

# Setting up your Raspberry Pi Zero W (Wireless)

*Instructions below are*

- specific to the **Raspberry Pi Zero W** target board
- valid as of August 2022.

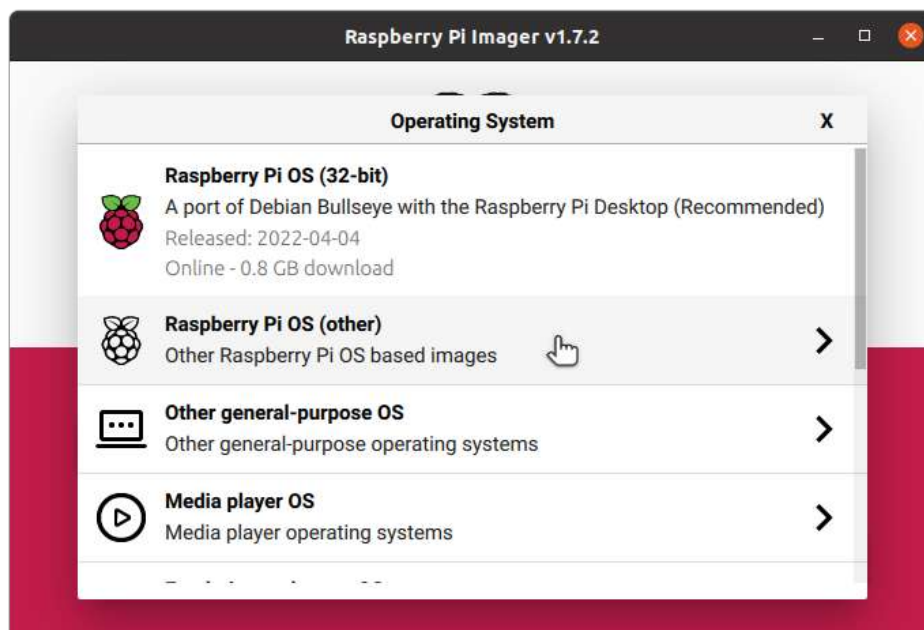


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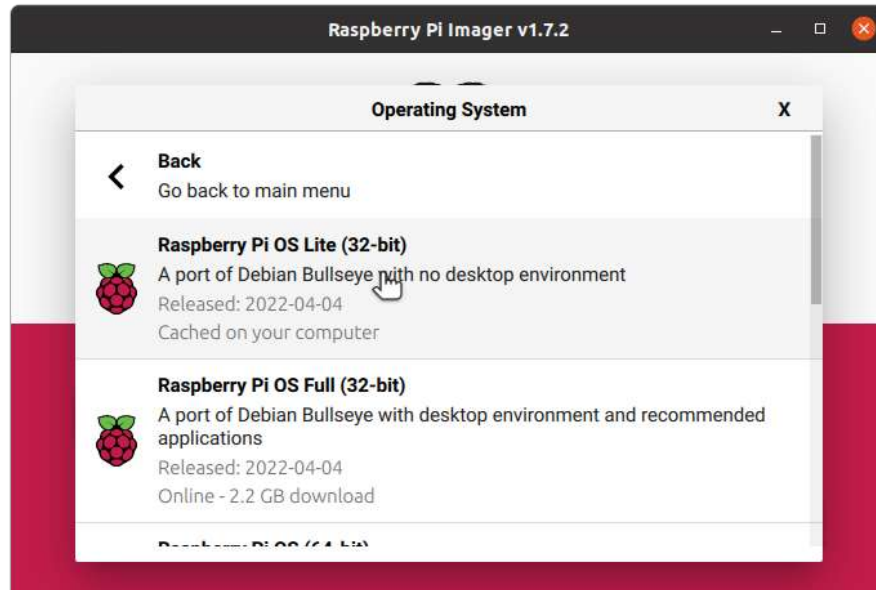
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# I Installing the Raspberry Pi OS on an SD card

