POLITÉCNICO
DO PORTO
ESCOLA
SUPERIOR
DE MEDIA ARTES
E DESIGN

P.PORTO

# BASES DE DADOS
# Módulo III

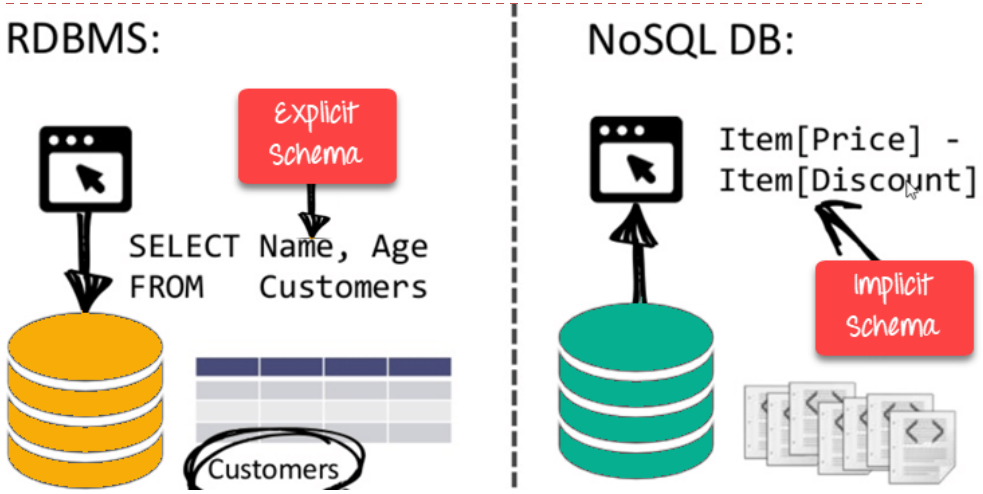
## *NoSQL*

TECNOLOGIAS E SISTEMAS DE INFORMAÇÃO PARA A WEB

# Agenda

- **NoSQL**
- **SQL vs NoSQL**
- ***MongoBD***
  - ***Introduction***
  - ***GUI tools***

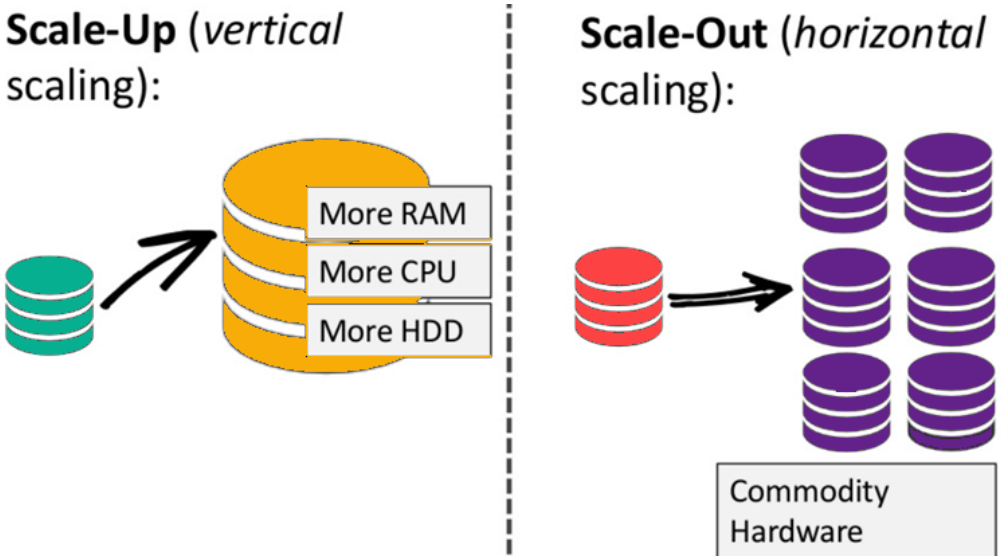
# NoSQL




- NoSQL is similar to "Non SQL" or "Not only SQL"
- Non-relational databases doesn't require object-relational mapping and data normalization. So, they avoid joins!
- No complex features like query languages, query planners, referential integrity
- Easy to scale, because they not require a fixed schema. Flexible structure
- Used mainly for Big data and real-time web apps

# NoSQL

- The concept of NoSQL databases became popular with Internet giants like Google, Facebook, Amazon, etc.
- They deal with huge volumes of data. The system response time becomes slow when you use relational DBMS for massive volumes of data




"scale up" our systems by upgrading our existing hardware

"scaling out", distribute database load on multiple hosts whenever the load increases

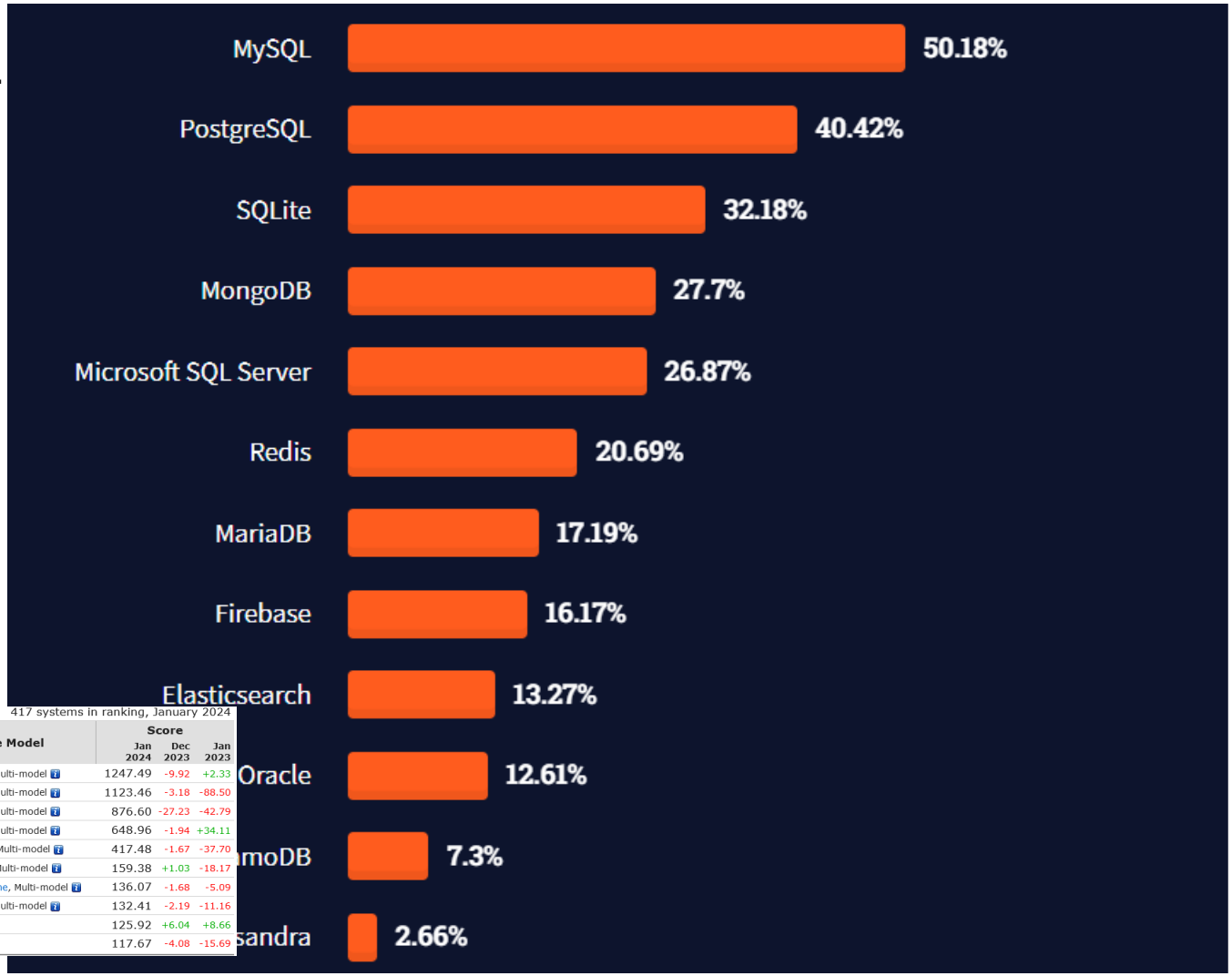
## NoSQL | Evolution perspective

- 1998- Carlo Strozzi use the term NoSQL for his lightweight, open-source relational database
- 2000- Graph database Neo4j is launched
- 2004- Google BigTable is launched
- 2005- CouchDB is launched
- 2007- The research paper on Amazon Dynamo is released
- 2008- Facebooks open sources the Cassandra project
- 2009- The term NoSQL was reintroduced
- 2009- MongoBD is launched (probably the most popular NoSQL Database)

