

Lab 7

Database Lab Setup

Learning Objectives

- Be able to set up the lab environment with either a pre-built virtual machine or manual installation of MySQL server.
- Get familiar with MySQL

Lab Assessment

This lab is assessed, and is worth 0.5% of your final grade.

You can set up the environment for the database labs in one of the following two ways:

- If you use a lab computer, you need to set up the lab environment with a pre-built Virtual Machine (VM) following the steps given in Section 7.1 and Section 7.2.
- If you use your own computer, you can either use the provided VM or directly install MySQL server in your computer following the instructions given in Section 7.3.

Note that VirtualBox only works on older Intel Macs. If you have a new ARM Mac, you will either need to install MySQL directly, or use the lab machines.

7.1 Using the pre-built VM

We have created a VM running Ubuntu 20.04.4 LTS with the required software pre-installed. In the following, we will use the interfaces in Windows to illustrate the importing of the VM appliance. So if you are using your own computer running MacOS or Linux, the interfaces can be slightly different. VirtualBox has been installed on all lab machines. If you use your own computer and don't have VirtualBox installed, you can download and install it from <https://www.virtualbox.org/wiki/Downloads>.

Import the VM appliance following these steps:

- Type **virtualbox** in the **Search bar** along the bottom left of the screen adjacent to the **Start Menu** button (see Fig. 7.1). In the pop-up menu, click **Oracle VM VirtualBox** to

launch VirtualBox, after which you will see the VirtualBox main interface as shown in Fig. 7.2.