1. Burn the microSD card with a recent and stable Raspberry Pi OS image; simultaneously have the Raspberry Pi *Imager* app setup the network, username, and so on...
  - i. Download the Raspberry Pi Imager app  
Navigate to <https://www.raspberrypi.com/software/> , download and install it on your host system (you can even install it onto a Linux guest (that supports graphics) and run it from there)
  - ii. Run it, thus installing a recent stable Raspberry Pi OS image onto your microSD card!
    - a) A 45 second video demonstrating how: <https://youtu.be/ntaXWS8Lk34> ; take a look!
  - iii. Select the OS:
    - a) click the 'CHOOSE OS' button
    - b) To optimize, and for the Raspberry Pi Zero (W) target, click on the second choice: Raspberry Pi OS (other) [below]



- c) then click on the first one:  
*Raspberry Pi OS Lite (32-bit)* – no desktop environment

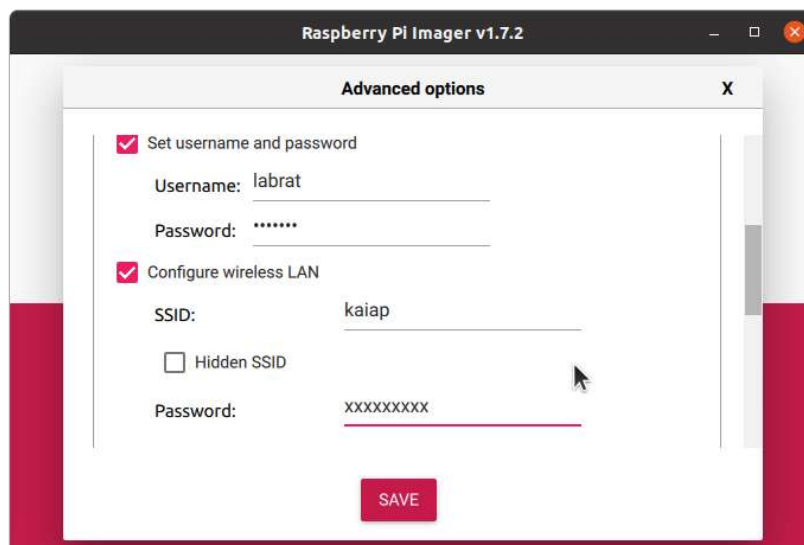


iv. Then select the microSD card via the STORAGE button

v. **NOTE: Very IMPORTANT -**

Next, before writing the image, DO make use of the Imager app's **Settings gearwheel** button! It's *very useful* to use the Imager app to pre-configure the R Pi OS – you can select:

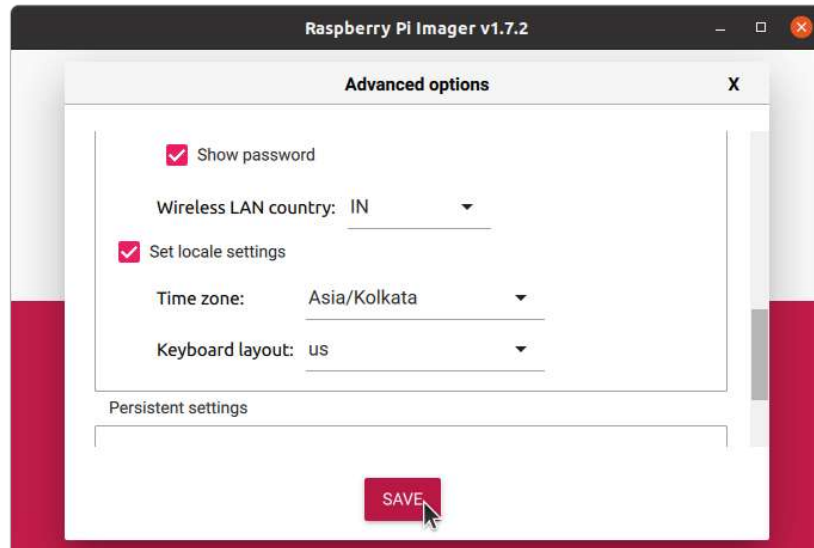
- a) the board hostname ('rpi0w\_<myname>' perhaps)
- b) do Enable SSH
  - i. to keep it simple, you can initially use password authentication, but, as you learn more, DO switch to authentication via SSH keys only – its far more secure!
- c) Security: be sure to choose a username other than the default one (pi); f.e., labrat ; supply a password
- d) **Very Important:** Configure the wireless LAN - the WiFi AP; specify the SSID and password. We're going to use the Raspberry Pi Zero W in 'headless' mode – no HDMI monitor and all that jazz! You'll need to configure the WiFi AP in order to login over SSH.



