Introduction to databases - MySQL

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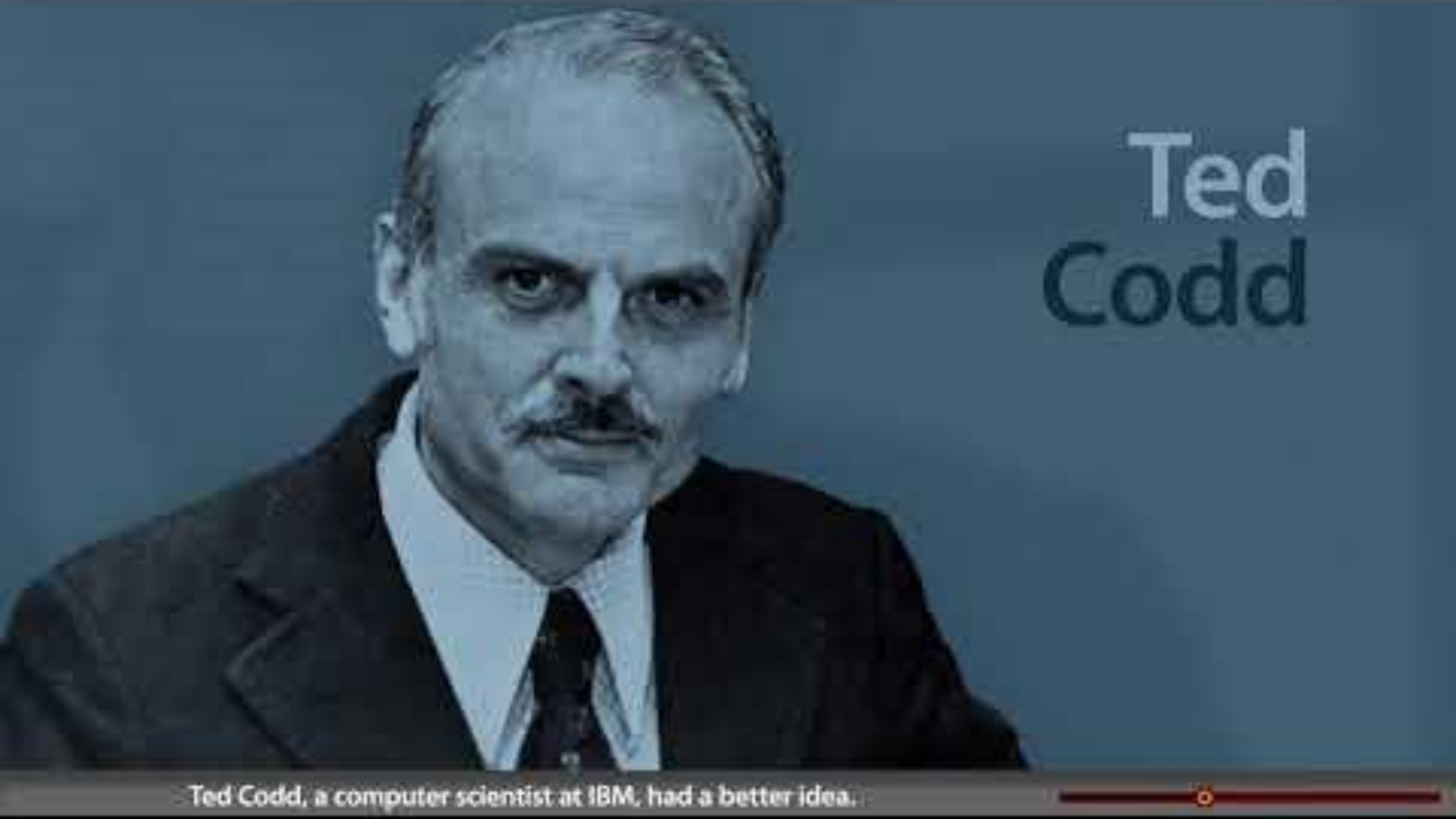
What we’ll do learn today

- What are Databases ?
- Types of database
  - Relational databases
  - Non-Relational databases
- MySQL
- Database Clients


Ted
Codd
Ted Codd, a computer scientist at IBM, had a better idea.

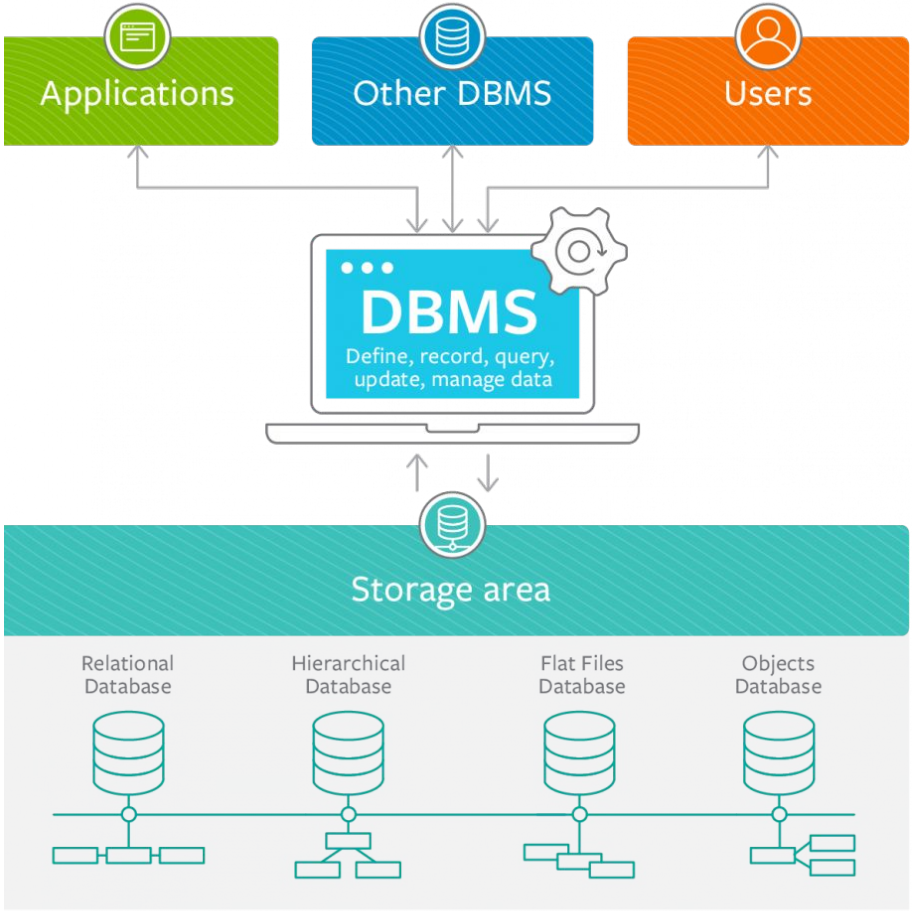
What is a Database ?

So, databases ?

- **Data** is collection of values or information for a given purpose.
- A **database** is a structured ***collection of data***, especially one that is held in a computer and accessible in various ways.
    - Ideally organized in such a way that it can be **easily accessed**, managed, and updated.
- A **query** is a command you send to a database to get it to do something, whether that's to get information out of the database or to add/update/delete something in the database.

