



Creating a headless Raspberry Pi for collecting muon data



Creating a headless Raspberry Pi for collecting muon data.

During the session we will use various free software tools and a RaspberryPi 4 for demonstrations purposes. The following list of hardware and software is for reference and indicates where the various programmes can be found and downloaded. If you are using a windows version earlier than Windows 10 please take care to download an appropriate version of the software.

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REQUIREMENTS – Essential and / or Optional

This is for a windows installation – other operating systems are available.

Required hardware (essential):

1. Raspberry Pi 4 Model B (2GB) <https://thepihut.com/products/raspberry-pi-4-model-b>
2. Official UK Raspberry Pi 4 Power Supply (5.1V 3A) <https://thepihut.com/products/raspberry-pi-psu-uk>
3. SanDisk MicroSD Card (Class 10 A1) 32GB <https://thepihut.com/products/sandisk-microsd-card-class-10-a1>
4. Mini USB 2. MicroSD Card Reader <https://thepihut.com/products/mini-usb-2-0-microsd-card-reader>

Required hardware (optional):

1. Official Raspberry Pi 4 Case <https://thepihut.com/products/raspberry-pi-4-case>

Connecting to home Wi-Fi network:

1. Nothing more

Connecting to home LAN network:

1. RJ45 Cat5e Ethernet LAN Cable 2m <https://thepihut.com/products/rj45-cat5e-ethernet-lan-cable-2m-black>

Required Software (essential):

1. Raspberry Pi Imager <https://www.raspberrypi.com/software/>
2. PuTTY <https://www.putty.org/>
3. RealVNC viewer <https://www.realvnc.com/en/connect/download/viewer/>

Required Software (optional):

1. Notepad++ <https://notepad-plus-plus.org/>
2. Advanced IP Scanner <https://www.advanced-ip-scanner.com/>
3. WinSCP <https://winscp.net/eng/index.php>

Required information (optional):

1. Your WiFi SSID – name of WIFI
2. Your WiFi password

Required Code Editor for Python Tutorials

1. Visual Studio Code <https://code.visualstudio.com/>

Objectives of this session

By the end of this session you will be able to:

1. Understand and use a "headless" RPi
2. Make a RPi operating system microSD card ready for remote access
3. Connect your RPi to your home network and identify its address on the network – using both wired and wireless connections.
4. Set up and use RealVNC Viewer on your RPi and remote computer
5. Set up and use SSH access to your RPi from a remote computer
6. Download python script to the RaspberryPi and run it.

Prior Knowledge

Some prior knowledge will be helpful to you to gain the maximum value from the session. It is assumed that:

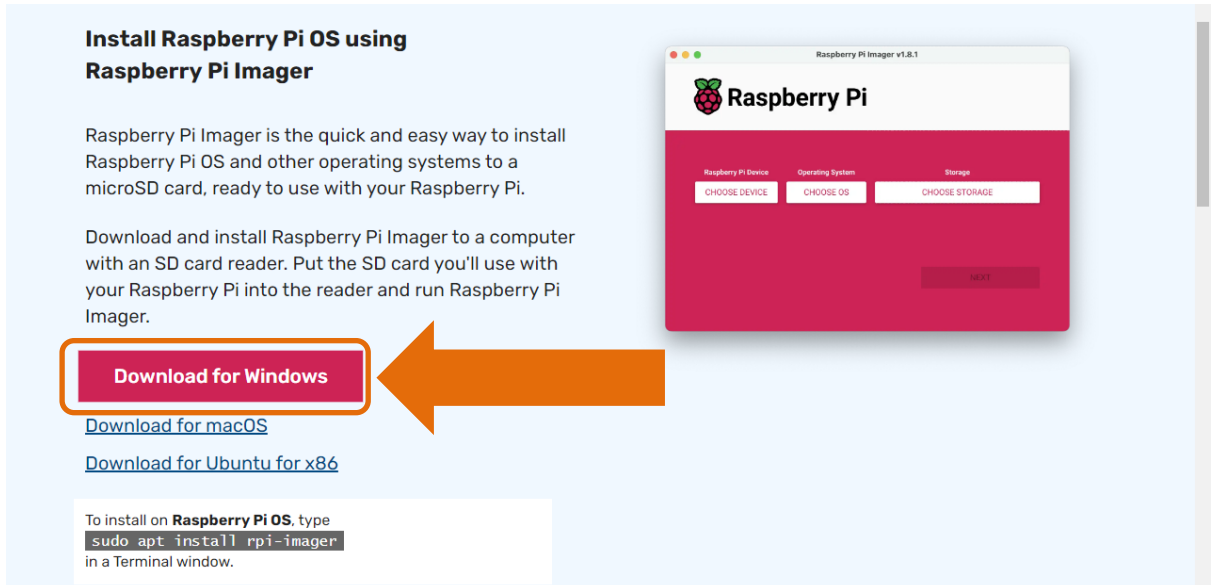
- You can download and install software from the internet onto your computer
- Know your Wi-Fi passwords and can connect new devices.

Running Order

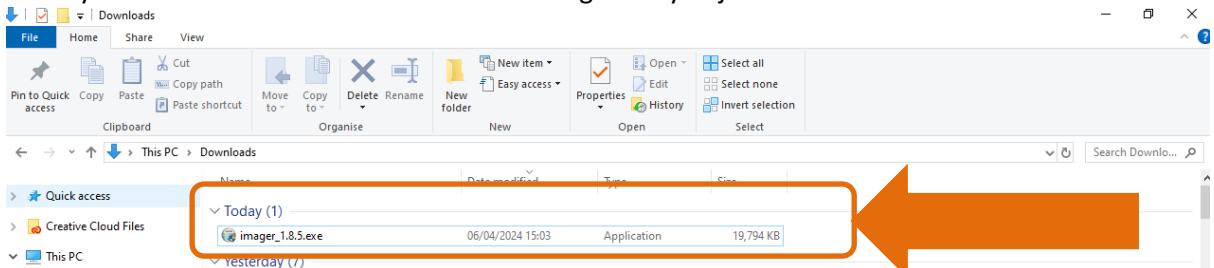
1. Creating an SD Card
 - a. Configuring WiFi and remote access
 - b. Which RaspberryPi OS version?
2. Power up the RaspberryPi
 - a. Identify the device on your network
3. Using RealVNC Viewer
4. Using WinSCP
5. Introduction to Linux
 - a. Some basic commands
 - b. Running a Python Script

Installing Raspberry Pi OS onto the MicroSD Card

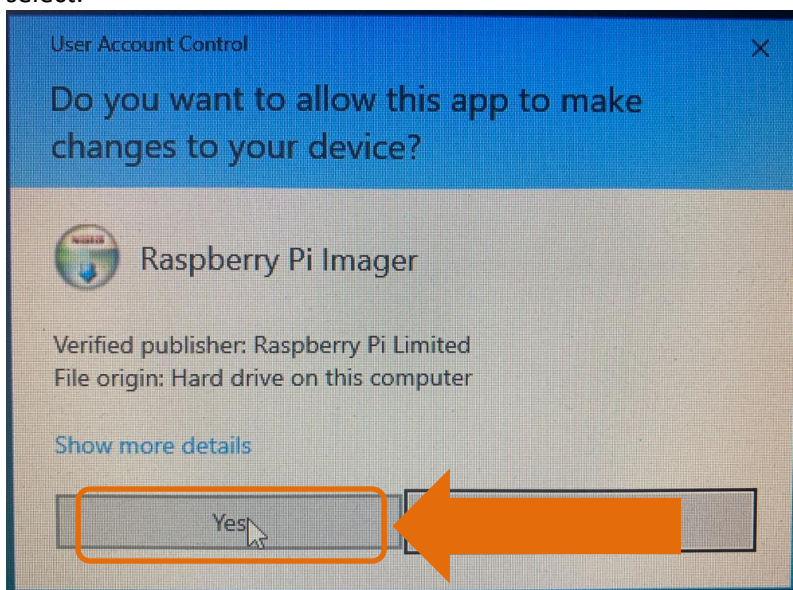
1. Use the following link to access Raspberry Pi Imager:
<https://www.raspberrypi.com/software/>.
2. Scroll down page to get to “Install Raspberry Pi OS using Raspberry Pi Imager”, then click on the tab “Download for Windows” – this will go from blue to red as you move your mouse over it.



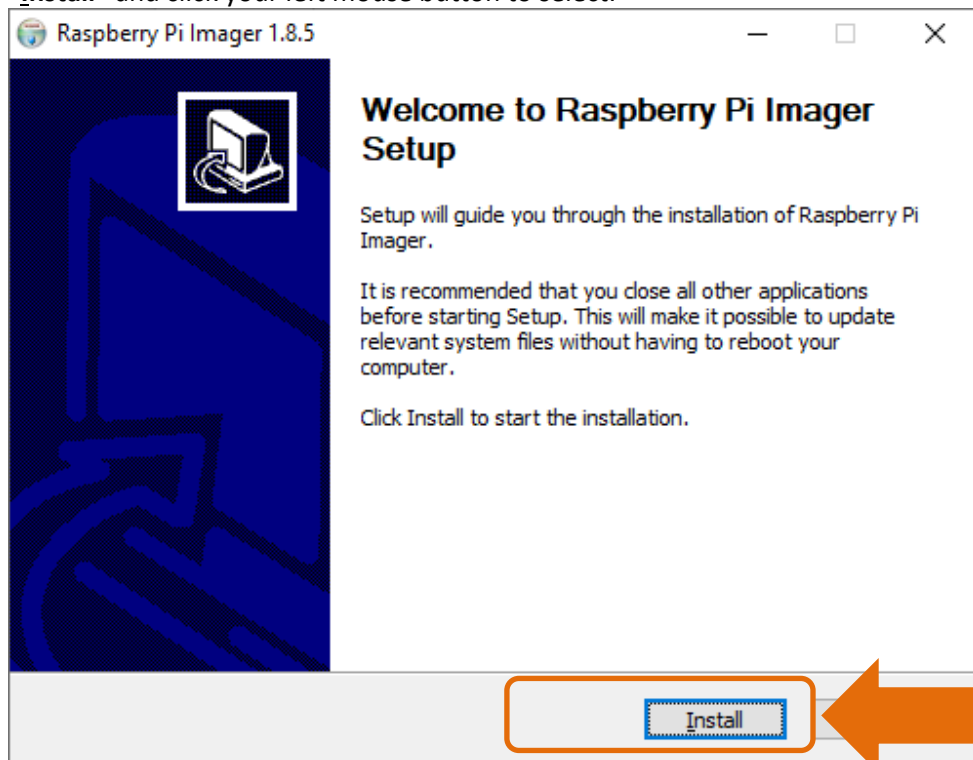
3. Go to your Downloads folder and locate the imager file you just downloaded.



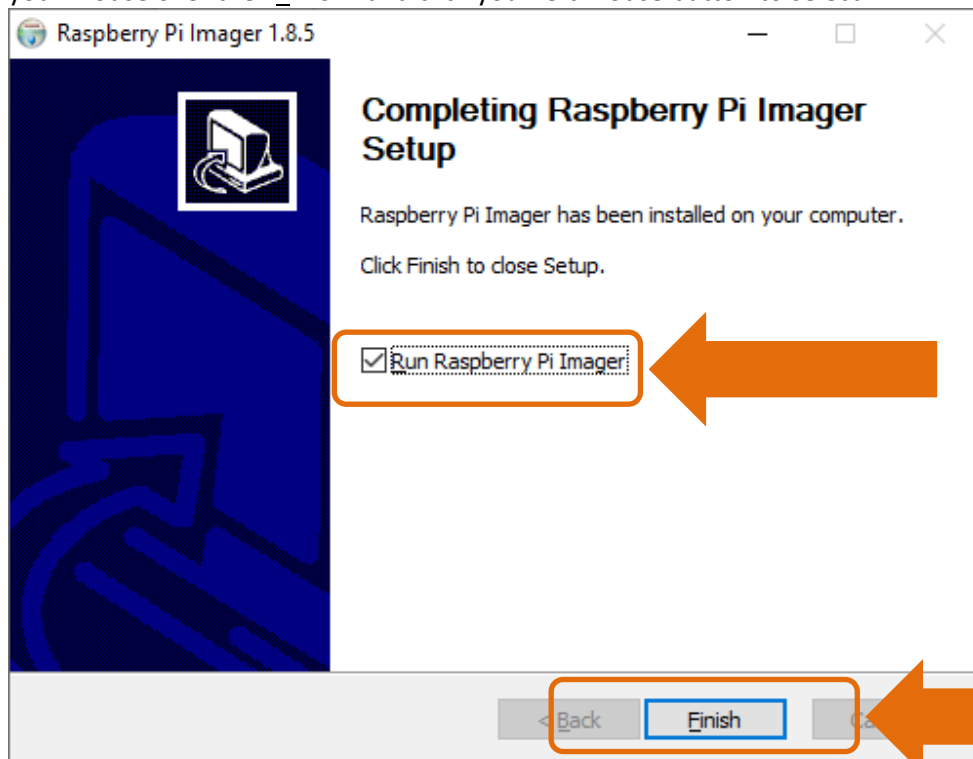
4. Double click on the **imager_x.x.x.exe** file to run and you will be presented with a Windows confirmation screen. Move your mouse over the “Yes” and click your left mouse button to select.



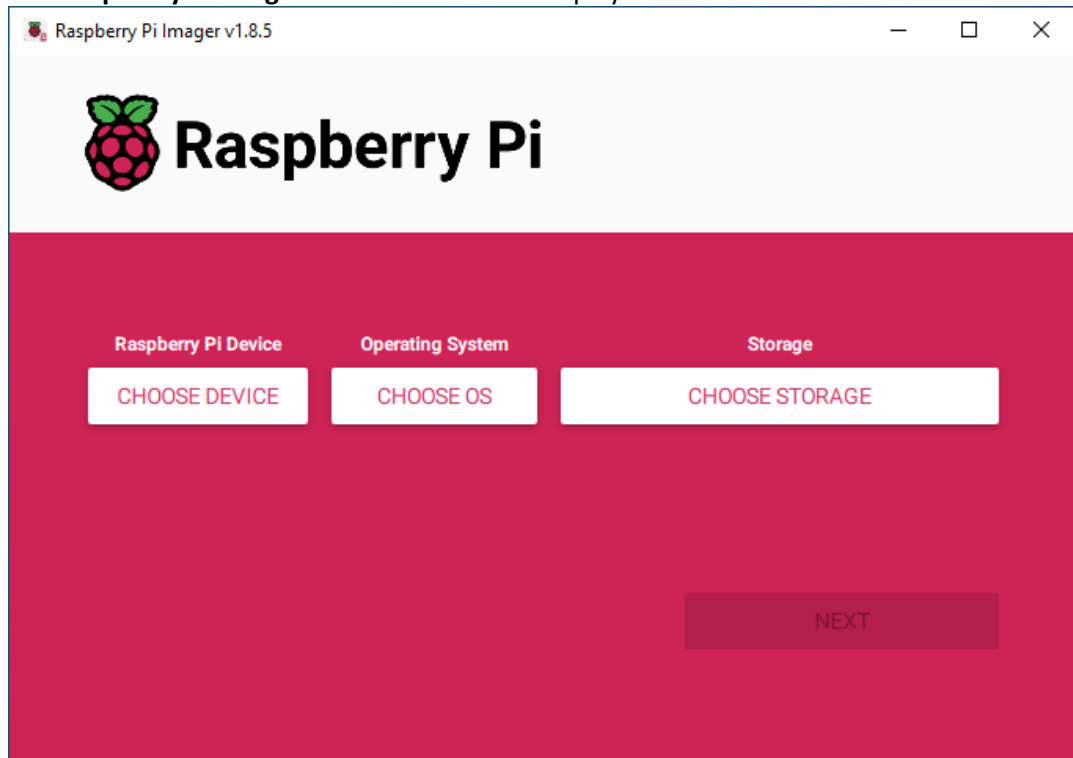
5. You will now have the **Raspberry Pi Imager** installer screen. Move your mouse over the **“Install”** and click your left mouse button to select.



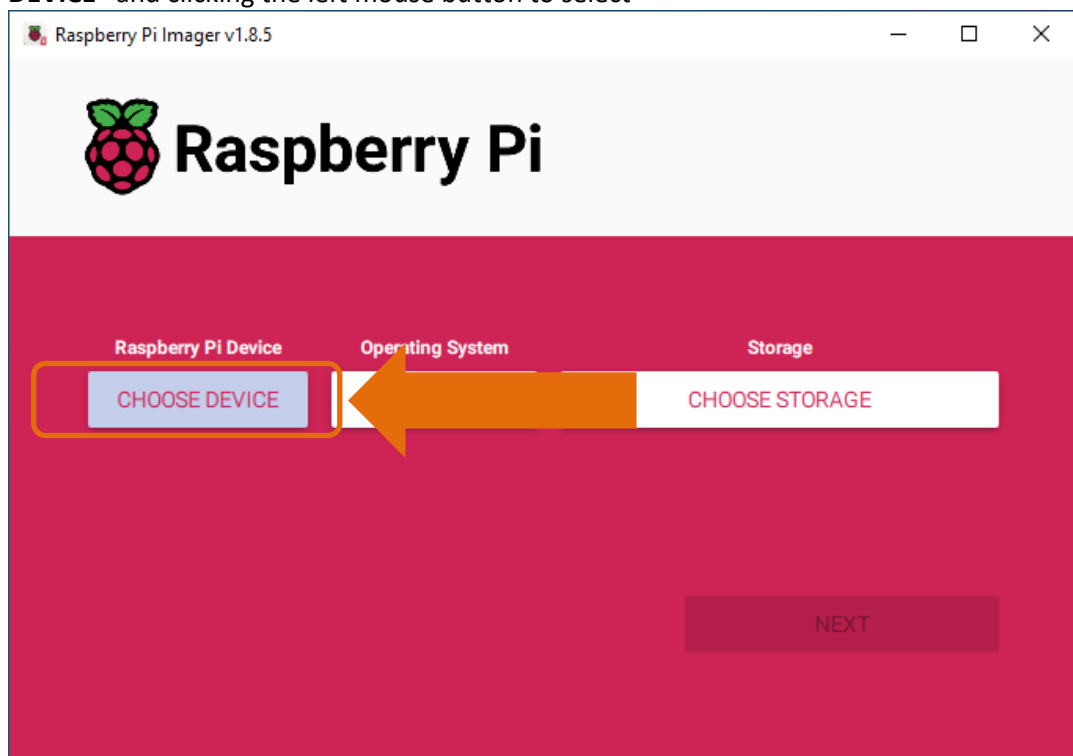
6. When the install is complete, ensure that **“Run Raspberry Pi Imager”** is checked and move your mouse over the **“Finish”** and click your left mouse button to select.



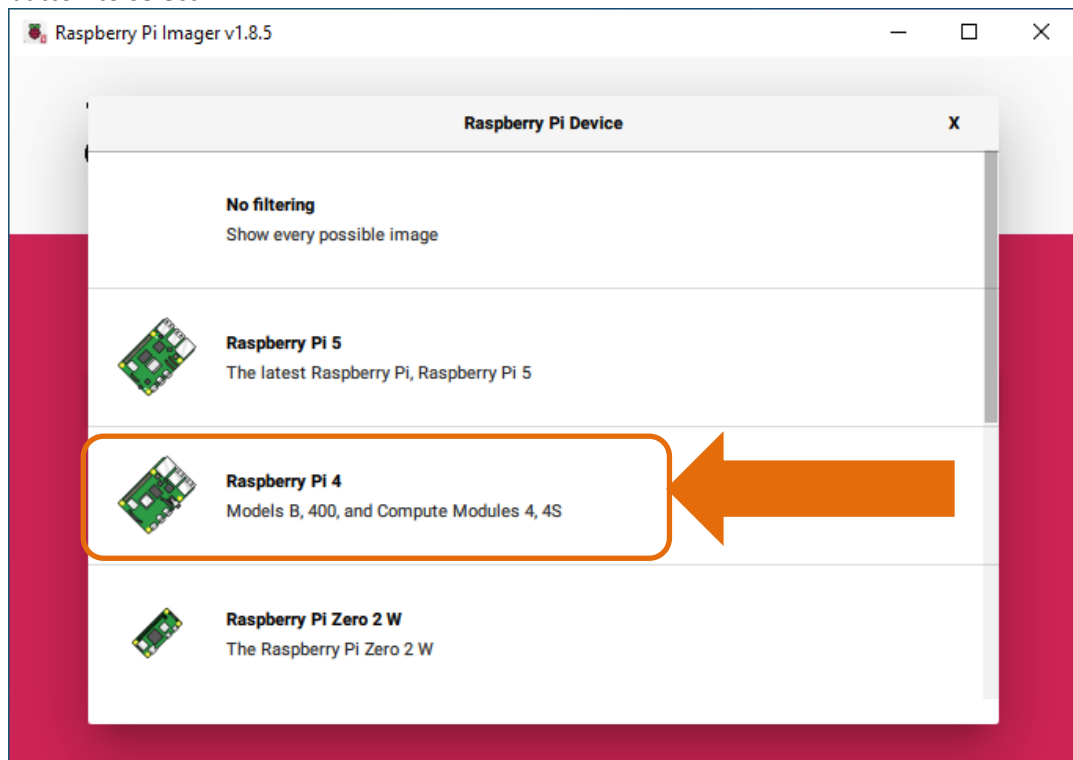
7. The **Raspberry Pi Imager** screen will now be displayed



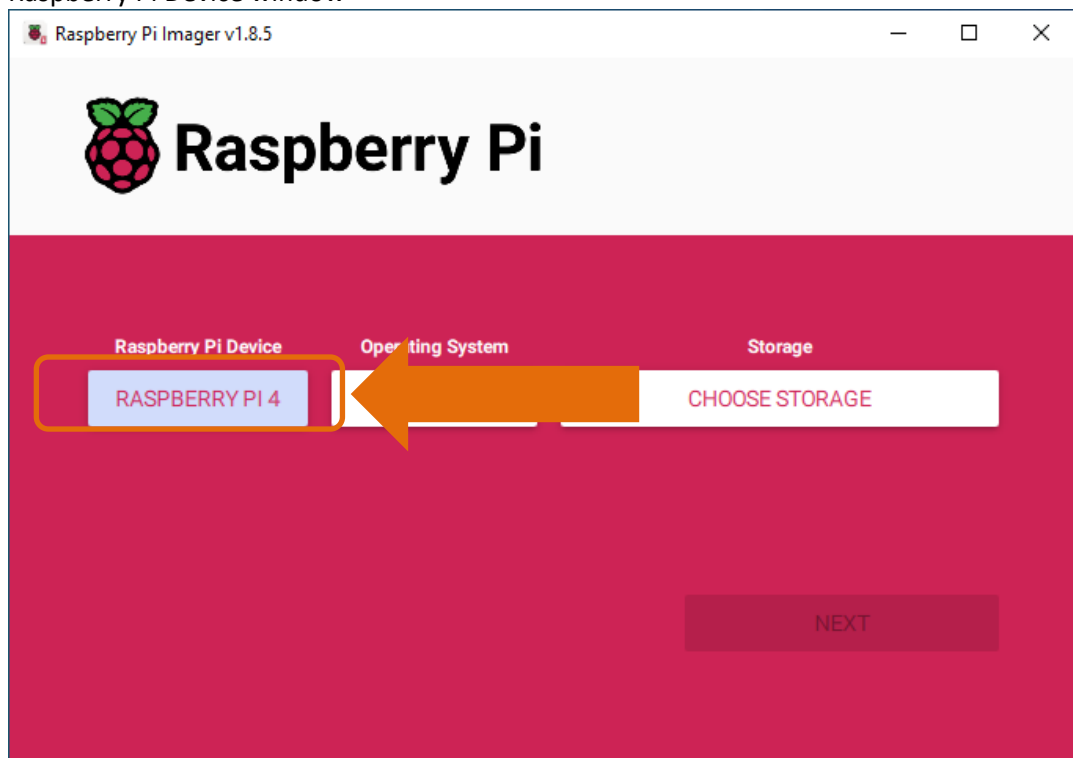
8. We are firstly going to select our **Raspberry Pi Device** by moving our mouse over “**CHOOSE DEVICE**” and clicking the left mouse button to select



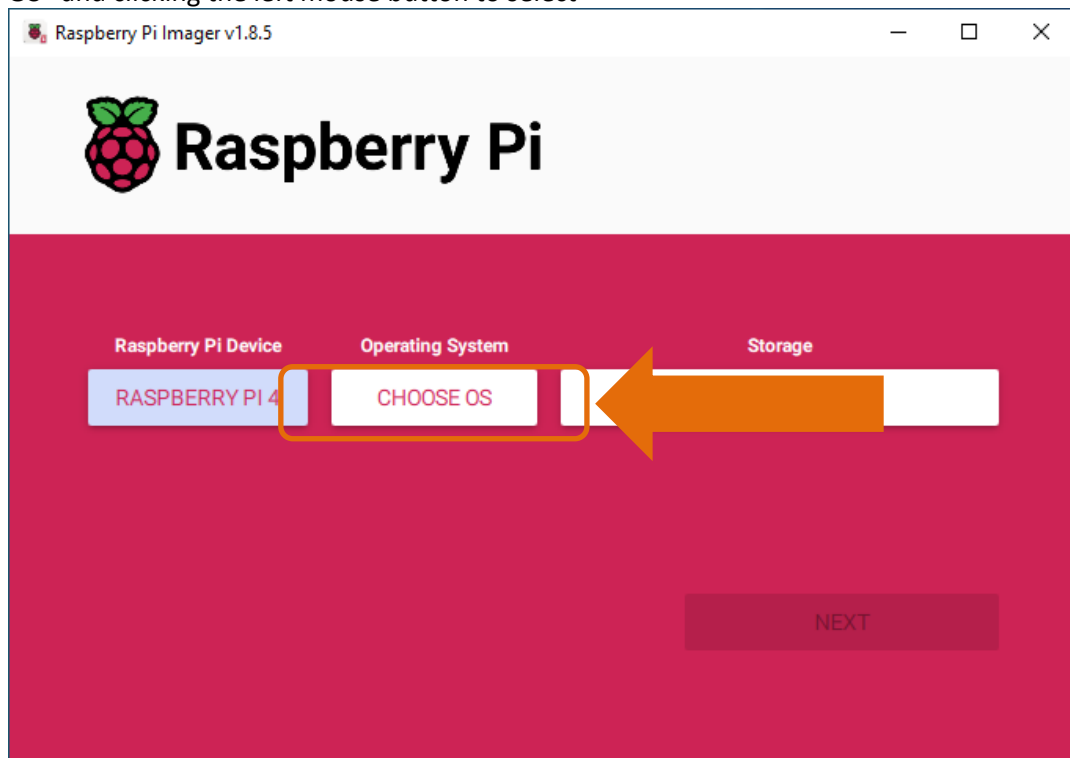
9. We will now have a list of **Raspberry Pi Devices** to select from. We are going to select the **“Raspberry Pi 4”** by moving our mouse over **“Raspberry Pi 4”** and clicking the left mouse button to select.



