Chapter 3, The Relational Model

Introduction to Relational Model

- Codd proposed the relational data model in 1970.
  - Prior to that, database systems were based on older data models (the hierarchical model and the network model); the relational model revolutionized the database field and largely supplanted these earlier models
  - Main idea was to organize data as groups of relations
  - Each relation describes a group of objects with similar attributes

Student ID	Name	Major
1161234	Ahmad	ENCS
1161455	Noor	COMP

Course ID	CODE	Name
56478	COMP333	Database management Systems
56479	COMP232	Data Structures

Relational data model example

Students(*sid:* `string`, *name:* `string`, *login:* `string`, *age:* `integer`, *gpa:* `real`)

The preceding schema says that each record in the Students relation has five fields, with field names and types as indicated.[2] An example instance of the Students relation

sid	*name*	*login*	*age*	*gpa*
53666	Jones	jones@cs	18	3.4
53688	Smith	smith@ee	18	3.2
53650	Smith	smith@math	19	3.8
53831	Madayan	madayan@music	11	1.8
53832	Guldu	guldu@music	12	2.0

Simplicity

- The relational model is very simple and elegant; a database is a collection of one or more relations, where each relation is a table with rows and columns.

- A DBMS permits the use of SQL to query, and manipulate data and relations in a database.

SQL

- DBMS Supports **Structured Query Language.**
  - Based on Relational Algebra

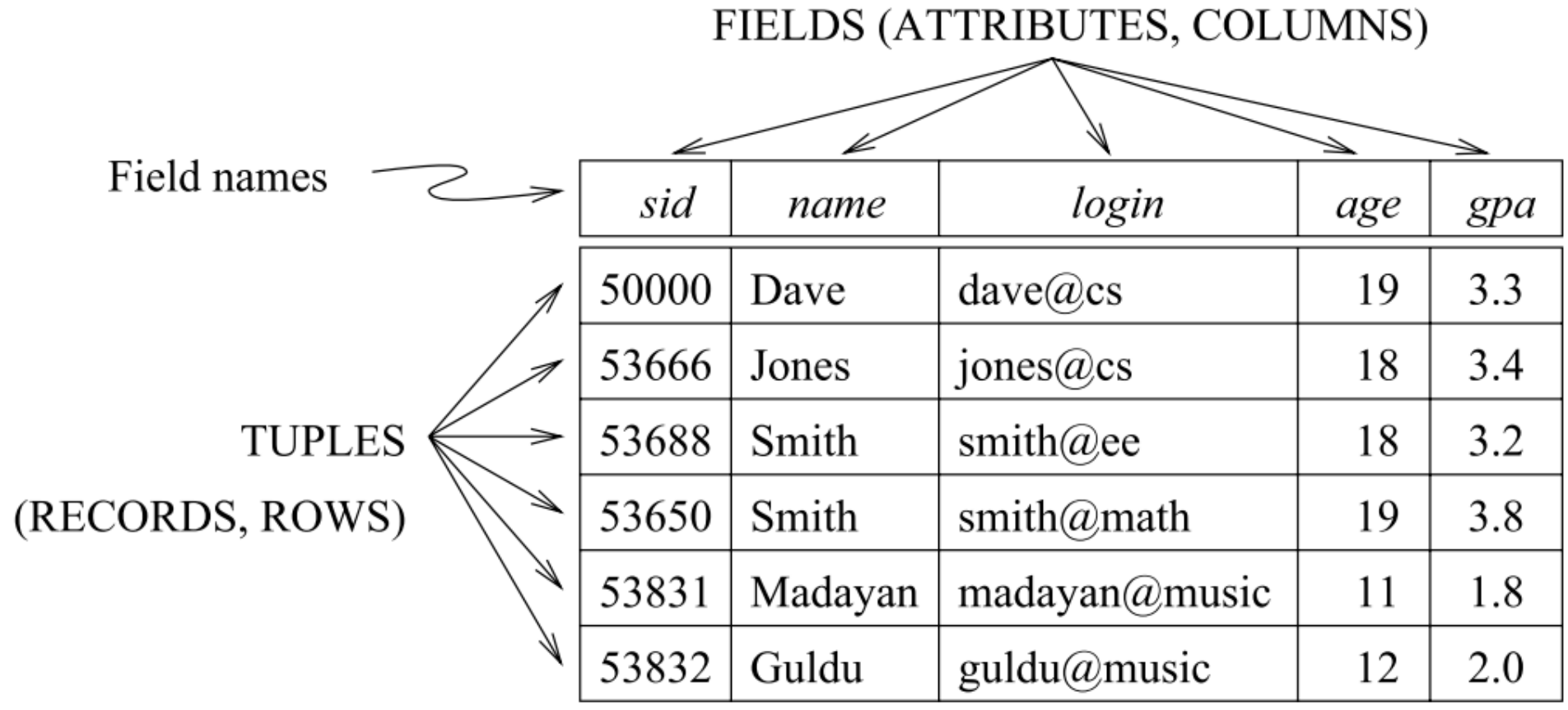
- Composed of
  - DDL
  - DML

Main Constructs

- The main construct in relational model is Relation
- A Relation consist of:
  - Schema
  - Instance
- There should be no redundant data (rows) inside a database
- Degree: number of fields (attributes)
- Cardinality: number of records (tuples)

Example:

Students(*sid:* `string`, *name:* `string`, *login:* `string`, *age:* `integer`, *gpa:* `real`)



sid	*name*	*login*	*age*	*gpa*
50000	Dave	dave@cs	19	3.3
53666	Jones	jones@cs	18	3.4
53688	Smith	smith@ee	18	3.2
53650	Smith	smith@math	19	3.8
53831	Madayan	madayan@music	11	1.8
53832	Guldu	guldu@music	12	2.0

Example SQL

```
CREATE TABLE Students ( sid     CHAR(20),
                        name    CHAR(30),
                        login   CHAR(20),
                        age     INTEGER,
                        gpa     REAL )
```

```
INSERT
INTO    Students    (sid, name, login, age, gpa)
VALUES  (53688, 'Smith', 'smith@ee', 18, 3.2)
```

Example SQL..2

```
DELETE
FROM    Students S
WHERE   S.name = 'Smith'
```

```
UPDATE  Students S
SET     S.age = S.age + 1, S.gpa = S.gpa - 1
WHERE   S.sid = 53688
```

mySql

- We will be using mySql server
  - Download from
  - https://dev.mysql.com/downloads/mysql/
- Must install a client to connect to server
  - Best: mySql WorkBench

MySQL :: Download MyS

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

Weather | M&N | edu | Misc | Apps | Ritaj | Plex | Selenium | CRM | Antalya | Shopping | QA | Estimates | Shopping Cart | Swar

Enterprise **Community** Yum Repository APT Repository SUSE Repository Windows Archives MyS

Thank you for your support!

Generally Available (GA) Releases

MySQL Community Server 8.0.12

Select Operating System:

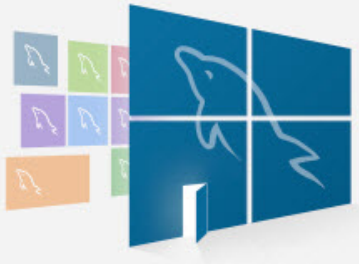
Microsoft Windows

Recommended Download:

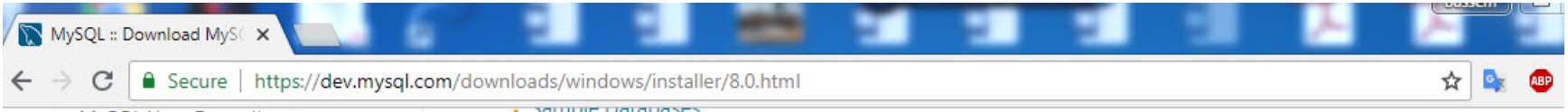
MySQL Installer for Windows

All MySQL Products. For All Windows Platforms. In One Package.

Starting with MySQL 5.6 the MySQL Installer package replaces the standalone MSI packages.



Windows (x86, 32 & 64-bit), MySQL Installer MSI **Go to Download Page >**



- MySQL Yum Repository
- MySQL APT Repository
- MySQL SUSE Repository
- MySQL Community Server
- MySQL Cluster
- MySQL Router
- MySQL Shell
- MySQL Workbench
- MySQL Connectors
- Other Downloads

- Sample Databases

Choosing the right file:

- If you have an online connection while running the MySQL Installer, choose the `mysql-installer-web-community` file.
- If you do NOT have an online connection while running the MySQL Installer, choose the `mysql-installer-community` file.

Note: MySQL Installer is 32 bit, but will install both 32 bit and 64 bit binaries.

Online Documentation

- MySQL Installer Documentation and Change History

Please report any bugs or inconsistencies you observe to our Bugs Database.
Thank you for your support!

Generally Available (GA) Releases

MySQL Installer 8.0.12

Select Operating System:

Microsoft Windows

Looking for previous GA versions?

Windows (x86, 32-bit), MSI Installer	8.0.12	15.9M	**Download**
(mysql-installer-web-community-8.0.12.0.msi)	MD5: `387bd57f0fb07e3880d10f0c21b81686` | Signature		
Windows (x86, 32-bit), MSI Installer	8.0.12	273.4M	**Download**
(mysql-installer-community-8.0.12.0.msi)	MD5: `53b3a9bb89db061862969b67c68b6f67` | Signature		

MySQL :: Begin Your Do

Secure | https://dev.mysql.com/downloads/file/?id=479862

Enterprise **Community** Yum Repository APT Repository SUSE Repository Windows Archives

- MySQL on Windows
- MySQL Yum Repository
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- Download technical White Papers and Presentations
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- Report and track bugs in the MySQL bug system
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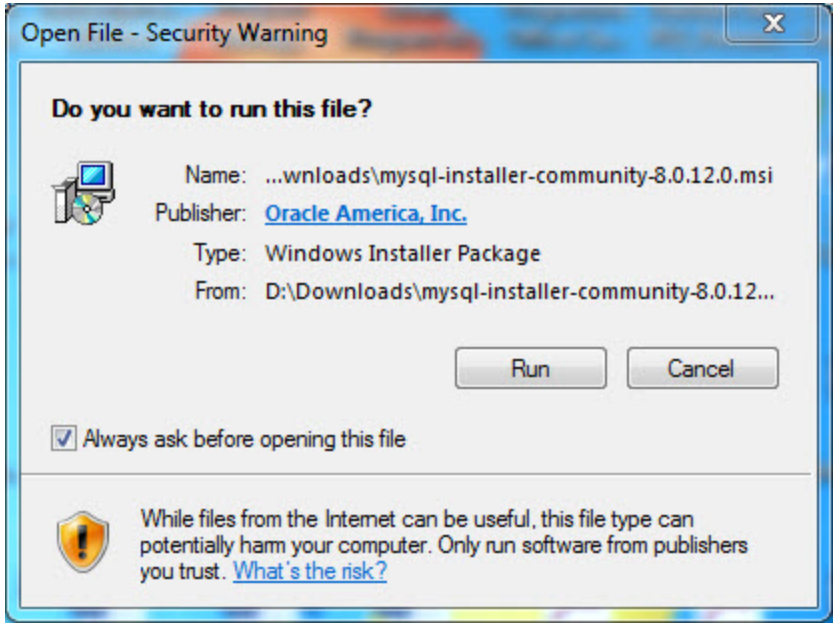
No thanks, just start my download.