DBMS

- A **database management system** (DBMS) is a **software** system specifically designed to ***manage databases easily.*** DBMS offers a systematic approach to manage databases via an interface for users.
- The core functionality is the storage, retrieval and update of data.
    - May also provide a set of utilities for administration purposes including import, export, monitoring, defragmentation and analysis utilities
- Examples of DBMS's include MySQL, PostgreSQL, MSSQL, Oracle Database, and Microsoft Access.


Applications
Other DBMS
Users
DBMS
Define, record, query, update, manage data
Storage area
Relational Database
Hierarchical Database
Flat Files Database
Objects Database

A **database** is a collection of related ***data*** & **DBMS** helps us to *manage a database*

Types of Databases/DBMS

- ***Relational database***
  - Data as rows and columns in a series of tables, and mostly use SQL for writing and querying data. Tables and relations are important here.
- **Hierarchical database**
  - Data is modeled in a tree-like structure with pointers. Each record having one parent record and many children.
- **Network database**
  - Network model allows each record to have multiple parent and child records
- **Object-Oriented database**
  - Information is represented in the form of objects, which have fields, properties, and methods .

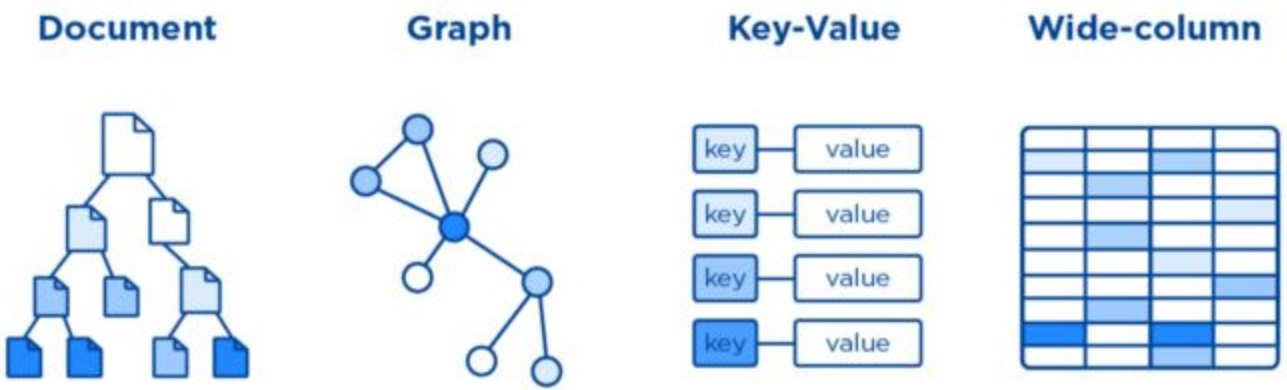
Other popular terms/classifications

- In-memory database
  - Database primarily relies on main memory (RAM) for data storage instead of disk storage mechanism. Has faster and more predictable performance.
  - Examples - **Redis**, Hazelcast, Aerospike, MemSQL, and SAP HANA
- Cloud databases
  - Runs on a cloud computing platform, and access to the database is provided **as-a-service**
  - Examples - Amazon Relational Database Service, MongoDB Atlas, Microsoft Azure SQL Database, Oracle Database Cloud, Google Cloud SQL etc

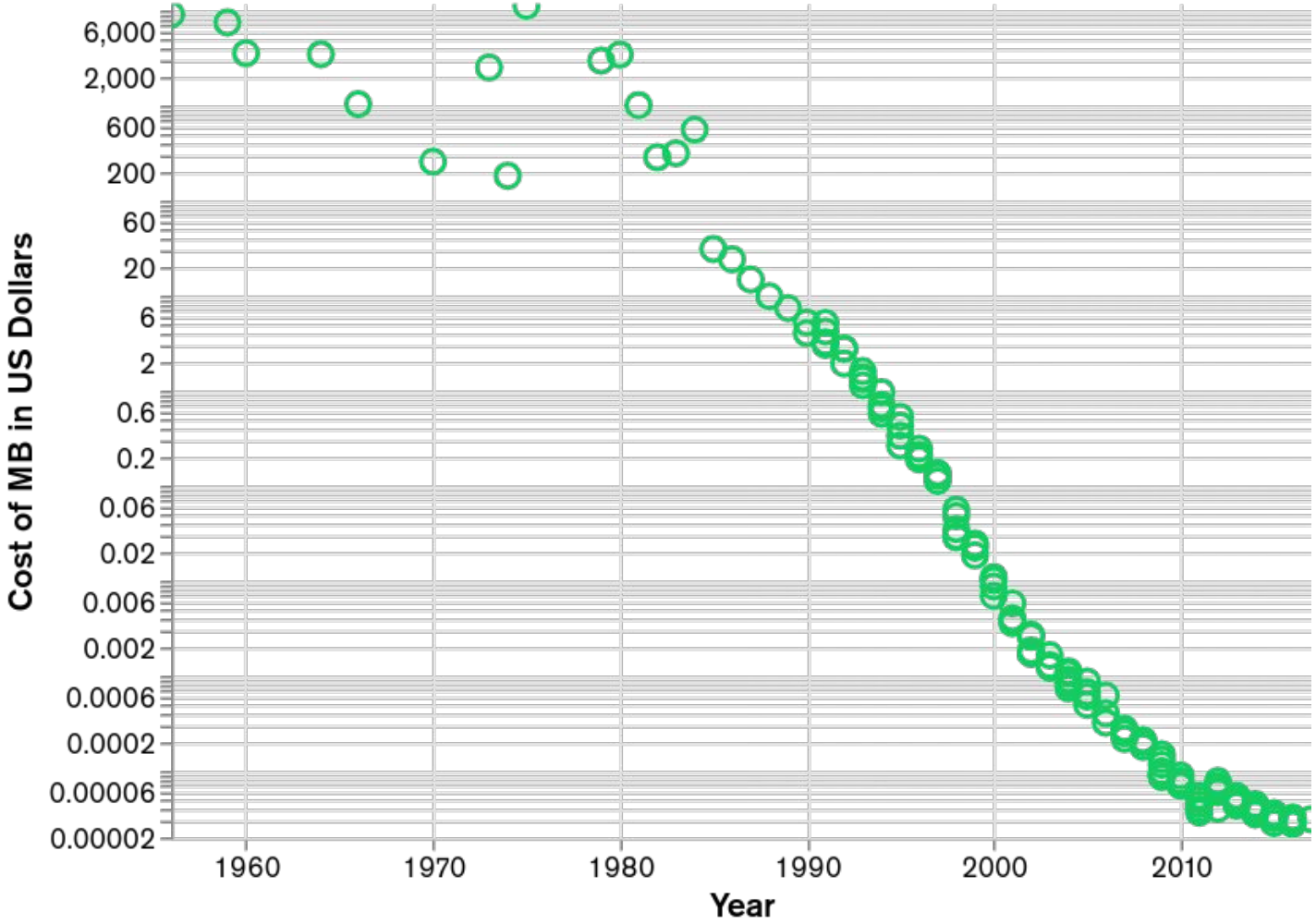
Other popular terms/classifications

- NoSQL databases (Not Only SQL or Not SQL)
  - Store data in a non-tabular way. Does not use SQL
  - Higher level of flexibility with newer data models.
  - Types include
    - ***Document databases***
    - Key-value databases
    - Wide-column stores
    - Graph databases

