Lab 3 - Delicious Raspberry Pi

CC3501

Overview

This week, you will set up your Raspberry Pi (Figure 1). Your goal is to compile and run an example application.

Figure 1: A Raspberry Pi with connected HDMI, Ethernet, and a serial console connected to the GPIO pins.

Equipment

You will receive the following equipment, which is loaned to you for the semester.

- Raspberry Pi Model 3 B+ or later version.
- Micro-SD card.
- USB micro power supply.
- Camera module, which we will use in a future lab. Please keep it safe because the ribbon cable is fragile.
- Optional, if using the serial console: PicoProbe board (custom hardware made at JCU).

There are also some SD card readers, which we will use to install a new image onto the micro-SD card. These are communal equipment and will be kept in the workshop.

Installing Linux on your Raspberry Pi

The Pi stores its operating system on the SD card. Please follow the vendor's instructions to install the software.

`https://www.raspberrypi.com/software/`

The official software can preconfigure certain settings. Choose the following settings:

- Enable SSH (secure shell), which is a protocol that you will use to log in over the network.
- Set a username and password. We recommend username "pi" and your choice of password. This device will be a computer on the JCU network that supports remote login, so you should choose a secure password.

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- Configure a wireless network. You have various options:
  - Preferred, a network that runs on the official wifi infrastructure: SSID JCUWifi with password elabspwd123!
  - Alterative, a network based on access points placed in each lab: SSID elequent with password elequent137
- When configuring wifi, select "AU" (Australia) as the country. This setting chooses which channels are legally available for use.
- Note that you can change or modify the wifi settings later, either through the graphical interface or by running the "raspi-config" command at the terminal.
- Choose the correct timezone.

A summary of the settings is shown in Figure 2.

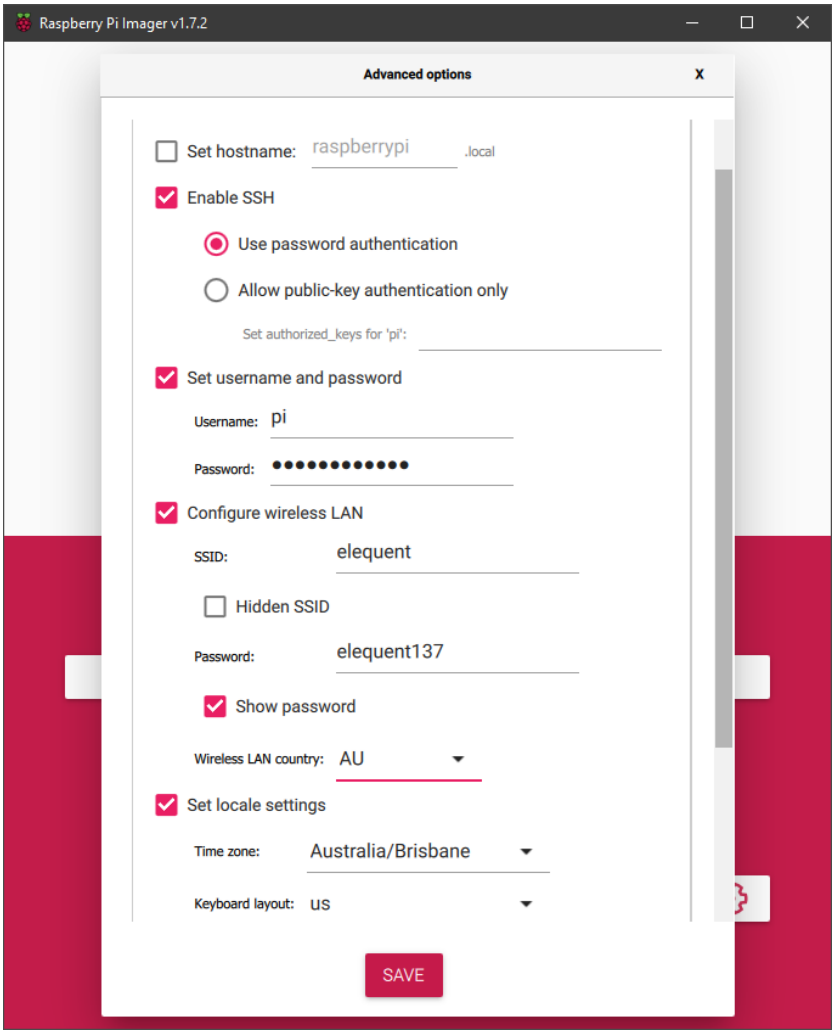

Figure 2: Configuration settings for the Raspberry Pi OS

Allow the imager software to copy the operating system installation onto the SD card.

