

Lab 06 – Database Application Development

Objective:

In this lab students learn:

- How to connect to an Oracle server from a C++ program.
- How to write and execute SQL queries in a C++ program.

Submission:

*Your submission will be a single text-based **.cpp** file including your C++ program for the Database Application lab.*

`L06_ID_LASTNAME.cpp`

Your submission needs to be commented.

Lab Instruction:

Connect to Oracle from Visual Studio C++

Download and Install Oracle Instant Client

Go to the following link to download the following version of Oracle Instant Client:

Oracle Database 12c Release 2 Client (12.2.0.1.0) for Microsoft Windows (x64)

You need to download “winx64_12201_client.zip” from the following link.

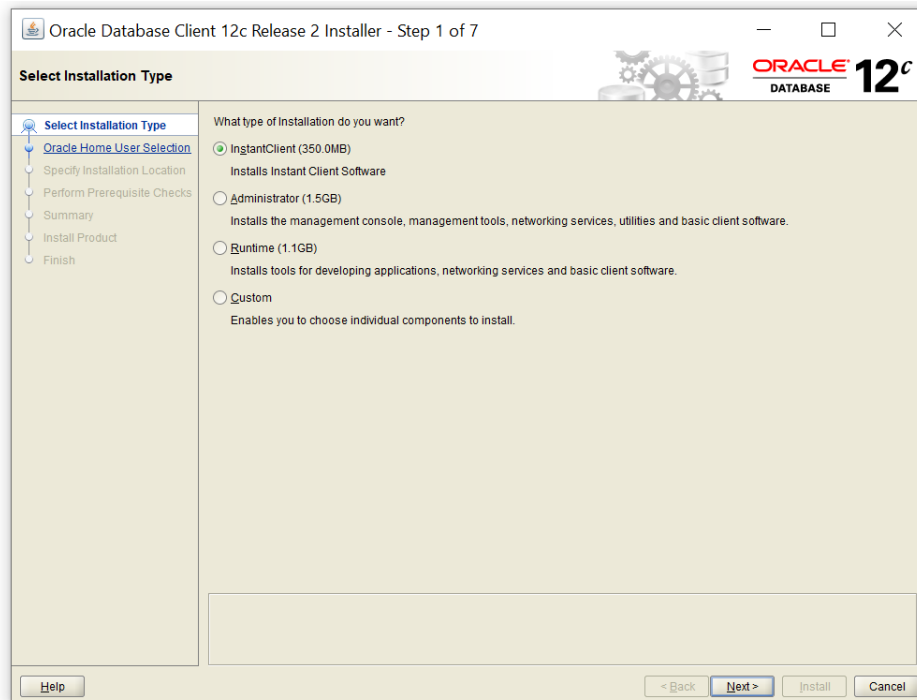
Link: <https://www.oracle.com/database/technologies/oracle12c-windows-downloads.html>

Extract the file. Execute the “setup.exe” in the following path where you downloaded Client Instant:

...\Oracle Instant Client\winx64_12201_client\client\setup.exe

Wait until the installation wizard starts. It may take time to start up.

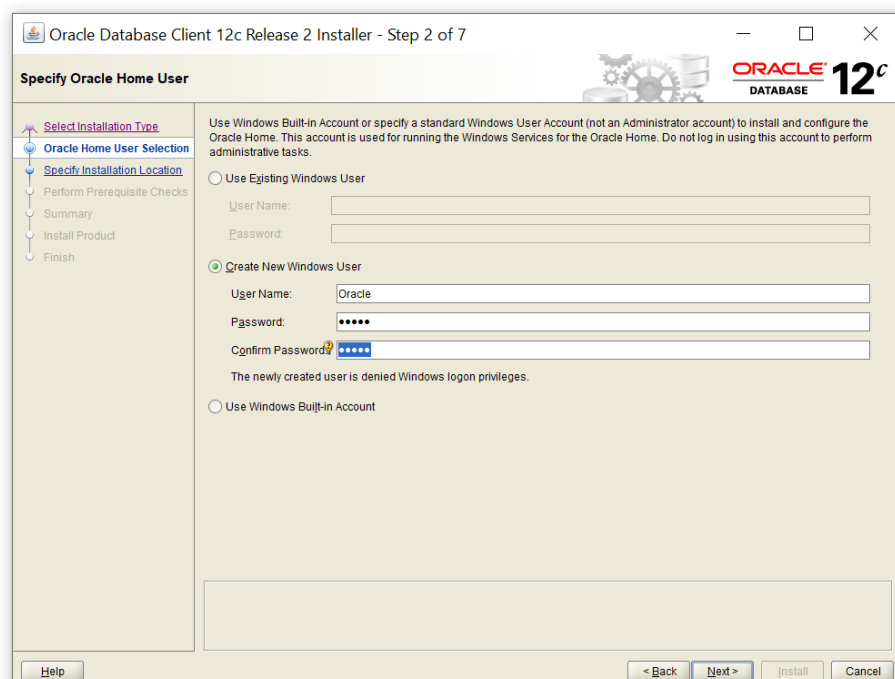
Choose the “Administrator” option, in the “Select Installation Type” page. Click “Next”



