Advanced Database Labs

ADB Labs

Amira Nasreldeein, Aseel, Salma

Table of contents

1. Advanced Database Labs

Welcome to the Advanced Database Lab course. This site provides hands-on labs to help you learn and simulate key concepts in **concurrency control** and **database recovery techniques**.

1.1 What You Will Learn

- How to install and use **MySQL**, **Python**, and **Visual Studio Code**
- An understanding of **transaction management** and **SQL implementation**
- Understanding concurrency control mechanisms (**2PL**, **Timestamp ordering**)
- Understanding Database recovery techniques (**ARIES**)
- An introduction to **database security** practices:
- **Role-Based Access Control (RBAC)**
- **Data encryption**

1.2 Tutorial Support video

Many labs include **video walkthroughs** that demonstrate how to solve key theoretical examples step by step.

- Transaction schedules and conflicts
- Concurency Control mechanisms
- Database recovery Techniques

Be sure to watch them alongside the written material for deeper understanding.

1.3 Labs Overview

Each lab builds on the previous one. Please complete them in sequence:

1. **Lab 0:** Environment Setup
2. **Lab 1:** Basics of Transaction Management and Its Properties
3. **Lab 2:** Concurrency Control Mechanisms
4. **Lab 3:** Database Recovery Techniques (ARIES)
5. **Lab 4:** Database Security Measures

> **Note**
>
> You can download a single PDF that contains all labs. It will be updated each time a new lab is uploaded.
> Download"

1.4 What You Should Do

> **Each lab includes an assignment that you are expected to complete as part of the learning process. Please submit the assignments on time.**

2. General Instructions

2.1 Please follow these instructions carefully:

2.1.1 File Submission

- Submit your assignment as a single PDF file.
- The PDF must include all required screenshots (code and output).

2.1.2 Screenshot Annotations

On every screenshot containing SQL script, add a comment at the top with the following information:

1. Student Name
2. Department
3. Student Index Number

```
-- Name: student name
-- Department: Computer Science, ...
-- Index: 01x-xxx
```

2.1.3 Lab Title

Write the lab title as "Lab 0, Lab 1, ..." clearly at the top of your PDF.

2.1.4 Deadline

1. Submissions must be uploaded before the deadline.
2. Late submissions may be penalised according to the situations.

3. Setup environment

Objective:

- To set up **MySQL Database Management System**
- To connect to **MySQL** server
- To set up **Python Programming Langauge**

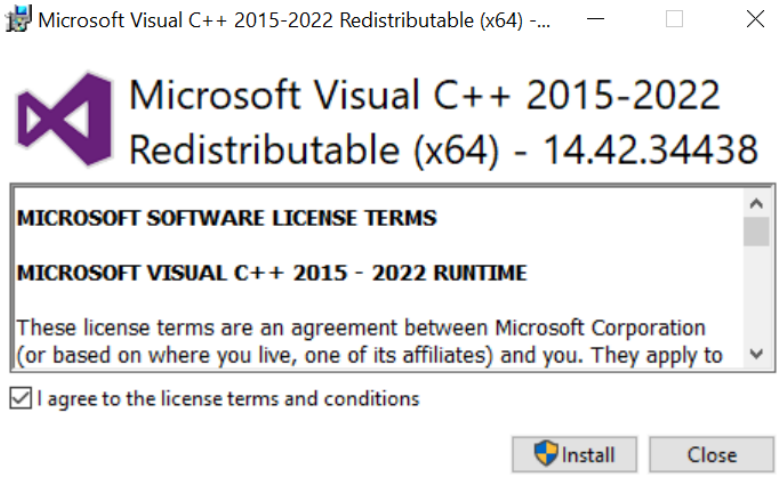
Software:

- MySQL installer (offline version)
- Visual Studio code (VS code)