Open File - Security Warning
Do you want to run this file?
Name: ...wnloads\mysql-installer-community-8.0.12.0.msi
Publisher: Oracle America, Inc.
Type: Windows Installer Package
From: D:\Downloads\mysql-installer-community-8.0.12...
Run
Cancel
Always ask before opening this file
While files from the Internet can be useful, this file type can potentially harm your computer. Only run software from publishers you trust. What's the risk?


DATABASE
RELATIONAL
SECURITY
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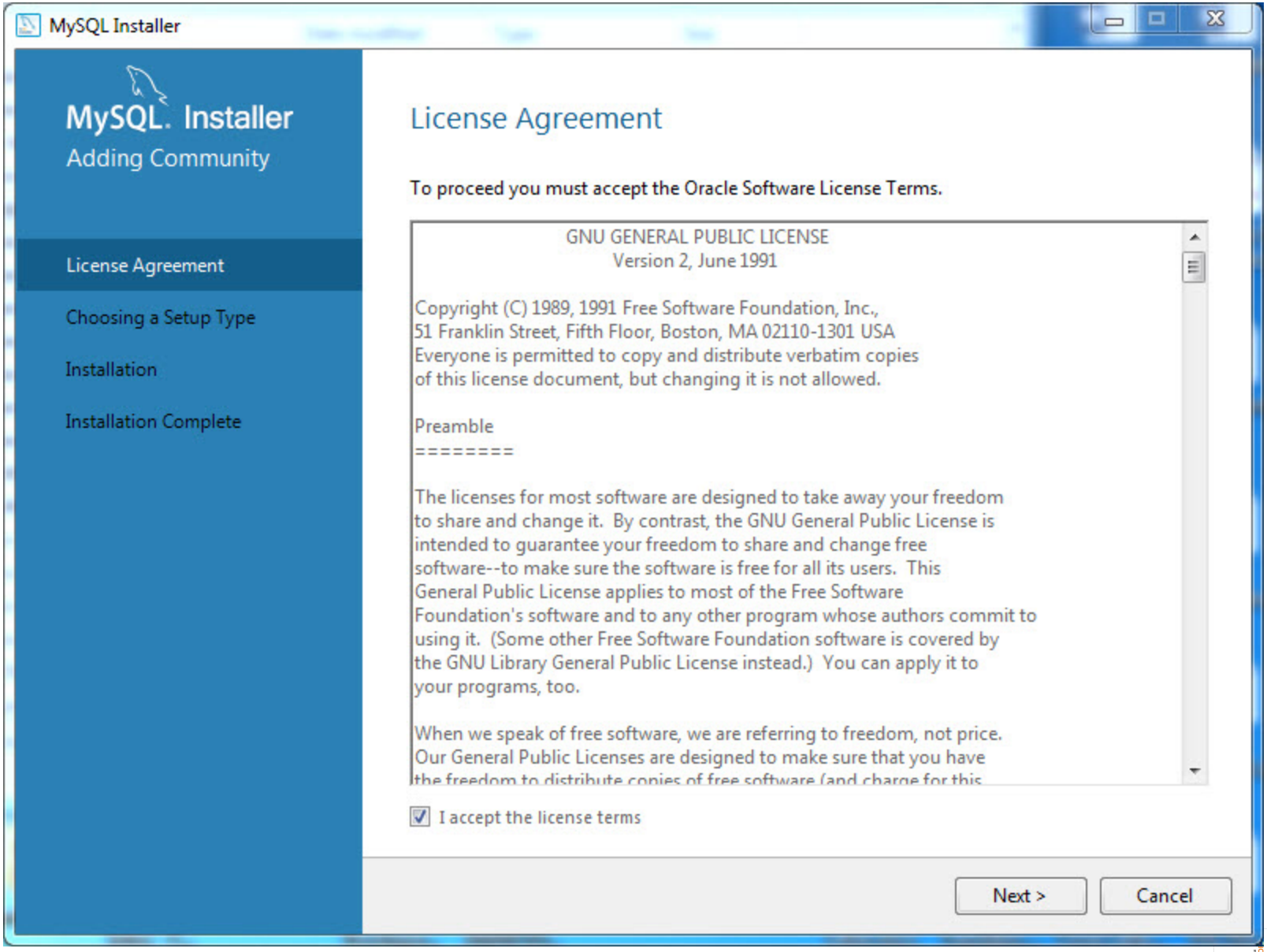
DATA
DESIGNER
DBMS
MIRRORING
LANGUAGE
KEY