Initial login

To log into your Pi over a network, you will need to know its IP address. The easiest way to find the address is to log in locally. Choose **one** of the following options:

1. Use a serial port to access the Linux command line from your computer; or
2. Connect the Pi to a HDMI monitor and use a mouse and keyboard to log in graphically.

more based

probably easier

Option 1 may be easier in Townsville because room 14-209 lacks TV monitors on the benchtops. Cairns students have easy access to TV monitors in room D4-007, so may prefer option 2.

Once you know the IP address, these options will be available to you:

3. Network login over SSH (for command line access).
4. Network login over VNC (for graphical access); only available after you have turned it on.

Login method 1: Serial port

You may skip this step if you intend to use a HDMI monitor, keyboard and mouse.

It is possible to log into the Pi using a UART (serial port). This option needs to be enabled. Follow these steps.

1. Plug your previously imaged SD card into your computer, and open the drive that appears.

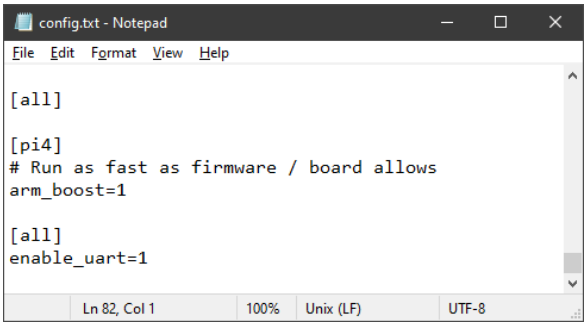

Figure 3: Add the line at the bottom.

2. Find the file called "config.txt" and add a line at the bottom, as shown in Figure 3.

```
enable_uart=1
```

The Raspberry Pi's UART pinout is shown in Figure 4. Use a PicoProbe (borrowed from the workshop; keep it in your kit because you'll use it again later in the subject). The PicoProbe acts as a UART to USB bridge. Connect it as follows.

Raspberry Pi Pin	PicoProbe (Rev. 1)	PicoProbe (Rev. 2)
GND	GND	GND
UART TX	Target TX	Our RX & Target TX
UART RX	Target RX	Our TX & Target RX

There are two revisions of PicoProbe, labelled on the silk-screen underneath the JCU logo on the back side of the board. Revision 2 has more descriptive labels for the UART pins.

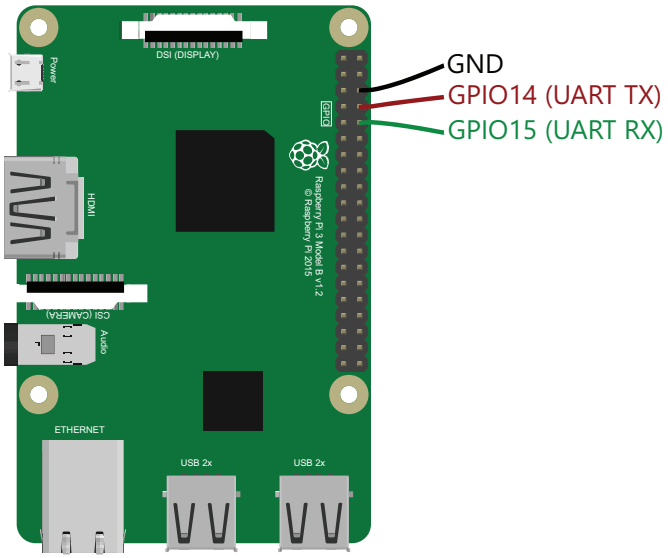

Figure 4: The UART pinout on the Raspberry Pi 3.

Using Putty on your computer, you can connect to the Raspberry Pi's serial console (Figure 5). The Raspberry Pi's UART operates at 115200 baud. Press Enter once you connect to ask the Pi to reprint the login prompt.