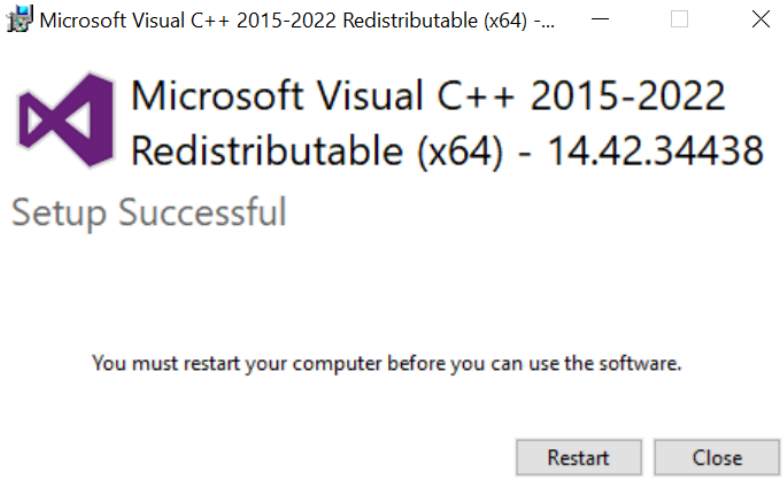
3.1 **Prerequisites:** Install Microsoft Visual C++ 2019 Redistributable

If you already have Microsoft Visual C++ 2019 Redistributable installed, you can skip this step and continue with the lab.

1. Go to the official Microsoft page. Download VC++ Redistributables
2. Download the file based on your system:
   - for 64-bit VC_redist.x64.exe
   - for 32-bit VC_redist.x86.exe
3. Open the downloaded file and check on **I agree to the license terms and conditions**.



4. After installation, **restart your PC**.



3.2 MySQL

MySQL is an open-source relational database management system (RDBMS) that uses SQL to create, manage, and query data.

3.2.1 Why we will use MySQL?

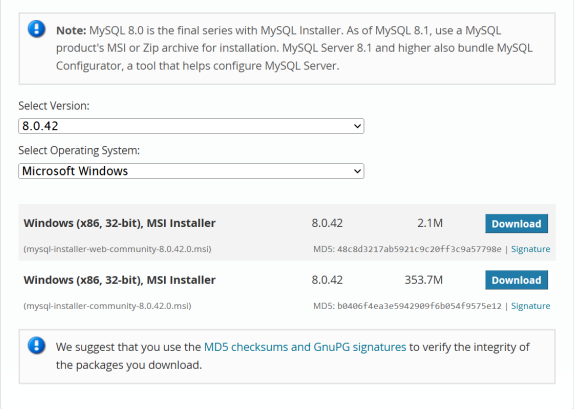
1. Support **ACID transaction properites**, essential for understanding transaction management
2. Uses the **InnoDB** transactional storage engine, which supports **concurrency control** and **recovery mechanisms**

3. Flexible and easy-to-use

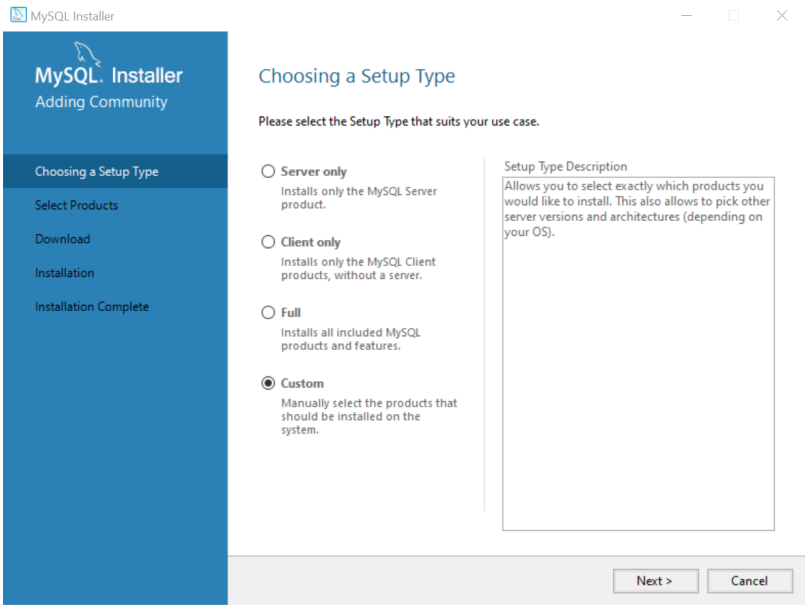
3.2.2 Installing MySQL (Offline)