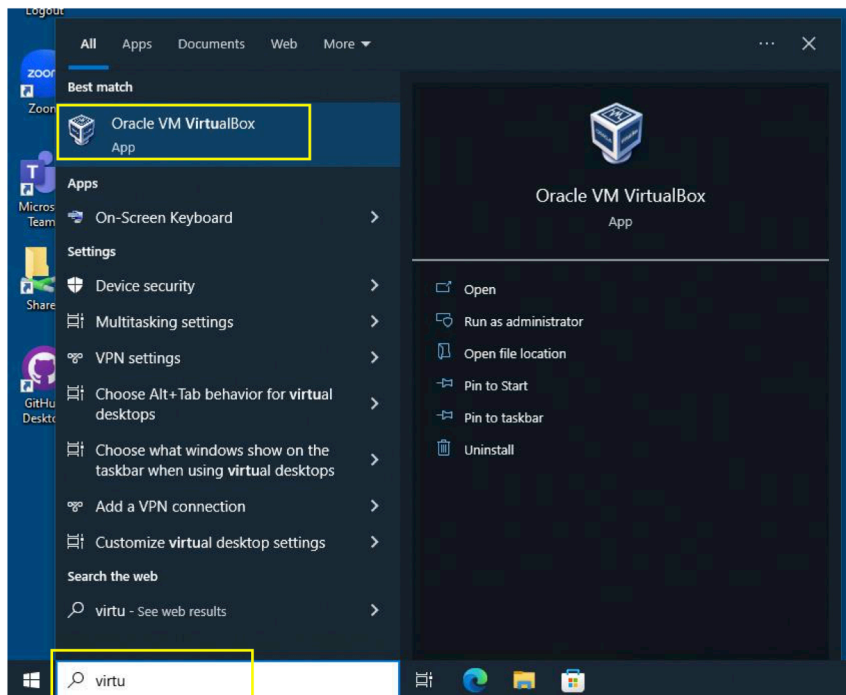


Figure 7.1: Launch VirtualBox

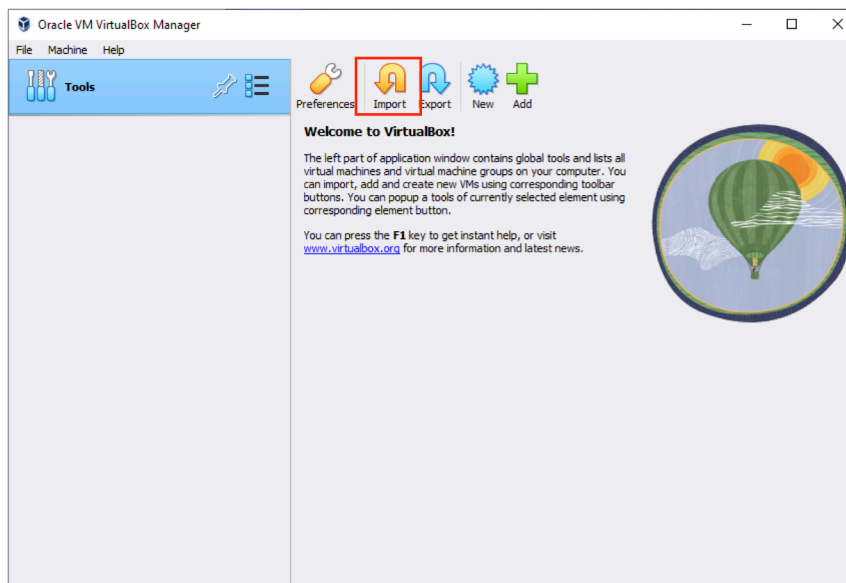


Figure 7.2: The main interface of VirtualBox

- Click the **Import** icon in the VirtualBox main interface (highlighted with a red box in Fig. 7.2). In the pop-up **Import Virtual Appliance** window (see Fig. 7.3), click the browse button (highlighted with a red box in Fig. 7.3) to open a dialogue to select the appliance file. Browse to **Coursework (K:)** (highlighted with a red box in Fig. 7.4), select the **cosc203** file in the **COSC203** folder, and then click the **Open** button.

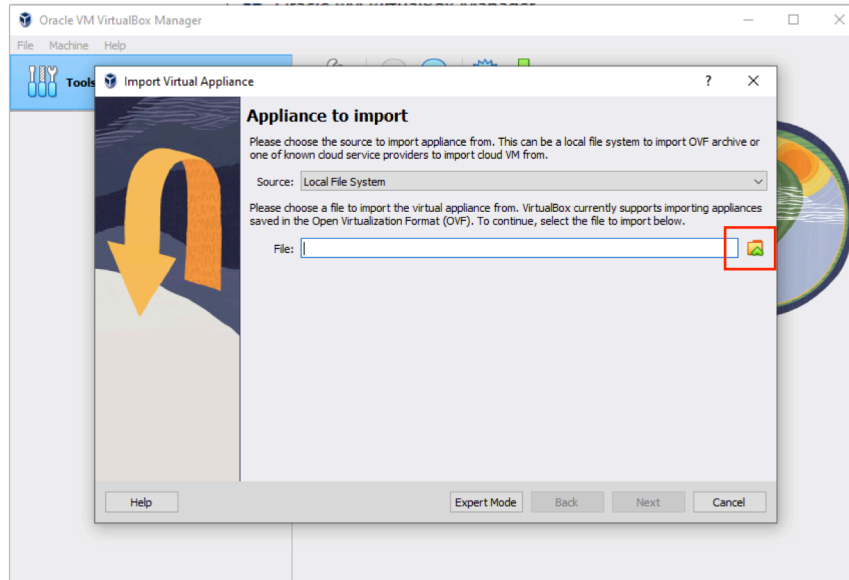


Figure 7.3: Dialog for import virtual appliance

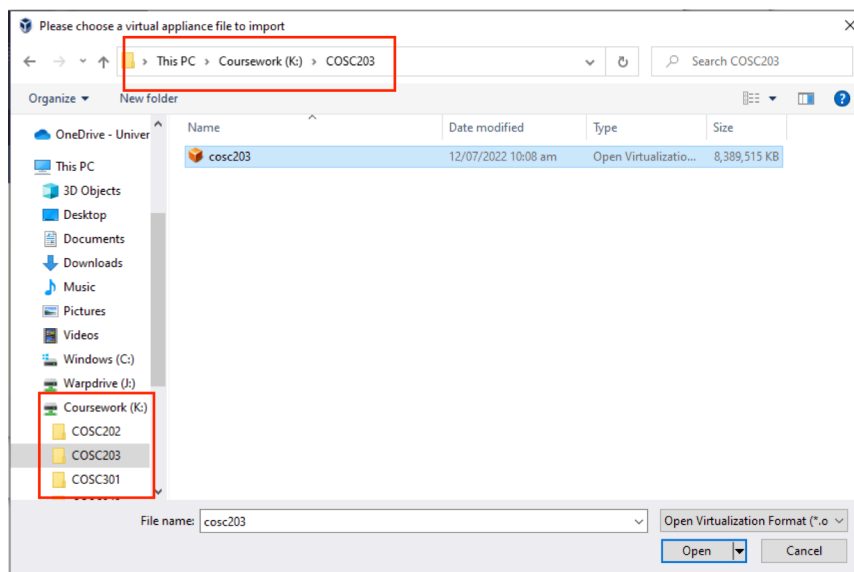


Figure 7.4: Dialog for choosing the VM appliance file

- In the **Import Virtual Appliance** window, click the **Next** button to import the selected appliance. As shown in Figure 7.5, a dialogue for appliance settings will be displayed. Keep all settings unchanged and click the **Finish** button.