https://www.ibm.com/cloud/learn/nosql-databases *https://aws.amazon.com/nosql/*



https://medium.com/swlh/4-types-of-nosql-databases-d88ad21f7d3b


Cost of MB in US Dollars
6,000
2,000
600
200
60
20
6
2
0.6
0.2
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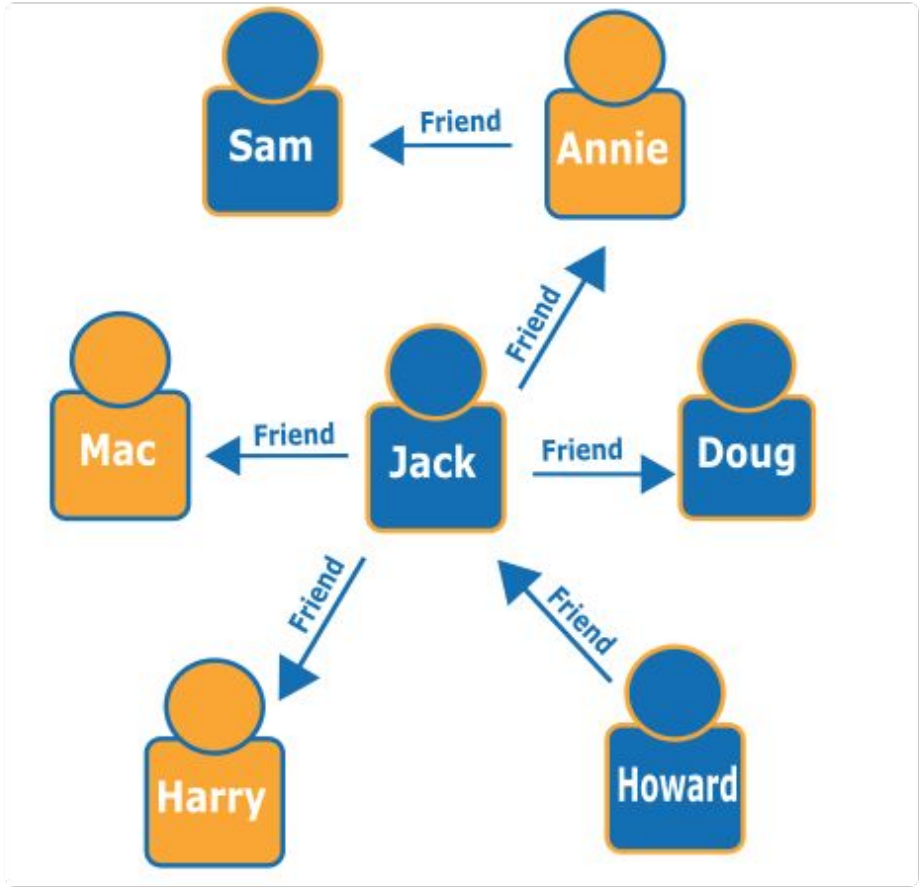
0.02
0.006
0.002
0.0006
0.0002
0.00006
0.00002
1960
1970
1980
1990
2000
2010
Year

Other terms/classifications

- Spatial database
  - Optimized for storing and querying data that **represents objects** defined in a **geometric space**.
  - Point, lines, polygons and other shapes.
  - Examples - ArcGIS geodatabase, PostGIS, mostly spatial extension or support for spatial indexes, not a DBMS as such.
- Graph databases
  - Graph database is a database designed to treat the **relationships between data** as equally important to the data itself. Graph databases use **nodes** to store data entities, and **edges** to store relationships between entities
  - Examples - Neo4j, ArangoDB, Amazon Neptune, FlockDB etc



https://gigaom.com/2013/06/25/how-facebook-matured-its-data-structure-and-stepped-into-the-graph-world

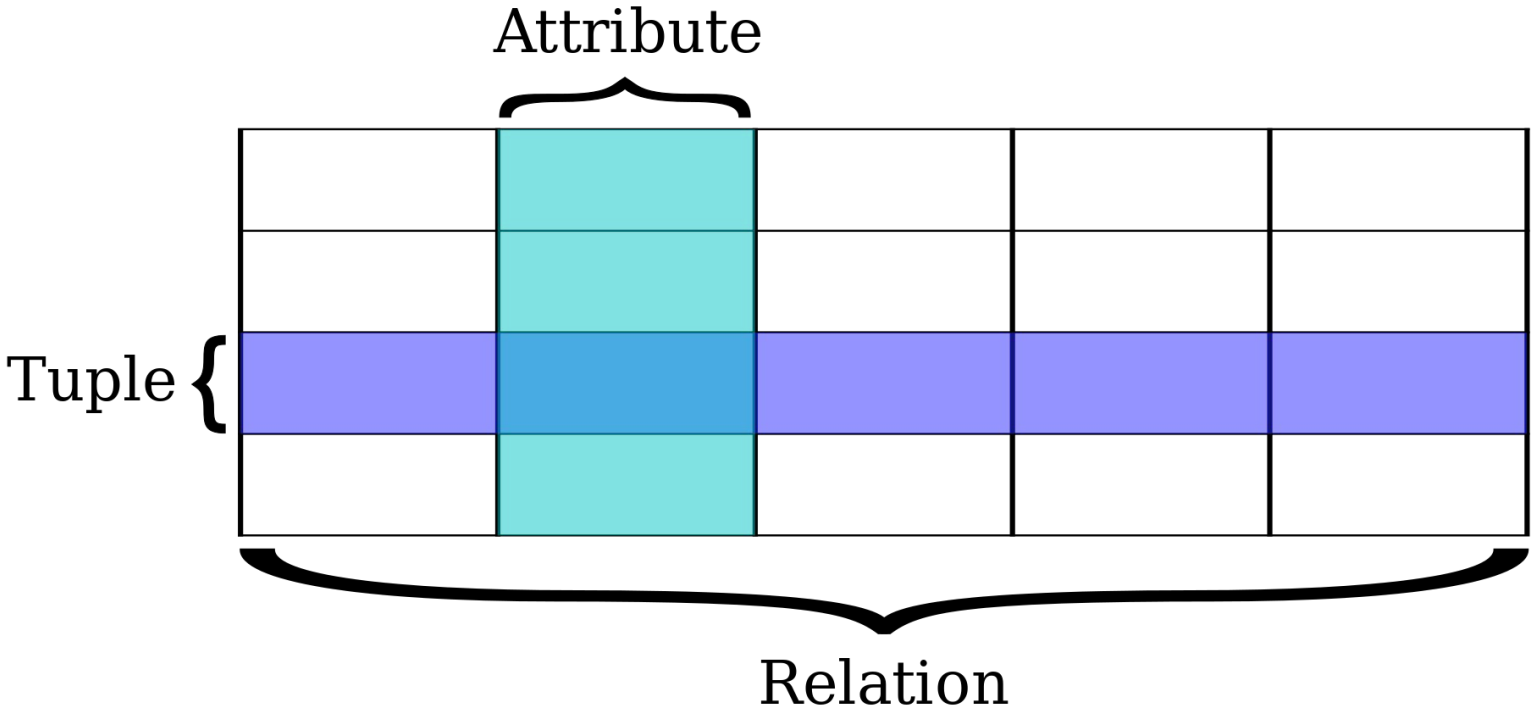
Other terms/classifications

- Real-time database
  - Uses real-time processing to handle workloads whose **state is constantly changing**.
  - Transaction is processed fast enough for the result to come back and be acted on right away.
  - Examples, Firebase Real-time database, Aerospike Database, VoltDB, SAP HANA etc

Relational Databases

Relational Databases

- A relational database organizes data into **tables** which can be linked—or related—based on data common to each.
- It uses a structure that allows us to identify and access ***data in relation to another piece of data*** in the database.
- Tables - A table is an arrangement of data in rows and columns :D
- **Rows** are often called **records/tuple** and **column** are often called **field/attribute** etc.


