

Department of Electrical Engineering

City University of Hong Kong

EE4090/EE4097 Engineering Training
Module 2 (M2) Raspberry PI and IoT

Database Server

What is Database Server ?

- It uses a database application that provides database services to other computer programs or computers. It is a **client-server model**.
- **Database management systems** (DBMSs) frequently provide database-server functionality, and some database management systems (such as MySQL) rely exclusively on the client–server model for database access
- Users access a database server either through a “**front end**” running on the user's computer which displays requested data or through the “**back end**”, which runs on the server and handles tasks such as data analysis and storage.
- You will build a database server in Raspberry Pi in this workshop. Also, you will develop the front end of your database, including web page and mobile application.

What is LAMP?

- LAMP (**L**inux, **A**pache, **M**ySQL, **P**HP/**P**erl/**P**ython)
- It is a very common example of a web service stack
- It named as an acronym of the names of its original four open-source components: the **Linux operating system**, the **Apache HTTP Server**, the **MySQL** relational database management system (RDBMS), and the **PHP** programming language.
- The LAMP components are largely interchangeable and not limited to the original selection. As a solution stack, LAMP is suitable for building dynamic web sites and web applications.

What is Linux operating system?

- It is a **Unix-like** computer operating system assembled under the model of free and open-source software development and distribution.
- Most Linux distributions, as collections of software based around the Linux kernel and often around a package management system, provide complete **LAMP** setups through their packages.
- For desktop systems, the default user interface is usually graphical, although the CLI is commonly available through terminal emulator windows or on a separate virtual console.
- In this workshop, we are using **Raspberry Pi OS** which also known as Raspbian, is a Debian-based operating system for Raspberry Pi. Debian is a Linux distribution composed of free and open-source software.

What is Apache HTTP Server?

- Apache is **open-source software**.
- A wide variety of features are supported, and many of them are implemented as compiled modules which extend the core functionality of Apache.
- The role of LAMP's web server has been traditionally supplied by Apache, and has since included other web servers such as Nginx. The Apache HTTP Server has been the most popular web server on the public Internet.
- In this workshop, you will install an Apache Server in your Raspberry Pi.

What is MySQL?

- MySQL is free and **open-source software**
- In 2010, forked the open-source MySQL project to create **MariaDB**
- A database management system makes it possible for users to **create, edit and update** data in database files. Once created, the DBMS makes it possible to store and retrieve data from those database files.
- MySQL's original role as the LAMP's relational DBMS (RDBMS) has since been alternately provisioned by other RDBMSs such as MariaDB or PostgreSQL, or even NoSQL databases such as MongoDB.

What is PHP?

- PHP is a **server-side** scripting language designed for web development but also used as a general-purpose programming language.
- PHP code is interpreted by a web server via a PHP processor module, which generates the resulting web page.
- PHP's role as the LAMP's application programming language has also been performed by other languages such as **Perl** and **Python**.
- in this workshop, you will develop a web page using PHP.

Challenge 3

Try to upload temperature measured by the Sense HAT to the database you just build. The result of the database should be similar to the following:

☐ Show all

Number of rows: 25

Filter rows: Search this table

Sort by key: None

+ Options

☐

Edit

Copy

Delete

106

2020-04-11 18:44:14

38.009

☐

Edit

Copy

Delete

107

2020-04-11 18:44:19

38.028

☐

Edit

Copy

Delete

108

2020-04-11 18:44:24

38.157

☐

Edit

Copy

Delete

109

2020-04-11 18:44:29

37.991

☐

Edit

Copy

Delete

110

2020-04-11 18:44:34

38.083

☐ Check all

With selected:

Edit

Copy

Delete

Export

☐ Show all

Number of rows: 25

Filter rows: Search this table

Sort by key: None

HINT:

Use the following library to learn about MySQL, an interface to the popular MySQL database server that provides the Python database API.

https://mysqlclient.readthedocs.io/user_guide.html

After finish your work, demonstrate your result to the technical staffs. Then, copy your code (.py) to a .txt file and zip it, then upload to Canvas, name it “**yourSID_myDB**”.

