Carlos J. costa

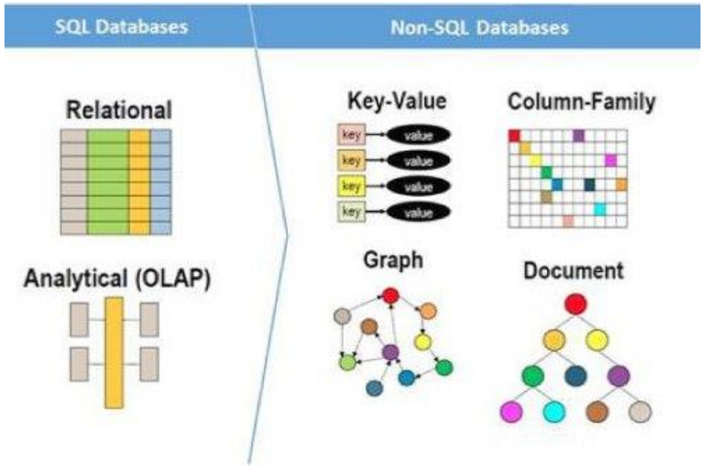
NOSQL

(VERSION 2023)

NoSQL

- Next Generation Databases mostly addressing some of the points:
  - being non-relational,
  - distributed,
  - open-source and
  - horizontal scalable.
- The original intention has

been modern web-scale databases.



NoSQL

- The movement began early 2009 and is growing rapidly.
- Often more characteristics apply as:
  - schema-free,
  - easy replication support,
  - simple API,
  - eventually consistent / BASE (not ACID),
  - a huge data amount, and more.

Relational Databases: ACID Properties

- **A**tomic
  - All of the work in a transaction completes (commit) or none of it completes
- **C**onsistent
  - A transaction transforms the database from one consistent state to another consistent state.
  - Consistency is defined in terms of constraints.
- **I**solated
  - The results of any changes made during a transaction are not visible until the transaction has committed.
- **D**urable
  - The results of a committed transaction survive failures

NoSQL: BASE Transactions

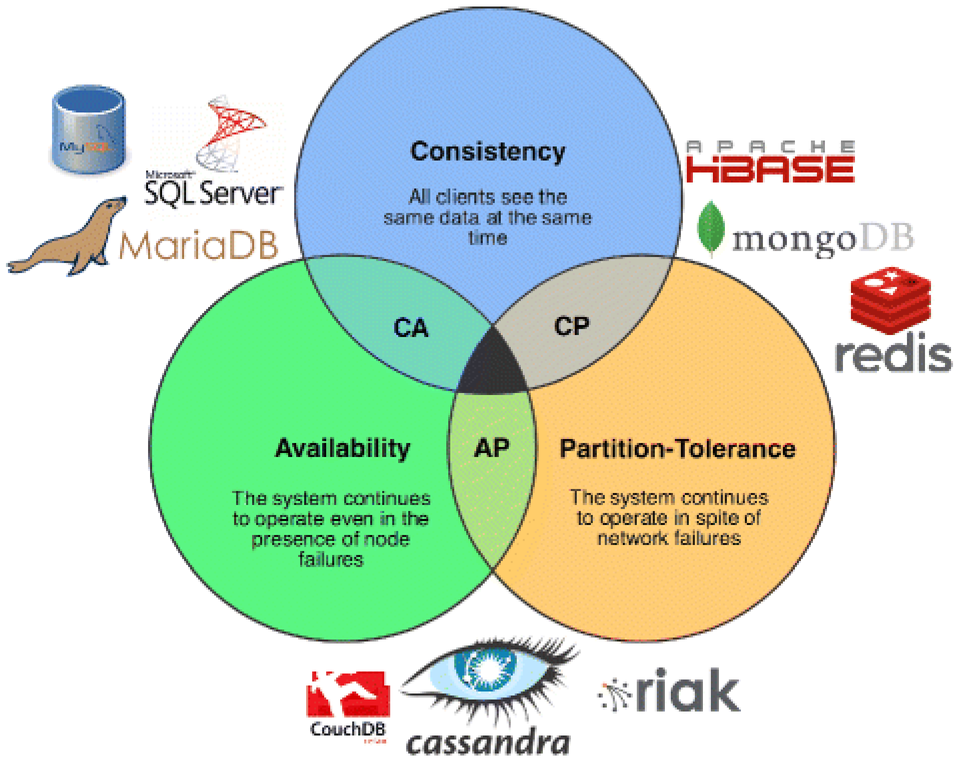
- Acronym opposite of ACID
  - **B**asically **A**vailable,
  - **S**oft state (State of the system may change over time)
  - **E**ventually Consistent (asynchronous propagation)

Brewer’s CAP Theorem

A distributed system can support only two of the following characteristics:

- Consistency
  - All replicas contain the same version of data
  - Client always has the same view of the data (no matter what node)
- Availability
  - Systems remains operational on failing notes
  - All clients can always read and write
- Partition tolerance
  - Multiple entry points
  - System remains operational on system communication malfunction
  - System works well across physical network partitions