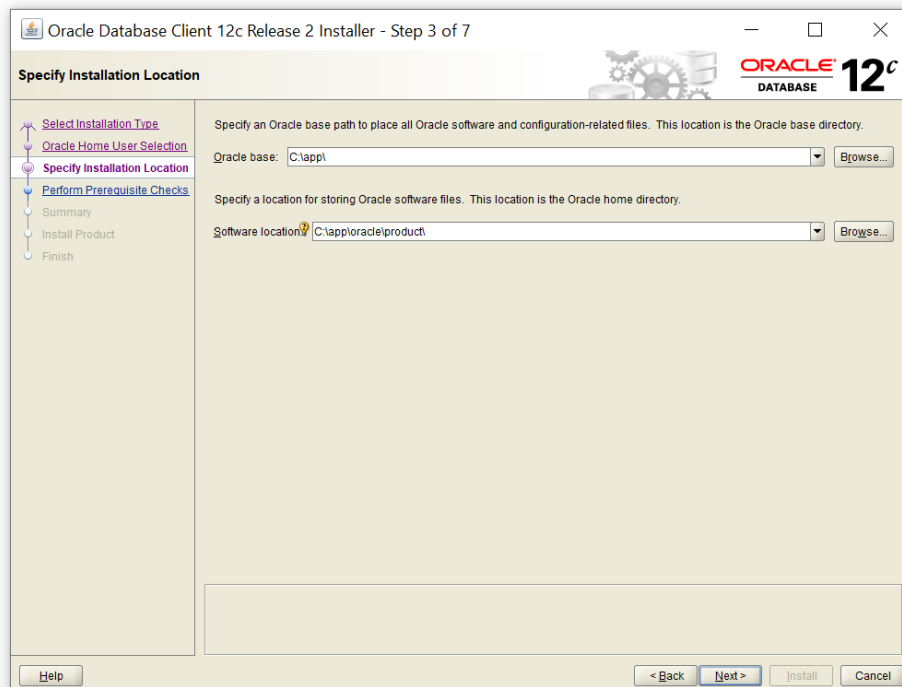
In this page, you create a username. Choose “Create New Windows User”. You can define any username and password. Make sure you choose a password that can be remembered easily. You may see the following message:

Administrative password:[INS-30011] The ADMIN password entered does not conform to the Oracle recommended standards.

