Challenge 03: Node-RED App

Task 02

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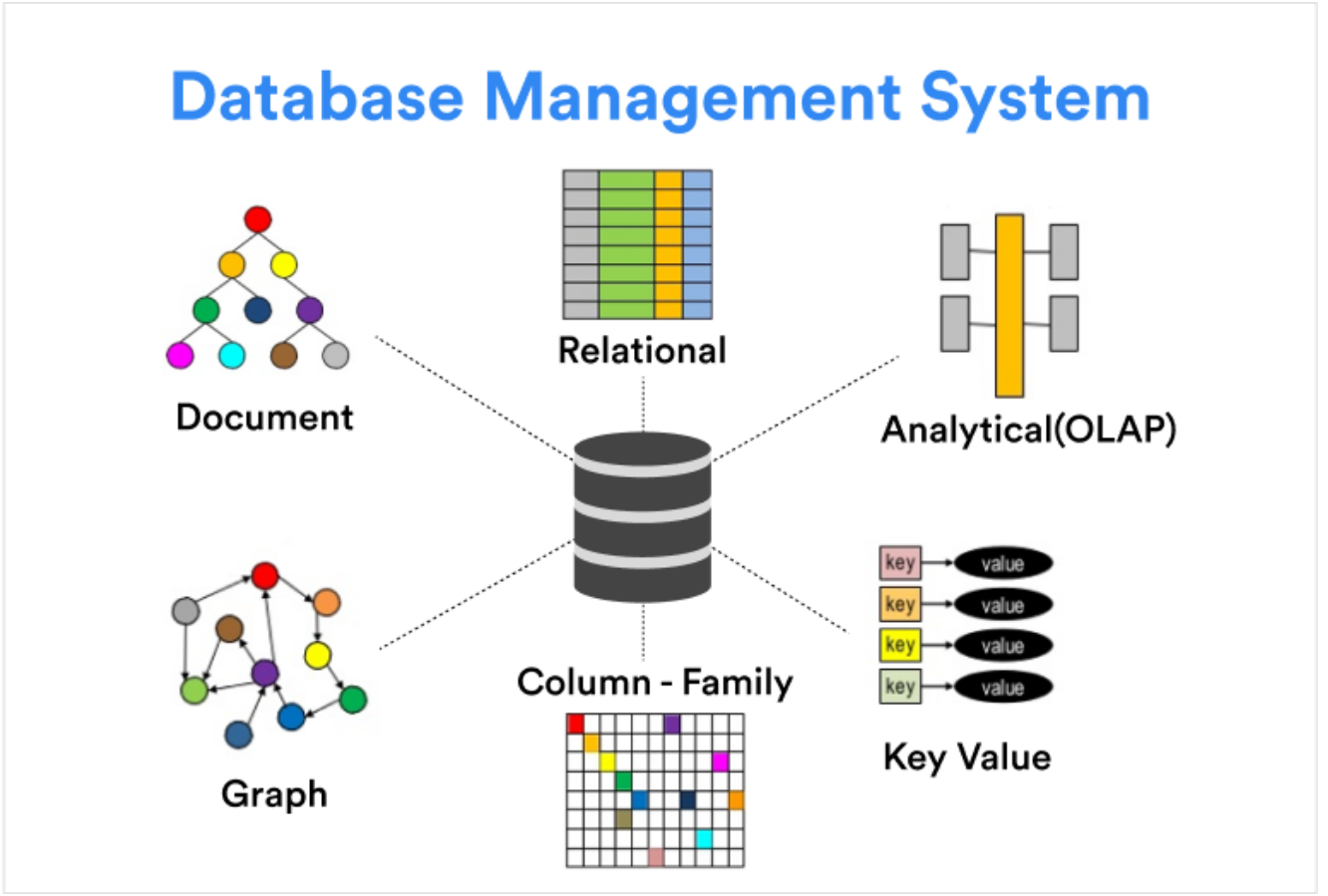
Challenge 03: ctrlX Node-RED App | Introduction to Database

Introduction to Database

What is a Database?

- The easiest way to understand a database is as a collection of related files.
- Imagine a file (either paper or digital) of sales orders in a shop.
- Then there's another file of products, containing stock records.
- To fulfil an order, you'd need to look up the product in the order file and then look up and adjust the stock levels for that particular product in the product file.
- A database and the software that controls the database, called a database management system (DBMS), helps with this kind of task.
- In our case, we are using **MariaDB**.
- MariaDB is a database system, a database server.



Information about Database can be found online:

- Introduction to Relational Database | MariaDB
- Beginner Tutorial Articles | MariaDB

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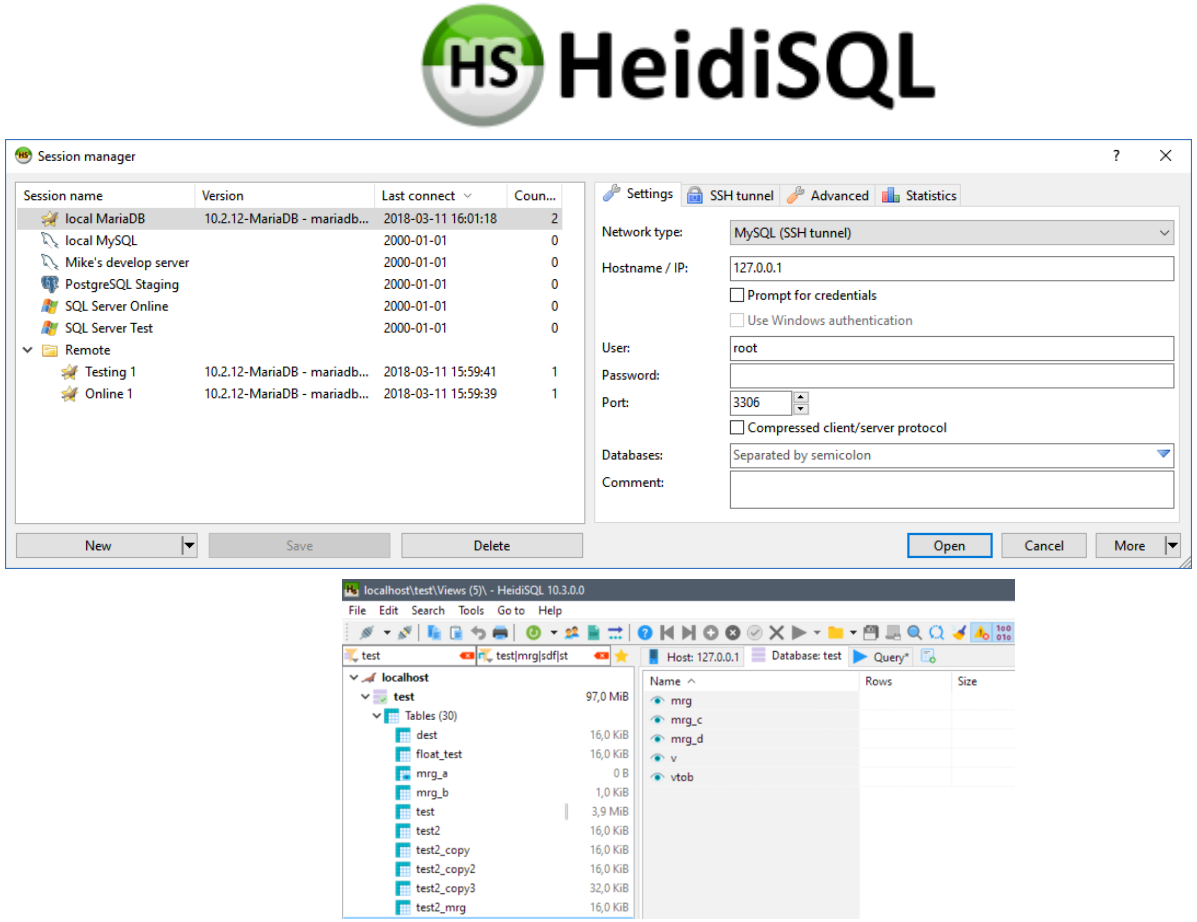
Introduction to Database