MySQL Installer
MySQL. Installer
Adding Community
License Agreement
Choosing a Setup Type
Installation
Installation Complete
License Agreement
To proceed you must accept the Oracle Software License Terms.
GNU GENERAL PUBLIC LICENSE
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Preamble
========
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software--to make sure the software is free for all its users. This
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Foundation's software and to any other program whose authors commit to
using it. (Some other Free Software Foundation software is covered by
the GNU Library General Public License instead.) You can apply it to
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Our General Public Licenses are designed to make sure that you have
I accept the license terms
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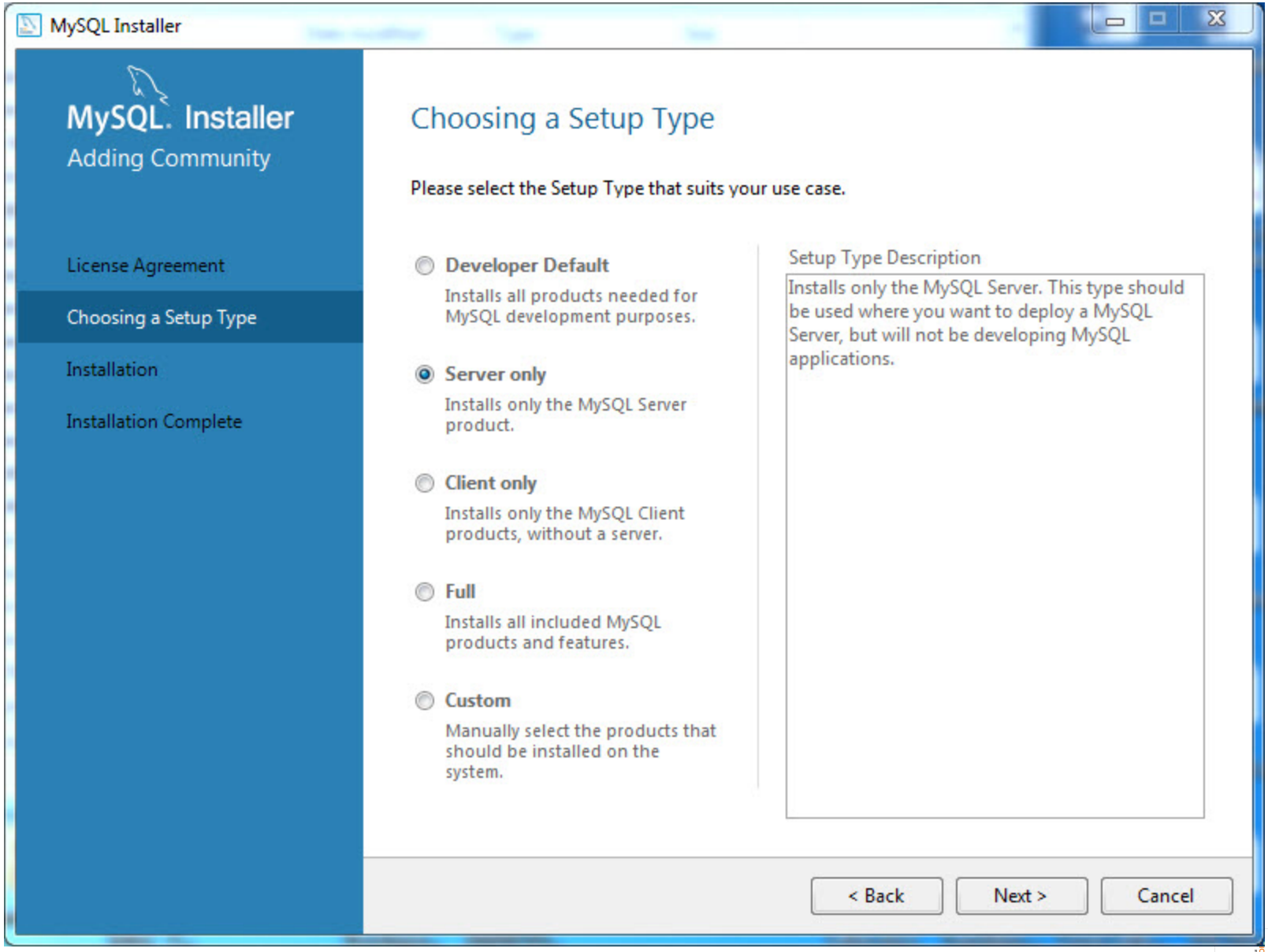
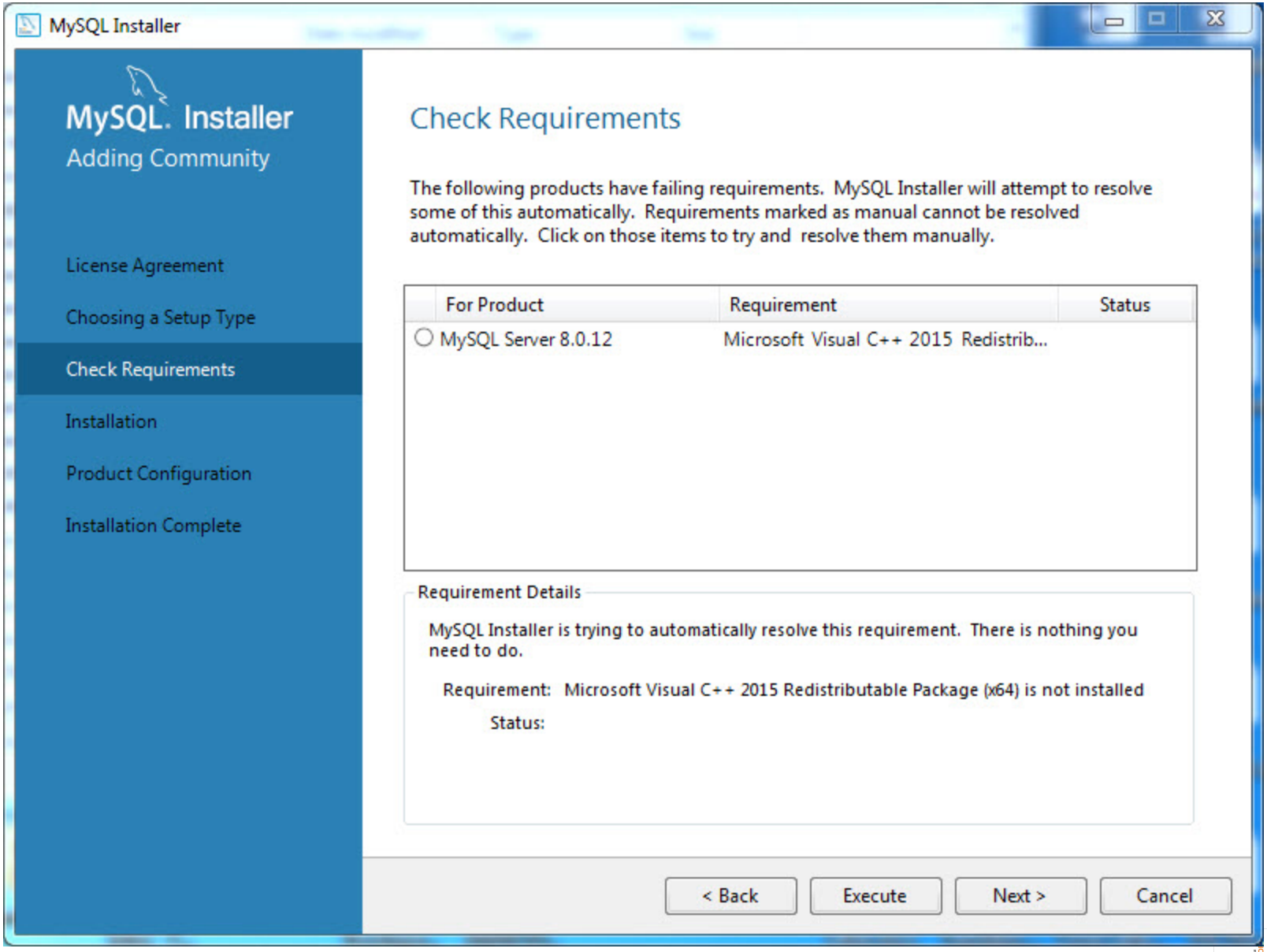
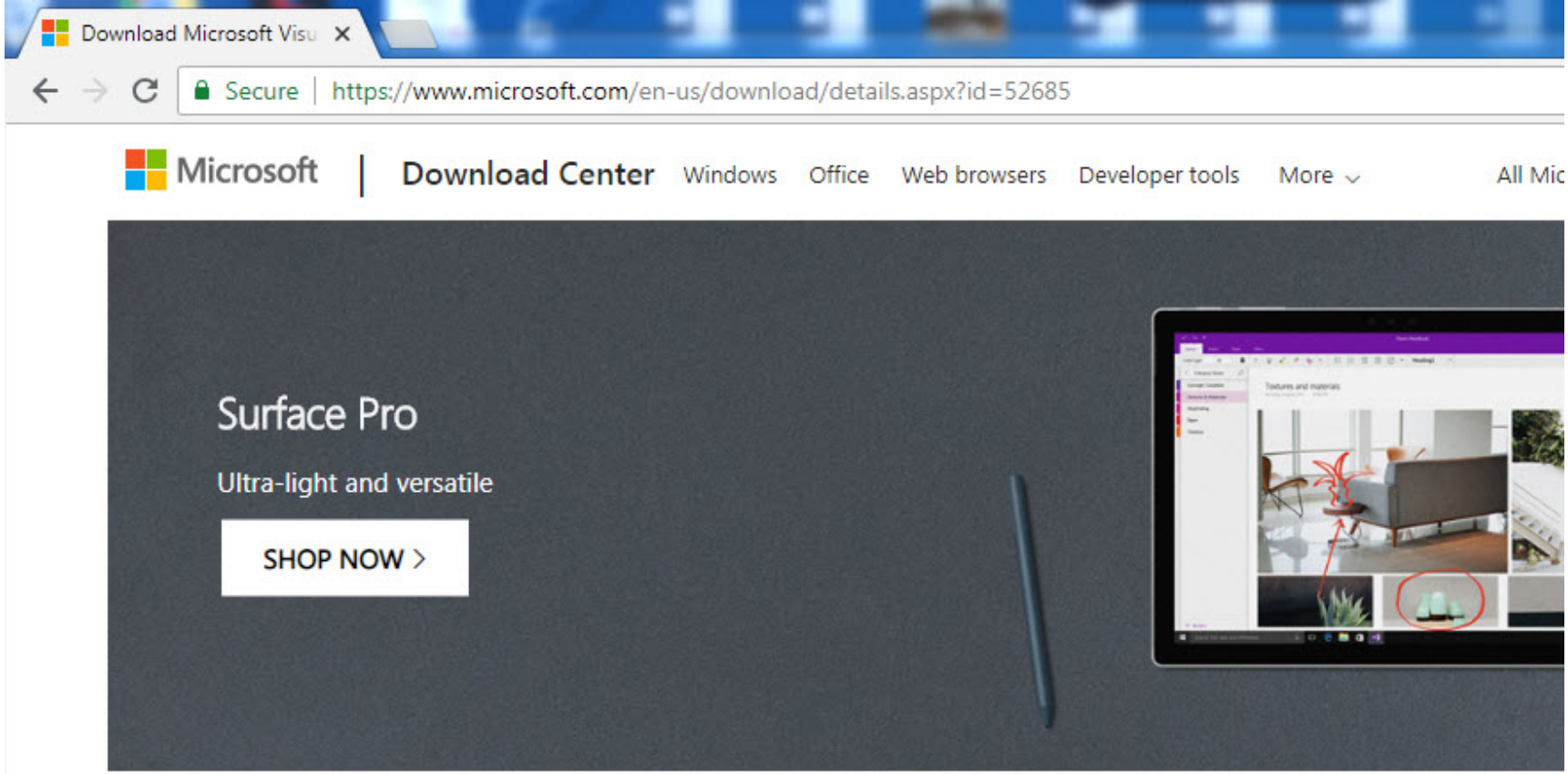

MySQL Installer
MySQL. Installer
Adding Community
License Agreement
Choosing a Setup Type
Installation
Installation Complete
Choosing a Setup Type
Please select the Setup Type that suits your use case.
Developer Default
Installs all products needed for MySQL development purposes.
Server only
Installs only the MySQL Server product.
Client only
Installs only the MySQL Client products, without a server.
Full
Installs all included MySQL products and features.
Custom
Manually select the products that should be installed on the system.
Setup Type Description
Installs only the MySQL Server. This type should be used where you want to deploy a MySQL Server, but will not be developing MySQL applications.
< Back
Next >
Cancel


MySQL Installer
MySQL. Installer
Adding Community
License Agreement
Choosing a Setup Type
Check Requirements
Installation
Product Configuration
Installation Complete
Check Requirements
The following products have failing requirements. MySQL Installer will attempt to resolve some of this automatically. Requirements marked as manual cannot be resolved automatically. Click on those items to try and resolve them manually.
For Product
Requirement
Status
MySQL Server 8.0.12
Microsoft Visual C++ 2015 Redistrib...
Requirement Details
MySQL Installer is trying to automatically resolve this requirement. There is nothing you need to do.
Requirement: Microsoft Visual C++ 2015 Redistributable Package (x64) is not installed
Status:
< Back
Execute
Next >
Cancel



Microsoft Visual C++ 2015 Redistributable Update 3 RC

Important! Selecting a language below will dynamically change the complete page content to that language.