**2010**- Redis, a key-value store that supports various data structures, is released as an open source project
**2011**- **Apache HBase**, a distributed column-oriented database modeled after Google BigTable, becomes a top-level Apache project
**2012**- Datomic, a distributed database that supports transactions, queries, and joins, is launched by Rich Hickey, the creator of Clojure

https://www.youtube.com/watch?v=hfKnFvv9vRU

# SQL vs NoSQL

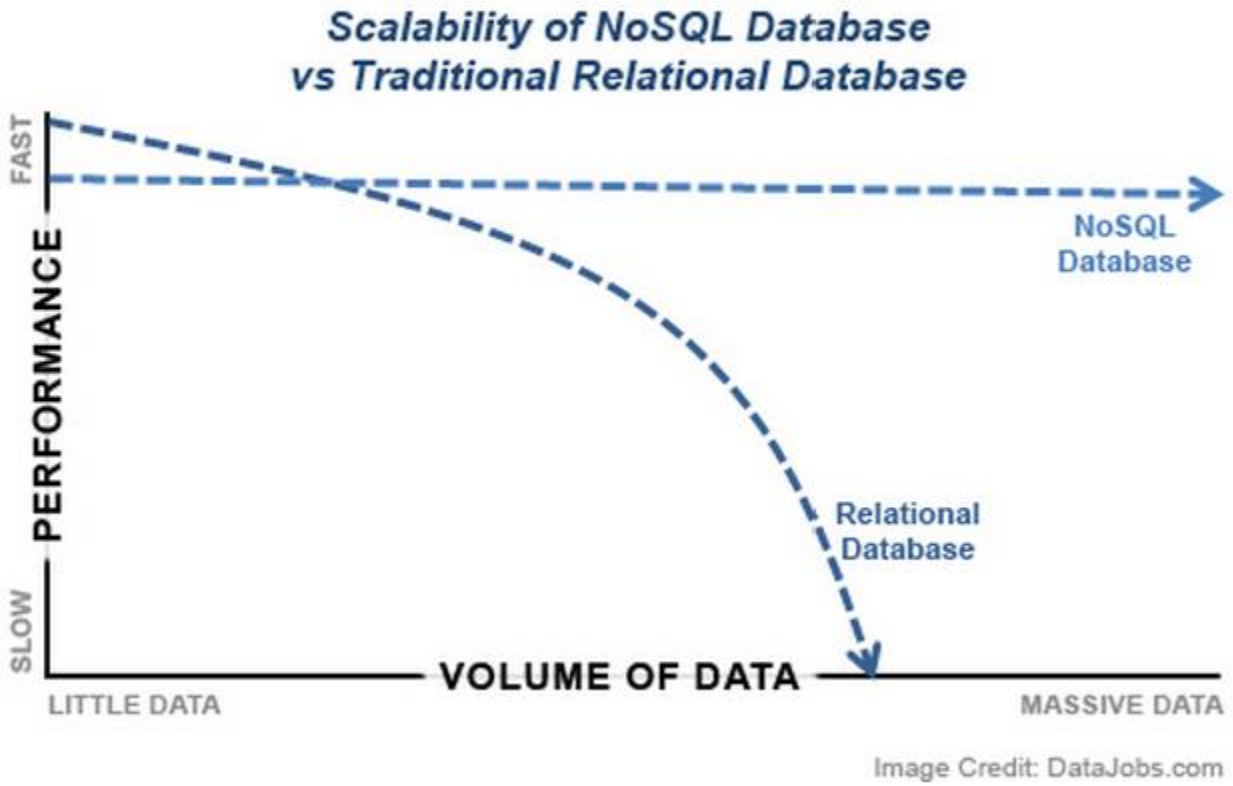



417 systems in ranking, January 2024

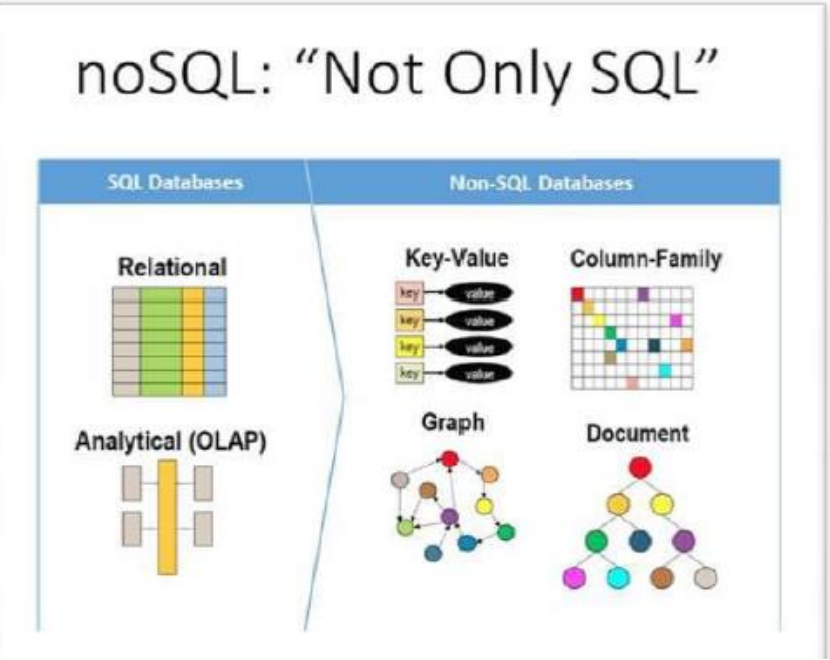
| Rank Jan 2024 | Rank Dec 2023 | Rank Jan 2023 | DBMS | Database Model | Score Jan 2024 | Score Dec 2023 | Score Jan 2023 |
|---|---|---|---|---|---|---|---|
| 1. | 1. | 1. | Oracle | Relational, Multi-model | 1247.49 | -9.92 | +2.33 |
| 2. | 2. | 2. | MySQL | Relational, Multi-model | 1123.46 | -3.18 | -88.50 |
| 3. | 3. | 3. | Microsoft SQL Server | Relational, Multi-model | 876.60 | -27.23 | -42.79 |
| 4. | 4. | 4. | PostgreSQL | Relational, Multi-model | 648.96 | -1.94 | +34.11 |
| 5. | 5. | 5. | MongoDB | Document, Multi-model | 417.48 | -1.67 | -37.70 |
| 6. | 6. | 6. | Redis | Key-value, Multi-model | 159.38 | +1.03 | -18.17 |
| 7. | 7. | ↑ 8. | Elasticsearch | Search engine, Multi-model | 136.07 | -1.68 | -5.09 |
| 8. | 8. | ↓ 7. | IBM Db2 | Relational, Multi-model | 132.41 | -2.19 | -11.16 |
| 9. | ↑ 10. | ↑ 11. | Snowflake | Relational | 125.92 | +6.04 | +8.66 |
| 10. | ↓ 9. | ↓ 9. | Microsoft Access | Relational | 117.67 | -4.08 | -15.69 |

Fonte: StackOverflow, 2021 survey: https://insights.stackoverflow.com/survey/2021#technology

# SQL vs NoSQL


Scalability of NoSQL Database
vs Traditional Relational Database
FAST
PERFORMANCE
SLOW
NoSQL
Database
Relational
Database
VOLUME OF DATA
LITTLE DATA
MASSIVE DATA
Image Credit: DataJobs.com

# SQL vs NoSQL


noSQL: "Not Only SQL"
SQL Databases
Non-SQL Databases
Relational
Analytical (OLAP)
Key-Value
Column-Family
Graph
Document


NoSQL
Scalable
High Performance
Flexible

## SQL vs NoSQL

- **NoSQL** databases have existed since the late 1960s, but were only recognized as NoSQL at the beginning of the 21st century, with the emergence of web 2.0 applications such as Facebook, Amazon or Google.

