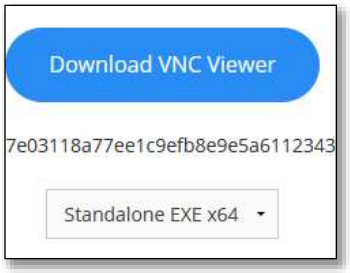
Raspberry Pi Bookworm Getting Started

Contents

Raspberry Pi Install

1. Use Raspberry Pi Imager to Create a MicroSD card image.
    a. Choose OS: Raspberry Pi OS Bookworm 64-bit
    b. Choose Storage: MicroSD adapter
    c. Click the Gear at the bottom right
    d. Set hostname
    e. Enable SSH → Use password authentication
    f. Set username and password: pi Password01
    g. Configure wireless LAN
    h. Set local settings
    i. Write file to MicroSD card
2. Insert MicroSD card → turn on Pi.
3. Use an IP scanner to find the IP address.
4. Go to https://www.chiark.greenend.org.uk/~sgtatham/putty/latest.html
5. Download the **PuTTY** client.
6. Start the **PuTTY** client. Type in the **IP address** of the Pi → Click **Open**.
7. **Accept** the **PuTTY Security Alert**.
8. Login as: **pi** Password: **Password01**
9. Type: **sudo raspi-config**
    a. **Interface Options → VNC** → Select **Yes.**
    b. **Interface Options -> I2C →** Select **Yes.**
10. Select **Finish** to exit

RealVNC Viewer



RealVNC viewer allows us to remotely control the Pi in headless mode over the network. Headless mode is when there isn't a keyboard, video, or mouse.

1. Go to https://www.realvnc.com/en/connect/download/viewer/
2. Download the VNC Viewer Standalone EXE
3. This is a self executing program, it does not need an installation
4. Double Click the downloaded file.
5. Type in the IP address of your robot → Click **Connect**.

If RealVNC doesn't work, try TigerVNC.

TigerVNC Viewer

1. https://sourceforge.net/projects/tigervnc/
2. Download the latest **vncviewer64.exe** file.
3. This is a self executing program, it does not need an installation
4. Double Click the downloaded **VNC Viewer**.
5. Type in the IP address of your robot → Click **Connect**.

Multiple SSID's

GUI

1. On the taskbar → Click the Network Connection icon.
2. **Advanced Options → Edit Connections**
3. Add or Edit a connection.

CLI

You can also use the command line **nmtui** for text based editing of the network connection.

1. sudo nmtui
2. Edit a connection

3. Add
4. Wi-Fi
5. Add your Wi-Fi SSID information.
6. Ok
7. Press Esc to exit.

Turn Off Wi-Fi Power Saving

If your Pi experiences Wi-Fi connection issues, turn off the power saving.

nmcli is a command line tool for managing network connections.

```
# Show the connection name
sudo nmcli connection show
# Change connection name
# The Raspberry Pi Imager names the wlan0 connection preconfigured
sudo nmcli conn modify <connection-name> connection.id <new-connection-name>
# Turn off power saving
sudo nmcli con modify <connection-name> 802-11-wireless.powersave 2
# Show all options
sudo nmcli con show <connection-name>
# Set WPA2 key
sudo nmcli conn modify <connection-name> wifi-sec.psk new_password
# Start wireless connection, ask for WPA key
sudo nmcli --ask con up <connection-name>
# Connect to different wlan card
sudo nmcli d wifi connect <ssid_here> ifname wlan1
```

Disable Onboard Wi-Fi

The internal Pi antenna works just fine. For better signal strength and range you may want to use an external USB Wi-Fi antenna.

To use an external Wi-Fi antenna only, disable the internal Wi-Fi.

1. Reconnect using SSH.

```
# Edit this file with nano
sudo nano /boot/firmware/config.txt
# Add this line to the end of the file and save it
dtoverlay=disable-wifi
```

2. Restart the Pi.

```
sudo reboot
```

NOTE: After you have disabled the on-board Wi-Fi, you must always plug a Wi-Fi adapter into a USB port.