Brewer's CAP Theorem

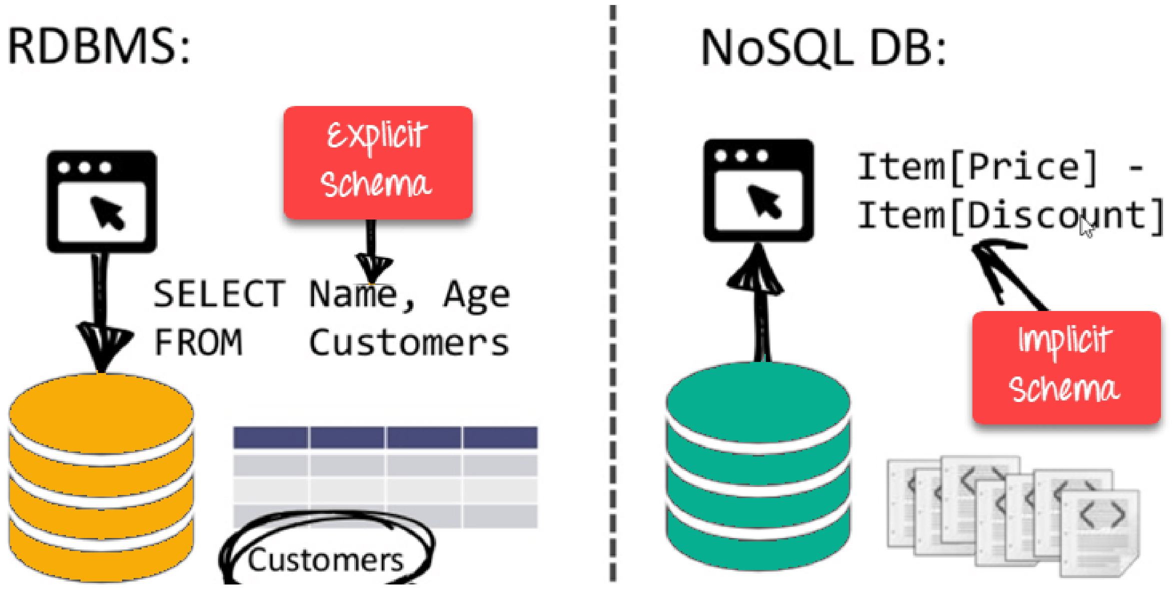


Consistency
All clients see the same data at the same time
Availability
The system continues to operate even in the presence of node failures
Partition-Tolerance
The system continues to operate in spite of network failures
CA
CP
AP
MySQL
Microsoft SQL Server
MariaDB
APACHE HBASE
mongoDB
redis
CouchDB
cassandra
riak

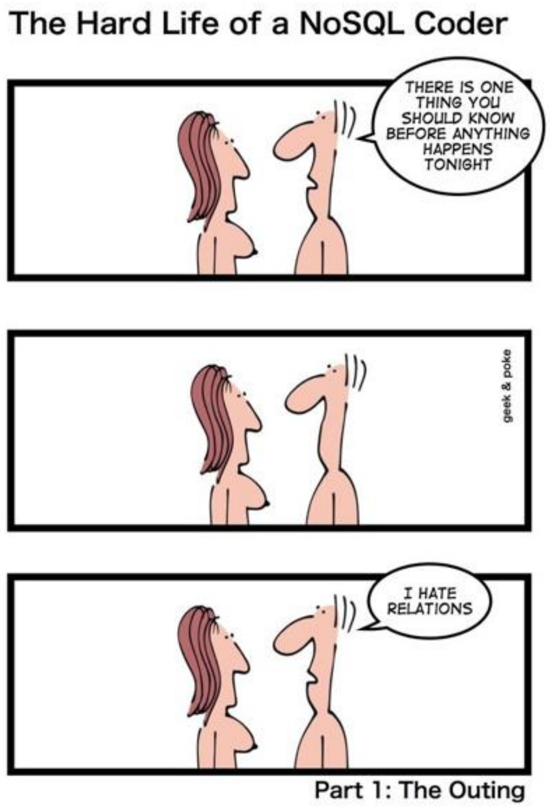
Brewer’s CAP Theorem

- What the CAP theorem really says:
  - If you cannot limit the number of faults and requests can be directed to any server and you insist on serving every request you receive then you cannot possibly be consistent