Attribute
Tuple
Relation

SQL term	a. k. a	Description
Row	***Tuple*** or ***record***	A data set representing a single item
Column	***Attribute*** or ***field***	A labeled element of a tuple, e.g. "Address" or "Date of birth"
Table	***Relation*** or ***Base relvar***	A set of tuples sharing the same attributes; a set of columns and rows
View or ***result set***	***Derived relvar***	Any set of tuples; a data report from the RDBMS in response to a query

MySQL

- MySQL is an open-source relational database management system (RDBMS).
- It is the one of the most popular SQL database, commonly used for web application development.
- Easy to use, inexpensive, reliable (has been around since 1995), and has a large developer community.

https://dev.mysql.com/downloads/

Database Clients

- Database client software allows you to communicate between a client application and the database management system.
- Database clients connect to the DBMS server and allows use to use it.
- Examples, SQL Developer, MySQL Workbench, RoboMongo, MongoDB Compass etc
- MySQL Workbench is a unified visual tool for database architects, developers, and DBAs.
    - Interface - Top toolbar, Panels - Navigation (left), Query area, Output window, Result window

Installation & Setup

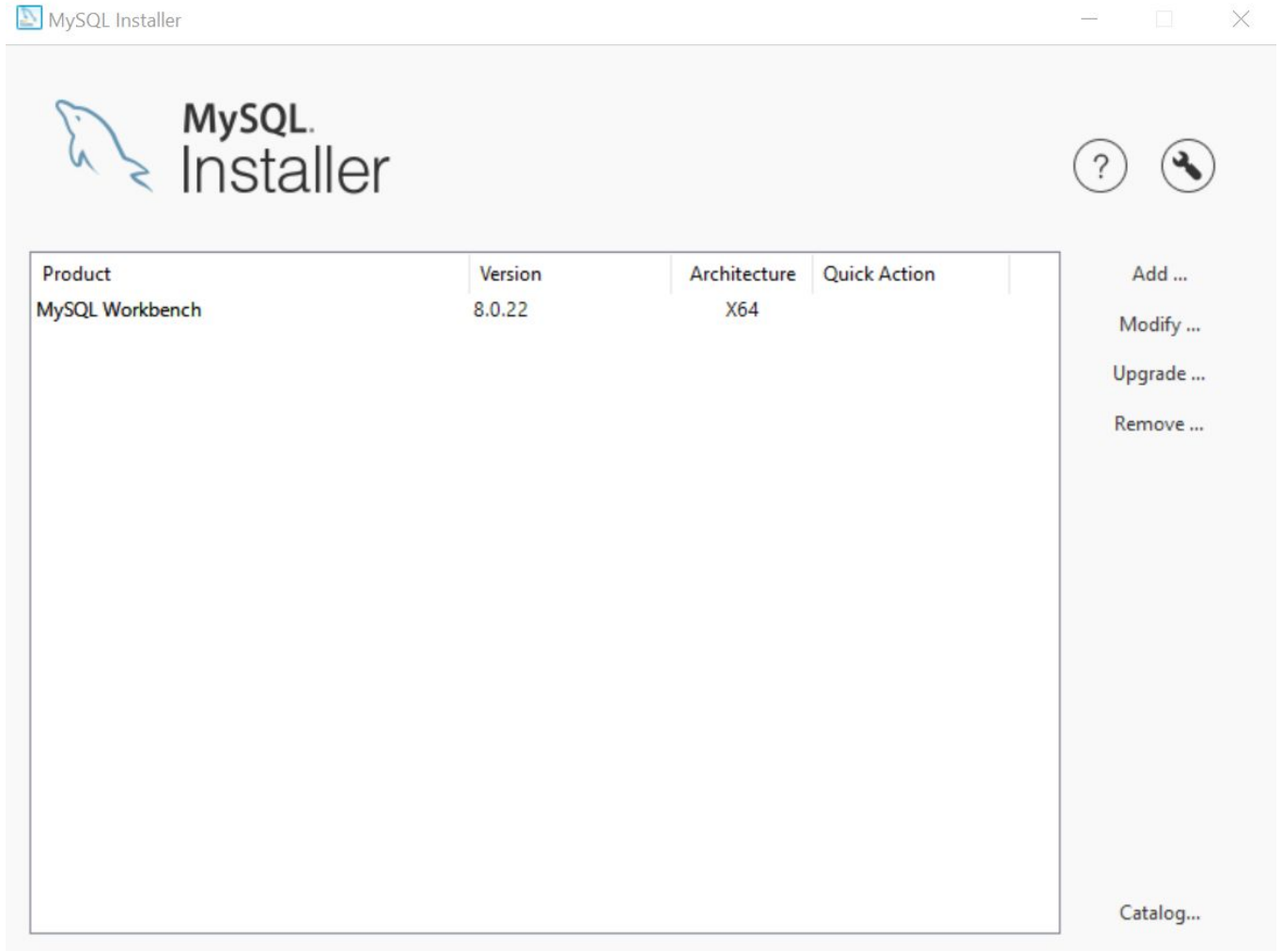
MySQL

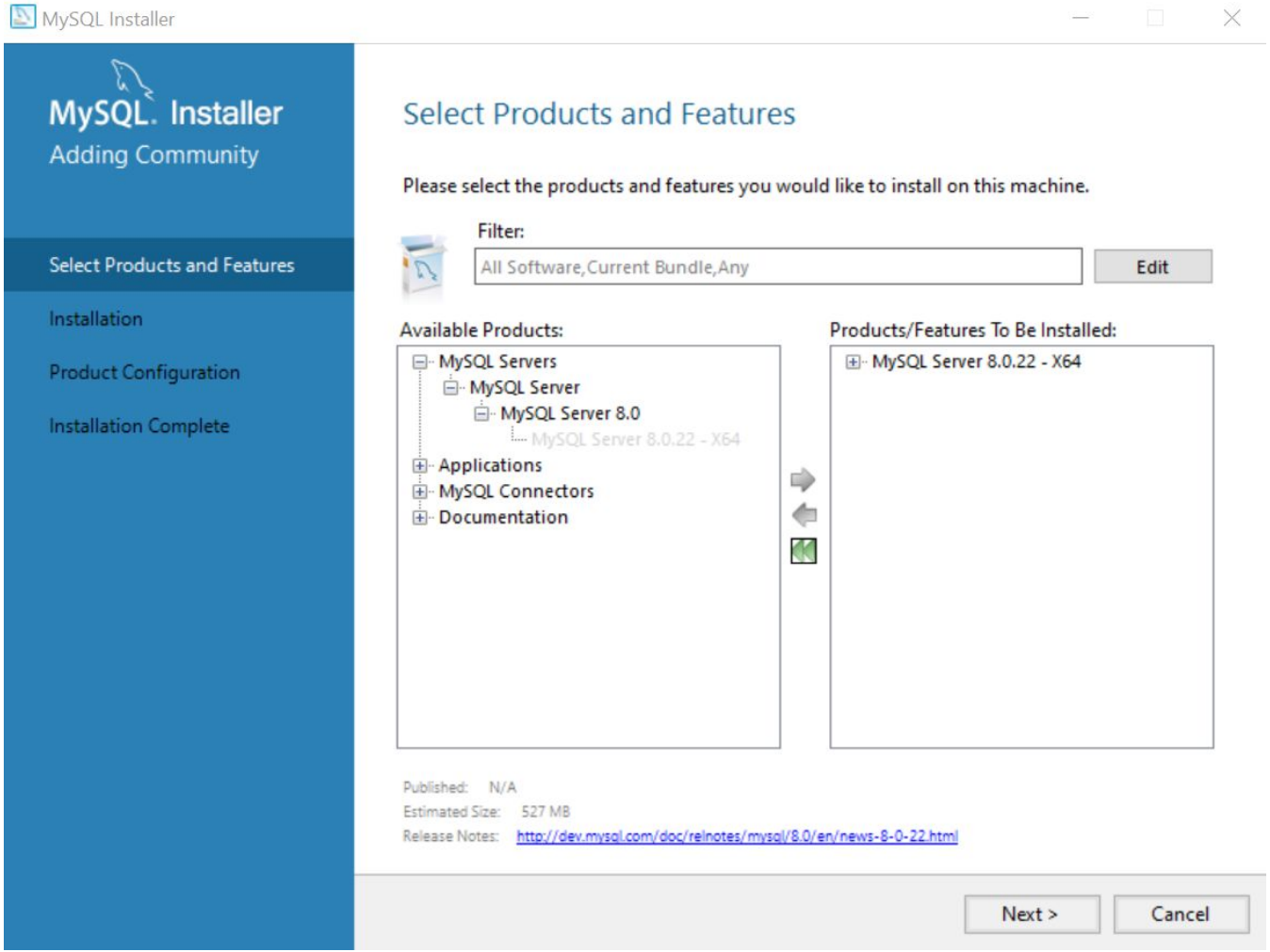
MySQL :: Download MySQL Installer - Windows

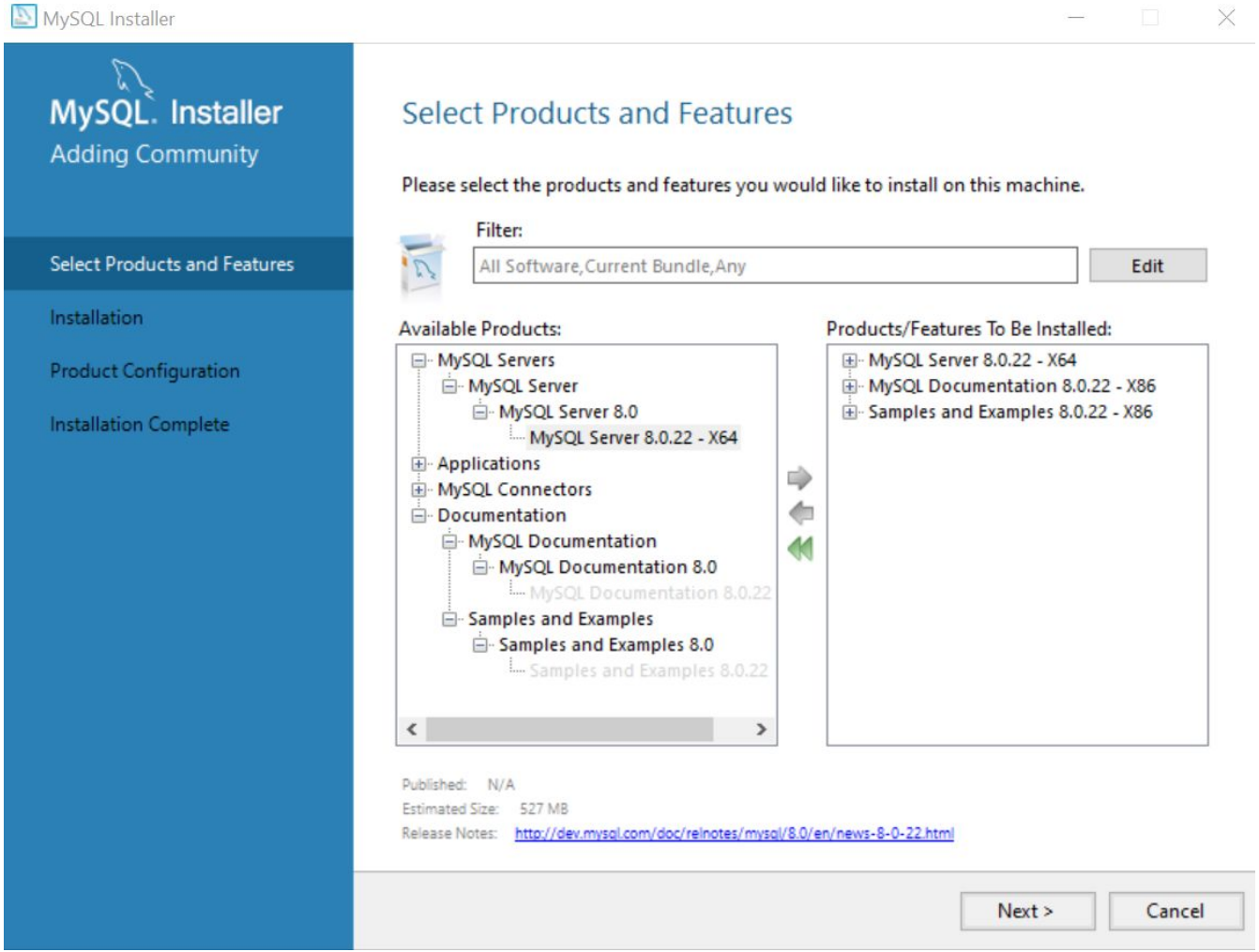
MySQL :: MySQL Community Downloads - All

MySQL Workbench

MySQL :: Download MySQL Workbench - All


MySQL Installer
MySQL.
Installer
Product
Version
Architecture
Quick Action
MySQL Workbench
8.0.22
X64
Add ...
Modify ...
Upgrade ...
Remove ...
Catalog...