Disable Cellular Modem (e.g., 4G/LTE):

The ModemManager service is not needed unless you are using cellular data.

```
sudo systemctl disable ModemManager.service
sudo systemctl stop ModemManager.service
sudo apt remove --purge modemmanager
```

Update Raspberry Pi OS

At a terminal:

```
# Update the apt package list
sudo apt update
# Upgrade all packages -y no prompt
sudo apt upgrade -y
# Remove any packages that are not needed
sudo apt autoremove
```

Configure Raspberry Pi OS (Optional)

1. Right Click Desktop → **Desktop Preferences** → **Layout**: No image
    a. Colour: Choose a colour you like.
2. **Change Clock Display:** Right Click Clock, Configure Plugin
    a. Clock Format: **%I:%M %p**
3. **Add Temperature Monitor:** Right Click Task Bar → Add/Remove Plugins.
    a. **Add** → **CPU Temp** → **Add to right**.

Email IP on Boot

1. Create a Code folder → **home/pi/Code**
2. Copy **startup_mailer.py** to this folder

3. Open a terminal.
4. Type in the following to make the script executable.

```
chmod +x /home/pi/Code/startup_mailer.py
```

5. There should not be any errors if the command was successful.
6. Test the script with the following command.

```
python3 /home/pi/Code/startup_mailer.py
```

7. In a few moments, you should receive an email with your Raspberry Pi IP address.

Run startup_mailer.py Script on Startup

1. At the terminal, type in the following command to access the Raspbian scheduler. (Don't add sudo)

```
crontab -e
```

2. Press **Enter** to edit the file with nano.
3. Cursor to the bottom of the file. (The mouse will not work.)
4. Enter the following information. (**sleep 15** waits 15 seconds after startup to run the script.)

```
@reboot sleep 15 && python3 /home/pi/Code/startup_mailer.py
```

5. Type **CTRL+S** to Save the file.
6. Press **CTRL+X** to Exit nano.
7. Type **sudo reboot**
8. You should receive an email with your IP address.

Wi-Fi Signal Strength

The **iwconfig** command will give you a snapshot of Wi-Fi quality.

wavemon will monitor Wi-Fi signal strength in real time.

```
sudo apt update
# Install wavemon
sudo apt install wavemon
# Run wavemon
wavemon
# Quit wavemon
q
```

Show all AP's in the area

```
# Show all AP's in the area.
sudo iwlist wlan0 scan | egrep "Cell|ESSID|Signal|Rates"
```

Link Quality

A network can have very good signal strength without good link quality.

This is how much of the data you send and receive will make it to the destination in good condition.

The quality indicator includes data like Bit Error Rate (BER), i.e., the number of bit errors in received bits that have been altered due to noise, interference, distortion, or bit synchronization errors. Others are Signal-to-Noise and Distortion Ratio (SINAD).

It is measured in percentage or on a scale of up to 70. You will see a value like "60/70".

Unlike signal strength, it is somewhat harder to say which values are still considered to be satisfactory.

If the value is low and your signal strength is high, you may have interference from, e.g., kitchen appliances or other electronic devices. Moving them further away may improve the link quality.

Signal Strength

The higher the signal strength, the more reliable the connection and higher speeds are possible. The signal strength is specified as -dBm (decibels related to one milliwatt).

Values between 0 and -100 are possible, with more being better. -51 dBm is a better signal strength than -60 dBm.

The value 0 is not realistic. Even -30 dBm is hard to reach, and you must stand almost directly next to the access point.

Some guidance on how to read the results:

- -50 dBm is considered an excellent signal strength.

- -67 dBm is said to be the minimum signal strength for reliable and relatively fast packet delivery.
- -70 dBm is the minimum signal strength for reliable packet delivery.
- -80 dBm is the minimum value for a basic connection. However, packet delivery is no longer necessarily reliable.
- -90 dBm is already very close to the basic noise. Here a connection probably does not work anymore.

Frequency

Another interesting indicator is the Wi-Fi frequency.

This shows if your Raspberry Pi connects to the slower and longer range 2.4 GHz network, or the faster but shorter range 5 GHz version.

Speedtest

Install speedtest-cli from Speedtest.net

```
sudo apt update
sudo apt dist-upgrade -y
sudo apt install speedtest-cli

speedtest
```

Find Ports with ls dev/tty

Pi serial port is ttyAMA0

```
sudo ls /dev/tty*
```

This will list all of the terminal interfaces.

