



Chapter 1.

Overview of NoSQL Database Management System

References

- MongoDB The Definitive Guide: Powerful and Scalable Data Storage 3rd Edition
- MongoDB Documents: <https://docs.mongodb.com/>

Learning objectives

- Compare SQL and NoSQL database
- Explain the basic features of MongoDB
- Explain key components of MongoDB
- Distinguish tools support and install

Contents

1. SQL and NoSQL database
2. What is MongoDB?
3. MongoDB features
4. Key components of MongoDB
5. MongoDB editions
6. MongoDB tools
7. MongoDB Atlas

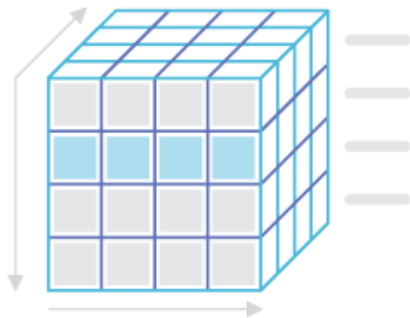
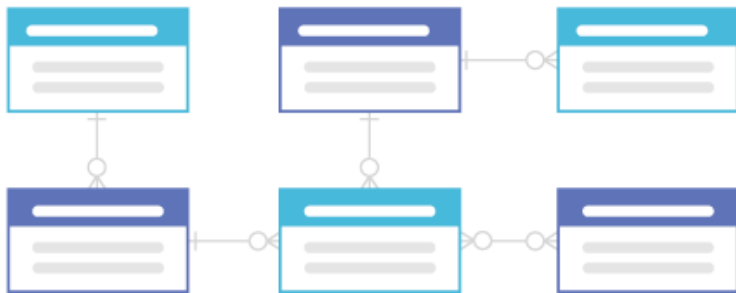
1. SQL and NoSQL database

- Database is an organized collection of data stored and accessed electronically.
- There are two types of databases used in general:
 - Relational databases: store data in a tabular format as rows and columns. The relationships between data are defined using multiple tables.
 - Non-relational databases (NoSQL databases): data stores are *not based on the conventional RDBMS* principles and are used for *handling large data sets*
 - solve the problem of storing unstructured and semi-structured data
 - store the data without a schema and also support dynamic schema

1. SQL and NoSQL database

SQL

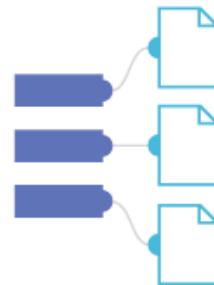
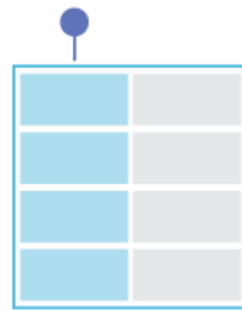
Relational Database Management Systems (RDBMS)



Online Analytical Processing (OLAP) Cube

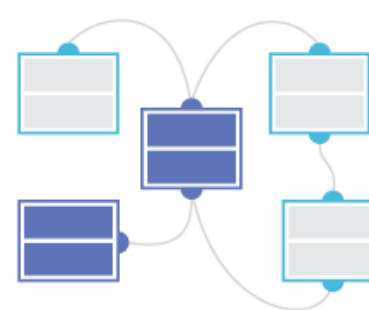
NoSQL

Key-Value

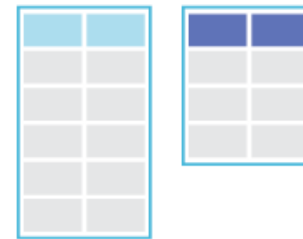


Document

Graph



Column store



key-value

Amazon
DynamoDB (Beta)