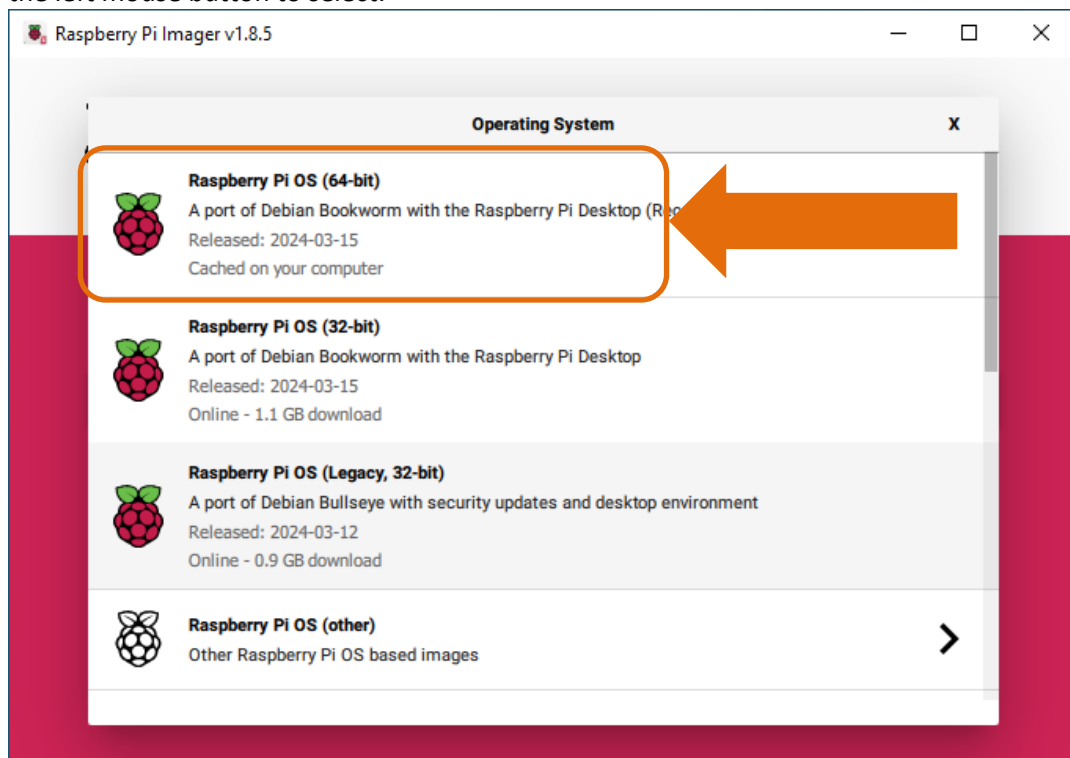
10. This will return us to the **Raspberry Pi Imager** screen, now there is **“RASPBerry PI 4”** in the Raspberry Pi Device window



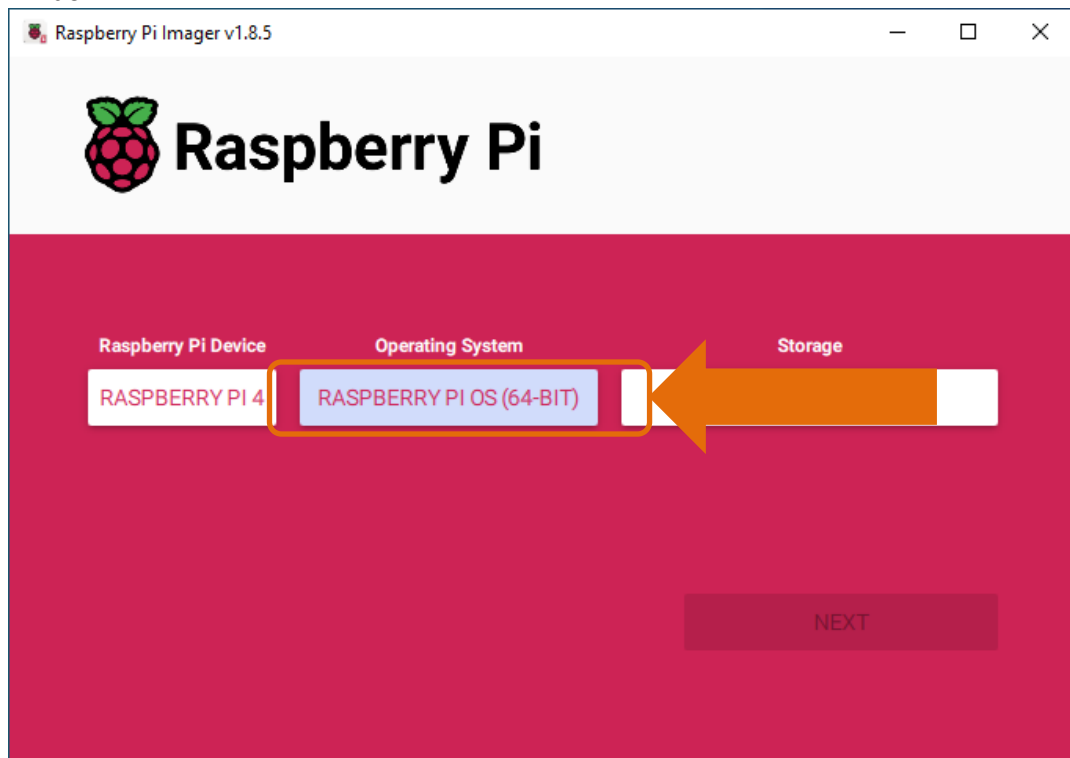
11. We are secondly going to select our **Operating System** by moving our mouse over “**CHOOSE OS**” and clicking the left mouse button to select



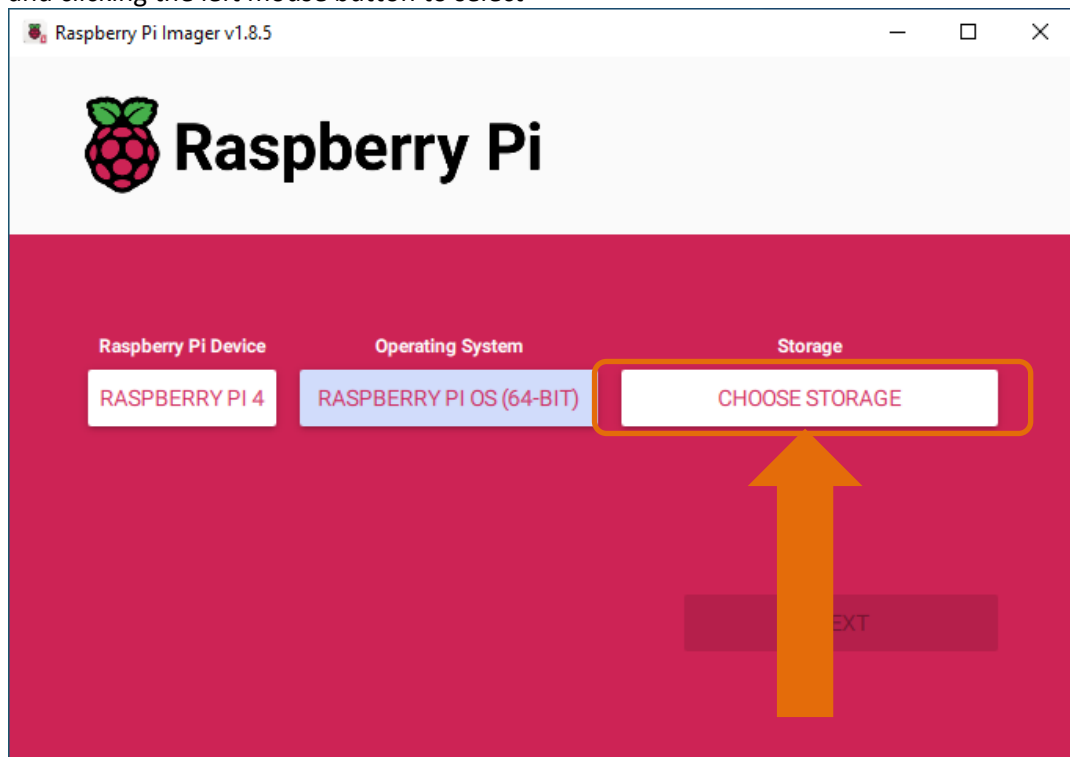
12. We will now have a list of **Operating Systems** to select from. We are going to select the “**Raspberry Pi OS (64 bit)**” by moving our mouse over “**Raspberry Pi OS (64 bit)**” and clicking the left mouse button to select.



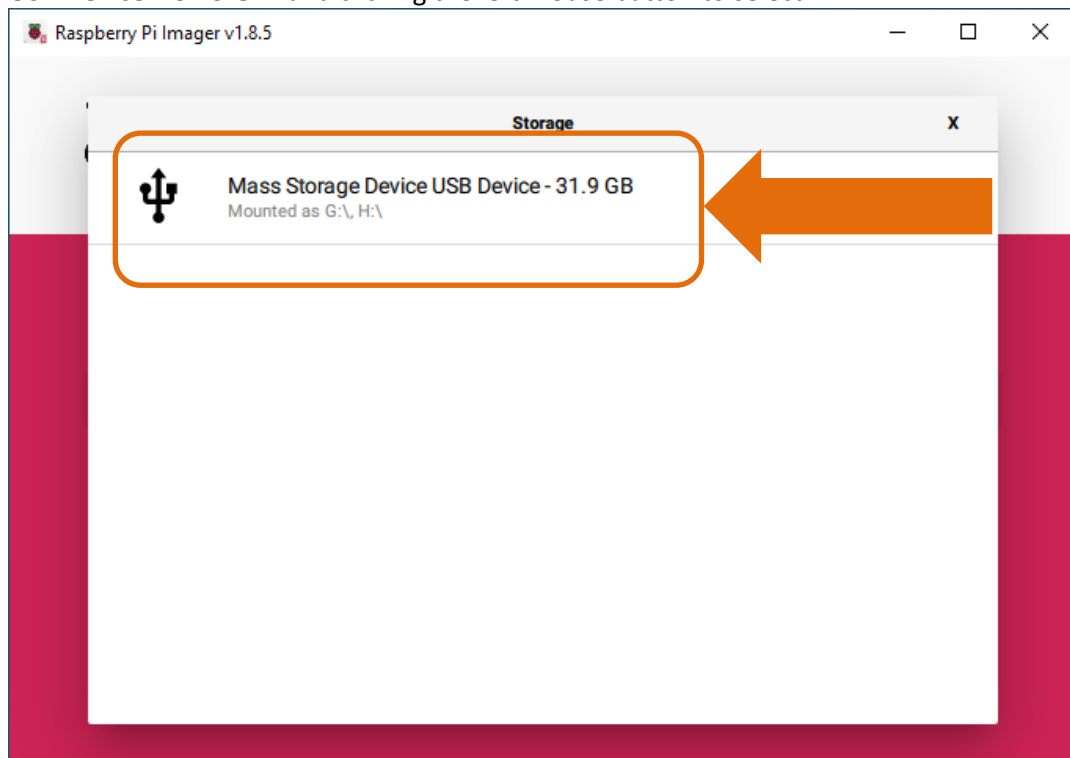
13. This will return us to the **Raspberry Pi Imager** screen, now there is “**RASPBerry PI 4**” in the **Raspberry Pi Device** window and “**RASPBerry PI OS (64-BIT)**” in the **Operating System** window



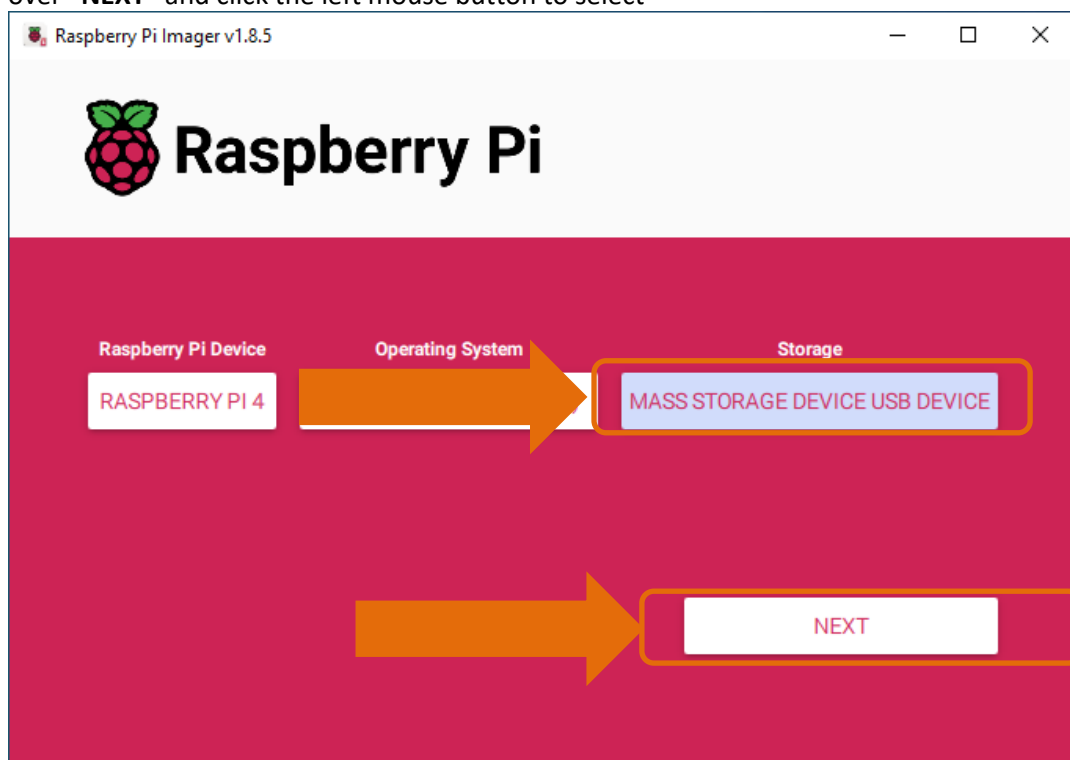
14. Plug your microSD card into your computer using a suitable adapter if needed.
15. We are lastly going to select our **Storage** by moving our mouse over “**CHOOSE STORAGE**” and clicking the left mouse button to select



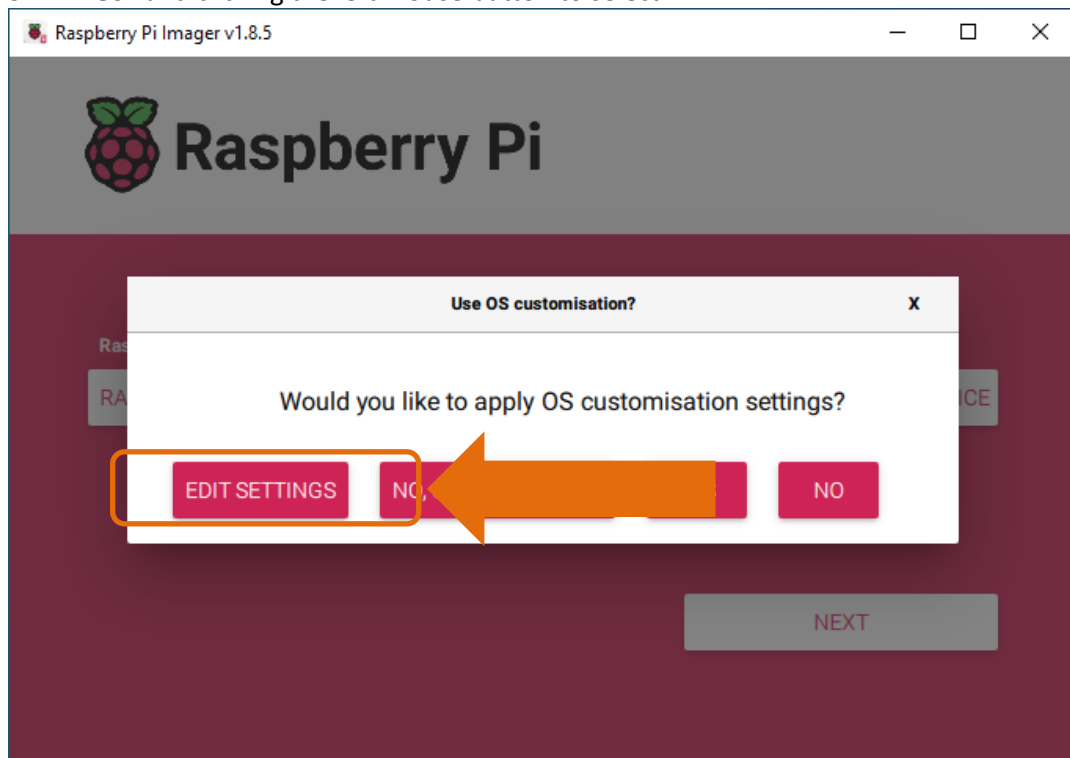
16. We will now have a list of **storage** options to select from. We are going to select the “**Mass Storage Device USB Device – 31.9 GB**” by moving our mouse over “**Mass Storage Device USB Device – 31.9 GB**” and clicking the left mouse button to select.



17. This will return us to the **Raspberry Pi Imager** screen, now there is “**RASPBERRY PI 4**” in the **Raspberry Pi Device** window and “**RASPBERRY PI OS (64-BIT)**” in the **Operating System** window and **MASS STORAGE DEVICE USB DEVICE** in the **Storage** window. Move your mouse over “**NEXT**” and click the left mouse button to select



18. We will now have the option to apply a customised operating system. We will want to do this so we are going to select the **“EDIT SETTINGS”** by moving our mouse over **“EDIT SETTINGS”** and clicking the left mouse button to select.



19. This will bring us to the first of three pages that we can use to customise our operating system.

20. On the first page **"GENERAL"** we are going to use the following options
- Set hostname: **"MuonPi"**
 - Set username and password
 - Username : **"pi"**
 - Password : **"PassWord"**
 - Configure wireless LAN
 - SSID: **"for your own Wi-Fi"**
 - Password : **"for your own Wi-Fi"**
 - Set Local settings
 - Time zone : **"Europe/London"**
 - Keyboard layout : **"gb"**

The screenshot shows a window titled "OS Customisation" with three tabs: "GENERAL", "SERVICES", and "OPTIONS". The "GENERAL" tab is selected and highlighted with a pink underline. The window contains several settings, each preceded by a checked checkbox (a pink square with a white checkmark). The settings are: "Set hostname: MuonPi .local", "Set username and password" (with fields for Username: pi and Password: a masked password of 10 dots), "Configure wireless LAN" (with fields for SSID: your own wi-fi name and Password: your own wi-fi password, and checkboxes for "Show password" (checked) and "Hidden SSID" (unchecked)), "Wireless LAN country: GB" (with a dropdown arrow), and "Set locale settings" (with fields for Time zone: Europe/London and Keyboard layout: gb, both with dropdown arrows). At the bottom center of the window is a large pink button labeled "SAVE".

OS Customisation

GENERAL SERVICES OPTIONS

☒ Set hostname: MuonPi .local

☒ Set username and password

Username: pi

Password: ●●●●●●●●●●

☒ Configure wireless LAN

SSID: your own wi-fi name

Password: your own wi-fi password

☒ Show password ☐ Hidden SSID

Wireless LAN country: GB ▼

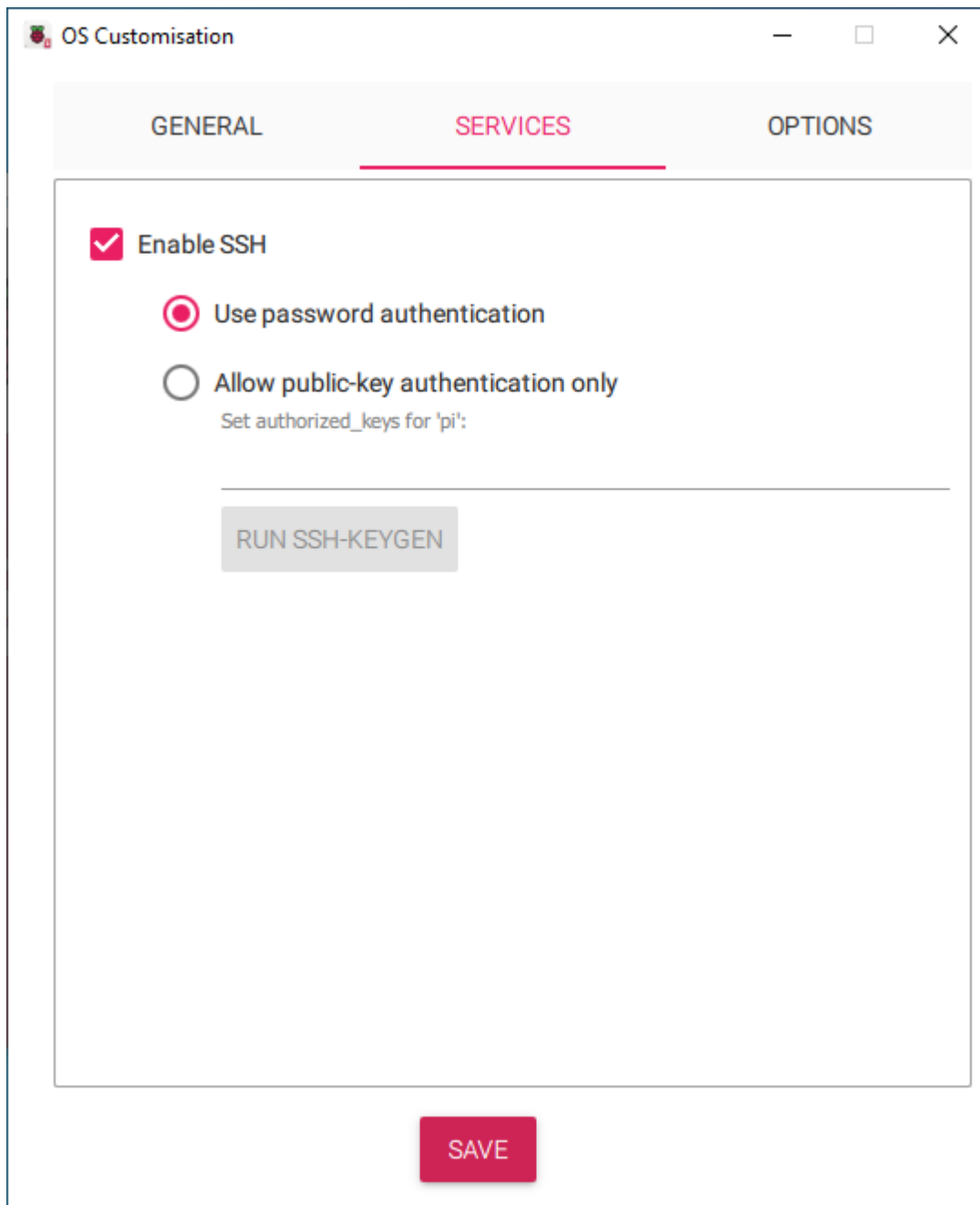
☒ Set locale settings

Time zone: Europe/London ▼

Keyboard layout: gb ▼

SAVE

21. On the second page “**SERVICES**” we are going to use the following options
- a. Enable SSH
 - i. Select **Use password authentication**



The screenshot shows a window titled "OS Customisation" with three tabs: "GENERAL", "SERVICES", and "OPTIONS". The "SERVICES" tab is selected and highlighted with a red underline. Inside the "SERVICES" tab, there is a section for SSH configuration. It starts with a checked checkbox labeled "Enable SSH". Below this, there are two radio button options: "Use password authentication" (which is selected) and "Allow public-key authentication only". Under the second option, there is a text input field with the placeholder text "Set authorized_keys for 'pi':". Below the input field is a button labeled "RUN SSH-KEYGEN". At the bottom of the window, there is a red "SAVE" button.

OS Customisation

GENERAL SERVICES OPTIONS

☒ Enable SSH

☒ Use password authentication

☐ Allow public-key authentication only
Set authorized_keys for 'pi':

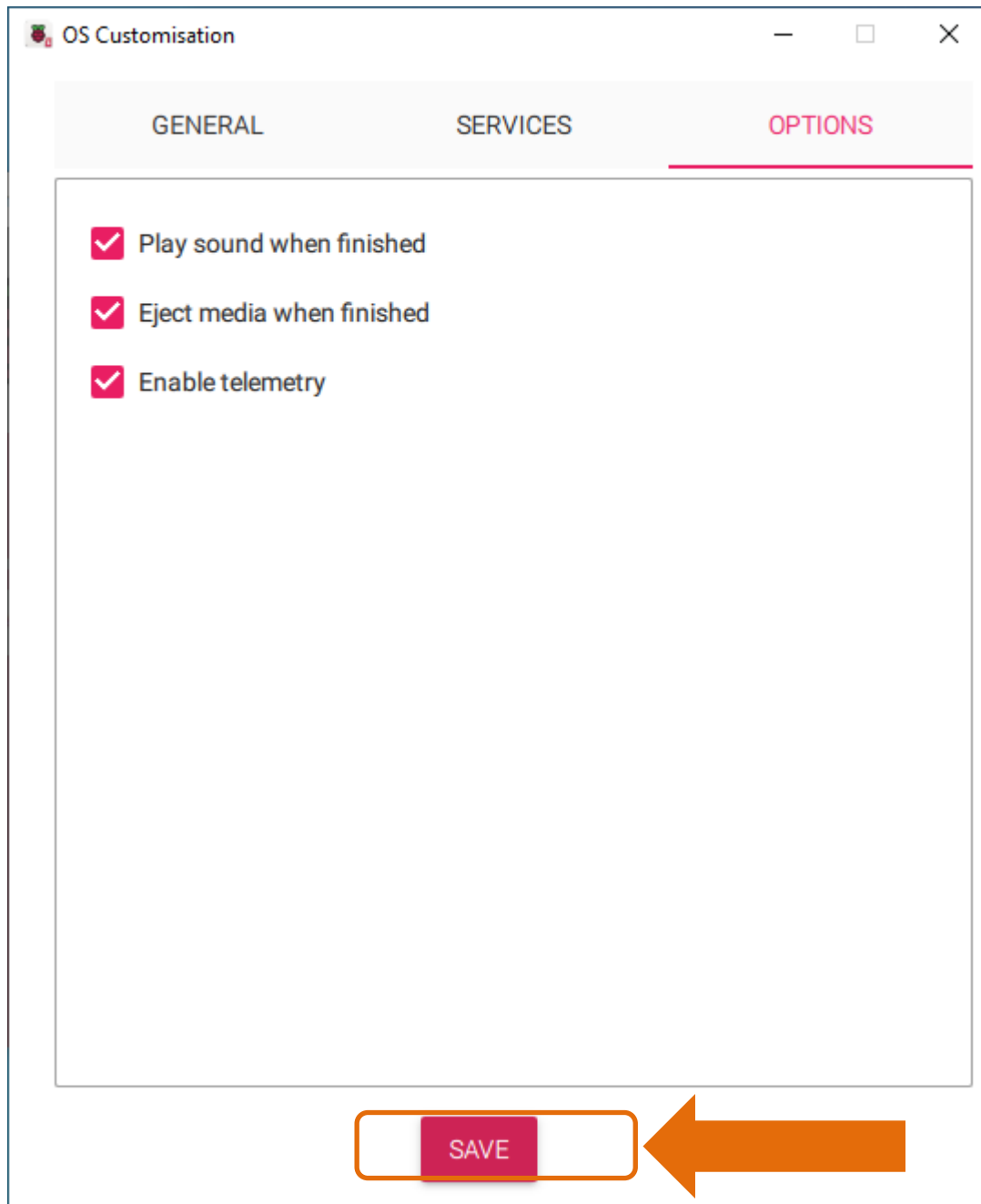
RUN SSH-KEYGEN

SAVE

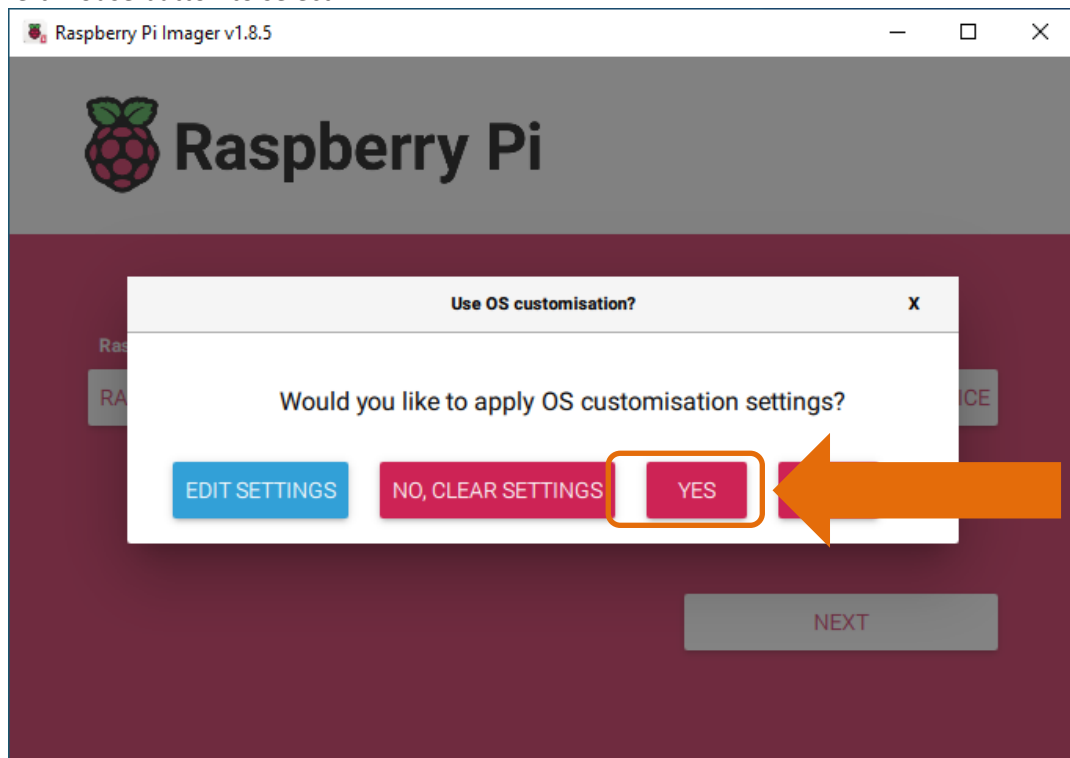
22. On the third page “**OPTIONS**” we are going to use the following options

- a. **Play sound when finished**
- b. **Eject media when finished**
- c. **Enable telemetry**

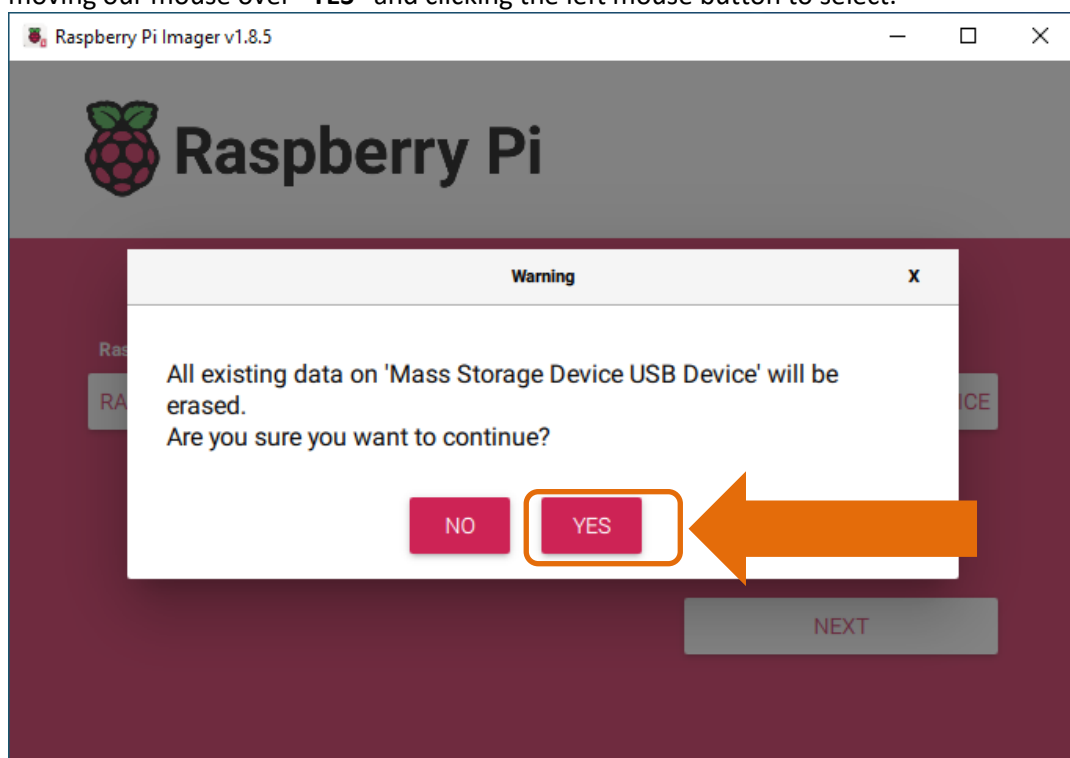
We will now have the option to save the customisations we have made. We do this by moving our mouse over “**SAVE**” and clicking the left mouse button to select.