- **NoSQL** databases are increasingly used to store large volumes of data and support Web applications

- Current NoSQL databases are more mature and ready for action. The adoption of NoSQL technology is largely being driven by three co-related trends:
  - cloud computing
  - large number of users (millions to billions)
  - big data

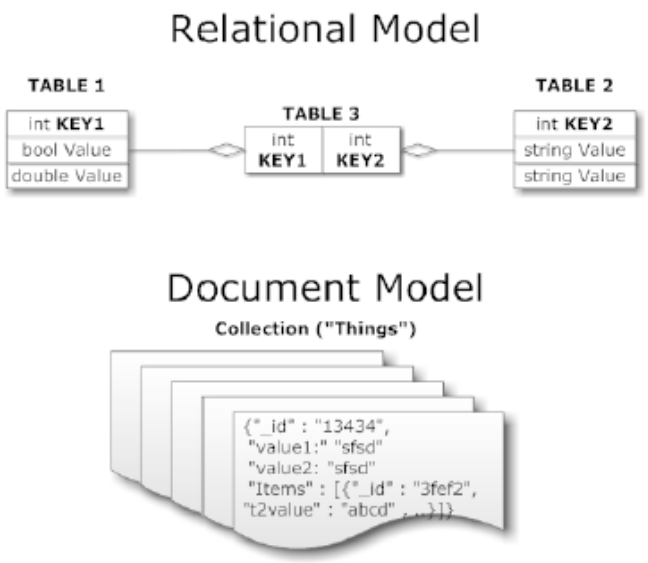
## SQL vs NoSQL

| | SQL | NoSQL |
|---|---|---|
| Type | Relational | Non-Relational |
| Data | Structured Data stored in Tables | Un-structured stored in JSON files but the graph database does supports relationship |
| Schema | Static | Dynamic |
| Scalability | Vertical | Horizantal |
| Language | Structured Query Language | Un-structured Query Language |
| Joins | Helpful to design complex queries | No joins, Don't have the powerful interface to prepare complex query |
| OLTP | Recommended and best suited for OLTP systems | Less likely to be considered for OLTP system |
| Support | Great support | community depedent, they are expanding the support model |
| Integrated Caching | Supports In-line memory(SQL2014 and SQL 2016) | Supports integrated caching |
| flexible | rigid schema bound to relationship | Non-rigid schema and flexible |
| Transaction | ACID | CAP theorem |
| Auto elasticity | Requires downtime in most cases | Automatic, No outage required |

**ACID**: **A**tomicidade, **C**onsistência, **I**solamento e **D**urabilidade (*Atomicity, Consistency, Isolation, Durability)*

**CAP theorem: C**onsistency (every read receives the most recent write or an error), **A**vailability, **P**artition tolerance:

# SQL vs NoSQL




| MySQL pros | MongoDB pros |
|---|---|
| - Atomic transactions support<br>- JOIN support<br>- Mature solution<br>- Privilege and password security system | - Document validation<br>- Integrated storage engines<br>- Shortened time between primary failure and recovery |
| **MySQL cons** | **MongoDB cons** |
| - Tough scaling<br>- Stability concerns<br>- Isn't community-driven development | - Not the best option for apps with complex transactions<br>- Not a snap-in replacement for legacy solutions<br>- Young solution |

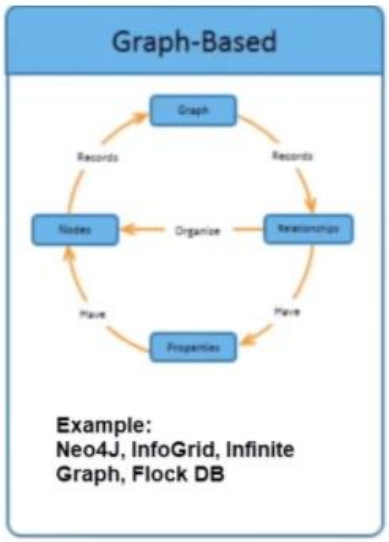
## SQL vs NoSQL | Overview

- SQL databases are relational, NoSQL are non-relational
- SQL databases use structured query language and have a predefined schema. NoSQL databases have dynamic schemas for unstructured data
- SQL databases are vertically scalable, NoSQL databases are horizontally scalable
- SQL databases are table based, while NoSQL databases are document, key-value, graph or column based
- SQL databases are better for multi-row transactions. NoSQL are better for unstructured data like JSON documents

# Types of NoSQL databases

- NoSQL databases can be divided into four distinct groups:



# Types of NoSQL databases

| Key | Value |
|---|---|
| 194252165973 | MacBook Pro 13" |
| 42406659611 | USB Microphone |
| 36000341362 | Hand Sanitizer |
| 36196308002 | Toilet paper |

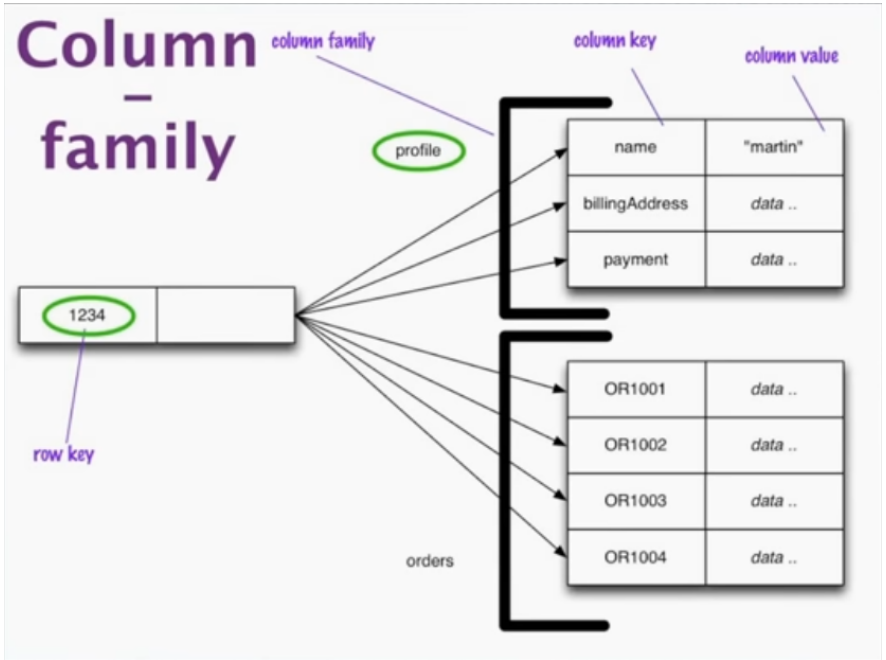
- NoSQL databases can be divided into four distinct groups.
  - **Key/value based:** These databases work by matching key with specific values, similar to a map or dictionary. They are efficient, extremely performant, and easily scalable.
  - Key-value pair storage databases store data as a hash table where each key is unique, and the value can be a JSON, BLOB(Binary Large Objects), string, etc



| Key | Value |
|---|---|
| 194252165973 | { name: "MacBook Pro 13", price: $1032.21, description: "laptop" } |
| 42406659611 | USB Microphone |
| 36000341362 | Hand Sanitizer |
| 36196308002 | Toilet paper |

# Types of NoSQL databases

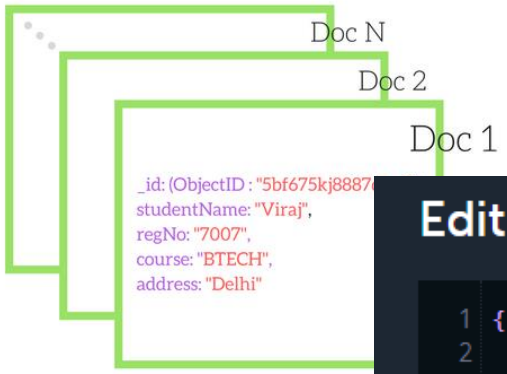

- NoSQL databases can be divided into four distinct groups.
  - **Column based:** These databases work by creating collections of one or more key/value pairs that match a specific record. They are also referred to as extensible record stores, wide columnar stores, or column oriented stores.

