MySQL Cookbook

100+ recipes for database development and administration in MySQL

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Dedicated to

My beloved parents:

***Aris Negrin** (Rest In Peace Dad)*

Anna Negrin

and

*My wife **Vayia** and my son **Aris***

About the Author

Elias Negrin, a multifaceted IT and Business professional with over 20 years of combined experience in diverse industries like Banking, Healthcare, Telecommunications, and Industrial Automation across international markets. Originally born and raised in Greece, he studied Business Administration and Computer Information Systems and specialized in Databases, Data Management, Software Engineering, Business Intelligence, Analytics and Business Computing. He is also certified in Scaled Agile and Scrum frameworks (SAFe 6 POPM, PSPO II, PSM II), leading implementation teams and product development. He has been working with major corporations in EMEA, Eurasia, Emerging, and APAC regions across various roles and positions, which has equipped him with a diverse and broad skill set. Since 2017, he has lived and worked in the Netherlands as an IT-Product Manager. Since 2023, he has also given presentations at Knowledge and Business Summits on topics around Agile Leadership and how to use data to help decision-making. Outside working hard, he enjoys doing sports, playing and listening to music (still collecting vinyls and CDs), reading, and traveling.

About the Reviewers

- **Sivanagaraju Gadiparthi** is experienced in data analytics and business intelligence who is recognized for his extensive expertise and leadership. He holds prominent roles such as reviewer for SciPy 2024 and mentor and judge at notable hackathons, including HackPrinceton 2024. Sivanagaraju significantly contributes to academic discourse as an editorial board member at IAEME and a reviewer for the International Journal of Science and Research. He also reviews conference papers and books. His industry recognition includes membership in IEEE, where he serves as chapter vice chair for the Princeton Central Jersey Section and the Institute of Analytics. Additionally, he is a member of The International Association of Engineers & Forbes Technology Council. Sivanagaraju's scholarly output includes articles on data breaches, business intelligence, blockchain, and AI-driven cloud optimizations published in respected journals. His contributions have earned him accolades such as the Titan Gold Award and the Global Recognition Award. A passionate mentor and speaker, he actively promotes STEM careers and data analytics to the next generation and supports professionals through ADPList. His efforts were recently recognized with LinkedIn's "Top Business Intelligence (BI) Voice" badge.

- **Naresh Kumar Miryala**, a distinguished engineering leader at Meta, possesses an extensive background in cloud and platform engineering honed over nearly two decades in the field. His deep understanding of both technical and business intricacies empowers him to pioneer innovative solutions spanning diverse domains such as database systems, large-scale backend infrastructure, multi-cloud environments (AWS/GCP/OCI/Azure), automation, cloud infrastructure, DevOps, Kubernetes, and Elasticsearch. Naresh is an adept engineering executive and technologist with extensive experience in working with cloud migrations, infrastructure implementation, database management, ERP solutions, DevOps deployments. Naresh is highly experienced in cloud migrations, particularly involving databases (Oracle/Exadata/MySQL/Postgres) and applications (EBS/Fusion/EPM/GTM). He played a pivotal role in ensuring their seamless execution. His experience in implementing infrastructure, databases, ERP solutions, and deployments has granted him a comprehensive understanding of the multifaceted technical and business challenges intrinsic to such projects. Naresh's affiliations include membership in IEEE, OATUG, AIM leadership council, and a fellowship at RSA. He holds certifications as a professional in Cloud and Database platforms and actively engages as a blogger and tech reviewer, and frequent speaker at international conferences.

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I am grateful to the companies and colleagues I have worked with, the courses I attended and the professional experience I have gained all these years. Thank you all for the hidden support provided.

I would also like to thank my teachers at high-school and college, for teaching me the foundations and the tools but also being an inspiration and mentor to me, I hope that this book can help students and professionals to grow as well.

My thanks and respect also go to the team at BPB Publications for being supportive enough to give me quite a long time to finish the book.