Challenge 4

Try to write a .php webpage to monitor the data without login the database. The result of the webpage should be similar to the following:

Raspberry Pi Temperature Recorder

No.	Date and Time	Temperature
35	2020-04-29 23:55:53	42.269
36	2020-05-02 19:13:49	41.750
37	2020-05-02 19:13:54	41.620
38	2020-05-02 19:13:59	41.824
39	2020-05-02 19:17:57	41.806
40	2020-05-02 19:18:02	41.713
41	2020-05-02 19:18:07	41.731
42	2020-05-02 19:18:12	41.731
43	2020-05-02 19:18:17	41.824
44	2020-05-02 19:18:22	41.694
45	2020-05-02 19:18:27	41.713
46	2020-05-02 19:18:32	41.639
47	2020-05-02 19:18:37	41.787
48	2020-05-02 19:18:42	41.694
49	2020-05-02 19:18:47	41.694
50	2020-05-02 19:18:52	41.824
51	2020-05-02 19:18:57	41.917

HINT:

Enter the following command in the terminal of your Raspberry Pi:

```
sudo chown -R pi /var/www/html
```

```
cd /var/www/html
```

```
rm index.html
```

```
nano index.php
```

You can start writing the .php webpage from here.

After finish your work, demonstrate your result to the technical staffs. Then, copy your code (.php) to a .txt file and zip it, then upload to Canvas, name it “**yourSID_myWP**”.

Assignment (IoT): Implementation of the Environment Recorder

Stage 1:

Try to upload three environment measurement, temperature, humidity and pressure, into a new local database. Also, upload the ID of your Raspberry Pi. The result should be similar to the following:

☐ Show all | Number of rows: 25 | Filter rows: Search this table | Sort by key: None

+ Options

		ID	rec_time	rec_temp	rec_humi	rec_press
<input type="checkbox"/>	Edit Copy Delete	1	2020-05-17 01:00:35	38.769	55.013	993.865
<input type="checkbox"/>	Edit Copy Delete	1	2020-05-17 01:00:40	38.731	54.926	993.886
<input type="checkbox"/>	Edit Copy Delete	1	2020-05-17 01:00:45	38.731	54.984	993.875
<input type="checkbox"/>	Edit Copy Delete	1	2020-05-17 01:00:50	38.491	54.800	993.852
<input type="checkbox"/>	Edit Copy Delete	1	2020-05-17 01:00:55	38.787	54.883	993.831

☐ Check all | With selected: Edit Copy Delete Export

☐ Show all | Number of rows: 25 | Filter rows: Search this table | Sort by key: None

Then, make a web page to monitor your new database. The result should be similar to the following:

Raspberry Pi Environment Recorder

ID	Date and Time	Temperature	Humidity	Pressure
1	2020-05-17 01:00:35	38.769	55.013	993.865
1	2020-05-17 01:00:40	38.731	54.926	993.886
1	2020-05-17 01:00:45	38.731	54.984	993.875
1	2020-05-17 01:00:50	38.491	54.800	993.852
1	2020-05-17 01:00:55	38.787	54.883	993.831

After finish your work, please demonstrate your database and web page to the technical staffs. Then, copy your code (.py and .php) to two .txt file and zip them, then upload to Canvas, name it “**yourSID_EnvironmentRecorder1**”.

Stage 2:

Try to upload three environment measurements by triggering the joystick to the common database 1. Based on the following:

- 1) the database name is: **mydb** and table name is **trainingdb1**,
- 2) the variable name of the common database 1: ID, rec_temp, rec_humi and rec_press.

You can check out the data of the common database by entering the database IP address to your browser, you will notice the data from your fellow classmate as well.

After finish your work, please switch to table name: **trainingdb2** and demonstrate the result to the technical staffs. Then, copy your code (.py) to a .txt file and zip it, then upload to Canvas, name it “**yourSID_EnvironmentRecorder2**”.