1. Go to the official MySQL Downloads Page

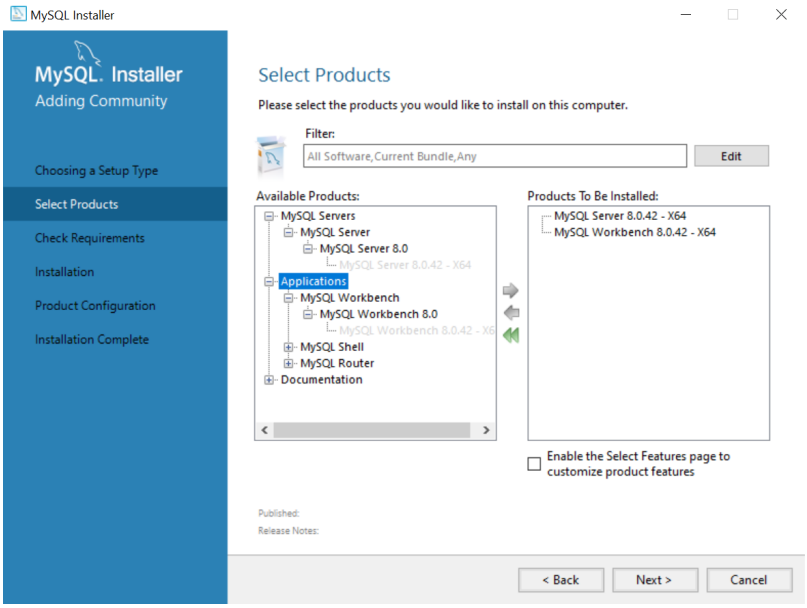
2. Download the **Windows (x86, 32-bit), MSI Installer** (Offline version ~353.7M)