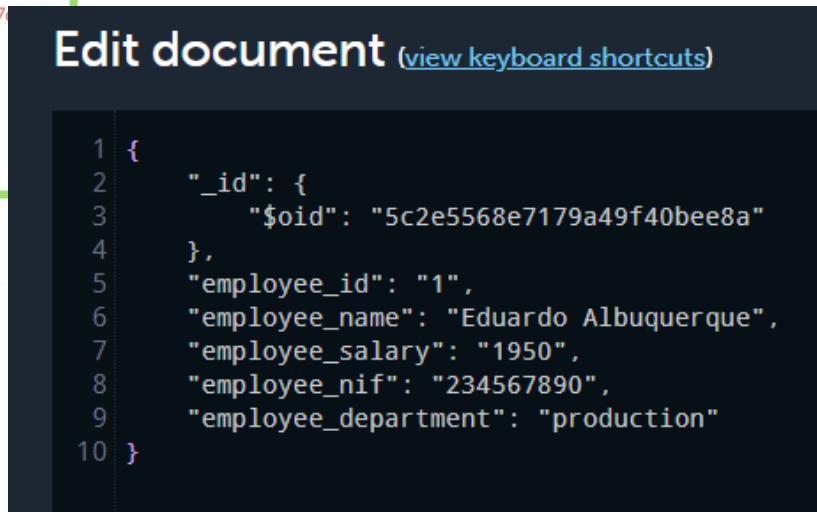



| ColumnFamily | | | |
|---|---|---|---|
| Row Key | Column Name | | |
| | Key | Key | Key |
| | Value | Value | Value |
| | Column Name | | |
| | Key | Key | Key |
| | Value | Value | Value |

## Types of NoSQL databases

- NoSQL databases can be divided into four distinct groups.
  - **Document based:** Key value pairs are encapsulated in JSON like documents. The keys within each document have to be unique. Unlike key based, the values are not opaque to the system and can be queried.



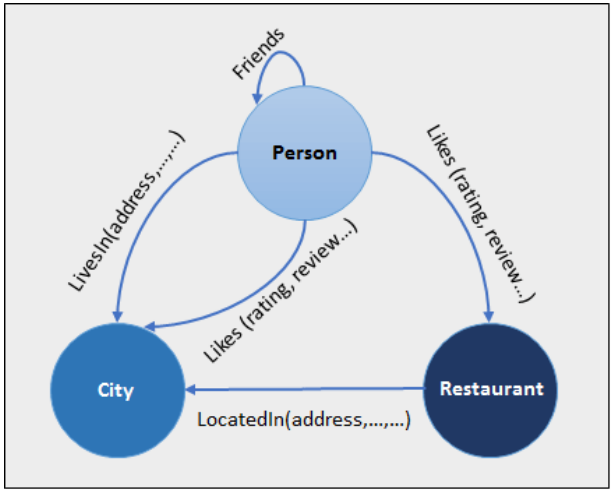

mongoDB.

Apache CouchDB relax

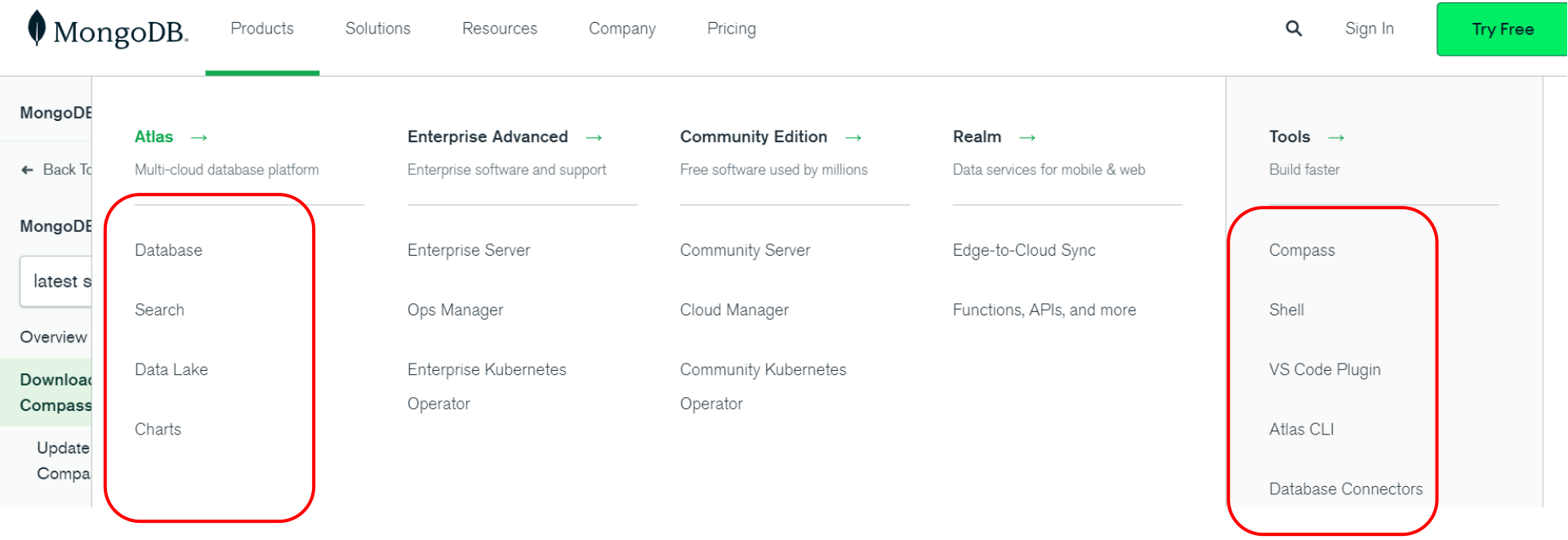
## Types of NoSQL databases

- NoSQL databases can be divided into four distinct groups.
  - **Graph based:** These databases are specialized in efficient management of heavily linked data.
  - A graph type database stores entities as well the relations amongst those entities. The entity is stored as a node with the relationship as edges.

