GENERALITAT VALENCIANA
Conselleria d'Educació, Cultura i Esport

ceedcv CENTRE ESPECÍFIC D'EDUCACIÓ A DISTÀNCIA DE LA COMUNITAT VALENCIANA

Unit 2. ACCESS TO DATABASES

Part 2. Working with Non-Relational Databases

Acceso a Datos (ADA) (a distancia en inglés)

CFGS Desarrollo de Aplicaciones Multiplataforma (DAM)

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Year 2023-2024

Credits

- Notes made by Abelardo Martínez.
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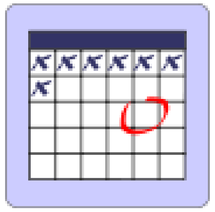
Unit progress



FROM	UNIT	WEEKNO.	DESCRIPTION	ASSESSABLE TASKS
	UNIT 1: ACCESS TO FILES			
18/09/23	UNIT 1	WEEK 1	Introduction, Java review, IDE installation and basics of Java	
25/09/23	UNIT 1	WEEK 2	Files and folders. Class File: methods, exceptions. File types	
02/10/23	UNIT 1	WEEK 3	Access types. Reading and writing operations	
09/10/23	UNIT 1	WEEK 4	Files: XML/XSL	
16/10/23	UNIT 1	WEEK 5	Files: XML/XSL	AT1.PRESENTATION
	UNIT 2: ACCESS TO DATABASES			
23/10/23	UNIT 2	WEEK 1	ACCESS TO RELATIONAL DBS	AT2.PRESENTATION
30/10/23	UNIT 2	WEEK 2	ACCESS TO NON RELATIONAL DBS	AT1.SUBMISSION
06/11/23	UNIT 2	WEEK 3	UNIT 1 AND UNIT 2 REVIEW	AT2.SUBMISSION
13/11/23	CONTENTS REVIEW			

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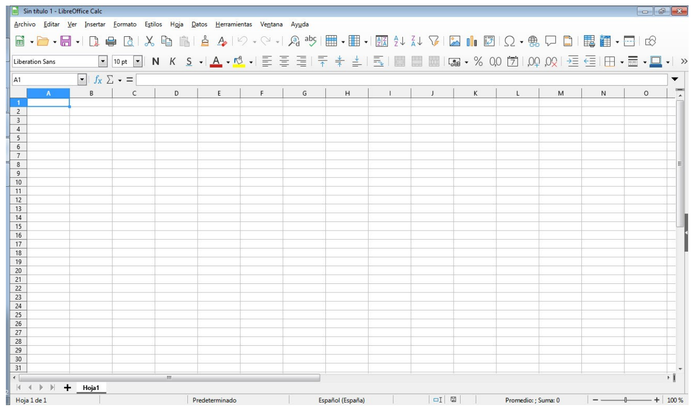
7. PATCHES IN JAVA
8. ACTIVITIES FOR NEXT WEEK
9. BIBLIOGRAPHY

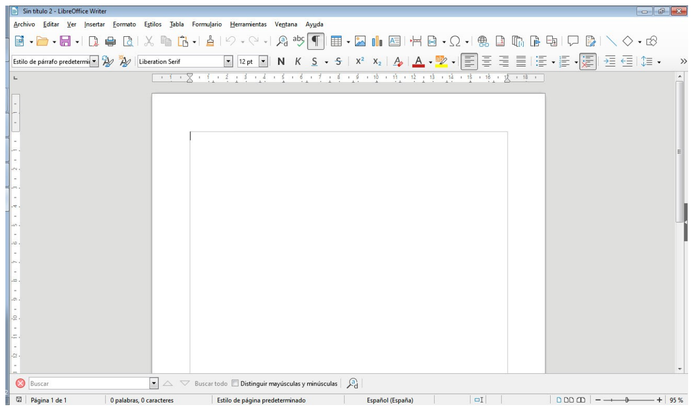
1. WHAT IS A NON-RELATIONAL DATABASE?

What is a non-relational database?

Imagine your data is a dog. In front of it, you place a **Spreadsheet** and a **Text processor document**. Which one will the dog go to?

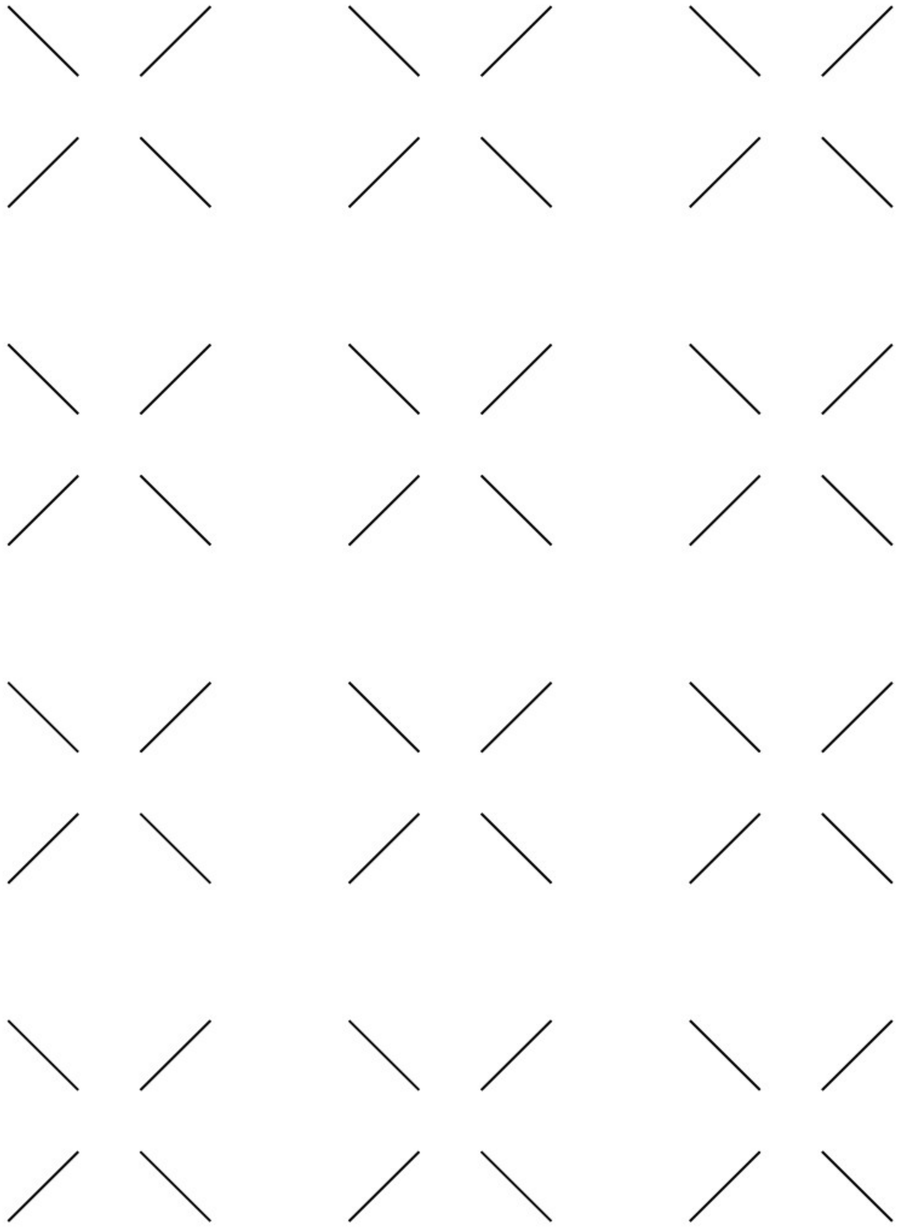
- It may be a little silly, but it’s a good way to understand exactly what kind of data works for the two main types of databases: relational and non-relational.
- Let’s go over the difference between these two types of databases, as well as list some key questions every business should answer before choosing a database.