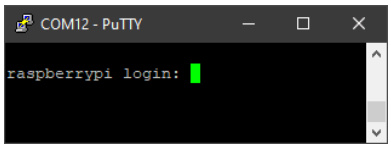

Figure 5: The login prompt as it appears over a serial console.

Login method 2: graphical log in

The Pi runs a graphical operating system, so you can use it like a computer. Connect the HDMI monitor before you power it on.

Once you are logged in, open the Terminal application to get to the command line. You may then proceed as below.

Determining the Pi's IP address

From the terminal (either the serial console or the graphical terminal app), run the command

```
ip addr
```

An example is shown in Figure 6.

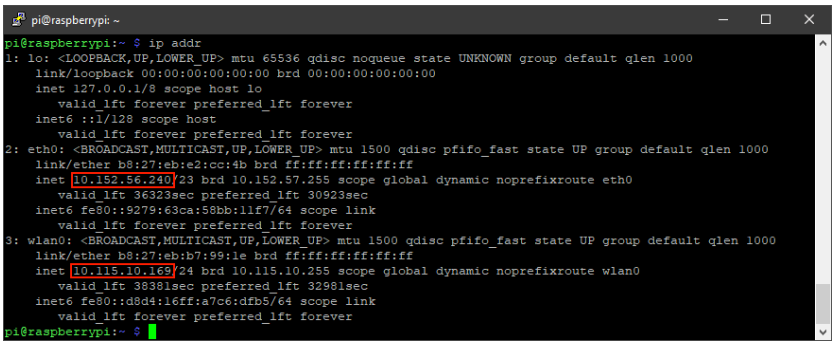

Figure 6: Example of running the "ip addr" command. In this case there are two IP addresses highlighted in red. The first relates to the "eth0" interface (Ethernet); the second the "wlan0" interface (wireless LAN, aka wifi).

If your Pi is not connected to the wifi, you can set the wifi network options by running

```
sudo raspi-config
```

and going into 1 System Options -> S1 Wireless LAN.

Login method 3: secure shell (SSH) log in

You can use Putty to log in over SSH. Choose SSH as the connection type and type the IP address into the box (Figure 7).

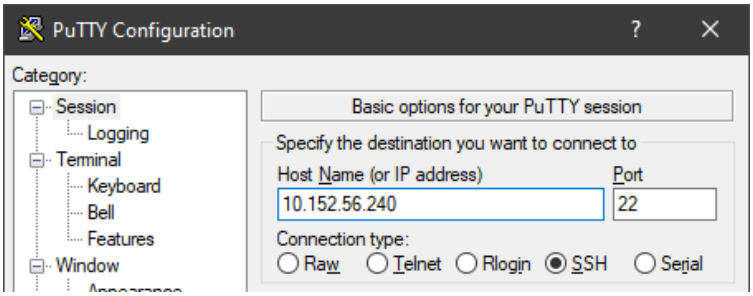

Figure 7: Example of logging in over SSH.

Login method 4: graphical log in over VNC → why???

Firstly, you need to turn on the VNC server because it is not enabled by default. Run the following command

```
sudo raspi-config
```

and follow the menu prompts to go into “Interface Options” then “VNC” (Figure 8).

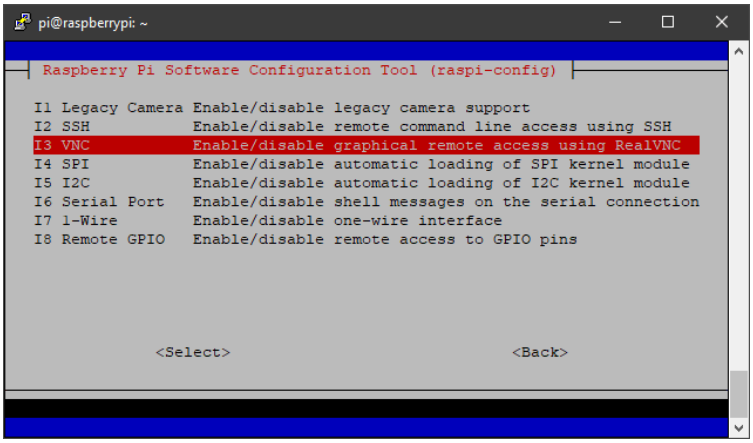

Figure 8: Use the raspi-config utility to enable the VNC server.