ORACLE
BERKELEY DB 11g

redis

graph

Neo4j
the graph database

InfiniteGraph

sones

column

HBASE

riak

Cassandra

document

CouchDB
relax

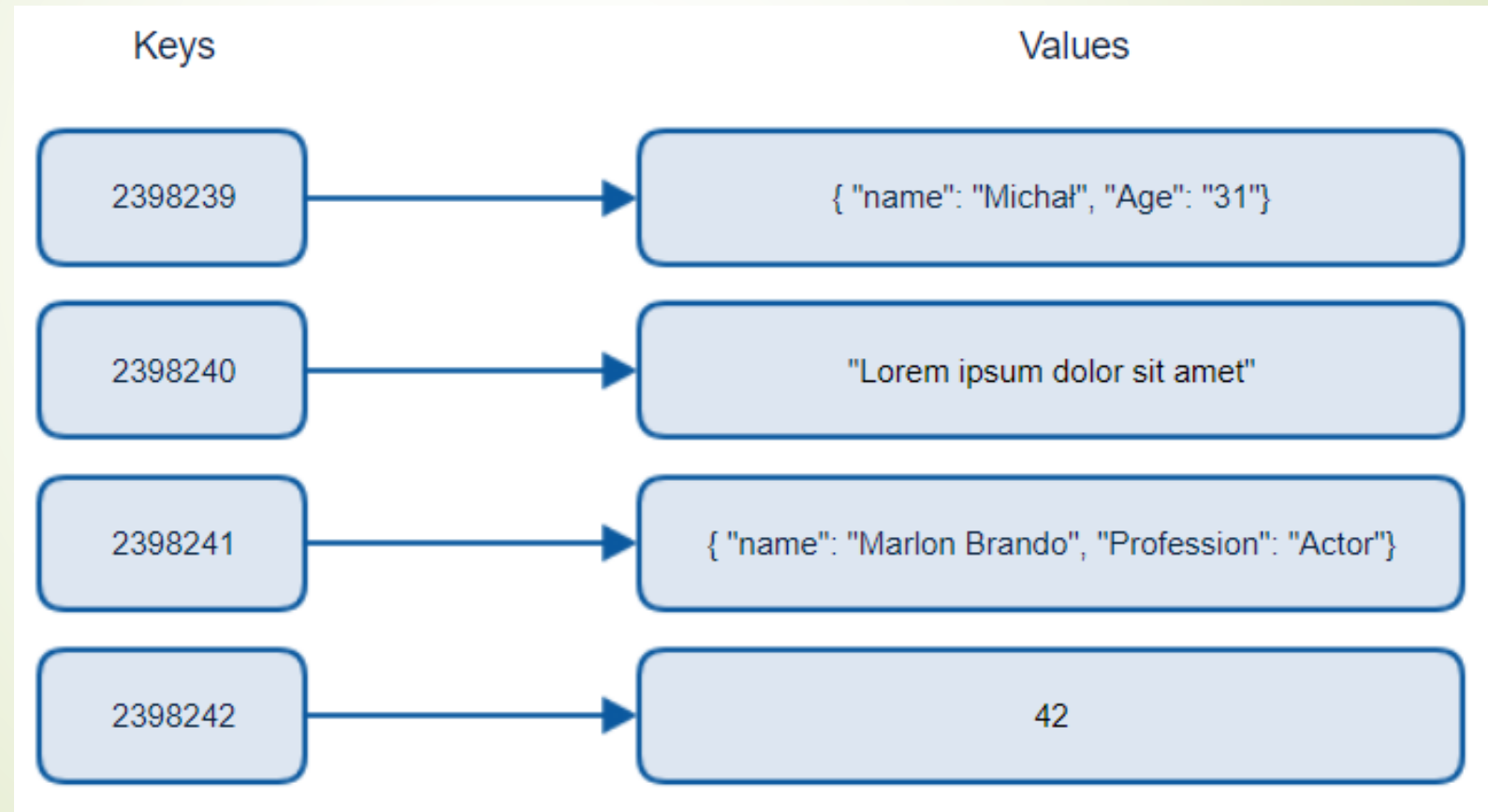
mongoDB

terracore

1. SQL and NoSQL database

Key-Value stores

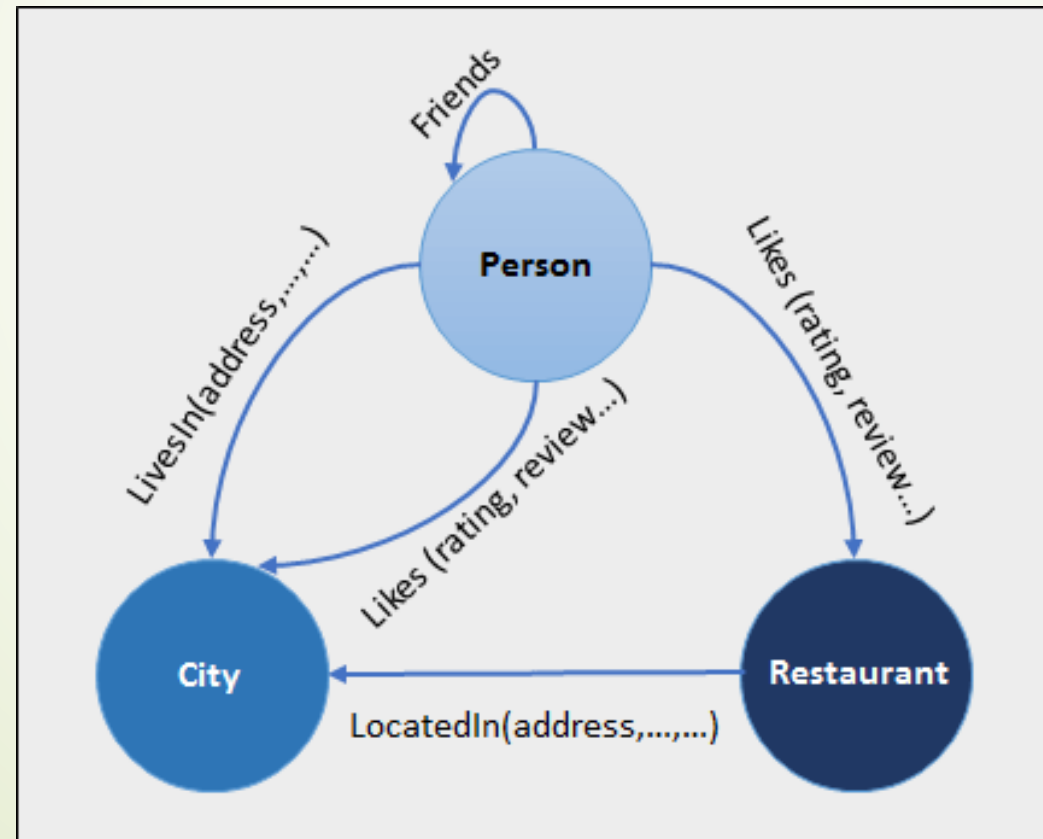
- Every data element in the database is stored as a key value pair.
- Example



1. SQL and NoSQL database

Graph databases

- Each element is stored as a node, with edges establishing relationships between these data nodes



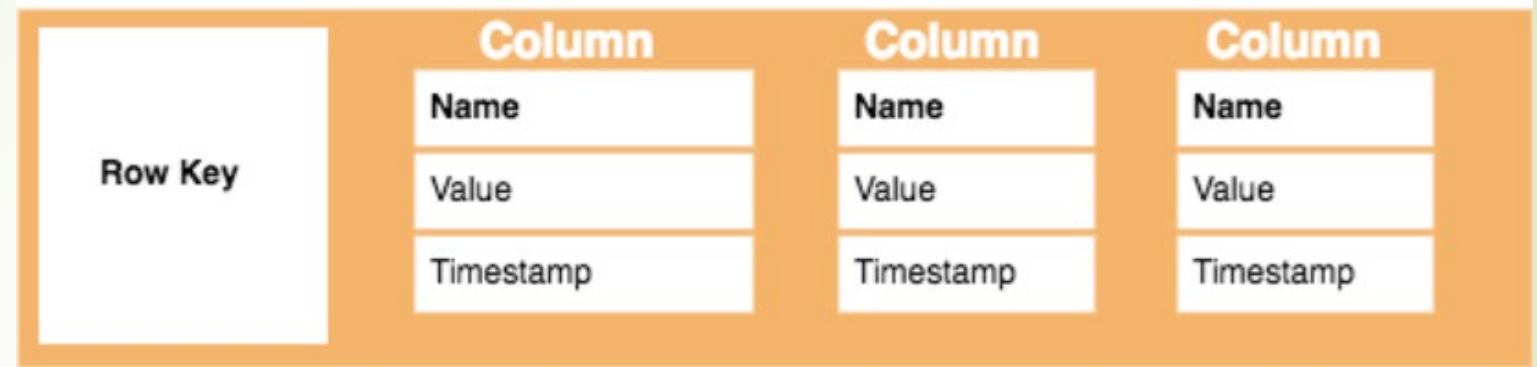
1. SQL and NoSQL database

Column-oriented databases

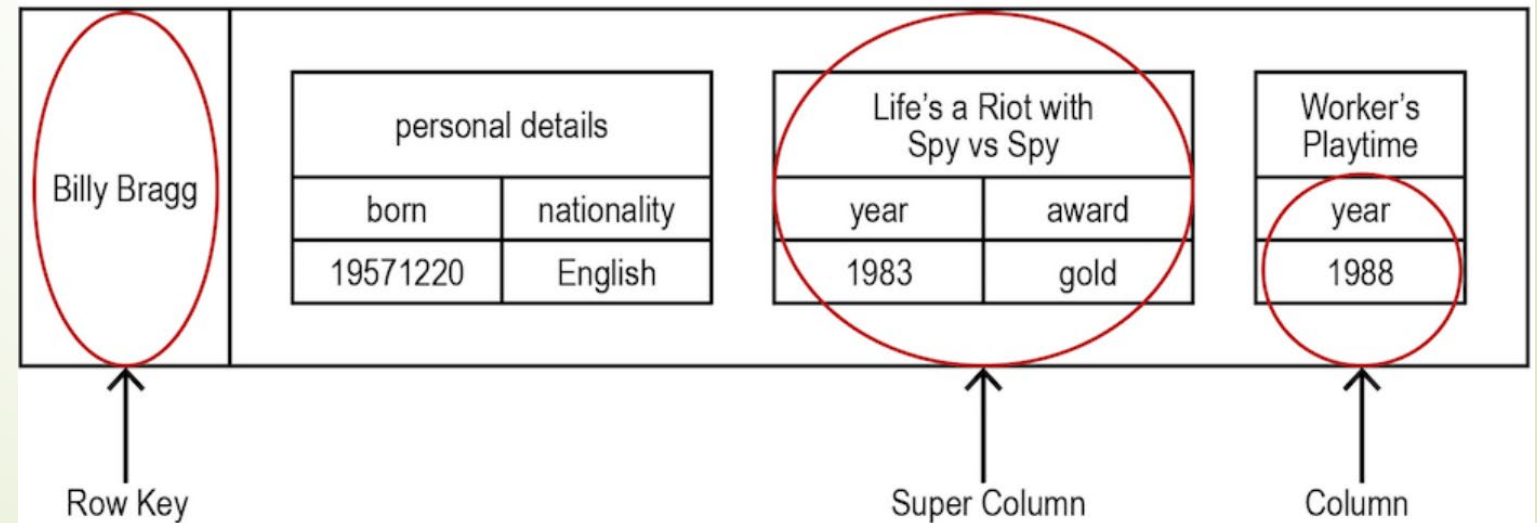
row-store



column-store



Example



1. SQL and NoSQL database Document stores

- Store data in JSON, BSON, or XML documents, which consist of field-value pairs objects.
- Example: JSON document

```
{  
  name: "Chaitanya",  
  age: 30,  
  website: "beginnersbook.com",  
  hobbies: ["teaching", "watching tv"]  
}
```

← Field: Value
← Field: Value
← Field: Value
← Field: Value



} Document

```
{  
  name: "Chaitanya",  
  age: 30,  
  website: "beginnersbook.com",  
  hobbies: ["Teaching", "Watching TV"]  
}
```

1. SQL and NoSQL database Comparison

	SQL Databases	NoSQL Databases
Development history	Developed in 1970.	Developed in 2000s.
Examples	SQL Server, Oracle, MySQL, PostgreSQL...	MongoDB, DynamoDB, Cassandra, Couchbase,...
Data storage model	Data is stored in rows and columns in a table , where each column is of a specific type. Joins are used to retrieve data from multiple tables.	The data is stored in different formats , depending on the provider. The standard storage structures are documents, graphs, key-values, and wide columns.

1. SQL and NoSQL database Comparison

	SQL Databases	NoSQL Databases
Schemas	Fixed structure and schema, so any change to schema involves altering the database.	Dynamic schema, new data types, or structures can be accommodated by expanding or altering the current schema. New fields can be added dynamically.
Scalability	Scale up/Vertical scaling 	Scale out/Horizontal scaling 
Support	High level of enterprise support is provided.	Open source model.

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7. MongoDB Atlas

2. What is MongoDB?

- MongoDB is a cross-platform, open-source, **document-oriented** NoSQL database which is programmed in C++.
- MongoDB developed by a company 10gen which is now known as MongoDB Inc.
- MongoDB stores data in **flexible**, the documents in a single collection don't necessarily need to have exactly the same set of fields.
- Documents in MongoDB are stored in the **BSON format**, which is a binary-encoded JSON format.
- MongoDB is a **distributed database** at its core, so **high availability**, **horizontal scaling**, and **geographic distribution** are built in and easy to use.
- MongoDB is free. The latest MongoDB release is 6.0 (2022).