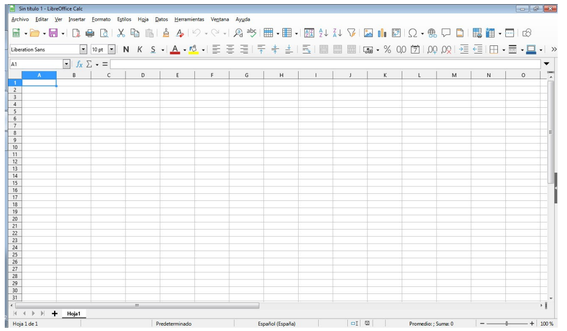
More information: https://www.logianalytics.com/relational-vs-non-relational-databases/

1.1 Relational databases



Relational Databases

Maybe the dog prefers the spreadsheet. Why? Because it fits nicely into rows and columns. A **relational database** is one that stores data in tables.



- The relationship between each data point is clear and searching through those relationships is relatively easy.
- The relationship between tables and field types is called a schema.
- For relational databases, **the schema must be clearly defined**.

Let's look at an example:

Name	Dry/Wet Food	Good Boy (Y/N)
Fido	Dry	Y
Rex	Wet	N
Bubbles	Dry	Y
Cujo	Wet	N

Tag #	Height (in)	Weight (lbs)
1573	15	21
2684	9	7
3795	27	130
4806	6	5

Tag #	Name	Breed	Color	Age
1573	Fido	Beagle	Brown/White	1.5
2684	Rex	Pekingese	White	9
3795	Bubbles	Rottweiler	Black	5
4806	Cujo	Chihuahua	Gold	4

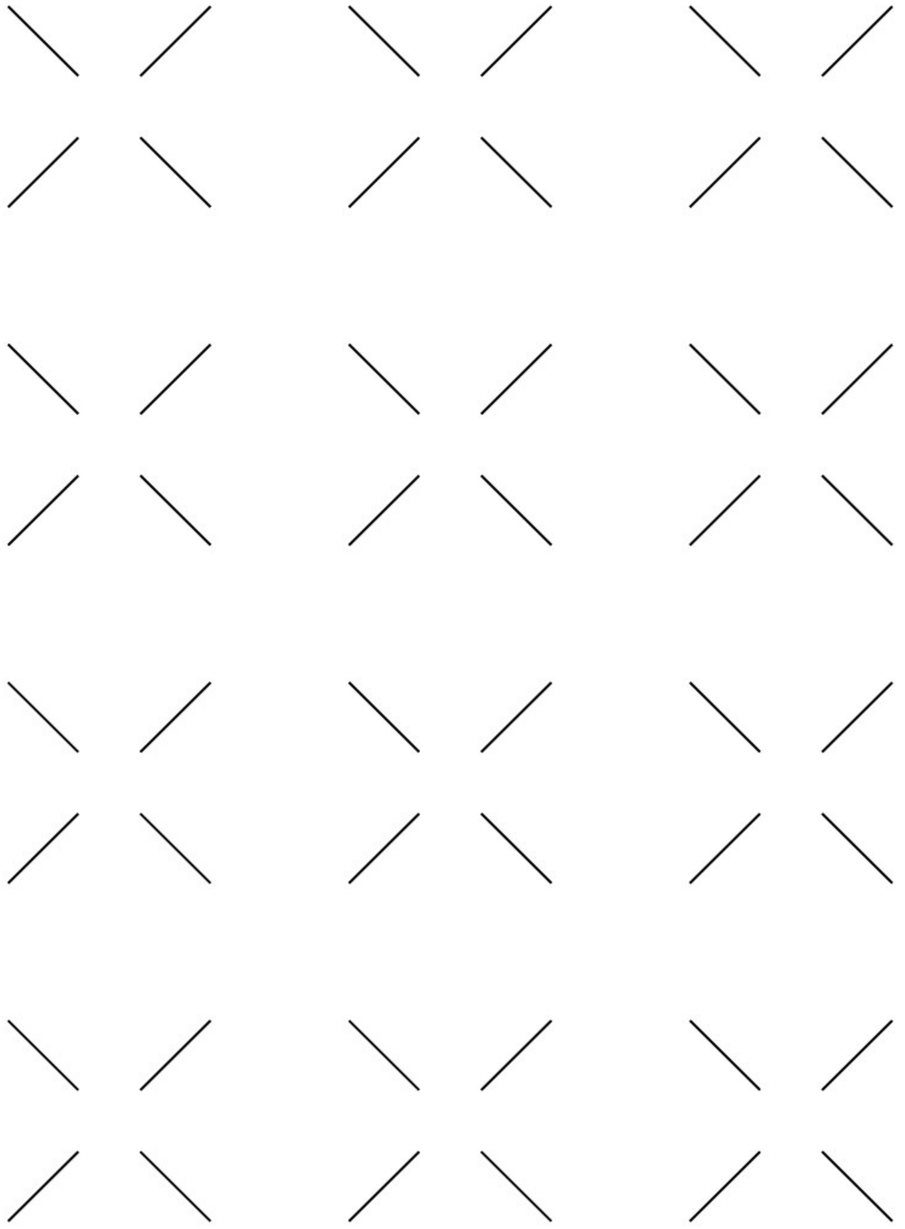
SQL language. RDBMSs

Relational databases are also called SQL databases.

- **SQL** stands for **S**tructured **Q**uery **L**anguage and it's the language relational databases are written in.
- SQL is used to execute queries, retrieve data, and edit data by updating, deleting or creating new records.

On the right you can see an infogram with the main RDBMSs.

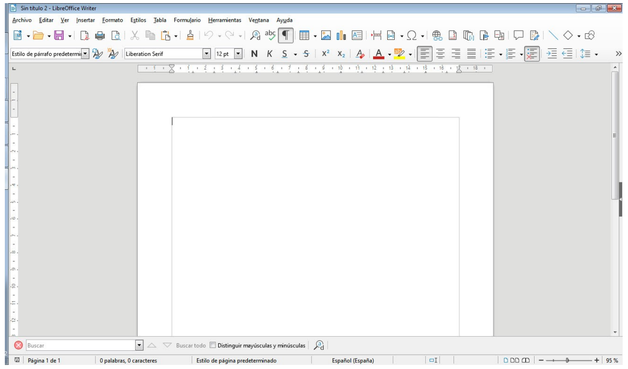
1.2 Non-Relational databases



Non-Relational Databases

Back to your “data dog.” This time, it went over to the **Text processor doc**. Why? All the open space! The data comes in all different shapes and sizes. It needs room to spread out.

A non-relational database is any database that **does not use the tabular schema of rows and columns like in relational databases**. Rather, its storage model is optimized for the type of data it’s storing.