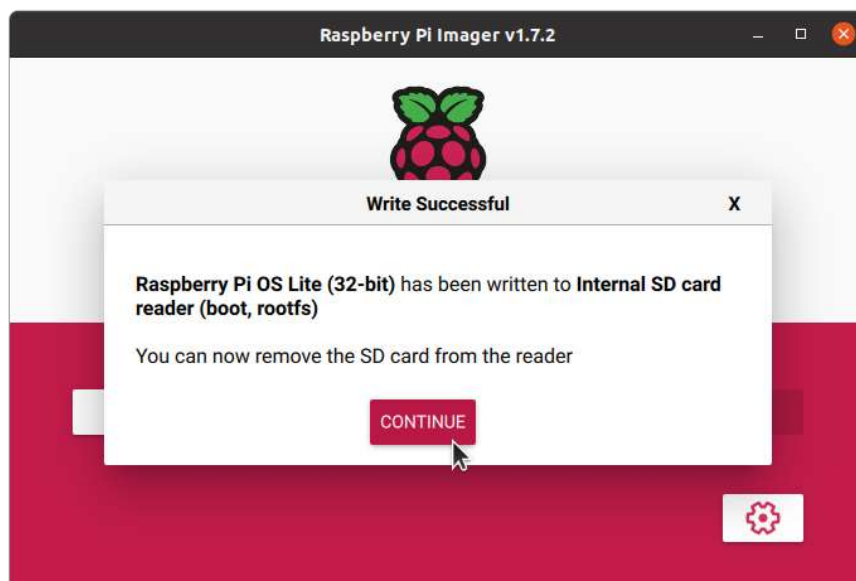
i. Don't forget to scroll down, set the:

1. Country for Wireless to India (IN)
2. Locale (Time zone as Asia/Kolkata, keyboard as 'us')

e) Click on the **SAVE** button when all set...



vi. Now click on the **WRITE** button; once you confirm, the image gets written and verified.



It can take a while, be patient... When done, eject the SD card, click on the **CONTINUE** button.

2. On a Linux (or MacOS) host (*or guest!*), I reinsert the SD card and do this to verify the OS image is written:

```

~ $ df -h | grep "^/dev/mmcblk"
/dev/mmcblk0p2 1.6G 1.2G 296M 81% /media/kaiwan/rootfs
/dev/mmcblk0p1 253M 50M 203M 20% /media/kaiwan/boot
~ $ ls /media/kaiwan/boot
bcm2708-rpi-b.dtb      bcm2710-rpi-3-b-plus.dtb  cmdline.txt      fixup.dat      overlays/
bcm2708-rpi-b-plus.dtb  bcm2710-rpi-cm3.dtb      config.txt      fixup_db.dat    start4cd.elf
bcm2708-rpi-b-rev1.dtb  bcm2710-rpi-zero-2.dtb  COPYING.linux  fixup_x.dat     start4db.elf
bcm2708-rpi-cm.dtb      bcm2710-rpi-zero-2-w.dtb  firstrun.sh    issue.txt      start4.elf
bcm2708-rpi-zero.dtb    bcm2711-rpi-400.dtb      fixup4cd.dat   kernel7.img    start4x.elf
bcm2708-rpi-zero-w.dtb  bcm2711-rpi-4-b.dtb      fixup4.dat     kernel7l.img   start_cd.elf
bcm2709-rpi-2-b.dtb     bcm2711-rpi-cm4.dtb      fixup4db.dat   kernel8.img    start_db.elf
bcm2710-rpi-2-b.dtb     bcm2711-rpi-cm4s.dtb     fixup4x.dat    kernel.img     start.elf
bcm2710-rpi-3-b.dtb     bootcode.bin             fixup_cd.dat   LICENCE.broadcom start_x.elf
~ $ ls /media/kaiwan/rootfs/
bin@ dev/ home/ lost+found/ mnt/ proc/ run/ srv/ tmp/ var/
boot/ etc/ lib@ media/      opt/ root/ sbin@ sys/ usr/
~ $ cat /media/kaiwan/rootfs/etc/issue
Raspbian GNU/Linux 11 \n \l
~ $
~ $ █