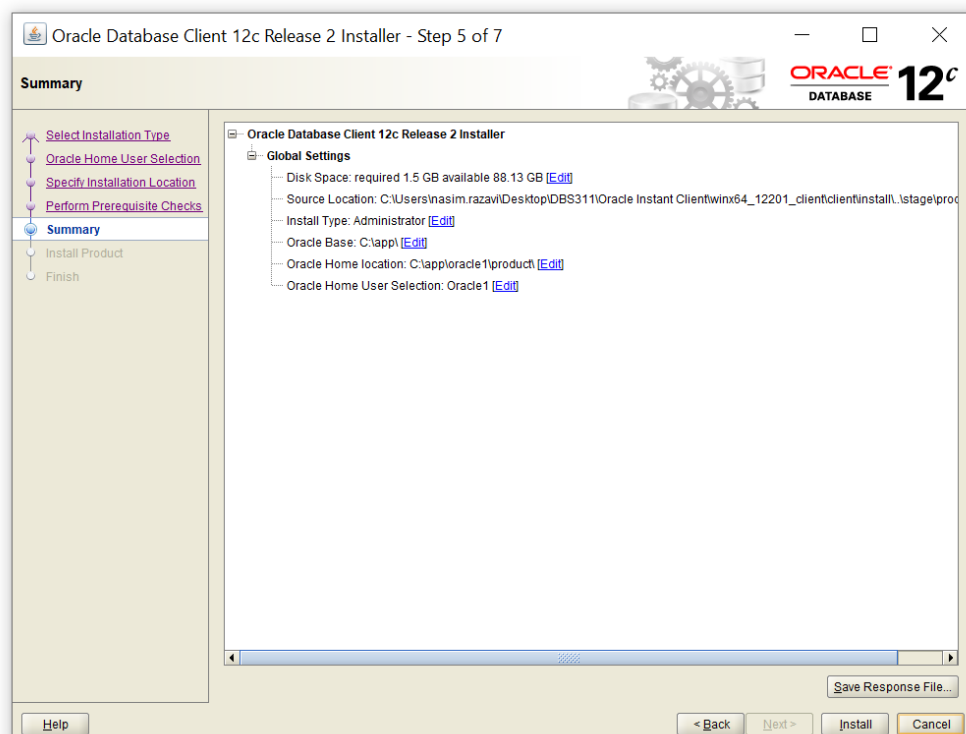
Ignore the message and continue. Click on “Next”.



In oracle base filed, you define where to install oracle. We use this location later to set up Oracle in Visual studio.



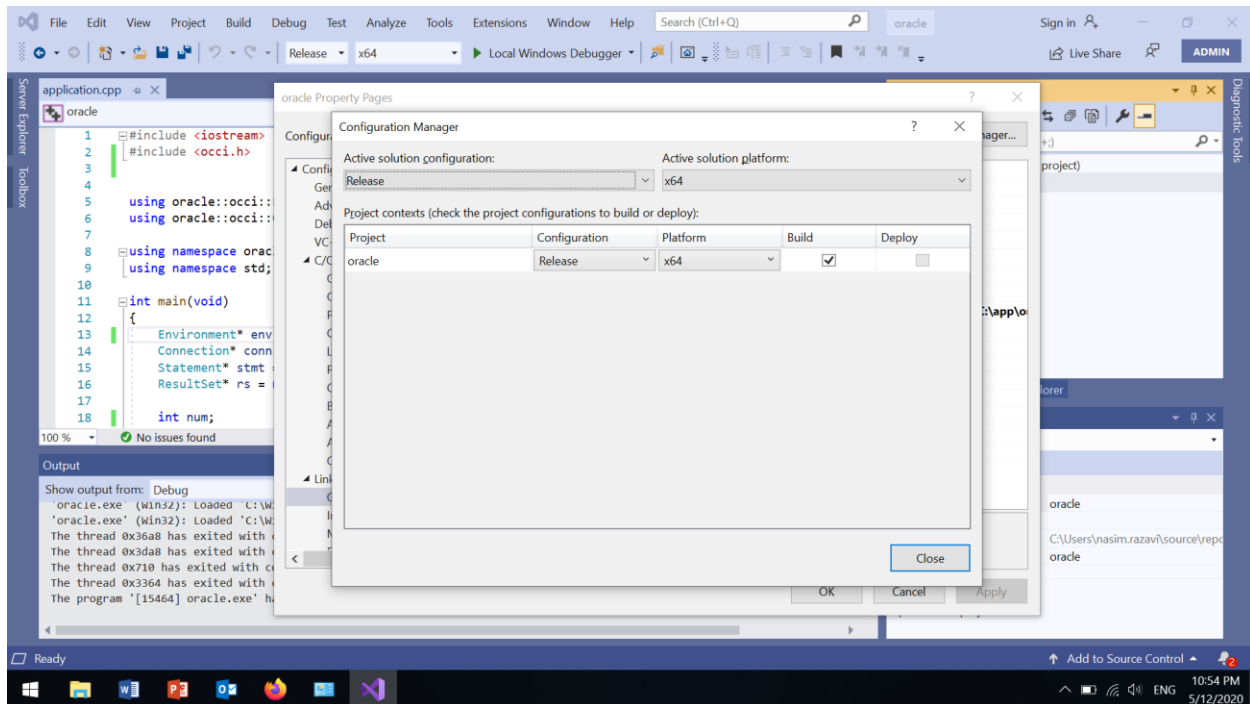
In the summary page, click on “Install” button.