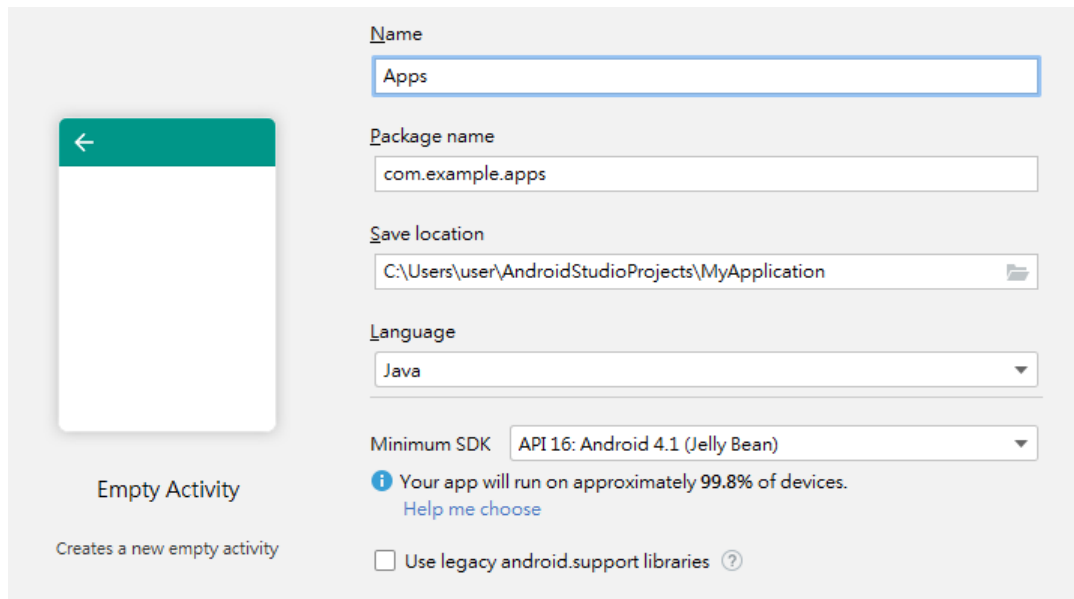
Stage 3:

Try to write a mobile application that monitor the data of the table **trainingdb2**. The IP address will be provided to you for extracting the data.

HINT:

1. Download “Android Studio” on your personal computer:
<https://developer.android.com/studio>
2. No need to change the “Configure your new project” → “Next”.
3. Then, select “Phone and Tablet” and the “Minimum SDK” select “API 16:Android 4.1 (Jelly Bean)” → “Next”.
4. Choose “Empty Activity” → “Next”.

5. Change the “Name” to “Apps”. Choose “Java” be the “Language” → “Finish”



←

Empty Activity

Creates a new empty activity

Name
Apps

Package name
com.example.apps

Save location
C:\Users\user\AndroidStudioProjects\MyApplication

Language
Java

Minimum SDK
API 16: Android 4.1 (Jelly Bean)

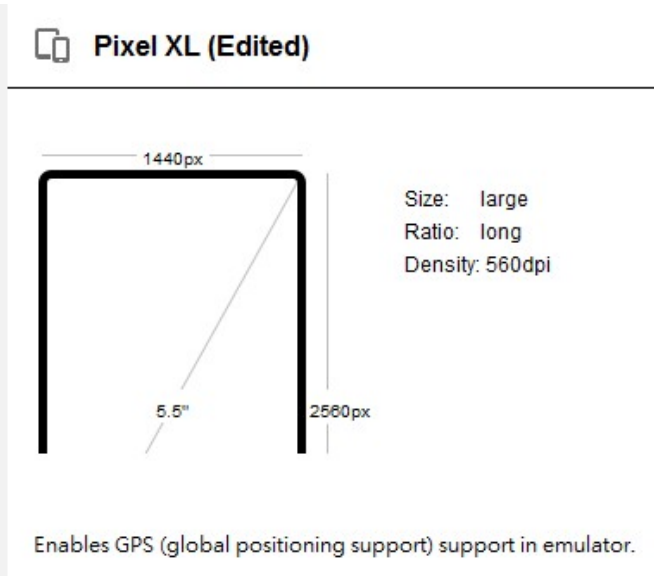
i Your app will run on approximately 99.8% of devices.
[Help me choose](#)

☐ Use legacy android.support libraries ?