MySQL Installer
MySQL. Installer
Adding Community
Select Products and Features
Installation
Product Configuration
Installation Complete
Select Products and Features
Please select the products and features you would like to install on this machine.
Filter:
All Software,Current Bundle,Any
Edit
Available Products:
MySQL Servers
MySQL Server
MySQL Server 8.0
MySQL Server 8.0.22 - X64
Applications
MySQL Connectors
Documentation
Products/Features To Be Installed:
MySQL Server 8.0.22 - X64
Published: N/A
Estimated Size: 527 MB
Release Notes: http://dev.mysql.com/doc/relnotes/mysql/8.0/en/news-8-0-22.html
Next >
Cancel


MySQL Installer
MySQL. Installer
Adding Community
Select Products and Features
Installation
Product Configuration
Installation Complete
Select Products and Features
Please select the products and features you would like to install on this machine.
Filter:
All Software,Current Bundle,Any
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Available Products:
MySQL Servers
MySQL Server
MySQL Server 8.0
MySQL Server 8.0.22 - X64
Applications
MySQL Connectors
Documentation
MySQL Documentation
MySQL Documentation 8.0
MySQL Documentation 8.0.22
Samples and Examples
Samples and Examples 8.0
Samples and Examples 8.0.22
Products/Features To Be Installed:
MySQL Server 8.0.22 - X64
MySQL Documentation 8.0.22 - X86
Samples and Examples 8.0.22 - X86
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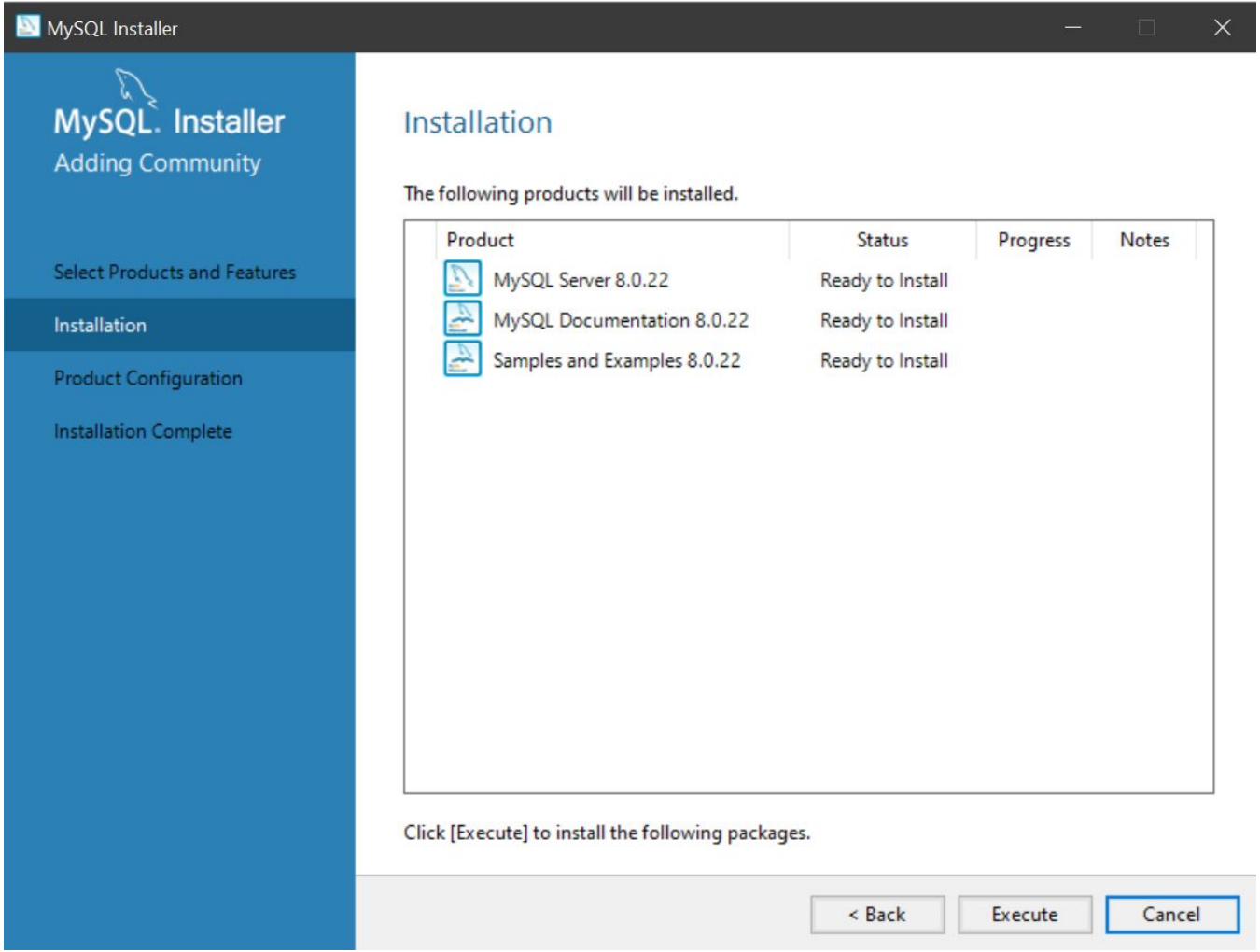
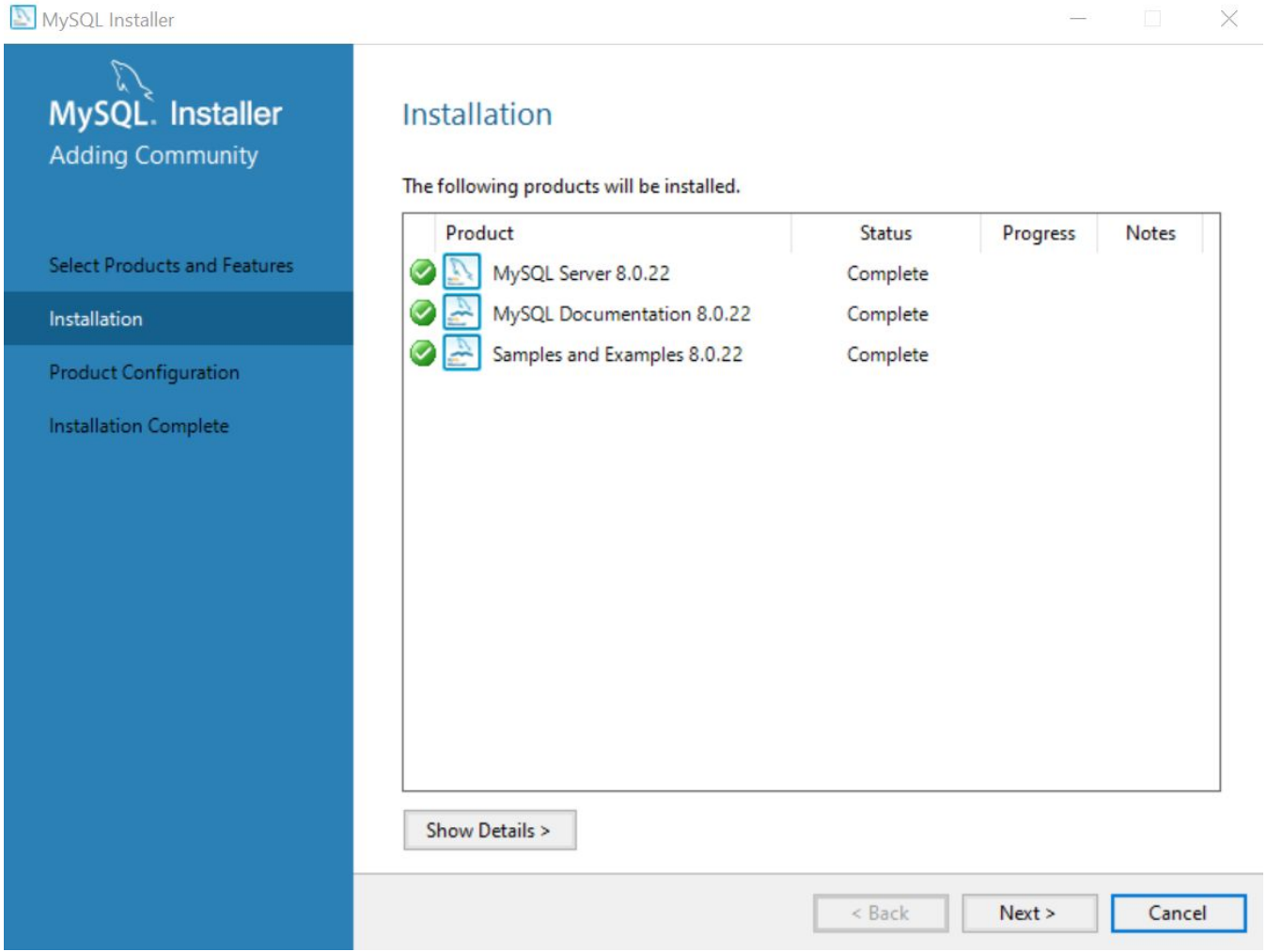
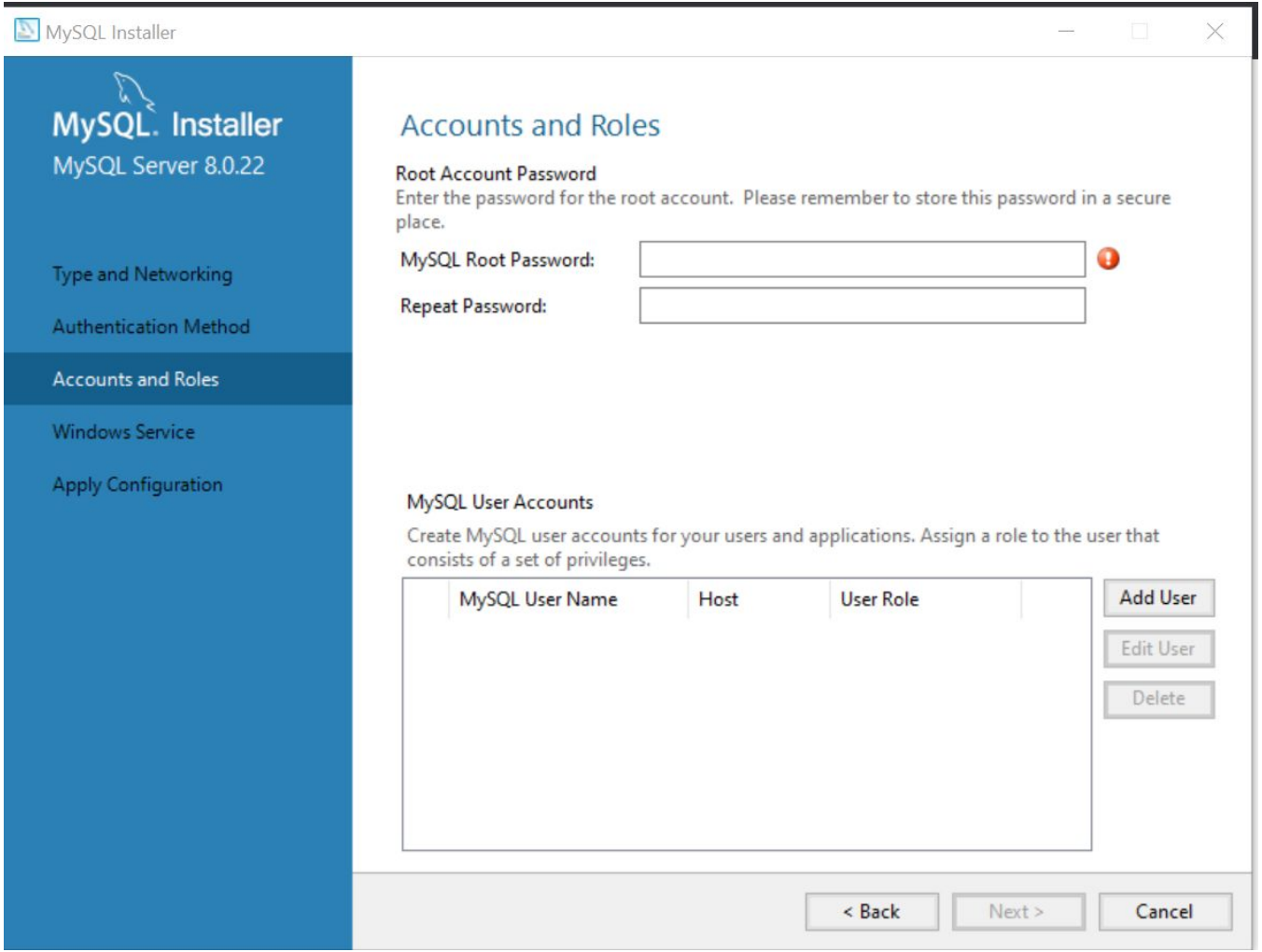
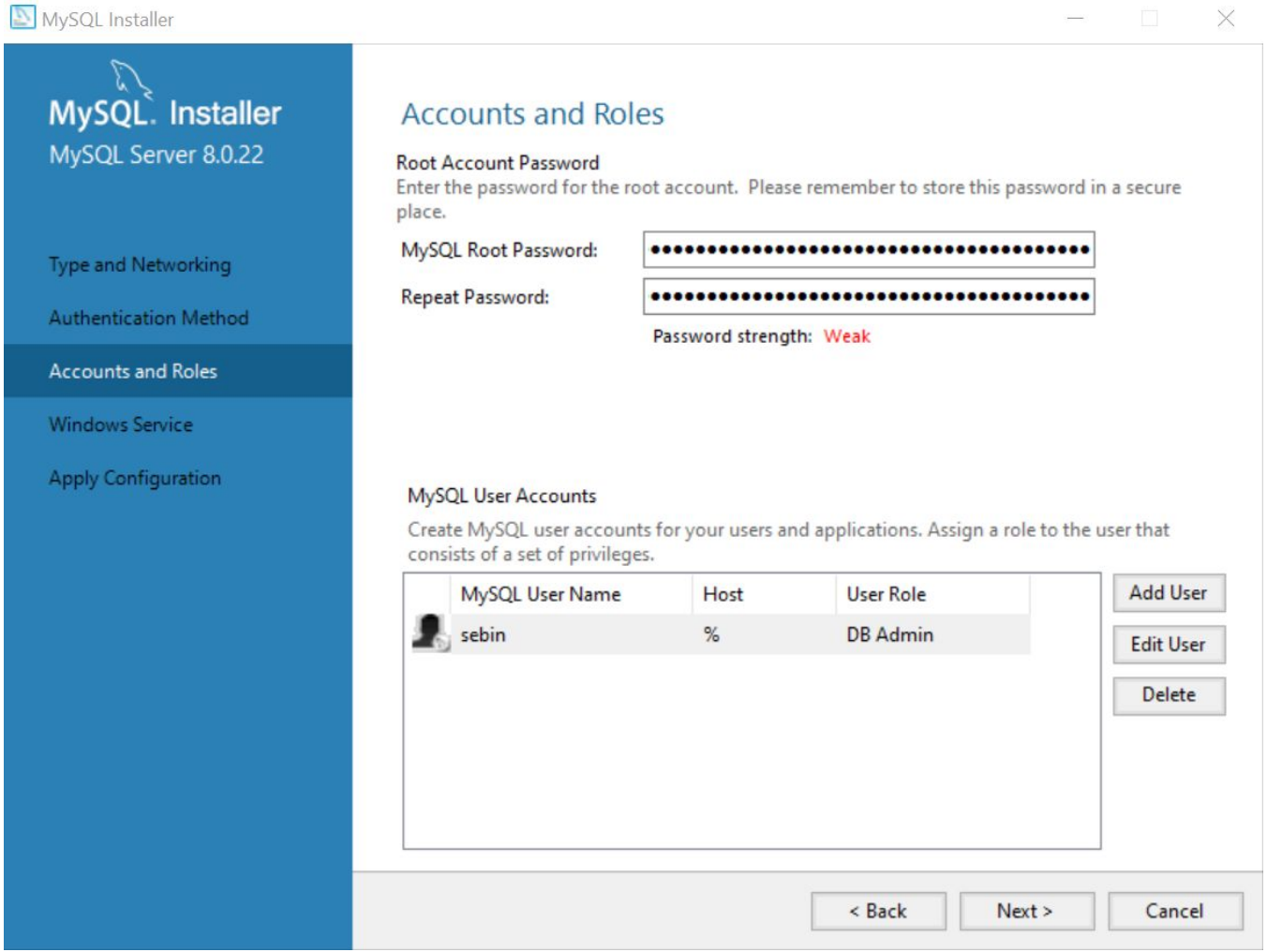
Next >
Cancel