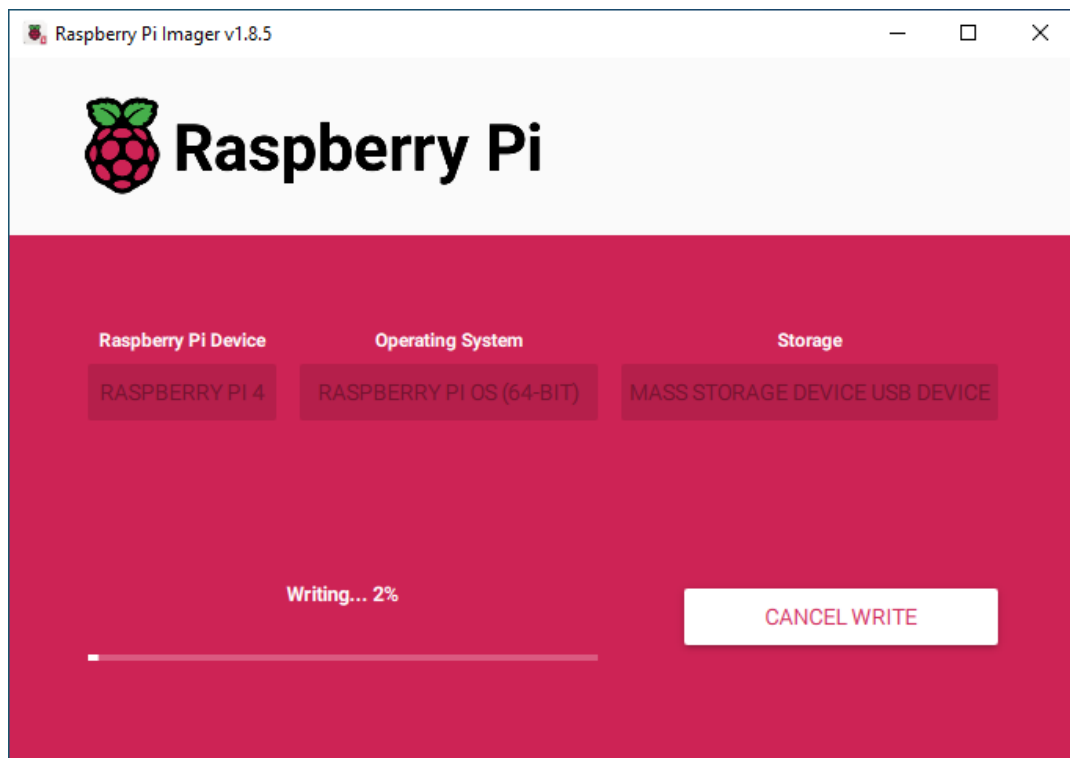
23. We return to “**Use OS customisation?**” screen and now have the option to use the customisations we have made. We do this by moving our mouse over “**YES**” and clicking the left mouse button to select.



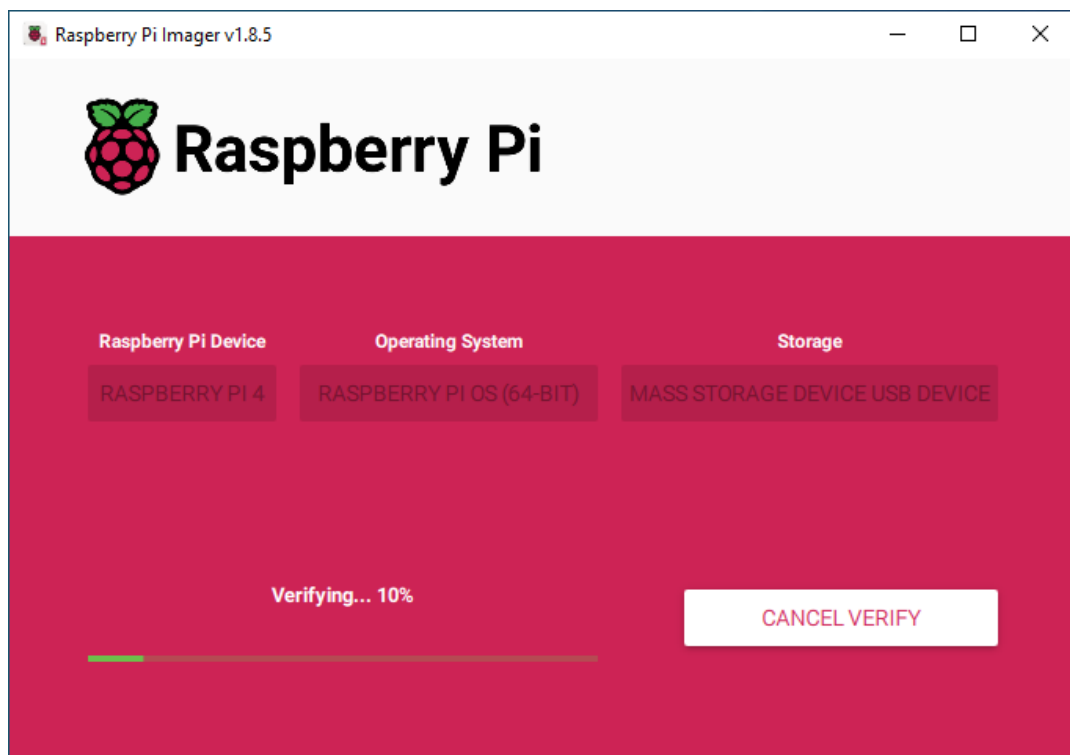
24. We now get a **warning** message about erasing the ‘**Mass Storage Device**’. Make sure you are going to write the Raspberry Pi operating system to the correct device, we do this by moving our mouse over “**YES**” and clicking the left mouse button to select.



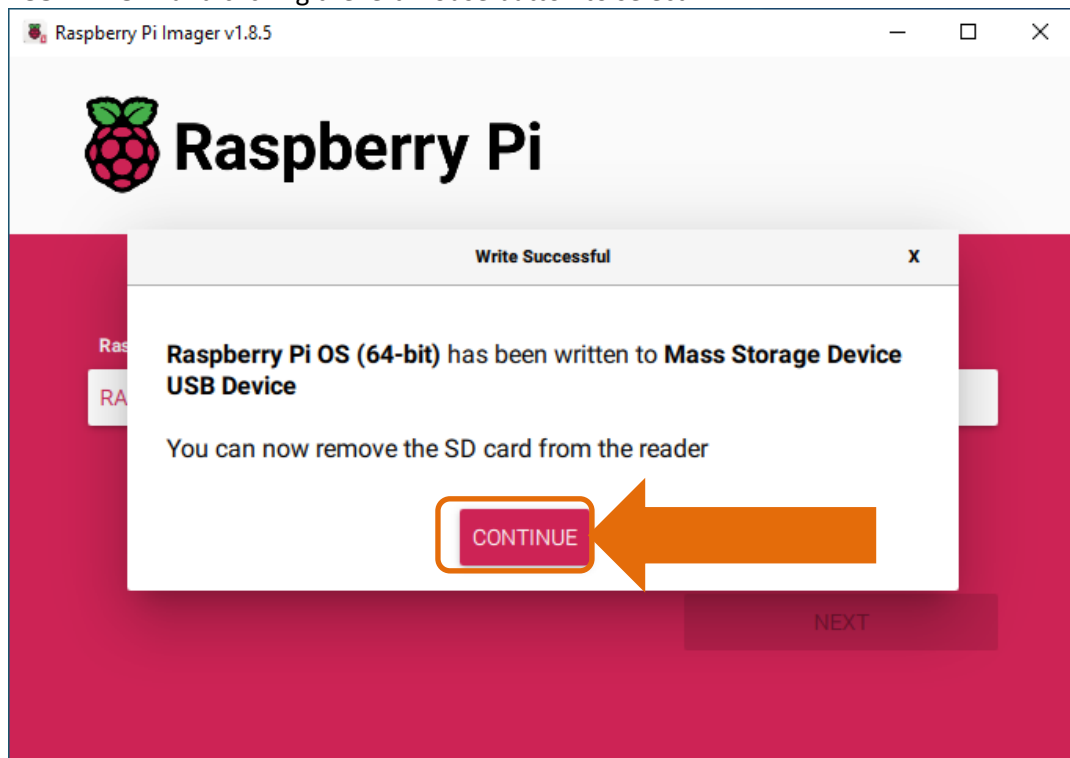
25. The **Raspberry Pi Imager** will now **write** the operating system to the mass storage device.
For a 32GB microSD card this takes about 7 minutes.



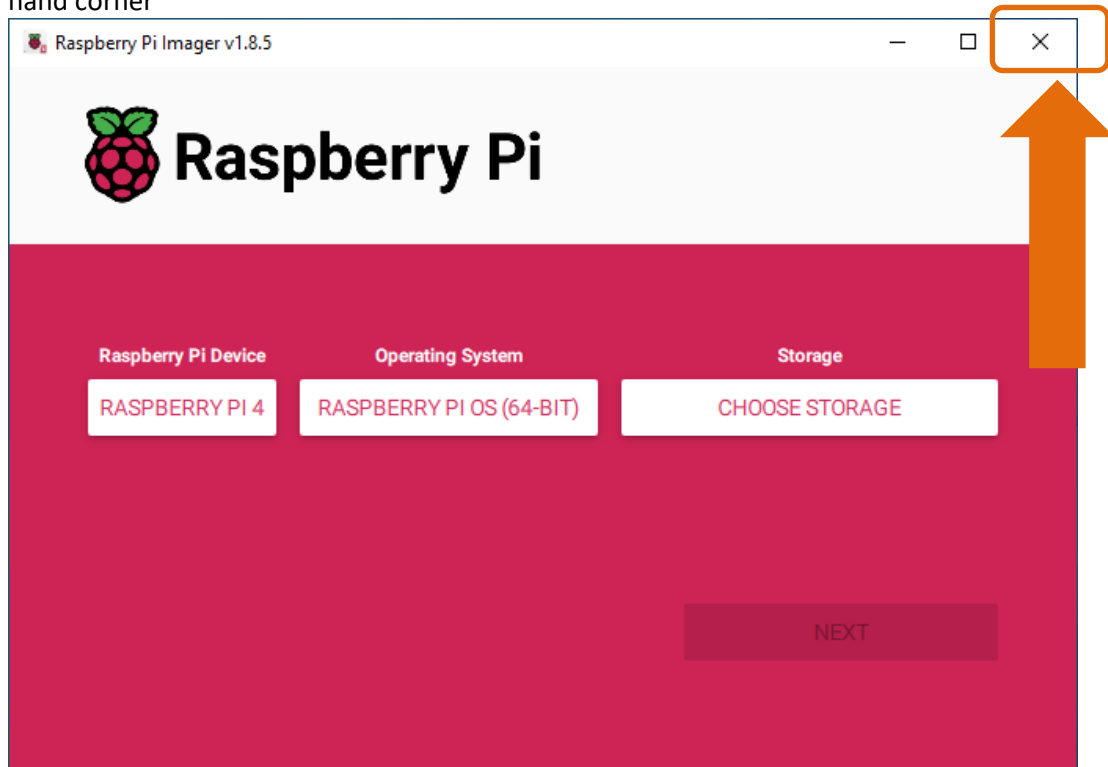
26. The **Raspberry Pi Imager** will now **verify** the operating system on the mass storage device.
For a 32GB microSD card this takes about 7 minutes.



27. The **Raspberry Pi Imager** will confirm what it has done. We can now remove the SD card from the computer and close the **Raspberry Pi Imager** by moving our mouse over “**CONTINUE**” and clicking the left mouse button to select.

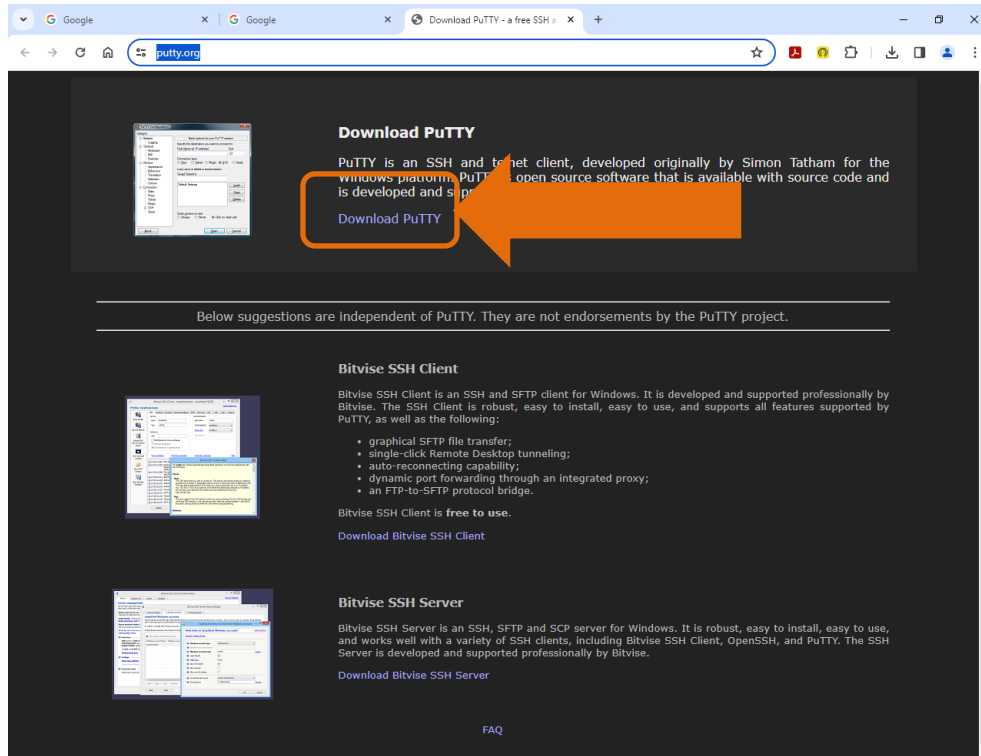


28. And then closing the Raspberry Pi Imager main window with the X button in the top right hand corner

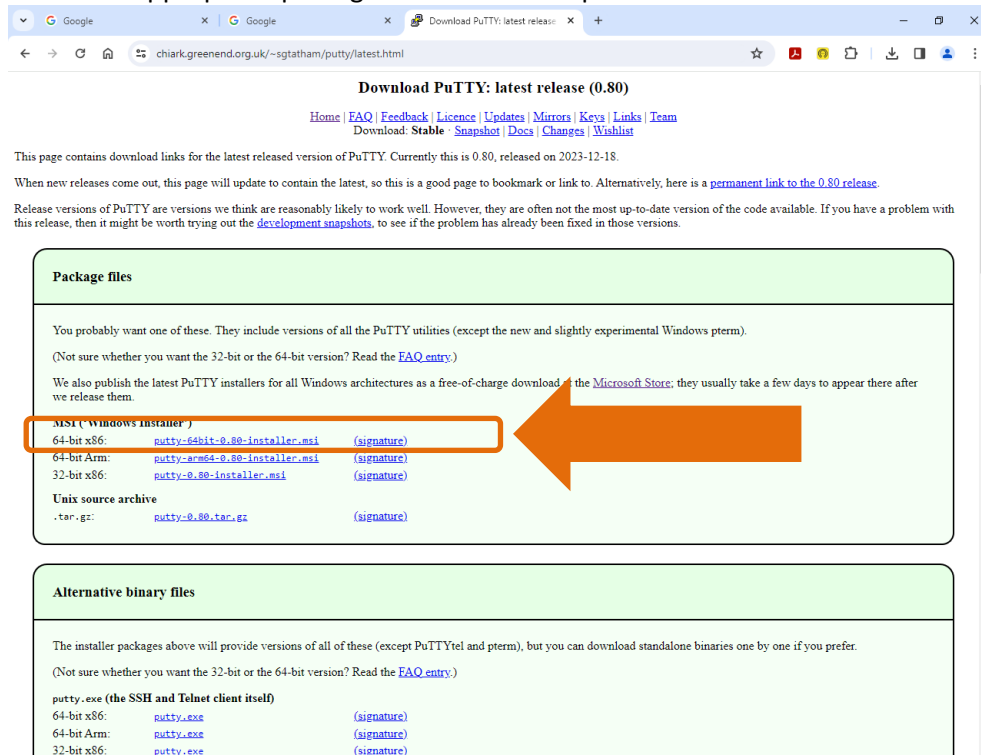


Installing PuTTY on your PC

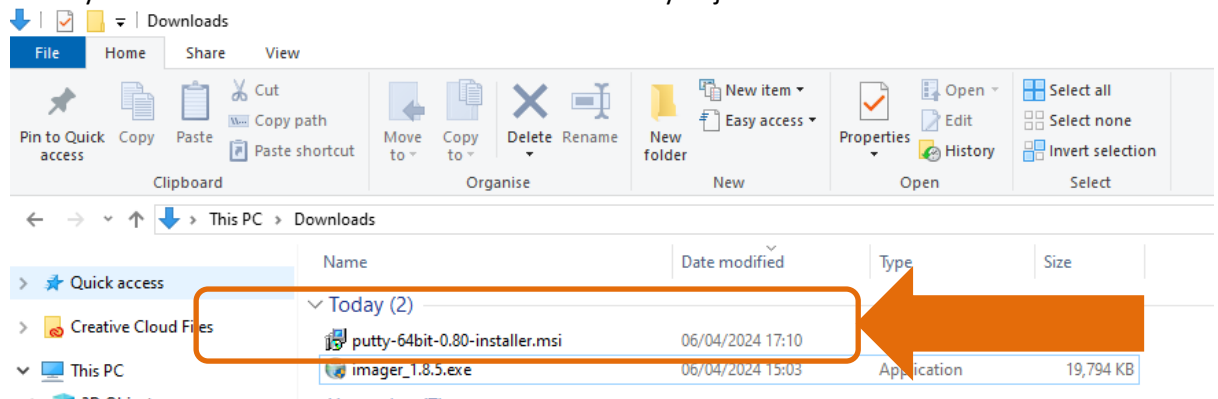
1. Use the following link to access PuTTY: <https://www.putty.org/>. Click on the link "Download PuTTY"



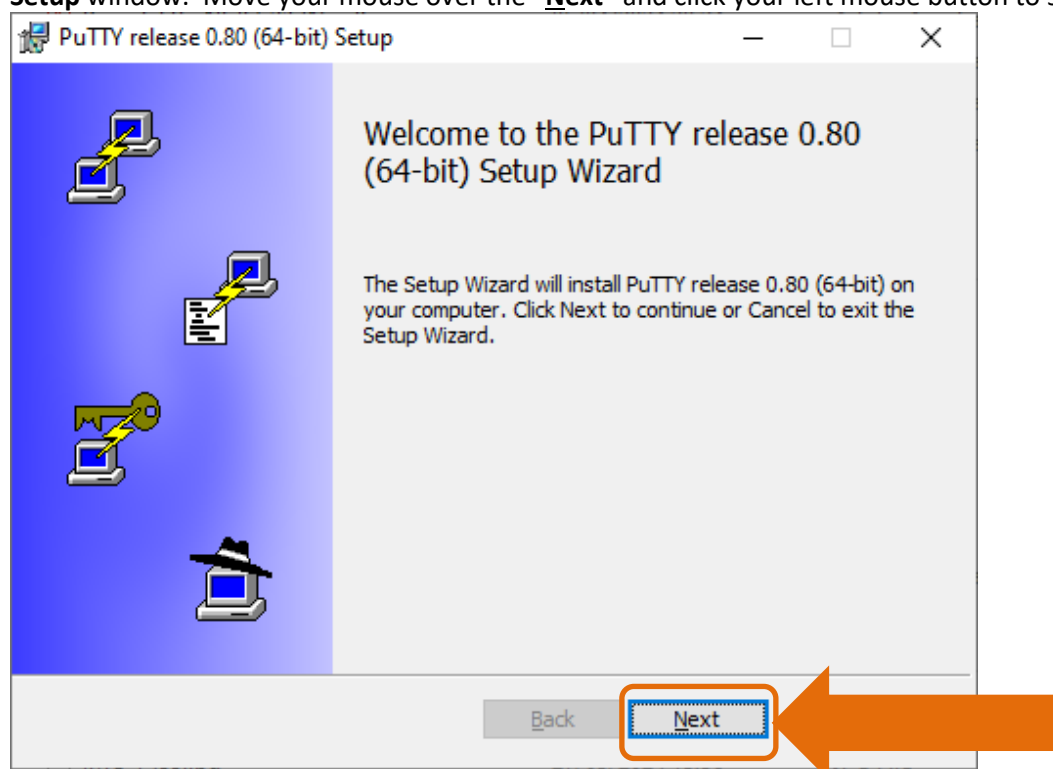
2. Select the appropriate package file from the list provided – in this case 64-bit x86.



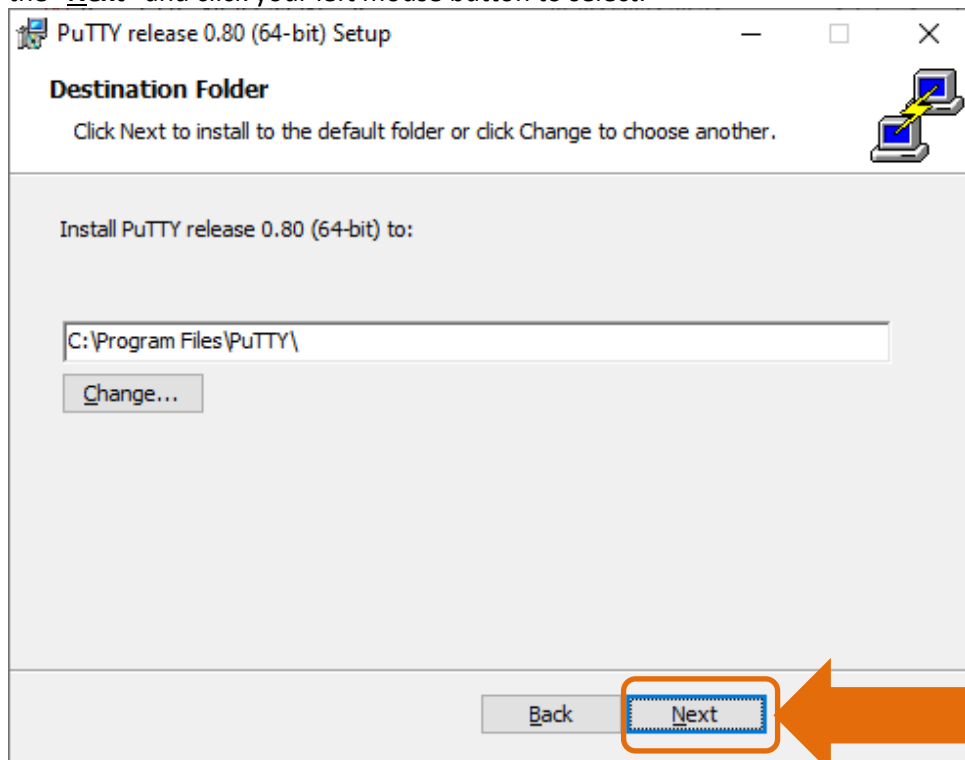
3. Go to your Downloads folder and locate the PuTTY file you just downloaded.



