



The poster features a background image of a lit lightbulb with a glowing filament, set against a dark blue background with faint circuit board patterns. In the top left corner is the University of Washington Tacoma logo, which consists of a large purple 'W' above the word 'TACOMA' in purple. A dark blue rectangular box in the center contains the text 'RASPBERRY PI HACKATHON' in large white capital letters, followed by '2ND WORKSHOP' and '2019.5.13' in smaller white capital letters. In the bottom right corner, the text 'Funded by STFC' is displayed, with 'STFC' in yellow. In the bottom left corner, the text 'TECHNOLOGY LENDING PLATFORM PROJECT - UNIVERSITY OF WASHINGTON TACOMA' is written in small yellow capital letters.

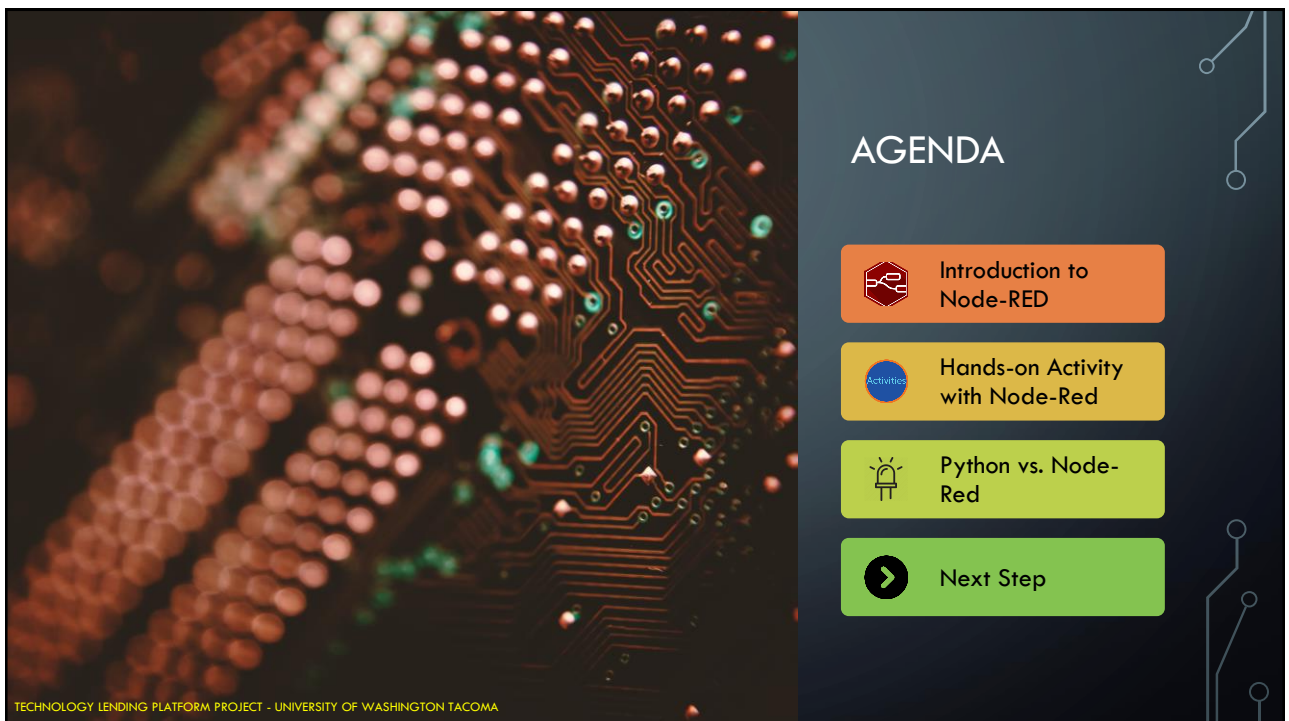
W
TACOMA

RASPBERRY PI HACKATHON

2ND WORKSHOP
2019.5.13





Funded by
STFC

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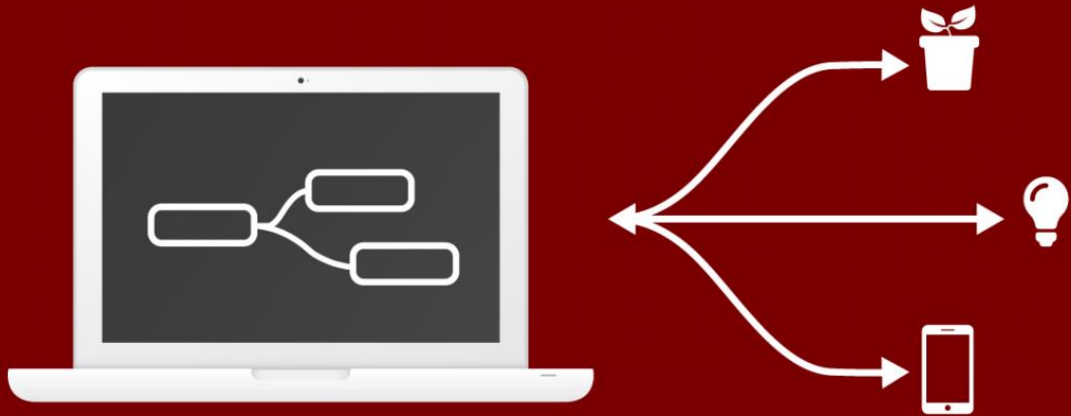
The slide has a dark background with a close-up, bokeh-style image of a circuit board on the left side. On the right side, the word 'AGENDA' is written in white capital letters. Below it are four colored rectangular buttons, each containing an icon and text. The first button is orange and contains a Node-RED icon and the text 'Introduction to Node-RED'. The second button is yellow and contains a blue circle icon with the word 'Activities' and the text 'Hands-on Activity with Node-Red'. The third button is