- How it is interpreted:
  - You must always give something up: consistency, availability or tolerance to failure and reconfiguration

RDBMS vs NoSQL



Taxonomy of NoSQL


The Hard Life of a NoSQL Coder
THERE IS ONE THING YOU SHOULD KNOW BEFORE ANYTHING HAPPENS TONIGHT
geek & poke
I HATE RELATIONS
Part 1: The Outing

- Key-Value
- Graph Database
- Document-oriented
- Column Family

http://nosql-database.org/

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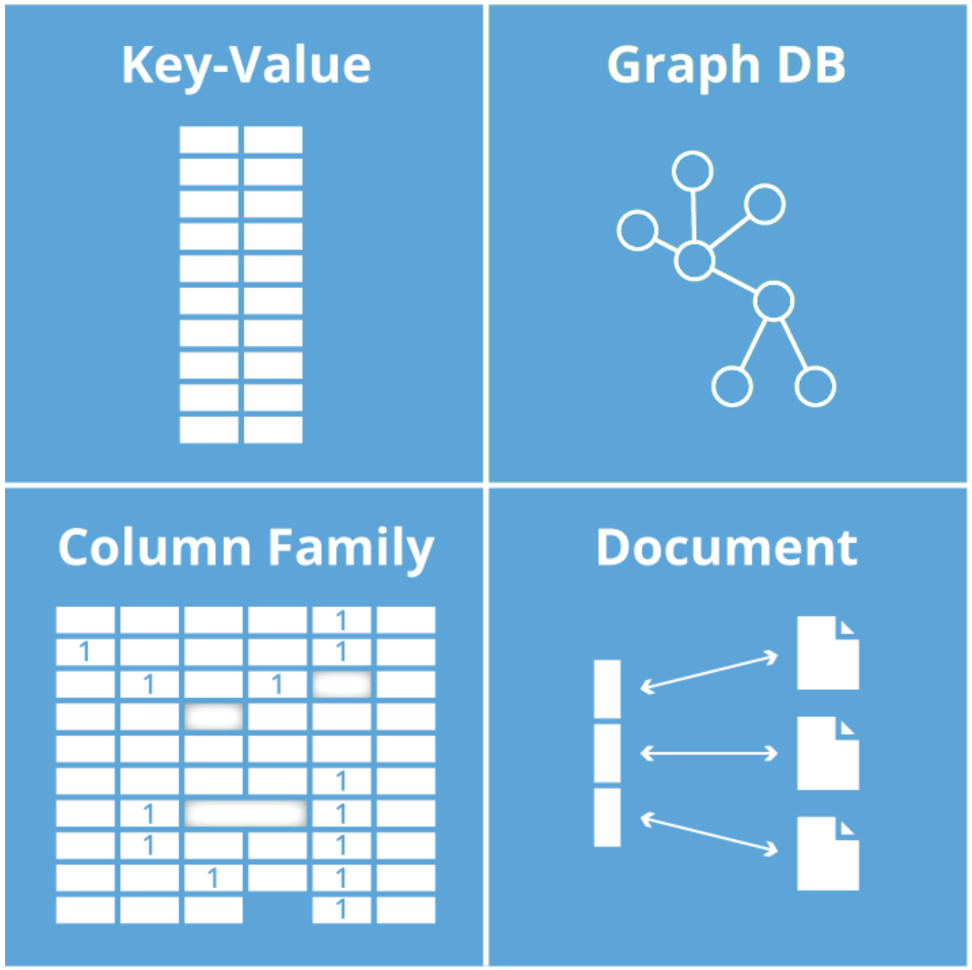
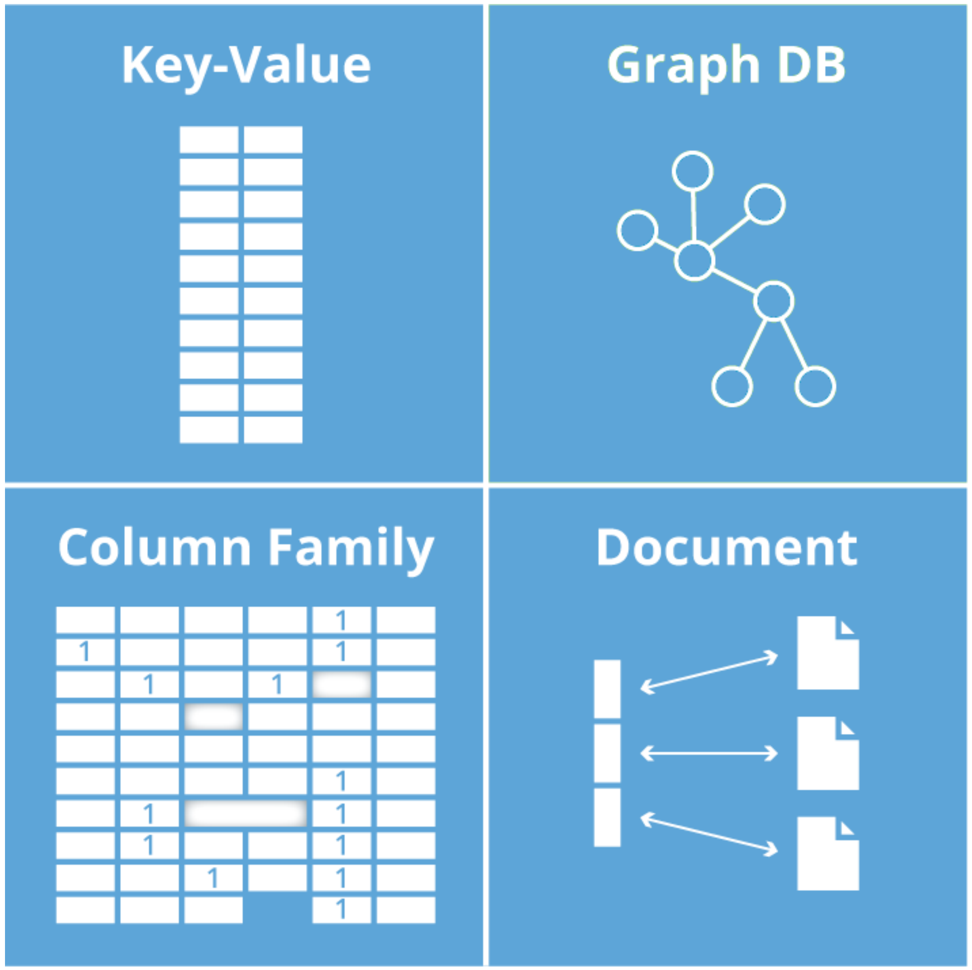