Database Client Application

- To interface with the MariaDB server, you can use a client program such as HeidiSQL to interface with the MariaDB server.
- HeidiSQL is a free Windows client software for MariaDB and MySQL, and is bundled with the Windows version of MariaDB
- "Heidi" lets you see and edit data and structures from computers running one of the database systems MariaDB, MySQL, Microsoft SQL, PostgreSQL and SQLite.
- Invented in 2002 by Ansgar, HeidiSQL belongs to the most popular tools for MariaDB and MySQL worldwide.



Information about HeidiSQL Database Client can be found online:

- HeidiSQL

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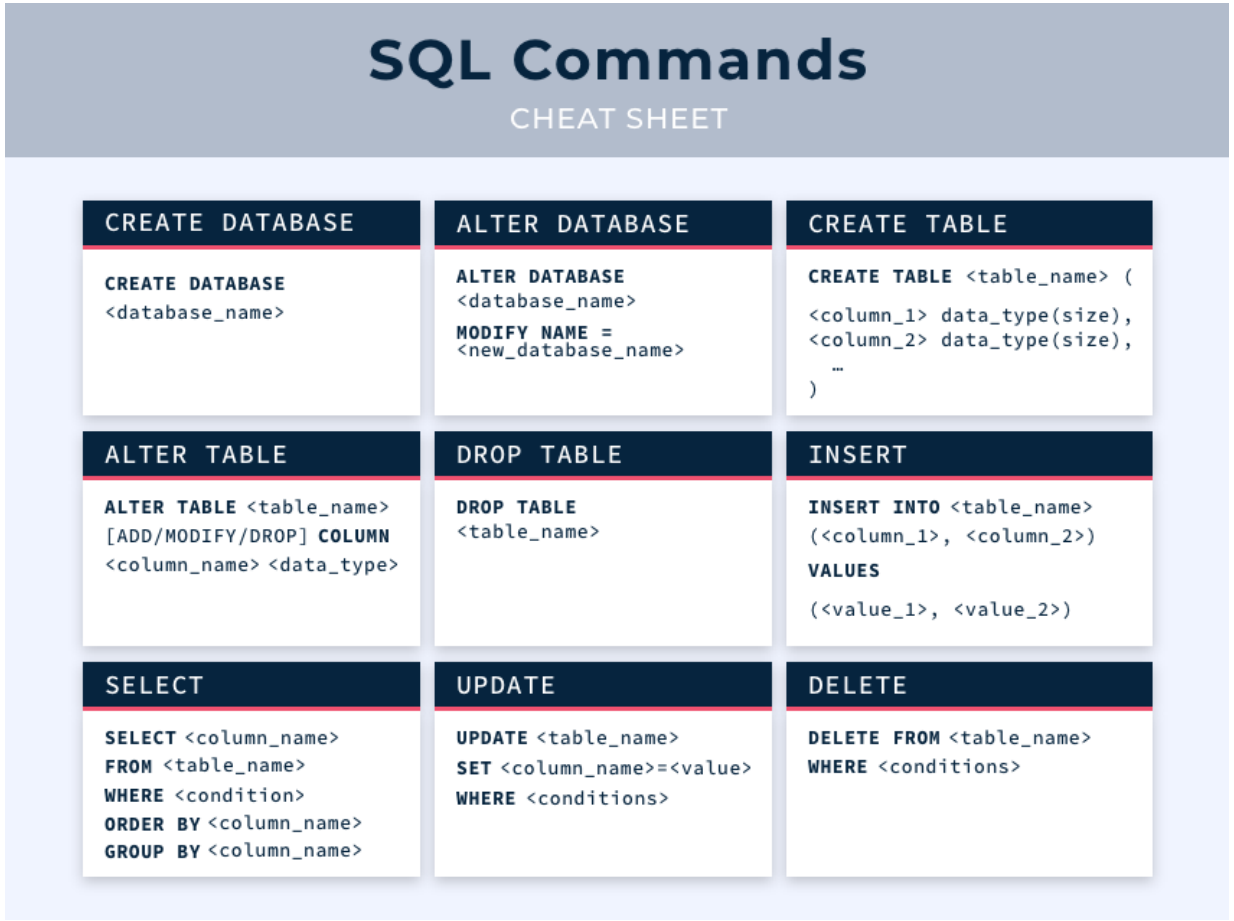
Introduction to Database

The Basics of SQL

- SQL stands for Structured Query Language.
- To make changes to a database or to retrieve data with the Database Client Application such as HeidiSQL, you will need to enter an SQL statement.
- An SQL statement that requests data is called a query.
- Databases store information in tables.
- They're like spreadsheets, but much more efficient at managing data.

Information about SQL can be found online:

- What is SQL | simplilearn
- Basic SQL Commands | freecodecamp
- SQL Query Basic Elements | learnsql



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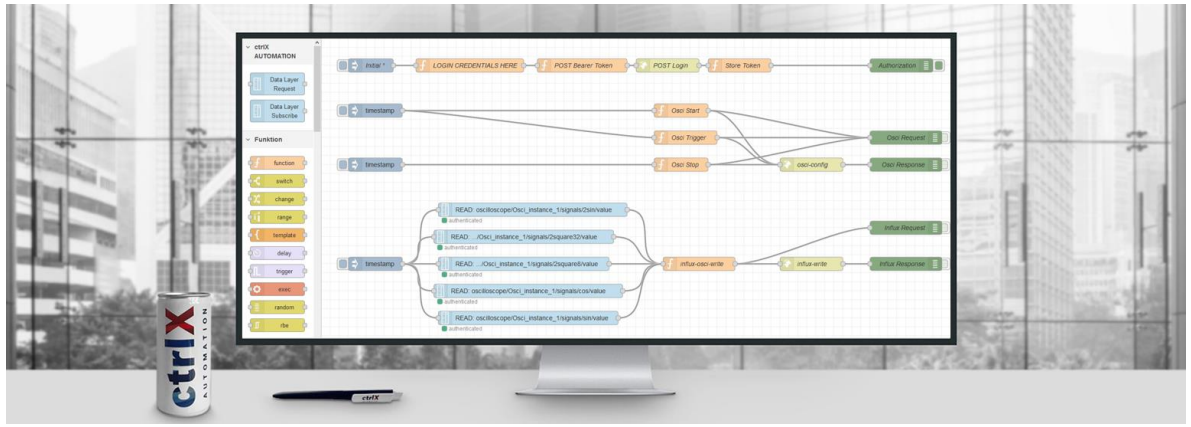