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3. MongoDB features

- **Queries**

- By field
- By regular expression
- By user defined java script functions
- By range

- **Indexes**

- Primary and secondary
- Any document field

3. MongoDB features

- **Replication**

- Creates multiple copies of the data and sends these copies to a different server so that if one server fails, then the data is retrieved from another server

- **Sharding**

- A method for distributing or partitioning data across multiple machines
- It is useful when no single machine can handle large modern-day workloads, by allowing you to *scale horizontally*

- **Load balancing**

- Via horizontal scaling features like *replication* and *sharding*

3. MongoDB features

- When MongoDB should be used?
 - Large data
 - Complex data structures
 - Delivering data in high-performance
 - Supporting hybrid and multi-cloud applications
 - Supporting agile development and collaboration

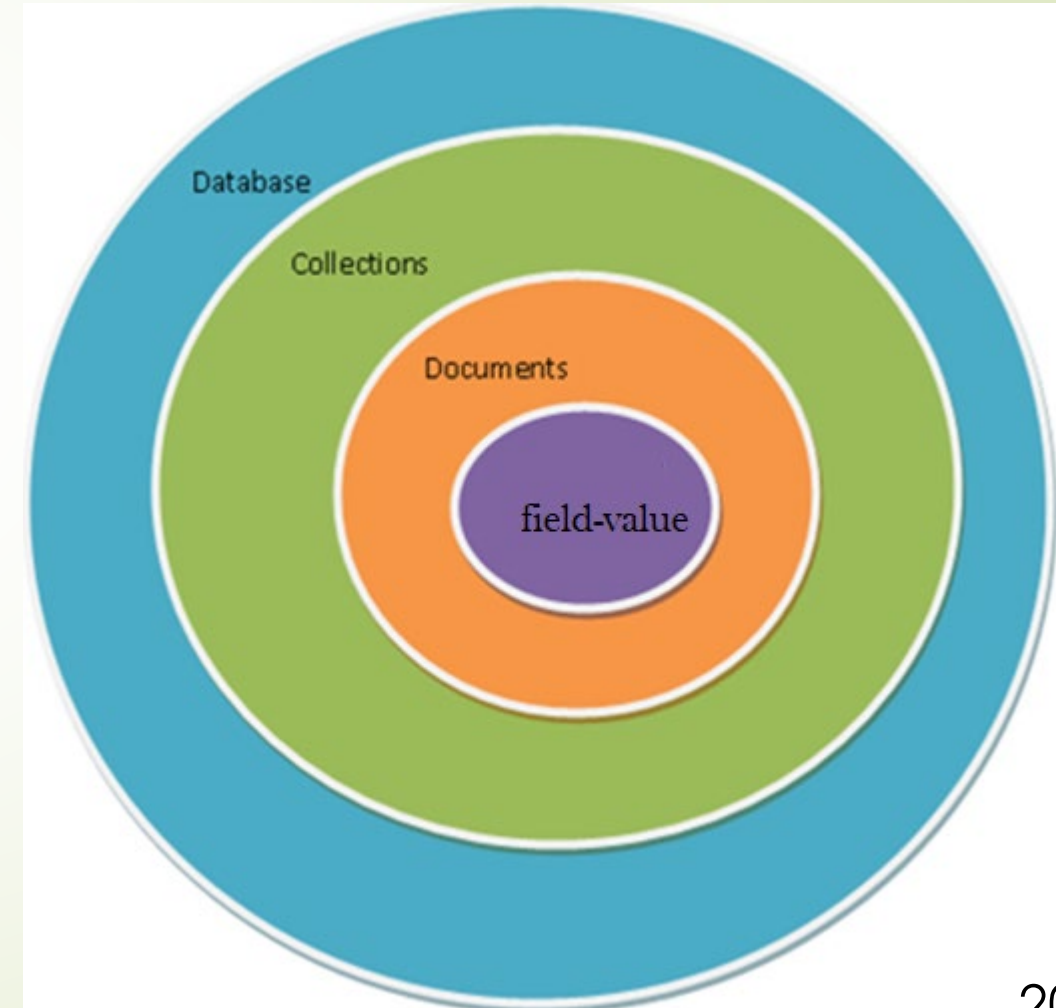
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4. Key components of MongoDB

- A database server
 - has many databases
- A **database**
 - has many collections
- A **collection**
 - has many documents
- A **document**
 - consist of **field-value pairs** which are the basic unit of data

Document databases



4. Key components of MongoDB

■ Document

- Composed of field-and-value pairs, the values of fields may include other documents, arrays, or arrays of documents.
- Every document has a unique key: "_id"

Document structure:

```
{  
  field1: value1,  
  field2: value2,  
  field3: value3,  
  ...  
  fieldN: valueN  
}
```

Example:

```
{  
  name: "sue",  
  age: 26,  
  status: "A",  
  groups: [ "news", "sports" ]  
}
```


4. Key components of MongoDB

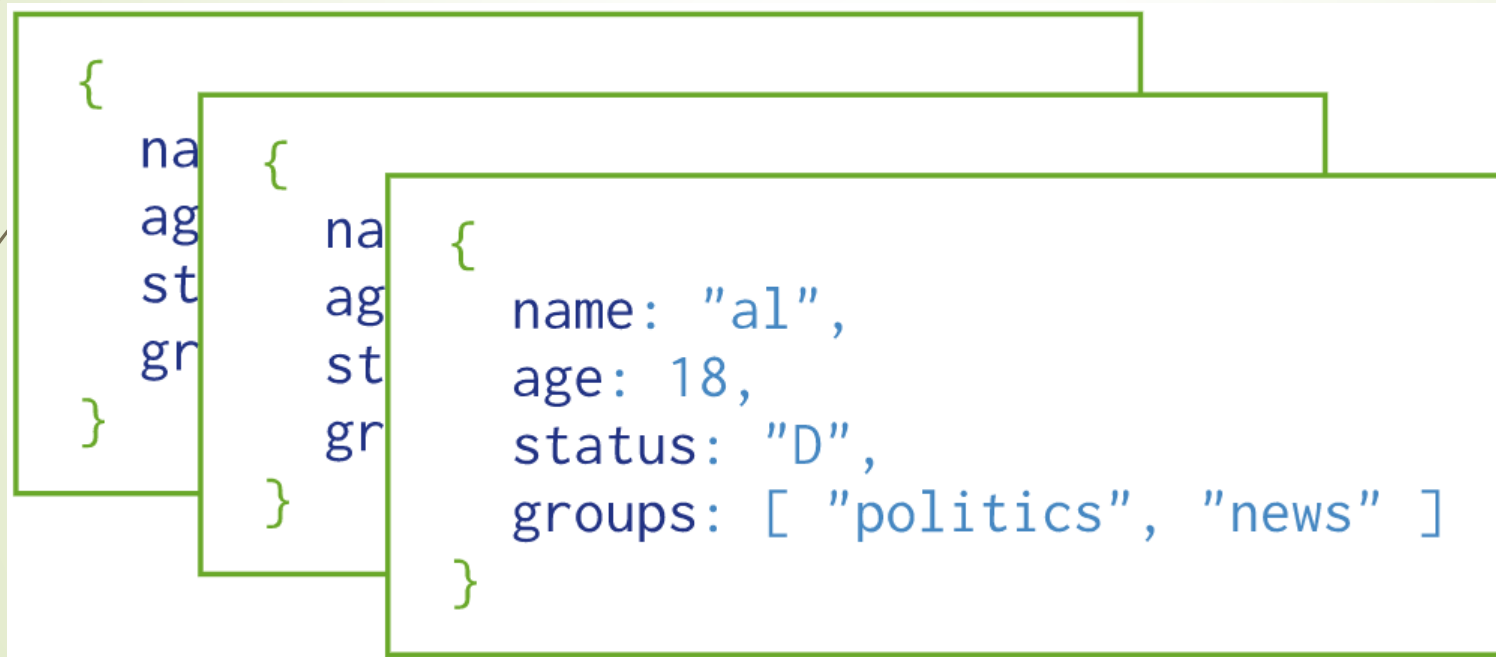
- **Document**

Example

```
{  
  _id: ObjectId("5099803df3f4948bd2f98391"),  
  name: { first: "Alan", last: "Turing" },  
  birth: new Date('Jun 23, 1912'),  
  death: new Date('Jun 07, 1954'),  
  contribs: [ "Turing machine", "Turing test", "Turingery" ],  
  views : NumberLong(1250000)  
}
```


4. Key components of MongoDB

- **Collection**: a group of documents
- **Example**:



```
{
  name: "al",
  age: 18,
  status: "D",
  groups: [ "politics", "news" ]
}
```

4. Key components of MongoDB

RDBMS	MongoDB
Database	Database
Table	Collection
Row	Document
Column	Field
Table join	Embedded documents
Primary key	Primary key (Default key _id provided by MongoDB itself)