```

On a Windows host you can always lookup the SD card content with the File explorer app.

Don't forget to unmount (eject) the SD card before physically removing it from it's slot.

## II Login to the board over SSH

To login over SSH, we obviously **require the system's (DHCP-assigned) IP address**. We're assuming you've installed the Raspberry Pi OS and configured the wireless network – as the previous section described.

**IMP:** To enable SSH on the R Pi board:  
Create an empty file named `ssh` in the boot partition.

### Obtain the device's IP address

- Power off the Raspberry Pi board
- Insert the microSD card containing the installed Raspberry Pi OS into your board, and apply power
- It should boot up ... give it a minute or two and then proceed to the next step...
- Ensure you're *on the same local network* as the device (f.e. 192.168.1.x or 10.20.1.x). To find it's IP address:
  - On a Windows host, via a browser:
    - navigate to the router gateway (f.e. 192.168.1.1 or 10.20.1.1)
    - login if required
    - Lookup the DHCP client list in the web browser app; the Raspberry Pi should show up; look for the hostname you gave it when installing the image. Once located, note it's allocated IP address.



- On a Linux/Mac host:
  - Here too you can of course use a browser as in the previous paragraph (assuming you're on a Linux system running a graphical desktop)
  - Via the Linux CLI, there are several ways to figure the device's IP address; among them are:
    - Install the nmap and arp-scan utils:  
`sudo apt install nmap arp-scan -y`
    - `sudo arp-scan --localnet | egrep -i "Raspberry"`
    - `sudo nmap -sn -PR <domain-to-scan>/24` # domain f.e. 10.20.1.0
    - The 'nmap' way tends to be best; use my [localnet\\_discov.sh](#) helper script to make it easy!

An example of using it to discover the board's IP address:

```
~ $ localnet_discov.sh 10.20.1.0 | grep -i rpi0wlabrat
B8:27:EB: [redacted], rpi0wlabrat.wlan, 10.20.1.63
~ $
```

You can see the board hostname (highlighted in red colour) clearly.

#### *Advanced: how to setup the Wireless network on the CLI*

Just in case the Raspberry Pi Imager app does not succeed in setting up the wireless network...

1. On your Linux host, run `wpa_passphrase` and obtain the required snippet for a given SSID:

```
~ $ wpa_passphrase
usage: wpa_passphrase <ssid> [passphrase]

If passphrase is left out, it will be read from stdin
~ $
~ $ wpa_passphrase OfficeNet01 WelCome2WF0@Last
network={
    ssid="OfficeNet01"
    #psk="WelCome2WF0@Last"
    psk=b03af193ebd2ad742ea6f397f9da0357a005c644bcc91329b7f61b17d0046c3d
}
~ $
```

2. Copy-paste the output into the `wpa_supplicant.conf` file on the SD card:

```
sudo nano <rootfs_mountpoint>/etc/wpa_supplicant/wpa_supplicant.conf
<copy-paste>
<save & exit>
```

Obviously, delete the commented-out cleartext password line for security.