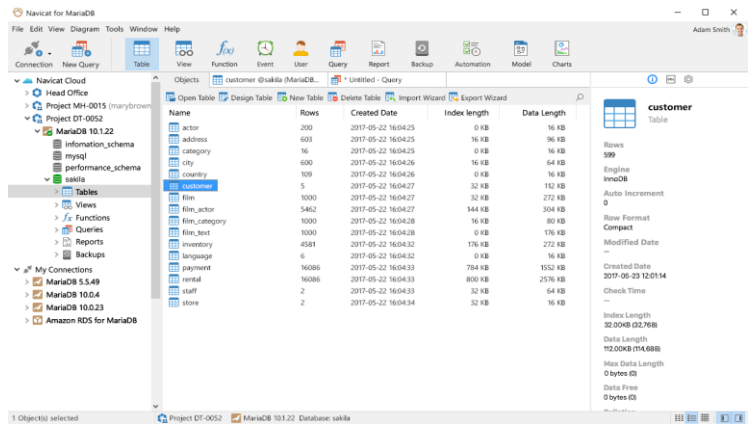

Description

From Task 1, you have completed the User Interface/ User Experience (UI/ UX) element with Node-RED. Now you are given the task to Store/ Log the real-time data of the system in a Database. When the system is either on or off, you should be able to store the status of the inputs and outputs of the ctrlX PLC in a Database using Node-RED. You could use this information to analyze your system behavior.

Task

This task will test your understanding on Database Management System (DBMS), Node-RED and its working principles. Follow the procedures to create a Database and solve the problems presented in the Node-RED Flow Editor to accomplish this task.

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Safety instructions for the project exercise

In order to ensure the operational capability and to identify the possible hazards of machines and systems, the safety regulations must be observed before and during the order execution.

The ctrlX CORE may only be operated in technically perfect condition. The intended use, performance data and operating conditions may not be changed. No protective devices/components may be deactivated.

In case of emergency, failure or other irregularities:

- Before connecting or disconnecting any electrical components, ensure that the power to the ctrlX CORE unit and associated equipment is turned off.

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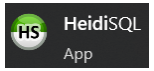
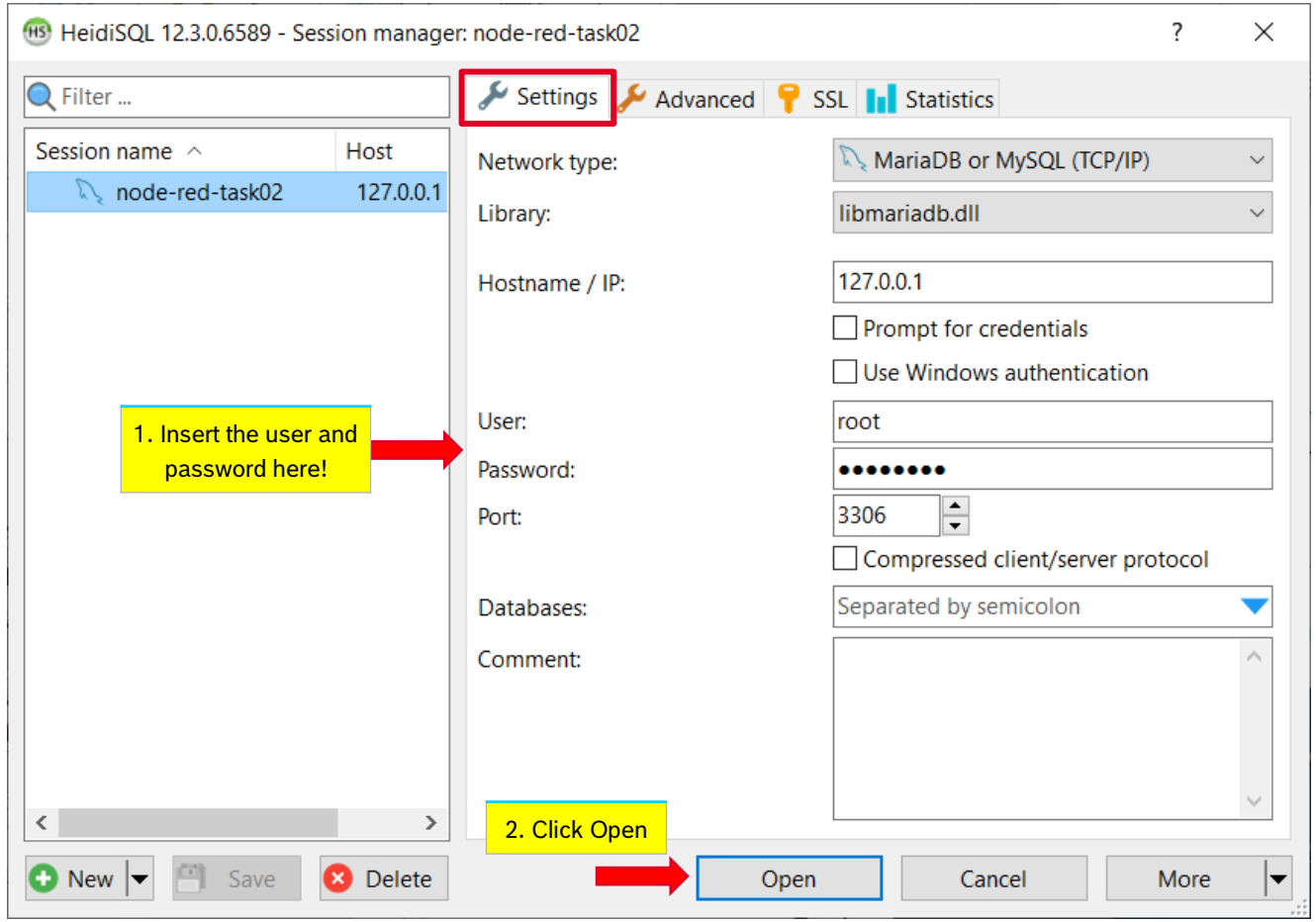
Steps

1. Open the Database Client Application, **HeidiSQL** on Windows

HeidiSQL Client – Session Manager

- Search in Windows for the HeidiSQL application 

- HeidiSQL's Session manager window will open
- Fill in the session "**Settings**" tab:
  - Network type: **MariaDB or MySQL (TCP/IP)**
  - Library: **libmariadb.dll**
  - Hostname / IP: **127.0.0.1**
  - User: **root**
  - Password: **password**
  - Port: **3306** (default port)
  - Databases: **Separated by semicolon**
- Click **Open**