Preface

This book provides answers to your data-related problems, quick solutions, and techniques, as well as focuses on bite-size to moderately sized pieces of code, worked-out examples, and clear-concise explanations on one of the most popular open-source databases in the world. The book starts simple with connecting, issuing queries, and retrieving results and data from the MySQL Server, continues with working with data types, strings, and dates formatting and manipulation, sorting and grouping/aggregating results, and more similar areas. This book also covers more advanced concepts and objects like dataset characteristics, working with procedures and functions, routines, triggers, events, and scheduling. Additionally, the book shows how to perform simple MySQL administration tasks, understand monitoring fundamentals, and how to set up replication.

This book is divided into 15 chapters. They cover installation, MySQL development environment and tools, SQL basics, and more advanced concepts in MySQL and database development. This will increase learners' interest and understanding of MySQL and database tools. The details are listed below:

Chapter 1: Using the MySQL Client Program - will cover an overview of the MySQL Client Program (Workbench) and its main features. We will also cover the development environment to be used throughout this book, learn how to Connect and Manage connections, query the server and retrieve results, use the Modeller, and save and open scripts.

Chapter 2: Using MySQL Shell - will introduce the MySQL Shell tool, where we can perform our tasks in a command line Shell fashion. We will learn how to use the different topics and commands: Introduction and getting help, using a working schema, using Shell commands and retrieving results, executing SQL statements from a text file, executing multi-line statements, displaying results vertically, switching to JavaScript mode and run SQL or getting session information and Global objects or modules.

Chapter 3: Using MySQL Replication - will cover how to set up MySQL Replication (on Windows) using the minimum possible installation and a single (physical) server in a master/slave relationship. Will explain the prerequisites and set up a second Windows server and MySQL (slave) instance. Then, it will show how to configure the installation, create a replication user, synchronize and lock tables on the master before starting the process (optional), create a snapshot of the data, connect the slave to the master, and finally start the slave and verify the replication process.

Chapter 4: Writing MySQL-based Programs - will cover the essential elements of MySQL programming using Python language as an example: how to connect to the server, issue queries, retrieve the results, and handle errors. We will also discuss how to handle special characters and NULL values in queries, introduce regular expressions as a powerful string pattern searching and replacing mechanism, how to write library files to encapsulate code for commonly used operations, and various ways to gather server variables and parameters.

Chapter 5: Querying Data from Tables: Tables Management - will cover various ways to: select data from Tables, join Tables, use of sub-queries and common data manipulation statements to insert, update and delete data in tables. Moreover, will also cover data definition statements to create, alter, drop, truncate and rename Tables. Finally, will cover how to acquire exclusive table access to perform transactions.

Chapter 6: Working with Strings - will cover and deep dive into various string data types such as CHAR, VARCHAR, BINARY, VARBINARY, BLOB, TEXT, ENUM, and SET. It will additionally cover string manipulation techniques using functions and operators to do comparisons, use regular expressions, character sets, and collation of function results.

Chapter 7: Working with Dates and Times - will cover different date and time data types like DATETIME and TIMESTAMP, how to work with dates and times and handle common issues, how to do comparisons between dates and how to do conversions between date and time types. Moreover, it will show how to work with date and time functions in order to return certain information from a date value.

Chapter 8: Sorting Query Results - will cover different ways of using the ORDER BY clause to sort query results. In other words, the order in which the rows are returned for a given query result set. It will also cover the most common ways to use expressions, date-based, variable-length substrings, and ENUM values or special considerations like treating nulls and character set (collation). Many database (even experienced) professionals can benefit by reading this chapter, as it is common that some options are not widely known and can be handy in many situations.

Chapter 9: Using Stored Routines, Triggers, and Scheduled Events - will cover how to work with Stored Objects and Programs, create Procedures, Functions, and how they best fit in different applications. Moreover, will see Triggers and how to schedule and execute Events. Stored programs, procedures, functions, and triggers in MySQL provide a way to encapsulate and manage SQL logic within the database. They enhance code organization, promote reusability, and allow for the execution of complex operations. Developers can leverage these database objects to streamline their applications and enforce business rules directly at the database level.