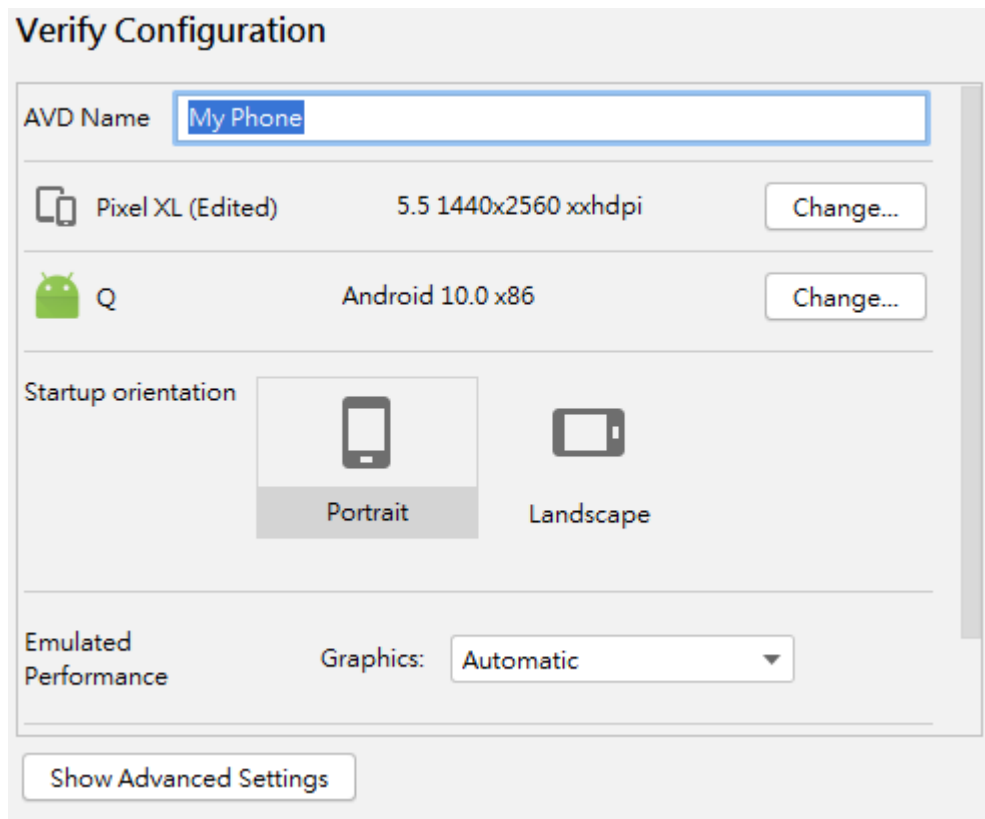
6. To create a Virtual Device.

“Tools” → “AVD manager” → “Create Virtual Device”. Choose “Phone on Category”. Choose “Pixel XL” → “Clone Device” on lower right corner. Disable “GPS” under “Sensors” → “Finish”

Memory	RAM: <input type="text" value="1536"/> <input type="text" value="MB"/>
Input	<input type="checkbox"/> Has Hardware Buttons (Back/Home/Menu) <input type="checkbox"/> Has Hardware Keyboard Navigation Style: <input type="text" value="None"/>
Supported device states	<input checked="" type="checkbox"/> Portrait <input checked="" type="checkbox"/> Landscape
Cameras	<input checked="" type="checkbox"/> Back-facing camera <input checked="" type="checkbox"/> Front-facing camera
Sensors	<input checked="" type="checkbox"/> Accelerometer <input checked="" type="checkbox"/> Gyroscope <input type="checkbox"/> GPS <input checked="" type="checkbox"/> Proximity Sensor



7. “Next”, Download “Q” → “Next”. Change “AVD Name” to “My Phone” → “Finish”



8. To change the version of phone.

“Tools” → “SDK manager”. Choose “SDK Tools” Tab, Tick “Show Package Details” on lower right corner. Under “Android SDK build”, only enable “Android SDK Build-Tools 30 rc2” and “29.0.3” → “Apply” .

