# Theory: Introduction to databases



10 minutes 0 / 4 problems solved



The world today is overloaded with information, and so are we. How do you keep important information safe and sorted? You may simply hope you neither forget nor confuse anything, but it's better to write it down or save it on your device. So you have it on your computer or phone, and the program keeps the information safe. While the program is active, it "remembers" everything. However, quitting the program may result in losing all that information. That's why it's better to keep the data using more sophisticated tools.

The challenge is to navigate a huge and complex web of information and ensure everything important is safe and organized: a task that **databases** handle well.

## §1. Database

A **database** is a collection of data that is specifically organized for rapid search and retrieval processed by a computer.

The difference between a database and a usual file is that a file may be structured or not, but a database must have a specific structure. For example, you can create a file with a to-do list:

To-do

1. Do groceries
2. Work out
3. Read a book
4. ...

Obviously, we'd say that this file has some kind of a structure, but from a computer's perspective, it's still a plain file, until you write a program that manages data in it. Usually, the information in databases is compressed and stored as binaries rather than plain text, so it's clear that this kind of structure is meant for computers, not humans.

Unlike us, computers can easily understand the binary format of data, but what allows them to read and write it correctly? It is a program called **Database Management System** that controls the data in a database.

## §2. Database Management System

Database Management System (**DBMS**) is a type of software that allows users to define, create, and control data in a database.

DBMS is a mediator between a user and a database, which means that users can work with databases through the interface of DBMS.

We need DBMS to make databases more efficient, because developers can optimize data structures and algorithms for databases independently of the user interface.

Another goal of this software is to help users work with different databases without exposing their actual differences.

Current topic:

Introduction to databases

Topic depends on:

✓ Files

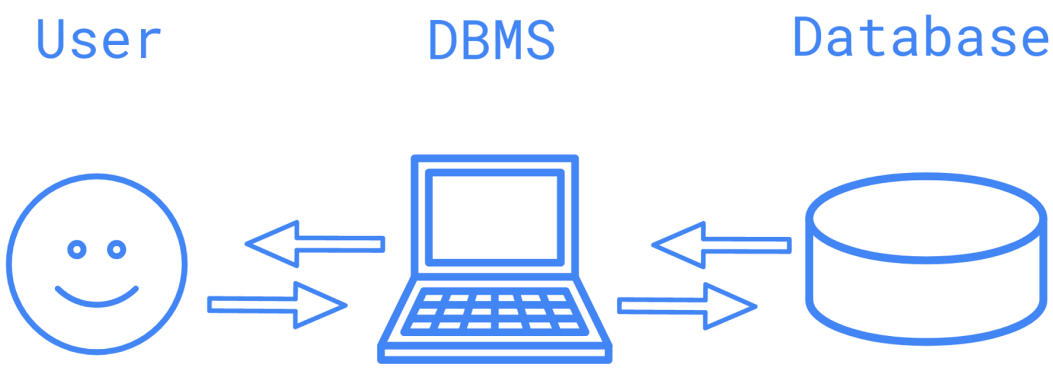
Topic is required for:

What is SQL

H2 database

Introduction to JPA

Connecting to a database with JDBC




Most database management systems have pretty good descriptions and tutorials on their sites. There are also specific languages that you need to learn to start working with a database, but if you know programming languages, you can work with a database with their tools instead.

> Although it sounds like all databases have different syntax, most of them actually implement common standards. Almost all relational databases use the SQL standard, so you can apply the same commands in different DBMS's.