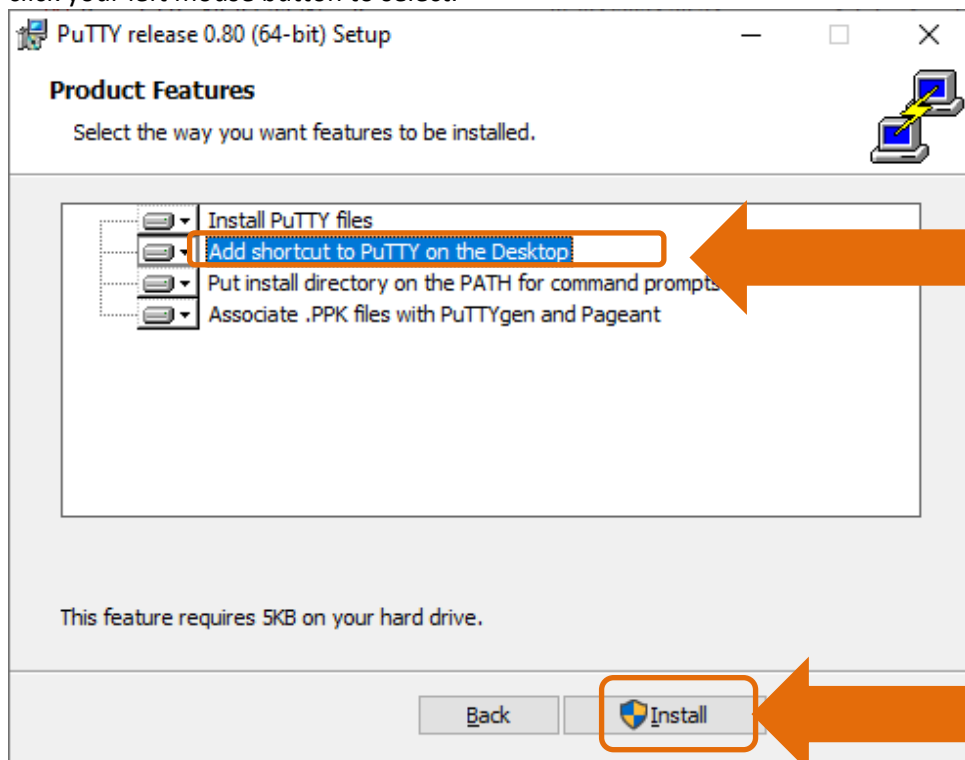
4. Double click on the putty-64bit file to run and you will be presented with a **PuTTY release Setup** window. Move your mouse over the “**Next**” and click your left mouse button to select



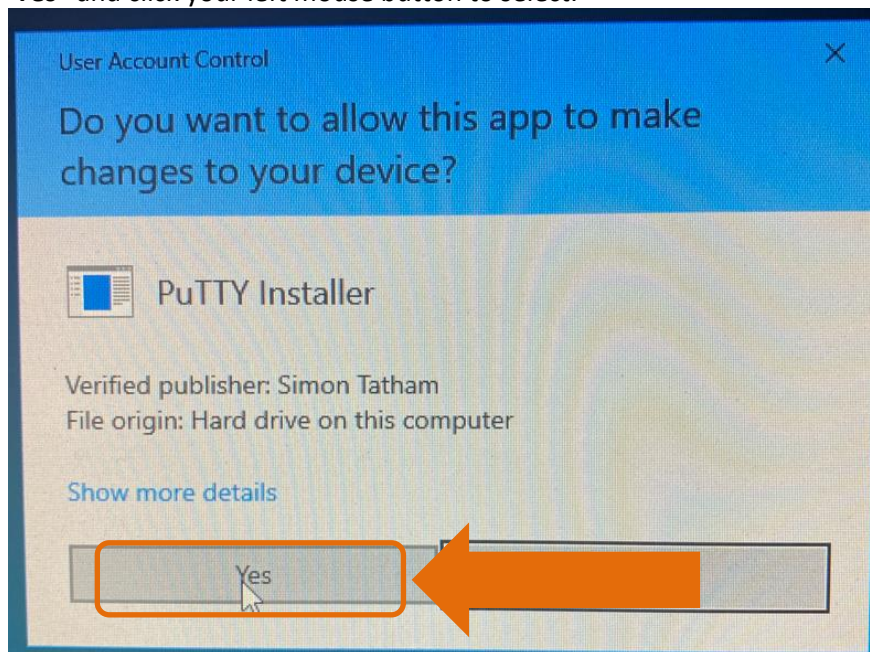
5. You will be asked where you want PuTTY installed – go with default. Move your mouse over the “**N**ext” and click your left mouse button to select.



6. You will be asked about **Product Features** for PuTTY. Select “**A**dd shortcut to PuTTY on the Desktop” – will be installed on local hard drive. Move your mouse over the “**I**nstall” and click your left mouse button to select.



7. You will be presented with a Windows confirmation screen. Move your mouse over the “Yes” and click your left mouse button to select.



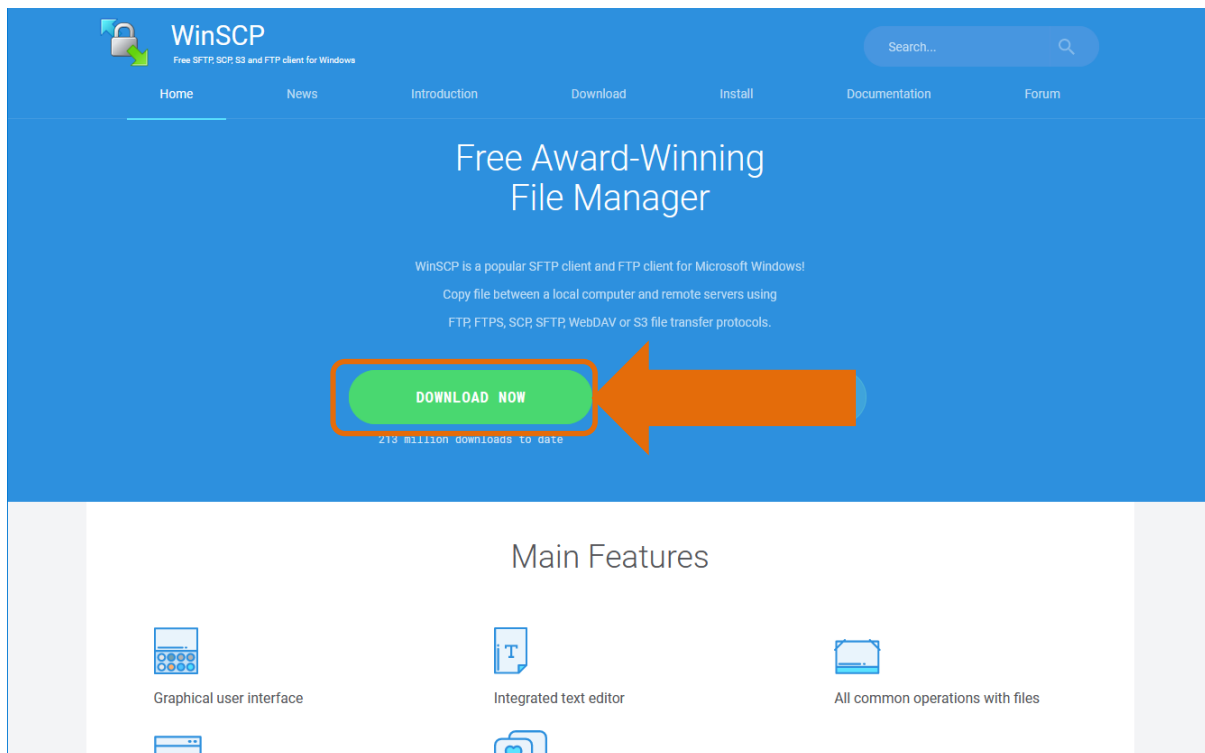
8. PuTTY will finish installing and present the following window when complete. Move your mouse over the “Finish” and click your left mouse button to select. You can deselect the View README file if desired.



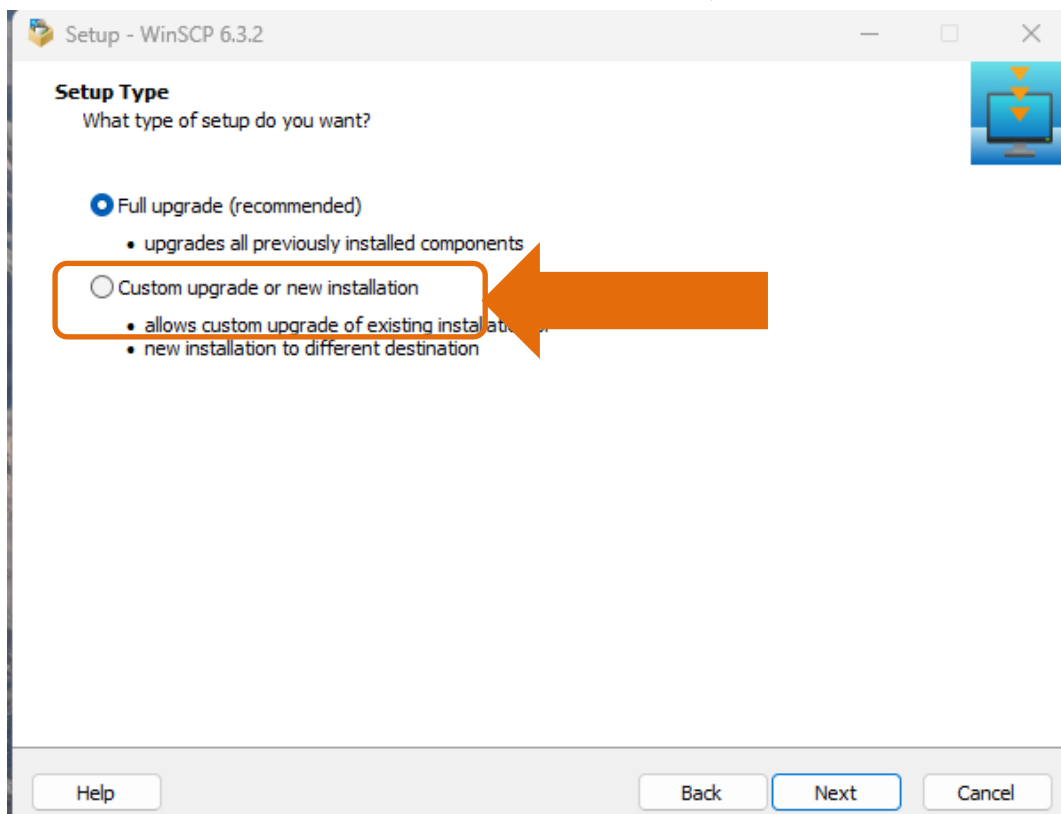
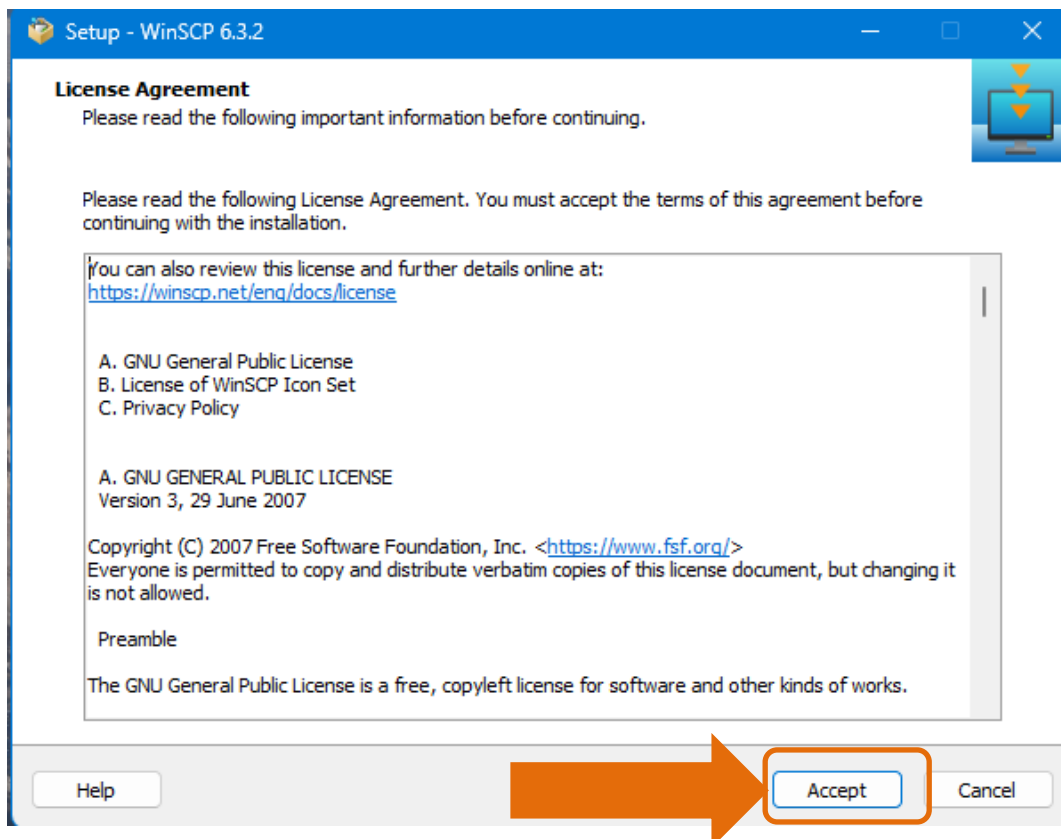
9. There should now be a short-cut icon on your desktop for PuTTY

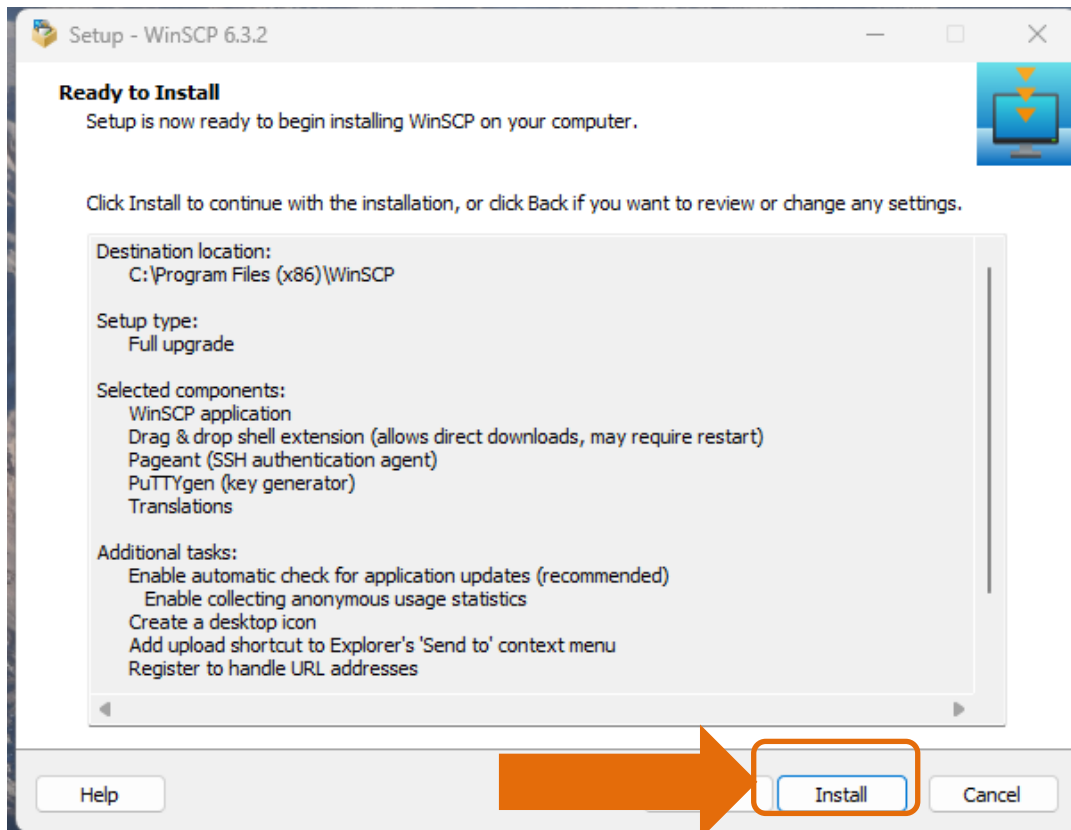
Installing WinSCP

1. Use the following link to access WinSCP: <https://winscp.net/eng/index.php>. Click on the link “Download Now”.

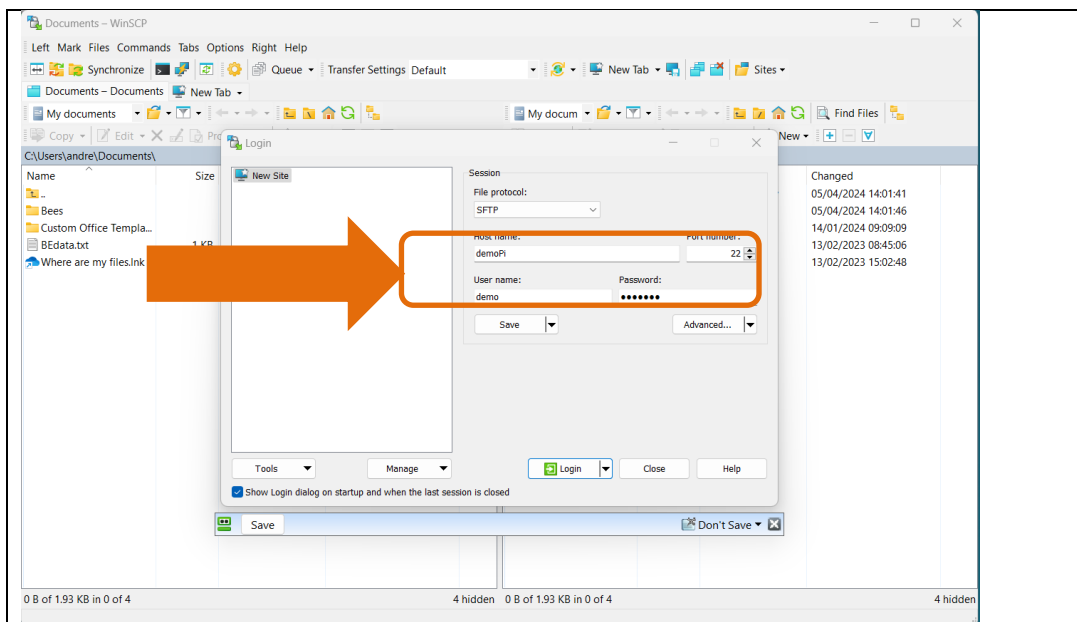


This will download an installation programme. Double click on the file to execute it.

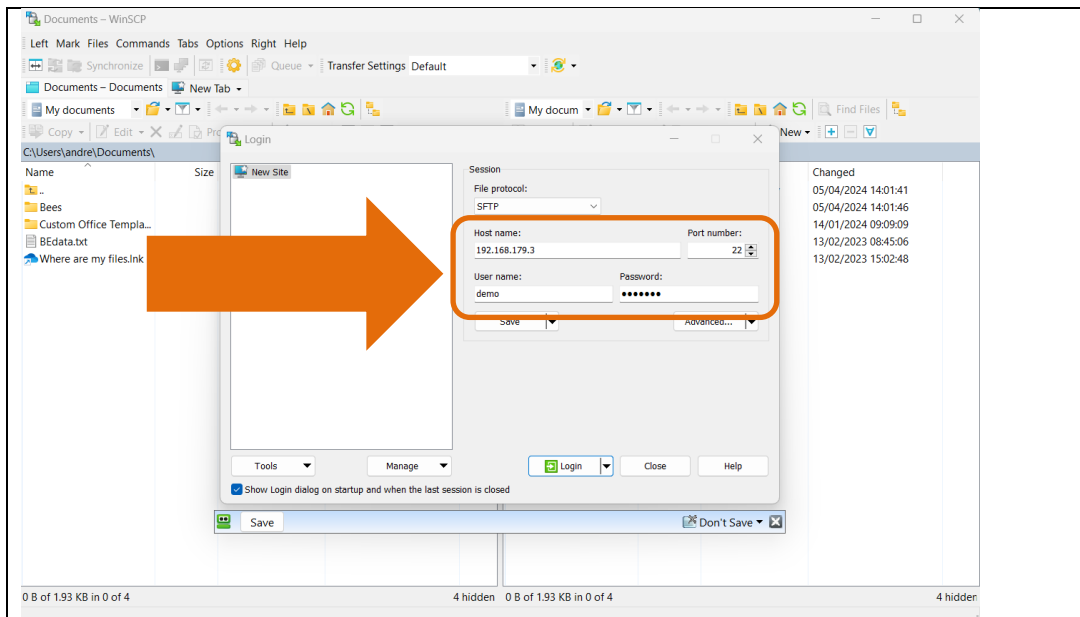




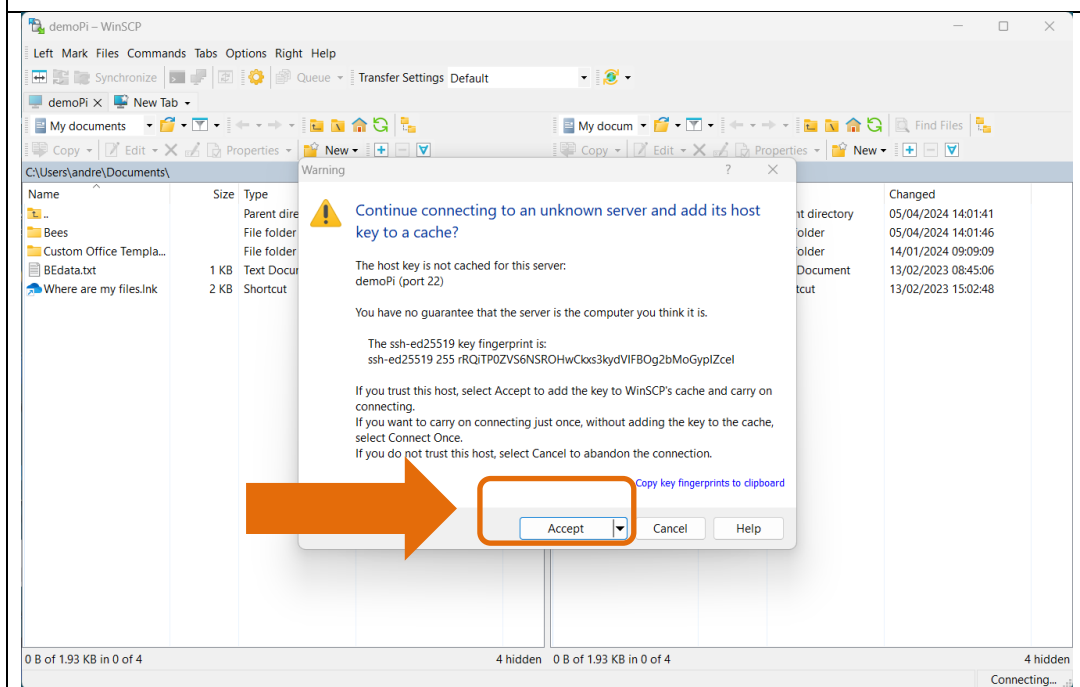
Next Launch the installed WinSCP programme. The next screenshots are a brief introduction to WinSCP and show how to connect to a RaspberryPi.



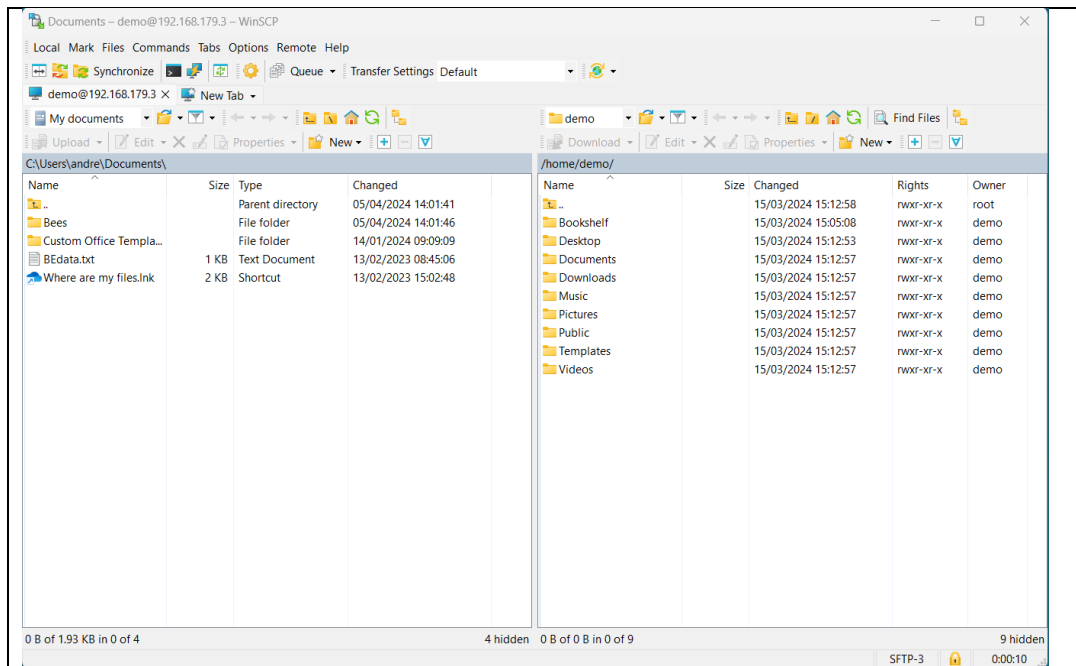
Enter the host name, user name and password. This is either be the host name configured on the microSD card or the RaspberryPi's ip address. This screen uses the device's host name.



Enter the host name, user name and password. This is either be the host name configured on the microSD card or the RaspberryPi's ip address. This screen shows the device's ip address



Accept the security screen



The left panel shows the windows pc user's documents directory. Navigation is similar to Windows Explorer.

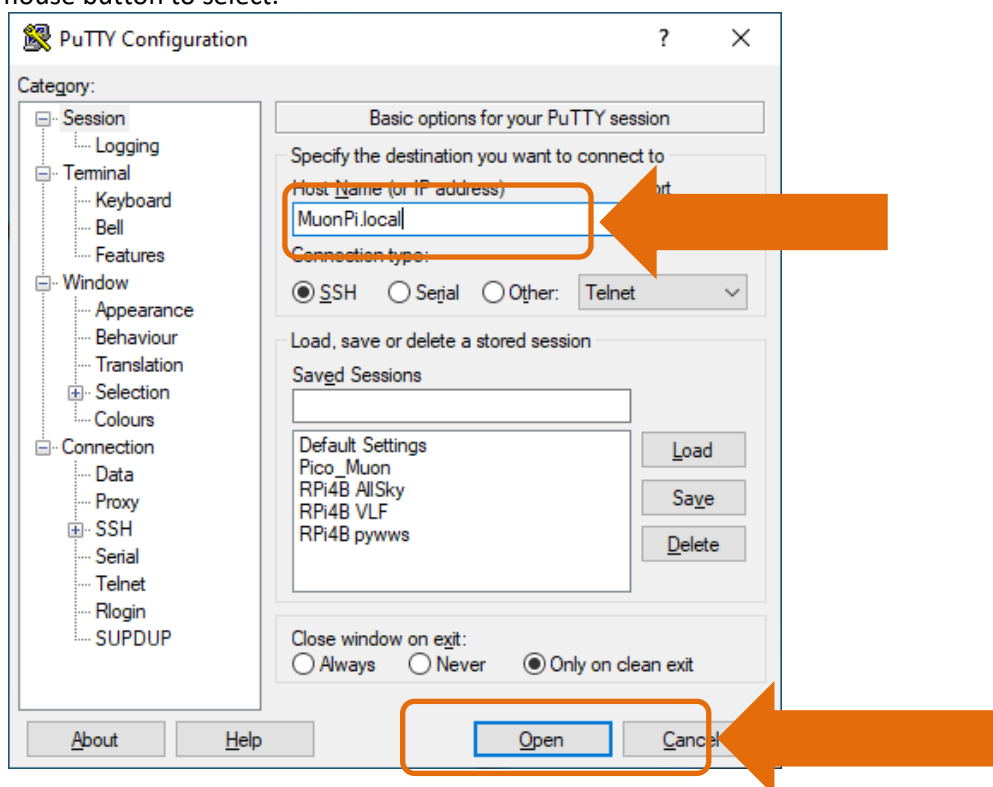
The right panel is the home directory on the RaspberryPi. Navigation is similar to Windows Explorer.