SDK Platforms <u>SDK Tools</u> SDK Update Sites		
Below are the available SDK developer tools. Once installed, Android Studio will automatically check for updates. Check "show package details" to display available versions of an SDK Tool.		
Name	Version	Status
▼ <input checked="" type="checkbox"/> Android SDK Build-Tools 30-rc3		
<input type="checkbox"/> 30.0.0-rc3	30.0.0 rc3	Not installed
<input checked="" type="checkbox"/> Android SDK Build-Tools 30 rc2	30.0.0 rc2	Installed
<input type="checkbox"/> 30.0.0-rc1	30.0.0 rc1	Not installed
<input checked="" type="checkbox"/> 29.0.3	29.0.3	Installed
<input type="checkbox"/> 29.0.2	29.0.2	Not installed
<input type="checkbox"/> 29.0.1	29.0.1	Not installed
<input type="checkbox"/> 29.0.0	29.0.0	Not installed
<input type="checkbox"/> 28.0.3	28.0.3	Not installed
<input type="checkbox"/> 28.0.2	28.0.2	Not installed
<input type="checkbox"/> 28.0.1	28.0.1	Not installed
<input type="checkbox"/> 28.0.0	28.0.0	Not installed
<input type="checkbox"/> 27.0.3	27.0.3	Not installed
<input type="checkbox"/> 27.0.2	27.0.2	Not installed
<input type="checkbox"/> 27.0.1	27.0.1	Not installed
<input type="checkbox"/> 27.0.0	27.0.0	Not installed
<input type="checkbox"/> 26.0.3	26.0.3	Not installed
<input type="checkbox"/> 26.0.2	26.0.2	Not installed
<input type="checkbox"/> 26.0.1	26.0.1	Not installed
<input type="checkbox"/> 26.0.0	26.0.0	Not installed
<input type="checkbox"/> 25.0.3	25.0.3	Not installed
<input type="checkbox"/> 25.0.2	25.0.2	Not installed
<input type="checkbox"/> 25.0.1	25.0.1	Not installed
<input type="checkbox"/> 25.0.0	25.0.0	Not installed

After finish your work, please screen capture your Android Emulator and zip the photo. Then, submit the file to Canvas, name it “**yourSID_**iotApps3”.

Optional: You can try to download the application to your phone if you are using Android phone.

ID	Date and Time	Temperature	Humidity	Pressure
1	2020-05-17 01:00:35	38.769	55.013	993.865
1	2020-05-17 01:00:40	38.731	54.926	993.886
1	2020-05-17 01:00:45	38.731	54.984	993.875
1	2020-05-17 01:00:50	38.491	54.800	993.852
1	2020-05-17 01:00:55	38.787	54.883	993.831
1	2020-05-17 01:29:29	39.157	53.983	993.217
1	2020-05-17 01:29:31	39.083	54.416	993.219
1	2020-05-17 01:30:49	39.250	54.031	993.212
1	2020-05-17 01:30:54	39.139	54.132	993.215
1	2020-05-17 01:30:59	39.213	54.562	993.181
1	2020-05-17 01:31:05	39.083	54.548	993.192
1	2020-05-17 01:31:10	39.102	54.092	993.213
1	2020-05-17 01:31:24	39.194	54.255	993.194
1	2020-05-17 01:31:25	39.102	54.390	993.198
1	2020-05-17 01:31:26	39.120	54.401	993.209
1	2020-05-17 01:31:28	39.157	54.373	993.213
1	2020-05-17 01:31:29	39.120	54.413	993.210
1	2020-05-17 01:31:30	39.009	54.390	993.187
1	2020-05-17 01:31:31	39.065	54.620	993.221
1	2020-05-17 01:32:34	39.269	53.902	993.221
1	2020-05-17 01:32:35	39.213	54.043	993.226
1	2020-05-17 01:32:37	39.139	53.914	993.185
1	2020-05-17 01:32:38	39.213	54.000	993.196
1	2020-05-17 01:32:40	39.269	54.109	993.178
1	2020-05-17 01:32:41	39.417	54.172	993.200
1	2020-05-17 01:32:42	39.213	54.135	993.182