3. After open the Installer Choose **Custom**

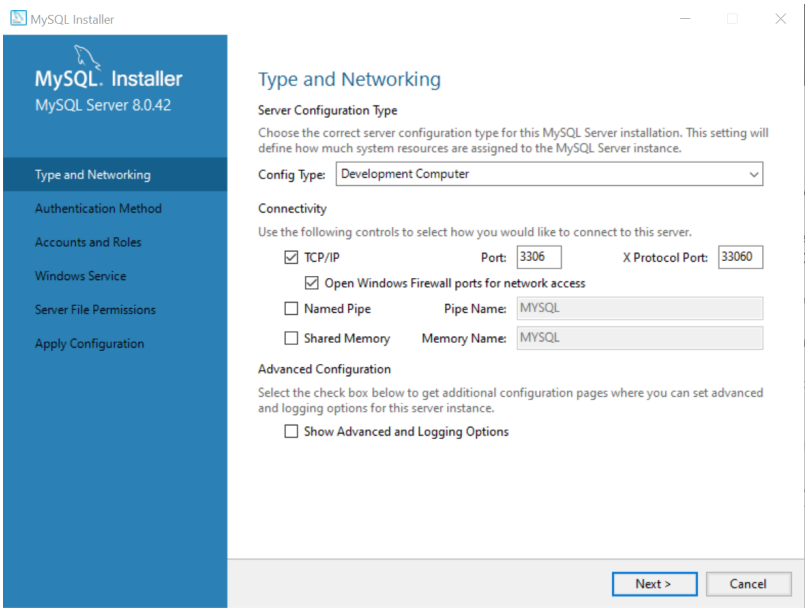


4. Select **MySQL Servers** and **MySQL Workbench**

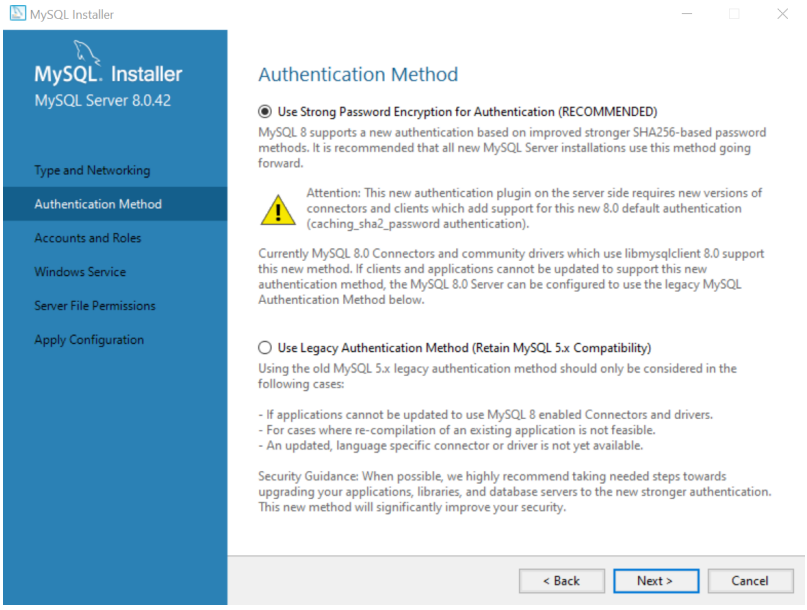


5. Proceed through the installation wizard

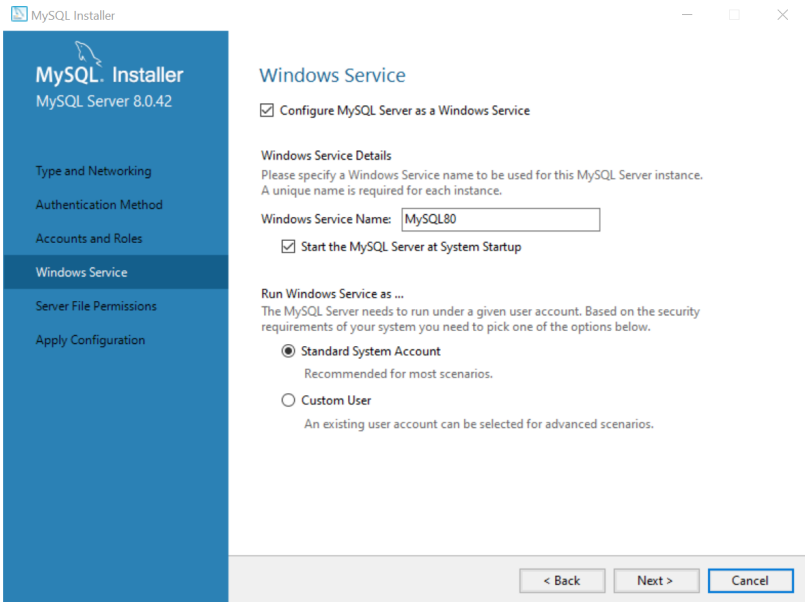
6. Use the default port (3306)



7. Choose the Authentication Method as below



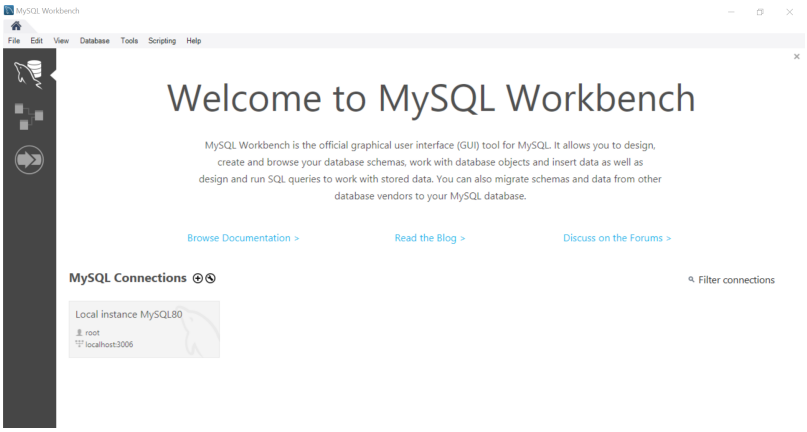
8. Create a root password
9. Choose Windows Service as below