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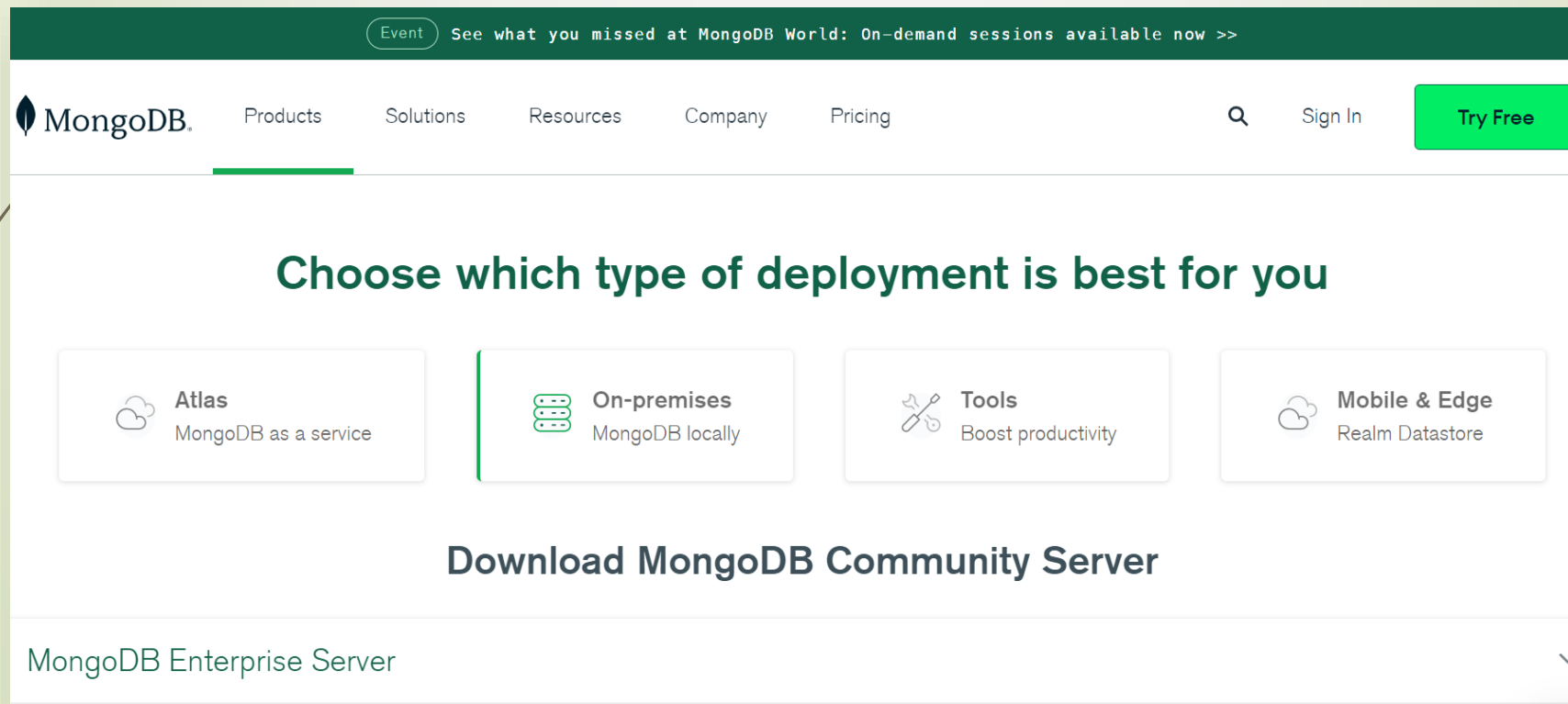
5. MongoDB editions

- **MongoDB Community Server**
 - free and available for Windows, Linux, and macOS.
- **MongoDB Enterprise Server**
 - the commercial edition of MongoDB, available as part of the MongoDB Enterprise Advanced subscription.

5. MongoDB editions

Installing & configuring MongoDB on Windows

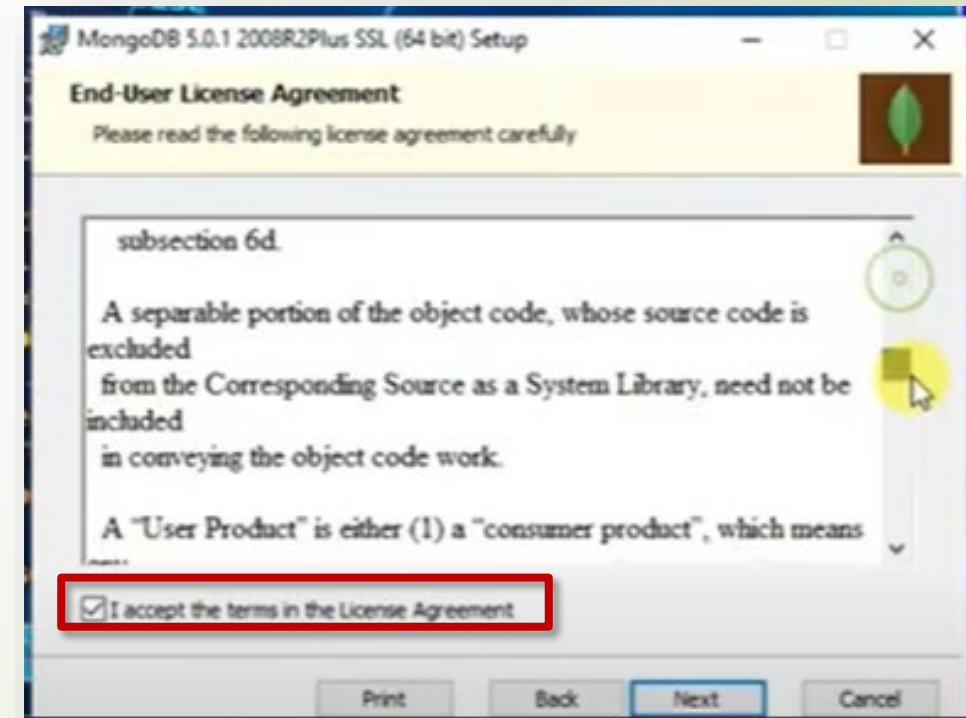
- Go to the MongoDB Download website:
<https://www.mongodb.com/try/download/community>



5. MongoDB editions

Installing & configuring MongoDB on Windows

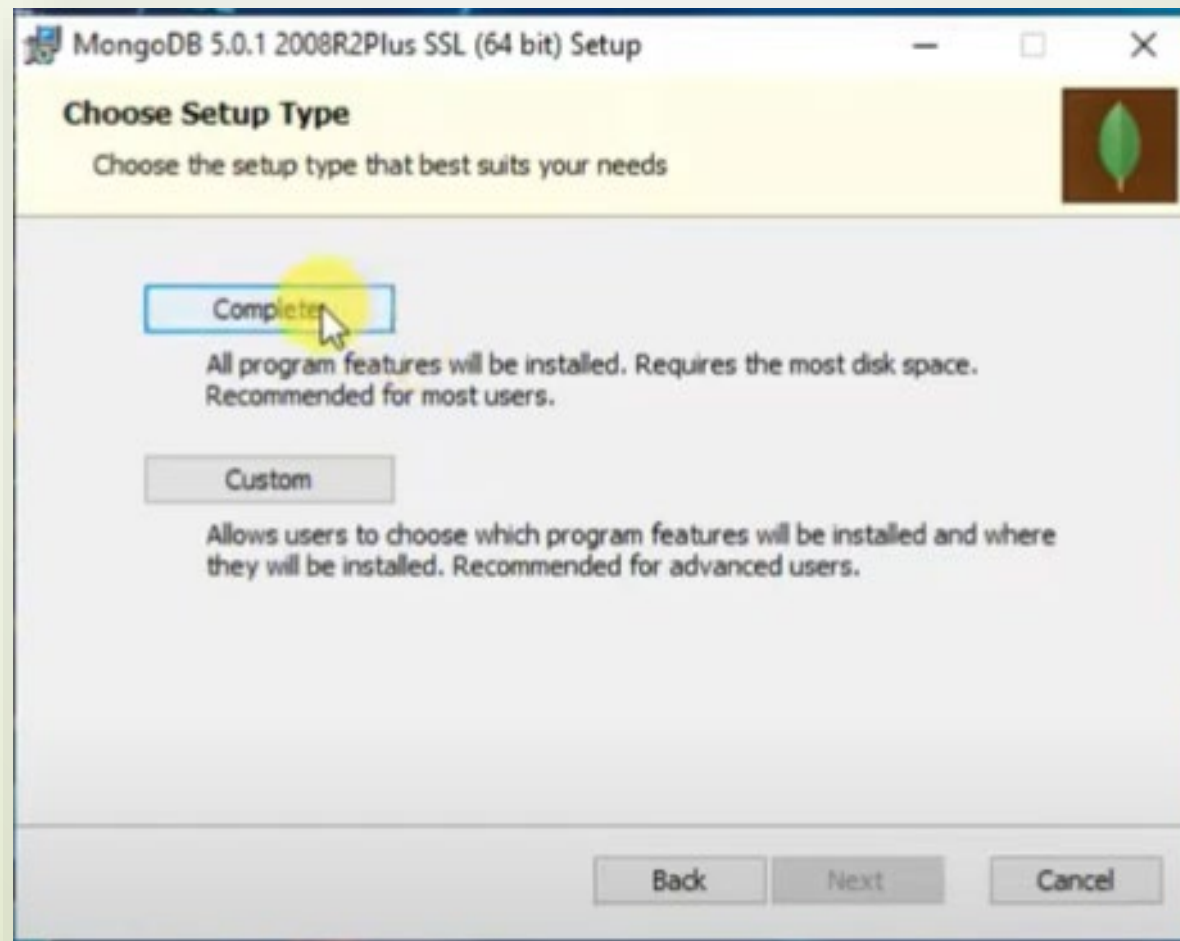
- In the available downloads section, select the current version.



