

# MySQL

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## ABSTRACT

This paper covers various aspects relating to the MySQL. Topics covered include a basic overview of the technology, modern use cases in the area of Big Data, infrastructure needs, and further educational resources.

## General Terms

Database, Relational Database, Relational Database Management System, Structured Query Language

## 1. INTRODUCTION

MySQL is an "...Open Source SQL database management system [that] is developed, distributed, and supported by Oracle Corporation." [1] MySQL Server provides the means to manage data stored in a relational database. [1] The origins of MySQL can be traced back to 1979 when Michael Widenius began creating an in-house tool for managing databases. [2]

## 2. DATABASE

A database provides a logical way to store information that can later be retrieved. [3] Databases also provide a structure to data that can facilitate the access to stored data.

## 3. RELATIONAL DATABASE

Relational databases, which were invented by E.F. Codd in 1970, are a type of database that allows for the access and reassembly of data in a database without the need to entirely reorganize the database. [4] A simple example of the flexibility of a relational database is the ability to add new data categories without having to modify existing applications. [4] The categories in the table correspond to the columns in the table while each row of a table defines a separate entry into that table. [5] In more abstract terms, the columns of a table are referred to as attributes and the rows or entries in a table are referred to as tuples. This framework provides the structure by which data can be logically organized, thus allowing for easy access and analysis of the data. The data in the various tables of the database can be analyzed and filtered based on various sets of criteria and the results presented in a view to an end user. [4]

A simple top down overview of the structure of, say, a database managed with MySQL is database>table>entry. A database consists of a table or tables. Every table contains columns that attempt to define the type of data that is to be stored in the column. Tables are in turn made up of rows which

correspond to separate entries in the table. A potentially useful analogy is to think of a database as a warehouse. The warehouse can be partitioned into different sections. The different sections of the warehouse are like the tables in a database. Each section of the warehouse is responsible for storing a particular type of container. The different containers in the sections of the warehouse are analogous to the individual entries in a table. These containers are themselves partitioned further so that corresponding sections of different containers contain the same type or category of stuff (data). The various sections within the containers are similar to the different columns in a table. While the utility of this analogy may be limited, it may prove useful in providing a basic idea of the different parts that allow the structured storage of data in a database.

## 4. RDBMS

Relational Database Management Systems (RDBMS) are programs that allow for the creation, updating and administration of relational databases. [4] Many commercial RDBMS softwares use Structured Query Language to access and interact with the relational databases they manage. [6] SQL is a standardized programming language used to perform tasks in relational databases such as creating databases and tables, adding and deleting entries, and querying databases and tables. [7] Databases that utilize the SQL language are colloquially referred to as SQL databases. [7] According to [7], "an official SQL standard was adopted by the American National Standards Institute (ANSI) in 1986 and then by the International Organization for Standardization, known as ISO, in 1987." Although a standard SQL syntax is defined, many RDBMSs have added their own extensions to the language which, in many cases, can only be used with their own systems. [8]

## 5. MYSQL USE CASES

MySQL has been used by many different organizations to solve many different problems. [9]. The number of organizations that are listed in [9], and the wide array of problems that they use MySQL to solve, demonstrates the flexibility and utility of relational databases managed by MySQL. Some of the applications that MySQL has been applied to range from science to marketing to health-care. [9] These applications have a wide ranging impact on those that utilize their services.