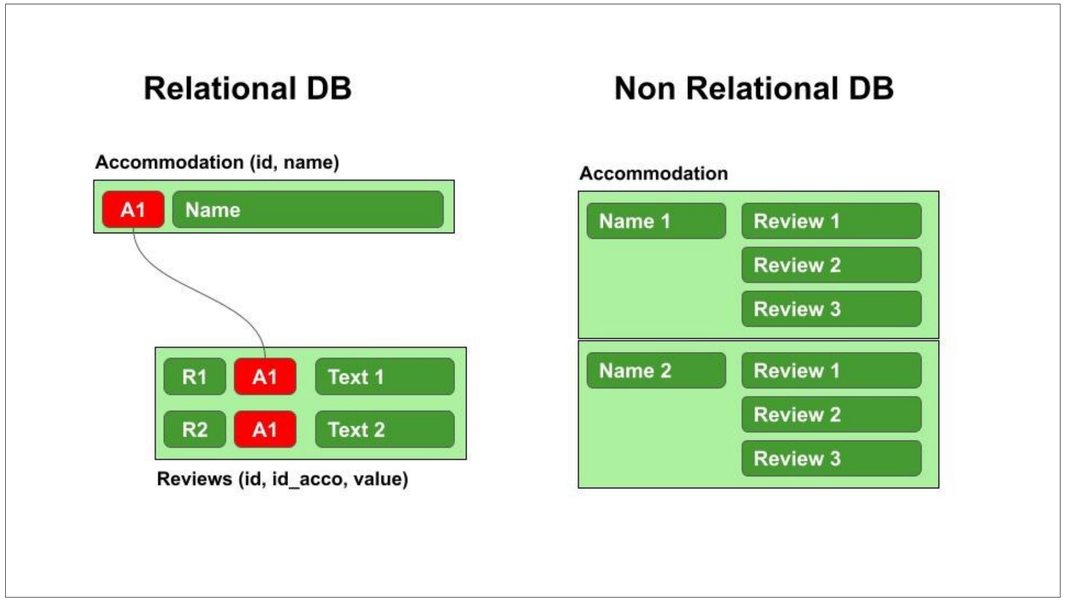


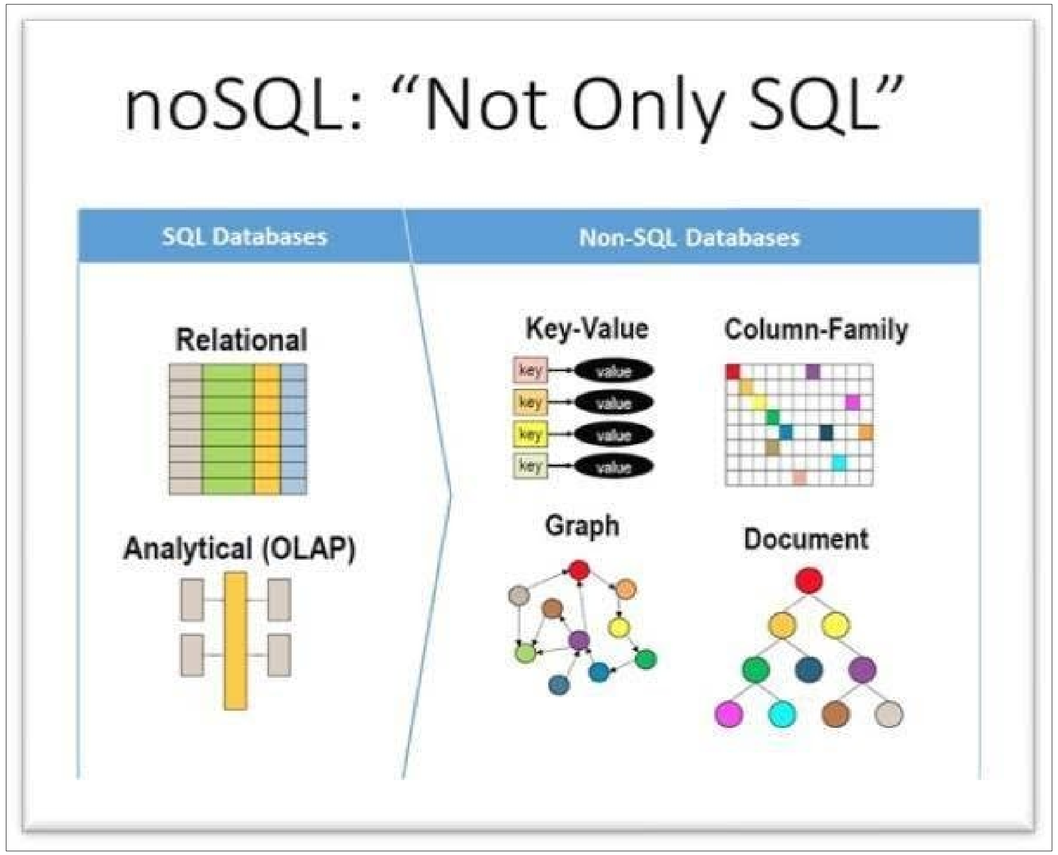
RELATIONAL DATABASE
VERSUS
NONRELATIONAL DATABASE

RELATIONAL DATABASE	NONRELATIONAL DATABASE
A database based on the relational model of the data, as proposed by E.F. Codd in 1970	A type of database that provides a mechanism for storing and retrieving data that is modeled in a way other than the tabular relations used in relational databases
Also called SQL databases	Also called NoSQL databases
Tables can be joined together	There is no joint concept
Use SQL	Do not use SQL
Cannot be categorized further	Types include key-value, documents, column, and graph databases
Help to achieve complex querying, provide flexibility and help to analyze data	Work well with a large amount of data, reduce latency and improve throughput
Ex: MySQL, SQLite3, and, PostgreSQL	Ex: Cassendra, Hbase, MongoDB, and, Neo4