5. MongoDB editions

Installing & configuring MongoDB on Windows

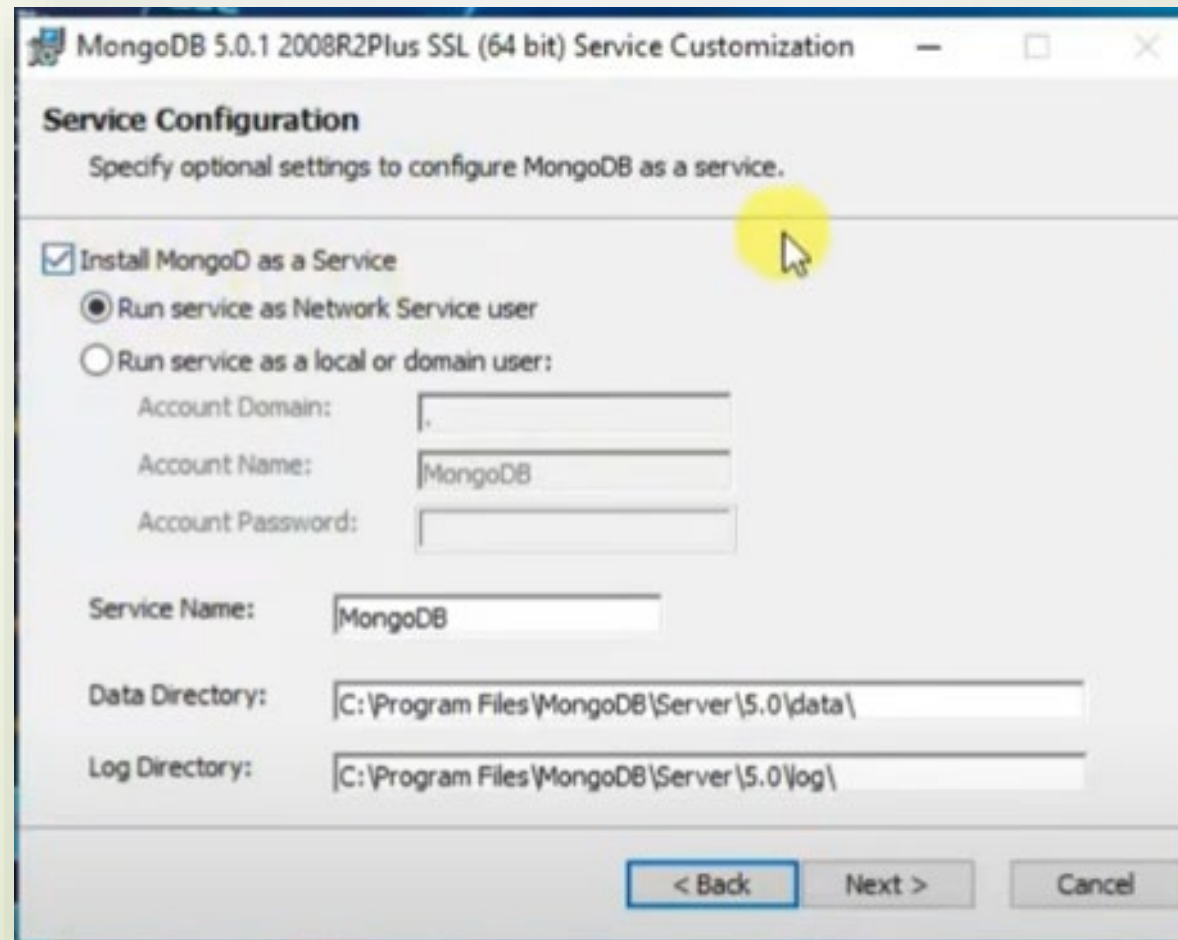
- Click on the complete button to install all of the components.



5. MongoDB editions

Installing & configuring MongoDB on Windows

- Select Run service as Network Service user. Click Next



5. MongoDB editions

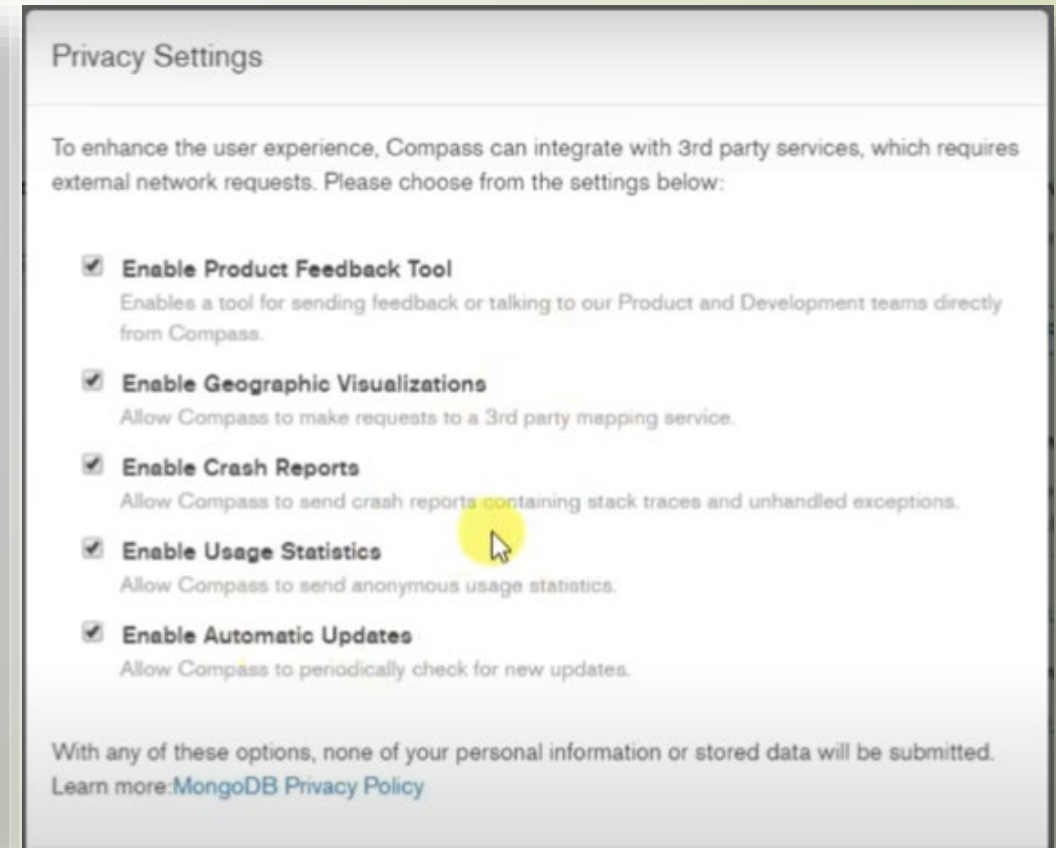
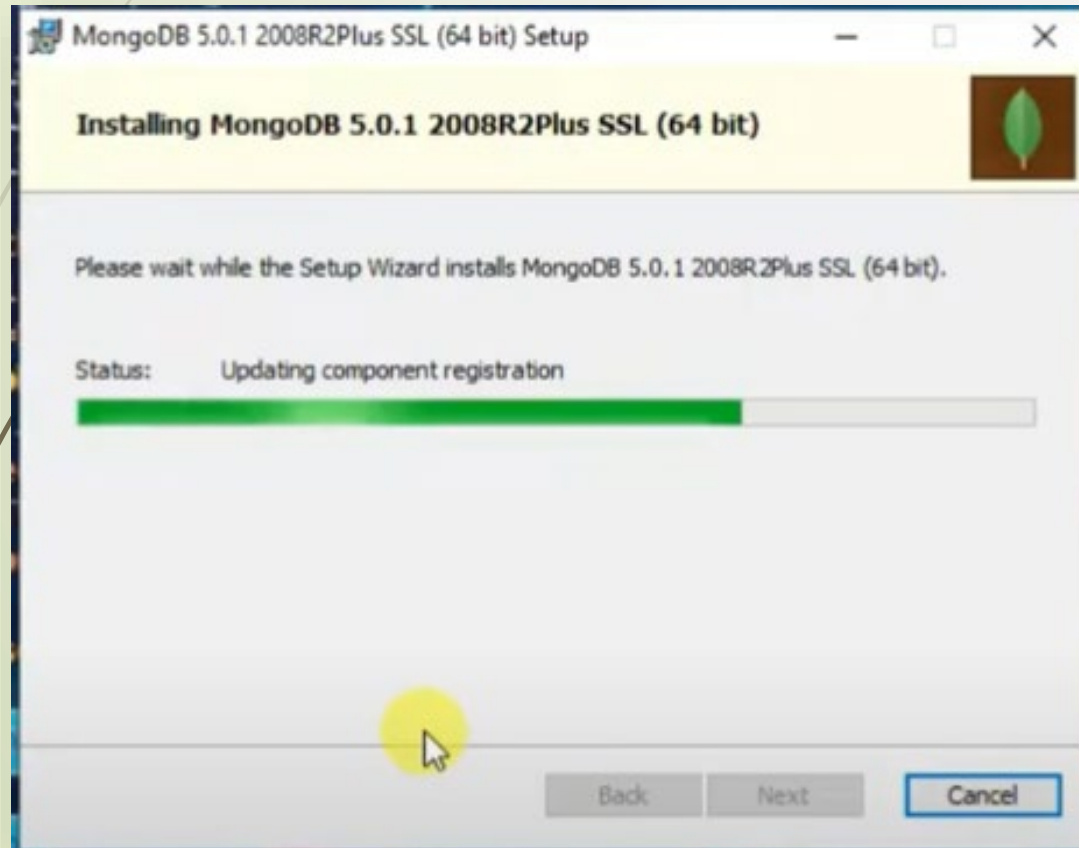
Installing & configuring MongoDB on Windows

- Select either:
 - Run the service as Network Service user (Default): This is a Windows user account that is built-in to Windows
 - Run the service as a local or domain user
 - For an existing local user account, specify a period for the Account Domain and specify the Account Name and the Account Password for the user.
 - For an existing domain user, specify the Account Domain, the Account Name and the Account Password for that user.
 - Service Name: Default name is MongoDB.
 - Data Directory: Specify the data directory, which corresponds to the --dbpath.
 - Log Directory: Specify the Log directory, which corresponds to the --logpath.