Configure Visual Studio C++

Create a new project in VC++. Add your .cpp source file to your project. Then, go to the project properties:

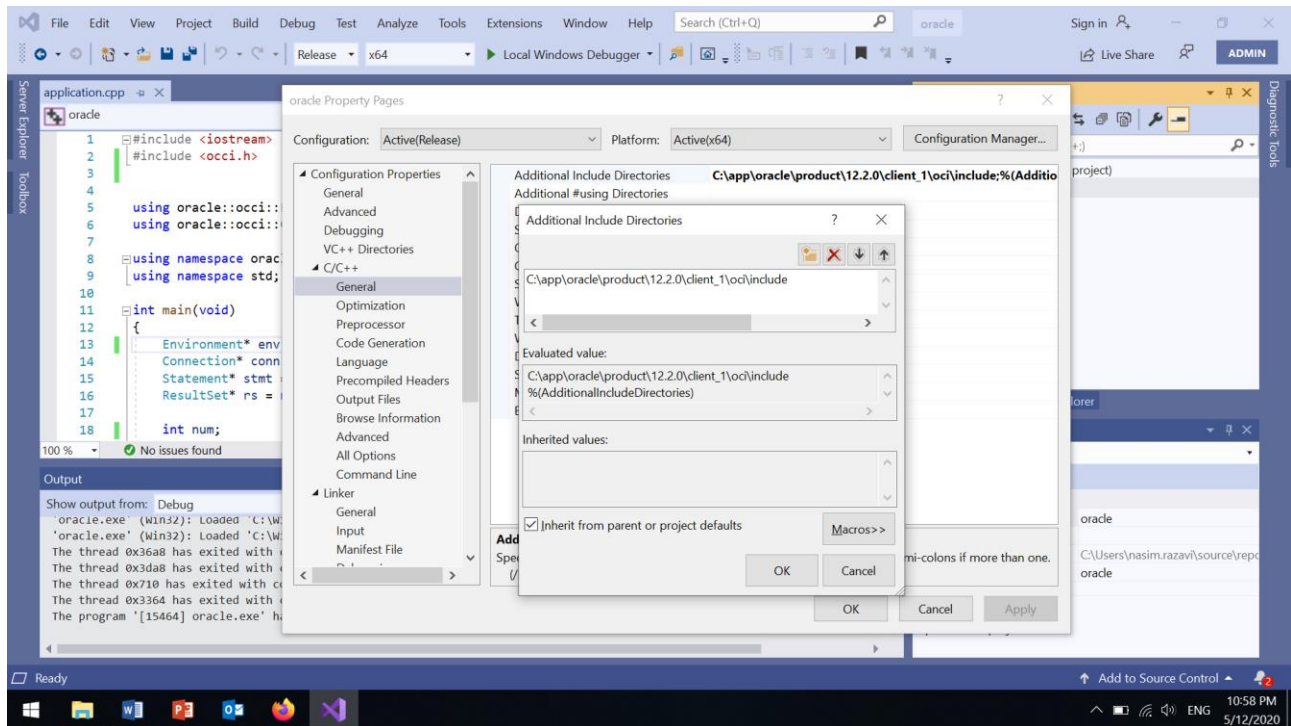
Open “Configuration Manager”, set “Active solution configuration” to “release” and “Active solution platform” to “x64”.



In the project properties navigator, under C/C++, select “General”. Add the following path to “Additional Include Directories”.