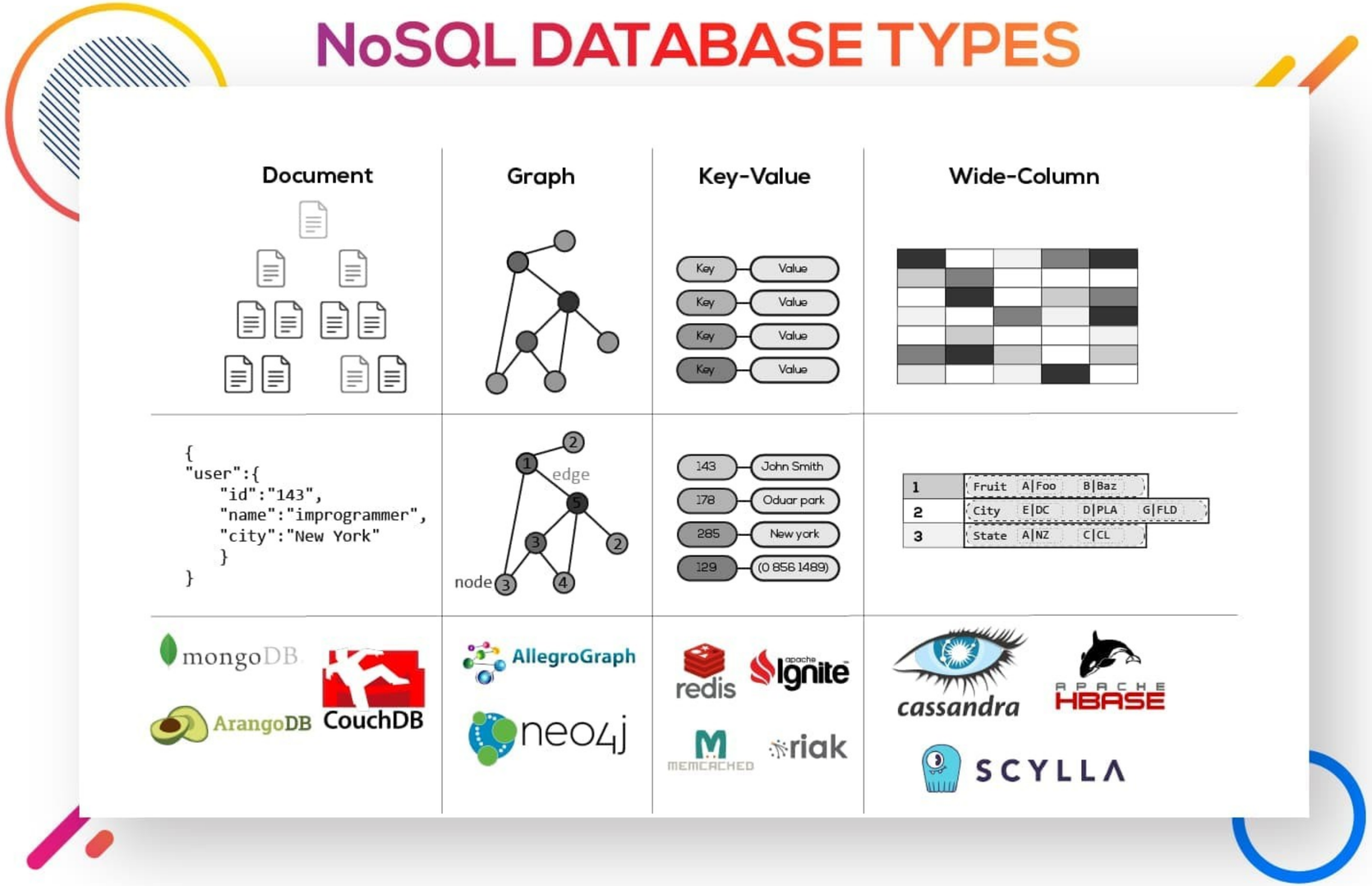
Visit www.PEDIAA.com

Relational and Non-Relational databases. Differences

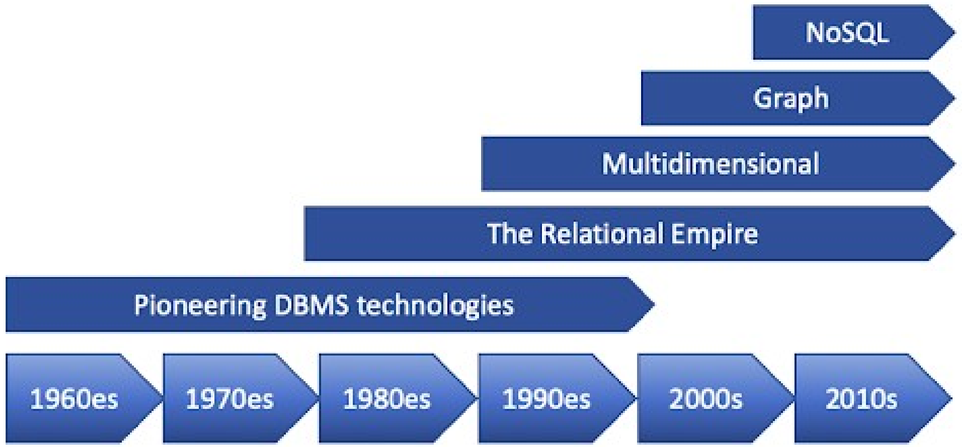


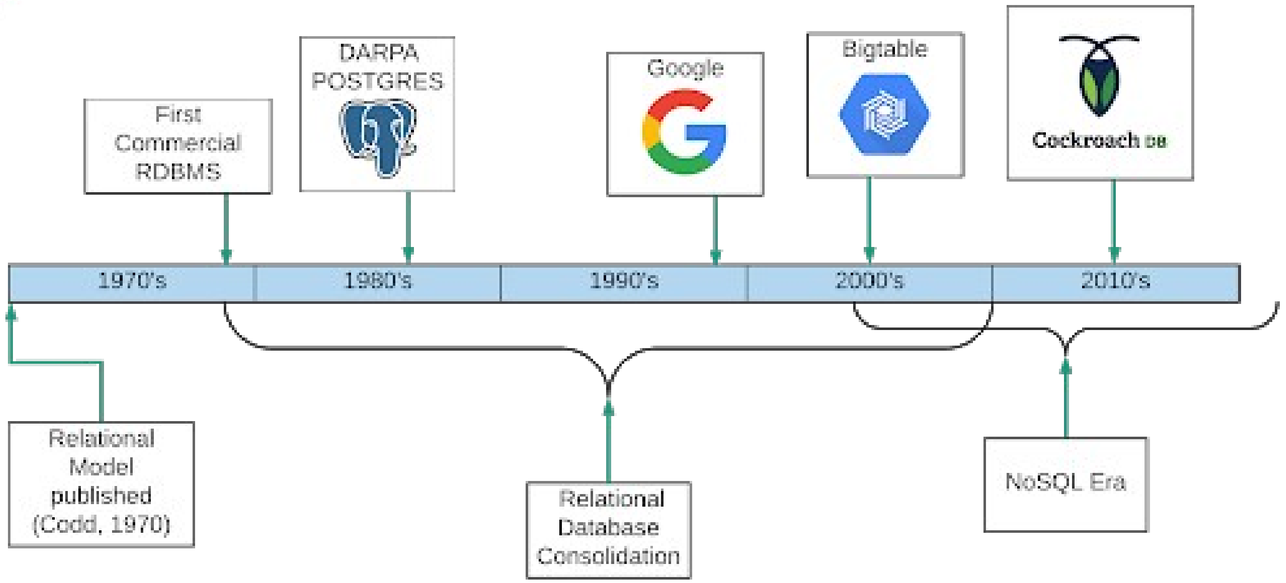


Types of Non-Relational databases



Databases timeline



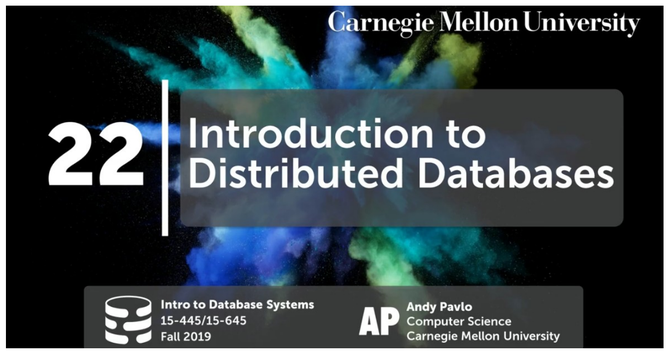


Recommended resources

We’re not going to go deeper into those databases in this module; instead we will be accessing MongoDB from Java, one non-relational DBMS which its growing has been exponential last decade.