Select Language: English

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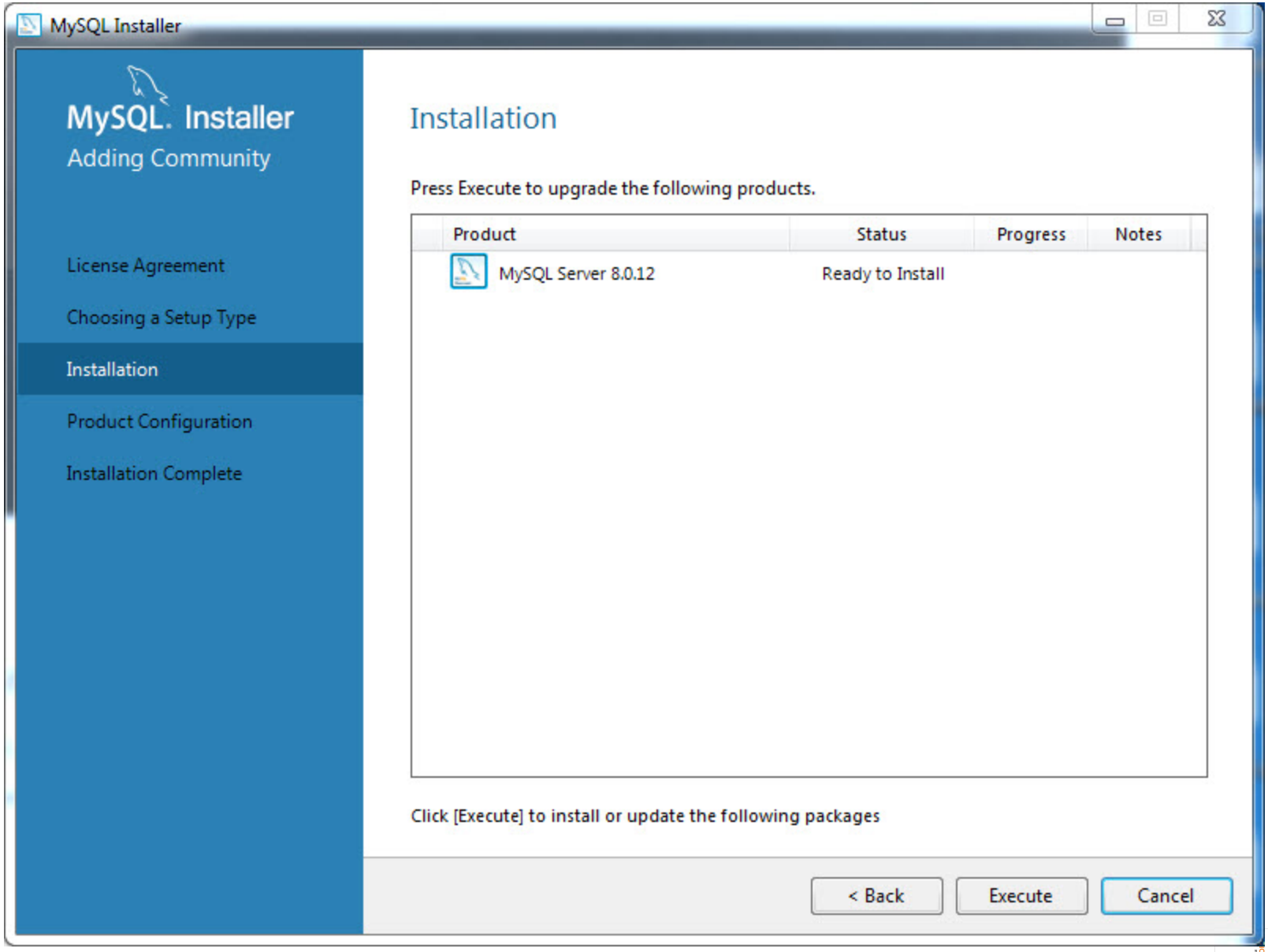
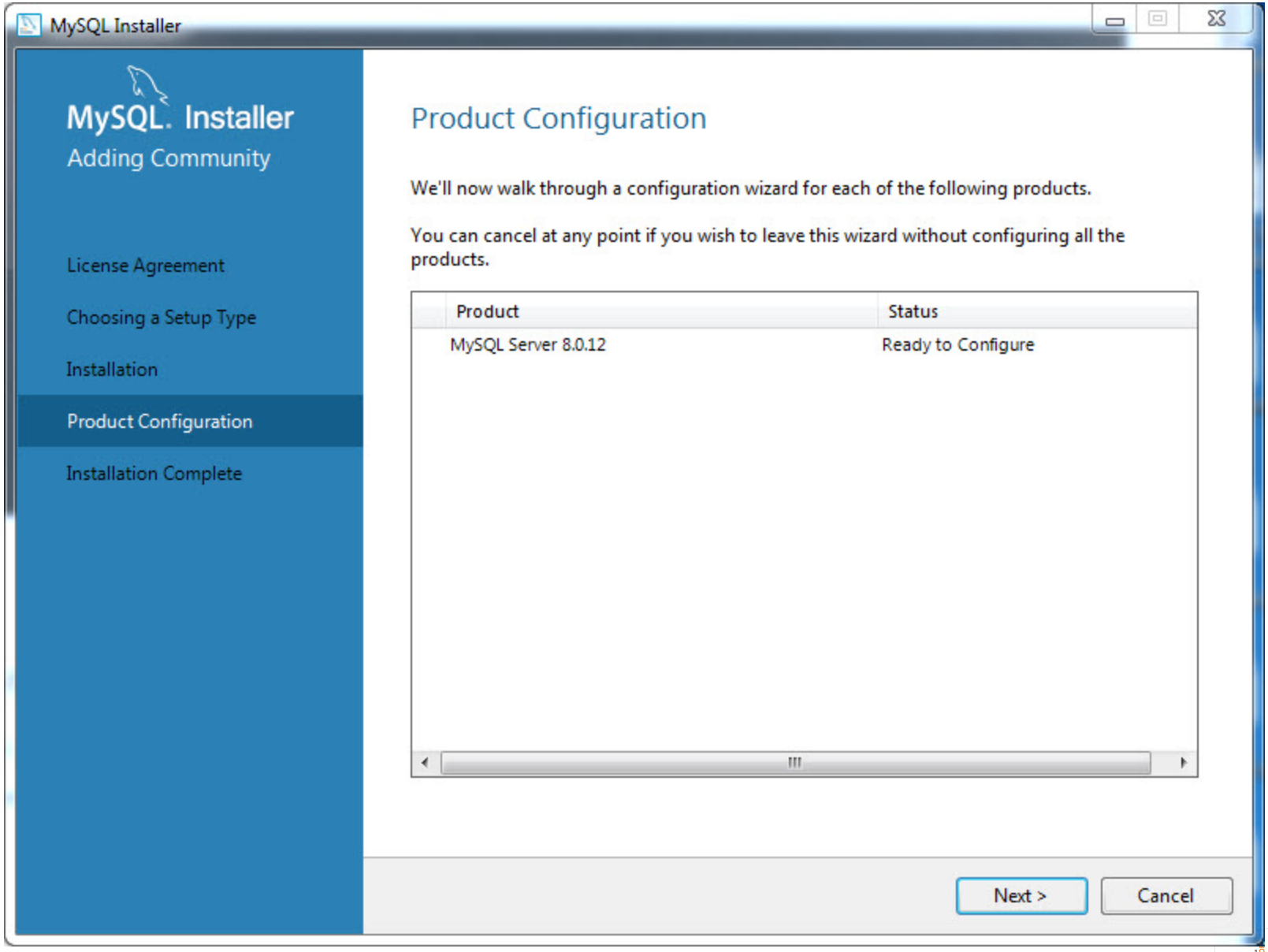

MySQL Installer
MySQL. Installer
Adding Community
License Agreement
Choosing a Setup Type
Installation
Product Configuration
Installation Complete
Installation
Press Execute to upgrade the following products.
Product
Status
Progress
Notes
MySQL Server 8.0.12
Ready to Install
Click [Execute] to install or update the following packages
< Back
Execute
Cancel


MySQL Installer
MySQL. Installer
Adding Community
License Agreement
Choosing a Setup Type
Installation
Product Configuration
Installation Complete
Product Configuration
We'll now walk through a configuration wizard for each of the following products.
You can cancel at any point if you wish to leave this wizard without configuring all the products.
Product
Status
MySQL Server 8.0.12
Ready to Configure
Next >
Cancel

MySQL Installer

MySQL. Installer
MySQL Server 8.0.12

- Group Replication
- Type and Networking
- Authentication Method
- Accounts and Roles
- Windows Service
- Logging Options
- Advanced Options
- Apply Configuration

Group Replication

(•) Standalone MySQL Server / Classic MySQL Replication

Choose this option if you want to run the MySQL Server either standalone with the opportunity to later configure classic MySQL Replication.

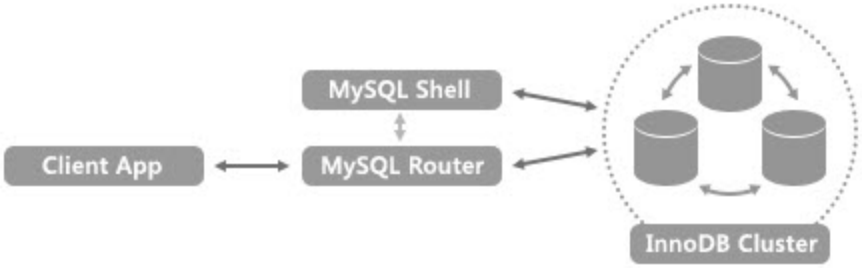
Using this option you can manually configure your replication setup and provide your own high availability solution if required.

( ) Sandbox InnoDB Cluster Setup (for testing only)

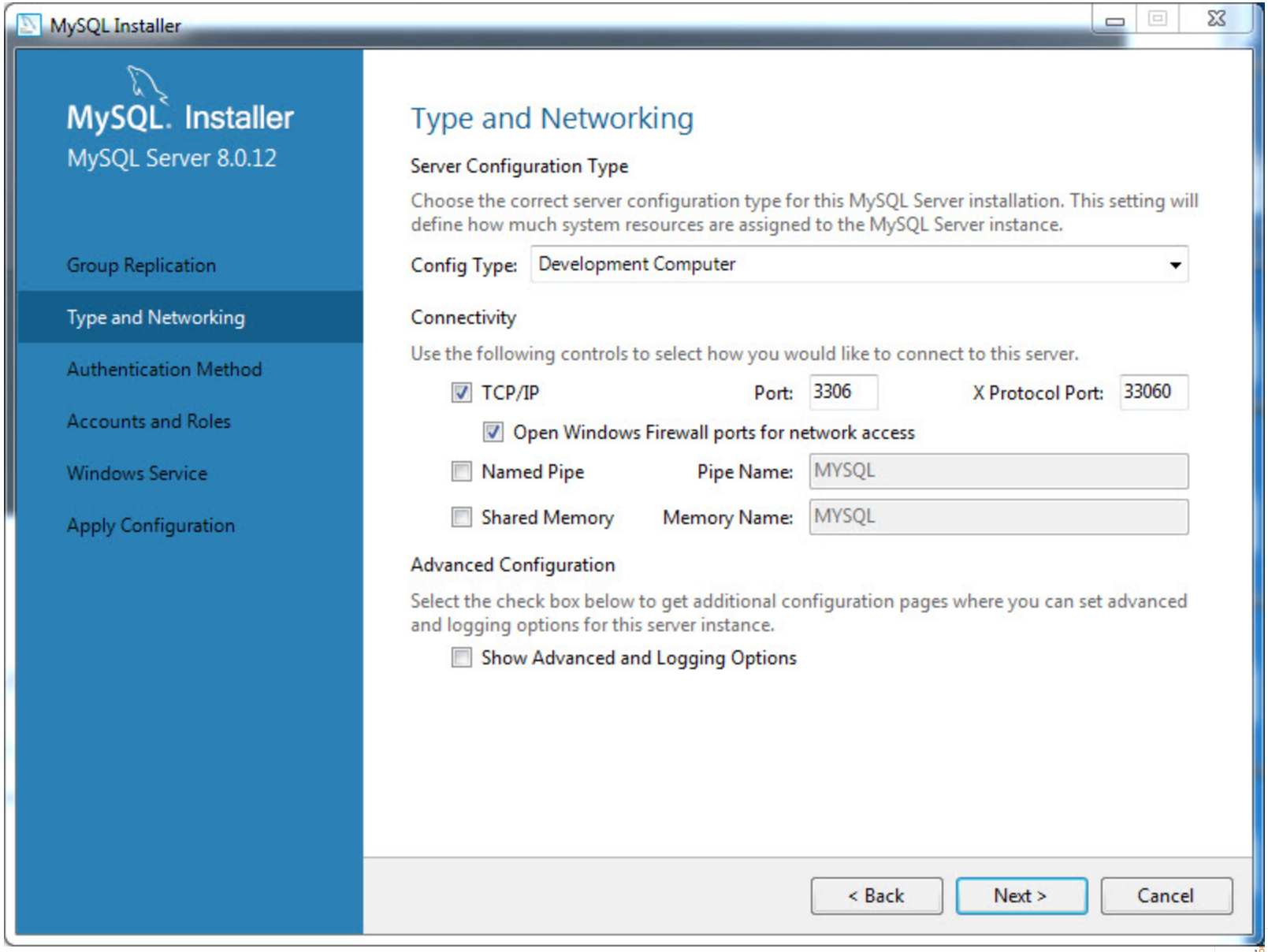
The InnoDB cluster technology provides an out-of-the-box HA (high availability) solution for MySQL using Group Replication technology.