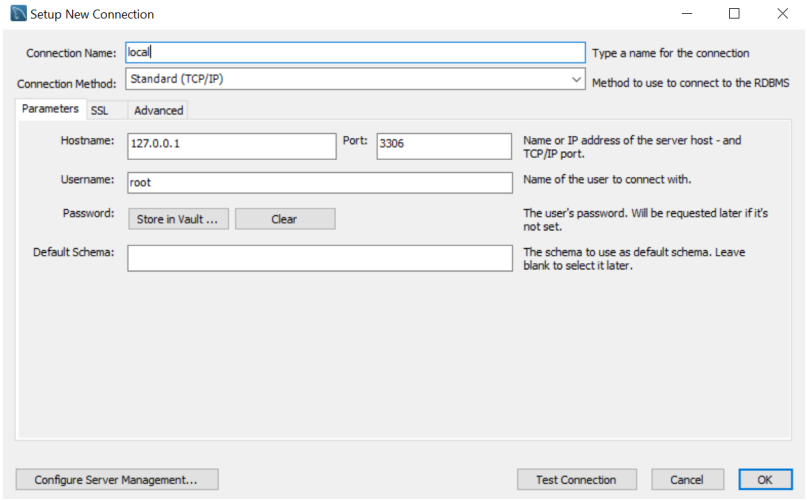
10. Proceed through the installation wizard untill finish

3.2.3 What after install MySQL?

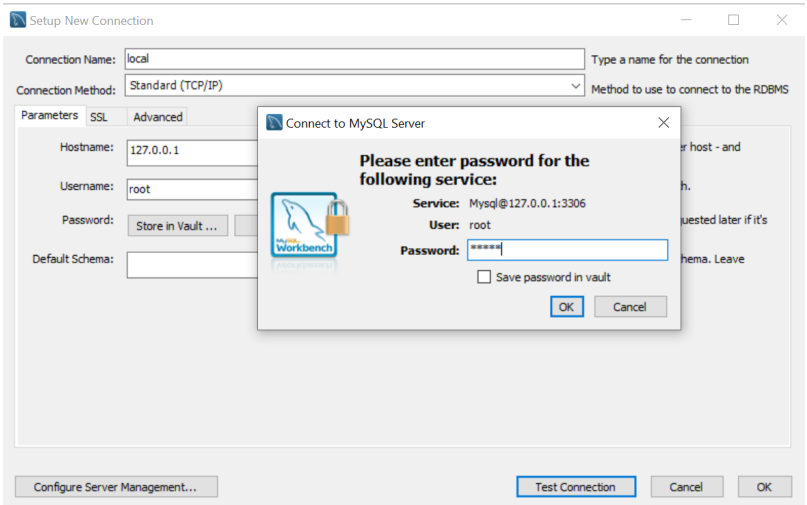
1. After installing MySQL, connect to the **MySQL Server**. by clicking the `+` symbol next to MySQL Connections