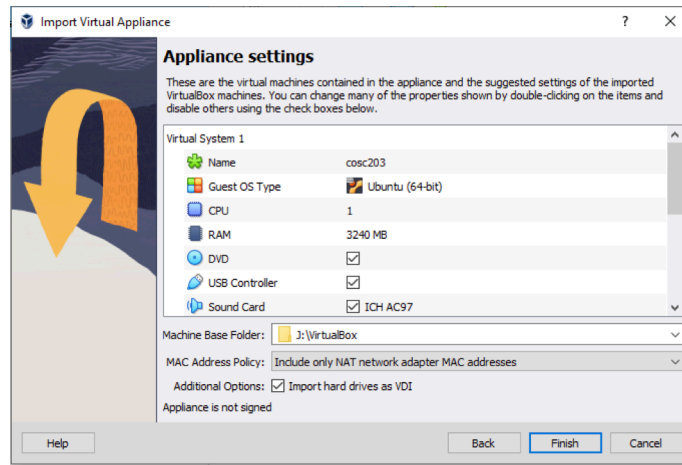


Figure 7.5: Dialog for appliance settings

- It will take several minutes to import the virtual machine. A progress bar on the right side of the VirtualBox main interface displays the percentage of completed import process. Once the importing is finished, you should see a new VM named **cosc203** in VirtualBox, as shown in Figure 7.6. Select the cosc203 VM and click the **Start** button to launch it.

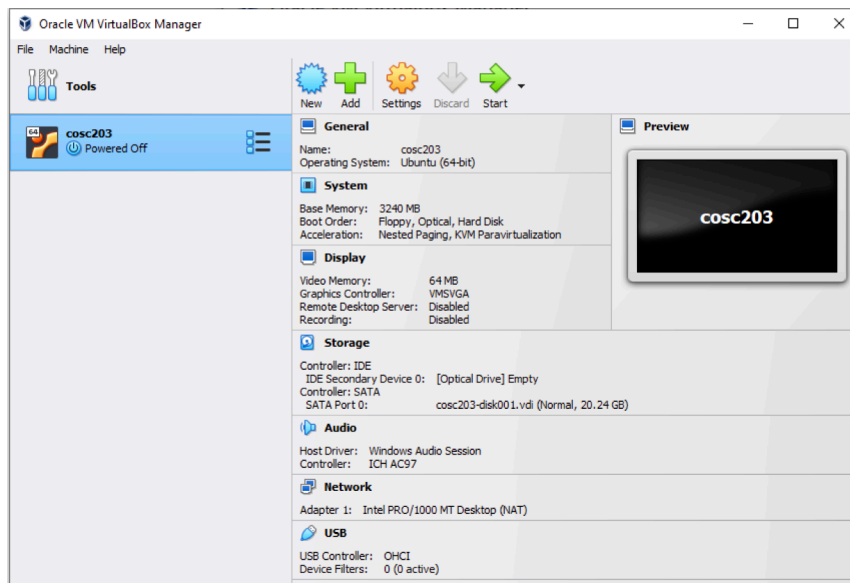


Figure 7.6: VirtualBox interface after appliance import

- Your virtual machine importing is successful if you see the following interface. You will be logged into Ubuntu automatically. However, in case that you were logged out, you can log on using the username **cosc203** and password **cosc203**. You may be asked for software update. Just ignore it. There is NO need to update system and software.

