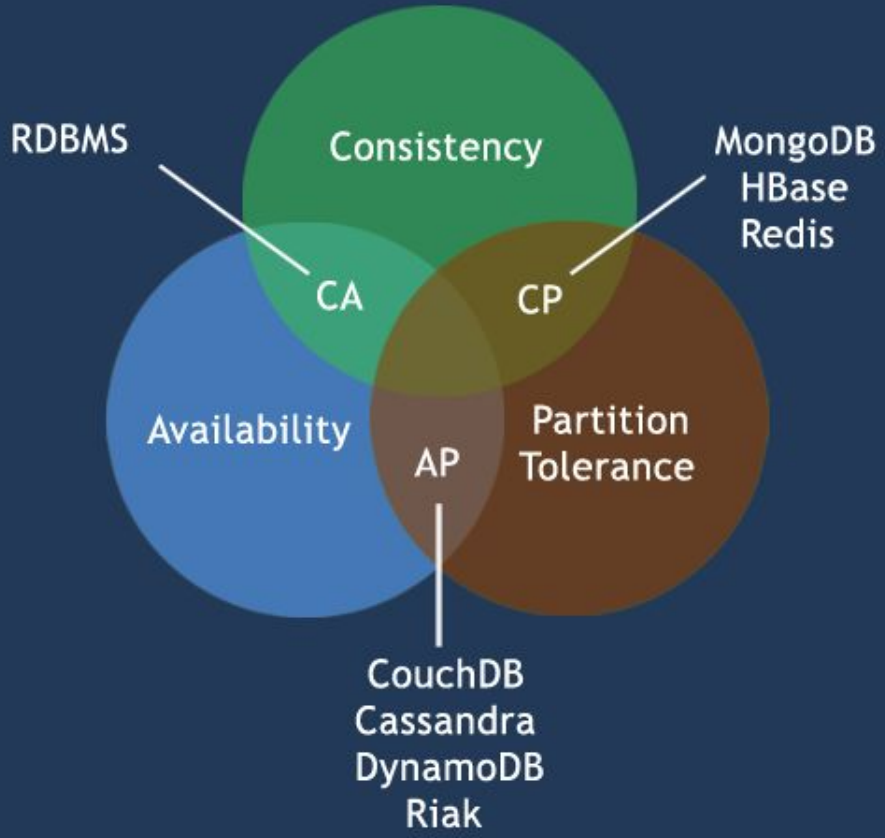
- Not unusual to follow the ACID rules
- Suitable for 'specific' problems:
  - Routing
  - User click path
  - Social links

Neo4J

The bank case revisited

Choose the database(s) to use for the 'Bank'

CAP Theorem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Ronald's database wis'dom's

A million rows is not a lot

Start with writing the queries

Inspect the query plans

Use indexes

But… an index for the indexes shouldn't be needed

Do not datamine the application database

Conclusion

Conclusion

- RDBMS
  - Complex joins
  - Complex multi entity transactions
  - ACID
  - 'Small' datasets (several million rows is considered small)
- NoSQL
  - Horizontal scaling
  - Schema flexibility
  - High performance
  - Indexes of the RDBMS do not fit in memory
- Both
  - If the needs depend on the data use both databases!

Questions?