Turn on your Raspberry Pi and connect to it with PuTTY

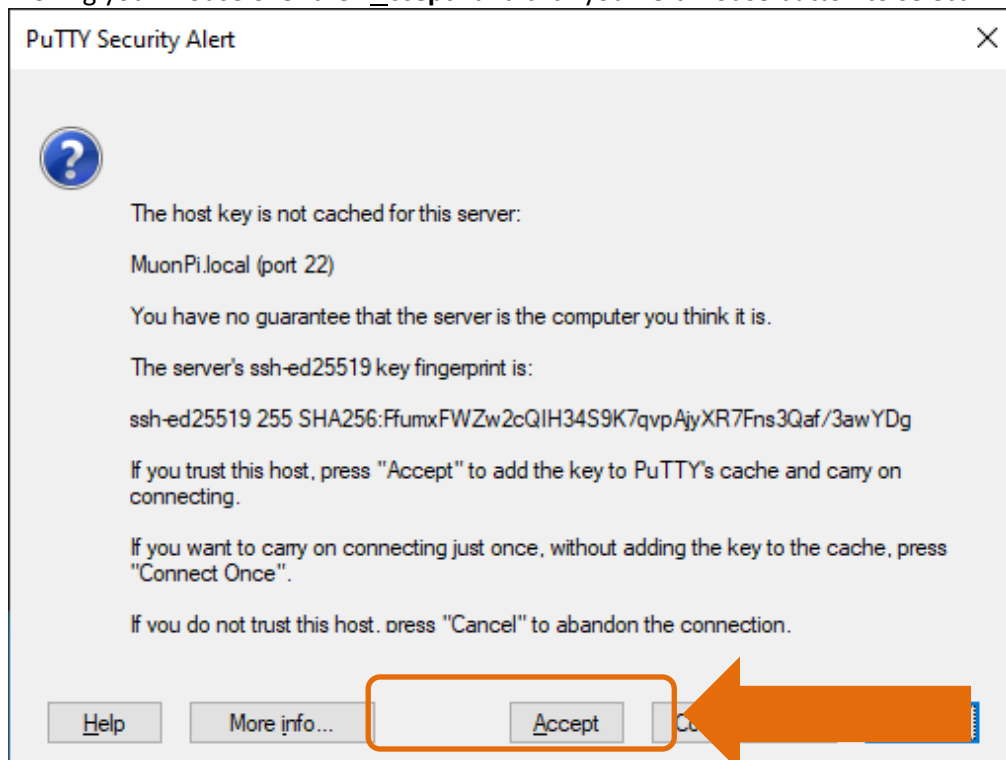
1. Insert the microSD card into your Raspberry Pi
2. If using Ethernet – connect CAT5 cable from your home network to the Raspberry Pi.
3. Connect suitable power supply to your Raspberry Pi.
4. Turn power on – we should see solid red LED on Raspberry Pi illuminated (correct power) as well as flashing green LED (program running).
5. Let us connect to the Raspberry Pi using PuTTY.



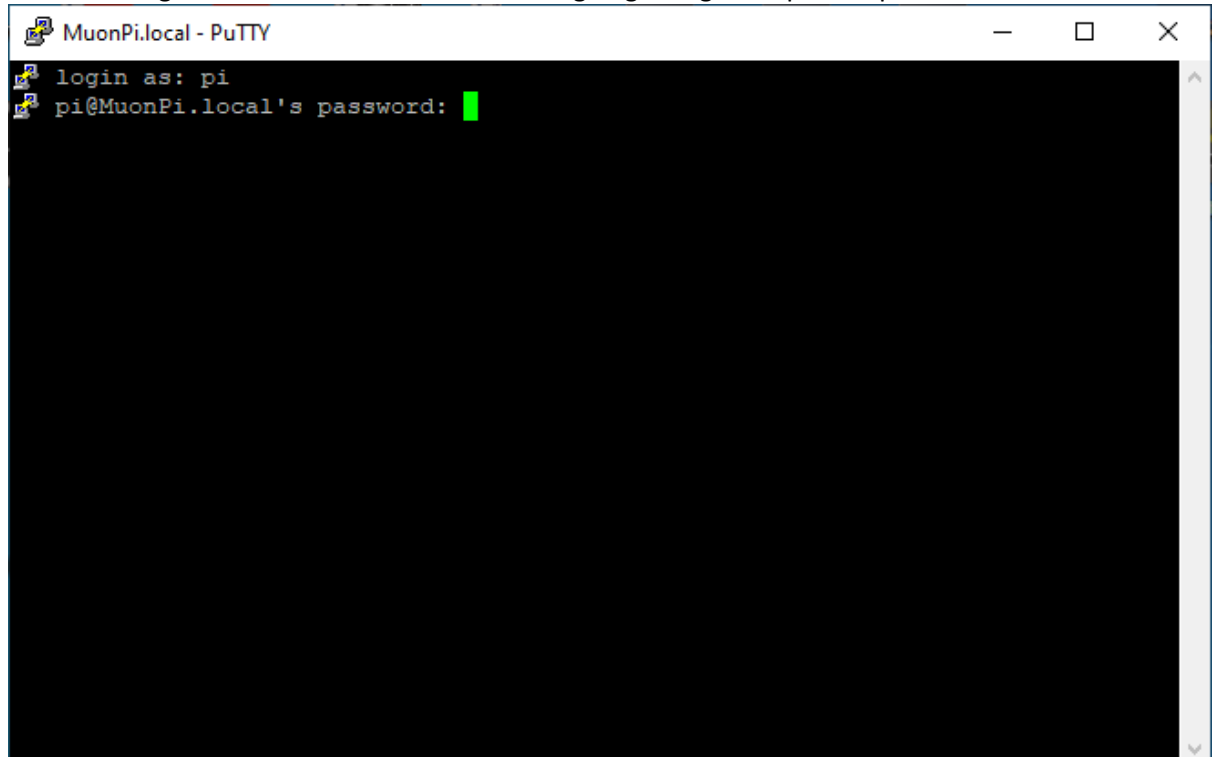
6. Open PuTTY using the desktop shortcut
7. We see the **PuTTY Configuration** window. We are going to enter the name we gave to the Raspberry Pi into the Host Name box – for us it was **MuonPi.local**, next we are going to connect to the Raspberry Pi by moving your mouse over the “**O**pen” and click your left mouse button to select.



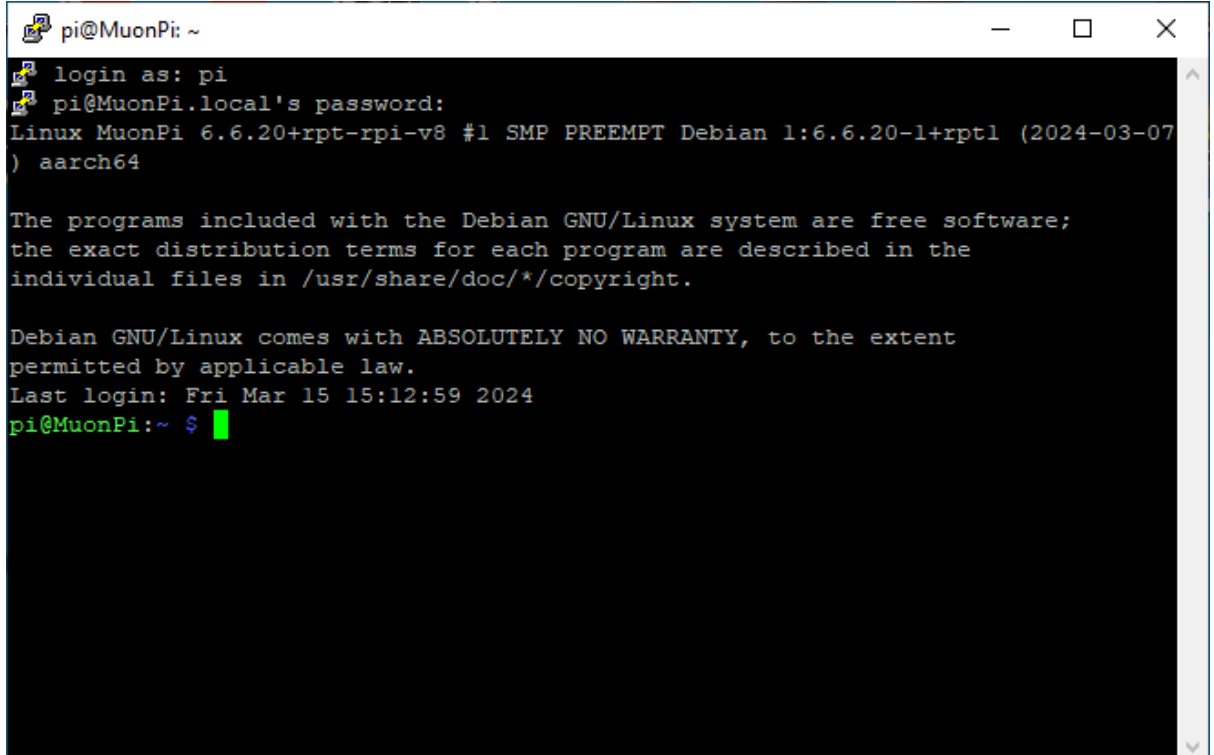
8. We will now get a **PuTTY Security Alert** window, as this is the first time we have accessed the Raspberry Pi. We are going to accept the notice and connect to the Raspberry Pi by moving your mouse over the **“Accept”** and click your left mouse button to select.



9. This will bring us to a terminal window. We are going to login as “pi” and press return

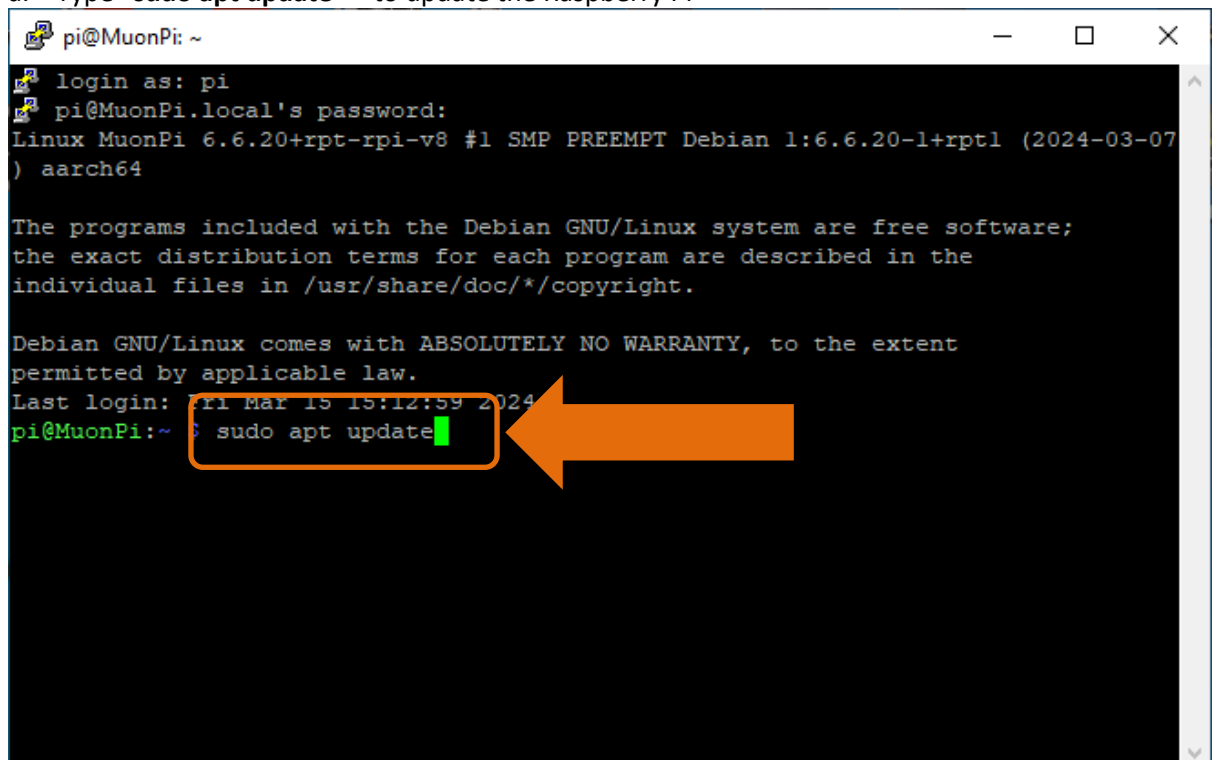


10. We will then enter the password for the pi – PassWord, and now we are in the Raspberry Pi.



```
pi@MuonPi: ~  
login as: pi  
pi@MuonPi.local's password:  
Linux MuonPi 6.6.20+rpt-rpi-v8 #1 SMP PREEMPT Debian 1:6.6.20-1+rpt1 (2024-03-07)  
) aarch64  
  
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: Fri Mar 15 15:12:59 2024  
pi@MuonPi:~ $
```

11. Two commands to start with
a. Type “**sudo apt update**” – to update the Raspberry Pi



```
pi@MuonPi: ~  
login as: pi  
pi@MuonPi.local's password:  
Linux MuonPi 6.6.20+rpt-rpi-v8 #1 SMP PREEMPT Debian 1:6.6.20-1+rpt1 (2024-03-07)  
) aarch64  
  
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: Fri Mar 15 15:12:59 2024  
pi@MuonPi:~ $ sudo apt update
```

- b. There may be some packages that need to be updated and this will occur automatically. You will also be informed if there are any packages that need upgrading – in this case 20

```
pi@MuonPi: ~  
permitted by applicable law.  
Last login: Fri Mar 15 15:12:59 2024  
pi@MuonPi:~ $ sudo apt update  
Hit:1 http://deb.debian.org/debian bookworm InRelease  
Get:2 http://deb.debian.org/debian-security bookworm-security InRelease [48.0 kB]  
Get:3 http://archive.raspberrypi.com/debian bookworm InRelease [23.6 kB]  
Get:4 http://deb.debian.org/debian bookworm-updates InRelease [55.4 kB]  
Get:5 http://archive.raspberrypi.com/debian bookworm/main arm64 Packages [374 kB]  
Get:6 http://archive.raspberrypi.com/debian bookworm/main armhf Packages [383 kB]  
Get:7 http://deb.debian.org/debian-security bookworm-security/main arm64 Packages [147 kB]  
Get:8 http://deb.debian.org/debian-security bookworm-security/main armhf Packages [144 kB]  
Get:9 http://deb.debian.org/debian-security bookworm-security/main Translation-en [90.3 kB]  
Fetched 1,210 kB in 1s (1,191 kB/s)  
Reading package lists... Done  
Building dependency tree... Done  
Reading state information... Done  
20 packages can be upgraded. Run 'apt list --upgradable' to see them.  
pi@MuonPi:~ $
```

- c. Type “**sudo apt upgrade**” – to upgrade the packages

```
pi@MuonPi: ~  
permitted by applicable law.  
Last login: Fri Mar 15 15:12:59 2024  
pi@MuonPi:~ $ sudo apt update  
Hit:1 http://deb.debian.org/debian bookworm InRelease  
Get:2 http://deb.debian.org/debian-security bookworm-security InRelease [48.0 kB]  
Get:3 http://archive.raspberrypi.com/debian bookworm InRelease [23.6 kB]  
Get:4 http://deb.debian.org/debian bookworm-updates InRelease [55.4 kB]  
Get:5 http://archive.raspberrypi.com/debian bookworm/main arm64 Packages [374 kB]  
Get:6 http://archive.raspberrypi.com/debian bookworm/main armhf Packages [383 kB]  
Get:7 http://deb.debian.org/debian-security bookworm-security/main arm64 Packages [147 kB]  
Get:8 http://deb.debian.org/debian-security bookworm-security/main armhf Packages [144 kB]  
Get:9 http://deb.debian.org/debian-security bookworm-security/main Translation-en [90.3 kB]  
Fetched 1,210 kB in 1s (1,191 kB/s)  
Reading package lists... Done  
Building dependency tree... Done  
Reading state information... Done  
20 packages can be upgraded. Run 'apt list --upgradable' to see them.  
pi@MuonPi:~ $ sudo apt upgrade
```

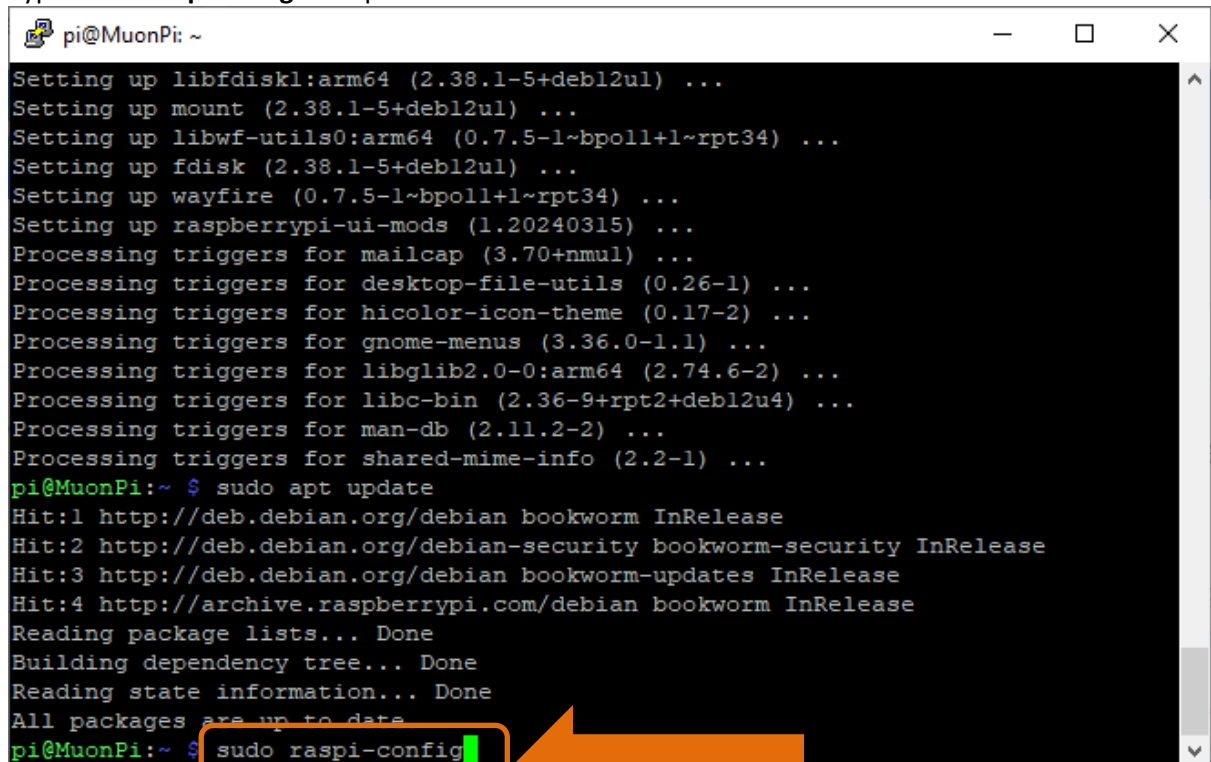
- d. You will be asked if you want to continue – type **Y** and press enter to continue. The packages will be downloaded automatically and installed on the Raspberry Pi

```
pi@MuonPi: ~  
Get:7 http://deb.debian.org/debian-security bookworm-security/main arm64 Package  
s [147 kB]  
Get:8 http://deb.debian.org/debian-security bookworm-security/main armhf Package  
s [144 kB]  
Get:9 http://deb.debian.org/debian-security bookworm-security/main Translation-e  
n [90.3 kB]  
Fetched 1,210 kB in 1s (1,191 kB/s)  
Reading package lists... Done  
Building dependency tree... Done  
Reading state information... Done  
20 packages can be upgraded. Run 'apt list --upgradable' to see them.  
pi@MuonPi:~ $ sudo apt upgrade  
Reading package lists... Done  
Building dependency tree... Done  
Reading state information... Done  
Calculating upgrade... Done  
The following packages will be upgraded:  
  bsdxtrautils bsdxutils eject fdisk firefox gui-pkinst libblkid1 libfdisk1  
  libmount1 libsmartcols1 libuuid1 libwfs-utils0 mount piwiz  
  raspberrypi-ui-mods raspi-utils rfdisk util-linux util-linux-extra wayfire  
20 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.  
Need to get 67.1 MB of archives.  
After this operation, 1,252 kB of additional disk space will be used.  
Do you want to continue? [Y/n] Y
```

- e. When upgrade has finished you may be informed that there are some packages that are no longer needed – in this case none

```
pi@MuonPi: ~  
Setting up bsdxtrautils (2.38.1-5+deb12u1) ...  
Setting up firefox (124.0.1-1+rpt4) ...  
Setting up raspi-utils (20240402-1) ...  
Setting up gui-pkinst (0.15) ...  
Setting up eject (2.38.1-5+deb12u1) ...  
Setting up rfdisk (2.38.1-5+deb12u1) ...  
Setting up piwiz (0.68) ...  
Setting up libfdisk1:arm64 (2.38.1-5+deb12u1) ...  
Setting up mount (2.38.1-5+deb12u1) ...  
Setting up libwfs-utils0:arm64 (0.7.5-1~bpo11+1~rpt34) ...  
Setting up fdisk (2.38.1-5+deb12u1) ...  
Setting up wayfire (0.7.5-1~bpo11+1~rpt34) ...  
Setting up raspberrypi-ui-mods (1.20240315) ...  
Processing triggers for mailcap (3.70+nmu1) ...  
Processing triggers for desktop-file-utils (0.26-1) ...  
Processing triggers for hicolor-icon-theme (0.17-2) ...  
Processing triggers for gnome-menus (3.36.0-1.1) ...  
Processing triggers for libglib2.0-0:arm64 (2.74.6-2) ...  
Processing triggers for libc-bin (2.36-9+rpt2+deb12u4) ...  
Processing triggers for man-db (2.11.2-2) ...  
Processing triggers for shared-mime-info (2.2-1) ...  
pi@MuonPi:~ $
```

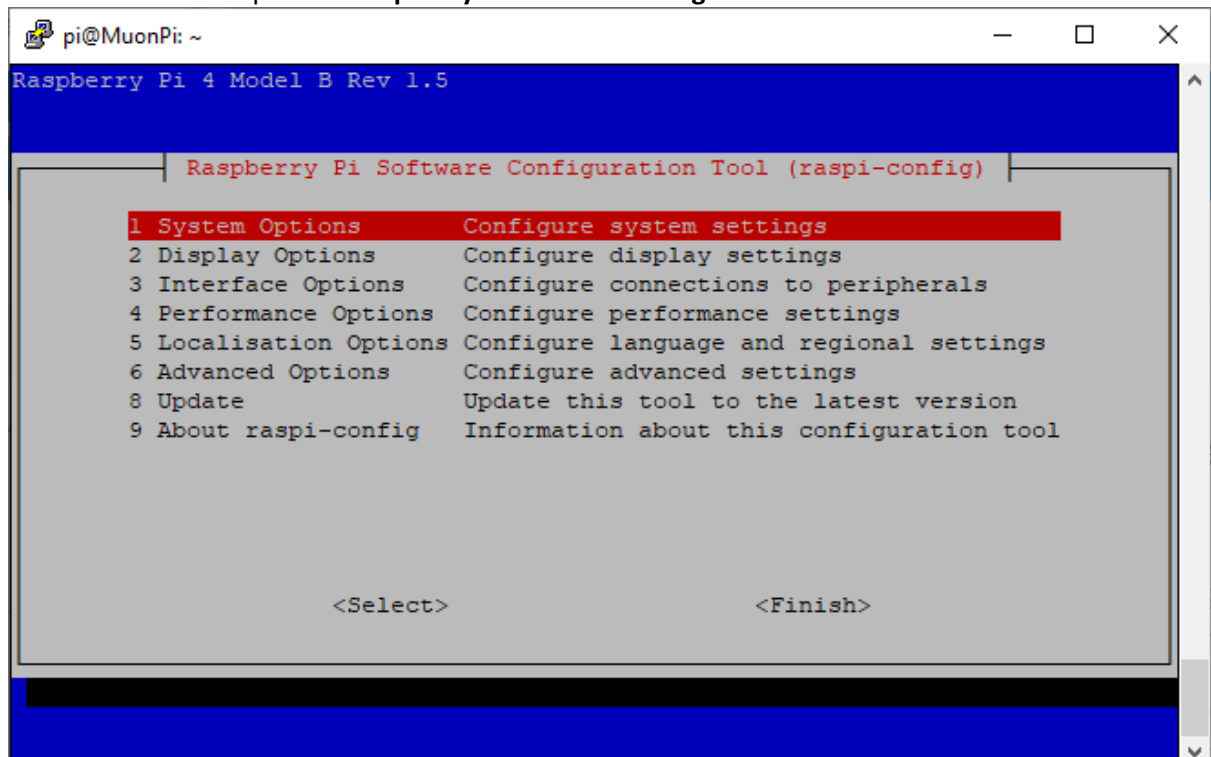

12. We now need to set the Raspberry Pi up to be accessible through a Virtual Network Connection “VNC”. We do this through the raspberry pi configuration program
13. Type “**sudo raspi-config**” and press enter



```
pi@MuonPi: ~  
Setting up libfdisk1:arm64 (2.38.1-5+deb12u1) ...  
Setting up mount (2.38.1-5+deb12u1) ...  
Setting up libwf-utils0:arm64 (0.7.5-1~bpo11+1~rpt34) ...  
Setting up fdisk (2.38.1-5+deb12u1) ...  
Setting up wayfire (0.7.5-1~bpo11+1~rpt34) ...  
Setting up raspberrypi-ui-mods (1.20240315) ...  
Processing triggers for mailcap (3.70+nmul) ...  
Processing triggers for desktop-file-utils (0.26-1) ...  
Processing triggers for hicolor-icon-theme (0.17-2) ...  
Processing triggers for gnome-menus (3.36.0-1.1) ...  
Processing triggers for libglib2.0-0:arm64 (2.74.6-2) ...  
Processing triggers for libc-bin (2.36-9+rpt2+deb12u4) ...  
Processing triggers for man-db (2.11.2-2) ...  
Processing triggers for shared-mime-info (2.2-1) ...  
pi@MuonPi:~ $ sudo apt update  
Hit:1 http://deb.debian.org/debian bookworm InRelease  
Hit:2 http://deb.debian.org/debian-security bookworm-security InRelease  
Hit:3 http://deb.debian.org/debian bookworm-updates InRelease  
Hit:4 http://archive.raspberrypi.com/debian bookworm InRelease  
Reading package lists... Done  
Building dependency tree... Done  
Reading state information... Done  
All packages are up to date  
pi@MuonPi:~ $ sudo raspi-config
```

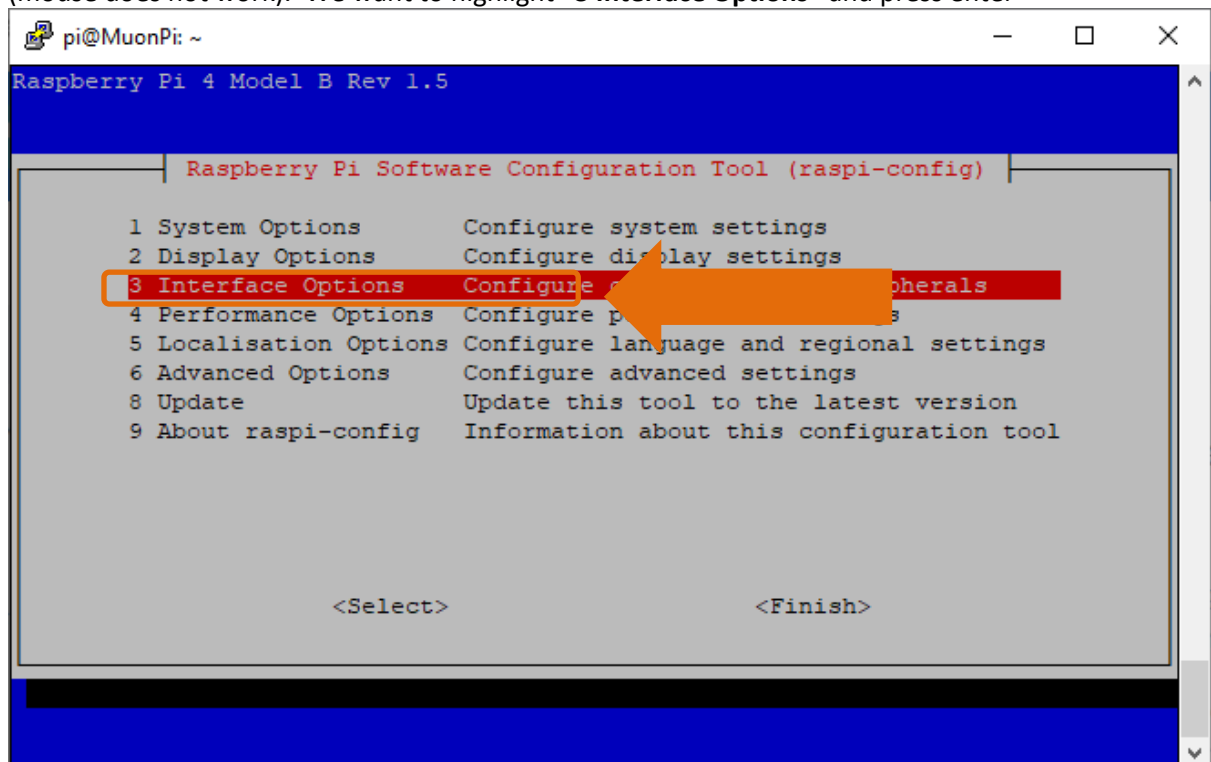
An orange arrow points from the terminal output to the next step.