For a deeper dive into non-relational databases, here are a few recommended resources:

- Introduction to No-SQL Databases. https://www.youtube.com/watch?v=uD3p_rZPBUQ
- Introduction to MongoDB (video tutorial). https://www.youtube.com/watch?v=pWbMrx5rVBE
- Introduction to MongoDB (tutorial). https://www.tutorialspoint.com/mongodb/index.htm
- No-SQL Database Guide for Beginners. https://hostingdata.co.uk/how-to-use-nosql-databases-guide/
- Seminar on Distributed Databases (90 min). https://www.youtube.com/watch?v=0_m5gPfzEYQ



2. WHAT IS MONGODB?

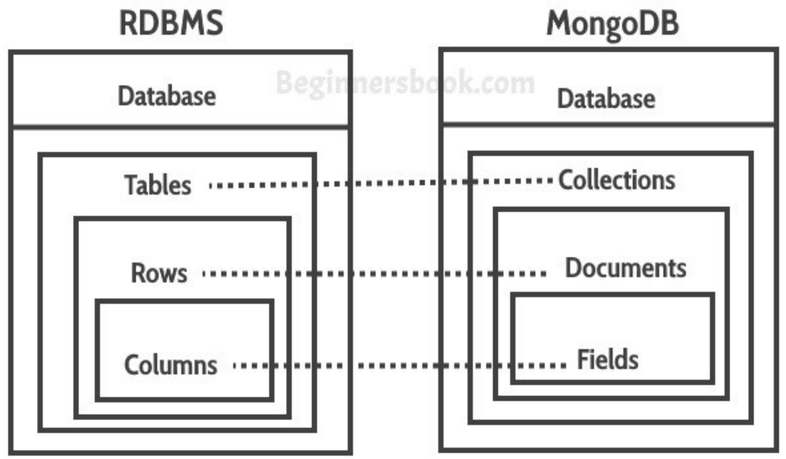
MongoDB

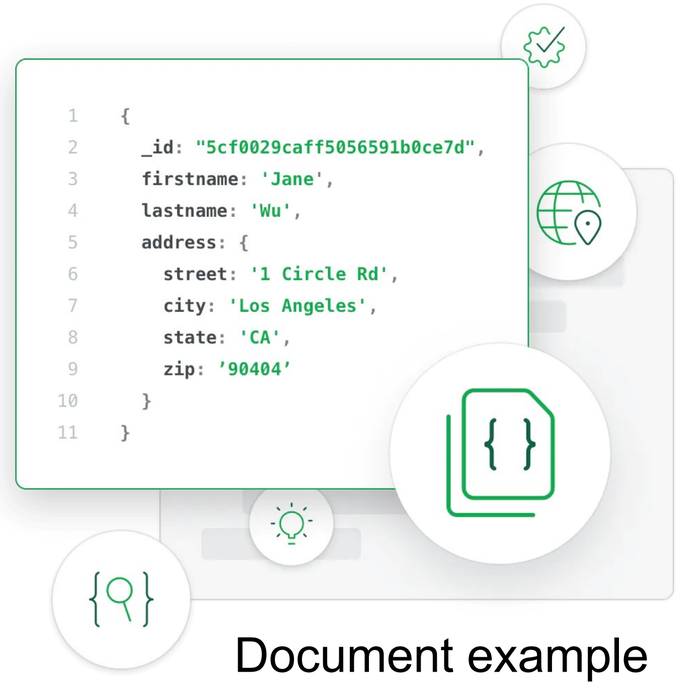
MongoDB is a **document-oriented No-SQL database** used for high volume data storage.

Instead of using tables and rows as in the traditional relational databases, MongoDB makes use of collections and documents.

- **Documents** consist of key-value pairs which are the basic unit of data in MongoDB.
- **Collections** contain sets of documents and function which is the equivalent of relational database tables.

MongoDB is a database which came into light around the mid-2000s.





Document example

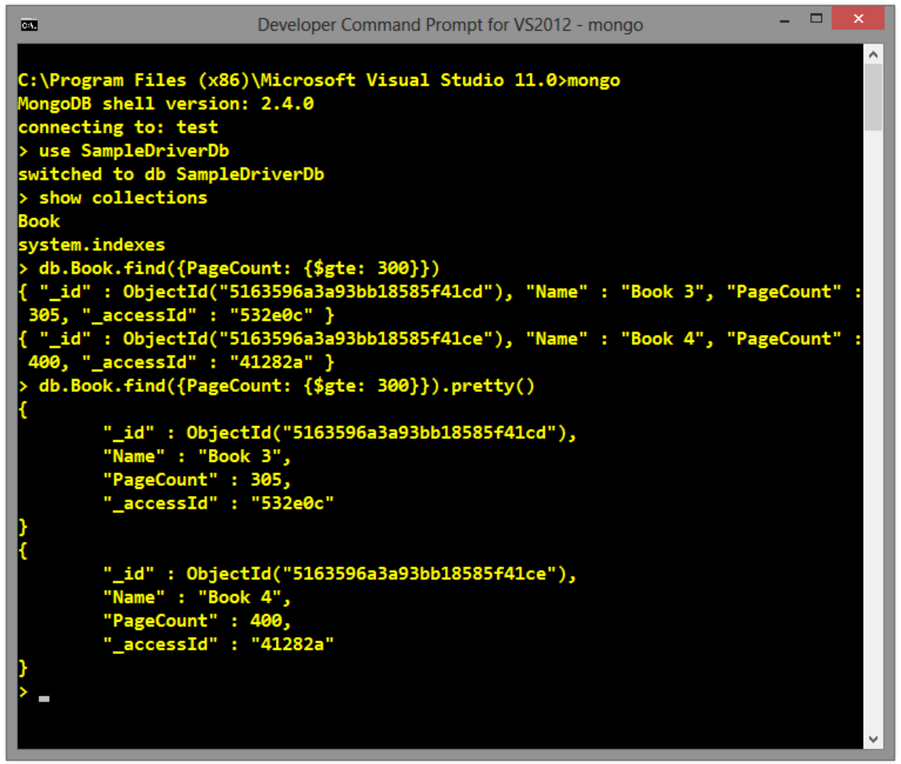
MongoDB. Installation

Everything you know changes in non-relational databases.

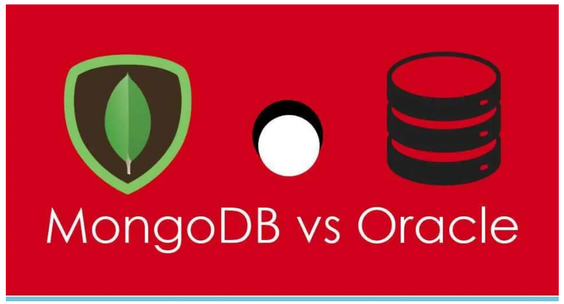
To install MongoDB you can use these resources:

- Official website: Install MongoDB Community Edition on Ubuntu
- Easy tutorial: How To Install MongoDB In 2 Minutes

Then, you can use Compass, Atlas or the console.