C:\app\oracle\product\12.2.0\client_1\oci\include

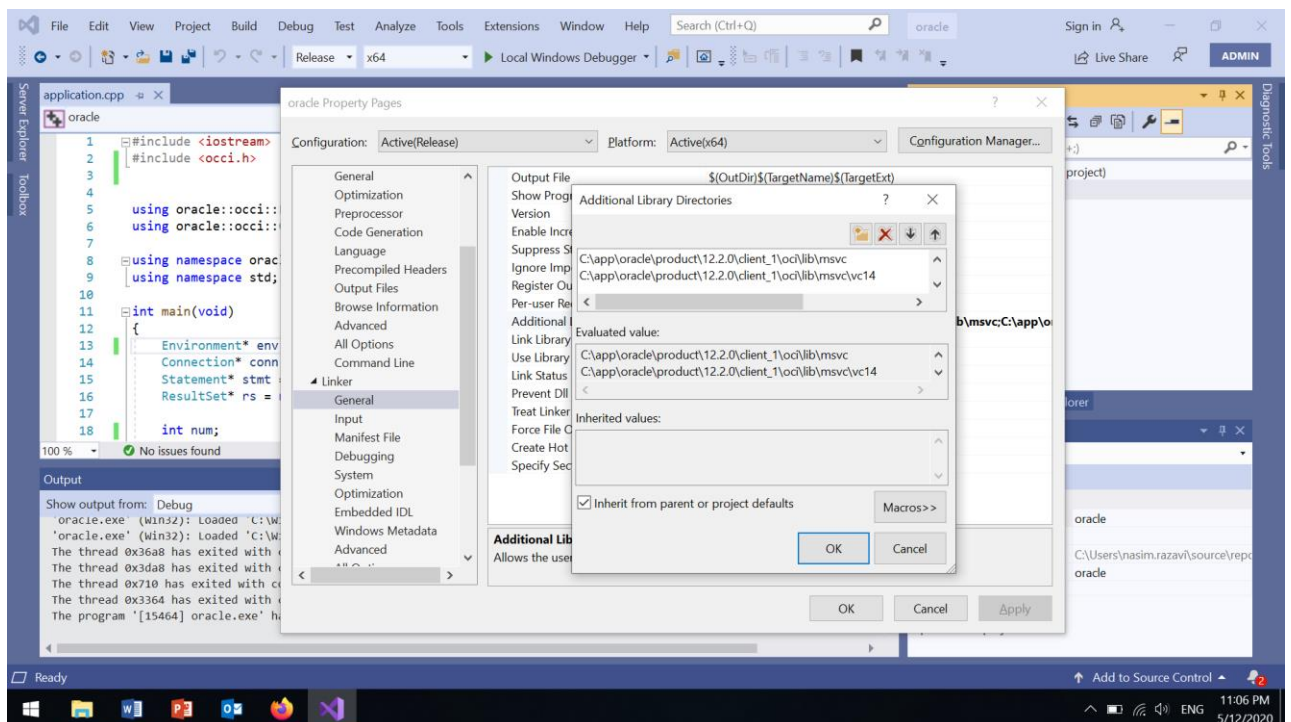
“oracle” is the new windows user name that I created when installing Oracle Instant Client. If you have chosen a different user name, you will see your username in the C:\app\ folder.



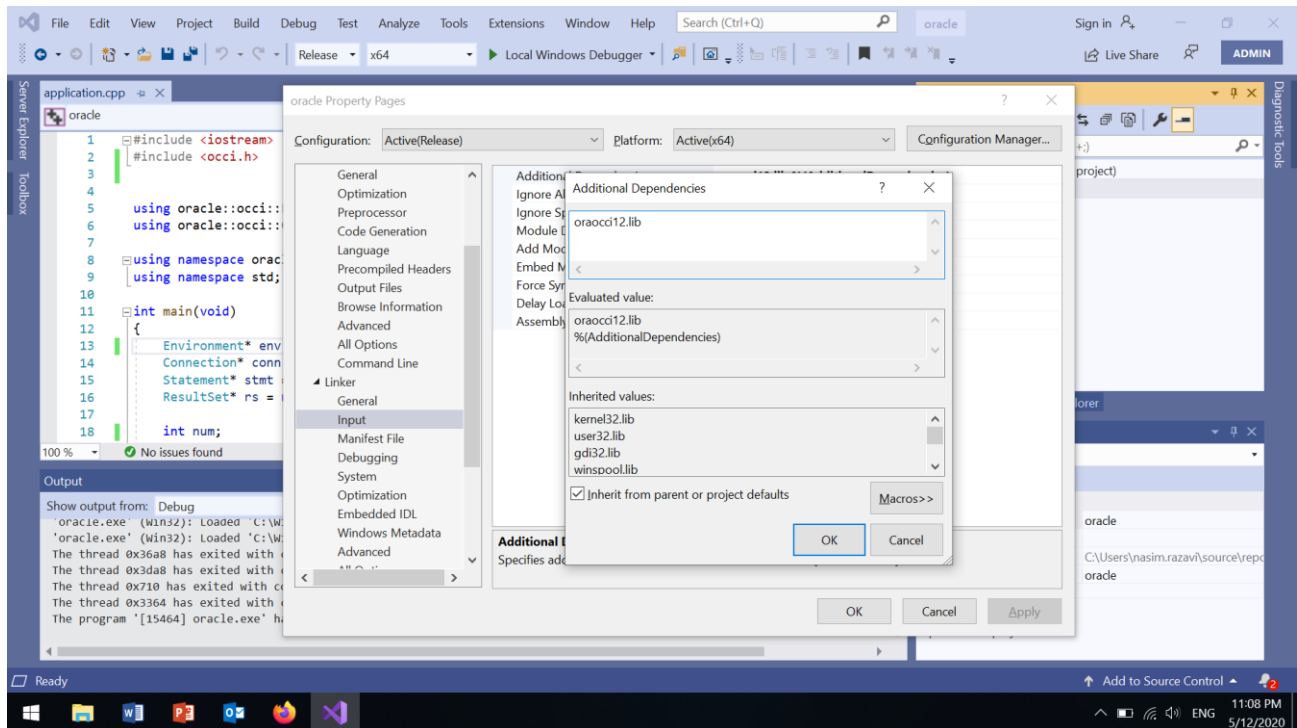
In “Linker/General”, add the following paths to “Additional Library Directories”:

C:\app\oracle\product\12.2.0\client_1\oci\lib\msvc

C:\app\oracle\product\12.2.0\client_1\oci\lib\msvc\vc14



In “Linker/Input”, write “oraocci12.lib” to “Additional Dependencies”.



Click “Apply” and then “Ok”.

Connecting to an Oracle database from a C++ Program

- Create a new C++ project in Visual Studio. Add a source code named databaseConnection.cpp to your project.
- At the beginning of the C++ program, add the following libraries.

```
#include <iostream>
#include <occi.h>

using oracle::occi::Environment;
using oracle::occi::Connection;

using namespace oracle::occi;
using namespace std;
```

- Before building the connection, you need to create an environment. The Environment class provides an OCCI environment to manage memory and other resources for OCCI objects.

To define an environment instance define a reference of type Environment class.

```
Environment* env = nullptr;

env = Environment::createEnvironment(Environment::DEFAULT);

{
    . . .
}

Environment::terminateEnvironment(env);
```

Terminate the environment when the connection is not required.

Opening and Closing a Connection

- To define a pointer (reference variable) to the Oracle database.

```
Connection* conn = nullptr;
```

- After creating the environment, create a connection.

```
conn = env->createConnection(user, pass, constr);
```

You must close and terminate the collection at the end of a working session.

```
env->terminateConnection(conn);
```

See the following code:

```
env = Environment::createEnvironment(Environment::DEFAULT);
// environment scope starts
{
    conn = env->createConnection(user, pass, constr);
    . . . // work with the database
    env->terminateConnection(conn);
}
// environment scope ends
Environment::terminateEnvironment(env);
```

- To establish a connection to the Oracle server write the following command:

```
conn = env->createConnection(user, pass, constr);
```

You need to declare the following variables before creating the connection:

```
string user = "username";
string pass = "password";
string constr = "myoracle12c.senecacollege.ca:1521/oracle12c";
```

Use your Oracle username and password to set the variable *user* and *pass*.

- Use try-catch statements to handle any errors as a result of a connection failure.

```
try {
    env = Environment::createEnvironment(Environment::DEFAULT);
    {
        conn = env->createConnection(user, pass, constr);
        cout << "Connection is Successful!" << endl;
        env->terminateConnection(conn);
    }
    Environment::terminateEnvironment(env);
}
catch (SQLException& sqlExcp) {
    cout << sqlExcp.getErrorCode() << ": " << sqlExcp.getMessage();
}
```

See the following sample code for establishing a connection to a database:

```
#include <iostream>
#include <occi.h>

using oracle::occi::Environment;
using oracle::occi::Connection;
using namespace oracle::occi;
using namespace std;

int main(void)
{
    /* OCCI Variables */
    Environment* env = nullptr;
    Connection* conn = nullptr;
    /* Used Variables */
    string user = "username";
    string pass = "password";
    string constr = "myoracle12c.senecacollege.ca:1521/oracle12c";
    try {
        env = Environment::createEnvironment(Environment::DEFAULT);
        conn = env->createConnection(user, pass, constr);
        cout << "Connection is Successful!" << endl;
        env->terminateConnection(conn);
        Environment::terminateEnvironment(env);
    }
    catch (SQLException& sqlExcp) {
        cout << sqlExcp.getErrorCode() << ": " << sqlExcp.getMessage();
    }
    return 0;
}
```