Neo4j



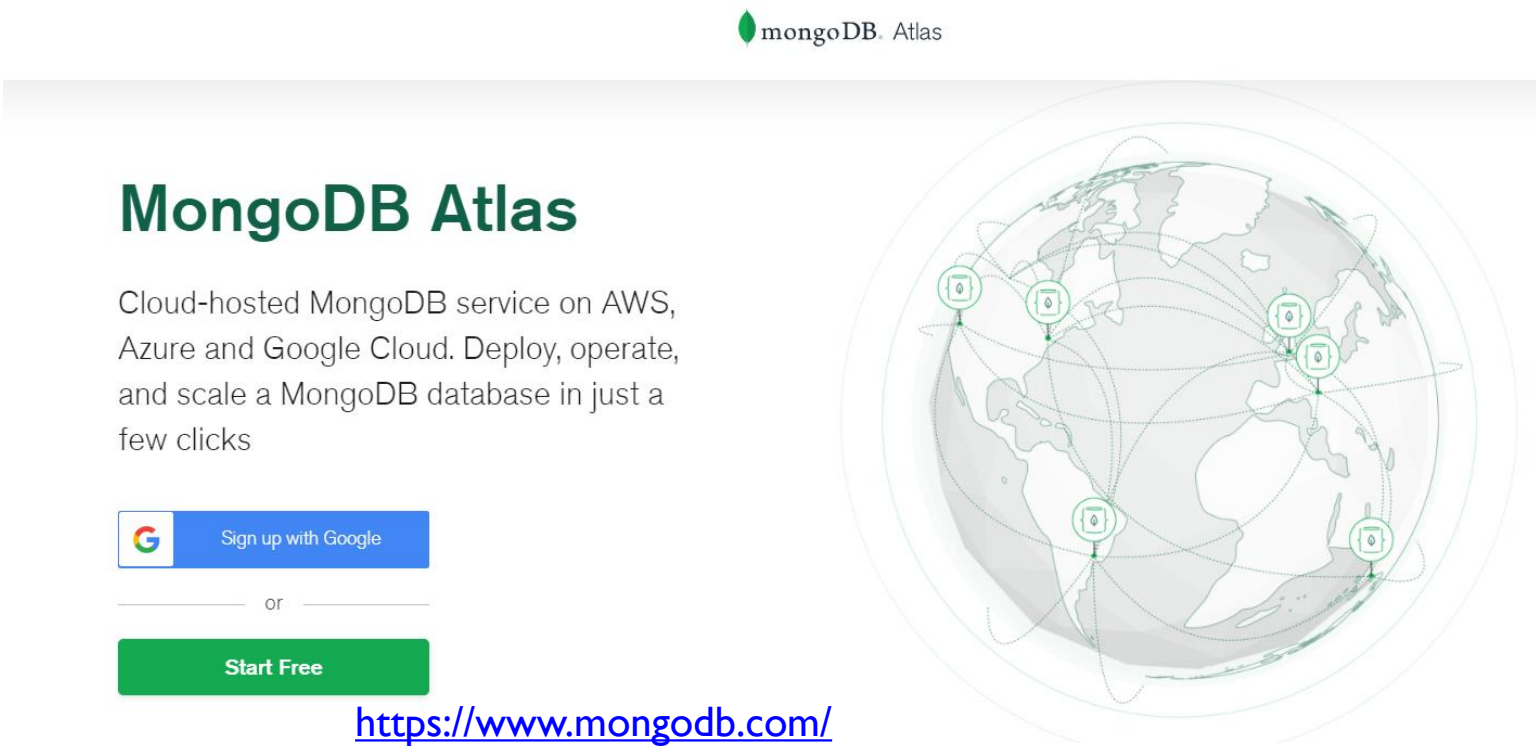
# MongoDB


https://www.mongodb.com/

# MongoDB Atlas

- MongoDB as a Service
- Cloud Hosting Services  AWS (Amazon Web Services)

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# MongoDB Atlas

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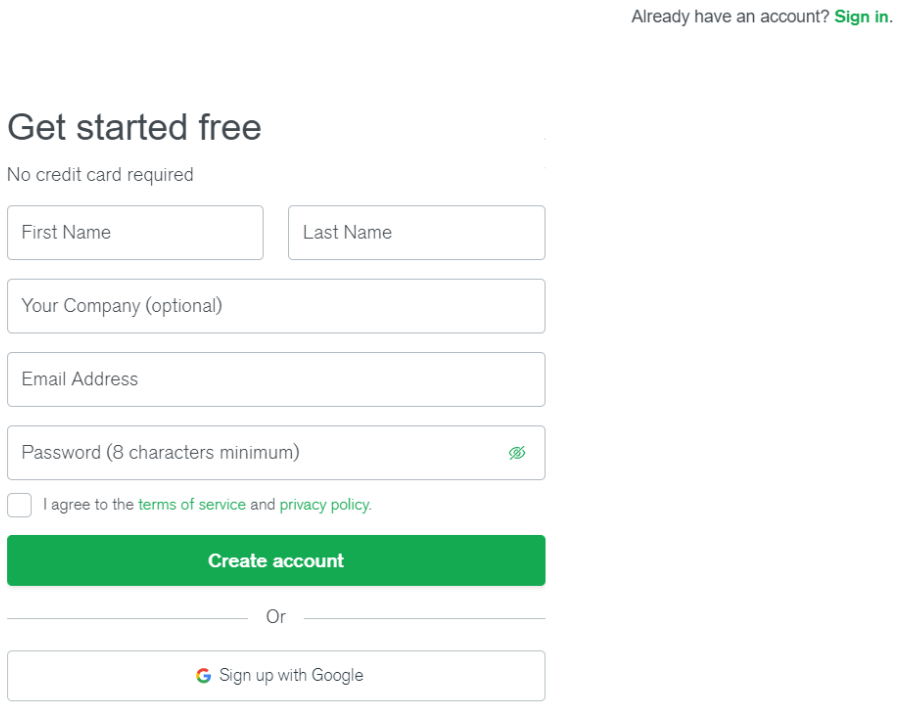
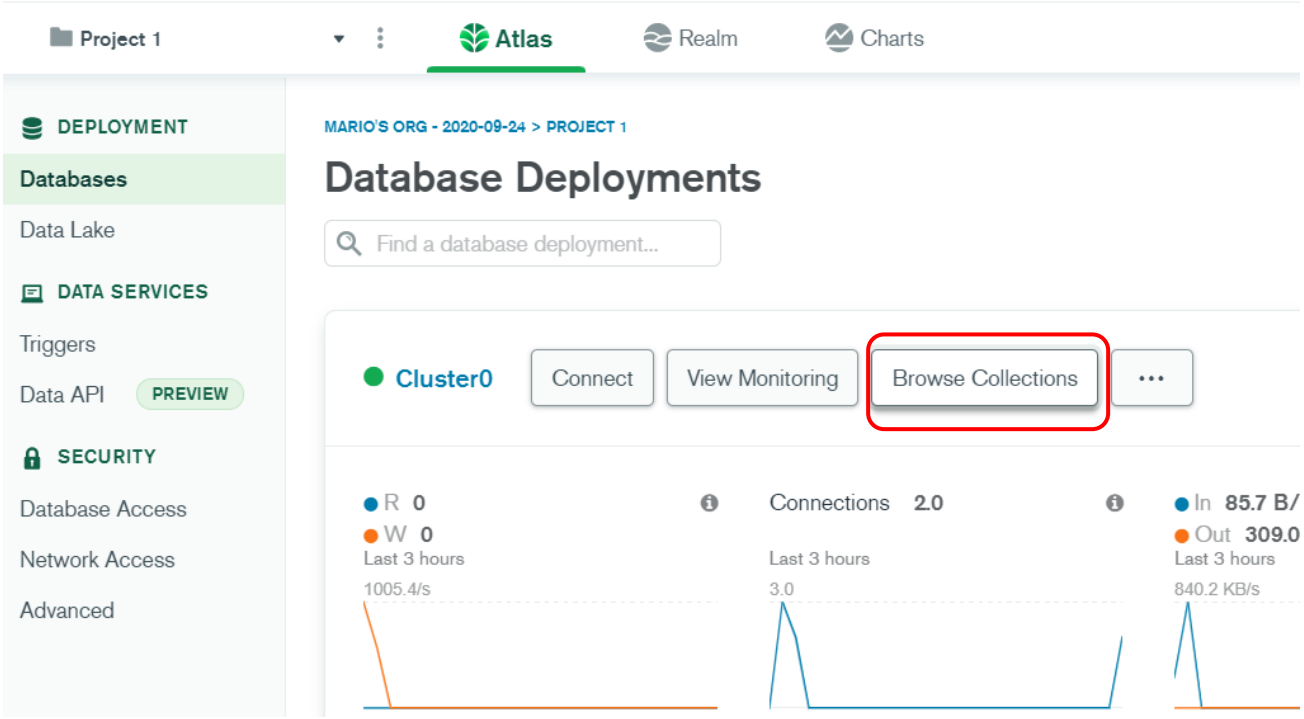