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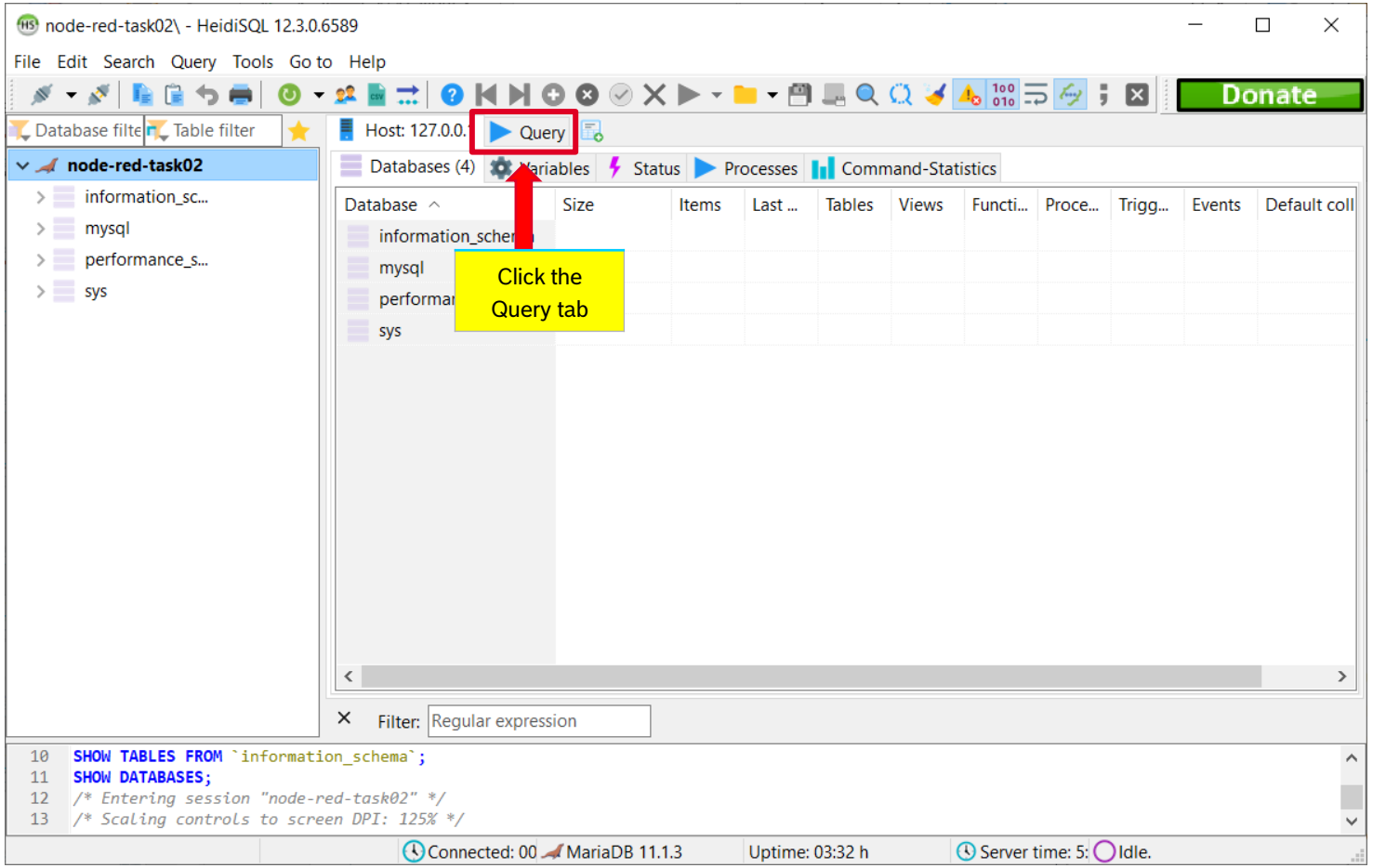
Steps

2. Familiarize with the **HeidiSQL** Database Client Main Window/ Interface

HeidiSQL Client – Main Interface

- After logging into the session, you are greeted with a main window / interface
- The main window contains:
  - The database tree which contains the list of databases and tables on the left section
  - Menu and Tool bar on the top section
  - Main query window/ workspace in the center section
  - The bottom output section displays all the SQL statement sent to the database
- In the main query window is where we will insert SQL statement to create a Dat Query
- Click on the "**Query**" tab



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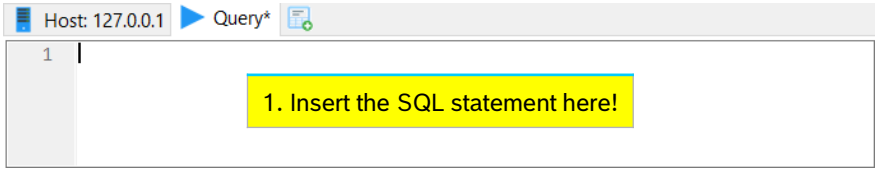
Steps

3. First, create a Database using SQL statement with **HeidiSQL** Database Client Application

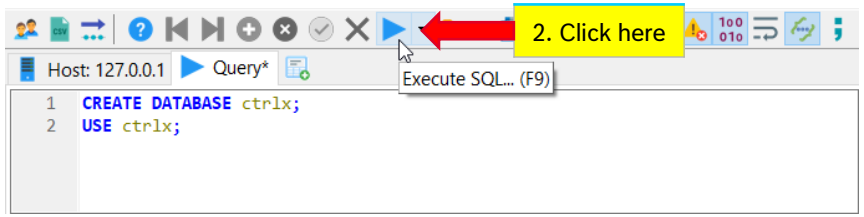
Create a Database

- After clicking on the "**Query**" tab, insert the SQL statement below in the field:

```
CREATE DATABASE ctrlx;
USE ctrlx;
```

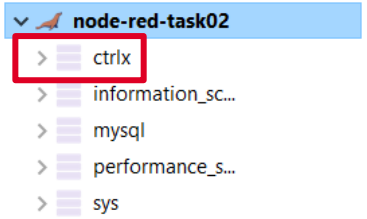


- Then click the "**Execute SQL...**" button located in the tool bar



- Observe in the output section that the SQL statement have been executed and there is no error/ warning

- Click the "**Refresh**" button  in the toolbar
- Observe in the database tree in the left section that the "**ctrlx**" database is created
- Clear the SQL statement in the "**Query**" field



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Steps

4. Next, create a Table using SQL statement with **HeidiSQL** Database Client

Create a Table

- In the "**Query**" tab, insert the SQL statement below in the field:

```
CREATE TABLE `system_outputs` (
    `id` INT AUTO_INCREMENT PRIMARY KEY,
    `red_lamp` VARCHAR(50) NULL,
    `green_lamp` VARCHAR(50) NULL,
    `buzzer` VARCHAR(50) NULL,
    `timestamp` TIMESTAMP NOT NULL DEFAULT CURRENT_TIMESTAMP() ON UPDATE CURRENT_TIMESTAMP()
    ) ENGINE=InnoDB DEFAULT CHARSET=utf8mb4 COLLATE='utf8mb4_general_ci';
```

- Then click the "**Execute SQL...**" button located in the tool bar
- Observe in the output section that the SQL statement have been executed and there is no error/ warning
- Usually an error message will indicate the error type such as syntax error, etc
- Also observe that when the "**Refresh**" button is clicked, the table is not yet present in the left section