light green and contains a lightbulb icon and the text 'Python vs. Node-Red'. The fourth button is green and contains a black circle with a white right-pointing arrow and the text 'Next Step'. In the bottom left corner, the text 'TECHNOLOGY LENDING PLATFORM PROJECT - UNIVERSITY OF WASHINGTON TACOMA' is written in small yellow capital letters. Faint circuit board patterns are visible on the right side of the slide.

AGENDA

-  Introduction to Node-RED
-  Hands-on Activity with Node-Red
-  Python vs. Node-Red
-  Next Step

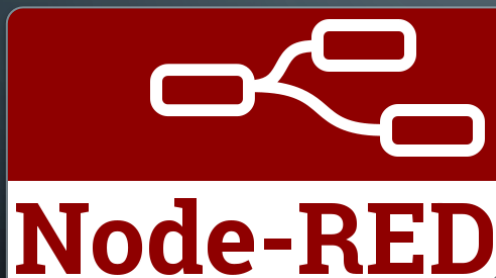
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Intro to Node-RED



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WHAT IS NODE-RED?



Node-RED is a flow-based development framework (originally developed by IBM) for visual programming with the Internet of Things (IoT). It built connections between sensors, APIs, and online services as part of the IoT.

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WHAT IS FLOW-BASED PROGRAMMING (FBP)?

Flow-based programming (FBP) is a programming model that defines applications using the metaphor of a "data factory" or black boxes.

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GETTING TO KNOW NODE-RED

- An open source visual editor
- The internet of things connection

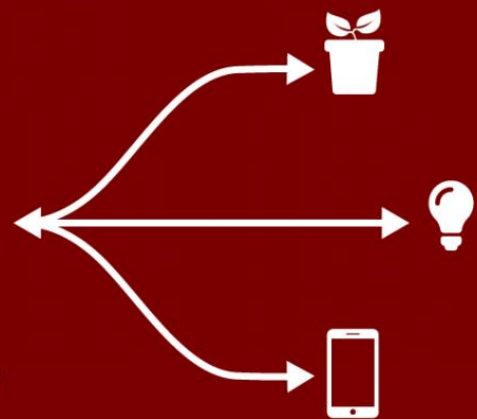
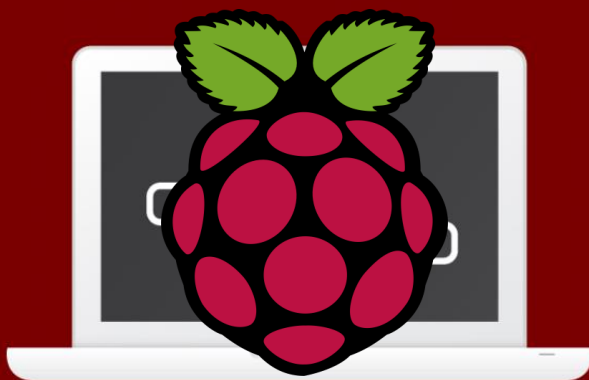
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HANDS-ON ACTIVITY