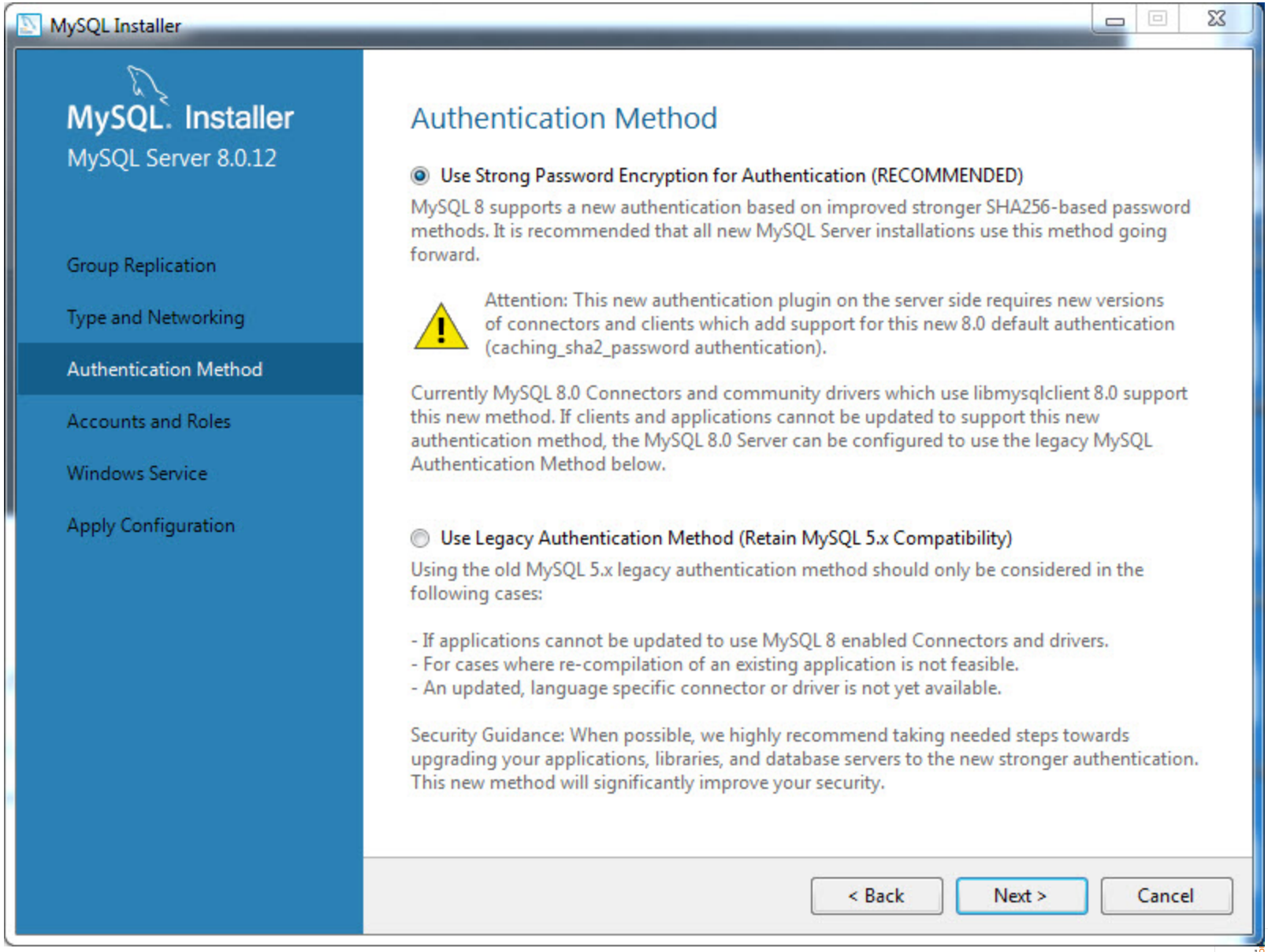
This option allows you to test an InnoDB cluster setup on your local computer using several MySQL Server sandbox instances. Read more about this here .

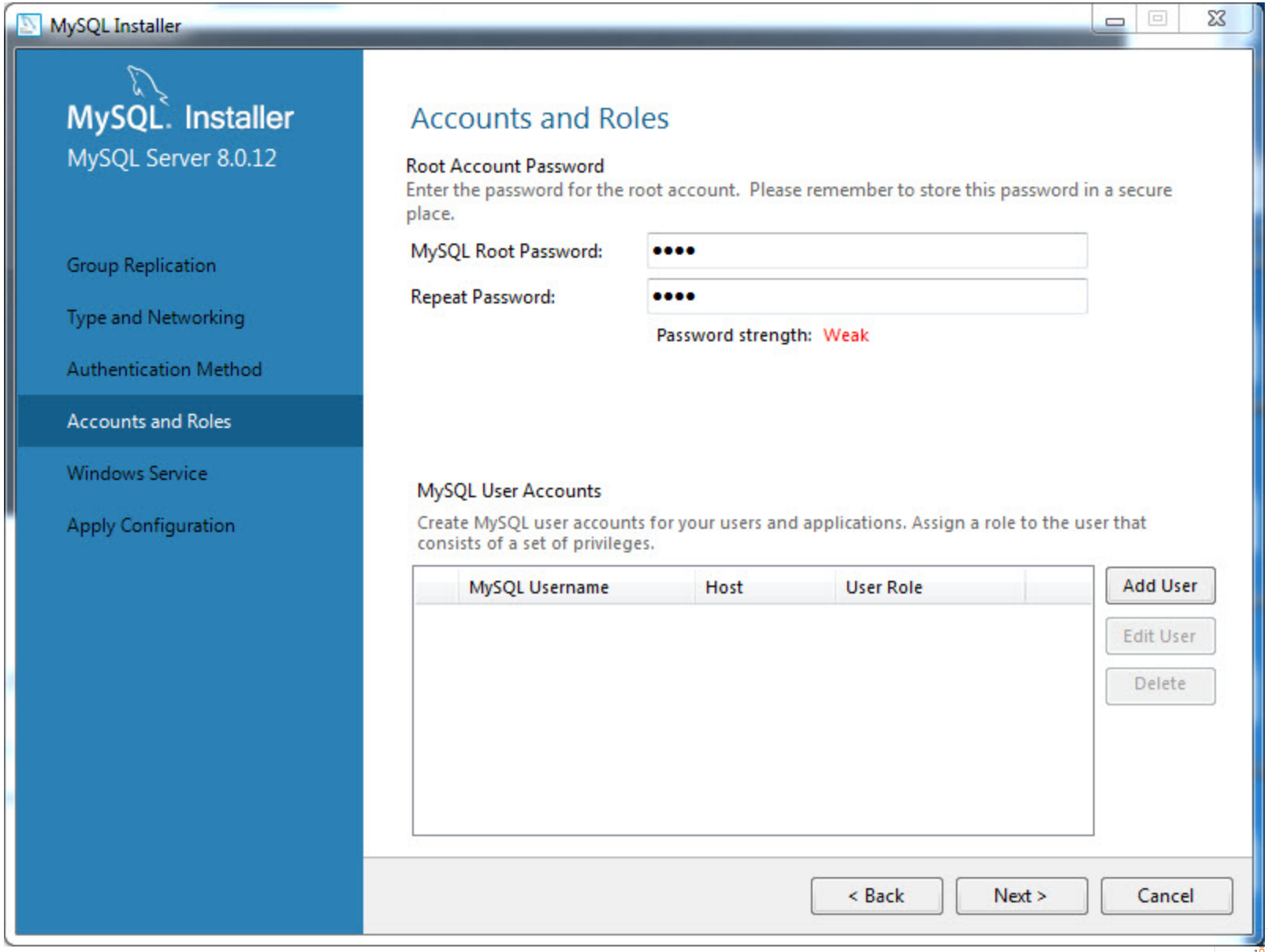
To setup a real-world production InnoDB cluster please choose the standard MySQL Server configuration instead on all desired hosts and use the MySQL Shell afterwards to create or expand the InnoDB cluster setup.