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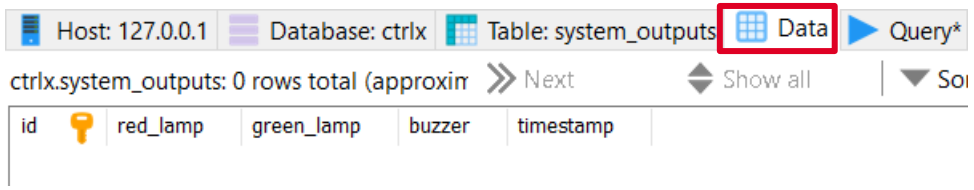
Steps

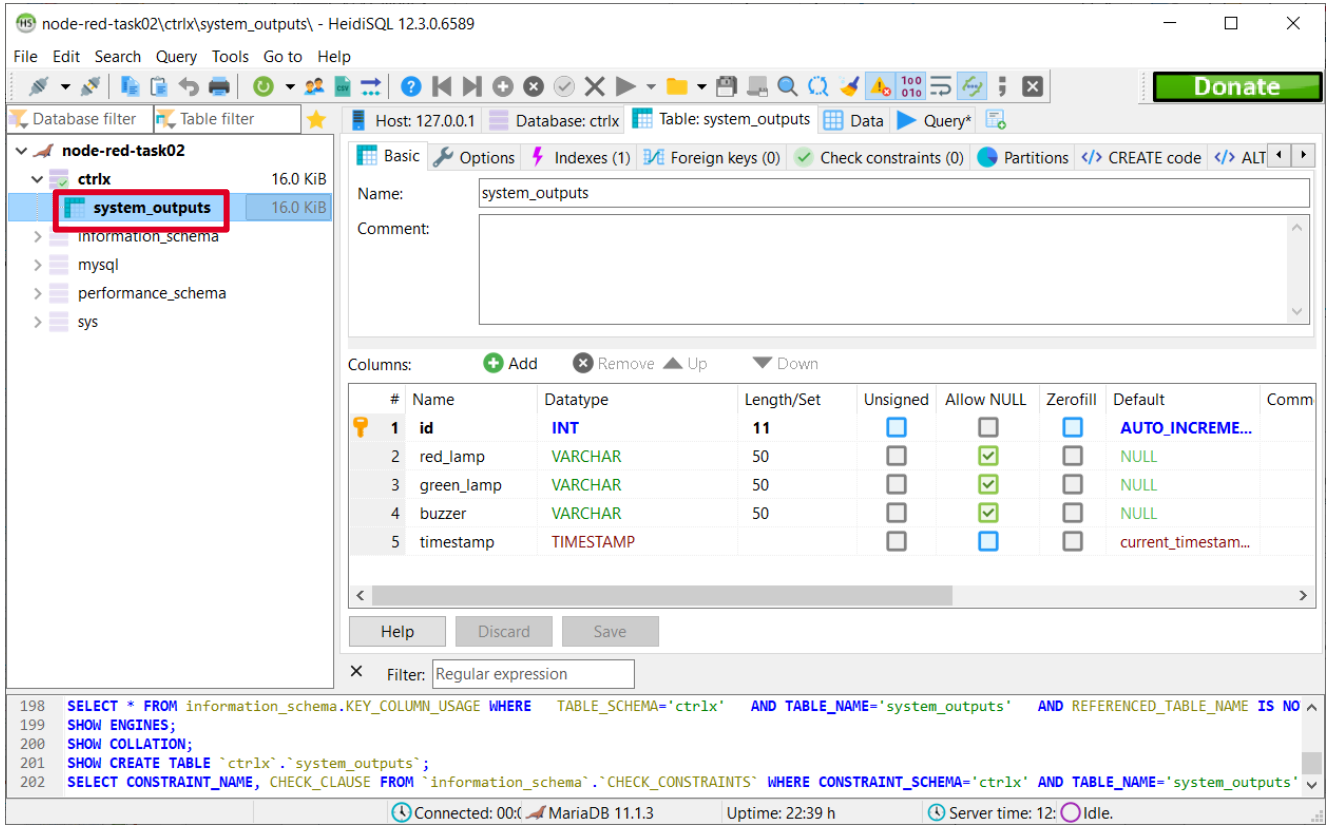
4. Next, create a Table using SQL statement with **HeidiSQL** Database Client

Create a Table

- Click the “**Close selected database connection**“ button 
- Reconnect to the database session from Step 1
- Now observe in the database tree in the left section that the table **“system_outputs**“ is created
- Click the “**Data**“ tab in the center main query section
- From the previous SQL statement that has been executed, the Columns below have been added to the table:

  ‘id‘,‘red_lamp‘,‘green_lamp‘,‘buzzer‘ and ‘timestamp‘





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Steps

5. After creating tables within a database, you will want to create users to control who has access to that data and who can perform specific operations on it.

Create a User for ctrlX CORE to access the database

- In the "**Query**" tab, insert the SQL statement below in the field:

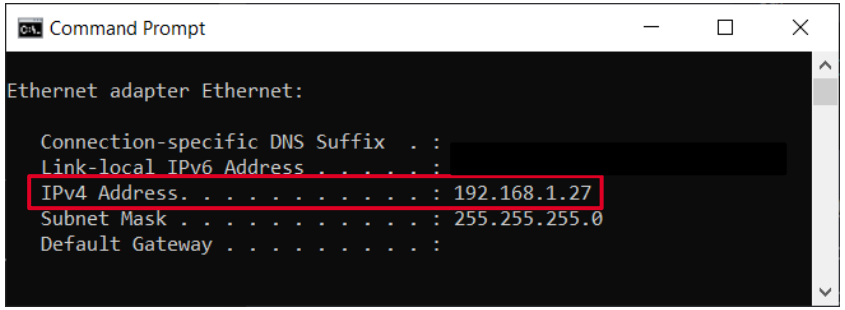
```
CREATE USER 'ctrlxcore'@'localhost' IDENTIFIED BY 'password';
CREATE USER 'ctrlxcore'@'192.168.1.27' IDENTIFIED BY 'password';
CREATE USER 'ctrlxcore'@'%' IDENTIFIED BY 'password';
```

- Then click the "**Execute SQL...**" button located in the tool bar
- Observe in the output section that the SQL statement have been executed and there is no error/ warning
- Clear the SQL statement in the "**Query**" field.
- Once we have created the user, next is to grant the user access to the database
- In the "**Query**" tab, insert the SQL statement below in the field and then execute the SQL statement:

```
GRANT ALL PRIVILEGES ON ctrlx.* TO 'ctrlxcore'@'localhost';
GRANT ALL PRIVILEGES ON ctrlx.* TO 'ctrlxcore'@'192.168.1.27';
GRANT ALL PRIVILEGES ON ctrlx.* TO 'ctrlxcore'@'%';
```

- Observe in the output section that the SQL statement have been executed and there is no error/ warning
- In the next step, Login with the User that has been created

Find for your own computer's IPv4 Address via:
Press: Windows key → Type: CMD → Type: ipconfig → Enter
Look under Ethernet adapter