- Objective: complete an application using flow-based programming

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Install / Upgrade Node-RED on RPi



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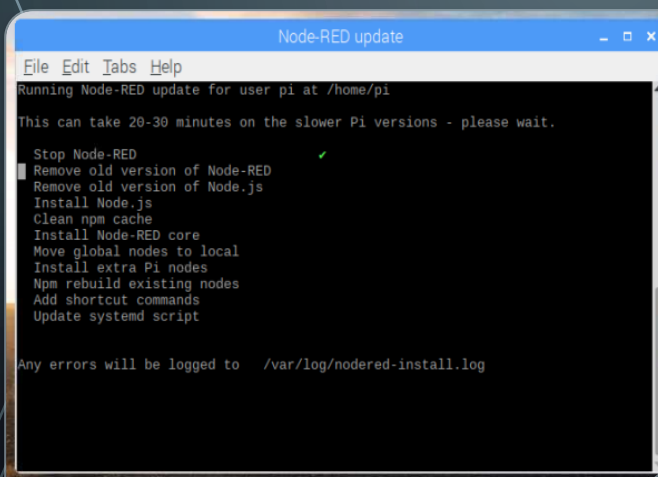
INSTALL / UPGRADE NODE-RED ON RPI

Step 1. First, Raspbian comes with Node-RED preinstalled. Now we will install/upgrade it. Open the terminal window and enter the following command.

```
bash <(curl -sL https://raw.githubusercontent.com/node-red/raspbian-deb-package/master/resources/update-nodejs-and-nodered)
```

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INSTALL / UPGRADE NODE-RED ON RPI



```
Node-RED update
File Edit Tabs Help
Running Node-RED update for user pi at /home/pi
This can take 20-30 minutes on the slower Pi versions - please wait.
Stop Node-RED
Remove old version of Node-RED
Remove old version of Node.js
Install Node.js
Clean npm cache
Install Node-RED core
Move global nodes to local
Install extra Pi nodes
Npm rebuild existing nodes
Add shortcut commands
Update systemd script
Any errors will be logged to /var/log/nodered-install.log
```

Step 2. After entering the above command, the following status will show on the terminal:

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INSTALL / UPGRADE NODE-RED ON RPI

Step 3. The installation might take a while. Wait until it completes. Once completed, it will display the message "All done."

```
Any errors will be logged to /var/log/nodered-install.log

All done.
You can now start Node-RED with the command node-red-start
or using the icon under Menu / Programming / Node-RED
Then point your browser to localhost:1880 or http://{your_pi_ip-address}:1880

Started Fri May 10 13:25:26 PDT 2019 - Finished Fri May 10 13:30:46 PDT 2019
```

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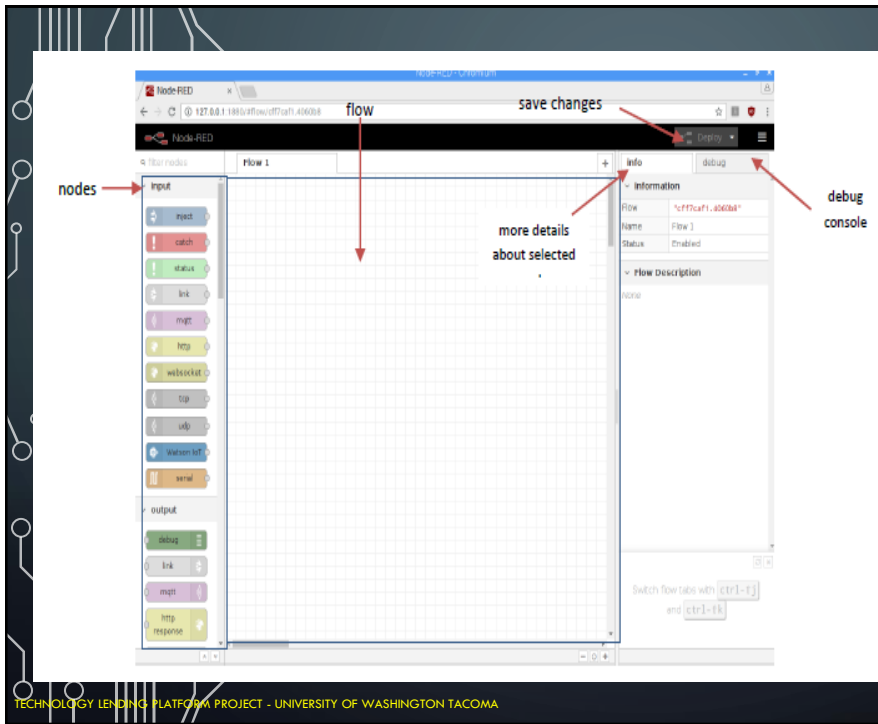
INSTALL / UPGRADE NODE-RED ON RPI