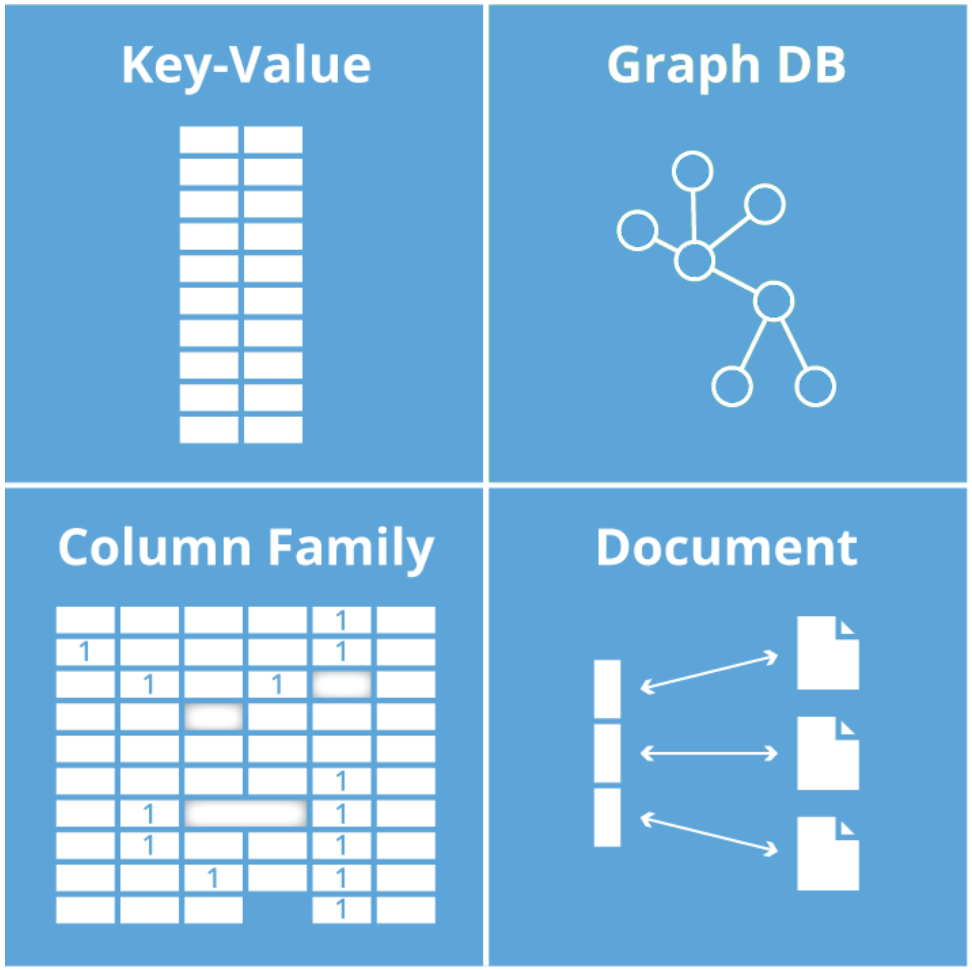
Taxonomy of NoSQL

Key-Value – is a hash table of keys



Taxonomy of NoSQL

Key-Value



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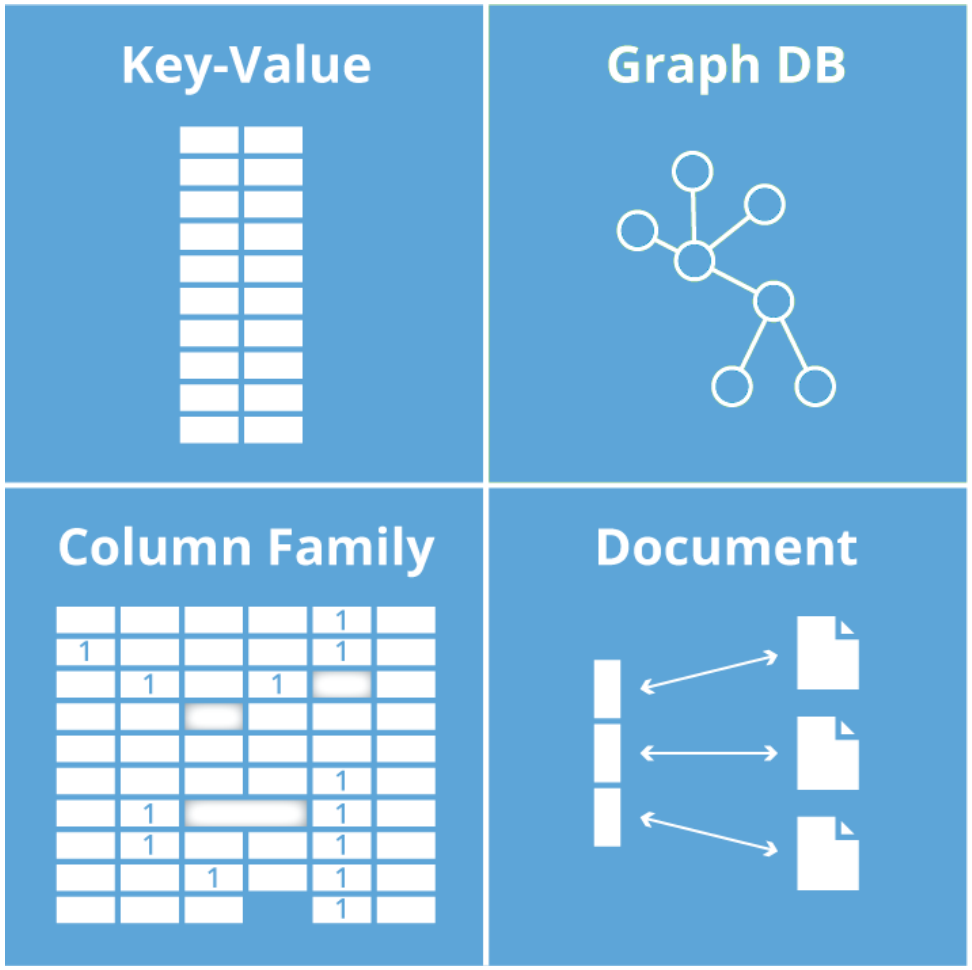
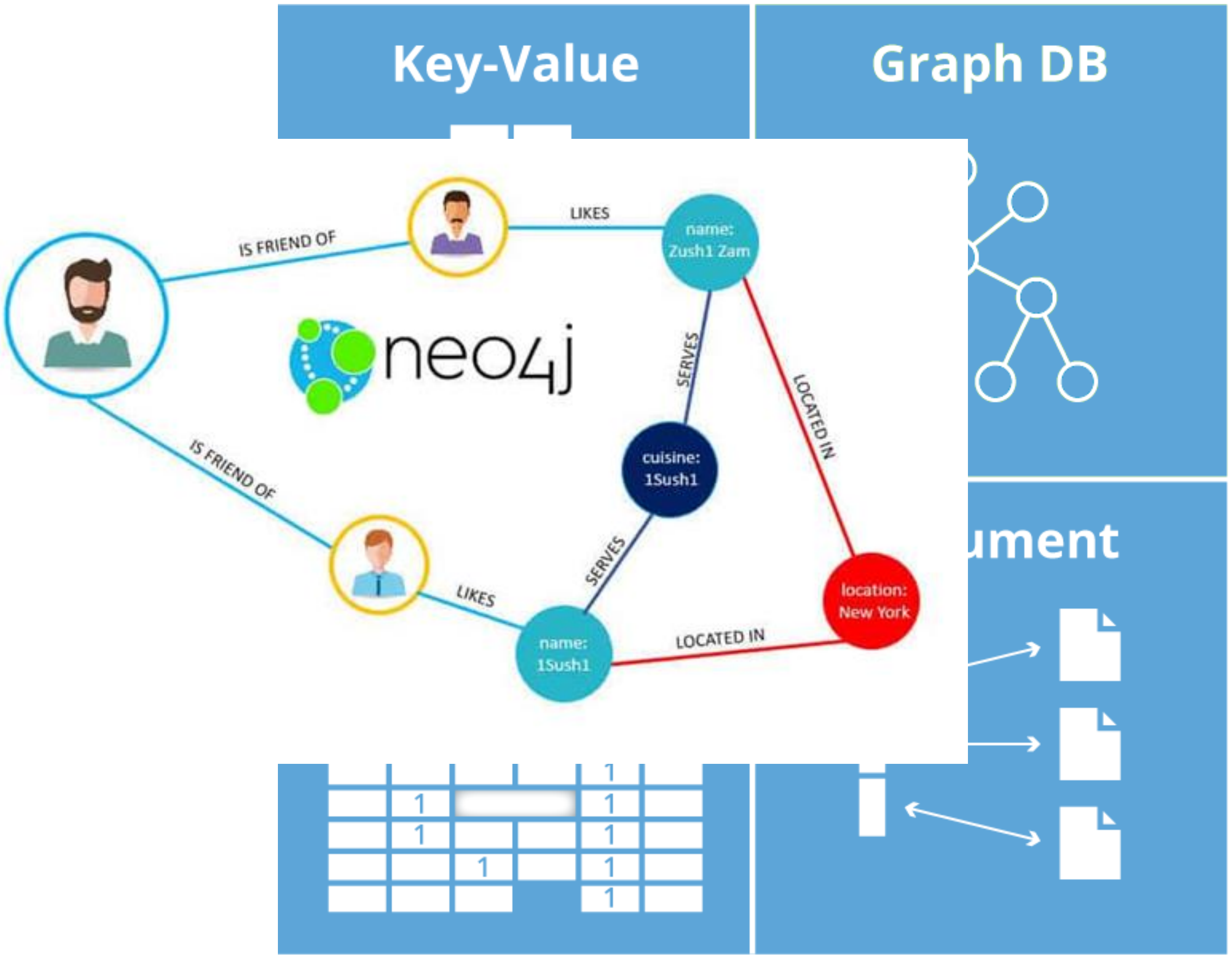


Graph Database
- uses graph structures for queries with nodes, edges and properties to represent and store data.