Creating and Terminating a Statement

- If the connection is successfully established, you can execute SQL queries in your C++ program. To execute a query, you need to create a statement object by calling a method of the connection object:

```
// define a reference to an object statement
Statement* stmt = nullptr;

// call method createStatement() to create an statement object
conn->createStatement("SELECT * FROM product_categories");
```

Terminate a statement before closing the connection when you do not need that object any more.

```
conn->terminateStatement(stmt);
```


Executing a Statement and Store the Query Result into a Result Set

- After declaring your SQL statement, you can execute it by calling the `executeQuery()` method:

```
stmt->executeQuery();
```

The `executeQuery()` method returns a `ResultSet` Object. To store the returning result set, you need to declare a `ResultSet` object.

```
// define a reference to an object resultset
ResultSet* rs = nullptr;

// store the result set
rs = stmt->executeQuery();
```

Fetching Data from a result set

- After calling the `executeQuery()` method, you can check if the result is empty or not.

```
if (!rs->next()) {
    // if the result set is empty
    cout << "ResultSet is empty." << endl;
}
```

The `next()` method of the `ResultSet` object is used to fetch the data. Every time you call this method, one row will be fetched from the result set if exists.

When there is no data to be fetched, this method returns false (0).

Be careful when you are using the `next()` method to see if the result set is empty. This method fetches a row from your result set. If you want to display all data in your result set, make sure you do not miss the first row.

If you want to print all the rows, you need a loop. See the following code:

```
if (!rs->next()) {
    // if the result set is empty
    cout << "ResultSet is empty." << endl;
}else{
    while (rs->next()) {
        cout << "Category ID: " << rs->getInt(1) << " Category Name: " << rs->getString(2) << endl;
    }
}
```

If you use the above code to check the result set and then read the data and print them out, you will miss printing the first since you have not printed the data fetch the first time you called the `next()` method.

To fix this problem, you first need to print the first row fetch by the first call of the `next()` method. Then, use a loop to read the rest of the result set.

```

if (!rs->next()) {
    // if the result set is empty
    cout << "ResultSet is empty." << endl;
}
else {
    // if the result set is not empty
    do {
        cout << "Category ID: " << rs->getInt(1) << " Category Name: " << rs->getString(2) << endl;
    } while (rs->next()); //if there is more rows, iterate
}

```

Lab Requirements:

In this lab, you need to write a C++ program to execute the following queries and display the result returned by each query. For the output format, see the sample output.

1. Display Employee Number, First Name, Last Name, Phone Number, and Extension of all Employees who work in San Francisco. See the following Sample output. (Sort the report according to the employee number)
2. Display Employee Number, Last Name, Phone Number, and Extension for all managers. (You can use column reports to find the managers' employee number)

Your program will output only the following reports.

Remove any outputs (messages) from your program that you have used for testing your code such as printing "The connection is successful".

----- Report 1 (Employee Report) -----				
Employee ID	First Name	Last Name	Phone	Extension
1002	Diane	Murphy	+1 650 219 4782	x5800
1056	Mary	Patterson	+1 650 219 4782	x4611
1076	Jeff	Firrelli	+1 650 219 4782	x9273
1143	Anthony	Bow	+1 650 219 4782	x5428
1165	Leslie	Jennings	+1 650 219 4782	x3291
1166	Leslie	Thompson	+1 650 219 4782	x4065
----- Report 2 (Manager Report) -----				
Employee ID	First Name	Last Name	Phone	Extension
1002	Diane	Murphy	+1 650 219 4782	x5800
1056	Mary	Patterson	+1 650 219 4782	x4611
1088	William	Patterson	+61 2 9264 2451	x4871
1102	Gerard	Bondur	+33 14 723 4404	x5408
1143	Anthony	Bow	+1 650 219 4782	x5428
1621	Mami	Nishi	+81 33 224 5000	x101