Find all serial ports

```
dmesg | grep tty
```

Cron Scheduled shutdown or restart

```
# Edit root crontab
sudo crontab -e
# Shutdown at 10:30 pm each day.
30 22 * * /usr/sbin/shutdown -h now
# Restart at midnight
0 0 * * * /usr/sbin/shutdown -r now
```

Pi 2 W Blinking LED Issue

These programs can optimize a Pi 2 W.

zram which compresses ram, at the cost of slightly more power use/CPU usage to decompress the data:

```
sudo apt update
sudo apt install zram-tools       # 12 kB package, zero config files
echo -e "ALGO=zstd\nPERCENT=60" | sudo tee /etc/default/zramswap
sudo systemctl restart zramswap   # creates a ~300 MiB compressed swap in RAM
```

The above will create a 300 MiB swap in ram.

earlyoom does exactly what you think it does, enable here:

```
sudo apt install earlyoom
sudo systemctl enable --now earlyoom
```

Turn WIFI power save off:

sudo iw dev wlan0 set power_save off

Login Menu

To implement a shell script menu that appears upon user login on a Raspberry Pi, the script needs to be executed automatically when a user successfully logs into the system. This can be achieved by placing the script's execution command in a file that is processed during the login sequence.

1. Create the Shell Script Menu:

First, create the shell script that will display your menu and perform desired actions. For example, create a file named login_menu.sh in your home directory (/home/pi/):

```
#!/bin/bash

function display_menu {
    clear
    echo "-----------------------------------"
    echo "  Raspberry Pi Login Menu"
    echo "-----------------------------------"
    echo "1. Run Program A"
    echo "2. Run Program B"
    echo "3. System Information"
    echo "4. Exit"
    echo "-----------------------------------"
    read -p "Enter your choice: " choice
}

while true; do
    display_menu
    case $choice in
        1)
            echo "Running Program A..."
            # Add commands for Program A here
            read -p "Press Enter to continue..."
            ;;
        2)
            echo "Running Program B..."
            # Add commands for Program B here
            read -p "Press Enter to continue..."
            ;;
        3)
            echo "Displaying System Information..."
            uname -a
            df -h
            read -p "Press Enter to continue..."
            ;;
        4)
            echo "Exiting menu. You can now use the terminal."
            break
            ;;
        *)
            echo "Invalid choice. Please try again."
            read -p "Press Enter to continue..."
            ;;
    esac
done
```

Make the script executable:

```
chmod +x /home/pi/login_menu.sh
```

2. Configure Automatic Execution on Login:

The most common and straightforward method to execute a script upon login for a specific user is to add a call to it in the user's .bashrc file. This file is executed every time a new interactive shell is started.

Edit the **.bashrc** file in the user's home directory (e.g., /home/pi/.bashrc):

```
nano /home/pi/.bashrc
```

Add the following line at the very end of the file:

```
/home/pi/login_menu.sh
```

3. Test the Setup:

Reboot your Raspberry Pi or log out and log back in to test the menu. Upon successful login, the shell script menu should automatically appear, allowing the user to interact with the defined options.

Hardware Information

```
# The top command will show memory, cpu, processes, etc
top
# This one has colors and is prettier
htop
# Quit
q
```

```
cat /proc/cpuinfo
# Display the current CPU temperature
vcgencmd measure_temp
```

```
# Displays detailed information about the hardware
sudo apt update
sudo apt install lshw
sudo lshw
sudo lshw -short
```

Disable Bluetooth

Stop the Bluetooth service using systemctl.

```
sudo systemctl disable bluetooth
sudo systemctl stop bluetooth
sudo systemctl disable hciuart
```

xscreensaver

The default Window manager in Bookworm, Wayland, does not have a good way to automatically display a screensaver or blank the screen.

Switch from Wayland to X11 display at a terminal.

```
sudo raspi-config
6 Advanced Options → A6 Wayland → W1 X11
```

Install xscreensaver.

```
# Install xscreensaver
sudo apt update
sudo apt install xscreensaver xscreensaver-data xscreensaver-gl xscreensaver-gl-extra
# Start the xscreensaver daemon
xscreensaver -nosplash &
# Configure xscreensaver with a GUI
screensaver-demo
```

WiFi Enable

On a fresh install, you must specify the country where you use your device. This allows your device to choose the correct frequency bands for 5GHz networking. Once you have specified a wireless LAN country, you can use your Raspberry Pi's built-in wireless networking module.