2. In the dialog box, enter a **Connection name**, e.g., `Local`

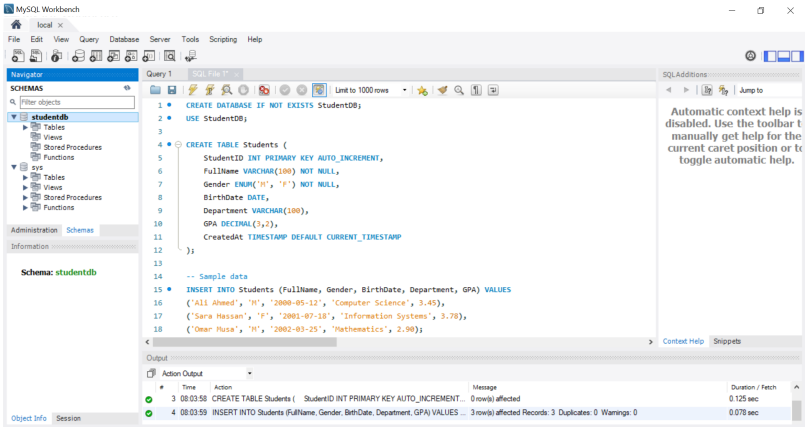


3. Click **Test Connection** and enter your MySQL root password to verify the connection



4. After successfully connecting to the MySQL server, create a new database called `StudentDB` :

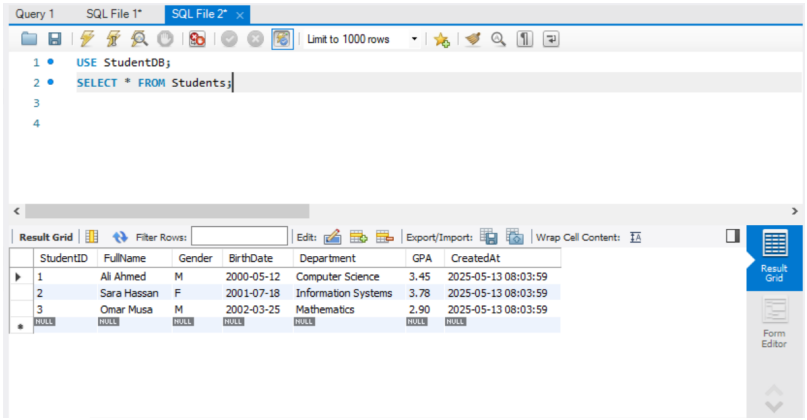
- Open `local` connection
- Click **Create new SQL** from the top-left corner
- Write SQL commands to create the `StudentDB` database, a `Students` table, and insert sample data.
- Execute the Script using Execute button ⚡




```sql
/*
Name: Amira Naser Aldeein
Index: 01x-xxx
Department: e.g., CS
*/

CREATE DATABASE IF NOT EXISTS StudentDB;
USE StudentDB;

CREATE TABLE Students (
    StudentID INT PRIMARY KEY AUTO_INCREMENT,
    FullName VARCHAR(100) NOT NULL,
    Gender ENUM('M', 'F') NOT NULL,
    BirthDate DATE,
    Department VARCHAR(100),
    GPA DECIMAL(3,2),
    CreatedAt TIMESTAMP DEFAULT CURRENT_TIMESTAMP
);

-- Sample data
INSERT INTO Students (FullName, Gender, BirthDate, Department, GPA) VALUES
('Ali Ahmed', 'M', '2000-05-12', 'Computer Science', 3.45),
('Sara Hassan', 'F', '2001-07-18', 'Information Systems', 3.78),
('Omar Musa', 'M', '2002-03-25', 'Mathematics', 2.90);
```

> **Once you create the database, you will see it listed under the Schemas section on the left panel**

5. Now you can run SQL queries on your new database




```
USE StudentDB;
SELECT * FROM Students;
```

What do we mean by Connection and Port?

A database connection is a communication link between a client application (e.g., MySQL Workbench) and the MySQL server. When an application (the client) needs to perform operations such as creating databases, running queries, or retrieving data, it establishes a connection to communicate with the server. The port is a communication endpoint on your machine. By default, MySQL uses port `3306` to listen for incoming client requests. In short, a connection is essential to allow your client tools or applications to interact with the MySQL server, run queries, manage data, and exchange information.

3.3 Python programming language

We will use the **Python programming language** to simulate the following: * Concurrency control algorithms * Database recovery techniques