Chapter 10: Importing and Exporting Data - will cover the Import and Export data capabilities of MySQL Server. These features are essential for managing data, backups, and migrations. It will show how to export using SQL statements, our complete database, a schema, or only selected objects and see advanced options available. Then, it will show how to import data from a disk using either a Dump Project Folder or SQL/dump file. Use cases include sharing data, backup, migrations, setting up development environments, or restoring databases.

Chapter 11: Validating and Reformatting Data - will cover how to convert values from one type to another, grouping data, using encryption, compression, numeric, aggregate, window, ranking, partition and related row calculations in a result set and Extensible Markup Language (XML) functions. Validating and reformatting data in MySQL involves several techniques to ensure data accuracy, integrity, consistency, and efficiency in database operations. These techniques play a crucial role in optimizing data management and analysis processes within MySQL databases.

Chapter 12: Generating and Using Sequences - will cover how to create and use sequences. We will learn what the AUTO_INCREMENT column attribute is and how it works using practical, ready-to-use data manipulation statements like adding, updating, deleting and altering tables having an AUTO_INCREMENT column. Moreover, will show how to use a sequence in a multiple-column index and finally how to use LAST_INSERT_ID() function in a sequence.

Chapter 13: Working with JSON - will cover the JavaScript Object Notation (JSON) data type. This chapter will show how to create a column, insert and pull data from a JSON column using a website configuration practical example, searching, modifying, ordering and converting between JSON and non-JSON values. In the last section will show how to use JSON in order to manage event-related data.

Chapter 14: Server Administration - will cover the MySQL Server Administration essentials. In this chapter, we will learn how to perform common database administration tasks like, starting and stopping the server, managing users, getting schema and tables metadata information, backup and restore. Will also cover maintaining database and tables, as well as, finding out what activity is taking place through server logs.

Chapter 15: Monitoring the Database Server and Security - will cover practical Database Server Monitoring capabilities like; managing the server status, client connections, performance dashboard and reports, and setting up performance schema. Moreover, it will show how to use authentication plug-ins and the password validation component. Additionally, readers will learn how to use MySQL and PowerShell clients to send emails as a proactive monitoring and maintenance mechanism, for example, in case of certain database server events or to alert database users.

Code Bundle and Coloured Images

Please follow the link to download the
Code Bundle and the ***Coloured Images*** of the book:

https://rebrand.ly/22ef27

The code bundle for the book is also hosted on GitHub at
https://github.com/bpbpublications/MySQL-Cookbook.
In case there's an update to the code, it will be updated on the existing GitHub repository.

We have code bundles from our rich catalogue of books and videos available at **https://github.com/bpbpublications**. Check them out!

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Table of Contents

Chapter 1
Using the MySQL Client Program

Introduction

In this chapter, we will cover an overview of the MySQL client program (Workbench) and its main features. We will also be covering the development environment to be used throughout this book. We will learn how to connect and manage connections, query the server and retrieve results, using the modeler, saving and opening scripts.

Structure

In this chapter, we will discuss the following topics:

- Installation guidance
- Recipe 1: Licensing consideration for installation software
- Main features of the client program (Workbench)
    - The main toolbar
    - The navigator pane
    - Administration view
    - Schemas view
- Recipe 2: Connecting to a database
- Recipe 3: Managing connections

- Recipe 4: Using the query editor and retrieve results from the server
- Recipe 5: Using the modeler
- Recipe 6: Saving and opening scripts

Objectives

In the first chapter of our journey, we will cover an overview of the MySQL client program (Server and Workbench) to be used in the book and its main features. We will also be covering the development environment to be used throughout this book. We will learn how to connect and manage connections, query the server and retrieve results, using the modeler, saving and opening scripts.