MySQL Installer
MySQL. Installer
Adding Community
Select Products and Features
Installation
Product Configuration
Installation Complete
Installation
The following products will be installed.
Product
Status
Progress
Notes
MySQL Server 8.0.22
Ready to Install
MySQL Documentation 8.0.22
Ready to Install
Samples and Examples 8.0.22
Ready to Install
Click [Execute] to install the following packages.
< Back
Execute
Cancel


MySQL Installer
MySQL. Installer
Adding Community
Select Products and Features
Installation
Product Configuration
Installation Complete
Installation
The following products will be installed.
Product
Status
Progress
Notes
MySQL Server 8.0.22
Complete
MySQL Documentation 8.0.22
Complete
Samples and Examples 8.0.22
Complete
Show Details >
< Back
Next >
Cancel


MySQL Installer
MySQL. Installer
MySQL Server 8.0.22
Type and Networking
Authentication Method
Accounts and Roles
Windows Service
Apply Configuration
Accounts and Roles
Root Account Password
Enter the password for the root account. Please remember to store this password in a secure place.
MySQL Root Password:
Repeat Password:
MySQL User Accounts
Create MySQL user accounts for your users and applications. Assign a role to the user that consists of a set of privileges.
MySQL User Name
Host
User Role
Add User
Edit User
Delete
< Back
Next >
Cancel


MySQL Installer
MySQL. Installer
MySQL Server 8.0.22
Type and Networking
Authentication Method
Accounts and Roles
Windows Service
Apply Configuration
Accounts and Roles
Root Account Password
Enter the password for the root account. Please remember to store this password in a secure place.
MySQL Root Password:
Repeat Password:
Password strength: Weak
MySQL User Accounts
Create MySQL user accounts for your users and applications. Assign a role to the user that consists of a set of privileges.
MySQL User Name
Host
User Role
sebin
%
DB Admin
Add User
Edit User
Delete
< Back
Next >
Cancel

SQL

Structured Query Language

- Structured Query Language (SQL) is the standard language for interacting with DBMS.
- SQL syntax is similar to the English language, which makes it relatively easy to write, read, and interpret.
    - SQL is a ‘Question, we ask the database a question by using SQL.
    - SQL is used by writing declarative statements, often referred to as **queries**.
- Many RDBMSs use SQL (and variations of SQL) to access the data in tables.
- SQL is not case-sensitive, convention - use CAPITAL for keywords.
    - Linebreaks and spaces are ignored.

SQL is basically combination of four different languages, they are

- DQL (Data **Query** Language)
  - DQL is used to **fetch** the information from the database which is already stored there.
- DDL (Data Definition Language)
  - DDL is used to **define table** schemas.
- DCL (Data Control Language)
  - DCL is used for user & permission management. It **controls the access** to the database.
- DML (Data **Manipulation** Language)
  - DML is used for **inserting, updating and deleting** data from the database.

https://dev.mysql.com/doc/refman/8.0/en/sql-statements.html

Data Manipulation Language and Data Query Language

- SELECT: Retrieve rows of data.
- INSERT: Place new rows of data in the database.
- UPDATE: Replace existing values in the database with new values.
- DELETE: Delete rows of data in the database.

SELECT

- SELECT is used to retrieve rows selected from one or more tables
- SELECT is the most commonly used data manipulation language (DML) command.

```
SELECT column1, column2, …

FROM table_name;
```

- FROM - Specifies from which table to get the data.
- WHERE - Specifies conditions to filter or return only certain results.

Optional clauses for SELECT

- WHERE
  - Specifies which rows to retrieve. It filter the results and apply conditions
- GROUP BY
  - Groups rows sharing a property so that an aggregate function can be applied to each group.
- HAVING
  - Selects among the groups defined by the GROUP BY clause.
- ORDER BY
  - Specifies how to order the returned rows.

Operators in The WHERE Clause

=	Equal
>	Greater than
<	Less than
>=	Greater than or equal
<=	Less than or equal
<> or !=	Not equal
BETWEEN	Between a certain range, eg - WHERE Price BETWEEN 10 AND 20;
LIKE	Search for a pattern, eg
IN	To specify multiple possible values for a column

DISTINCT modifier

- The SELECT DISTINCT statement is used to **return only distinct (different) values**.

```
SELECT DISTINCT column1, column2, …
FROM table_name;
```

- When only one expression is provided in the DISTINCT clause, the query will return the unique values for that expression.
- When more than one expression is provided in the DISTINCT clause, the query will retrieve unique combinations for the expressions listed.

LIKE Operator

Used for pattern matching using an SQL pattern. Compares data with an expression using wildcard operators

```
SELECT column1, column2, ...
FROM table_name
WHERE columnN LIKE pattern;
```

Two wildcard characters in the pattern:

- **%** - any number of characters, even zero characters.
- **_** - exactly one character.

NOT LIKE - similar, but exclude those rows which are matching the criterion

IS Operator

Used for pattern matching using an SQL pattern.

```
SELECT column1, column2, ...
FROM table_name
WHERE columnN LIKE pattern;
```

Two wildcard characters in the pattern:

- **%** - any number of characters, even zero characters.
- **_** - exactly one character.

NOT LIKE - similar, but exclude those rows which are matching the criterion

Thank you