On your PC, download VNC Viewer from
https://www.realvnc.com/en/connect/download/viewer/
and install it.

Inside VNC Viewer, select that you want to continue without logging in, then type your Pi’s IP address in the box and press enter.

Update the software

Run the following commands to update the installed software:

```
sudo apt update
sudo apt upgrade
```

In these commands “update” means to fetch the latest catalogue of software but don’t actually change anything, and “upgrade” means install new versions of all installed software packages. You need to run “update” periodically before trying to install new software. However, the “upgrade” command will take several minutes to run, so you can skip it for now if you’re in a hurry.

Install necessary software for example application

The example application uses a library called “OpenCV” (open computer vision). It is not installed by default, so you’ll need to install it in order to compile the example application.

```
sudo apt install libopencv-dev
```

You’ll also need to install cmake (cross platform make).

```
sudo apt install cmake
```

Download source code for example app

The example application is published at Github:

https://github.com/bronsonp/opencv-starter-app

You can clone it to your Pi by running:

```
git clone https://github.com/bronsonp/opencv-starter-app.git
```

Hint: Right click on Putty will paste from the clipboard. login method 3

Build the application

Follow these steps:

1. Create a directory called "build" inside the "opencv-starter-app" directory. (Use the mkdir command.)
2. Change directory into build.
3. Generate the makefile using cmake:

   ```
   cmake ..
   ```

4. Compile the application using make:

   ```
   make
   ```

An example of this is shown in Figure 9.

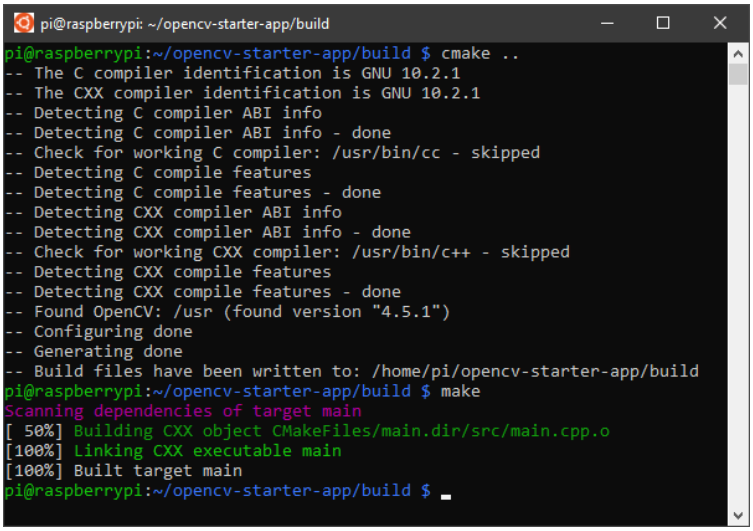

Figure 9: Compiling the example code.

Run the application

This is a graphical application, so you need to run it from the native HDMI output or the VNC server. Change into the build directory and run the main application (Figure 10).

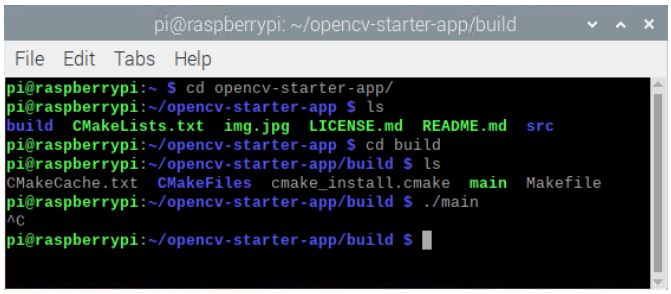

Figure 10: Running the application (from the graphical desktop of the Pi).

Press Control+C in the terminal window to quit the running application.

Extension exercise

Replace the image with a different one and experiment with the colour selector.

You can upload new files to the Pi's filesystem using a program called WinSCP. It uses the SSH protocol to copy files back and forward.

Assessment

There is no assessment this week. In future labs, you will be required to demonstrate achievement of the lab task to receive a mark.