Taxonomy of NoSQL



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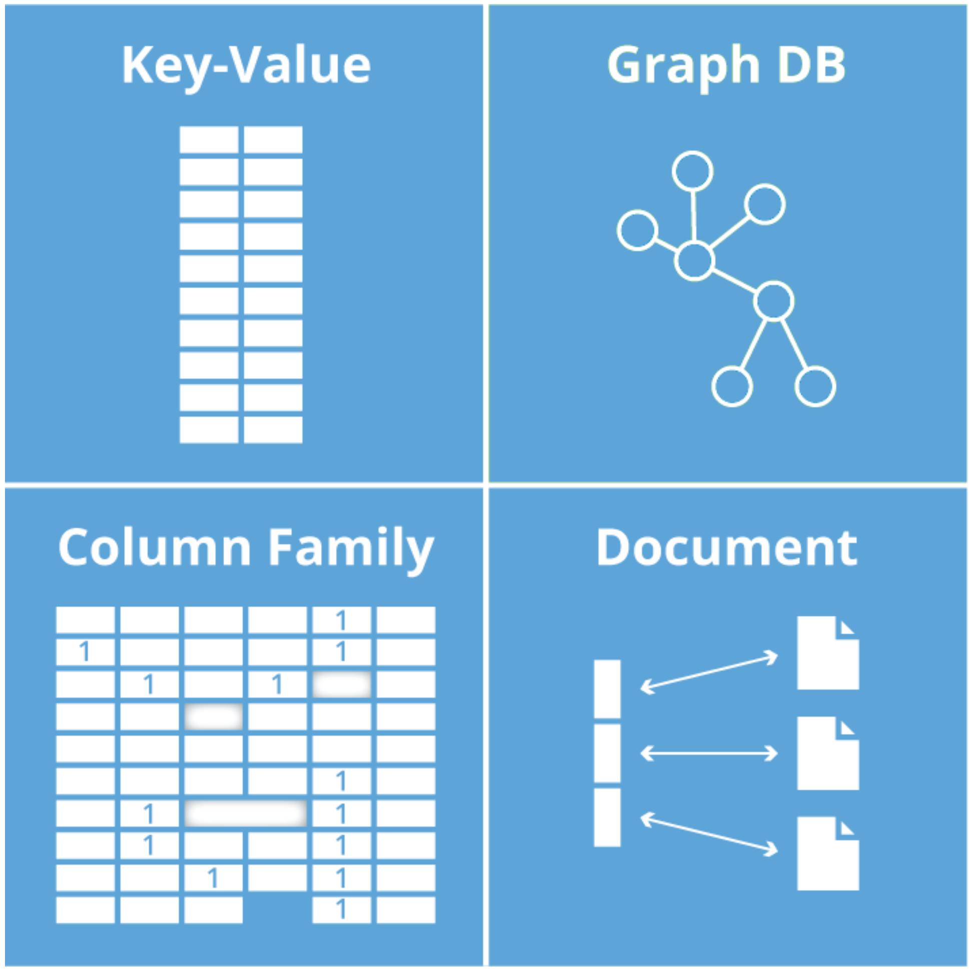
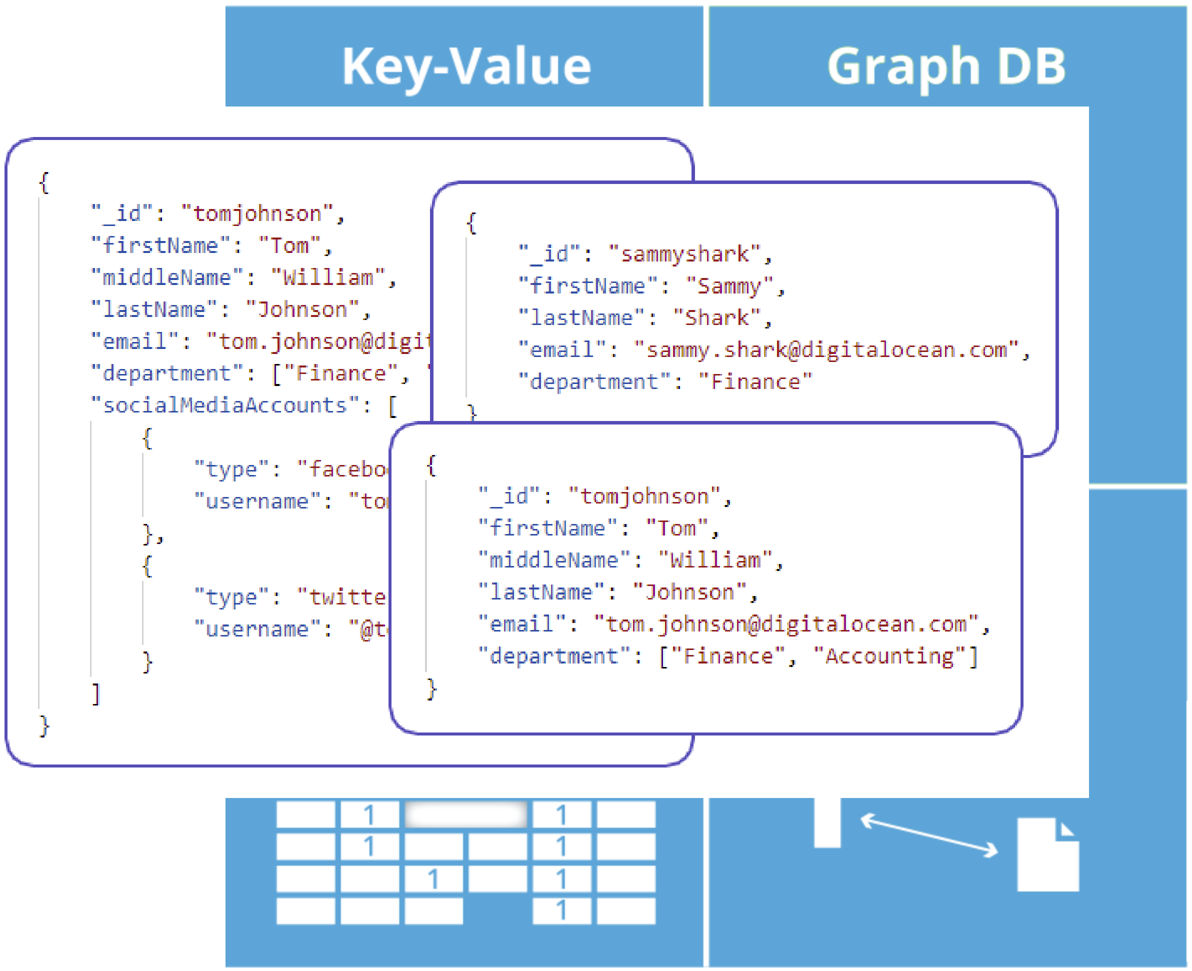