To do this, set your wireless LAN country with the command line raspi-config tool. Run the following command:

sudo raspi-config

Select the **Localisation options** menu item using the arrow keys. Choose the **WLAN country** option. Pick your country from the dropdown using the arrow keys. Press Enter to select your country.

You should now have access to wireless networking. Run the following command to check if your Wi-Fi radio is enabled:

nmcli radio wifi

If this command returns the text "enabled", you're ready to configure a connection. If this command returns "disabled", try enabling Wi-Fi with the following command:

nmcli radio wifi on

Find networks

To scan for wireless networks, run the following command:

nmcli dev wifi list

Run the following command to configure a network connection, replacing the <example_ssid> placeholder with the name of the network you're trying to configure:

sudo nmcli --ask dev wifi connect <example_ssid>

Enter your network password when prompted.

Your Raspberry Pi should automatically connect to the network once you enter your password.

If you see error output that claims that "Secrets were required, but not provided", you entered an incorrect password. Run the above command again, carefully entering your password.

Enable snaps on Raspberry Pi and install btop

Snaps are applications packaged with all their dependencies to run on all popular Linux distributions from a single build. They update automatically and roll back gracefully.

Snaps are discoverable and installable from the Snap Store, an app store with an audience of millions.

On a Raspberry Pi running the latest version of Raspbian snap can be installed directly from the command line:

```
sudo apt update
sudo apt install snapd
```

You will also need to reboot your device:

```
sudo reboot
```

To install btop, simply use the following command:

```
sudo snap install btop
```

Filesystem Checks and Repair

The Linux filesystem can be damaged under various circumstances, e.g., system crash, power loss, disconnected disk, accidentally overwritten i-node, etc. Thus it is a good idea to check the integrity of the filesystem regularly to minimize the risk of filesystem corruption.

The Linux filesystem can be damaged under various circumstances, e.g., system crash, power loss, disconnected disk, accidentally overwritten i-node, etc. It is a good idea to check the integrity of the filesystem regularly to minimize the risk of filesystem corruption. Add the following to `/boot/cmdline.txt`:

```
fsck.mode=force
```

Make sure that file remains all one line. Parameters should be separated with spaces.

You'll probably notice `fsck.repair=yes` is already there; these are not the same thing. From `man systemd-fsck` (these are parameters that are passed on by the kernel to init, i.e., systemd):

fsck.mode=

One of "auto", "force", "skip". Controls the mode of operation. The default is "auto", and ensures that file system checks are done when the file system checker deems them necessary. "force" unconditionally results in full file system checks. "skip" skips any file system checks.

fsck.repair=

One of "preen", "yes", "no". Controls the mode of operation. The default is "preen", and will automatically repair problems that can be safely fixed. "yes " will answer yes to all questions by fsck and "no" will answer no to all questions.

To do a filesystem check on the next reboot, do the following

```
sudo touch /forcefsck
```

Once you create an empty file named `forcefsck` in the root directory, it will force filesystem check the next time you boot up. After successful booting, `/forcefsck` will automatically be removed.

An alternative is to shut down the system with the `-F` option like this:

```
sudo shutdown -r -F now
```

Static IP

We now need to plug this information into the Pi's network configuration file using a text editor. I always use nano text editor. . .

sudo nano /etc/network/interfaces

Simply change the line that reads:

iface eth0 inet dhcp to **iface eth0 inet static**

Then directly below this line enter the following (Please Note. **You will need your own addresses we gathered in Part B, more details below**). . . .

address 192.168.9.30
netmask 255.255.255.0
network 192.168.9.0
broadcast 192.168.9.255
gateway 192.168.9.1

CTRL X to save and exit

Turn Off HDMI

vcgencmd display_power 0 turns off the screen

vcgencmd display_power 1 turns on the screen

~~Bluetooth and Serial Port~~

~~vcgencmd measure_clock isp / v3d~~
~~vcgencmd measure_clock core~~

~~mini uart settings~~

```
~~# Set cpu core to 250 or 500~~
~~core_freq=250~~
~~# or~~
~~force_turbo=1~~
~~# Enable Bluetooth to use miniuart~~
~~dtoverlay=miniuart-bt~~
```

~~another~~

```
~~force_turbo=1~~
~~gpu_freq=250~~
~~gpu_freq_min=250~~
```