MongoDB vs Oracle



#1. About & Description

MongoDB	Oracle
MongoDB is one of the most famous stores of documents.	Oracle Database is multi-model database management system and it is highly used RDBMS to build enterprise applications.

#2. Secondary Database Models

MongoDB	Oracle
In MongoDB, it uses Secondary database models is Key-value store:From an API perspective, Key-value stores are the very easiest NoSQL data stores to use and these are the simplest form of DBMS. Key-value stores are always will have very high performance and can be easily scaled; this is because it always uses primary-key access.	In Oracle DB, it uses Secondary database models are Document store, Graph DBMS info, Key-value store and RDF store info.Document store: Document stores are characterized by its schema-free organization of data. Records in it need not have a uniform structure and those records can also have nested structure.Graph DBMS: It is also known as graph-oriented DBMS. In this type, data can be represented in graphical structures as nodes and edges.RDF store: The RDF (Resource Description Framework) is a methodology to describe the information, and it is exclusively developed to describe the metadata of IT resources.

#3. Implementation language

MongoDB	Oracle
A MongoDB is written in C++, C and JavaScript programming language.	An Oracle database is written in Assembly language, C, and C++ programming language.

#4. Server-side scripts

MongoDB	Oracle
In MangoDB, JavaScript is the programming language used in Server-side scripting.	In Oracle DB, PL/SQL is the programming language used in Server-side scripting.Also uses java in developing Stored procedures.

#5. Server Operating Systems

MongoDB	Oracle
MangoDB can be operated in the following Operating systems: Windows Vista and later, Linux, OS X 10.7 and later, Solaris, and FreeBSD.	MangoDB can be operated on all major platforms / operating systems including Windows, UNIX, Linux and Mac OS.

#6. Specific Characteristics

MongoDB	Oracle
MongoDB is considered as the next-generation database which helps in businesses transform their industries by taking a control over the power of data.	Oracle database is a multi-model and world's most popular database.It is commonly used for running online transaction processing (OLTP), data warehousing (DW) applications and mixed (OLTP & DW) database workloads.

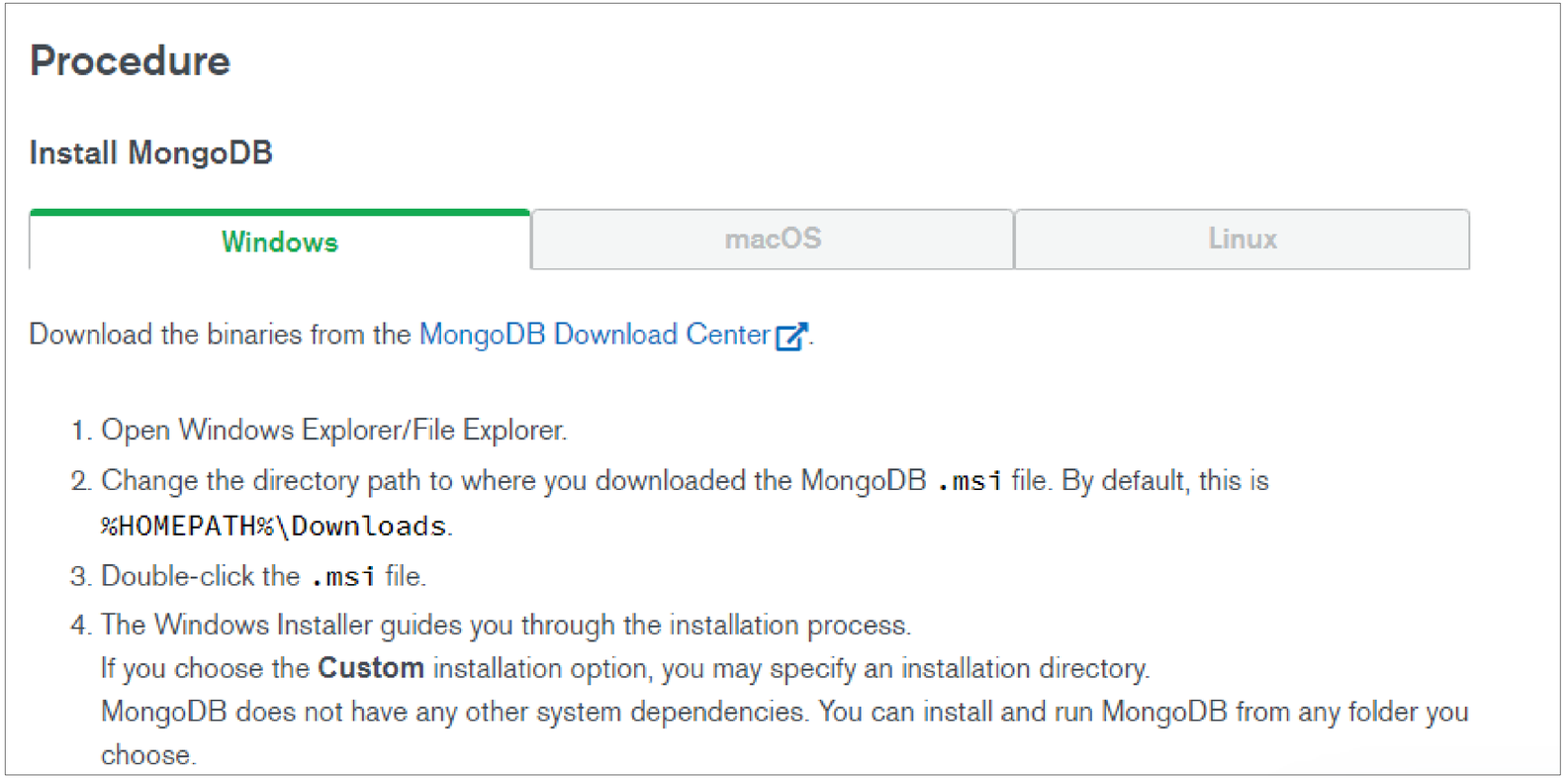
www.educba.com

3. CONNECTING TO MONGODB

Step 1. Install MongoDB

Let's see an example of a MongoDB database connection and query.

- Install MongoDB: https://www.mongodb.com/docs/manual/tutorial/install-mongodb-on-ubuntu/