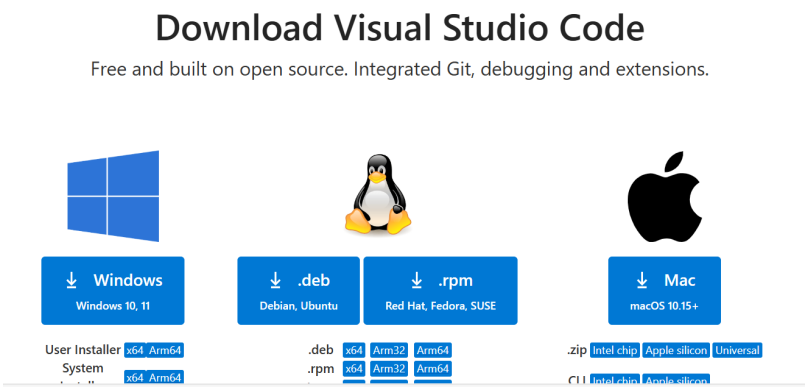
3.3.1 Download and Install Python

1. Go to the **Python** official website
2. Download the latest stable version
3. Open the installer and check

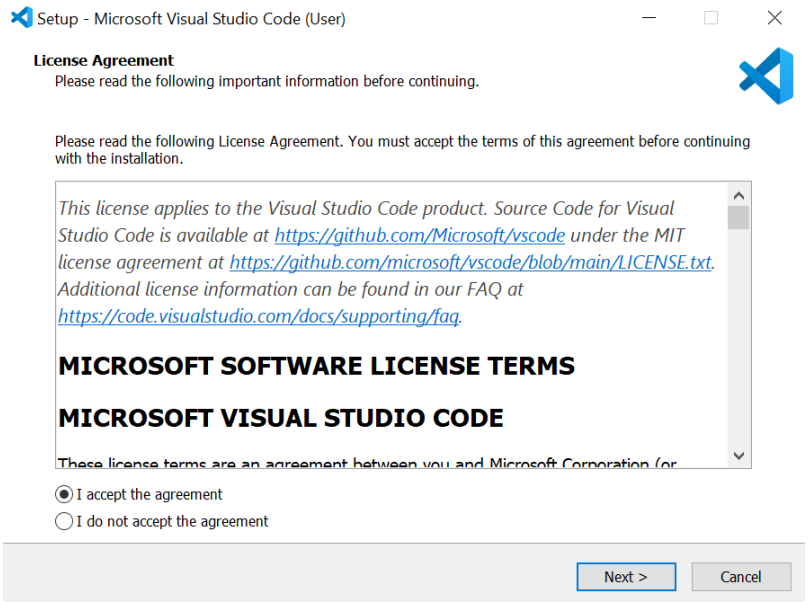
• Add Python to PATH

3.3.2 Download and Install VS Code

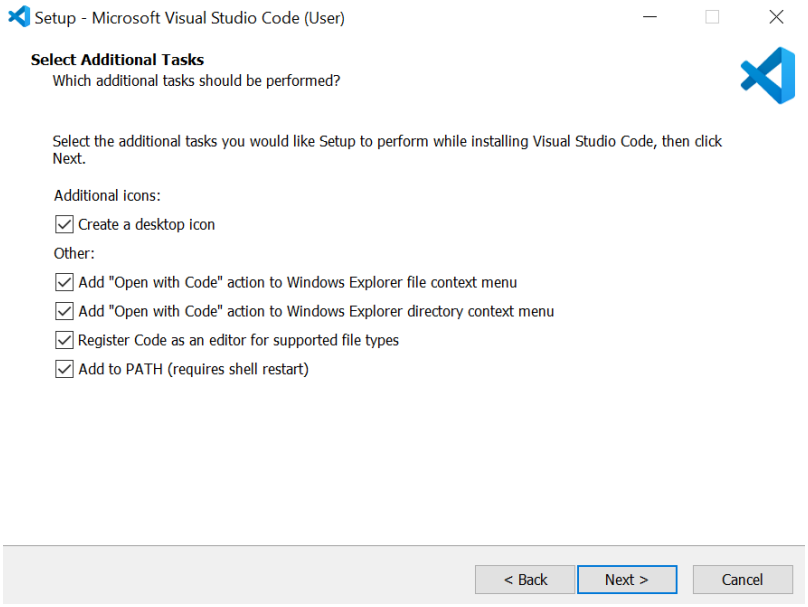
1. Visit the website **VS code** Click on `Windows` to download VS code for Windows, as shown below



2. After the download finished open the `VSCodeUserSetup` executable file, when it open select `I accept the agreement` then click on `Next`



3. Select all the option as seen below



4. Finally we are ready to install the VS code, click on `install` and wait untail the setup finish

5. On the Vs code, on the left-hand side, click on `extension` then in the search bar, write `Python` select `Python microsoft` and click on `Install` as shown below

3.4 Alteranative way to practice:

```
* Online Postgred server **[supabase](https://supabase.com/)**
* Online Python Editer **[programiz](https://www.programiz.com/python-programming/online-compiler/)**
```

3.5 Assignment: Install MySQL, Create a Database, and Query It

> **Due Date on 24/5/2025**

See the requirement about the structures of the lab **here**

1. Download and Install MySQL
2. Connect to the server
3. Create a New Database
4. Create a Table
5. Insert Data
6. Query the Data

```
USE DatabaseName;
SELECT * FROM TableName;
```

3.5.1 What to assign:

Take Screenshots:

1. SQL code (on MySQL)
2. The output of your query
3. Put it all on one document