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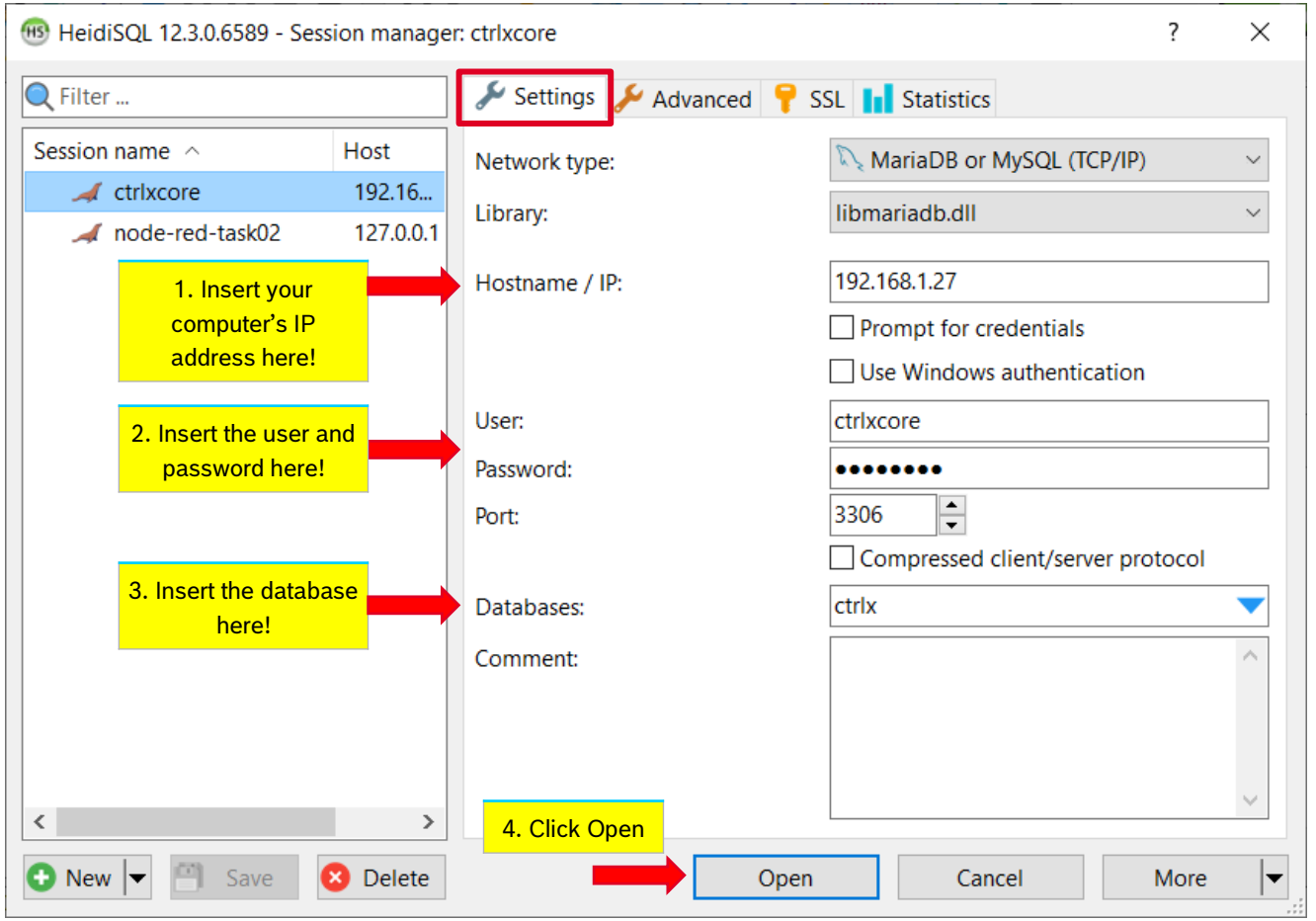
Steps

6. Access the database from the User that has been created in the previous step

Login User from HeidiSQL Client – Session Manager

- Click "**Close selected database connection**" button 
- In the HeidiSQL's Session manager, fill in the session "**Settings**" tab:
  - Network type: **MariaDB or MySQL (TCP/IP)**
  - Library: **libmariadb.dll**
  - Hostname / IP: **192.168.1.27**
  - User: **ctrlxcore**
  - Password: **password**
  - Port: **3306** (default port)
  - Databases: **ctrlx**
- Click **Open**



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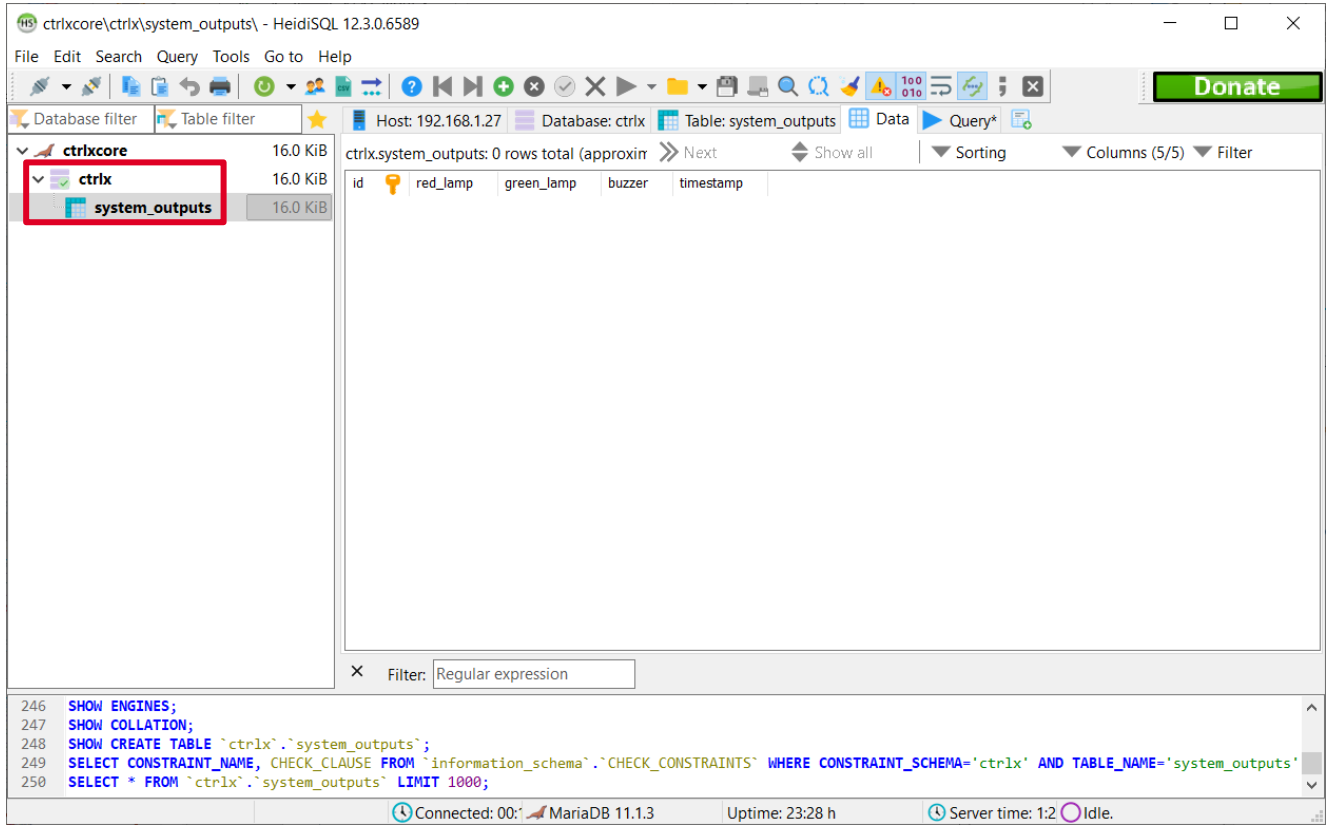
Steps