Step 6. Congrats! Node-red is installed/updated. Now we can open it from Start menu -> Programming.

To access Node-RED via the browser, in the Terminal window, the program will provide the address where it can be accessed. Default is **http://127.0.0.1:1880**

```
your credentials.
You should set your own key using the 'credentialSecret' option in
your settings file. Node-RED will then re-encrypt your credentials
file using your chosen key the next time you deploy a change.
-----
10 May 13:44:30 - [info] Server now running at http://127.0.0.1:1880/
10 May 13:44:30 - [info] Starting flows
10 May 13:44:30 - [info] Started flows
```

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INSTALL / UPGRADE NODE-RED ON RPI

Step 7. Open the browser and enter the address to launch Node-RED dashboard.

1. Node
2. Flow
3. Debug console
4. Info
5. Palette
6. Workspace
7. Sidebar

INSTALL / UPGRADE NODE-RED ON RPI

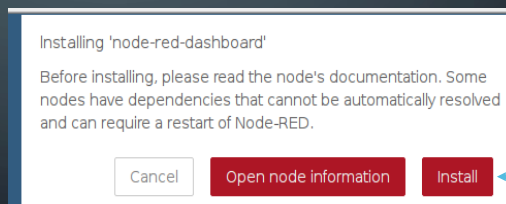
Step 8. From the top menu, expand the menu by clicking . Then select "Manage Palette".

INSTALL / UPGRADE NODE-RED ON RPI

Step 9. Click on the “**Install**” tab and then enter the following keyword in the search area “dashboard”.

Select the one titled “node-red-dashboard” and click install (to the right). A pop-up window will appear titled “Installing ‘node-red-dashboard’”.

Click install.



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INSTALL / UPGRADE NODE-RED ON RPI

Step 10. Once installed, it will list the nodes that have been added into Node-RED. The Dashboard enables you to create HTML objects easily on a webpage as well as dashboard elements such as gauge, slider, picker, etc.

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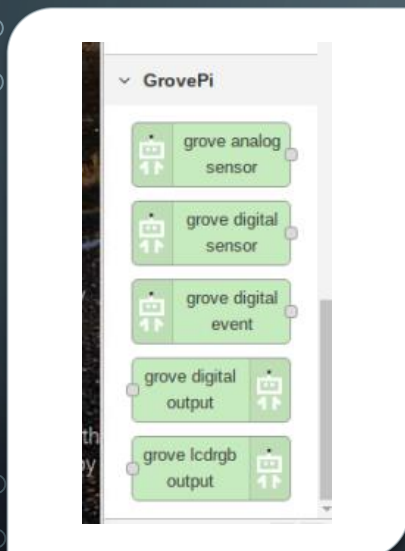
INSTALL / UPGRADE NODE-RED ON RPI

- Step 11. Again, open the **Manage Palette** window and enter the following keyword in the search area **“node-red-contrib-grovepi(v 0.1.8)”**. Click on **“install”** and select **“install”** from the pop-up window. Give it a while to install.

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INSTALL / UPGRADE NODE-RED ON RPI

- Step 12. Close Manage Palette. Check the palette section on the left, scroll down, you should see a section titled **GrovePi** and as shown:



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Congrats! GrovePi module is installed in Node-Red and we are ready for the demos.