5. MongoDB editions

Installing & configuring MongoDB on Windows

- Click on the Install button to start the installation



5. MongoDB editions

Installing & configuring MongoDB on Windows

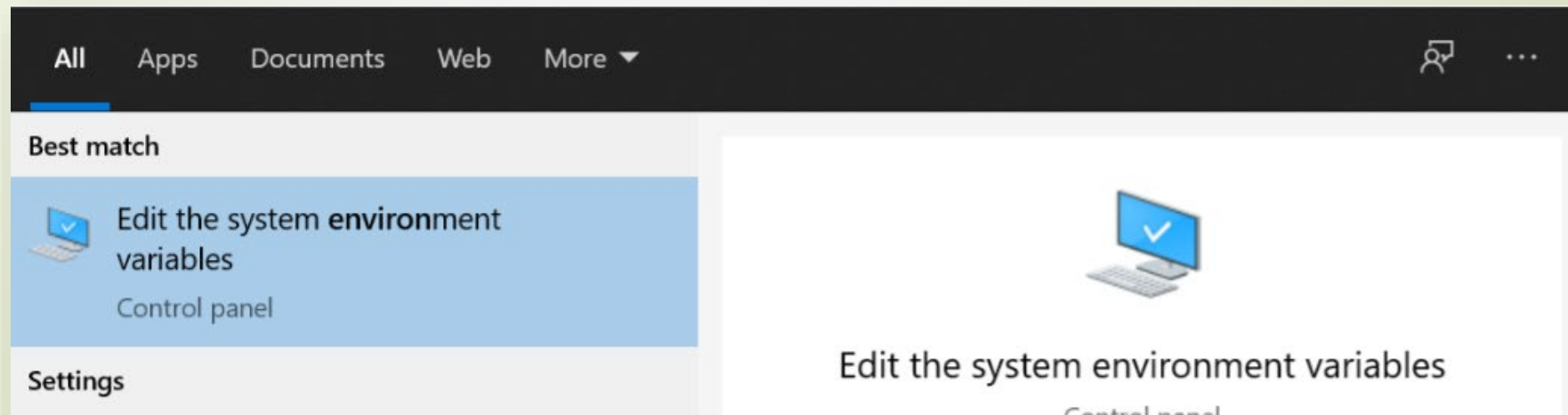
- Click Finish



5. MongoDB editions

Installing & configuring MongoDB on Windows

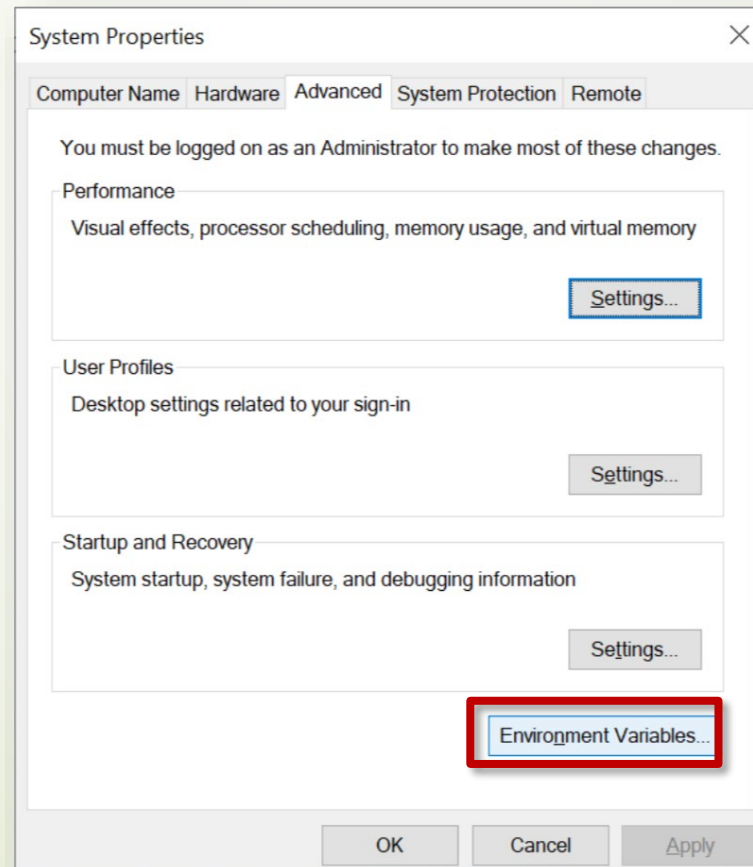
- Configuring MongoDB: After installing MongoDB, we need to open the MongoDB shell to manage MongoDB Server.
 - Add the MongoDB installation location to the system path variable:
 - Open “Edit the system environment variables”



5. MongoDB editions

Installing & configuring MongoDB on Windows

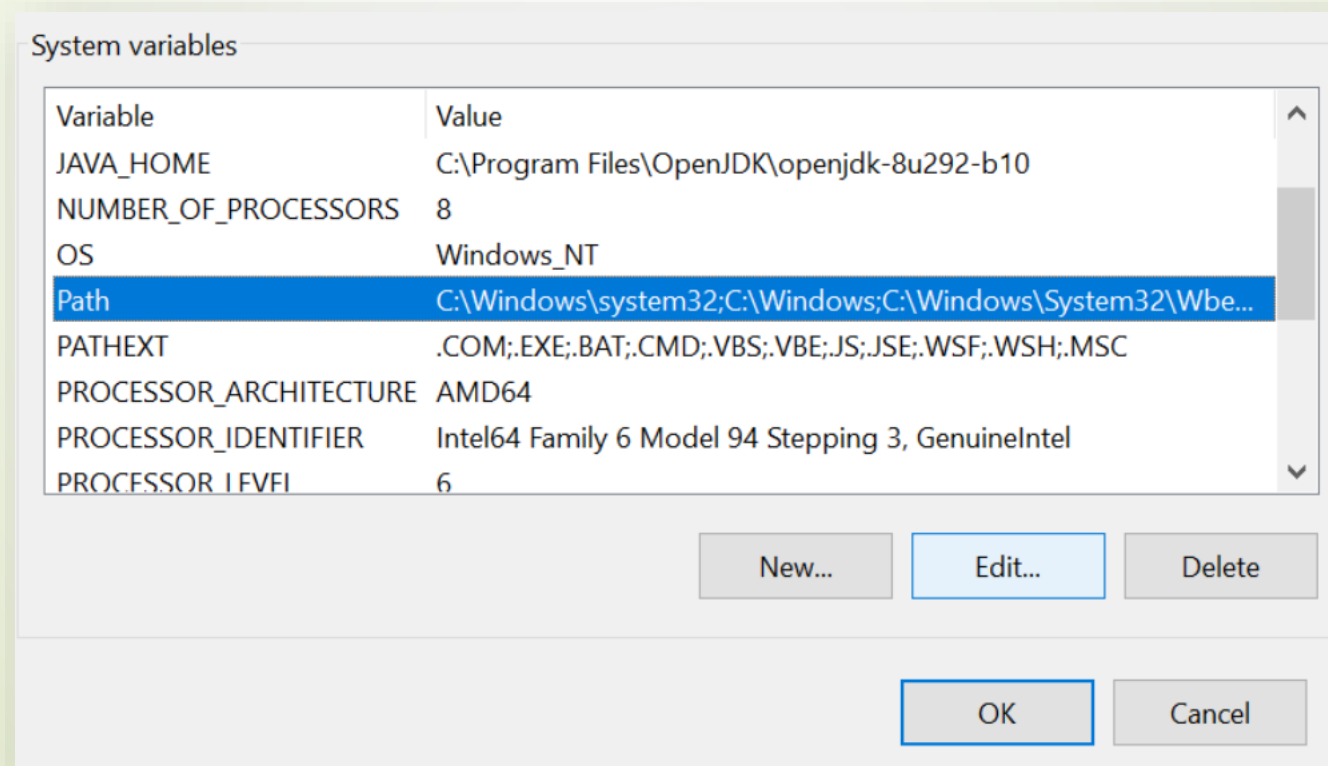
- Configuring MongoDB: Click Environment Variables button