7. Now the User can access the Database and Tables which has been assigned

User Access to Database and Table

- Observe in the database tree in the left section that the user has access to the database “**ctrlx**“ and the table “**system_outputs**“
- Click the “**Data**“ tab in the center main query section to view the table with the columns
- The table is empty so let‘s store the ctrlX PLC output data with **Node-RED**!



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Challenge 03: ctrlX Node-RED App | Task 01

Steps

8. Return to the Node-RED Flow Editor from Task 1 and insert the nodes into the workspace

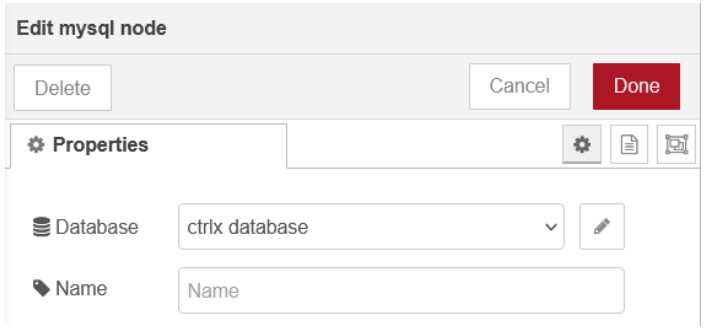
Insert Function and MySQL nodes in the Node-RED Flow

- From the Node Panel on the left, Drag & Drop the "**function**" and "**mysql**" nodes to the workspace of the flow for this task
- Double-click the "**function**" node and insert the SQL statement below in the field: 


```
const red_lamp = msg.payload;
msg.payload = [red_lamp];
msg.topic = `INSERT INTO system_outputs(red_lamp) VALUES('${red_lamp}')`;
return msg;
```

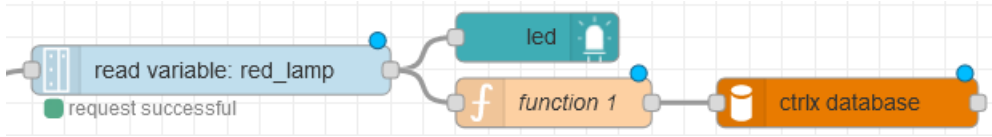
- Click the Done button
- Next, double-click the "**mysql**" node 

- In the Database property, select "**ctrlx database**" from the drop-down menu
- Click the Done button



- Connect the output of "**read variable: red_lamp**" Data Layer Request node to the input of the "**function**" node
- Connect the output of "**function**" node to the input of the "**mysql**" node
- Click on the "**Deploy**" 

button to deploy and execute the Flow
- If there is no error, observe that the "**mysql**" node will indicate "**OK**" 



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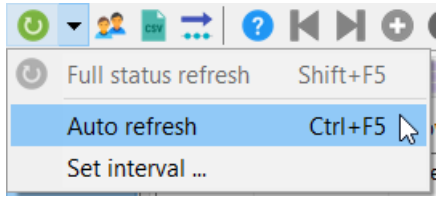
Challenge 03: ctrlX Node-RED App | Task 02

Steps

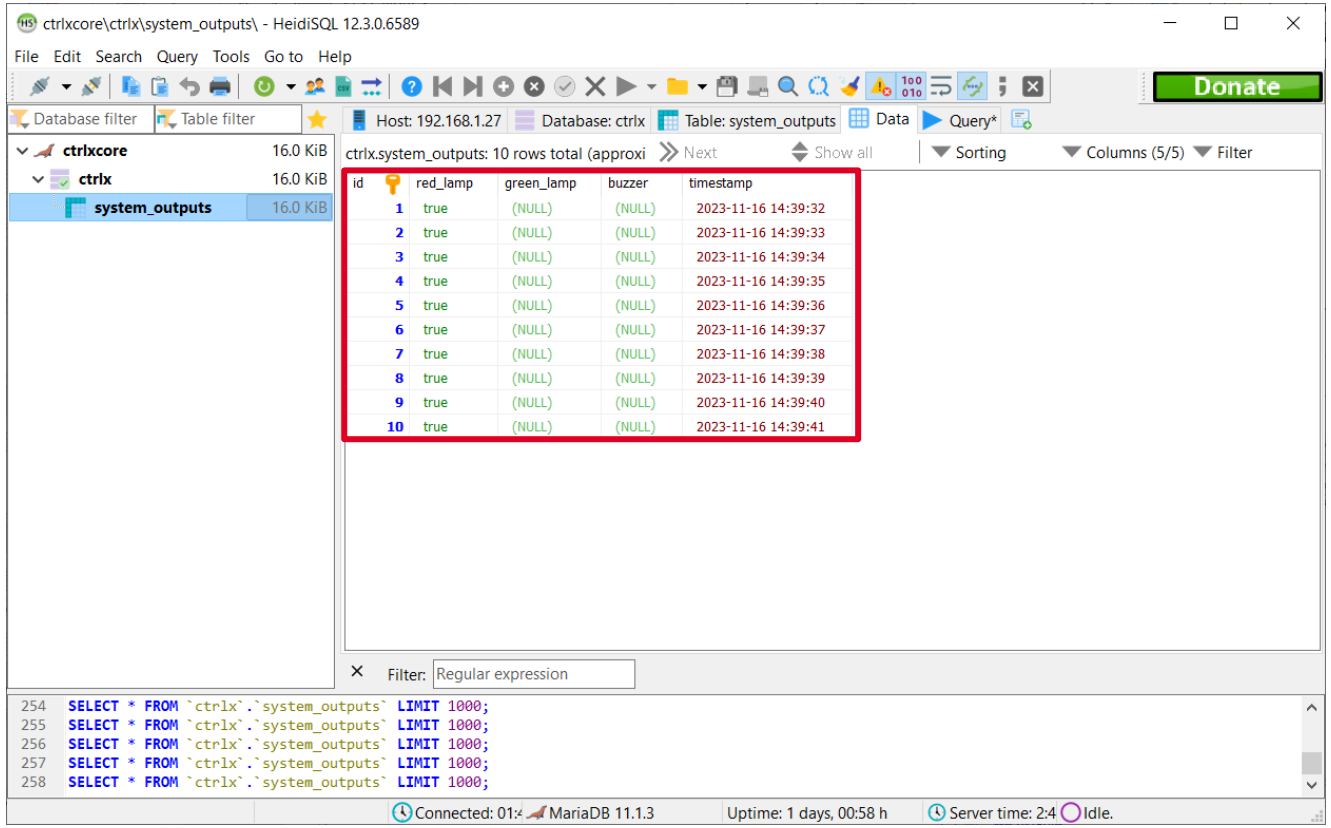
9. Now the data from ctrlX CORE is stored in the Database via Node-RED

View Stored Data in the Database and Table

- In the “**system_outputs**“ Table of the “**ctrlx**“ Database, click the “**Data**“ tab
- Observe that the data coming from the “**red_lamp**“ variable from ctrlX PLC should be inserted into the **red_lamp** column and is updated every second
- Click the “**Refresh**“ button to refresh the content of the table or select “**Auto refresh**“



- Congratulations! You have stored/ logged one of the ctrlX PLC data in a Database.