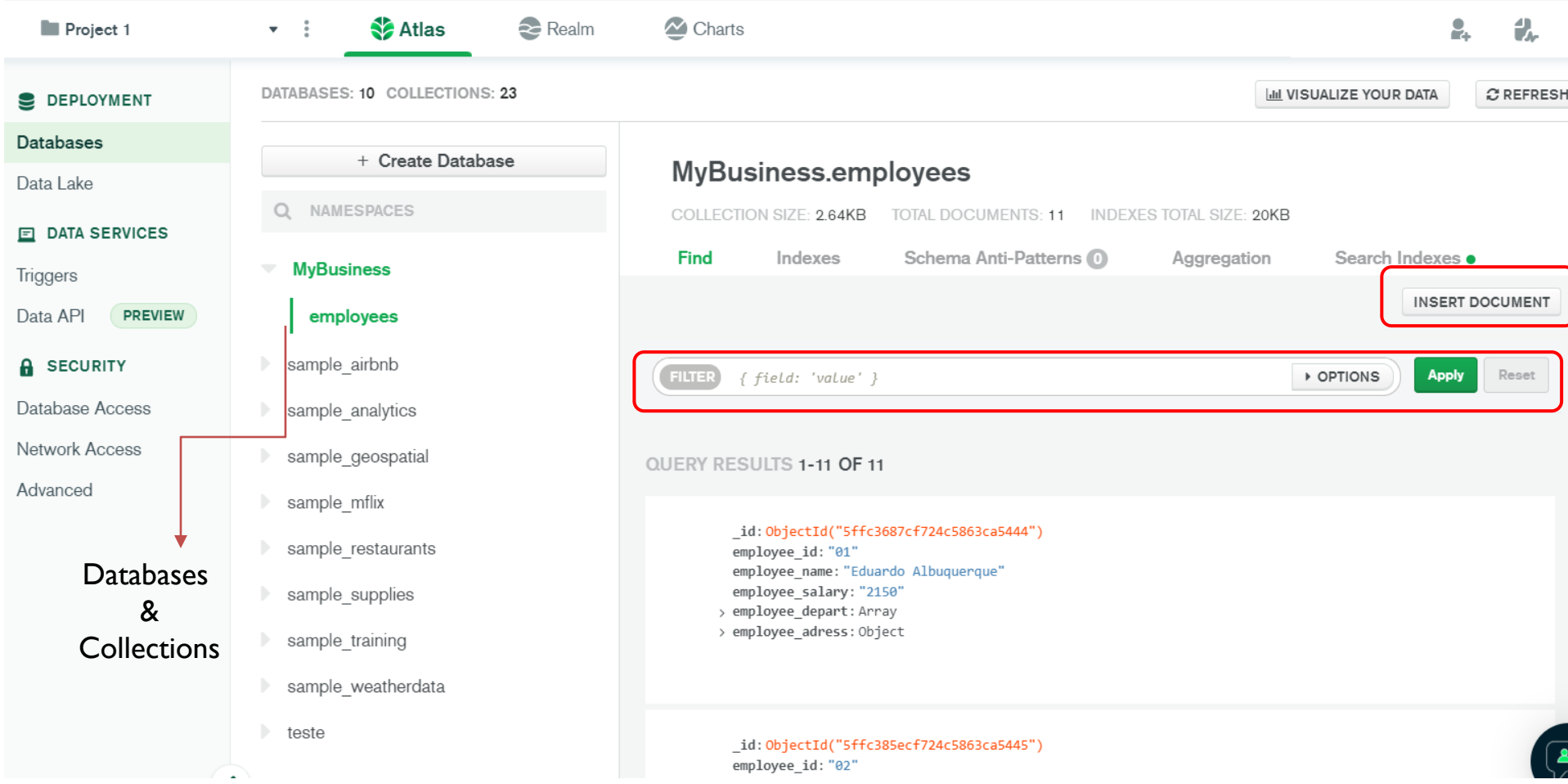

https://www.mongodb.com/atlas/database

# MongoDB Atlas

- MongoDB Cloud Hosting Services  AWS (Amazon Web Services)

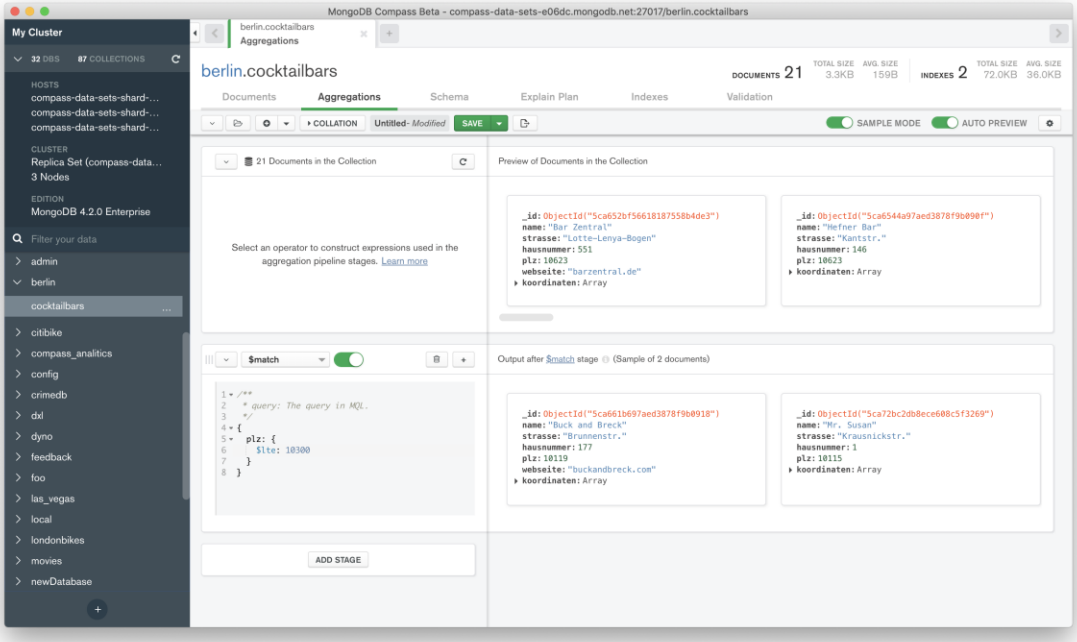


# MongoDB Atltas




Databases
&
Collections

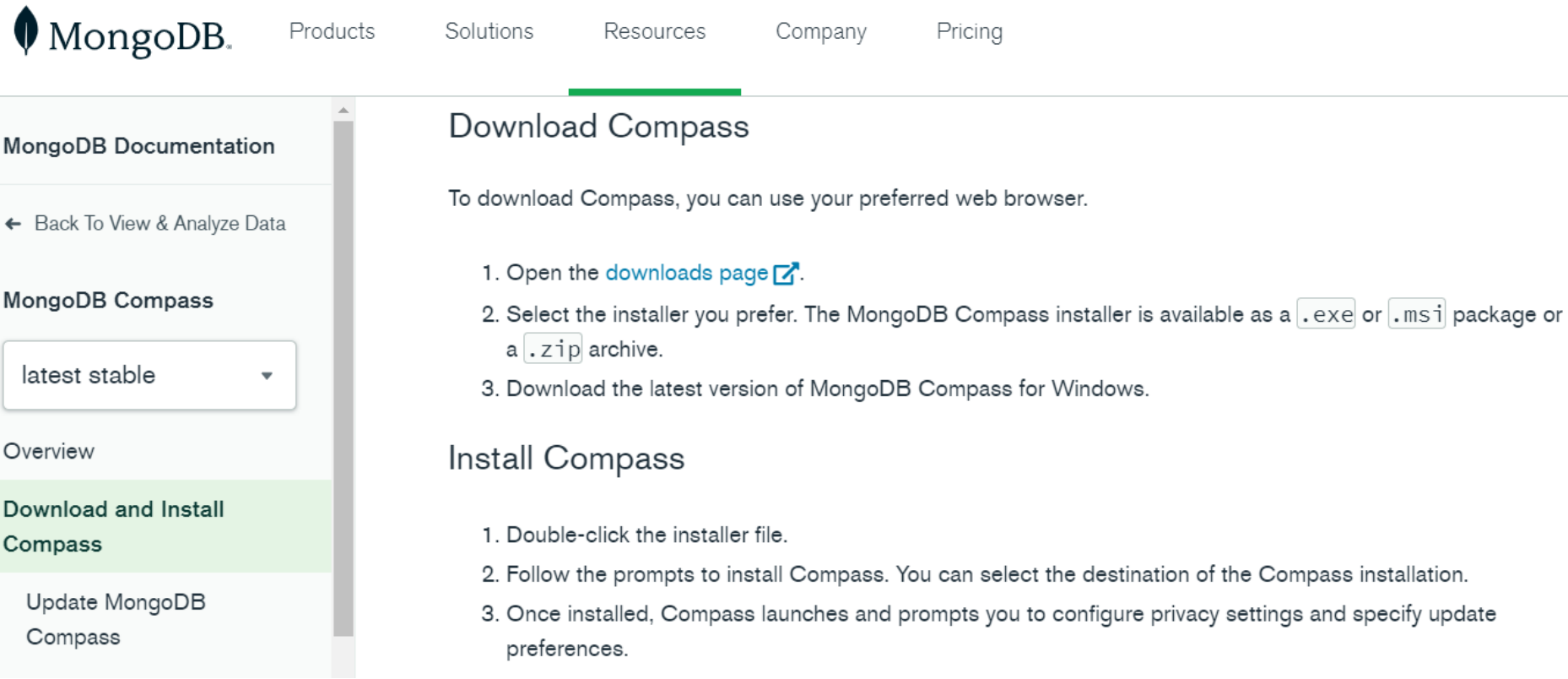
# Mongo BD GUI Tools:




- MongoDB Compass
- Robo 3T (formely Robomongo)
- Studio 3T ( formely MongoChef)
- Table Plus (GUI tool for relational databases like MySQL, PostgreSQL, SQLite, and NoSQL databases like MongoDB)

# MongoDB Compass

- Install Compass …




https://docs.mongodb.com/compass/current/install/

- MongoDB Compass: GUI Tool

mongoDB Compass

**Vizualize and explore**

Visualize, understand, and work with your data through an intuitive GUI.

**Insert, modify, and delete**

Modify your data with a powerful visual editing tool.

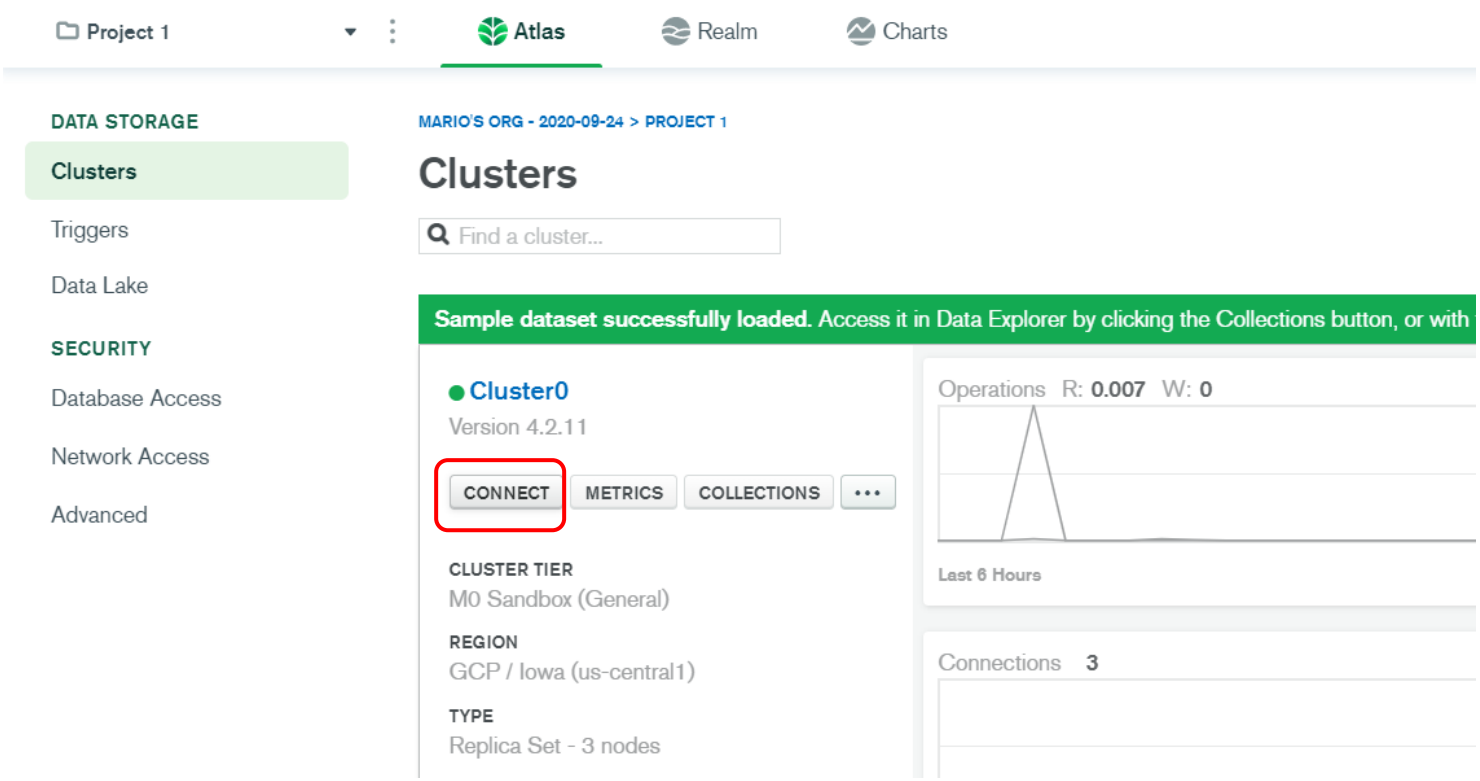
**Debug and optimize**

Understand performance issues with visual explain plans, view utilization and manage your indices.