5. MongoDB editions

Installing & configuring MongoDB on Windows

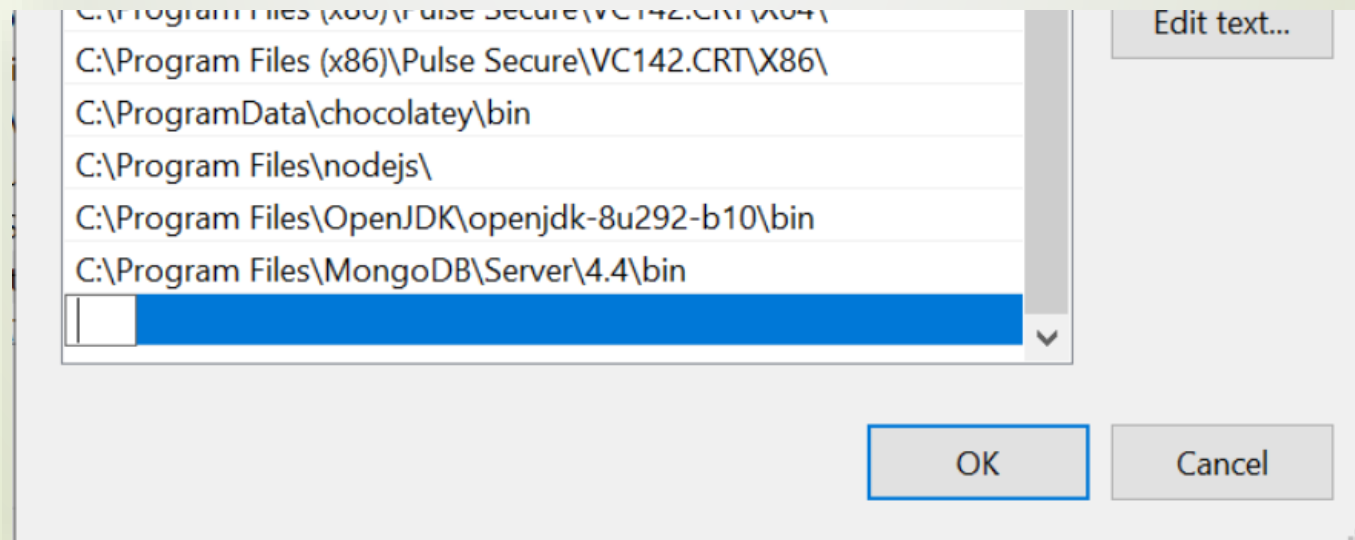
- Configuring MongoDB: Select Path from the System variables section and click edit



5. MongoDB editions

Installing & configuring MongoDB on Windows

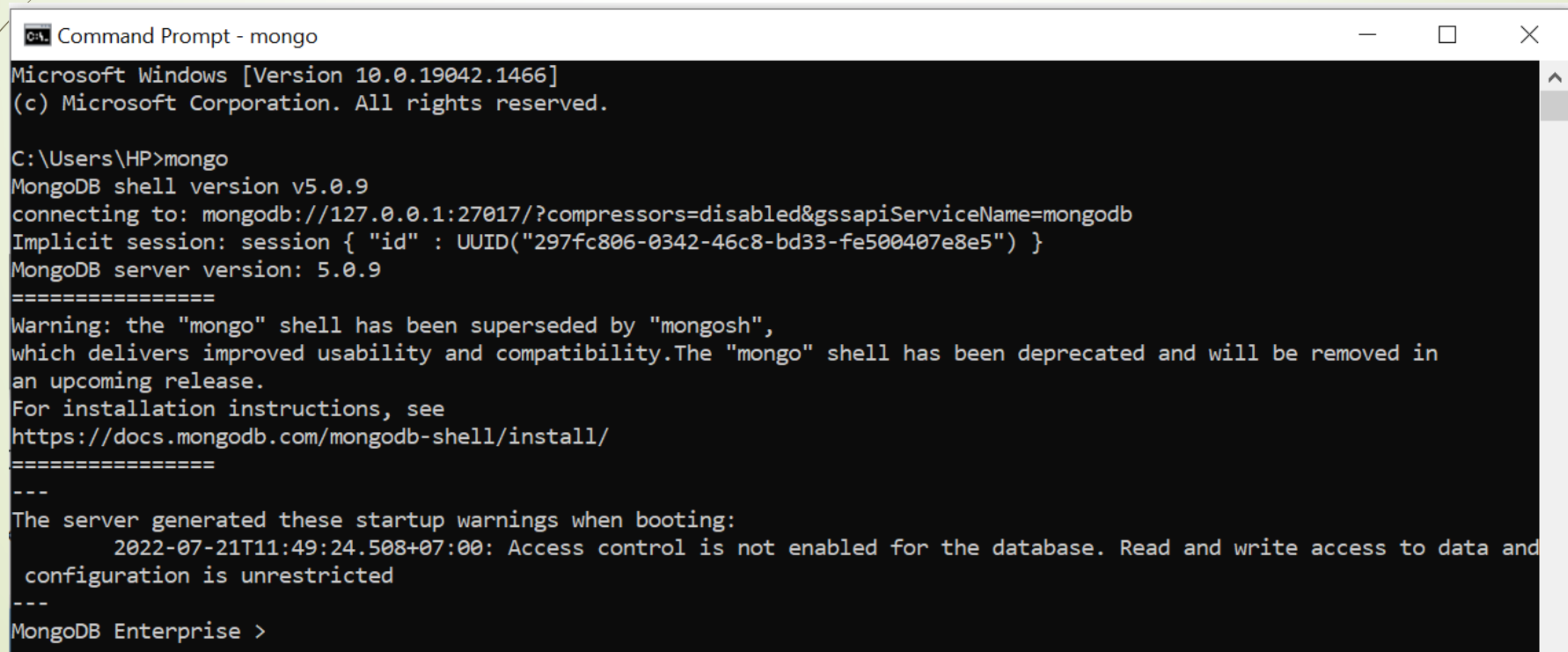
- Configuring MongoDB:
 - Click New and add the path to your mongod.exe inside the installation folder: **C:\Program Files\MongoDB\Server\5.0\bin**
 - Click OK



5. MongoDB editions

Installing & configuring MongoDB on Windows

- Configuring MongoDB:
 - Command Prompt and go to your MongoDB installation directory `cd C:\Program Files\MongoDB\Server\5.0\bin`



```
Command Prompt - mongo
Microsoft Windows [Version 10.0.19042.1466]
(c) Microsoft Corporation. All rights reserved.

C:\Users\HP>mongo
MongoDB shell version v5.0.9
connecting to: mongodb://127.0.0.1:27017/?compressors=disabled&gssapiServiceName=mongodb
Implicit session: session { "id" : UUID("297fc806-0342-46c8-bd33-fe500407e8e5") }
MongoDB server version: 5.0.9
=====
Warning: the "mongo" shell has been superseded by "mongosh",
which delivers improved usability and compatibility. The "mongo" shell has been deprecated and will be removed in
an upcoming release.
For installation instructions, see
https://docs.mongodb.com/mongodb-shell/install/
=====
---
The server generated these startup warnings when booting:
  2022-07-21T11:49:24.508+07:00: Access control is not enabled for the database. Read and write access to data and
  configuration is unrestricted
---
MongoDB Enterprise >
```

5. MongoDB editions

Installing & configuring MongoDB on Windows

- Configuring MongoDB
 - Start the MongoDB server by typing mongod.exe

```
C:\Users\HP>mongo
MongoDB shell version v5.0.9
connecting to: mongodb://127.0.0.1:27017/?compressors=disabled&gssapiServiceName=mongodb
Implicit session: session { "id" : UUID("f49f44c9-ffe2-4fdf-a774-607ba3195599") }
MongoDB server version: 5.0.9
=====
Warning: the "mongo" shell has been superseded by "mongosh",
which delivers improved usability and compatibility. The "mongo" shell has been deprecated and will be removed in
an upcoming release.
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=====
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    configuration is unrestricted
---
MongoDB Enterprise > show dbs;
admin    0.000GB
config  0.000GB
local   0.000GB
mydb    0.000GB
MongoDB Enterprise >
```

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6. MongoDB tools

- MongoDB Shell
 - Easily query data, configure settings, and execute other actions with this modern, extensible command-line interface — replete with syntax highlighting, intelligent autocomplete, contextual help, and error messages.
- MongoDB Compass
 - A powerful GUI for querying, aggregating, and analyzing your MongoDB data in a visual environment. Free to use, source available, and run on macOS, Windows, Linux..
- MongoDB Atlas CLI
 - manage MongoDB Atlas deployments from the command line
- ...