Demo 1: Controlling Lights via the Web

<https://www.youtube.com/watch?v=0XsqSTbCKa4>

Demo 2: Building an IoT Dashboard using Node-RED

<https://www.youtube.com/watch?v=TrCcdTFT51E>

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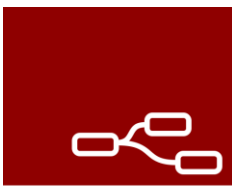
DATABASE WITH SQLITE

- CREATE
- SELECT
- UPDATE
- DELETE

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Python Demo

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Node-RED



SQLITE AND NODE-RED

- how to install SQLite on a Raspberry Pi,
- install an SQLite packaged for Node-RED and learn
- how to write simple SQL queries to interact with your SQLite database using Node-RED.

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PART A: INSTALL SQLITE

- Step 1. First, we need to install the SQLite onto the Raspberry Pi. Open the terminal and run the following command. Type “Y” if anything prompts.

`sudo apt-get install sqlite3`

```
pi@raspberrypi:~ $ sudo apt-get install sqlite3
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following packages were automatically installed and are no longer required:
  libc-ares2 libhttp-parser2.8 libuv1 nodejs-doc realpath vlc-plugin-notify vlc-plug
  vlc-plugin-video-splitter vlc-plugin-visualization
Use 'sudo apt autoremove' to remove them.
Suggested packages:
  sqlite3-doc
The following NEW packages will be installed:
  sqlite3
0 upgraded, 1 newly installed, 0 to remove and 75 not upgraded.
Need to get 709 kB of archives.
After this operation, 1,991 kB of additional disk space will be used.
Get:1 http://mirror.web-ster.com/raspbian/raspbian stretch/main armhf sqlite3 armhf
Fetched 709 kB in 0s (747 kB/s)
Selecting previously unselected package sqlite3.
(Reading database ... 155885 files and directories currently installed.)
Preparing to unpack .../sqlite3_3.16.2-5+deb9u1_armhf.deb ...
Unpacking sqlite3 (3.16.2-5+deb9u1) ...
Setting up sqlite3 (3.16.2-5+deb9u1) ...
Processing triggers for man-db (2.7.6.1-2) ...
```

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INSTALL / UPGRADE NODE-RED ON RPI

- Step 2. After the installation is completed, the SQLite libraries are supplied with an SQLite shell. Use this following command to launch the shell.

`sqlite3 sensordata.db`

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PART A: INSTALL SQLITE

Step 3. create a table.

a) use the following command to create a table:

```
sqlite> BEGIN;
```

```
sqlite> CREATE TABLE dhtreadings(id INTEGER PRIMARY KEY  
AUTOINCREMENT, temperature NUMERIC, humidity NUMERIC,  
currentdate DATE, currenttime TIME, device TEXT);
```

```
sqlite> COMMIT;
```

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PART A: INSTALL SQLITE

b) Type the following command to see all the tables:

```
sqlite> .tables
```

```
dhtreadings
```

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PART A: INSTALL SQLITE

c) It will return the newly created table named 'dhtreadings'. You can see the full schema of the tables when you type the following commands:

```
sqlite> .fullschema
```

```
CREATE TABLE dhtreadings(id INTEGER PRIMARY KEY  
AUTOINCREMENT, temperature NUMERIC, humidity NUMERIC,  
currentdate DATE, currenttime TIME, device TEXT);
```

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PART A: INSTALL SQLITE

Step 4. To insert new temperature and humidity readings in the database, we can do something like this:

```
sqlite> BEGIN;
```

```
sqlite> INSERT INTO dhtreadings(temperature, humidity,  
currentdate, currenttime, device) values(22.4, 48,  
date('now'), time('now'), "manual");
```

```
sqlite> COMMIT;
```

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PART A: INSTALL SQLITE

Step 5. To access the data stored in the database, we use the SELECT SQL statement:

```
sqlite> SELECT * FROM dhtreadings;  
1|22.4|48|2017-01-26|23:43:13>manual
```

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PART B: INSTALLING NODE-RED SQLITE

Step 1 <Install Node-RED SQLite>:

Install node-red-node-sqlite in your Node-RED user directory. These packages give us the basic access to an SQLite database.

```
pi@raspberrypi:~ $ cd ~/.node-red  
pi@raspberrypi:~/.node-red $ npm install node-red-node-sqlite
```

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PART B: INSTALLING NODE-RED SQLITE

b) Restart your Node-RED software with the next commands for the changes to take effect:

```
pi@raspberrypi:~/.node-red $ cd
```

```
pi@raspberrypi:~ $ node-red-stop
```

```
pi@raspberrypi:~ $ node-red-start
```

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PART B: INSTALLING NODE-RED SQLITE

Step 2 < Checking the installation>:

When your Node-RED software is back on, you can open it entering the RPI IP address in a web browser followed by :1880 as follows:

http://YOUR_RPi_IP_ADDRESS:1880

A new node called sqlite should appear on the left under the storage tab:



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PART B: INSTALLING NODE-RED SQLITE

- **Step 3 < Creating the flow>**: In this flow, you're going to send 2 SQL queries (INSERT, and SELECT) to your SQLite database. Follow these next 10 steps to create your flow:

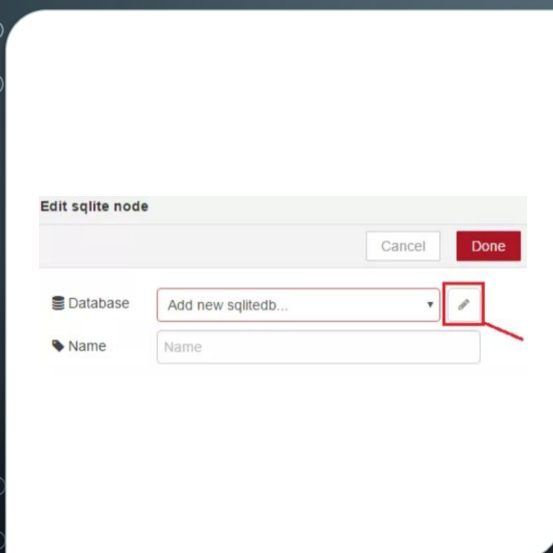
a) Drag 2 **inject** nodes, 1 **sqlite** node and 1 **debug** node



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PART B: INSTALLING NODE-RED SQLITE

b) Press the **Add new sqllitedb** button



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The screenshot shows the 'Properties' panel for a Node-RED node. The 'Name' field is set to 'SQLite'. The 'Database' field is a dropdown menu showing '/home/pi/sensordata.db'. The 'SQL Query' field is a dropdown menu showing 'Via msg.topic'.

PART B: INSTALLING NODE-RED SQLITE

c)
Type **/home/pi/sensordata.db** in
the **Database** field

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The screenshot shows the 'Edit inject node' dialog. The 'Payload' dropdown is set to 'timestamp'. The 'Topic' field contains the SQL query: 'INSERT INTO dhtreadings(temperature, humidity, currentdate, currenttime, device) values(22.4, 48, date('now'), time('now'), "Node-RED")'. The 'Repeat' dropdown is set to 'none'. The 'Name' field is set to 'INSERT'. A note at the bottom states: 'Note: "interval between times" and "at a specific time" will use cron. See info box for details.'

PART B: INSTALLING NODE-RED SQLITE

d) Configure your INSERT inject node:

```
INSERT INTO
dhtreadings(temperature,
humidity, currentdate,
currenttime, device)
values(22.4, 48,
date('now'), time('now'),
"Node-RED")
```

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Edit inject node

Cancel

Done

Payload

timestamp

Topic

SELECT * FROM dhtreadings

Repeat

none

☐ Inject once at start?

Name

SELECT

Note: "interval between times" and "at a specific time" will use cron.
See info box for details.

PART B: INSTALLING
NODE-RED SQLITE

e) Configure
your **SELECT** inject node with:

SELECT * FROM
dhtreadings

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PART B: INSTALLING NODE-RED SQLITE

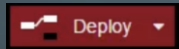
f) Connect all your nodes



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PART B: INSTALLING NODE-RED SQLITE

g) To save your application, you need to click the deploy button on the top right corner



Now, your application is saved and ready.

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What's next?

1. Basic with Azure
2. Real-time Streaming Data
3. Data Visualization