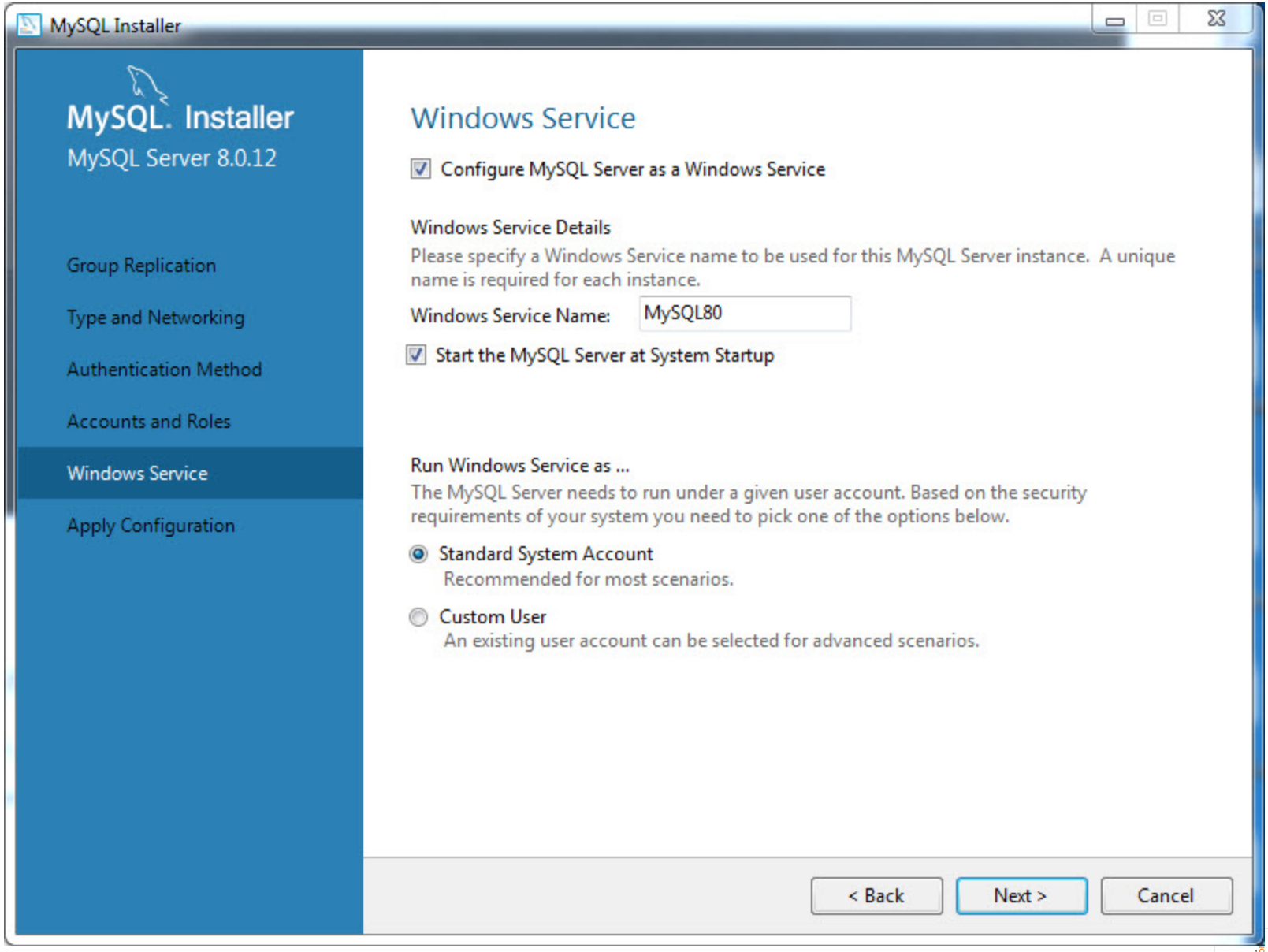


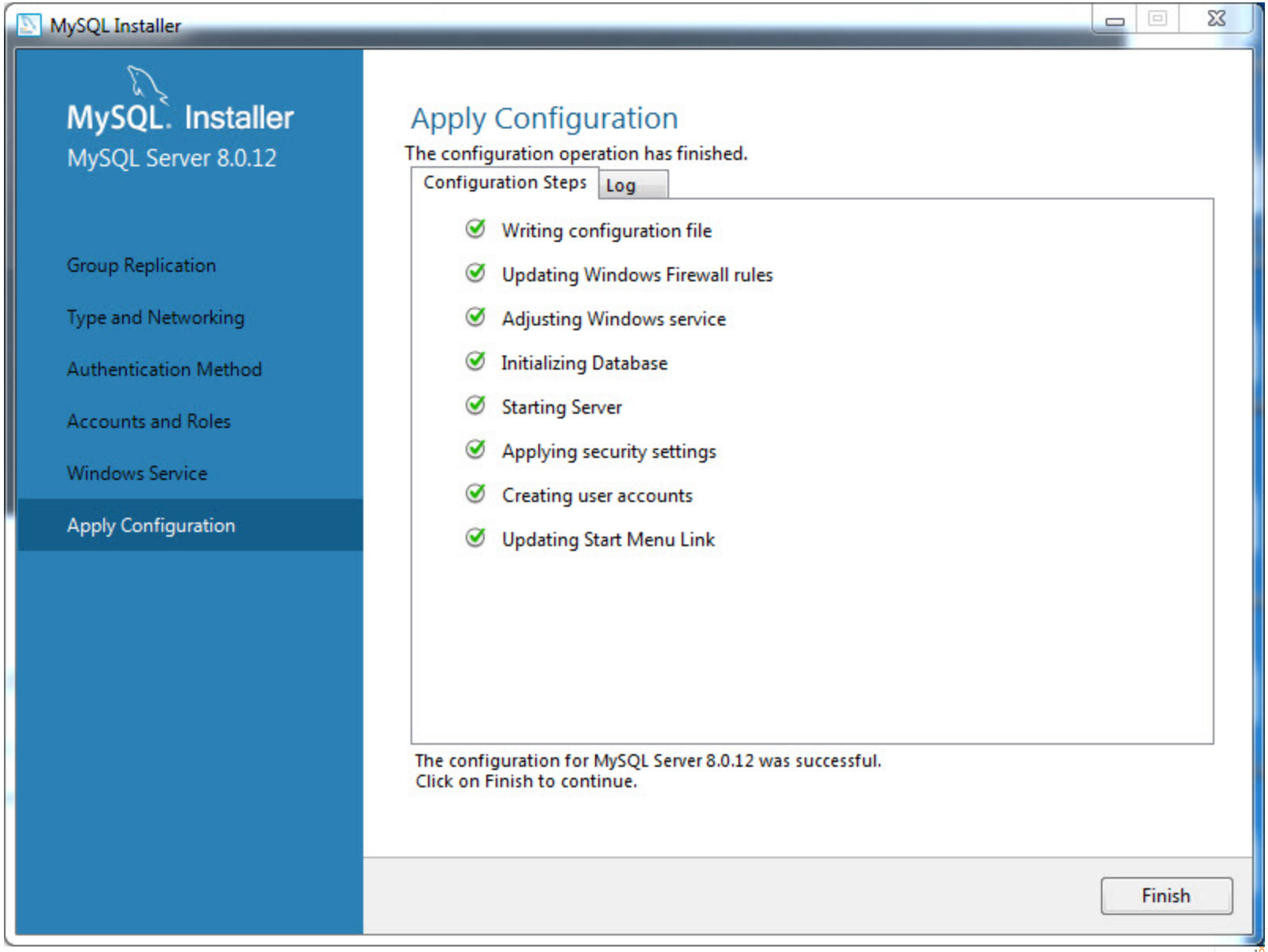
Next > Cancel

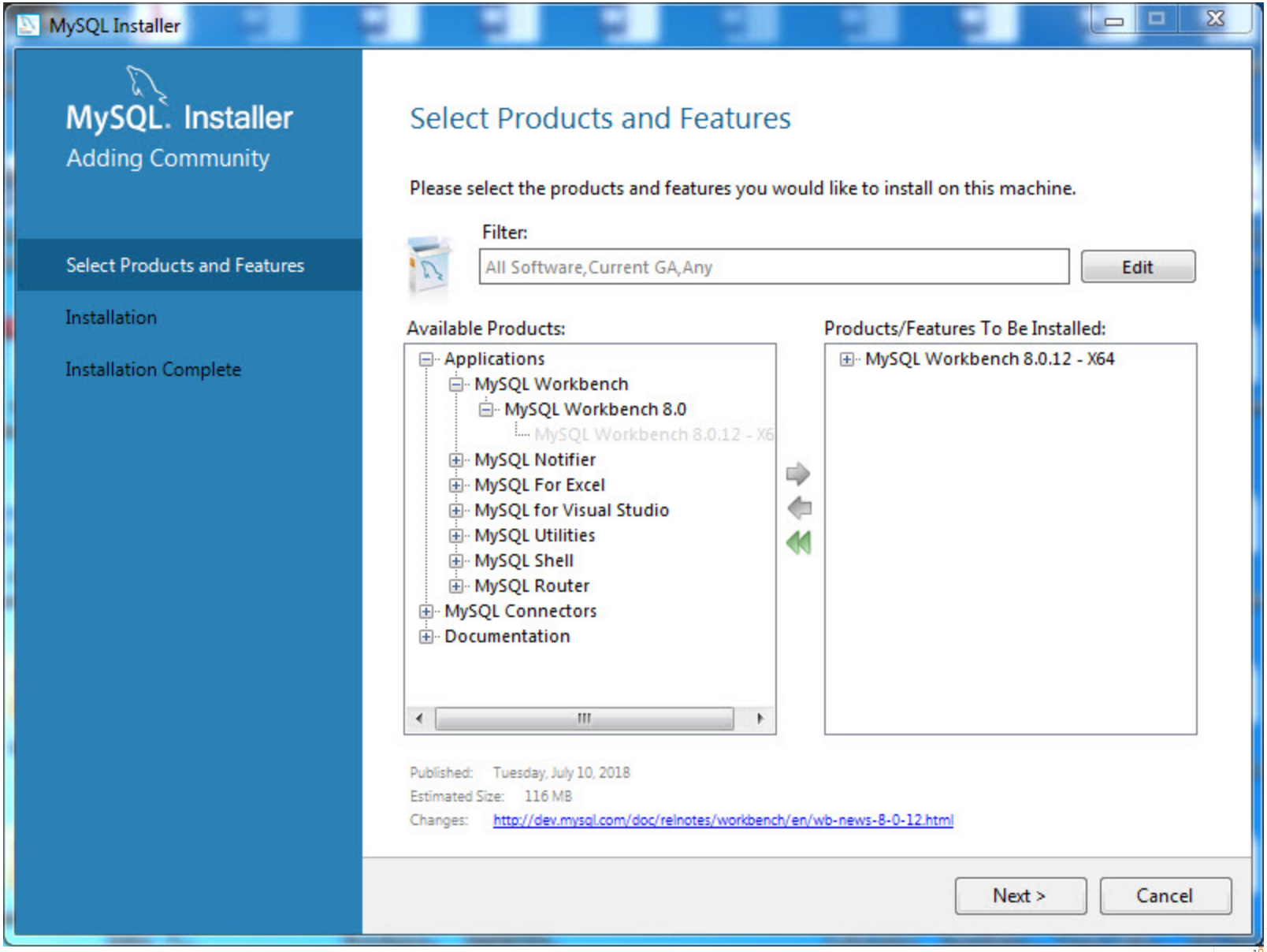

MySQL Installer
MySQL. Installer
MySQL Server 8.0.12
Group Replication
Type and Networking
Authentication Method
Accounts and Roles
Windows Service
Apply Configuration
Type and Networking
Server Configuration Type
Choose the correct server configuration type for this MySQL Server installation. This setting will define how much system resources are assigned to the MySQL Server instance.
Config Type: Development Computer
Connectivity
Use the following controls to select how you would like to connect to this server.
TCP/IP
Port: 3306
X Protocol Port: 33060
Open Windows Firewall ports for network access
Named Pipe
Pipe Name: MYSQL
Shared Memory
Memory Name: MYSQL
Advanced Configuration
Select the check box below to get additional configuration pages where you can set advanced and logging options for this server instance.
Show Advanced and Logging Options
< Back
Next >
Cancel