# Connecting Compass to Atlas

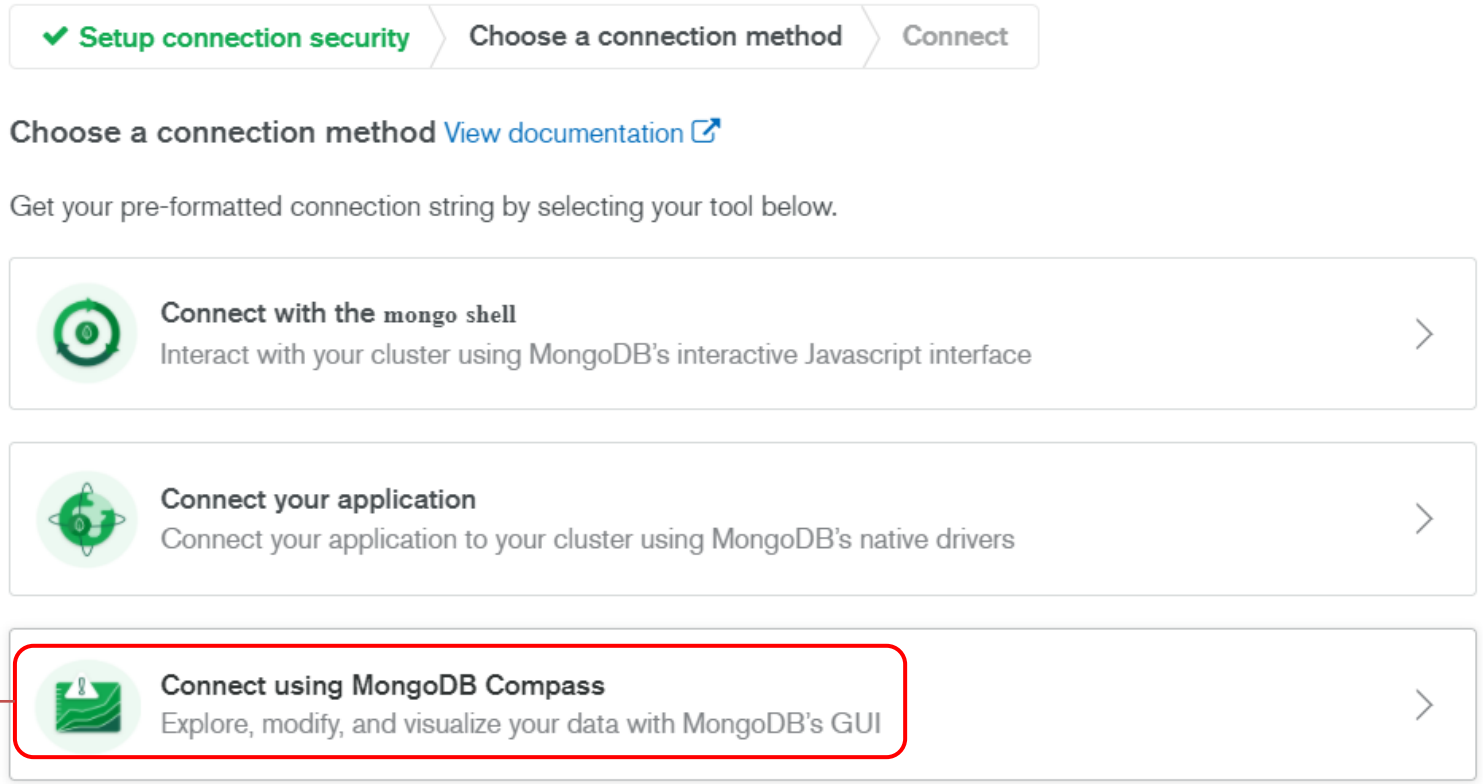
1

**Setp 1** – MongoBD Atlas – click on **Connect**



# Connecting Compass to Atlas

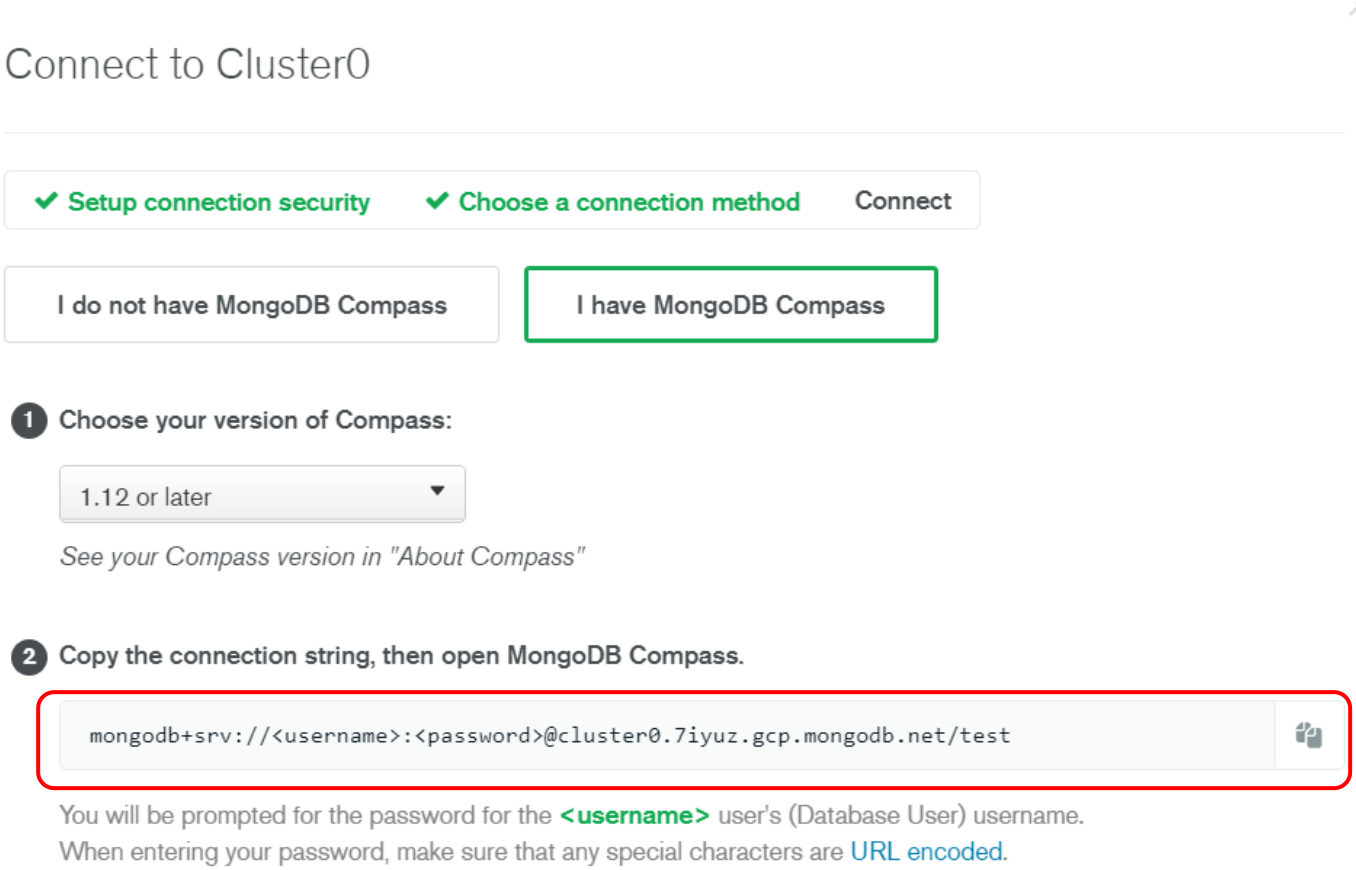
## 2 **Setp 2** – MongoBD Atlas – Connect using MongoBD Compass




GUI for MongoDB

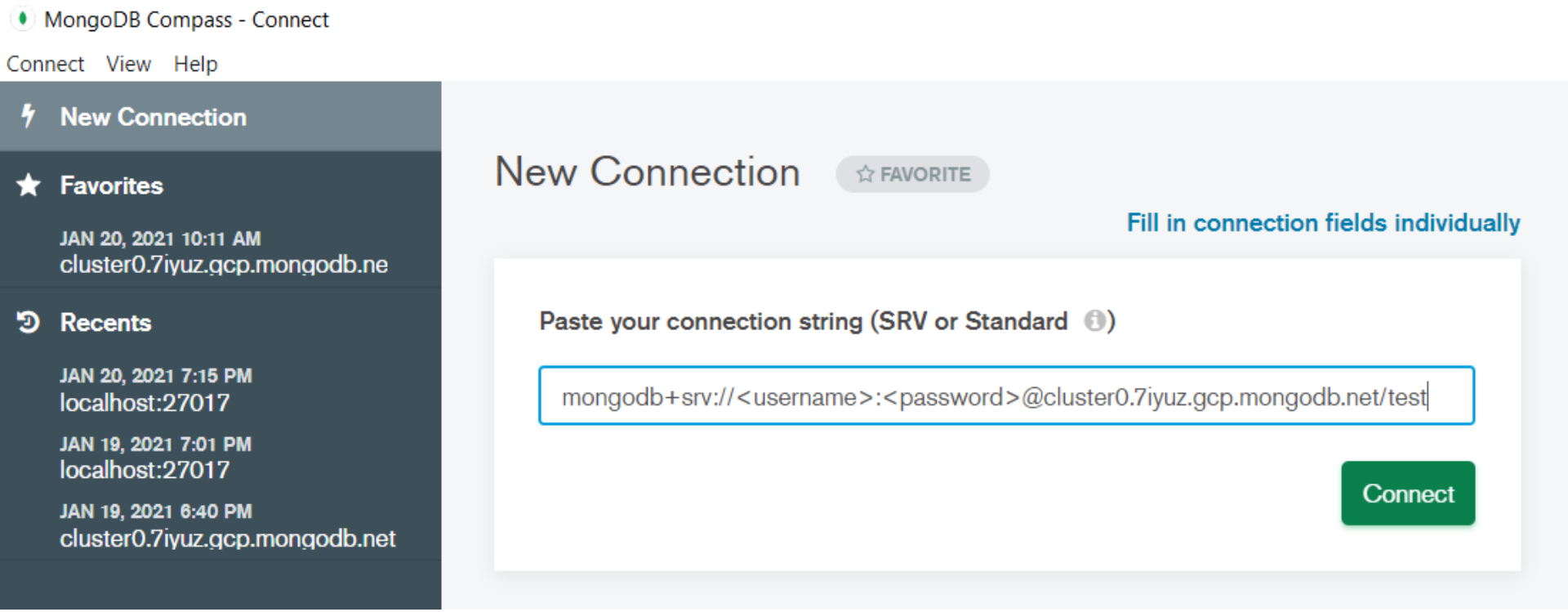
# Connecting Compass to Atlas

## 3 **Setp 3** – MongoBD Atlas – copy the connection string



# Connecting Compass to Atlas

**4** **Setp 4** – MongoBD Compass: **New Connection** & paste de string connection



# MongoBD Compass