## §3. Access to data

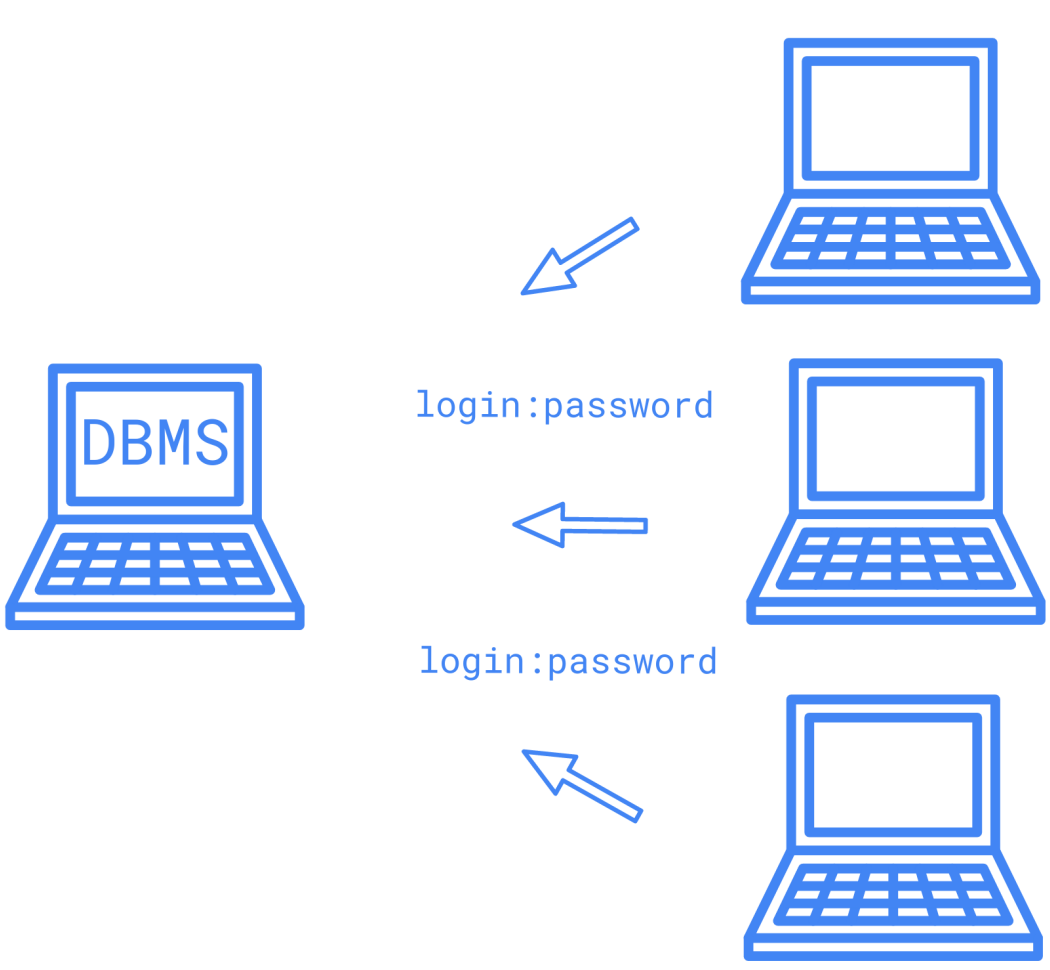
At this stage, you may still have doubts as to using databases. You have to learn a new language to update and select the data, which can be time-consuming, so why not use plain files instead?

Of course, you can keep the files locally, but as they grow in number, you won't be able to find information quickly. Databases provide **schemas** and **metadata** that allow for a quick search of the needed data.

> A schema describes how YOU organize the data. Metadata holds structural and statistical information.

If you want to access your data from multiple devices, most systems provide a convenient way to work with them through the web.

To open restricted access to another person, some management systems use simple login/password authentication, while some provide more powerful instruments. With their help, you can grant access to a limited portion of data for each user.



If you still are not convinced how great the DBMSs are, let's look at what else you can get from them.

## §4. Data consistency

One of the best features of databases is their ability to keep and restore the data correctly. It doesn't mean that the DBMS knows how to be correct, but once you define the correctness with the configuration or schema, you can be sure that nothing will break these rules. DBMS can provide you with formats you can use for your data. You can also set up all the tests and constraints that you want to have.

Say you have some data that multiple users with their devices have access to: this may potentially create a conflict of updates. Updates in files usually follow the "last save wins" rule. Databases, on the other hand, isolate different users and can be configured to resolve conflicts between their updates

There's another good thing about databases. When a usual file becomes corrupted and cannot be opened, you've lost your data forever. Using DBMS instead, you can make backups and then restore the data to continue your work.

> Of course, you can emulate all of these operations and develop your DBMS, but first, try to work with the existing solutions.

## §5. Conclusion

There's a lot of learning you need to do before you start working with databases. No pains, no gains, and here you can actually gain a lot.

With databases you can:

- Store, retrieve and update data
- Get metadata and data dictionaries
- Access database remotely
- Restrict accesses to data
- Make concurrent updates
- Recover to some point of time
- Check the rules for data consistency automatically

In a data-driven world, this kind of functionality is golden. Welcome to the world of new opportunities and good luck with exploring the databases!

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