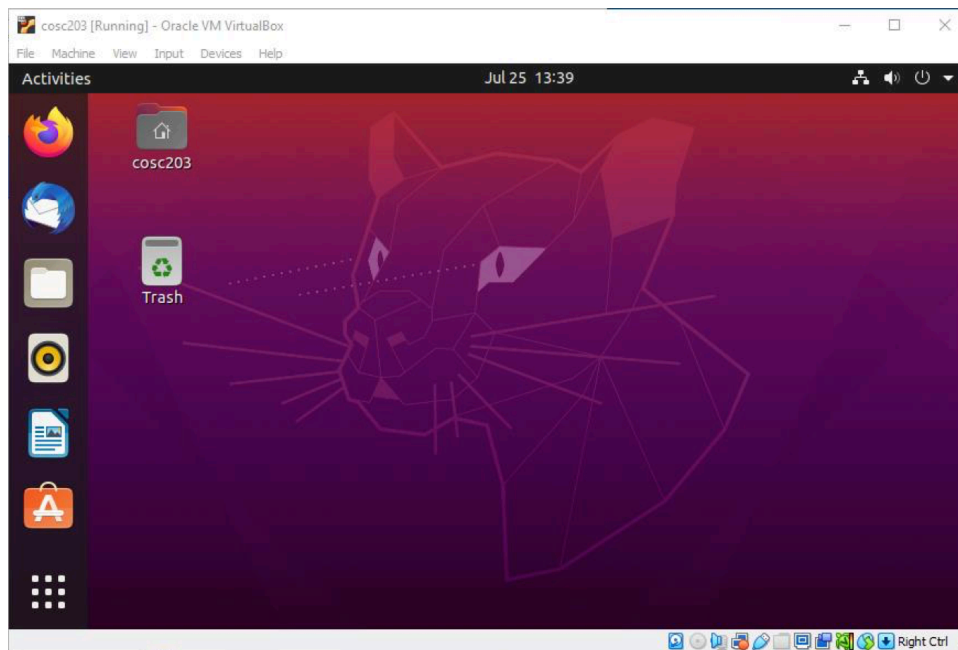


Figure 7.7: Ubuntu interface

- When you shut down the virtual machine, the following window will be popped up. There are three options to shut down a virtual machine:

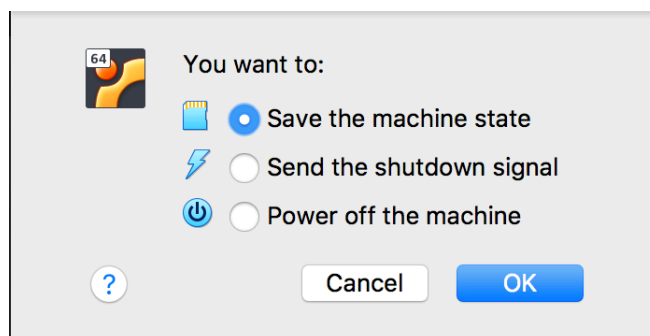


Figure 7.8: Options to shutdown a virtual machine

- **Save the machine state:** this is like hibernating a laptop - the contents of the system and graphics memory is saved by VirtualBox to non-volatile storage (i.e. somewhere on disk). **This should be used most of the time in your day-to-day work.**

- Send the shutdown signal: this is equivalent to pressing the power-switch on a modern computer. It will cause a power-management signal to be sent to the operating system to shutdown with saving the contents of the system.
- Power off the machine: Never choose this option unless you have to. This is like forcing a machine to turn off such as by pulling out the power cord or holding in a power button for several seconds. The operating system has no chance to clean up, so filesystem corruption can occur. This should be a last resort when the above two options do not work.

7.2 Sharing between the lab computer and the VM

- **Shared Clipboard:** Shared clipboard in VirtualBox allows to copy and paste between the lab computer and the VM. To enable shared clipboard, select the **cosc203** VM in VirtualBox, and then click the **Settings** icon. In the pop-up dialog, go to the **Advanced** tab, and select the **Bidirectional** option in the Shared Clipboard drop-down list.
- **Shared Folder:** If you would like to share files between the lab computer and the VM, the best way is to set up a shared folder. Do the following to set up a shared folder:
 1. In the **J:** disk, create a folder named **203VM**.
 2. Select **cosc203** in VirtualBox, and then click on **Settings**.
 3. In the pop-up dialog (see Fig. 7.9), select **Shared Folders** on the left and click on the folder icon with a green plus icon to add a new shared folder. In the pop-up dialog, select **Other...** in the **Folder path** drop-down list. Select the **203VM** folder in the **J:** disk, and then click on the **Open** button.