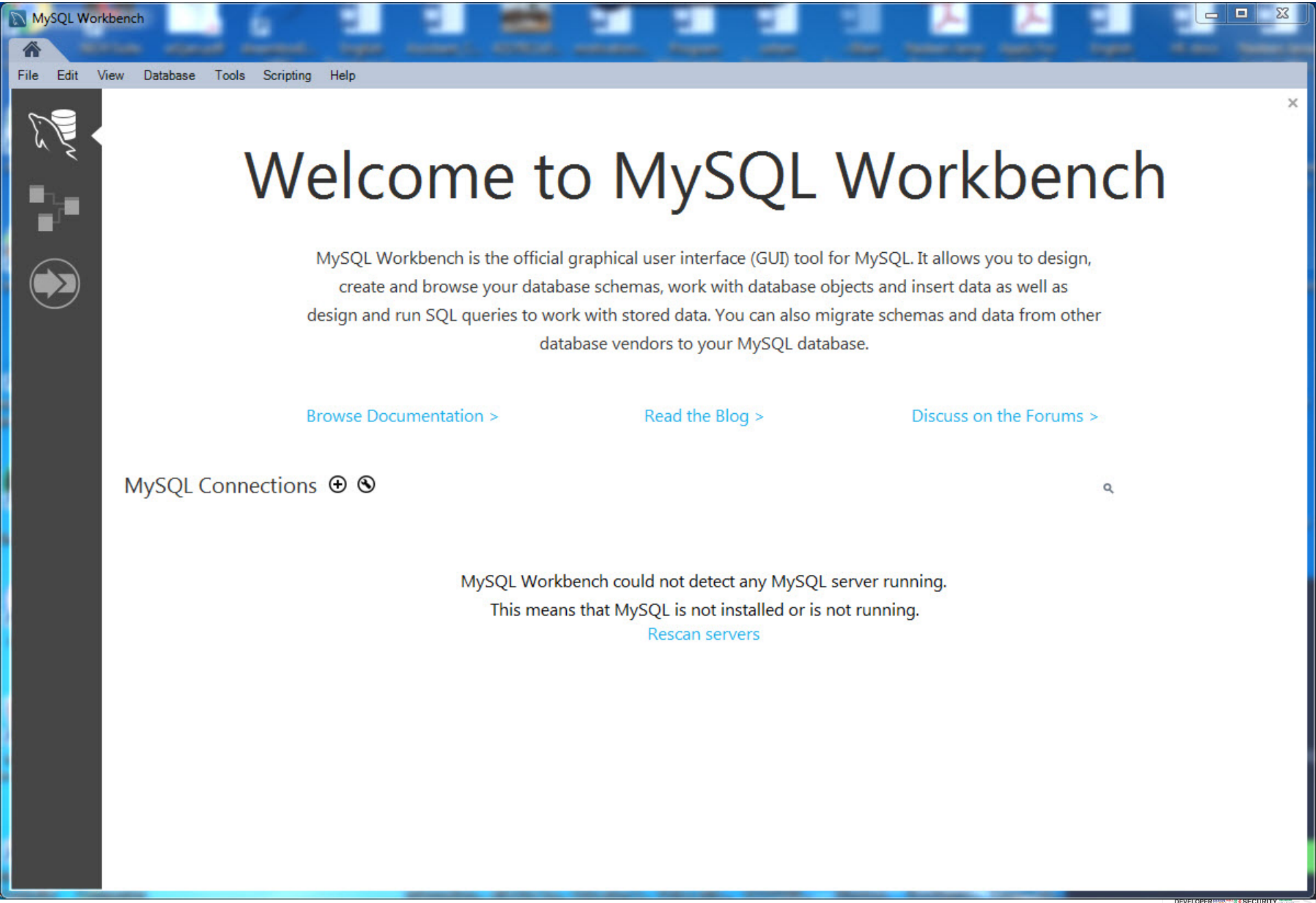

MySQL Installer
MySQL. Installer
MySQL Server 8.0.12
Group Replication
Type and Networking
Authentication Method
Accounts and Roles
Windows Service
Apply Configuration
Authentication Method
Use Strong Password Encryption for Authentication (RECOMMENDED)
MySQL 8 supports a new authentication based on improved stronger SHA256-based password methods. It is recommended that all new MySQL Server installations use this method going forward.
Attention: This new authentication plugin on the server side requires new versions of connectors and clients which add support for this new 8.0 default authentication (caching_sha2_password authentication).
Currently MySQL 8.0 Connectors and community drivers which use libmysqlclient 8.0 support this new method. If clients and applications cannot be updated to support this new authentication method, the MySQL 8.0 Server can be configured to use the legacy MySQL Authentication Method below.
Use Legacy Authentication Method (Retain MySQL 5.x Compatibility)
Using the old MySQL 5.x legacy authentication method should only be considered in the following cases:
- If applications cannot be updated to use MySQL 8 enabled Connectors and drivers.
- For cases where re-compilation of an existing application is not feasible.
- An updated, language specific connector or driver is not yet available.
Security Guidance: When possible, we highly recommend taking needed steps towards upgrading your applications, libraries, and database servers to the new stronger authentication. This new method will significantly improve your security.
< Back
Next >
Cancel

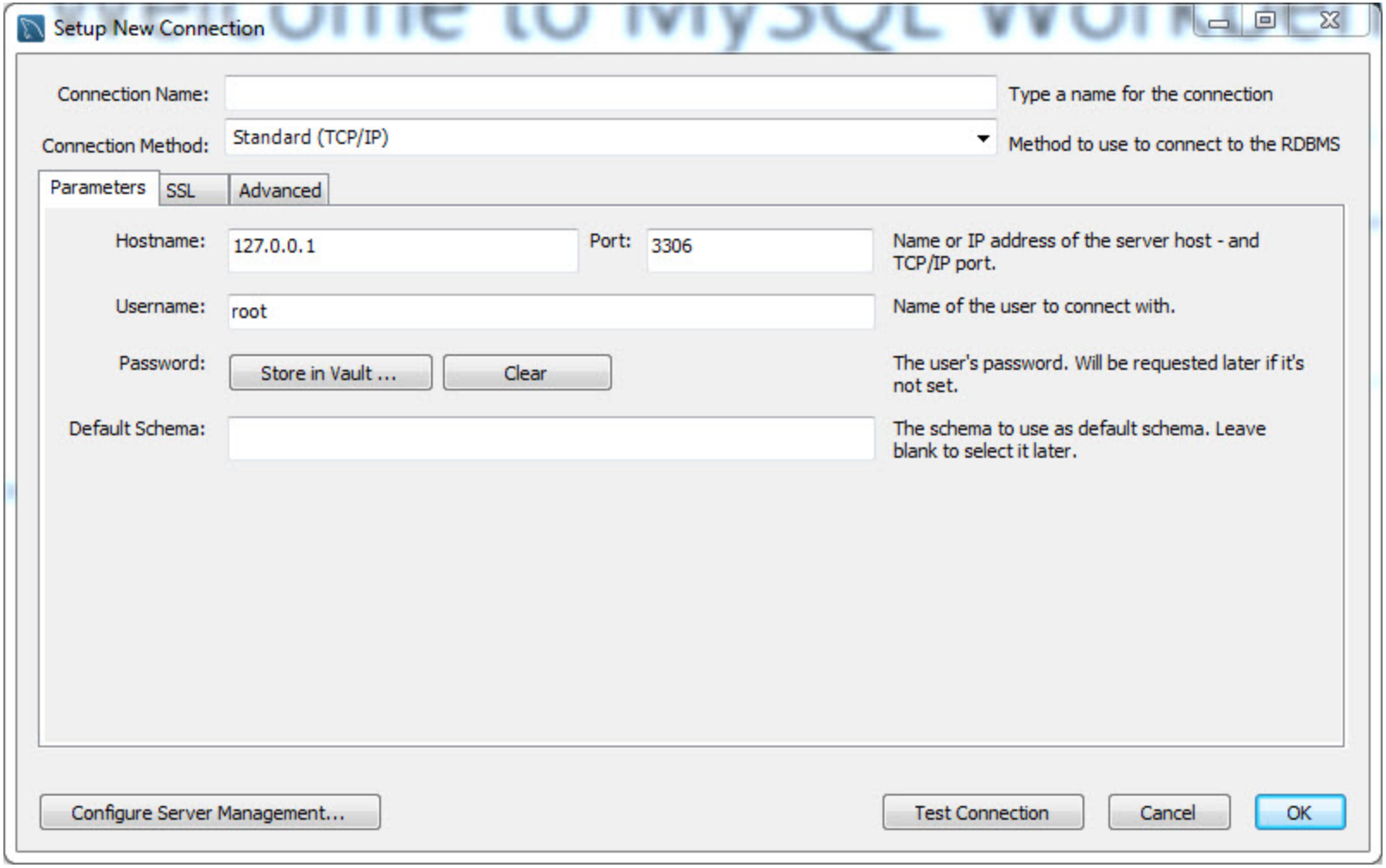

MySQL Installer
MySQL. Installer
MySQL Server 8.0.12
Group Replication
Type and Networking
Authentication Method
Accounts and Roles
Windows Service
Apply Configuration
Accounts and Roles
Root Account Password
Enter the password for the root account. Please remember to store this password in a secure 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 Username
Host
User Role
Add User
Edit User
Delete
< Back
Next >
Cancel


MySQL Installer
MySQL. Installer
MySQL Server 8.0.12
Group Replication
Type and Networking
Authentication Method
Accounts and Roles
Windows Service
Apply Configuration
Windows Service
Configure MySQL Server as a Windows Service
Windows Service Details
Please specify a Windows Service name to be used for this MySQL Server instance. A unique name is required for each instance.
Windows Service Name:
MySQL80
Start the MySQL Server at System Startup
Run Windows Service as ...
The MySQL Server needs to run under a given user account. Based on the security requirements of your system you need to pick one of the options below.
Standard System Account
Recommended for most scenarios.
Custom User
An existing user account can be selected for advanced scenarios.
< Back
Next >
Cancel

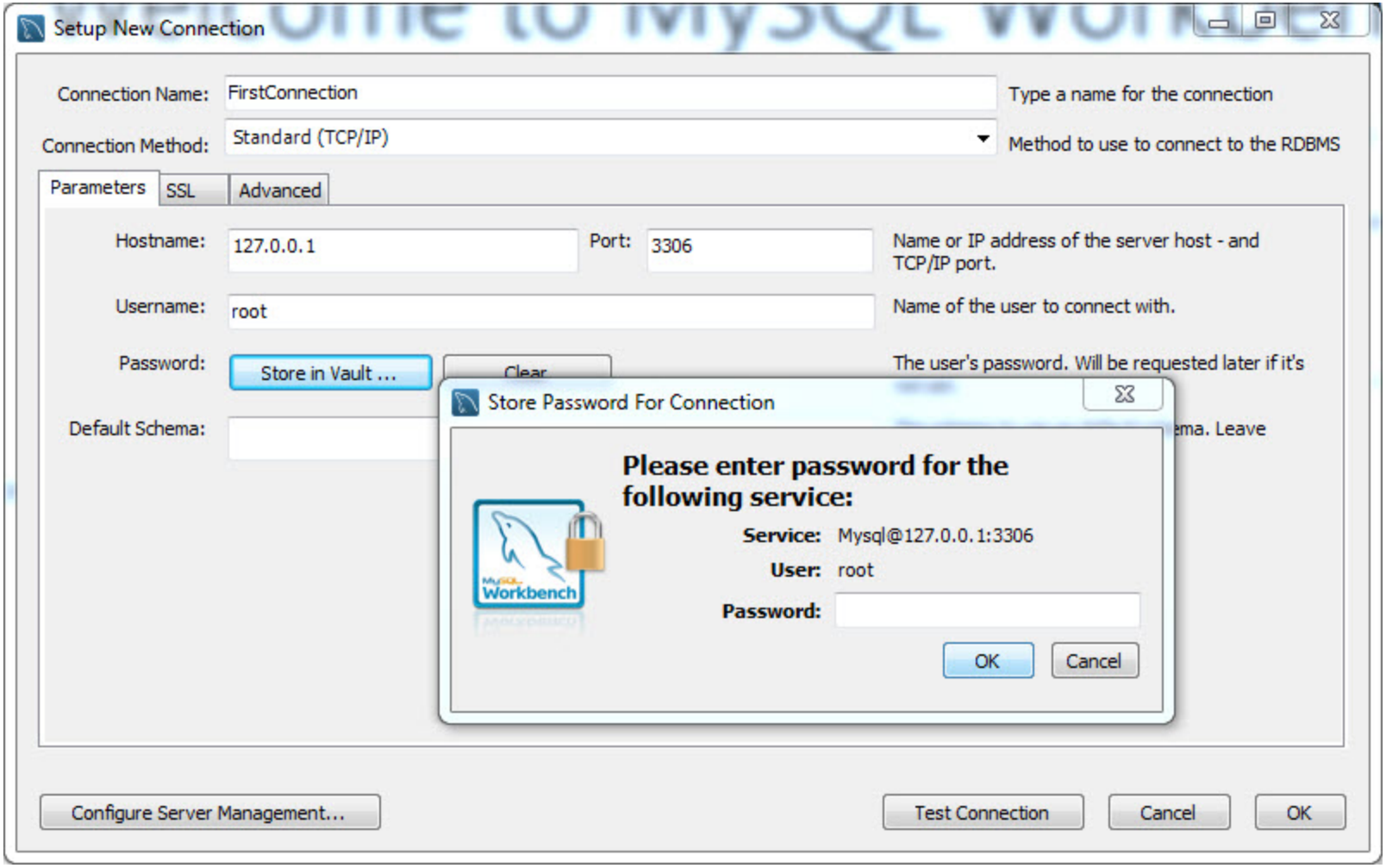

MySQL Installer
MySQL. Installer
MySQL Server 8.0.12
Group Replication
Type and Networking
Authentication Method
Accounts and Roles
Windows Service
Apply Configuration
Apply Configuration
The configuration operation has finished.
Configuration Steps
Log
Writing configuration file
Updating Windows Firewall rules
Adjusting Windows service
Initializing Database
Starting Server
Applying security settings
Creating user accounts
Updating Start Menu Link
The configuration for MySQL Server 8.0.12 was successful.
Click on Finish to continue.
Finish