Document-oriented – stores data in flexible hierarchical data structures

Taxonomy of NoSQL



```
{
    "_id": "tomjohnson",
    "firstName": "Tom",
    "middleName": "William",
    "lastName": "Johnson",
    "email": "tom.johnson@digit
    "department": ["Finance", '
    "socialMediaAccounts": [
        {
            "type": "facebo
            "username": "to
        },
        {
            "type": "twitte
            "username": "@t
        }
    ]
}
```

```
{
    "_id": "sammyshark",
    "firstName": "Sammy",
    "lastName": "Shark",
    "email": "sammy.shark@digitalocean.com",
    "department": "Finance"
}
```

```
{
    "_id": "tomjohnson",
    "firstName": "Tom",
    "middleName": "William",
    "lastName": "Johnson",
    "email": "tom.johnson@digitalocean.com",
    "department": ["Finance", "Accounting"]
}
```

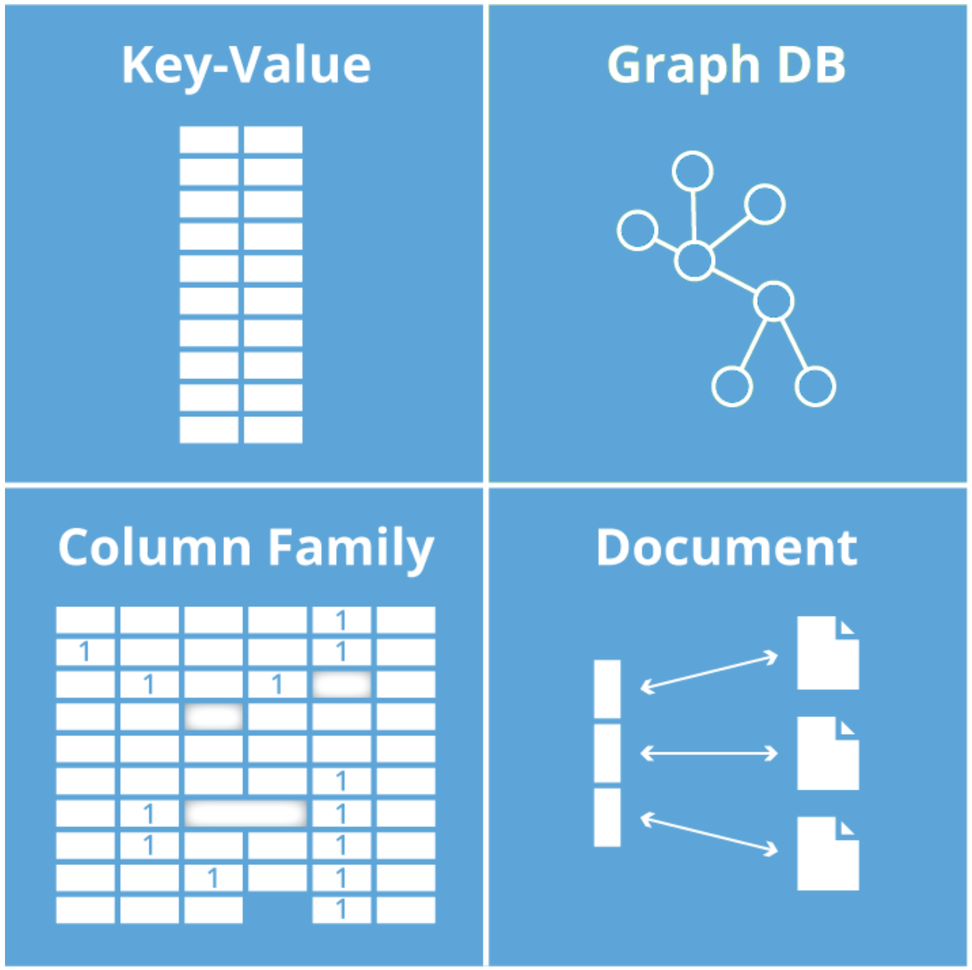
Document-oriented

mongoDB

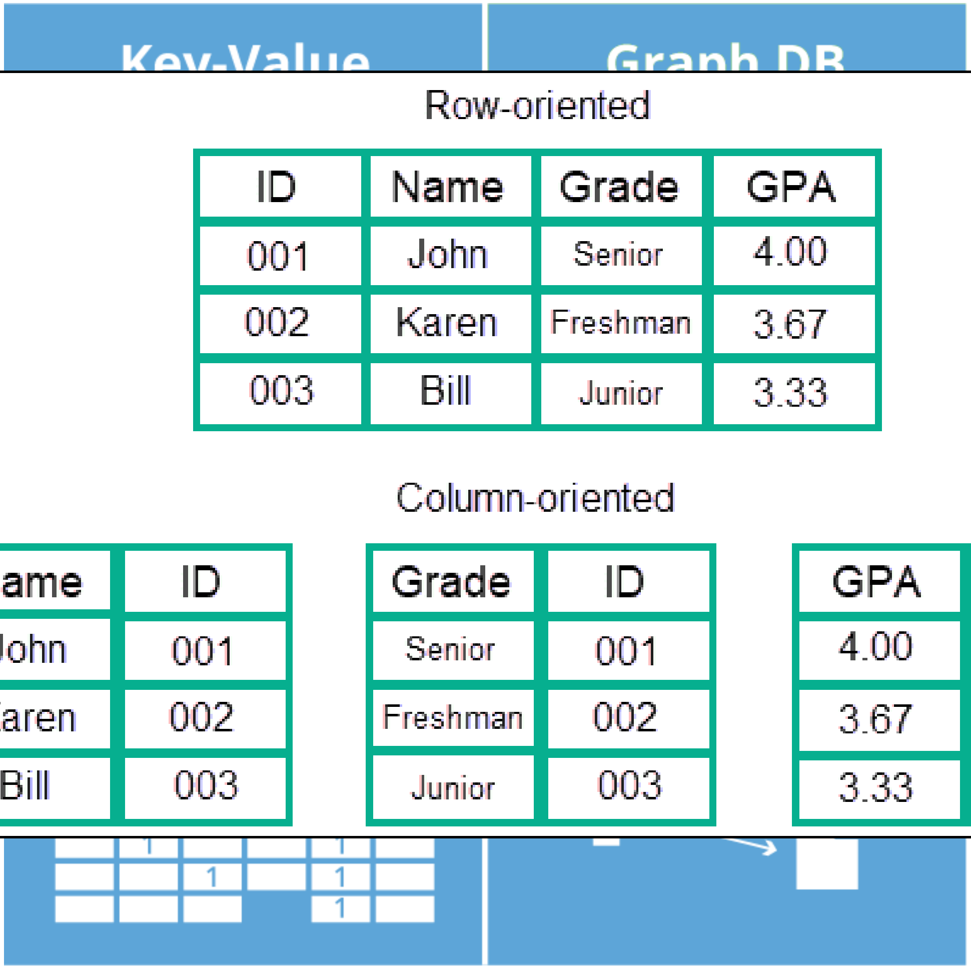
Taxonomy of NoSQL

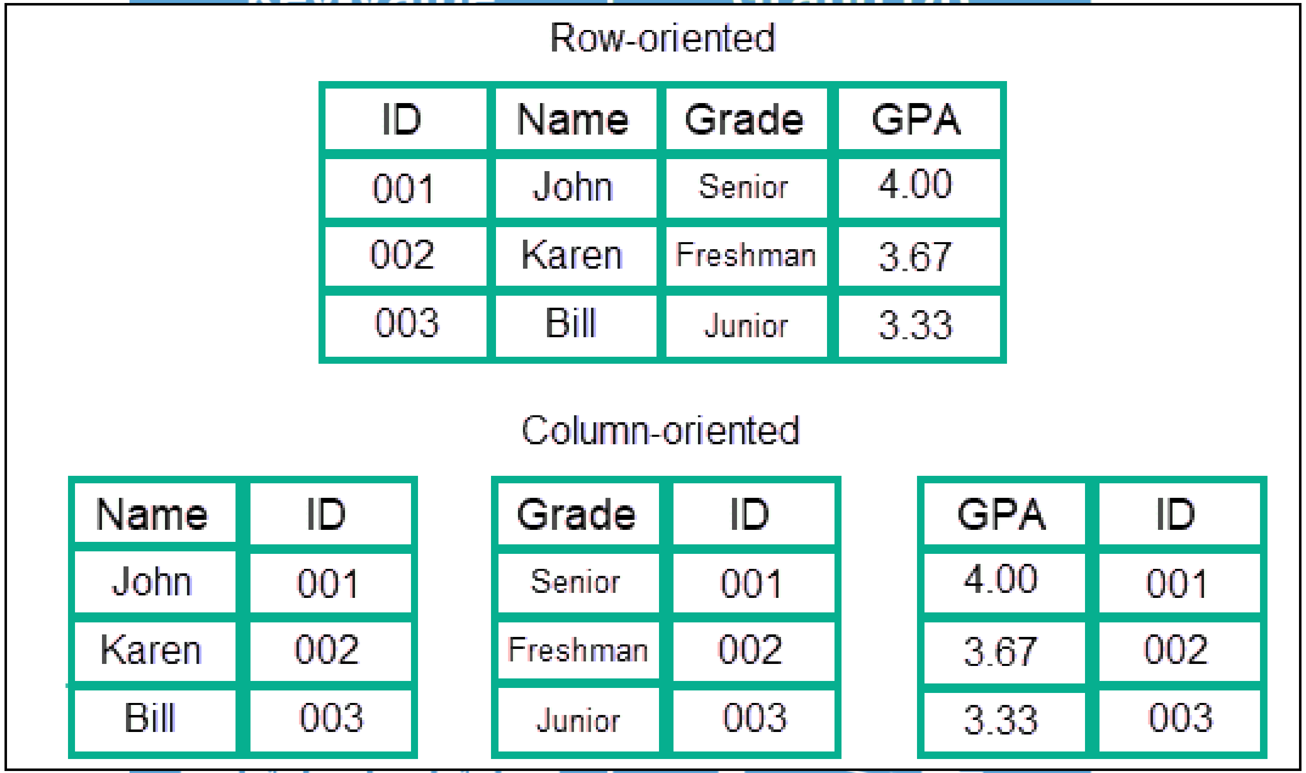
Column Family – Each storage block contains data from only one column

A wide-column store can be interpreted as a two-dimensional key–value store



Taxonomy of NoSQL





Row-oriented

ID	Name	Grade	GPA
001	John	Senior	4.00
002	Karen	Freshman	3.67
003	Bill	Junior	3.33

Column-oriented

Name	ID
John	001
Karen	002
Bill	003

Grade	ID
Senior	001
Freshman	002
Junior	003

GPA	ID
4.00	001
3.67	002
3.33	003

Column Family

cassandra

mongoDB®

- **Is a document database**
- **Stores data in flexible, JSON-like documents**
  – meaning fields can vary from document to document and data structure can be changed over time
- Is a **distributed database at its core**