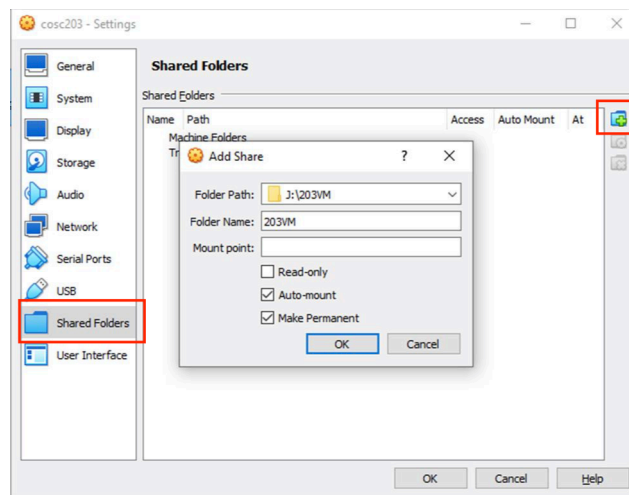


Figure 7.9: Set up a shared folder

4. Tick the box labelled **Auto-mount** and the box labelled **Make Permanent**, and then click the **OK** button. Click **OK** again to close the Shared Folders dialog.
5. Open a Terminal in your VM and enter the command:

```
ln -s /media/sf_203VM ~/203host
```

This means that when you change into your `~/203host` directory, you are really in the `/media/sf_203VM` directory. Any files that you put in that directory will be available in the `~/203VM` directory on your Host machine.

6. Test your setup for the shared folder by placing a file into `~/203host` in the VM and checking if you can see it from the 203VM folder in the host machine.

If you decide to use the VM, we **strongly recommend** you create a shared folder and put all your labwork (e.g. answers to questions and programs) in it. This not only makes it convenient to access them from the host machine, but also creates a backup of your labwork in case your VM becomes unbootable and the files can't be recovered!

7.3 Installing software in your own computer

If you don't like to use the VM, you can install the software in your computer. What you need to install is MySQL server (version 8.0 or any later version), but you need to select a version that is supported by your operating system. Go to <https://dev.mysql.com/downloads/mysql/>, input the type and version of your operating system, and then download the version compatible with your operating system. The detailed installation instructions for different platforms are given in [Chapter 2 \(installing and upgrading MySQL\)](#) of MySQL 8.0 Reference Manual.

If you install it on MacOS, you should install the MySQL preference pane. It enables you to start, stop, and control automated startup during boot of your MySQL installation. The instructions for installing MySQL preference pane is given in

<https://dev.mysql.com/doc/refman/8.0/en/installing.html>.

By default, MySQL server is installed at `/usr/local/`. To make it easy to connect to MySQL server from a bash terminal, execute the following commands to set up the PATH environment.

```
echo 'export PATH="$PATH:/usr/local/mysql/bin"' >> ~/.bash_profile
source ~/.bash_profile
```

7.4 Basic Unix Skills

You should already be familiar with navigating a Unix command line after completing COSC202. If you aren't then we suggest you complete the Software Carpentry Shell Novice lesson from COSC202 Lab 2: <https://oucs-teaching.github.io/2022-cosc202-shell-novice/>

7.5 MySQL introduction

MySQL is one of the most popular open-source database management systems. It is developed, distributed, and supported by Oracle Corporation. The MySQL Database Software is a client-server system that consists of a multithreaded SQL server, several different client programs, administrative tools, and a wide range of application programming interfaces (APIs).

Data is stored at the MySQL server. Different client programs such as a shell terminal or a web application can connect to the MySQL server to request data.

Before connecting to MySQL, you need to ensure that the MySQL server is running.

- If you are using the VM or you have installed MySQL sever on Linux, execute the command `systemctl status mysql` in a terminal to check the status of the MySQL server.

```
cosc203@cosc203VM:~$ systemctl status mysql
● mysql.service - MySQL Community Server
   Loaded: loaded (/lib/systemd/system/mysql.service; enabled; vendor preset: ena
   Active: active (running) since Tue 2022-06-07 13:07:15 NZST; 2 weeks 6 days
     Docs: man:mysqld(8)
           http://dev.mysql.com/doc/refman/en/using-systemd.html
   Main PID: 796 (mysqld)
    Status: "Server is operational"
     Tasks: 38 (limit: 3519)
   Memory: 299.1M
   CGroup: /system.slice/mysql.service
           └─796 /usr/sbin/mysqld

Jun 07 13:07:12 cosc203VM systemd[1]: Starting MySQL Community Server...
Jun 07 13:07:15 cosc203VM systemd[1]: Started MySQL Community Server.
lines 1-14/14 (END)
```

The MySQL sever is running on the backend, if the output shows **active (running)**; otherwise you can use the command `systemctl start mysql` to start the MySQL server.