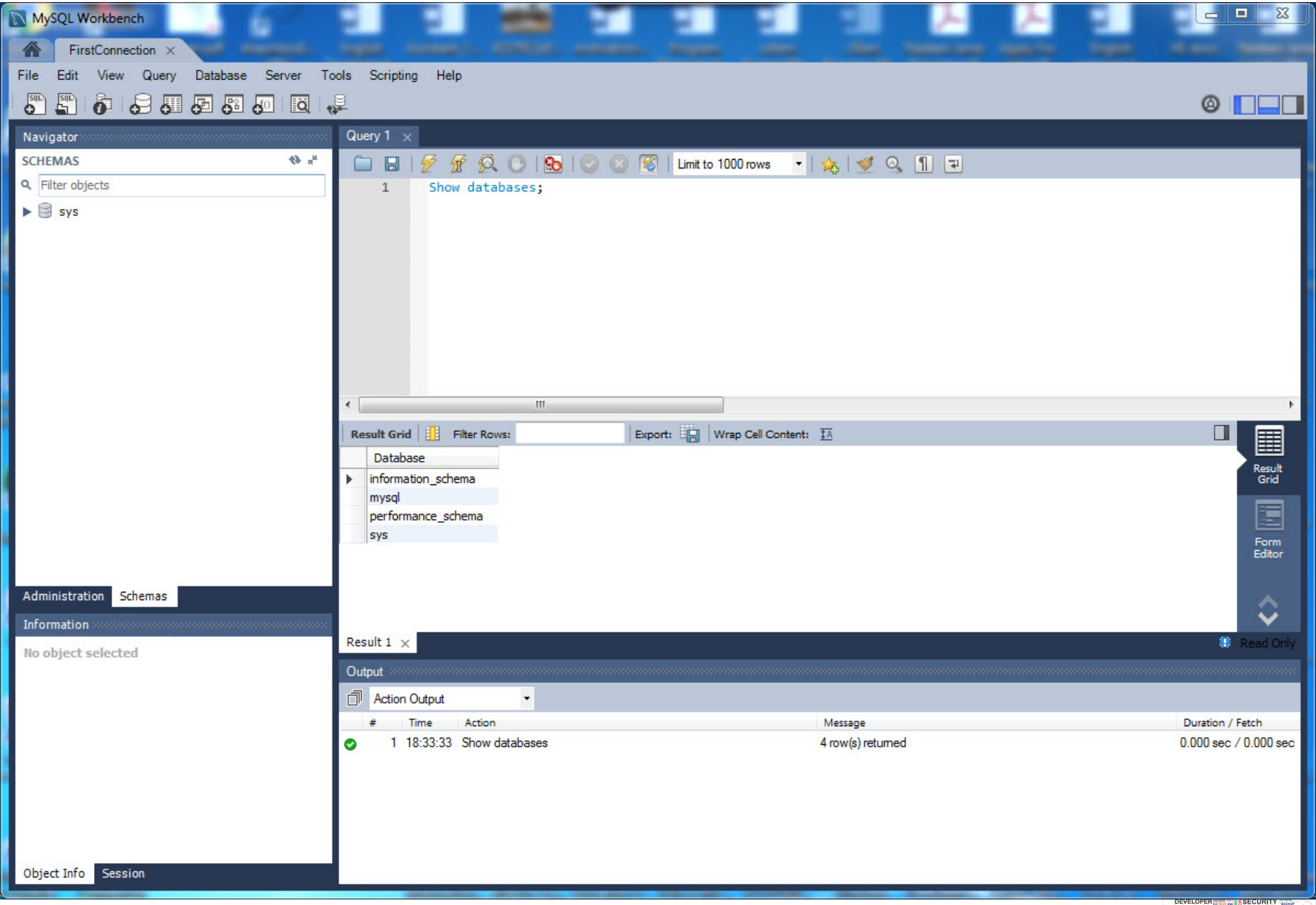

MySQL Installer
MySQL. Installer
Adding Community
Select Products and Features
Installation
Installation Complete
Select Products and Features
Please select the products and features you would like to install on this machine.
Filter:
All Software,Current GA,Any
Edit
Available Products:
Applications
MySQL Workbench
MySQL Workbench 8.0
MySQL Workbench 8.0.12 - X6
MySQL Notifier
MySQL For Excel
MySQL for Visual Studio
MySQL Utilities
MySQL Shell
MySQL Router
MySQL Connectors
Documentation
Products/Features To Be Installed:
MySQL Workbench 8.0.12 - X64
Published: Tuesday, July 10, 2018
Estimated Size: 116 MB
Changes: http://dev.mysql.com/doc/relnotes/workbench/en/wb-news-8-0-12.html
Next >
Cancel


MySQL Workbench
File Edit View Database Tools Scripting Help
Welcome to MySQL Workbench
MySQL Workbench is the official graphical user interface (GUI) tool for MySQL. It allows you to design, create and browse your database schemas, work with database objects and insert data as well as design and run SQL queries to work with stored data. You can also migrate schemas and data from other database vendors to your MySQL database.
Browse Documentation >
Read the Blog >
Discuss on the Forums >
MySQL Connections
MySQL Workbench could not detect any MySQL server running.
This means that MySQL is not installed or is not running.
Rescan servers


Setup New Connection
Connection Name:
Type a name for the connection
Connection Method:
Standard (TCP/IP)
Method to use to connect to the RDBMS
Parameters
SSL
Advanced
Hostname:
127.0.0.1
Port:
3306
Name or IP address of the server host - and TCP/IP port.
Username:
root
Name of the user to connect with.
Password:
Store in Vault ...
Clear
The user's password. Will be requested later if it's not set.
Default Schema:
The schema to use as default schema. Leave blank to select it later.
Configure Server Management...
Test Connection
Cancel
OK


DATABASE
RELATIONAL
DBMS
SECURITY
DEVELOPER
DESIGNER
MIRRORING
KEY


Setup New Connection
Connection Name:
FirstConnection
Type a name for the connection
Connection Method:
Standard (TCP/IP)
Method to use to connect to the RDBMS
Parameters
SSL
Advanced
Hostname:
127.0.0.1
Port:
3306
Name or IP address of the server host - and TCP/IP port.
Username:
root
Name of the user to connect with.
Password:
Store in Vault ...
Clear
The user's password. Will be requested later if it's
Default Schema:
Store Password For Connection
Please enter password for the following service:
Service:
Mysql@127.0.0.1:3306
User:
root
Password:
OK
Cancel
Configure Server Management...
Test Connection
Cancel
OK


MySQL Workbench
FirstConnection
File Edit View Query Database Server Tools Scripting Help
Navigator
SCHEMAS
Filter objects
sys
Administration Schemas
Information
No object selected
Object Info Session
Query 1
Limit to 1000 rows
1 Show databases;
Result Grid Filter Rows: Export: Wrap Cell Content:
Database
information_schema
mysql
performance_schema
sys
Result Grid
Form Editor
Result 1
Read Only
Output
Action Output
Time Action Message Duration / Fetch
1 18:33:33 Show databases 4 row(s) returned 0.000 sec / 0.000 sec

MySQL Basics – Data Definition

- SHOW DATABASES;
- CREATE DATABASE university;
- SHOW DATABASES;
- USE university;
- DROP DATABASE university;

MySQL Basics

- CREATE TABLE student (
  sid INT,
  sname VARCHAR(32),
  bdate DATE,
  gpa REAL,
  PRIMARY KEY (sid));
- SHOW TABLES;
- SHOW CREATE TABLE student;
- ALTER TABLE STUDENT ADD major VARCHAR(16);
- ALTER TABLE STUDENT ADD phone VARCHAR(16) AFTER bdate;
- DROP TABLE student;

MySQL Basics – Data Manipulation

- Query:

```
SELECT *
FROM student;
```

- INSERT INTO STUDENT VALUES (1051122, 'Ahmad', '1980-01-20', 99);
- SELECT * FROM student;
- INSERT INTO STUDENT (sid, sname) VALUES (1061122, 'Sireen’);
- DELETE FROM student WHERE sid>=1060000 AND sid<=1069999;
- Query:

```
SELECT sid, sname
FROM student
WHERE sname = ‘Ahmad’;
```

MySQL Basics – Auto increment

- ALTER TABLE student MODIFY sid int auto_increment;
- SELECT * FROM student;
- INSERT INTO student (sname) VALUES ('Iyad');
- ALTER TABLE student auto_increment=1070000;
- INSERT INTO student (sname) VALUES ('Gabi');
- ALTER TABLE student MODIFY gpa REAL DEFAULT 60;
- SELECT * FROM student;
- ALTER TABLE student MODIFY bdate DATE DEFAULT '1900-01-01';
- INSERT INTO student (sname) VALUES ('Gabi');

MySQL Basics – Data Control

- CREATE USER 'user1'@'localhost' IDENTIFIED BY ‘password';
- GRANT ALL PRIVILEGES ON university.* TO 'user1'@'localhost' WITH GRANT OPTION;
- CREATE USER 'user1'@'%' IDENTIFIED BY ‘password';
- GRANT ALL PRIVILEGES ON university.* TO 'user1'@'%' WITH GRANT OPTION;

- CREATE USER 'user2'@'localhost' IDENTIFIED BY ‘password2';
- GRANT SELECT ON university.* TO 'user2'@'localhost' WITH GRANT OPTION;
- CREATE USER 'user2'@'%' IDENTIFIED BY ‘password2';
- GRANT SELECT ON university.* TO 'user2'@'%' WITH GRANT OPTION;