  – high availability, horizontal scaling, and geographic distribution are built in and easy to use

- **Free and open-source**, published under the GNU Affero General Public License
- The document model **maps to the objects in your application code**, making data easy to work with
- **Ad hoc queries, indexing, and real time aggregation** provide powerful ways to access and analyze your data

- Here we are **connecting** to a locally hosted MongoDB database called test with a collection named restaurants.

```
# 1. Connect to MongoDB instance running on localhost
client = pymongo.MongoClient()

# Access the 'restaurants' collection in the 'test' database
collection = client.test.restaurants
```

- 5 example documents are being **inserted** into the restaurants collection. Each document represents a restaurant with a name, star rating, and categories (stored as an array).

```
# 2. Insert
new_documents = [
  {
    "name": "Sun Bakery Trattoria",
    "stars": 4,
    "categories": ["Pizza","Pasta","Italian","Coffee","Sandwiches"]
  }, {
    "name": "Blue Bagels Grill",
    "stars": 3,
    "categories": ["Bagels","Cookies","Sandwiches"]
  }, {
    "name": "Hot Bakery Cafe",
    "stars": 4,
    "categories": ["Bakery","Cafe","Coffee","Dessert"]
  }, {
    "name": "XYZ Coffee Bar",
    "stars": 5,
    "categories": ["Coffee","Cafe","Bakery","Chocolates"]
  }, {
    "name": "456 Cookies Shop",
    "stars": 4,
    "categories": ["Bakery","Cookies","Cake","Coffee"]
  }
]
collection.insert_many(new_documents
```

- In this example, we run a simple query to get all of the documents in the restaurants collection and store them as an array.

```
# 3. Query
for restaurant in collection.find():
  pprint.pprint(restaurant)
```