- If you have installed MySQL server on Windows, execute the command `net start` in the command prompt. The MySQL sever is running on the backend, if MySQL80 is in the

```
C:\>net start
These Windows services are started:

Application Information
AppX Deployment Service (AppXSVC)
Background Tasks Infrastructure Service
Microsoft Passport Container
Microsoft Store Install Service
MySQL80
Network Connection Broker
```

list of started services; otherwise execute the command `services.msc` in the command prompt and then start MySQL in the launched window.

- If you have installed MySQL server on MacOS, you can check the status of the MySQL server from the MySQL preference pane. Go to System Preferences and click on the MySQL icon. The MySQL preference pane will be launched, from which you can start and stop MySQL server.

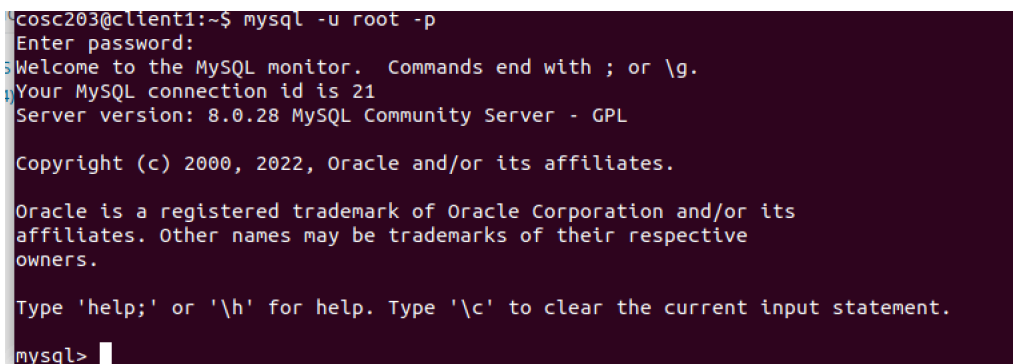
To connect to a MySQL server, you need to get the connection parameters including the host where the MySQL server is running, your MySQL account and password. Once you know the proper parameters, you should be able to connect LIKE this in a terminal or the Windows Command Prompt:

```
$> mysql -h host -u user -p
```

where `host` and `user` should be substituted with the name of the host where the MySQL server is running and your username, respectively. No matter if you are using the VM or you have installed MySQL server on your own computer, you are logging in on the same machine that MySQL server is running on. In such a case, there is no need to specify the hostname. Open a terminal window and type the following command:


```
$> mysql -u root -p
```

This will connect to the MySQL server using the root account. After hitting the enter or return key, the terminal will display `Enter password:` for MySQL in the VM, the password for the root account is set to `Cosc203$`. If you installed MySQL server on your own computer, the root account should have an empty password if you were not asked to set a password during the installation of MySQL server. Note that the terminal will not show the password you type for security reasons. If that works, you should see some introductory information followed by a `mysql>` prompt (see Figure 7.10), indicating you have connected to MySQL.



```
cosc203@client1:~$ mysql -u root -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 21
Server version: 8.0.28 MySQL Community Server - GPL

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owners.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql>
```

Figure 7.10: Connect to MySQL

To disconnect from the MySQL server, just type `quit` at the `mysql>` prompt and hit the enter or return key.

The root account is a superuser account that has all privileges and can do anything. You can create a new user account and grant privileges using the `CREATE USER` and `GRANT` statements at the `mysql>` prompt. The following will create a superuser account named `mal` with full global privileges to do anything, and the account is protected with a password `Cosc203%`.

```
mysql> CREATE USER 'mal' IDENTIFIED BY 'Cosc203%';
mysql> GRANT ALL ON *.* TO 'mal' WITH GRANT OPTION;
```

By specifying `WITH GRANT OPTION`, it allows `mal` to further grant privileges to other users. Using the `GRANT` statement, you can grant more fine-grained privileges (e.g. select or update on particular tables) to a user. If you want to explore more on how to use `grant`, please refer to the following page in the MySQL 8 Reference Manual:

<https://dev.mysql.com/doc/refman/8.0/en/grant.html>

7.6 What will be assessed

If you use the the pre-build VM,

- demonstrate that the VM has been successfully installed;
- demonstrate that the shared folder has been created;
- create a user account for yourself and grant all privileges to that account;

- demonstrate you can connect to MySQL server from a terminal using the account you created.

If you installed MySQL server in your computer,

- demonstrate that MySQL server has been successfully installed;
- create a user account for yourself and grant all privileges to that account;
- demonstrate you can connect to MySQL server from a terminal using the account you created.