Installation guidance

The main client program to be used throughout this book is the MySQL Workbench as part of the MySQL Installer for Windows, which you can download for free at the following link:

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

MySQL Workbench client is a GUI tool that can help accomplish any common or more complex task whether it is development or administration. Additionally, MySQL Shell client tool which is described in detail in *Chapter 2, Using MySQL Shell*, is another tool installed which offers a command-line interface where we can interact with the database. It offers SQL and JavaScript modes as well as interacting with the operating system (Windows, Linux or other).

Our installation guide will be based on Windows however all recipes and code snippets should work in any supported operating system (like Linux, Ubuntu, Fedora and macOS).

After you download the installer program, start it, choose the Developer Default option like shown in the following figure and then click on Next:

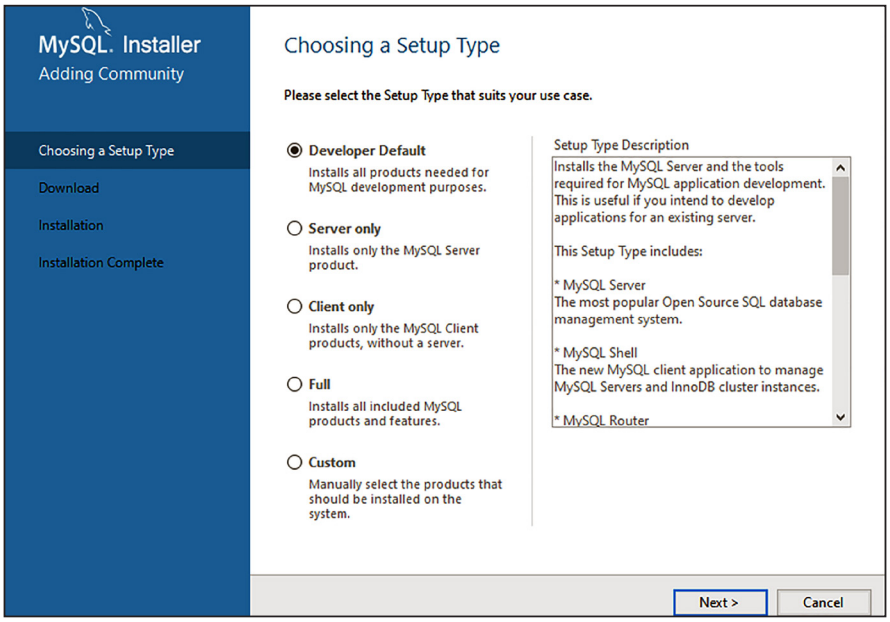

Figure 1.1: *My SQL installer Choosing a Setup Type screen*

In the following screen, you can leave the pre-selected **Path** and click Next or choose another installation folder (in our example, there is a Path Conflict due to a previous installation, you can ignore it if the previous installation is removed. Same folder will be reused and overwritten), as shown in the following figure:

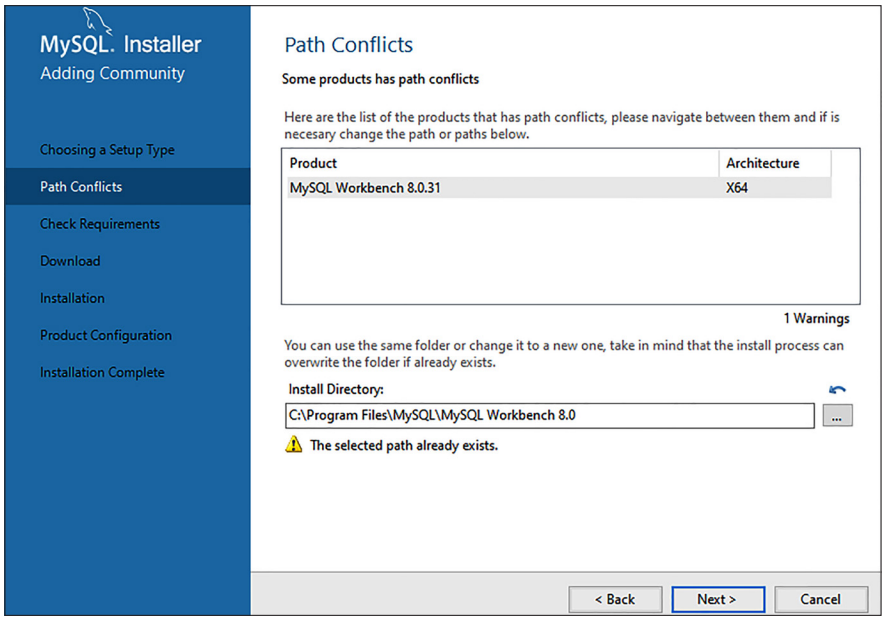

Figure 1.2: *MySQL Installer Path Conflicts screen*

In the following screen, certain requirements are checked based on the option chosen in the first screen, you will need to manually resolve these and download respective software (like Python and Visual Studio, as shown).

- Python software can be downloaded for free at:

  https://www.python.org/downloads/
- Visual Studio (free Community 2019 version) can be downloaded at:

  https://visualstudio.microsoft.com/vs/older-downloads/

Click Check and then Next when requirements are resolved and you will be ready to download MySQL software, as shown in the following figure:

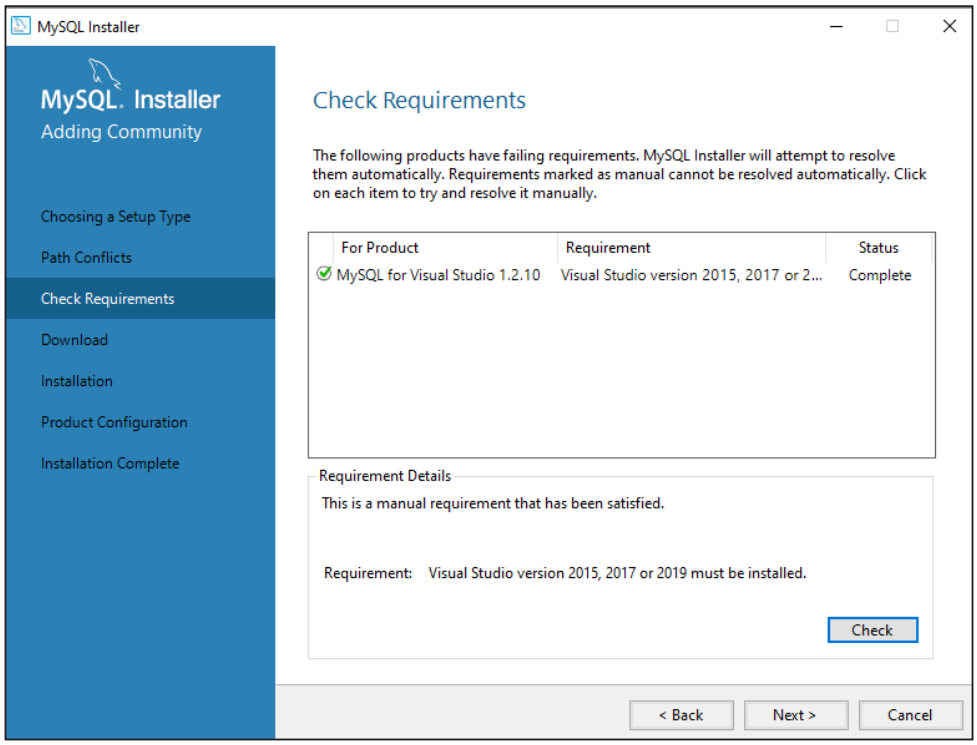

Figure 1.3: *MySQL Installer Check Requirements screen*

We are now ready to download and install MySQL software, click **Execute** in the screen as follows:

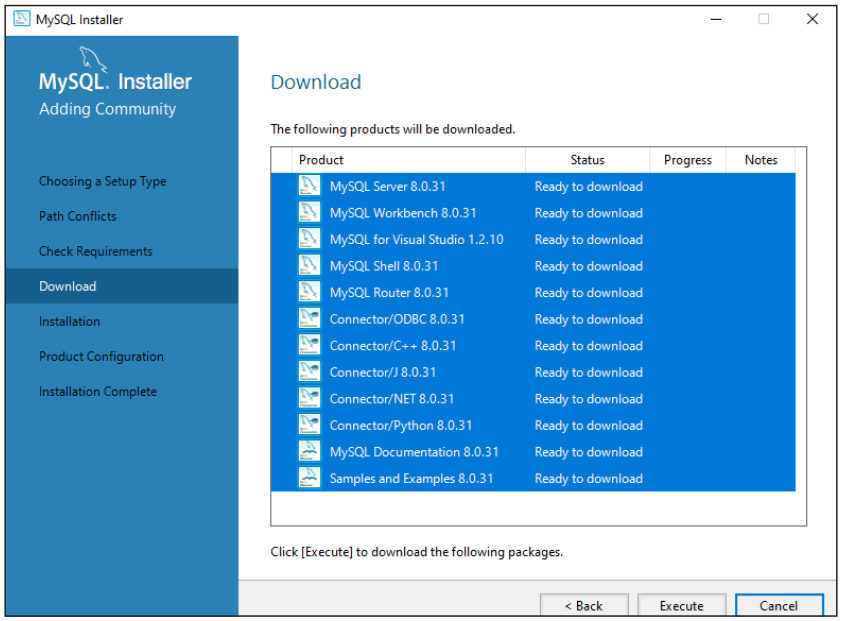

Figure 1.4: *MySQL Installer Download screen*

Once all the packages are downloaded successfully as shown in the following screen, you can click **Next** and then **Execute** to continue with installation:

Note: You might need to retry | click on Try again | if some package(s) fail to download, until all are done.

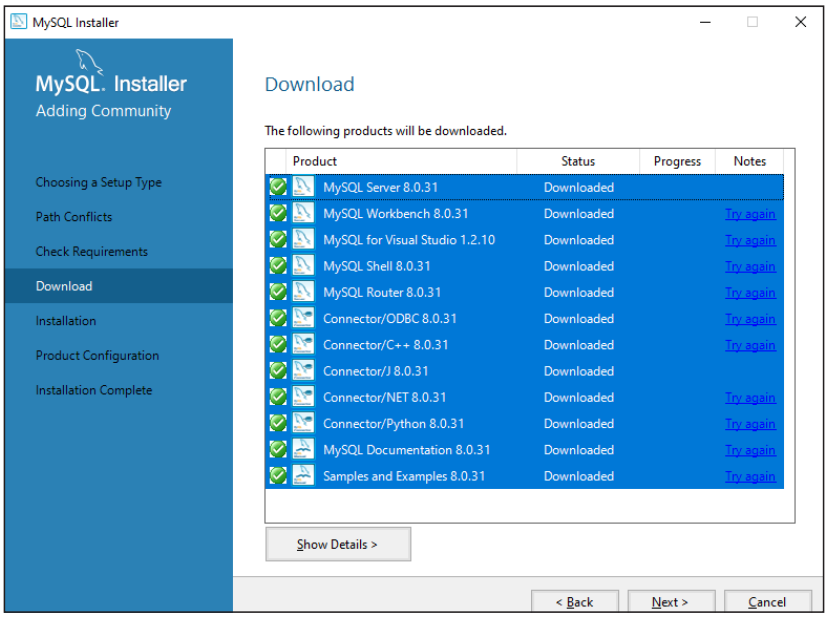

Figure 1.5: *MySQL Installer Download screen (cont.)*