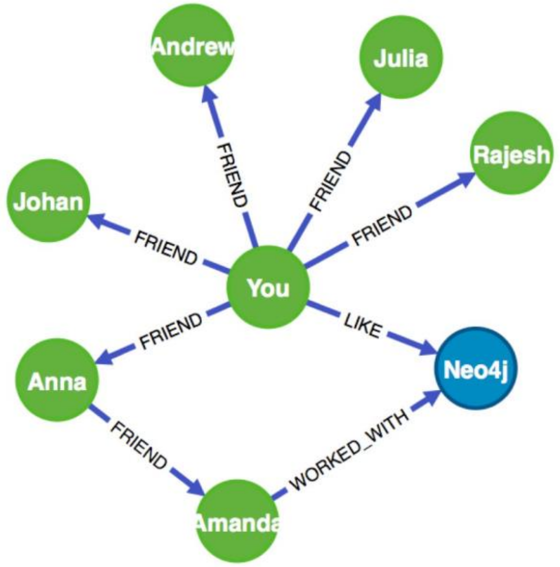
- Indexes in MongoDB are similar to indexes in other database systems. MongoDB supports indexes on any field or sub-field of a document in a collection.
- Here, we are building an index on the name field with sort order ascending.

```
# 4. Create Index
collection.create_index([('name', pymongo.ASCENDING)])
```

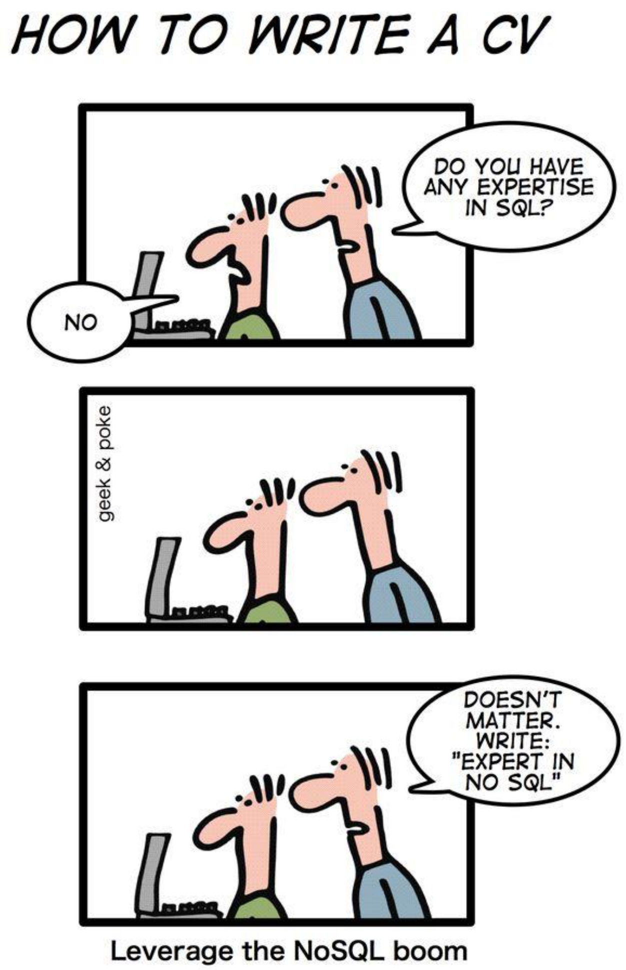
- Using MongoDB’s aggregation pipeline, you can filter and analyse data based on a given set of criteria.
- In this example, we pull all the documents in the restaurants collection that have a category of Bakery using the $match operator and then group them by their star rating using the $group operator. Using the accumulator operator, $sum, we can see how many bakeries in our collection have each star rating.

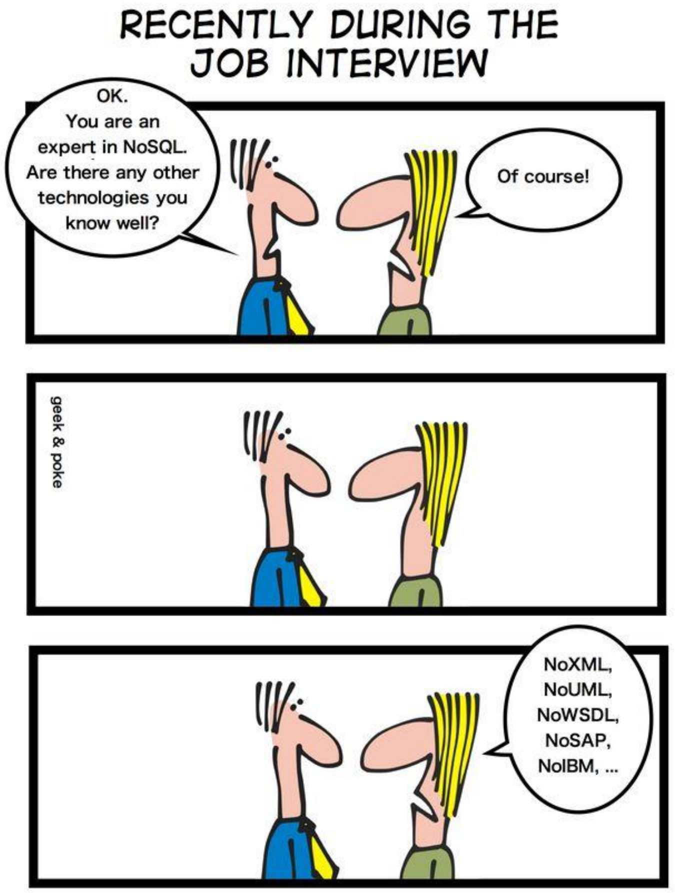
```
# 5. Perform aggregation
pipeline = [
  {"$match": {"categories": "Bakery"}},
  {"$group": {"_id": "$stars", "count": {"$sum": 1}}}
]

pprint.pprint(list(collection.aggregate(pipeline)))
```

Find Someone in your Network Who Can Help You Learn Neo4j



```
MATCH (you {name:"You"})
MATCH (expert)-[:WORKED_WITH]->(db:Database
{name:"Neo4j"})
MATCH path = shortestPath( (you)-[:FRIEND*..5]-(expert) )
RETURN db,expert,path
```


HOW TO WRITE A CV
DO YOU HAVE ANY EXPERTISE IN SQL?
NO
geek & poke
DOESN'T MATTER. WRITE: "EXPERT IN NO SQL"
Leverage the NoSQL boom


RECENTLY DURING THE JOB INTERVIEW
OK. You are an expert in NoSQL. Are there any other technologies you know well?
Of course!
geek & poke
NoXML, NoUML, NoWSDL, NoSAP, NoIBM, ...

References

- Node.js MongoDB Get Started. (n.d.). Retrieved November 26, 2017, from https://www.w3schools.com/nodejs/nodejs_mongodb.asp
- What Is MongoDB? (n.d.). Retrieved November 26, 2017, from https://www.mongodb.com/what-is-mongodb
- What is a Graph Database? A Property Graph Model Intro. (n.d.). Retrieved November 26, 2017, from https://neo4j.com/developer/graph-database/
- NOSQL Databases. (n.d.). Retrieved November 26, 2017, from http://nosql-database.org/