6. MongoDB tools

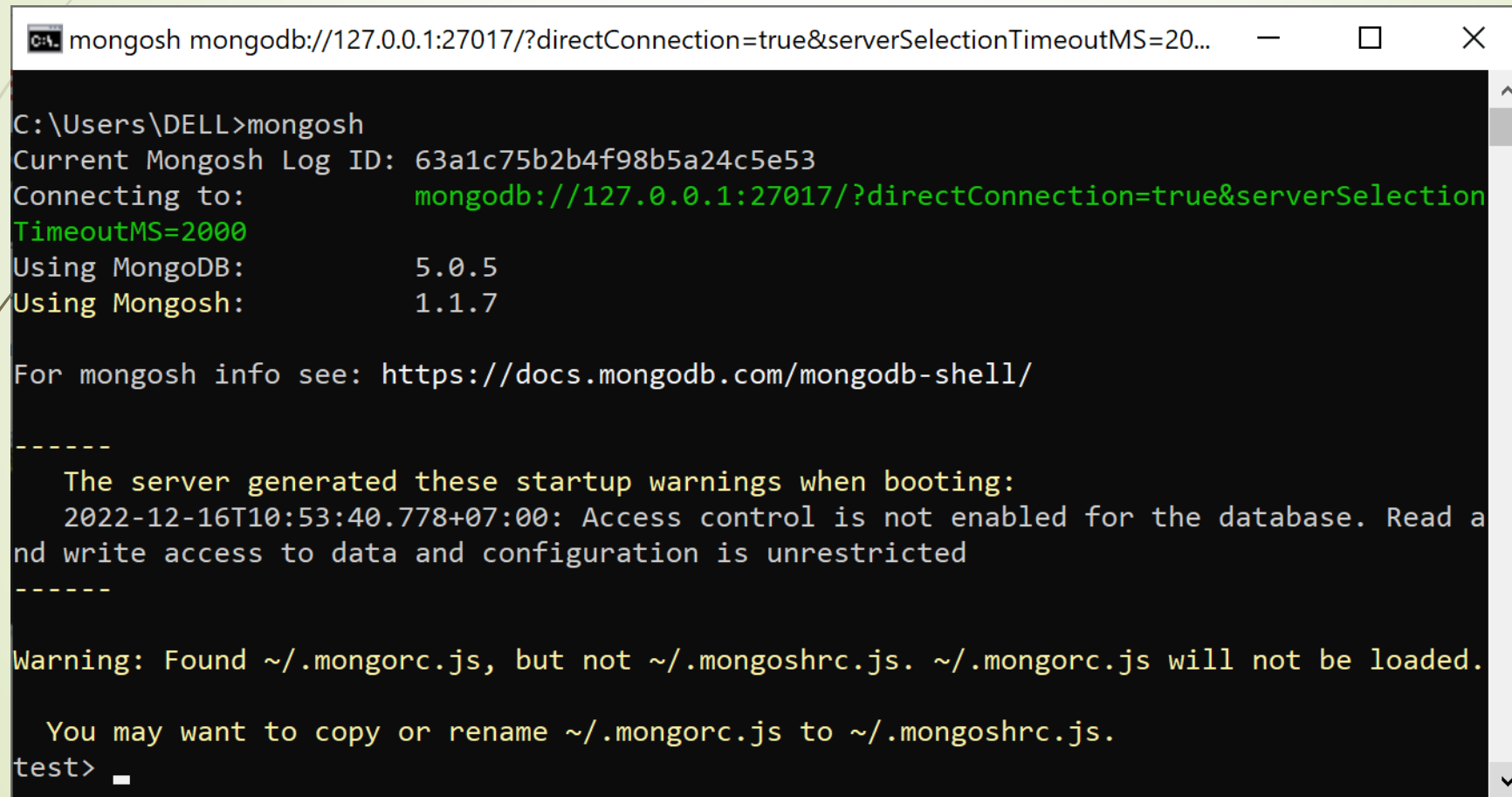
MongoDB Shell (mongosh)

- Connect to a deployment:
 - Connect to local MongoDB instance on default port:
 - `mongosh`
 - Connect to local MongoDB instance on non default port:
 - `mongosh --port 28015`
 - `mongosh --host localhost:28015`
 - Connect MongoDB instance on a remote host:
 - `mongosh "mongodb://mongodb0.example.com:28015"`
 - Connecting to Atlas:
 - `mongosh "mongodb+srv://cluster0.msr5i.mongodb.net/myFirstDatabase" -u mongobasic`

6. MongoDB tools

MongoDB Shell (mongosh)

- Example



```

C:\Users\DELL>mongosh
Current Mongosh Log ID: 63a1c75b2b4f98b5a24c5e53
Connecting to:      mongodb://127.0.0.1:27017/?directConnection=true&serverSelection
TimeoutMS=2000
Using MongoDB:      5.0.5
Using Mongosh:      1.1.7

For mongosh info see: https://docs.mongodb.com/mongodb-shell/

-----
The server generated these startup warnings when booting:
2022-12-16T10:53:40.778+07:00: Access control is not enabled for the database. Read a
nd write access to data and configuration is unrestricted
-----

Warning: Found ~/.mongorc.js, but not ~/.mongoshrc.js. ~/.mongorc.js will not be loaded.

You may want to copy or rename ~/.mongorc.js to ~/.mongoshrc.js.
test> 
```

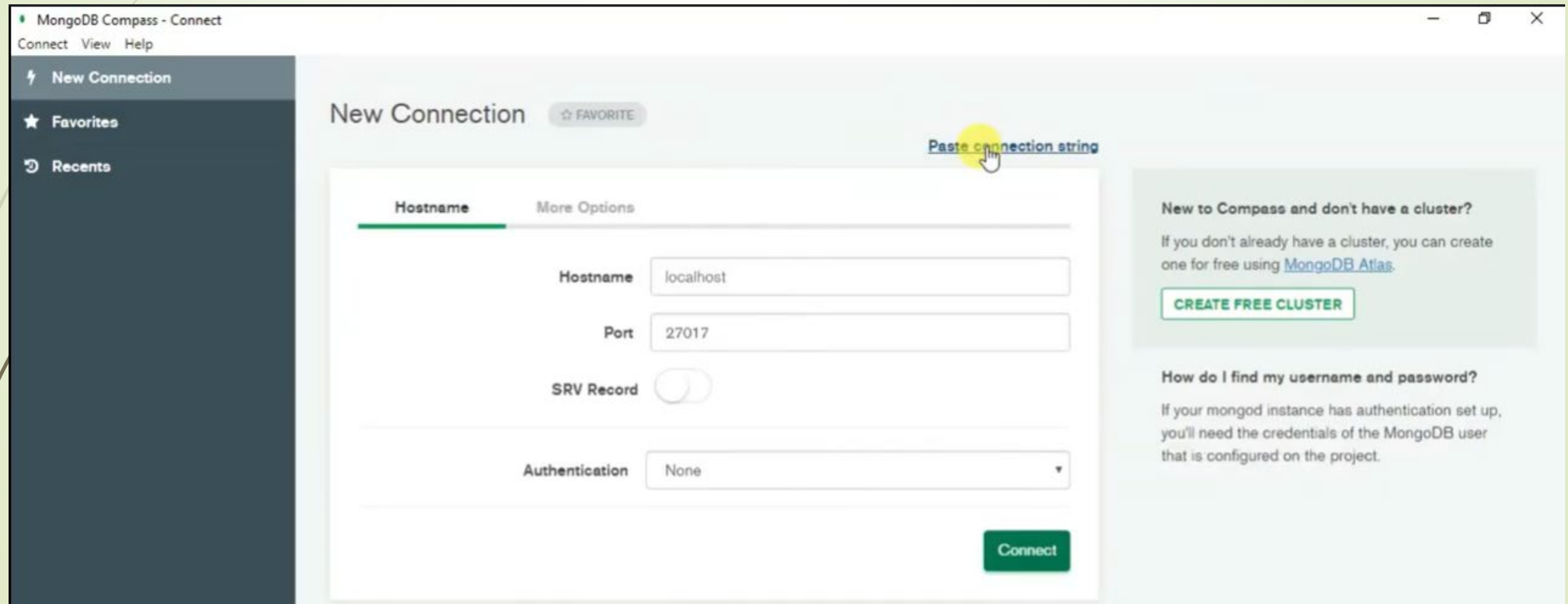
6. MongoDB tools

MongoDB Shell (mongosh)

- List the databases available to the user:
 - `show dbs`
- Switch/create databases:
 - `use <dbname>`
- List of all collections for current database:
 - `show collections`

6. MongoDB tools

MongoDB Compass



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7. MongoDB Atlas

- MongoDB Atlas is a Database-as-a-Service (DBaaS) for MongoDB. DBaaS is a service that allows you to set up, deploy, and scale a database without worrying about on-premise physical hardware, software updates, and the details of configuring for performance.
- MongoDB Atlas offers a free account using a shared cluster with up to 512MB of storage. For teams with advanced or production-ready needs, paid plans are available for dedicated and multi-region clusters.
- Atlas is available on more than 70 regions across AWS, GCP and Azure.

7. MongoDB Atlas

- How to use MongoDB Atlas?
 - Create a MongoDB Cloud account (<https://www.mongodb.com/cloud/atlas/register>)
 - Create a MongoDB Atlas cluster.
 - Configure network access and create a cluster user.
 - Connect to the cluster.



Câu hỏi hiểu bài

1. So sánh CSDL SQL và NoSQL.
2. Các đặc trưng của MongoDB.
3. Cần cài đặt gì để làm việc với CSDL MongoDB.
4. Có các công cụ hỗ trợ nào cho MongoDB.
5. MongoDB Atlas là gì.