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Challenge 03: ctrlX Node-RED App | Task 01

Steps

10. For Task 2, complete the tasks below.

Do It Yourself

1. Store the data coming from “**green_lamp**“ and “**buzzer**“ in the “**system_outputs**“ table

2. Create a new table called “**system_inputs**“ with columns: **‘id‘, ‘start_button‘, ‘stop_button‘ and ‘timestamp‘**

3. Store the data coming from “**start_button_opc**“ and “**stop_button_opc**“ variables from ctrlX PLC

GOOD LUCK!

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Challenge 03: ctrlX Node-RED App | Task 02

Steps

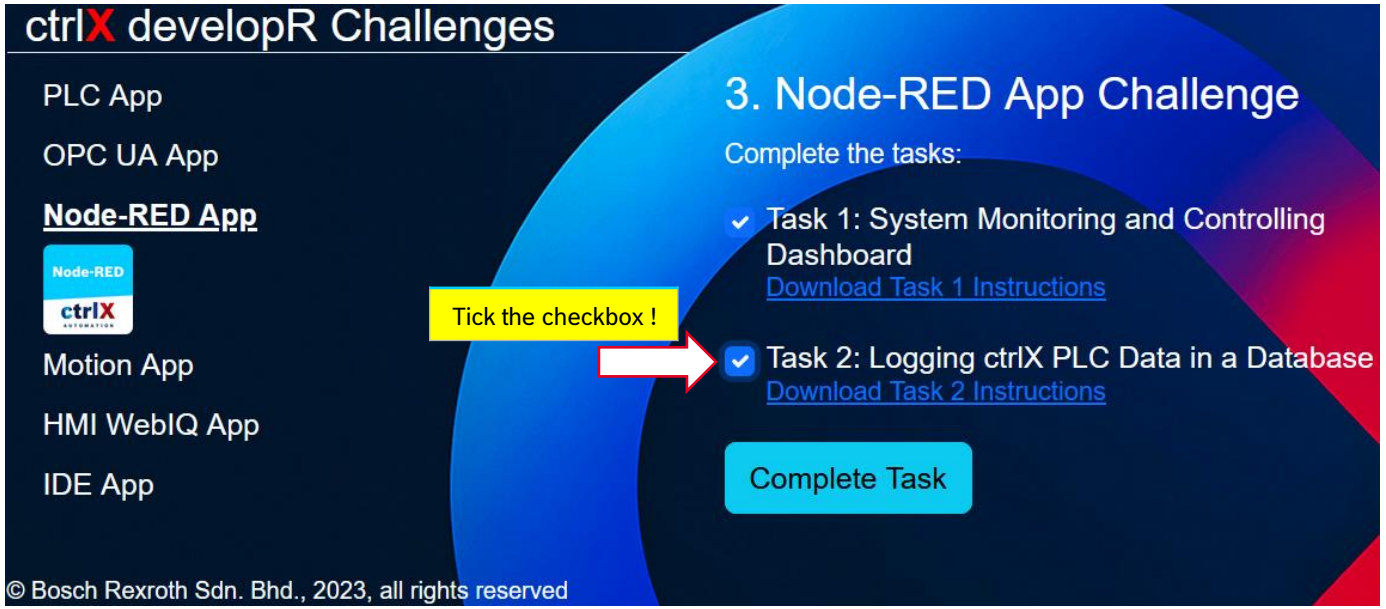
Once you have completed Task 2, follow the steps below.

How to complete Task 2 Node-RED App

- You can test your solution against the Task description
- Once it satisfies the requirements, confirm that you have completed the task by informing the available instructor for verification
- In the ctrlX developR challenge website, under the Node-RED App challenge section, tick [✓] the Task 2 checkbox

Congratulations, you've completed the tasks!

Follow the next step to complete the challenge!



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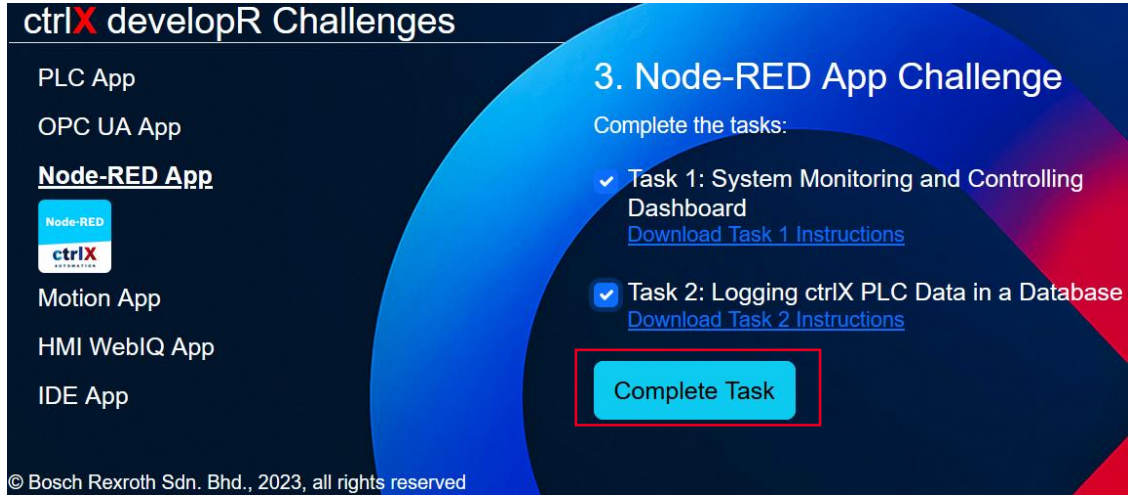
Challenge 03: ctrlX Node-RED App | Task 02

Steps

Once you have completed Task 1 and Task 2, follow the steps below.

How to complete the Node-RED App Challenge

- Finally, click on the "**Complete Task**" button



- Once pressed, the button text will change to "Task Completed" and you will be notified with a message that the challenge has been successfully submitted.
- By pressing the "Complete Task" button, the duration it takes for the team to complete the challenge will be automatically submitted.
- Submission only can be done once per challenge.

Congratulations, you've successfully completed the Node-RED App challenge! Wonderful!

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Congratulations!

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