14. This command will open the **Raspberry Pi Software Configuration Tool**

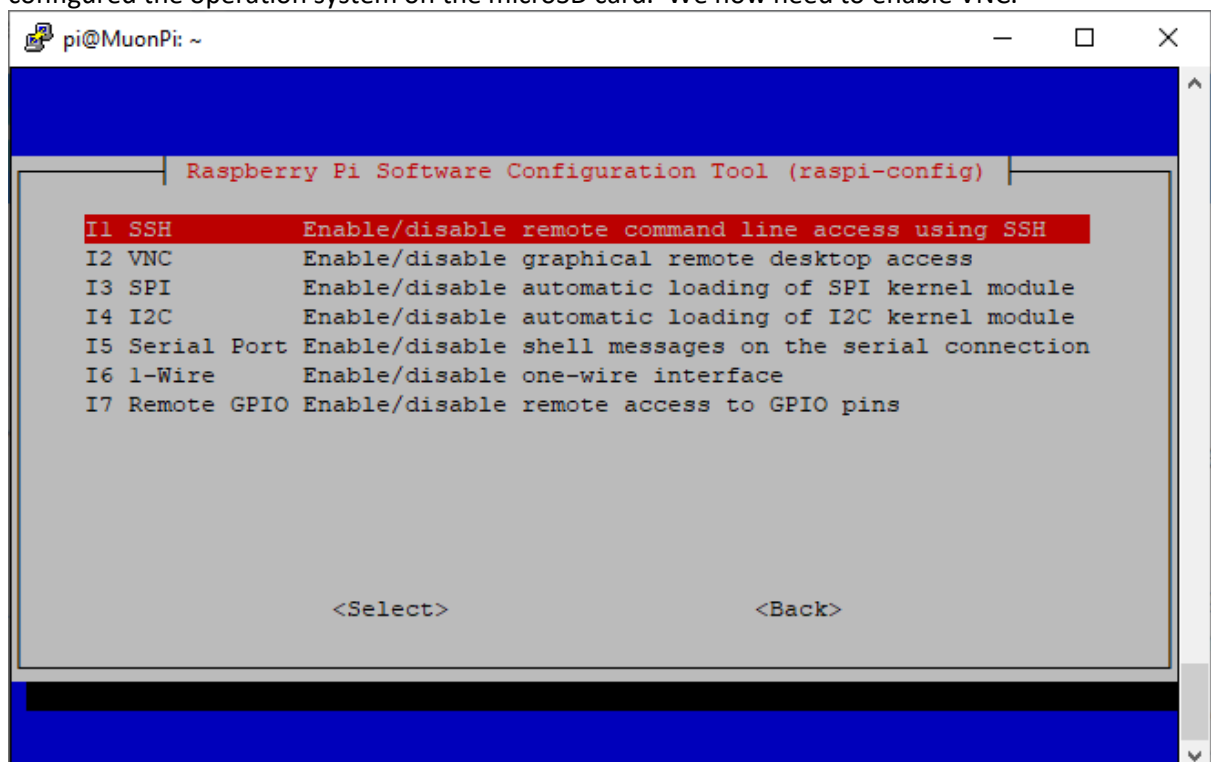


```
pi@MuonPi: ~  
Raspberry Pi 4 Model B Rev 1.5  
Raspberry Pi Software Configuration Tool (raspi-config)  
  
1 System Options          Configure system settings  
2 Display Options         Configure display settings  
3 Interface Options       Configure connections to peripherals  
4 Performance Options     Configure performance settings  
5 Localisation Options    Configure language and regional settings  
6 Advanced Options        Configure advanced settings  
8 Update                  Update this tool to the latest version  
9 About raspi-config      Information about this configuration tool  
  
<Select>                  <Finish>
```

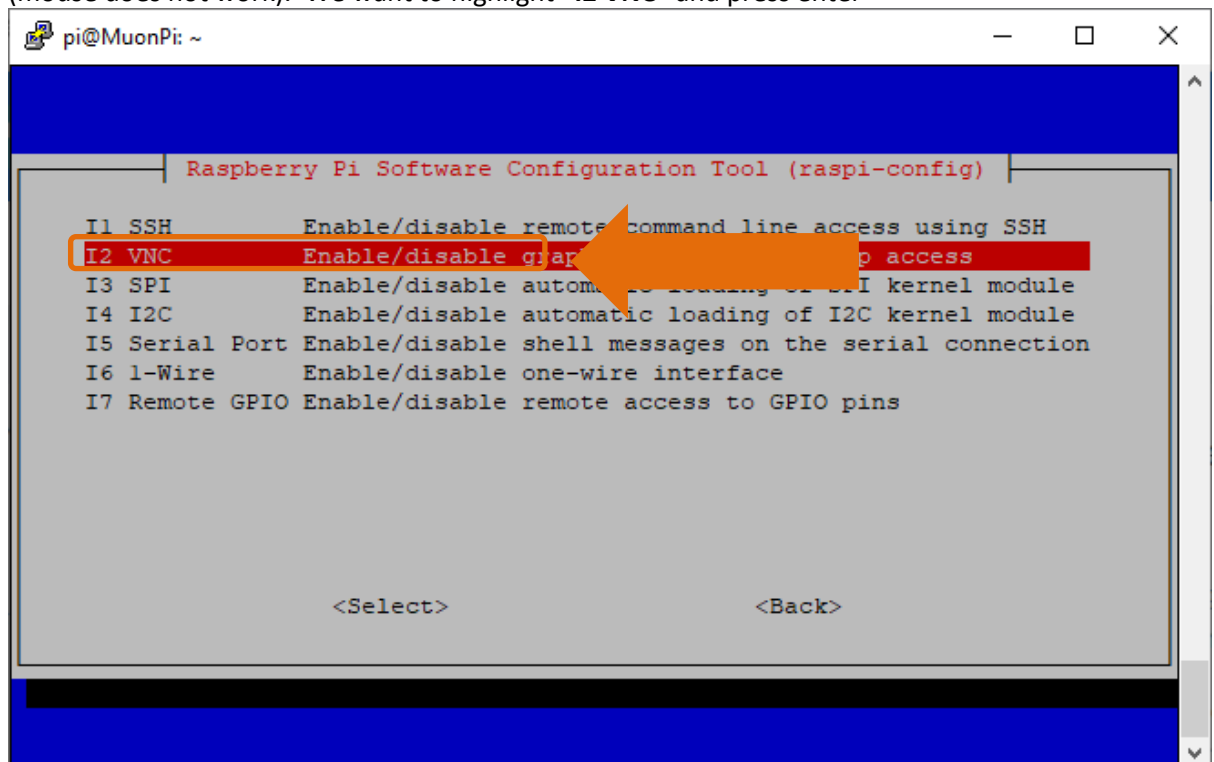
15. We can use the arrow keys on the keyboard to move the red highlighted cursor up or down (mouse does not work). We want to highlight **"3 Interface Options"** and press enter



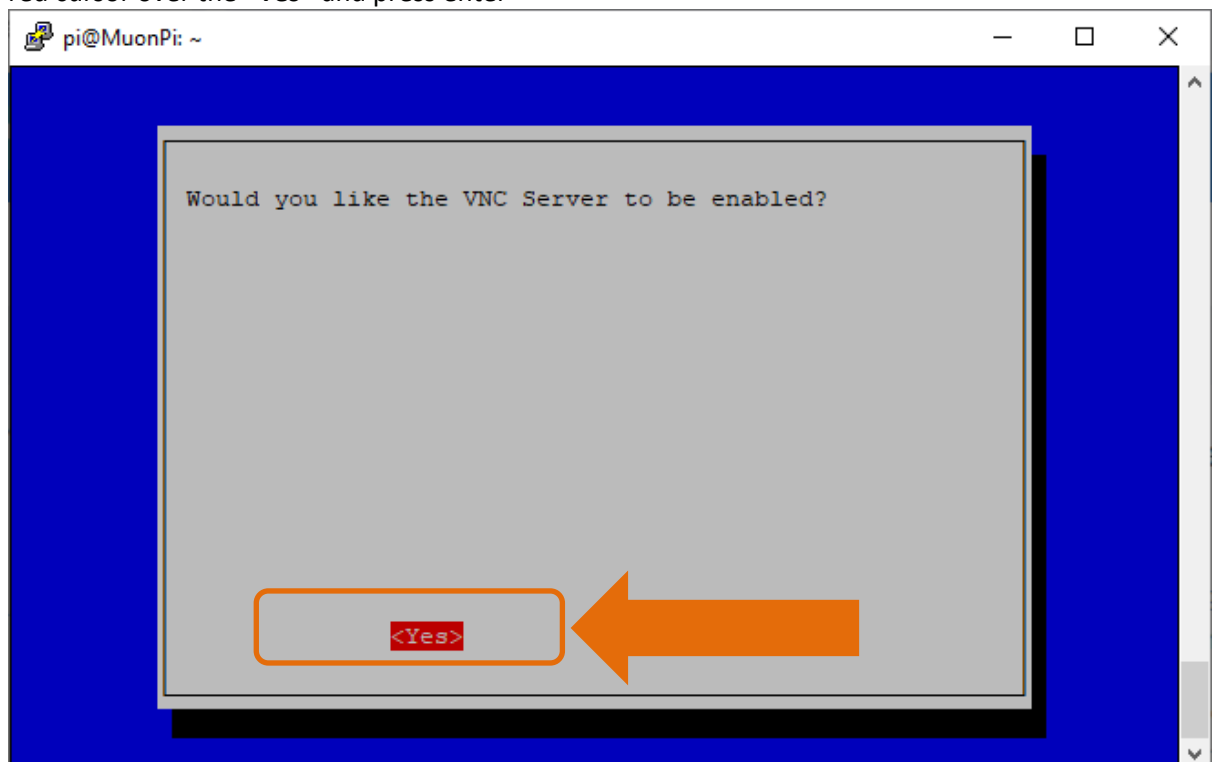
16. We now see the various interfaces available on the Raspberry Pi. We enabled SSH when we configured the operation system on the microSD card. We now need to enable VNC.



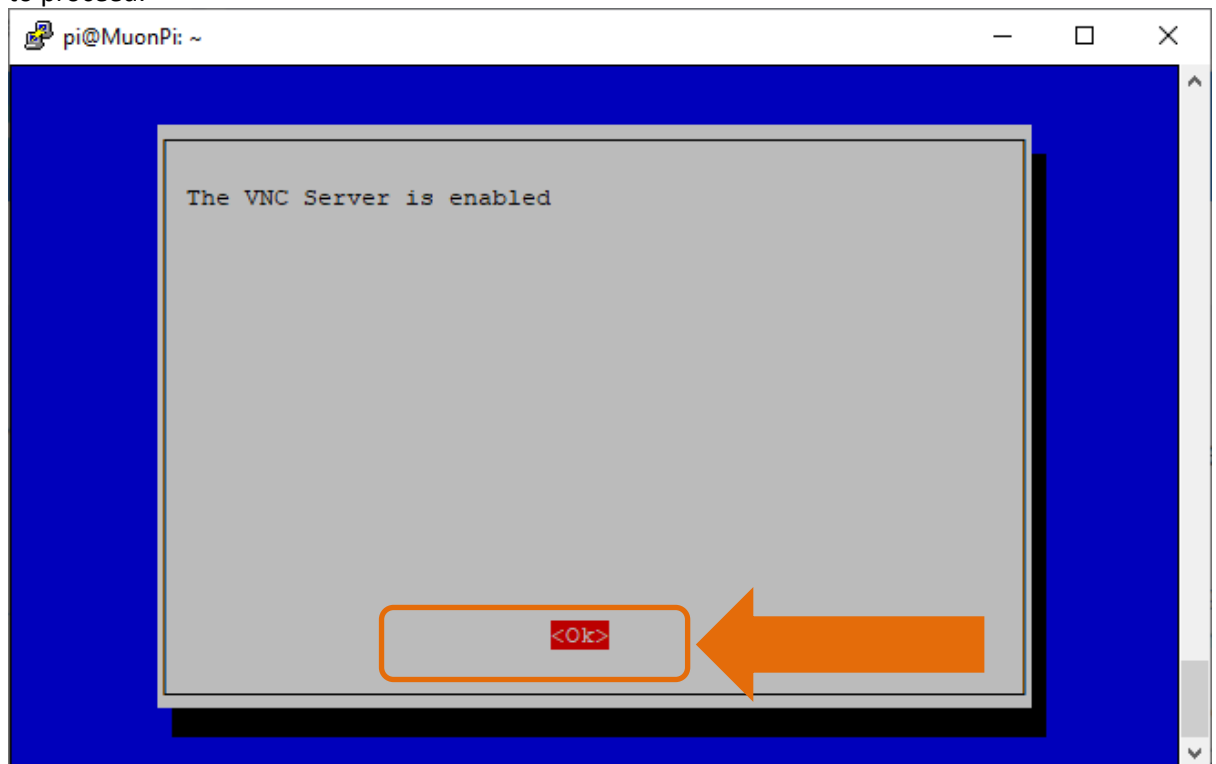
17. We can use the arrow keys on the keyboard to move the red highlighted cursor up or down (mouse does not work). We want to highlight “I2 VNC” and press enter



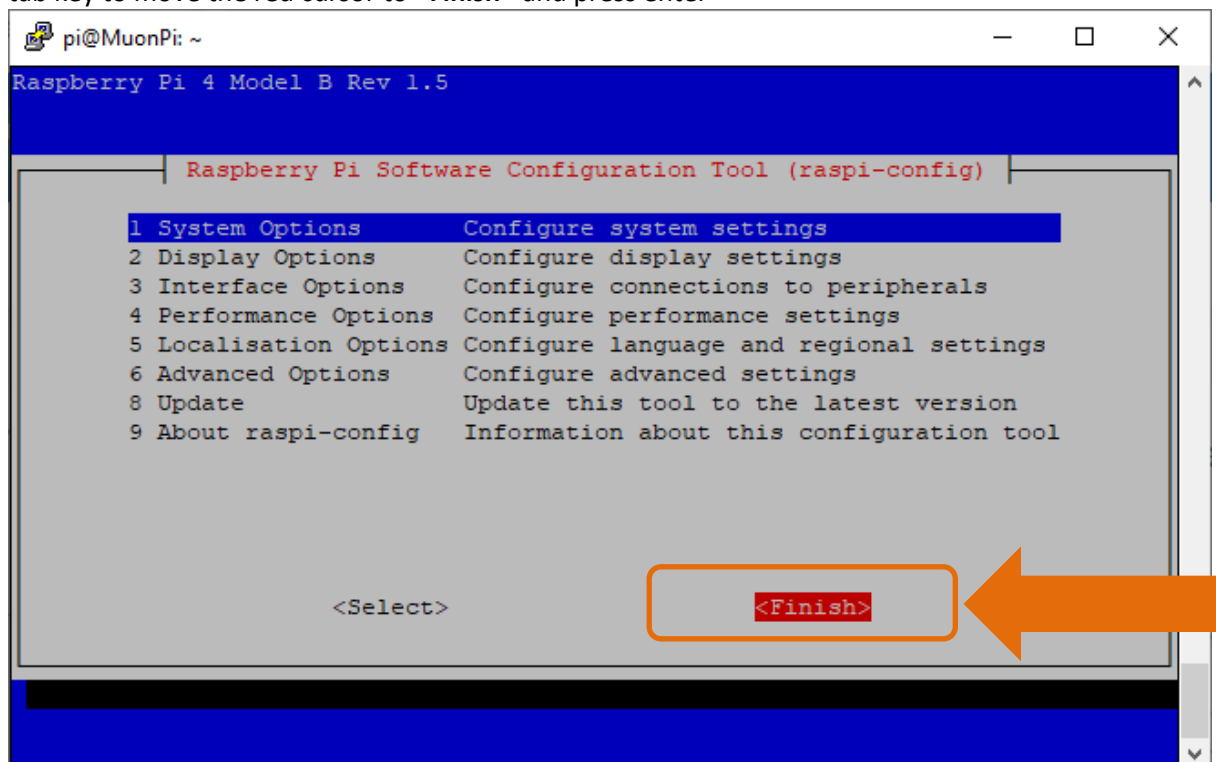
18. You will then be asked if you wish to enable VNC Server – press the “tab” key to move the red cursor over the <Yes> and press enter



19. You will then get a notification window to inform you that VNC server is enabled. Press enter to proceed.

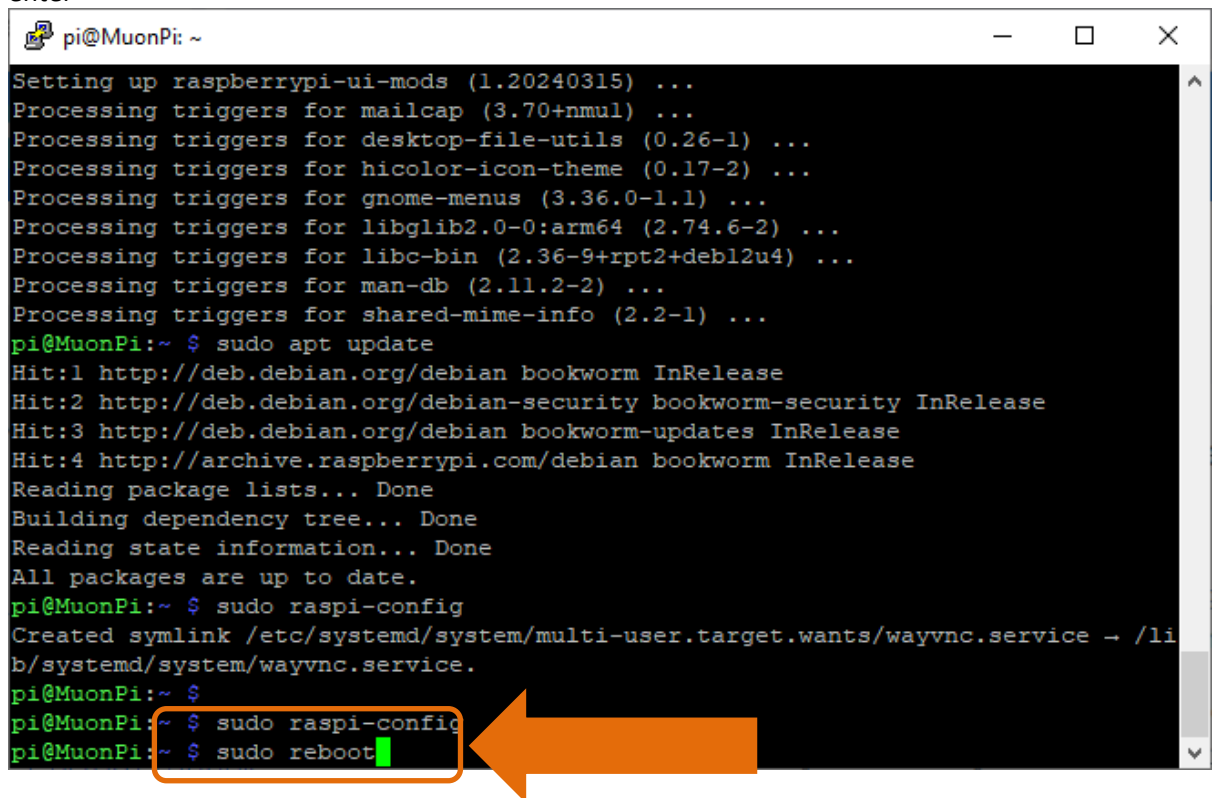


20. This takes you back to the **Raspberry Pi Software Configuration Tool** main menu – use the tab key to move the red cursor to **<Finish>** and press enter



21. We have now finished with PuTTY.

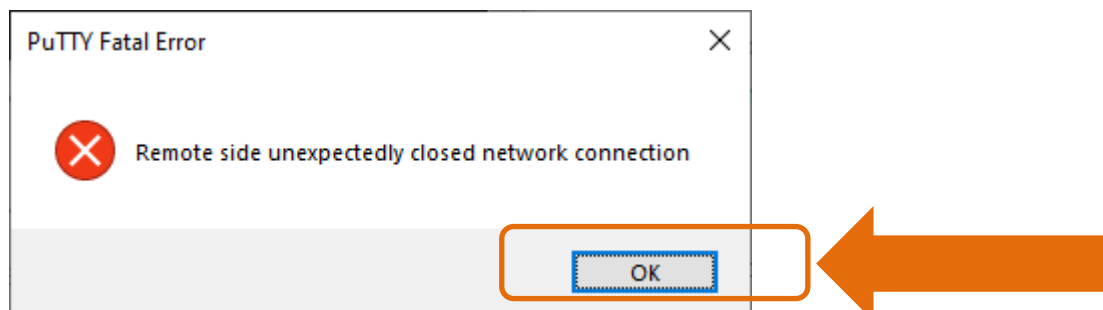
22. It is a good idea to reboot the pi. Enter the following command – **sudo reboot** and press enter



A terminal window titled 'pi@MuonPi: ~' showing the output of several commands. The commands executed are 'sudo apt update' and 'sudo raspi-config'. The output of 'sudo apt update' shows that all packages are up to date. The output of 'sudo raspi-config' shows that a symlink was created. The final command entered is 'sudo reboot', which is highlighted with an orange box and an orange arrow pointing to it.

```
pi@MuonPi:~ $ sudo apt update
Hit:1 http://deb.debian.org/debian bookworm InRelease
Hit:2 http://deb.debian.org/debian-security bookworm-security InRelease
Hit:3 http://deb.debian.org/debian bookworm-updates InRelease
Hit:4 http://archive.raspberrypi.com/debian bookworm InRelease
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
All packages are up to date.
pi@MuonPi:~ $ sudo raspi-config
Created symlink /etc/systemd/system/multi-user.target.wants/wayvnc.service → /lib/systemd/system/wayvnc.service.
pi@MuonPi:~ $
pi@MuonPi:~ $ sudo raspi-config
pi@MuonPi:~ $ sudo reboot
```

23. We will get a message from PuTTY that we have lost connection with the Raspberry Pi – this is okay

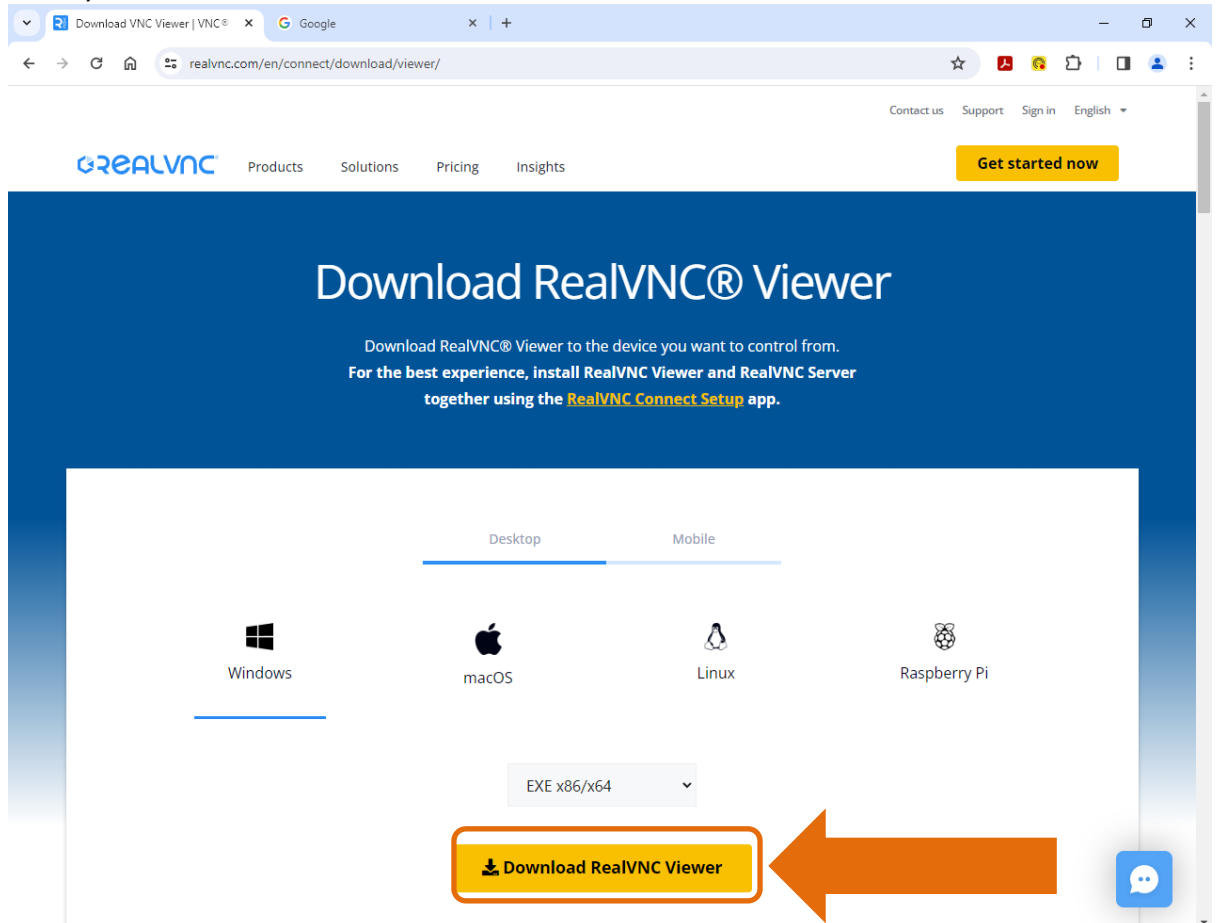


moving your mouse over the “OK” and click your left mouse button to select

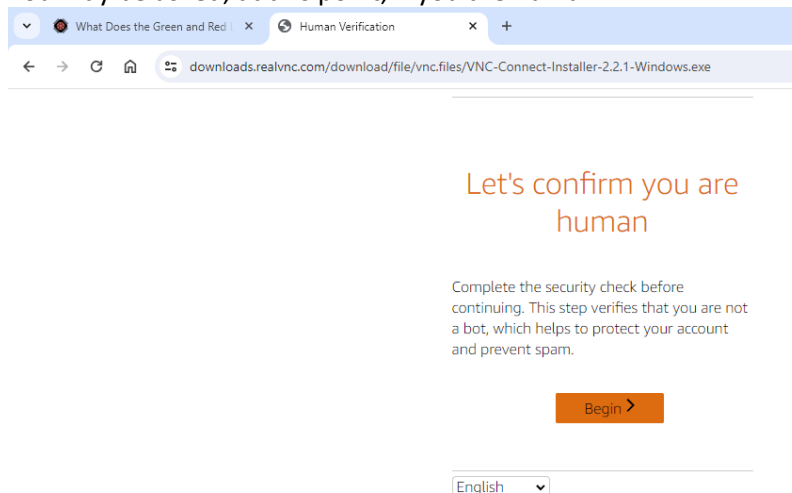
24. You can also close the open PuTTY terminal window as this is no longer needed.