## 5.1 CERN

MySQL has been employed at the European Organization for Nuclear Research (CERN). [10] Scientists at CERN use sensitive and complex instruments to study the fundamental building blocks and origin of our universe. [10] The IT department at CERN has offered a MySQL Database-as-a-Service to its employees and the scientists associated with its various projects to aid in the management of the data it collects. [10] The management of the database itself is handled by CERN's IT staff but is made available to those with responsibilities and interests in analyzing the data collected. [11]

A specific project at CERN that utilizes MySQL is the ATLAS project. [11] ATLAS uses MySQL to manage its Primary Numbers database. [11] These Primary Numbers are parameters that describe the "detector geometry and digitization in simulations, as well as certain reconstruction parameters, including the identifier maps of the detector elements." [11] An example of the type of data stored in the Primary Numbers database is are maps of magnetic fields associated with instrumentation used in the experiment. [11] One of the specific benefits that MySQL offers to the group at CERN, with relation to managing the Primary Numbers database with MySQL, is that the database can be used by a researcher although they are not currently connected to the central database. [11] Once they are connected to the database again, the database will be updated. [11] Other features that have been found useful include the transfer of data in binary form and MySQL's certificate authorization technology. [11]

## 5.2 boo-box

boo-box is an advertising network that primarily focuses on the South American market. [12] boo-box facilitates the coupling of marketing platforms with marketers to display approximately one billion advertisements per month. [12] boo-box connects marketers with marketing space on "web sites, blogs and social media properties." [12] MySQL is used by boo-box to log user activity such as what pages they view and their click-through rates. [12] Analyzing this data helps boo-box to accurately report and direct ads in marketing campaigns. [12]

MySQL has offered boo-box low latency query performance which allows them to place targeted advertisements in under 250 milliseconds. [12] Ruby and Python interact with boo-box's MySQL database to offer other services in their advertising platform. [12] boo-box is able to capture 2 TB of web logs and process 22 billion rows with MySQL. [12] boo-box is able to use MySQL to store over 8 TB of data and manage 1 TB in a Statistics database. [12]

## 5.3 Health-care

In the health-care industry, MySQL can be used to manage data related to scheduling, billing, prescriptions, and Electronic Medical Records. [13] A couple of the benefits of using MySQL in a health-care application include scalability and security options (with MySQL Enterprise Audit) allowing for compliance with applicable regulations. [13] Waiting Room Solutions (WRS) is a web-based service for physicians' offices that uses MySQL. [13] They offer solutions for the management of "electronic medical and health records,

billing, scheduling, electronic prescriptions, [and] online patient registration" among many other services. [13]

## 6. EDUCATION

MySQL has been available for download for free since 2000. [14] As such, it should come as no surprise that there are plenty of educational resources available free of charge to those who wish to learn how to use MySQL. [15] provides a list of 50 different sources that offer lessons about various aspects of using MySQL. w3schools.com offers free interactive lessons that cover the basics of the SQL language, which of course is an essential skill if one would like to work with and understand MySQL. [16] An educational resource that focuses more on MySQL can be found at [www.mysqltutorial.org](http://www.mysqltutorial.org). [15] The MySQL Tutorial website offers many lessons in using MySQL; from a Basic MySQL Tutorial to MySQL Administration to programming interfaces such as a Python MySQL Tutorial, this site is a near exhaustive resource to learn all things related to MySQL. [17]

## 7. ALTERNATIVES

MySQL is not the only RDBMS. Different RDBMSs have advantages and disadvantages in any given situation/application. [18] Two other RDBMSs that are worth comparing to MySQL are SQLite and PostgreSQL. [18] These three RDBMSs provide end users with a wide array of options, each possibly more suitable than the next in different situations.

### 7.1 SQLite

SQLite is an embedded RDBMS. [18] It is a file-based database that contains a many tools that enable it to deal with a wide array of data types. [18] SQLite is faster than server relational databases. [18] One of the main disadvantages of SQLite is that it doesn't offer user management. [18] Depending on the intended use, this can be a real concern if the application requires multiple users to access the database. [18]

### 7.2 PostgreSQL

PostgreSQL is another open-source RDBMS that is compliant with applicable SQL standards. [18] PostgreSQL is extensible, meaning that functions can be stored as procedures. [18] In addition to being a relational database management system, PostgreSQL is also objective and thus supports nesting. [18] One disadvantage of PostgreSQL is that it does not offer fast read operations. [18]

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