## Headless login over SSH

Once you obtain the board IP address, login over SSH:

```
ssh <username>@<IPAddr>
```

F.e.

```
ssh myname@192.168.1.108
```

If it fails with a message like:

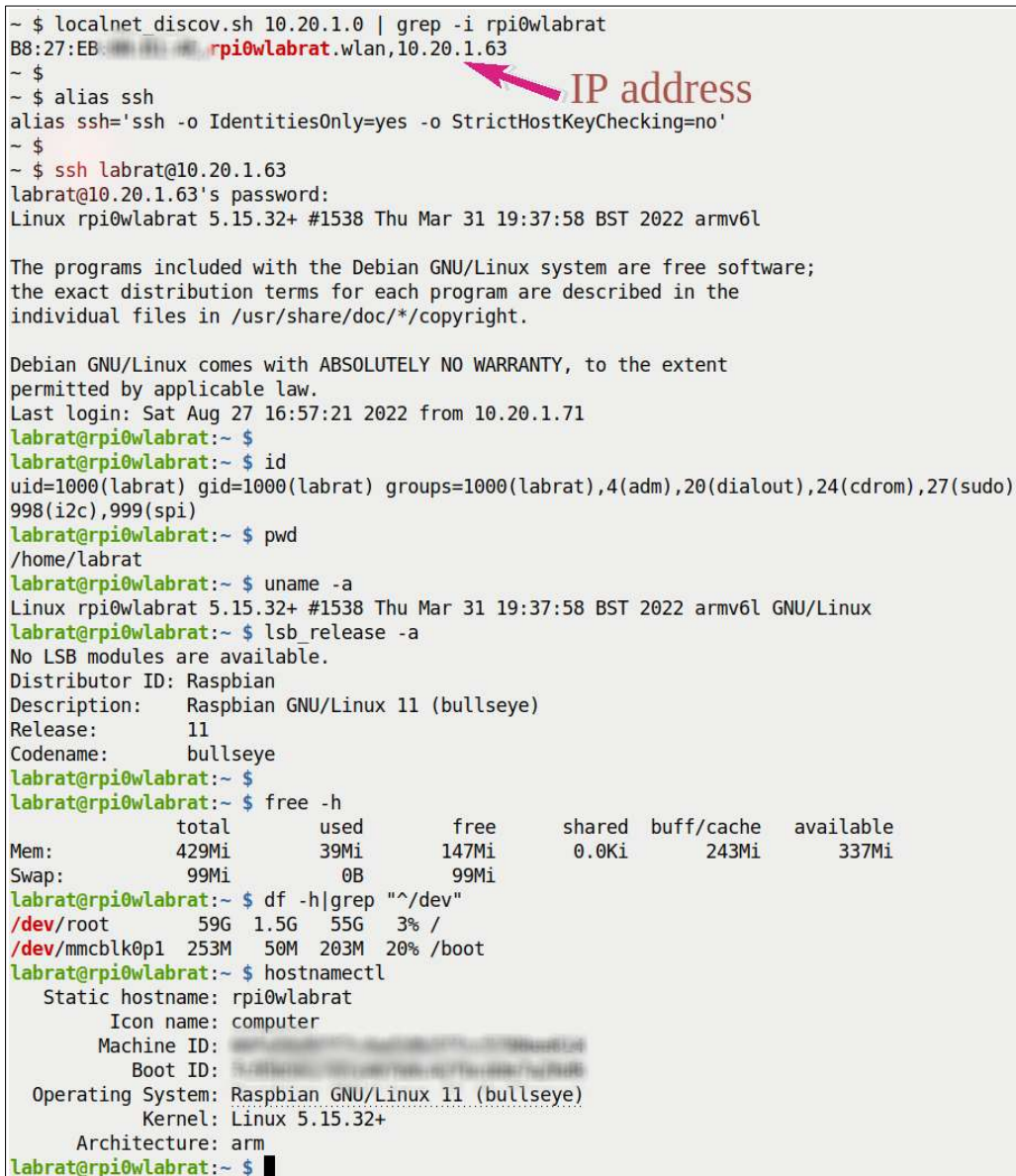
“... Too many authentication failures ...”

try this:

```
alias ssh='ssh -o IdentitiesOnly=yes -o StrictHostKeyChecking=no'
alias scp='scp -o IdentitiesOnly=yes -o StrictHostKeyChecking=no'
```

and then rerun the `ssh` command shown above! It should succeed.