Installing VNC viewer on your PC

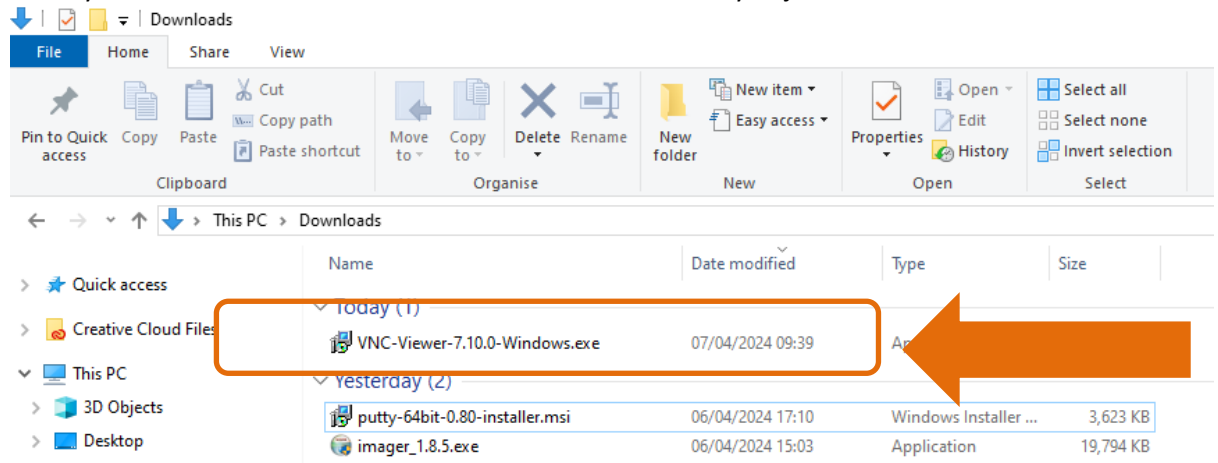
1. Use the following link to access VNC viewer:
<https://www.realvnc.com/en/connect/download/viewer/>
2. Move your mouse over **“Download RealVNC Viewer”** and double click



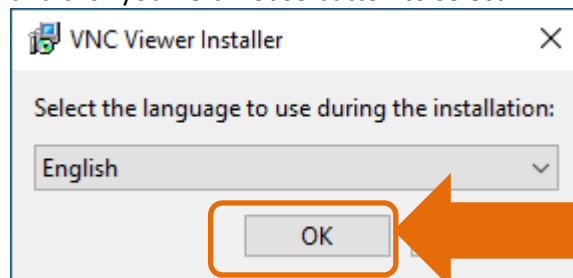
3. You may be asked, at this point, if you are human



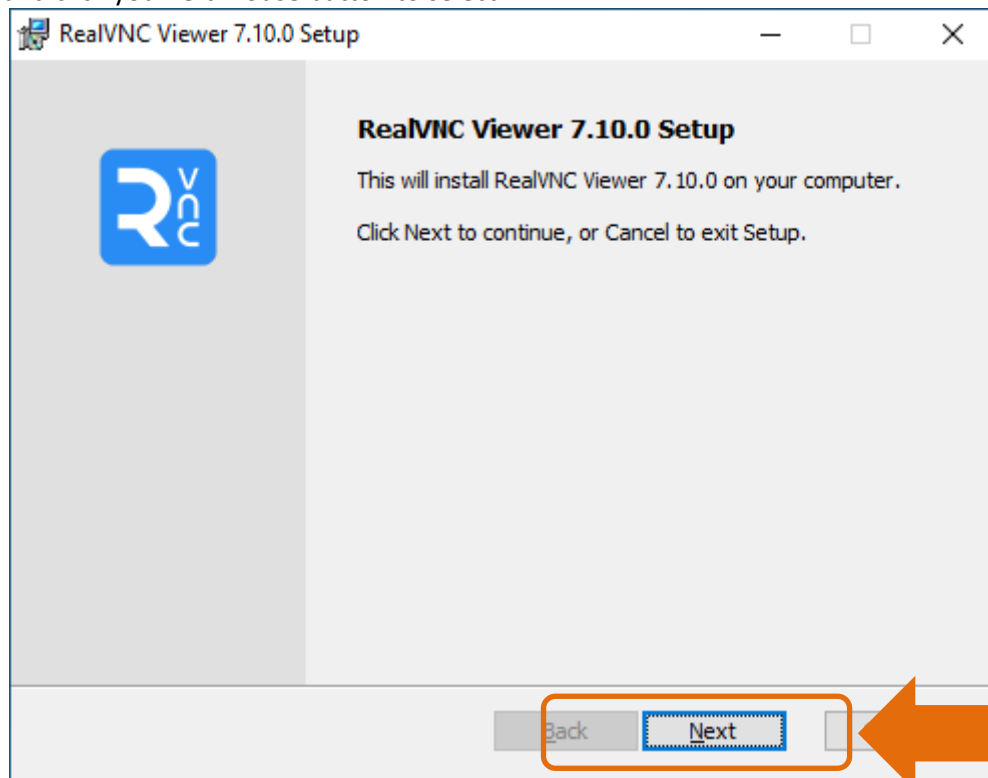
4. Go to your Downloads folder and locate the **VNC-viewer** file you just downloaded.



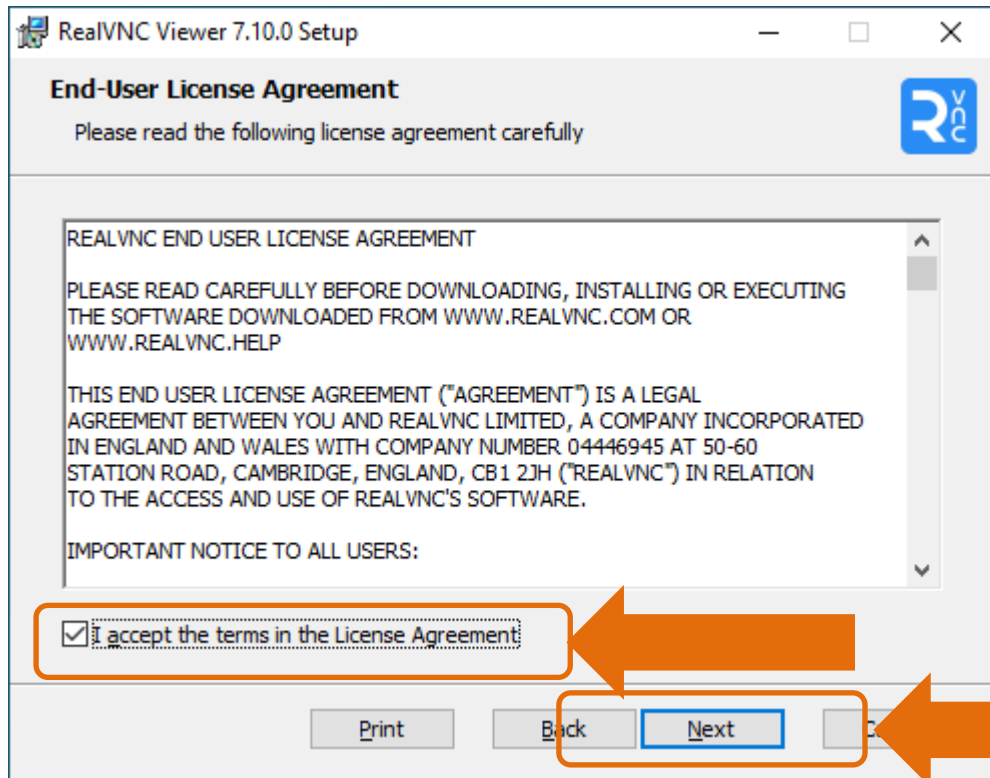
5. Double click on the **VNC-Viewer** file to run and you will be presented with a VNC Viewer Installer window. Select your appropriate language then move your mouse over the “**OK**” and click your left mouse button to select



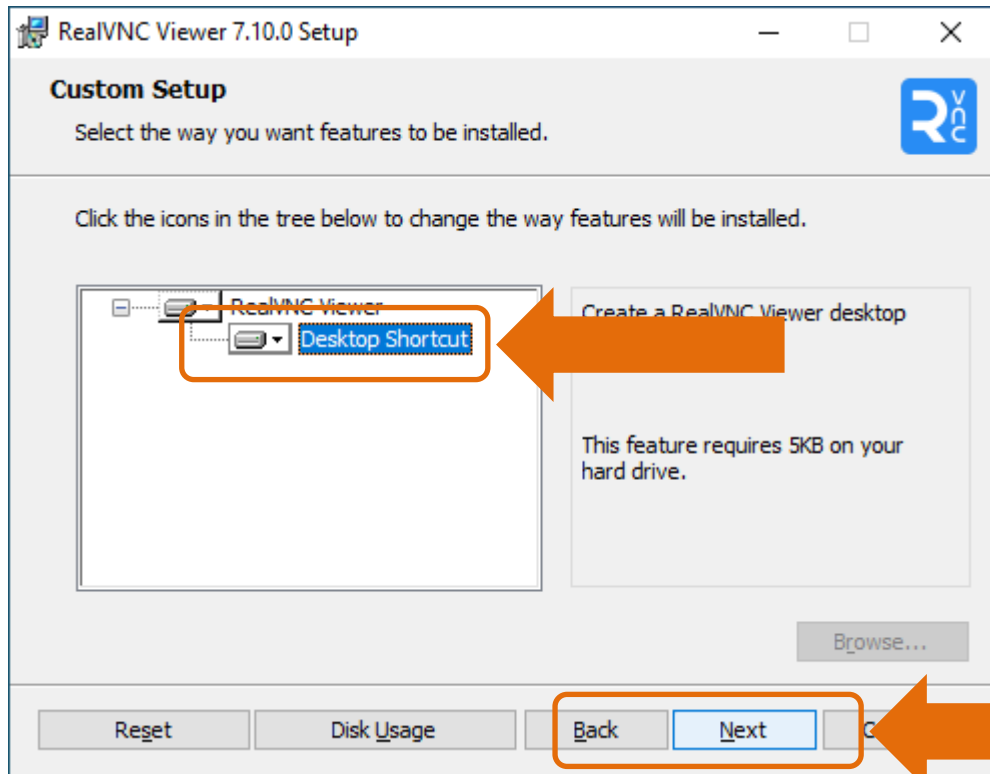
6. You will be presented with a **VNC Viewer Setup** window. Move your mouse over the “**Next**” and click your left mouse button to select.



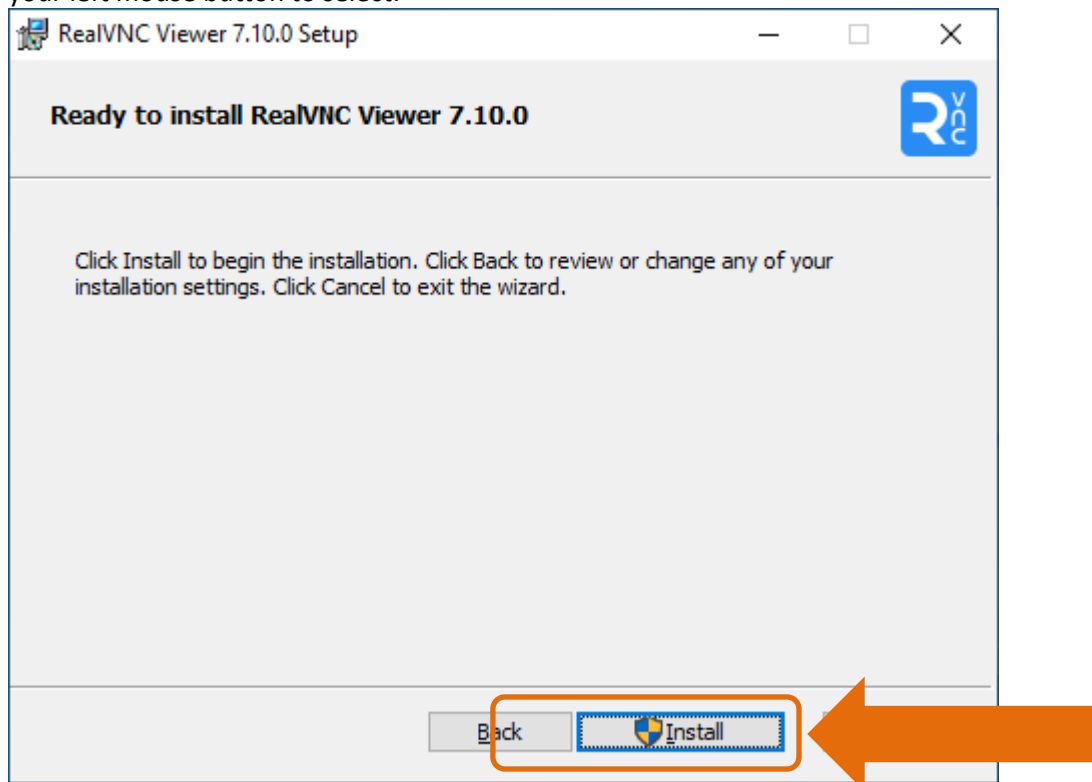
7. You will be presented with another **VNC Viewer Setup** window. Confirm you accept the **End License Agreement** then move your mouse over the “**Next**” and click your left mouse button to select.



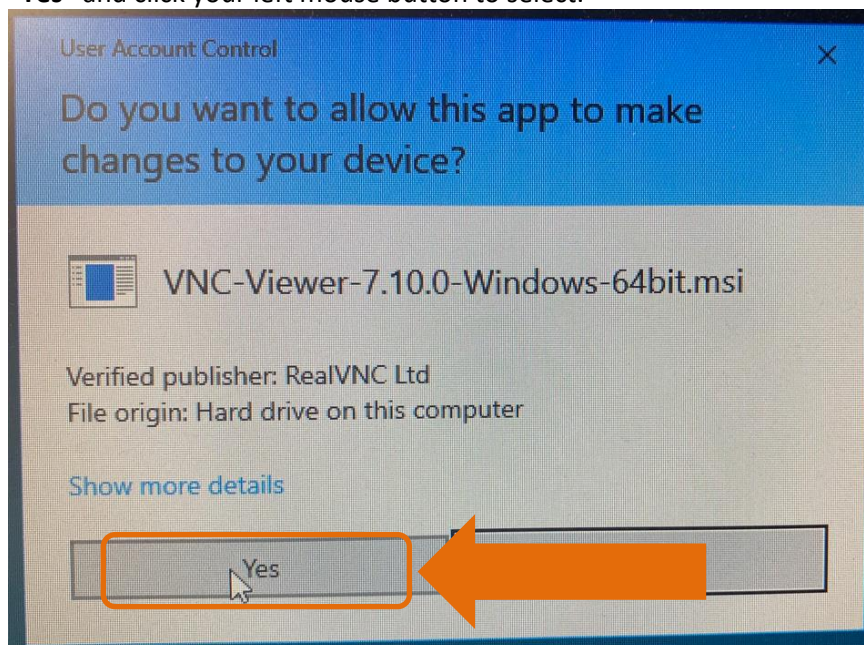
8. You will be presented with another **VNC Viewer Setup** window. To install a **Desktop Shortcut**, move your mouse over the red “X” click your left mouse button and select “**Will be installed on local hddrive**”, then move your mouse over the “**Next**” and click your left mouse button to select.



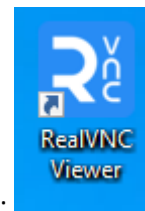
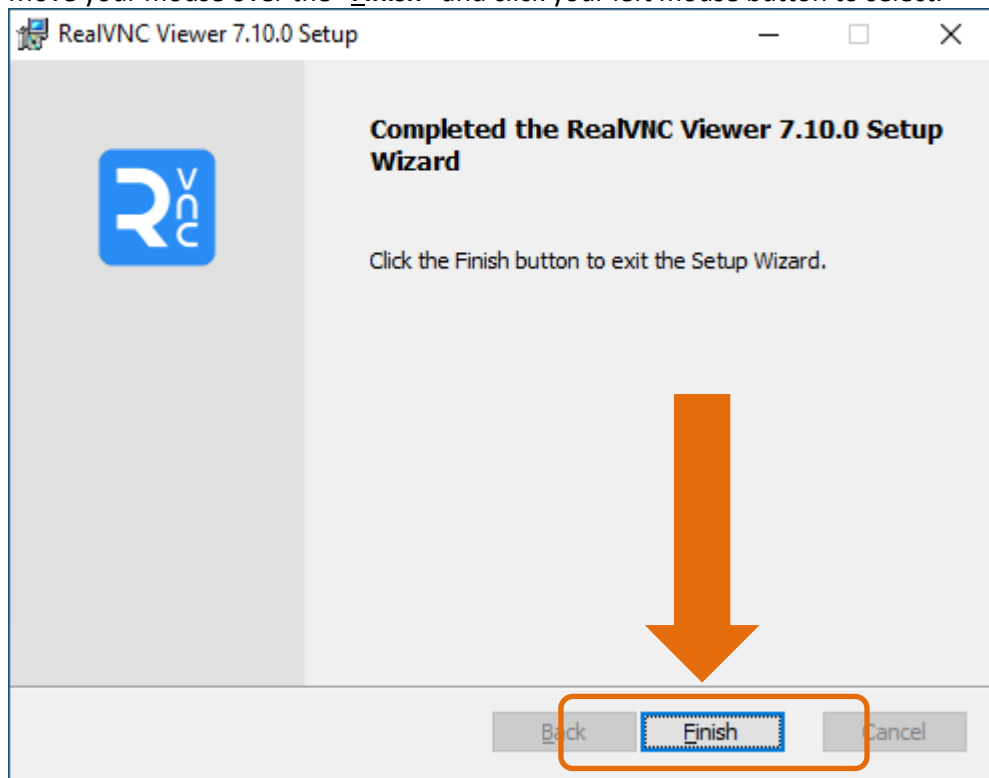
9. You will then be asked to confirm installation, move your mouse over the **“Install”** and click your left mouse button to select.



10. You will be presented with a Windows confirmation screen. Move your mouse over the **“Yes”** and click your left mouse button to select.



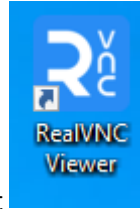
11. **VNC Viewer Setup** will finish installing and present the following window when complete. Move your mouse over the “**Finish**” and click your left mouse button to select.



12. VNC Viewer will have made a short-cut desktop icon for you :

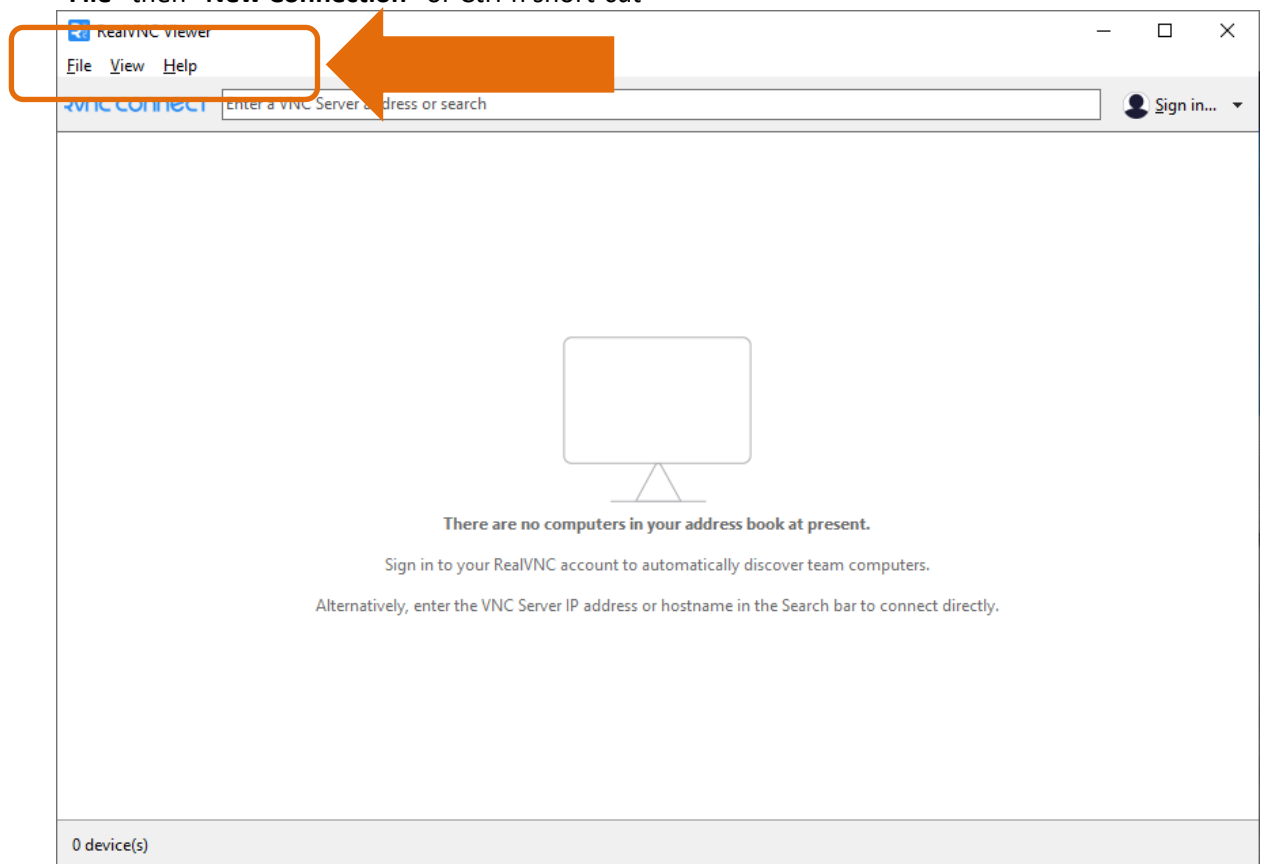
Connecting to your RPi using VNC Viewer

1. Let's connect to the Raspberry Pi using VNC Viewer.

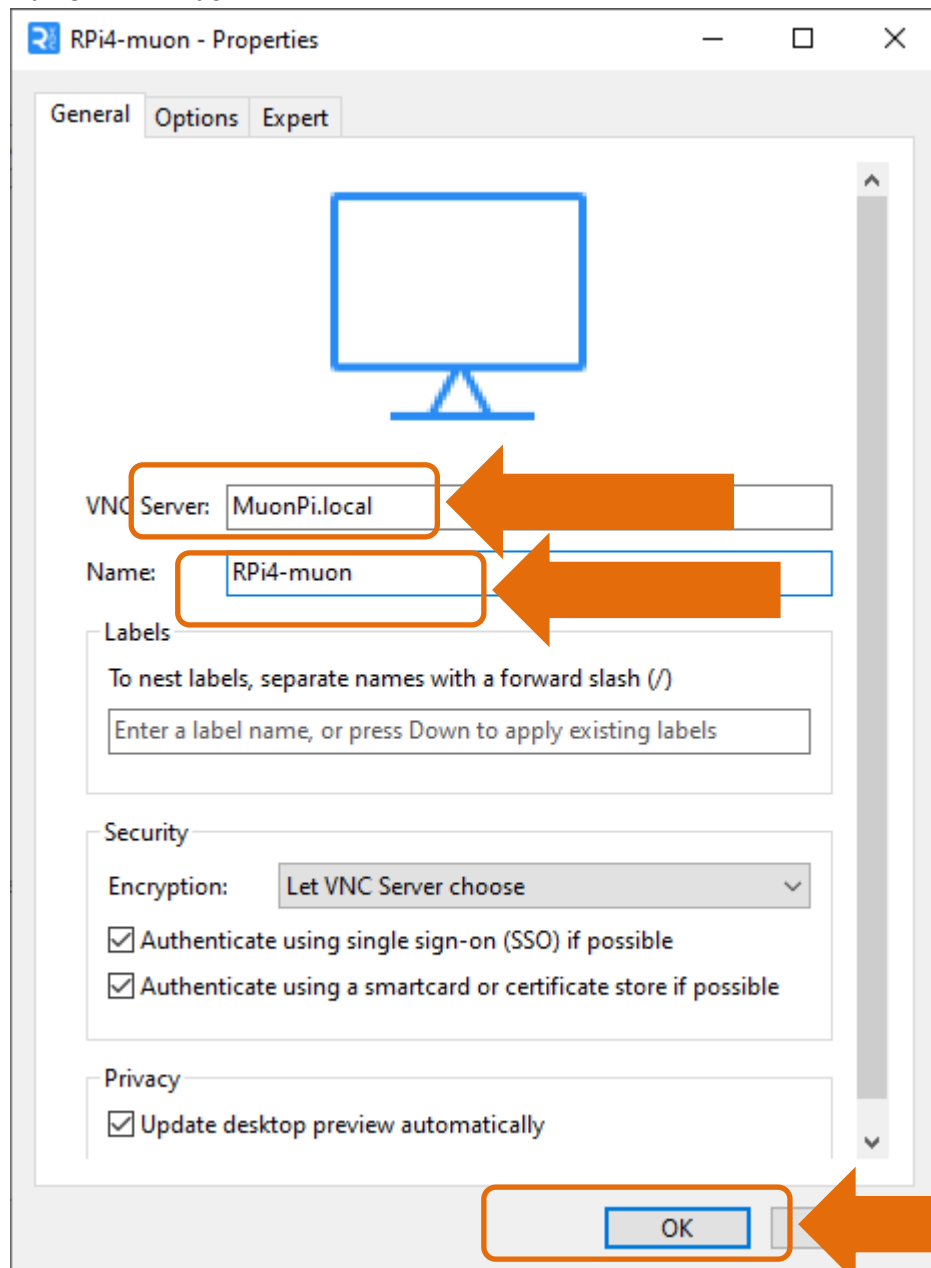


2. Open VNC Viewer using the desktop shortcut

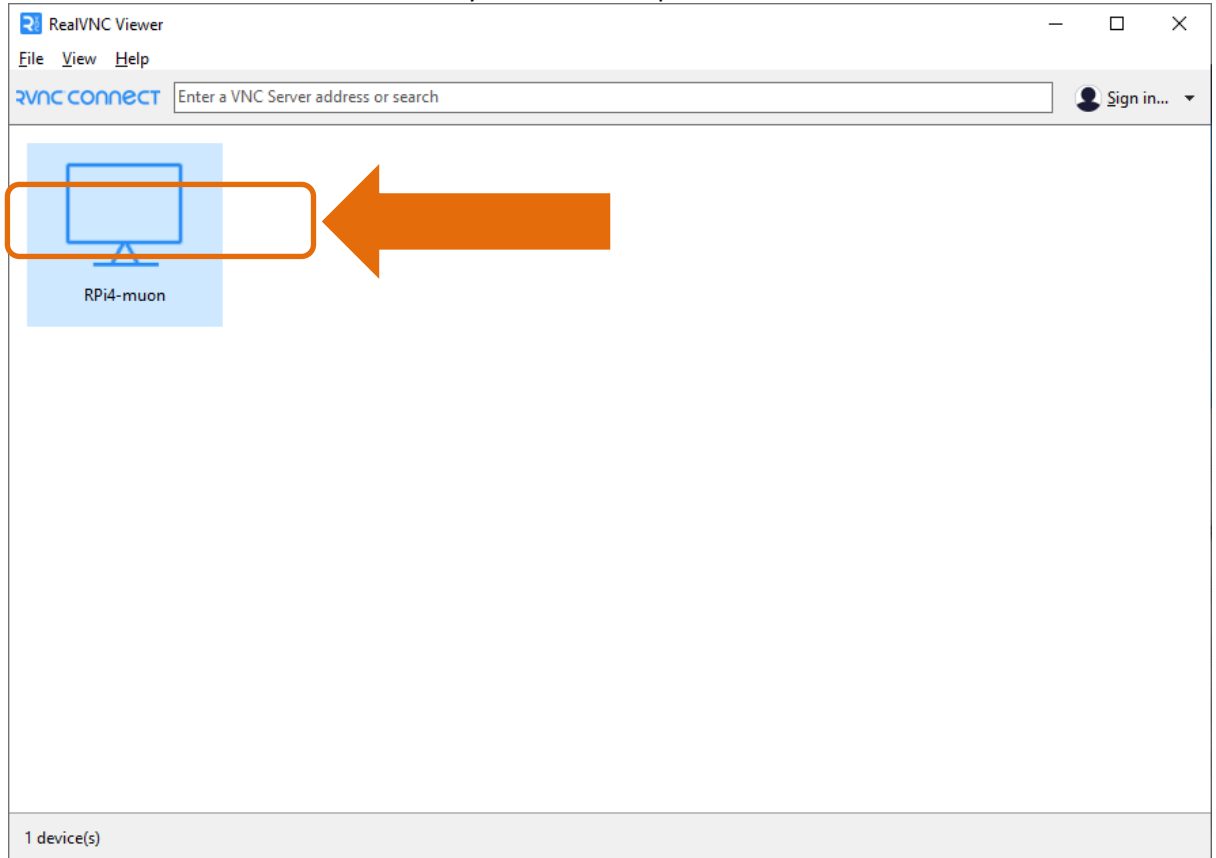
3. We now have the **VNC Viewer** home page – we want to make a new connection so we select **“File”** then **“New Connection”** or Ctrl-n short-cut