Procedure

Install MongoDB

Windows | macOS | Linux

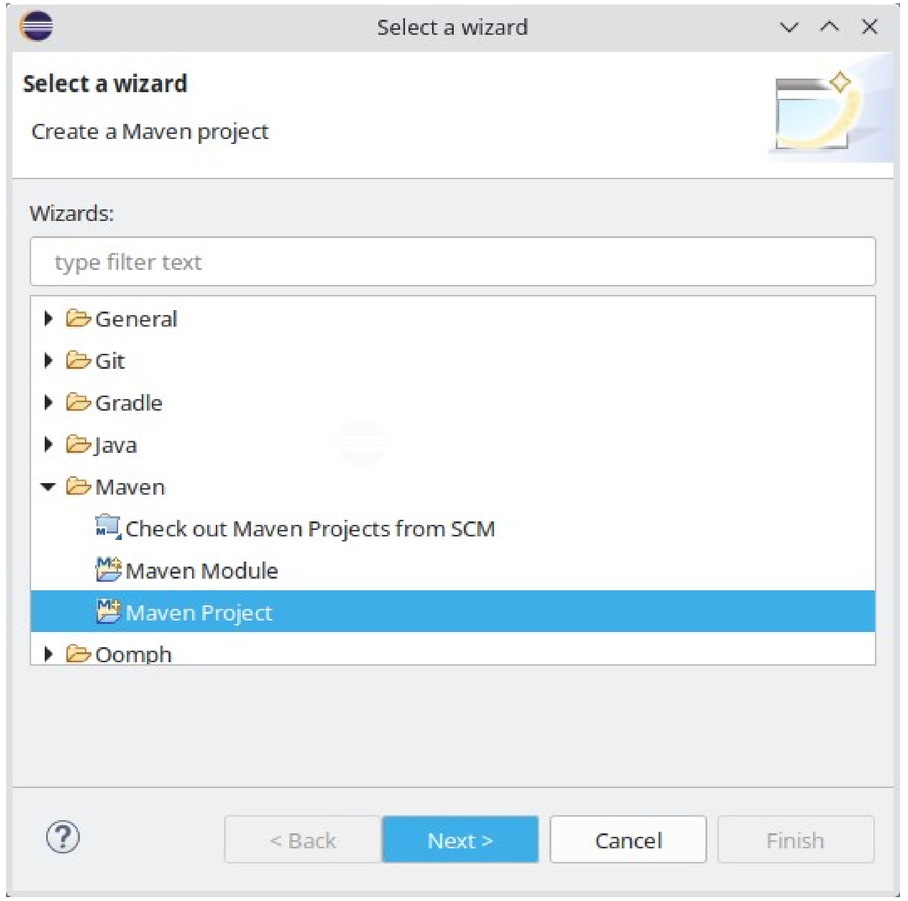
Download the binaries from the MongoDB Download Center.

1. Open Windows Explorer/File Explorer.
2. Change the directory path to where you downloaded the MongoDB `.msi` file. By default, this is `%HOMEPATH%\Downloads`.
3. Double-click the `.msi` file.
4. The Windows Installer guides you through the installation process.
   If you choose the **Custom** installation option, you may specify an installation directory.
   MongoDB does not have any other system dependencies. You can install and run MongoDB from any folder you choose.

Step 2. Create the project within the IDE

The first step is to open Eclipse, which comes with the integrated Maven environment.

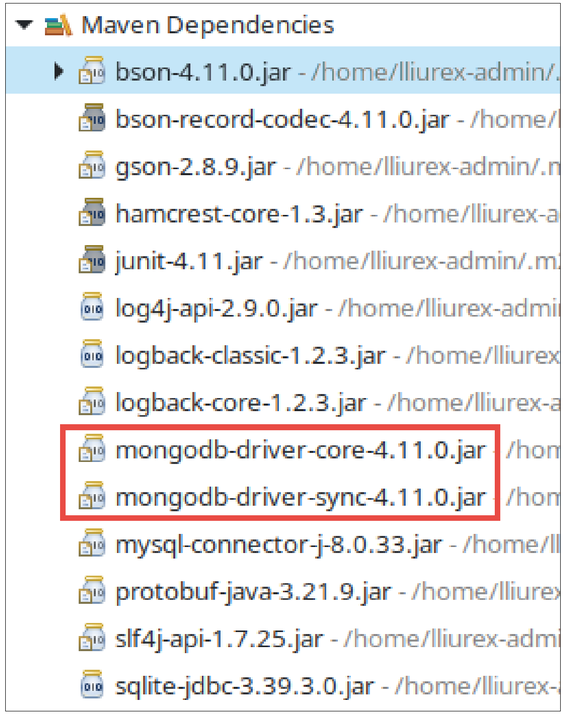
- Go to the File menu, option **New** → **Project**.
- Select the **Maven Project** option.
- We follow the rest of the steps explained in the extended notes.
- Finally, we select **Project** → **Clean** on our project so the necessary libraries and files have been downloaded correctly.



Step 3. Add the dependency to the POM file

```
<?xml version="1.0" encoding="UTF-8"?>
<project                                    xmlns="http://maven.apache.org/POM/4.0.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
                              xsi:schemaLocation="http://maven.apache.org/POM/4.0.0
http://maven.apache.org/xsd/maven-4.0.0.xsd">
  <modelVersion>4.0.0</modelVersion>
  <groupId>com.simplilearn</groupId>
  <artifactId>U2JDBCExample</artifactId>
  <version>0.0.1-SNAPSHOT</version>
  <name>U2JDBCExample</name>
      [...]
  <dependencies>
   <!-- https://mvnrepository.com/artifact/org.mongodb/mongodb-driver-sync -->
   <dependency>
       <groupId>org.mongodb</groupId>
       <artifactId>mongodb-driver-sync</artifactId>
       <version>4.11.0</version>
   </dependency>
   <!--  Gson: Java to Json conversion -->
   <dependency>
       <groupId>com.google.code.gson</groupId>
       <artifactId>gson</artifactId>
       <version>2.8.9</version>
       <scope>compile</scope>
   </dependency>
  </dependencies>
```

Go here and click on your MongoDB version number to get the code:
https://mvnrepository.com/artifact/org.mongodb/mongodb-driver-sync



Step 4. Create a class, the imports and connection methods

- We create a class called DBMongoDB.
- We create the necessary imports.
- We create the connection methods to the database

```
import com.mongodb.client.MongoClient;
import com.mongodb.client.MongoClients;
import com.mongodb.client.MongoCollection;
import com.mongodb.client.MongoCursor;
import com.mongodb.client.MongoDatabase;
import com.mongodb.client.MongoIterable;
import com.mongodb.client.model.Projections;

import org.bson.Document;
```

For further information “**Connect to MongoDB**”:
https://www.mongodb.com/docs/drivers/java/sync/upcoming/fundamentals/connection/connect/

```
    /*
     * Static method: Just try to connect to the database
     */
    public static MongoClient ConnectToDB() {

        try {
            // https://www.mongodb.com/languages/java
            // You can instantiate a MongoClient object without any parameters
to connect to
            // a MongoDB instance running on localhost on port 27017:
            MongoClient cnDB =
MongoClients.create("mongodb://localhost:27017");
            System.out.println("Connection to database has been established.");
            return cnDB;
        } catch (Exception exe) {
            System.out.println("Something was wrong while trying to connect to
the database!");
            exe.printStackTrace(System.out);
        }
        return null;
    }

    /*
     * Static method: Just try to disconnect to the database
     */
    public static void CloseDB(MongoClient cnDB) {

        try {
            cnDB.close(); //close connection to the DB
        } catch (Exception exe) {
            System.out.println("Something was wrong while closing the
database!");
            exe.printStackTrace(System.out);
        }
    }
```

Step 5. Connect to the database

Establish the connection

The connection to the DB is established using the getDatabase method passing as parameter DBNAME, which is the name of the DB.

```
public static void main(String[] stArgs) {
   MongoClient cnDB = ConnectToDB();

   try {
      //Instruction getDB is deprecated!
      //establish the connection to DBCompany
      MongoDatabase mDBCompany = cnDB.getDatabase(“DBCompany”);

   } catch (Exception exe) {
      System.out.println("Something went wrong!");
      exe.printStackTrace(System.out);
   }
   CloseDB(cnDB);

}
```