A sample screenshot:



```
~ $ localnet discov.sh 10.20.1.0 | grep -i rpi0wlabrat
B8:27:EB:00:00:00 rpi0wlabrat.wlan,10.20.1.63
~ $
~ $ alias ssh
alias ssh='ssh -o IdentitiesOnly=yes -o StrictHostKeyChecking=no'
~ $
~ $ ssh labrat@10.20.1.63
labrat@10.20.1.63's password:
Linux rpi0wlabrat 5.15.32+ #1538 Thu Mar 31 19:37:58 BST 2022 armv6l

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Sat Aug 27 16:57:21 2022 from 10.20.1.71
labrat@rpi0wlabrat:~ $
labrat@rpi0wlabrat:~ $ id
uid=1000(labrat) gid=1000(labrat) groups=1000(labrat),4(adm),20(dialout),24(cdrom),27(sudo),
998(i2c),999(spi)
labrat@rpi0wlabrat:~ $ pwd
/home/labrat
labrat@rpi0wlabrat:~ $ uname -a
Linux rpi0wlabrat 5.15.32+ #1538 Thu Mar 31 19:37:58 BST 2022 armv6l GNU/Linux
labrat@rpi0wlabrat:~ $ lsb_release -a
No LSB modules are available.
Distributor ID: Raspbian
Description: Raspbian GNU/Linux 11 (bullseye)
Release: 11
Codename: bullseye
labrat@rpi0wlabrat:~ $
labrat@rpi0wlabrat:~ $ free -h
              total        used        free      shared  buff/cache   available
Mem:           429Mi       39Mi       147Mi          0Ki       243Mi       337Mi
Swap:            99Mi          0B          99Mi
labrat@rpi0wlabrat:~ $ df -h|grep "^/dev"
/dev/root           59G   1.5G   55G    3% /
/dev/mmcblk0p1    253M    50M  203M   20% /boot
labrat@rpi0wlabrat:~ $ hostnamectl
  Static hostname: rpi0wlabrat
            Icon name: computer
        Machine ID: 75-4883a3e0-775c-4274-984a-684848484848
          Boot ID: 75-4883a3e0-775c-4274-984a-684848484848
Operating System: Raspbian GNU/Linux 11 (bullseye)
       Kernel: Linux 5.15.32+
   Architecture: arm
labrat@rpi0wlabrat:~ $
```