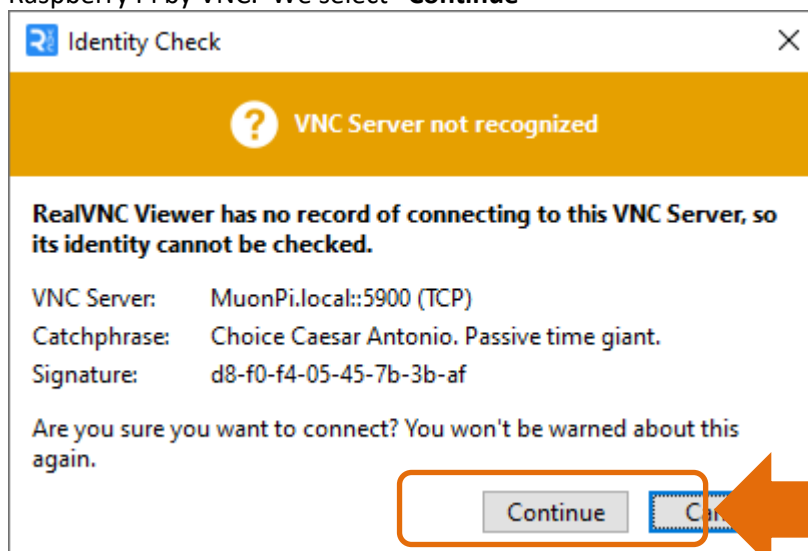
4. This will bring up the following properties window- we are only going to enter information in the **"General"** tab
- a. VNC Server: MuonPi.local
 - b. Name: "RPi4-muon"



5. You should now have a connection on your VNC workspace. Double click the icon

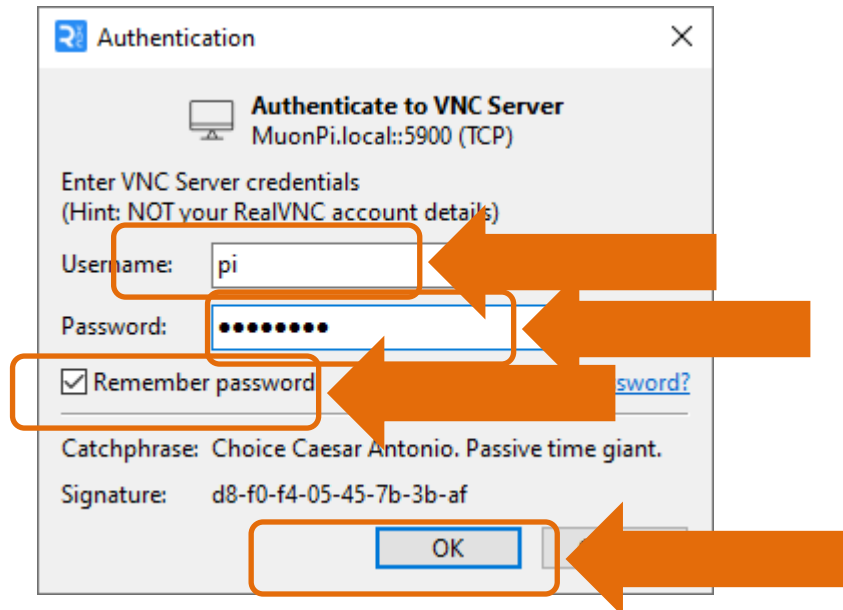


6. Similar to PuTTY – we now get an **Identity Check** message for our first connection to the Raspberry Pi by VNC. We select “Continue”

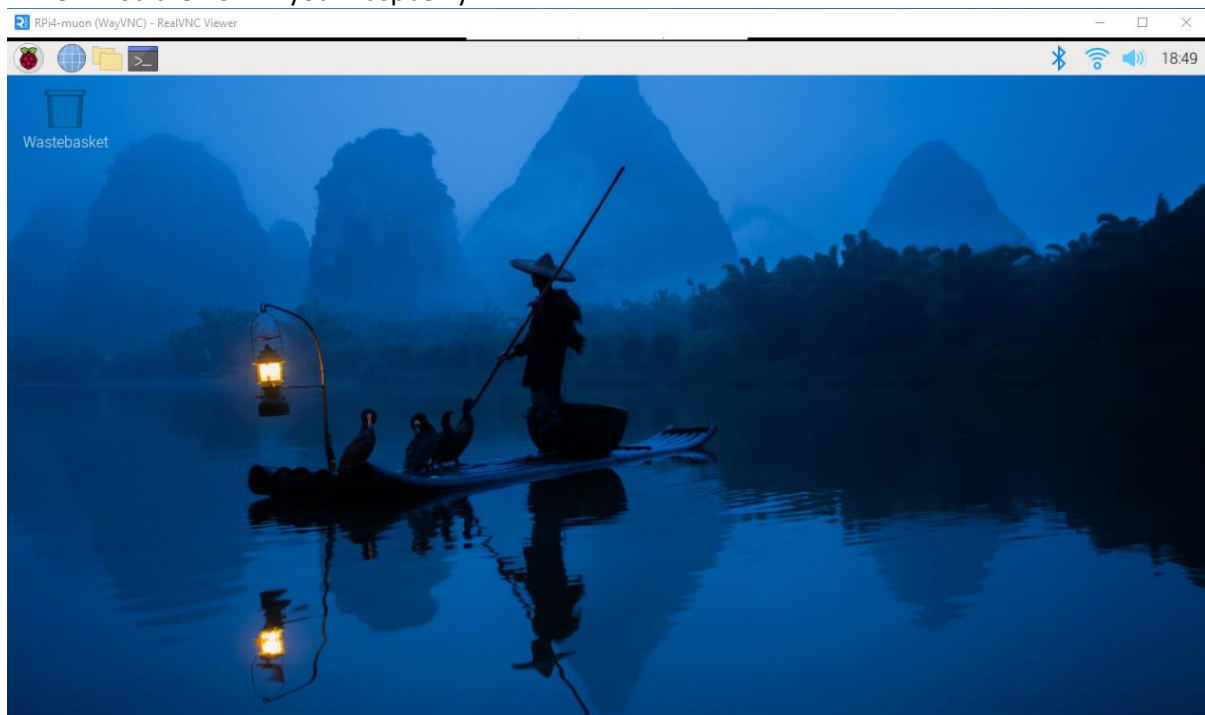


7. We now have to enter the Raspberry Pi

- c. Username: **"pi"**
- d. Password: **"PassWord"**
- e. Select **"Remember password"**
- f. Select **"OK"**



8. You are now in your Raspberry Pi



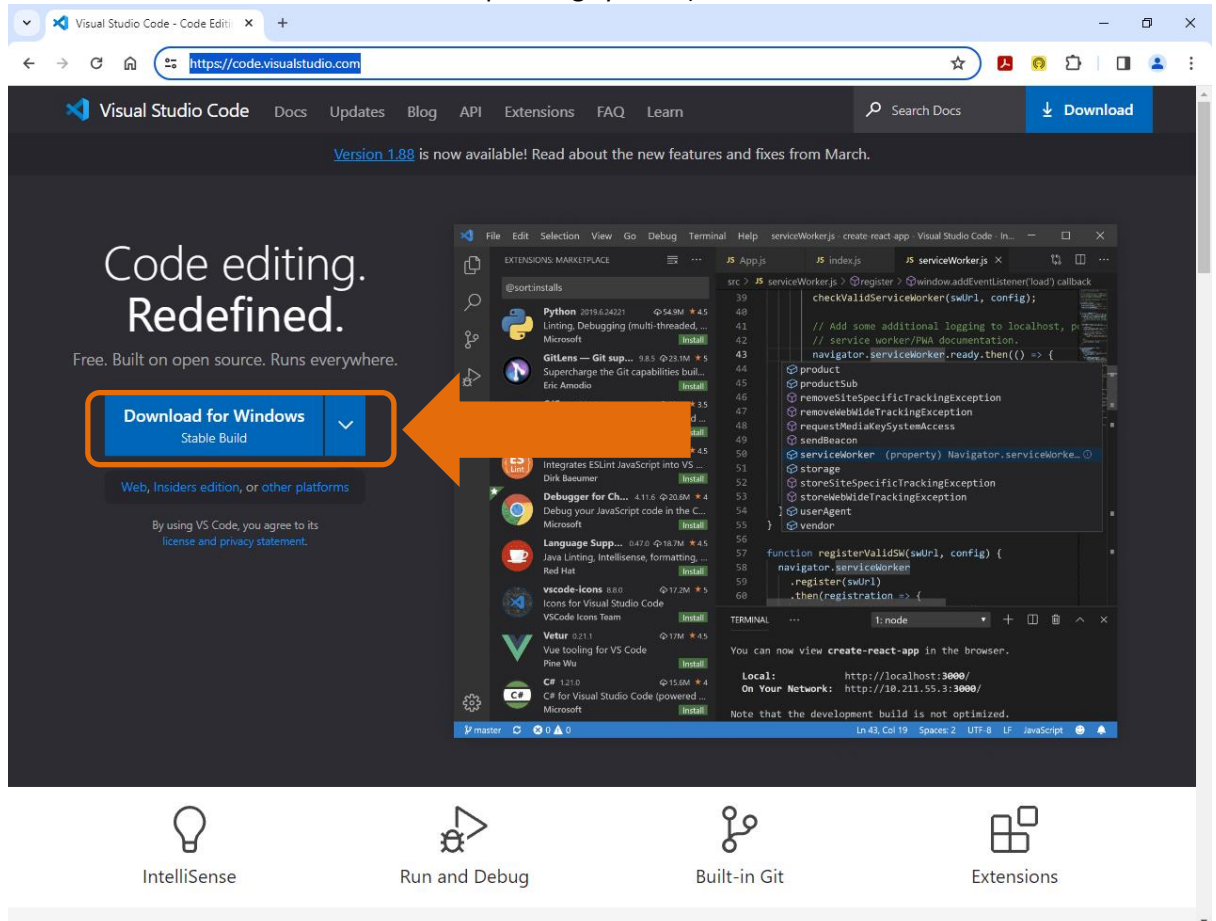
9. Time to explore

10. To end VNC session – there are controls that appear when your mouse is moved to the top of the screen. Selecting **"X"** will close the VNC session.

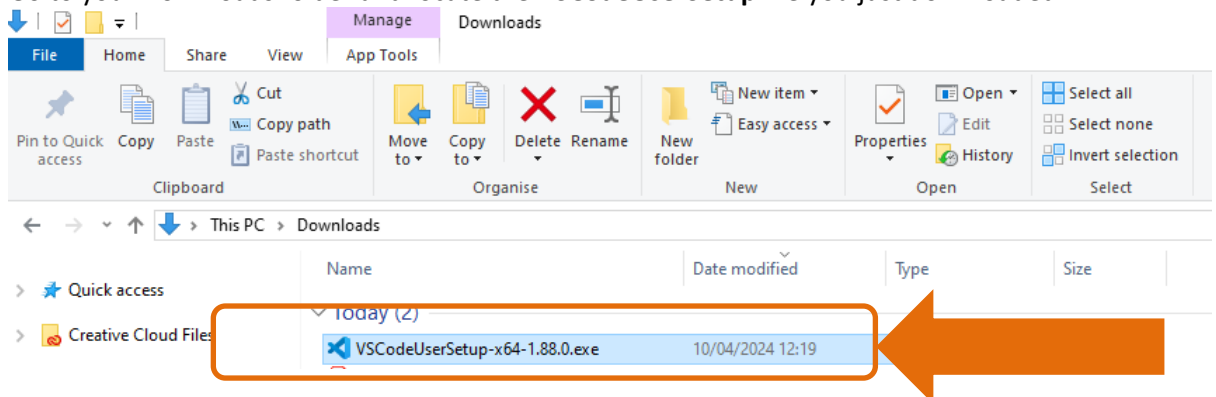
11. To get back to the pi, just double click on the shortcut in VNC workspace

Installing Visual Studio Code on your PC

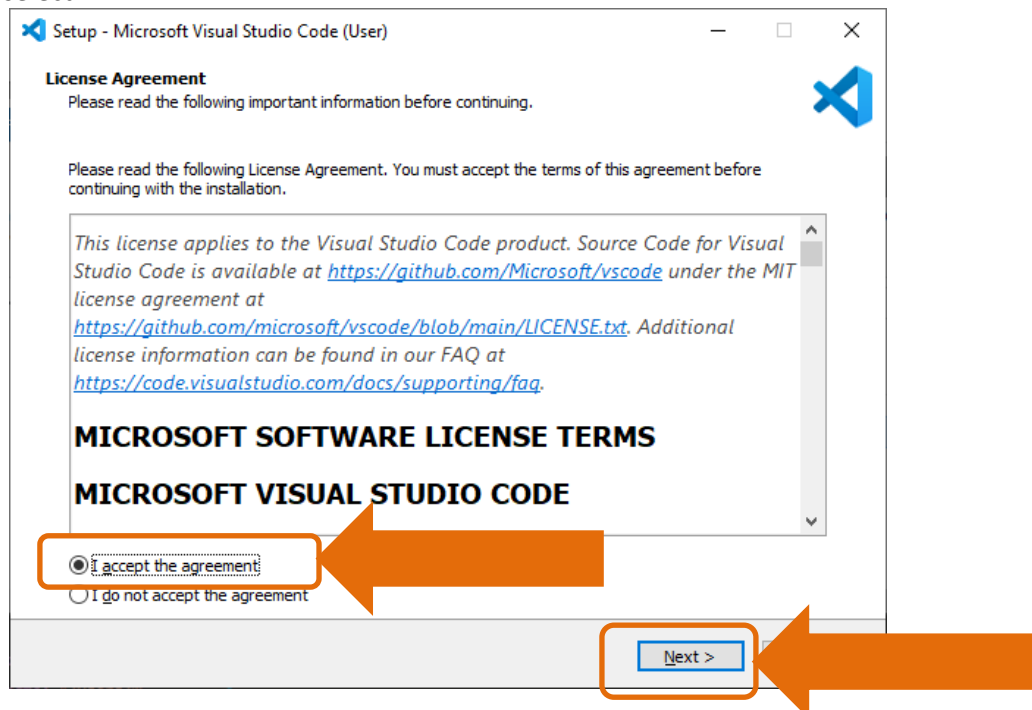
1. Use the following link to access Visual Studio Code: <https://code.visualstudio.com/>
2. Move your mouse over “**Download for Windows Stable Build**” and double click (use the down arrow head to select alternative operating systems)



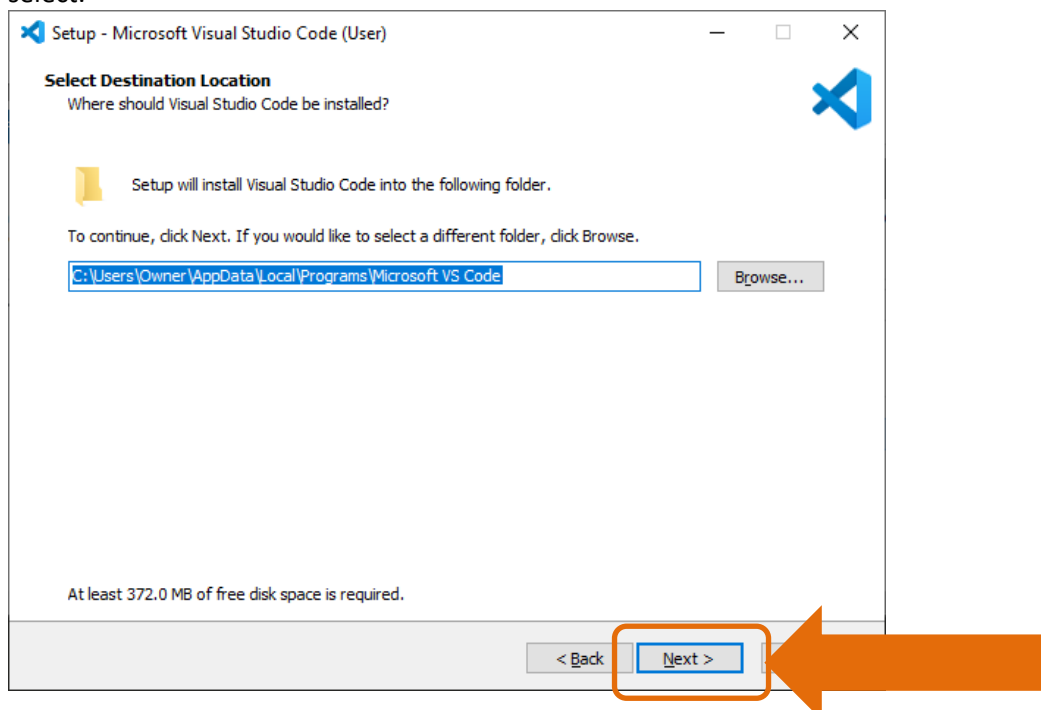
3. Go to your Downloads folder and locate the **VSCodeUserSetup** file you just downloaded.



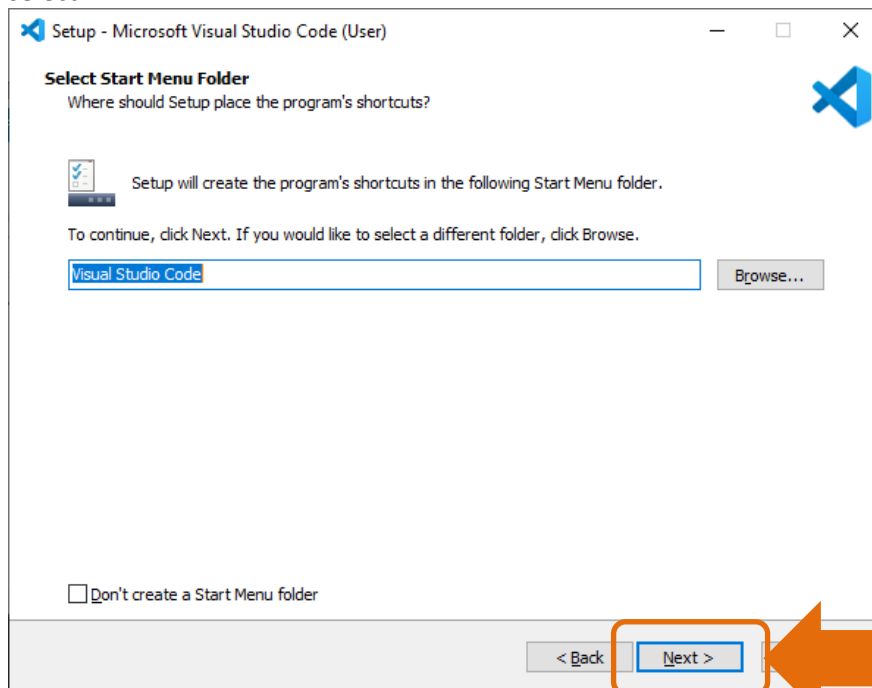
4. Double click on the **VSCodeUserSetup** file to run and you will be presented with a **Microsoft Visual Studio Code (User) License Agreement** window. Click the radial button **“I accept the agreement”** then move your mouse over the **“Next”** and click your left mouse button to select



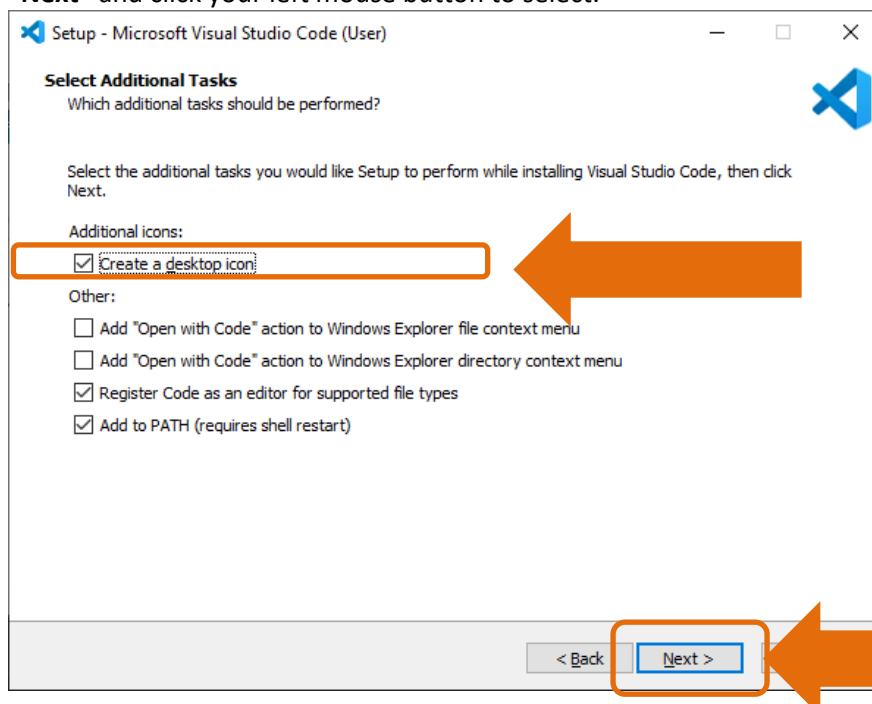
5. You will be presented with a **Microsoft Visual Studio Code (User) Select Destination Location** window. Move your mouse over the **“Next”** and click your left mouse button to select.



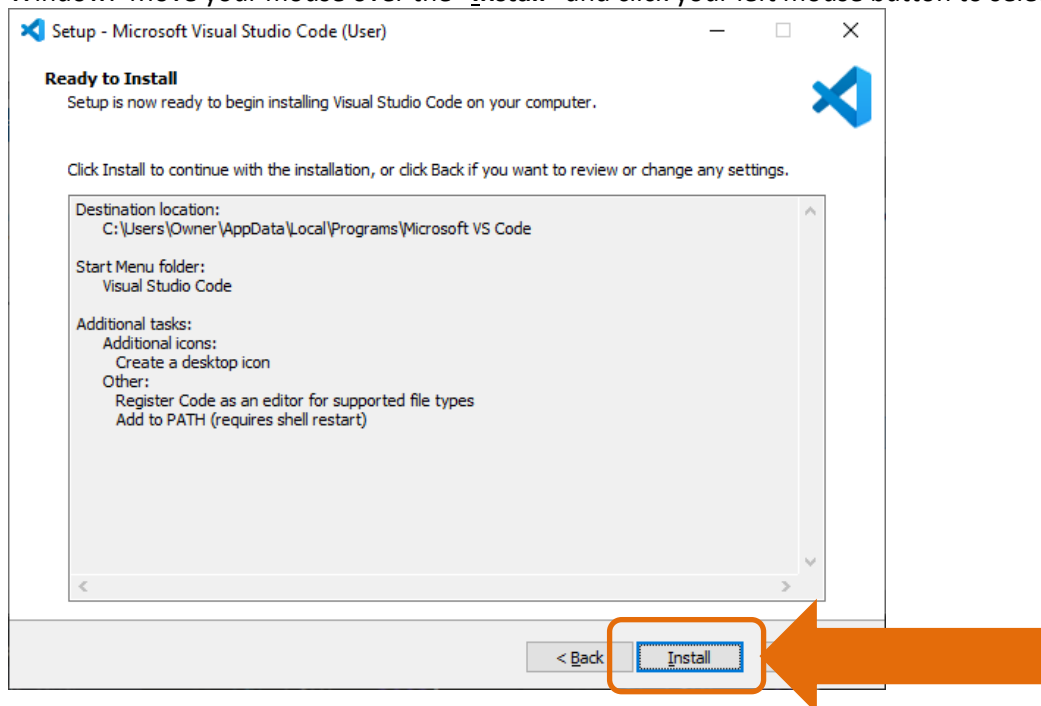
6. You will be presented with a **Microsoft Visual Studio Code (User) – Select Start Menu Folder** window. Move your mouse over the “Next” and click your left mouse button to select.



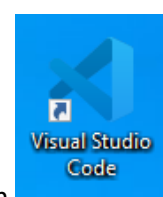
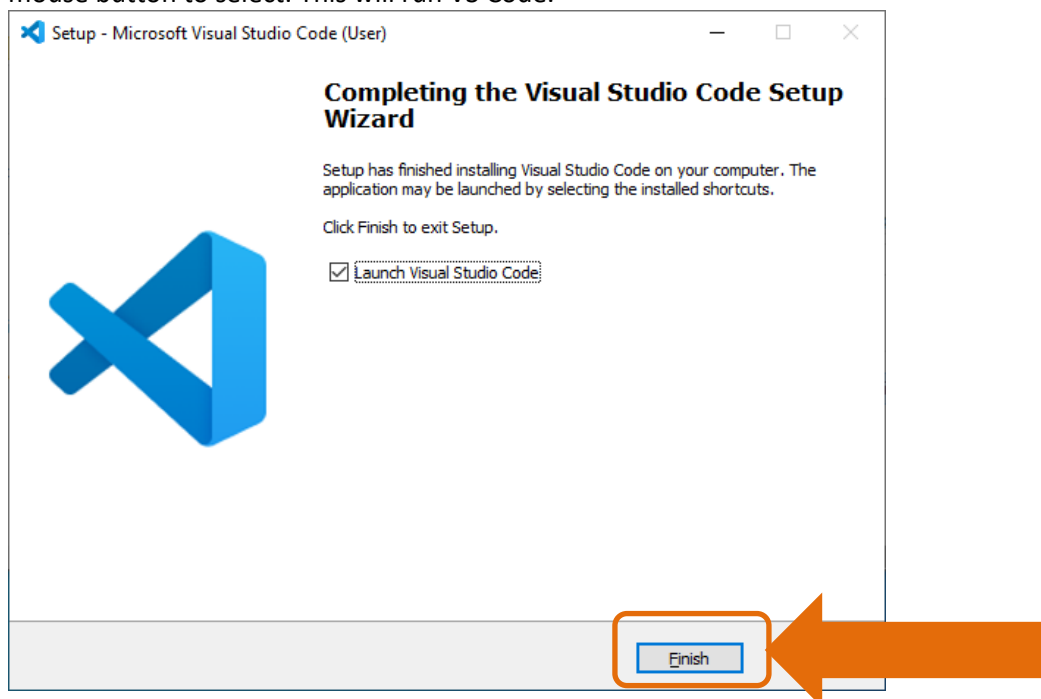
7. You will be presented with a **Microsoft Visual Studio Code (User) – Select Additional Tasks** Window. Check the square “Create a desktop icon” then move your mouse over the “Next” and click your left mouse button to select.



8. You will be presented with a **Microsoft Visual Studio Code (User) – Ready to install** Window. Move your mouse over the “**Install**” and click your left mouse button to select.



9. **Microsoft Visual Studio Code (User)** will now be installed on your PC. When completed you will be presented with a **Microsoft Visual Studio Code (User) – Completing the Visual Studio Code Setup Wizard** Window. Move your mouse over the “**Finish**” and click your left mouse button to select. This will run VS Code.



10. You can also run VS Code by double clicking on the desktop icon