4. DDL QUERIES

Execute DDL sentences

We can check if the collection exists or not and then create it.

```
public static void main(String[] stArgs) {
   MongoClient cnDB = ConnectToDB();

   try {
      //Instruction getDB is deprecated!
      //establish the connection to DBCompany
      MongoDatabase mDBCompany = cnDB.getDatabase("DBCompany");
      CreateCollectionIfNotExists(mDBCompany);

   } catch (Exception exe) {
      System.out.println("Something went wrong!");
      exe.printStackTrace(System.out);
   }
   CloseDB(cnDB);

}
```

```
   /*
    * Static method: Check if collection exists
    * https://stackoverflow.com/questions/53810753/how-to-check-
collection-mongo-db-in-java
    */
   public static boolean CollectionExists(String stCollection,
MongoDatabase mDBCompany) {

      MongoIterable<String> mitCollection =
mDBCompany.listCollectionNames();
      for (String stIterCollection : mitCollection) {
         if (stIterCollection.equals(stCollection)) {
            return true;
         }
      }
      return false;
   }

   /*
    * Static method: Create collection if not exists
    */
   public static void CreateCollectionIfNotExists(MongoDatabase
mDBFactory) {

      try {
         if (!(CollectionExists("Employees", mDBFactory))) {
            System.out.println("Collection does not exist");
            mDBFactory.createCollection("Employees");
            System.out.println("Created collection Employee in given
database...");
         }
      } catch (Exception exe) {
         System.out.println("Something was wrong when creating the
collection!");
         exe.printStackTrace(System.out);
      }
   }
```

5. DQL QUERIES

Reading a collection

Here you can see how we would do this using the console. In this case it refers to a database of books.

```
> db.books.find()
{ "_id" : ObjectId("61870b7ecb963b5a502f52e8"), "bookId" : "12312312", "bookName" : "HARRY POTTER" }
{ "_id" : ObjectId("61870b7ecb963b5a502f52e9"), "bookId" : "34556346", "bookName" : "ETERNALS" }
> db.books.find({},{_id:0})
{ "bookId" : "12312312", "bookName" : "HARRY POTTER" }
{ "bookId" : "34556346", "bookName" : "ETERNALS" }
>
```

```
      MongoCollection<Document> mcolBook =
mDBLibrary.getCollection("books");
      // Retrieving the documents
      MongoCursor<Document> mcuBook =
mcolBook.find().projection(Projections.excludeId()).iterator();
      int iNumItems = 0;
      while (mcuBook.hasNext()) {
         iNumItems++;
         Document docBook = mcuBook.next();
         System.out.println("Book ID: " + (String)
docBook.get("bookId"));
         System.out.println("Book name: " + (String)
docBook.get("bookName"));
      }
      if (iNumItems == 0)
         System.out.println("No items found at the collection");
      }
      mcuBook.close(); //close cursor
```

We need to remove the self-generated _id field

Output:

```
{ "bookId" : "12312312", "bookName" : "HARRY POTTER" }
{ "bookId" : "34556346", "bookName" : "ETERNALS" }
```

6. DML QUERIES

Inserting data

Here you can see how we would do this using the console. In this case it refers to a database of books.

```
> db.createCollection("books")
{ "ok" : 1 }
> db.books.insertMany([{bookId:"123112312", bookName: "HARRY POTTER"}, {bookId: "34556346", bookName: "ETERNALS"}])
{
        "acknowledged" : true,
        "insertedIds" : [
                ObjectId("61870da1ce53823a1e3fa27e"),
                ObjectId("61870da1ce53823a1e3fa27f")
        ]
}
> db.books.find({},{_id:0})
{ "bookId" : "123112312", "bookName" : "HARRY POTTER" }
{ "bookId" : "34556346", "bookName" : "ETERNALS" }
>
```

```
MongoClient cnDB = connectToDabatase();
try {
    MongoDatabase mDBLibrary = cnDB.getDatabase(“DBLibrary”);

    Iterator<Book> itBook = arlBook.iterator();
    Document docBook;
    while (itBook.hasNext()) {
        itemFound = (Book) (itBook.next());
        bookId = String.valueOf(itemFound.getISBN());
        bookName = String.valueOf(itemFound.getName());
        docBook = new Document("bookId", bookId).append("bookName",
bookName);
        System.out.println("Element about to be inserted...”);
        mDBLibrary.getCollection(“books”).insertOne(docBook);
    }
} catch (Exception exe) {
    System.out.println("Something was wrong while populating the
collection!");
    exe.printStackTrace(System.out);
}
closeDatabase(cnDB);
```

Assume that we have an arrayList with the books.

We can do several times **insertOne** or do just one **insertMany**

7. PATCHES IN JAVA

Useful resources

By default, Mongo driver shows a text message with every operation. Use this patch (imports + POM lines + method) to remove this annoyning feature.

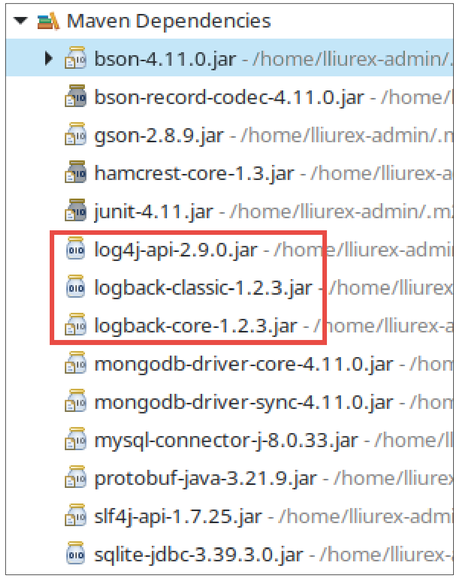
```
<!--  prevent log to print unwanted messages -->
<dependency>
    <groupId>org.apache.logging.log4j</groupId>
    <artifactId>log4j-api</artifactId>
    <version>2.9.0</version>
</dependency>
<!--  prevent log to print unwanted messages -->
<dependency>
    <groupId>ch.qos.logback</groupId>
    <artifactId>logback-classic</artifactId>
    <version>1.2.3</version>
</dependency>
```

```
import org.slf4j.LoggerFactory;

import ch.qos.logback.classic.Level;
import ch.qos.logback.classic.LoggerContext;

[…]

/*
 * Static method: Disable annoying mongoDB log messages This method require add some code to POM
 * https://stackoverflow.com/questions/30137564/how-to-disable-mongodb-java-driver-logging
 */
public static void DisableMongoLogging() {
   ((LoggerContext)
LoggerFactory.getILoggerFactory()).getLogger("org.mongodb.driver").setLevel(Level.ERROR);
}
```



Source: https://stackoverflow.com/questions/30137564/how-to-disable-mongodb-java-driver-logging

8. ACTIVITIES FOR NEXT WEEK

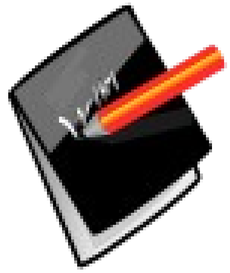
Proposed activities

Check the suggested exercises you will find at the “Aula Virtual”. **These activities are optional and non-assessable but** understanding these non-assessable activities is essential to solve the assessable task ahead.

Shortly you will find the proposed solutions.

9. BIBLIOGRAPHY

Resources



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