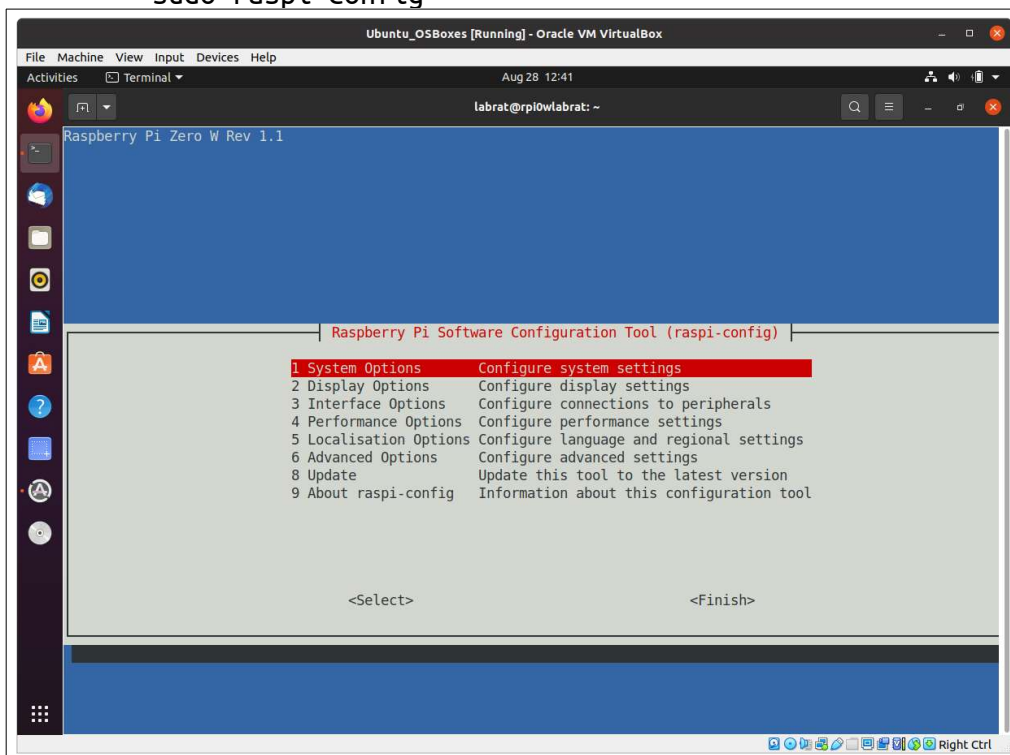
*Tips:*

- On a Windows host:
  - if required, setup the SSH client (eg. Putty) to use these parameters:  
 -o IdentitiesOnly=yes -o StrictHostKeyChecking=no  
 to ssh and scp
- On a Linux/Mac host:
  - put the ssh and scp aliases into a startup script
- *Security: use password-less logins by setting up SSH keys!*  
 Ref: <https://www.raspberrypi-spy.co.uk/2019/02/setting-up-ssh-keys-on-the-raspberry-pi/>
- **If all else fails when trying to ssh in**, power off the R Pi, attach a USB-to-serial dongle, setup a terminal emulator (Hyperterminal / Putty on Windows, minicom on Linux), login over it and get the IP address (ip a or ifconfig).  
 Ref: [WORKING ON THE CONSOLE WITH THE RASPBERRY PI, kaiwanTECH, Dec 2018.](#)  
 (Remember to add 'enable\_uart=1' to /boot/config.txt !).

## What to do once logged in to the Raspberry Pi

Once logged in to the R Pi board:

- First run  
`sudo raspi-config`



and set things up as required...



- Next, install minimally required packages first:

```
sudo apt install -y git perl
```

- Then - optional, useful – to install common development + other tooling and utils:

```
git clone https://github.com/kaiwan/init
```

The partially truncated screenshot shows cloning the ‘init’ repo and running the `apt_install_common_stuff.sh` to install common tooling...

```
labrat@pi0wlabrat:~ $ git clone https://github.com/kaiwan/init
Cloning into 'init'...
remote: Enumerating objects: 67, done.
remote: Counting objects: 100% (67/67), done.
remote: Compressing objects: 100% (50/50), done.
remote: Total 67 (delta 32), reused 40 (delta 17), pack-reused 0
Receiving objects: 100% (67/67), 16.77 KiB | 151.00 KiB/s, done.
Resolving deltas: 100% (32/32), done.
labrat@pi0wlabrat:~ $
labrat@pi0wlabrat:~ $ ls
init
labrat@pi0wlabrat:~ $ cd init/
labrat@pi0wlabrat:~/init $ ls
0setup_rpi.bash      dot_vimrc  README.md          source_repos.txt  ssh2rpi.sh
apt_install_common_stuff.sh  LICENSE   rpi_static_ip.txt  ssh2rpi          wpa_supplicant.conf
labrat@pi0wlabrat:~/init $
labrat@pi0wlabrat:~/init $ ./apt_install_common_stuff.sh
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following NEW packages will be installed:
  raspberrypi-kernel-headers
0 upgraded, 1 newly installed, 0 to remove and 0 not upgraded.
Need to get 28.6 MB of archives.
After this operation, 182 MB of additional disk space will be used.
Get:1 http://archive.raspberrypi.org/debian bullseye/main armhf raspberrypi-kernel-headers armhf
.6 MB]
Fetched 28.6 MB in 9s (3,070 kB/s)
Selecting previously unselected package raspberrypi-kernel-headers.
(Reading database ... 42376 files and directories currently installed.)
Preparing to unpack .../raspberrypi-kernel-headers_1%3a1.20220328-1_armhf.deb ...
Unpacking raspberrypi-kernel-headers (1:1.20220328-1) ...
Progress: [ 20%] [#####.....]
```

(This script even sets up a useful startup script that will auto-execute whenever you spawn a shell!).

There, you're all set!