



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:

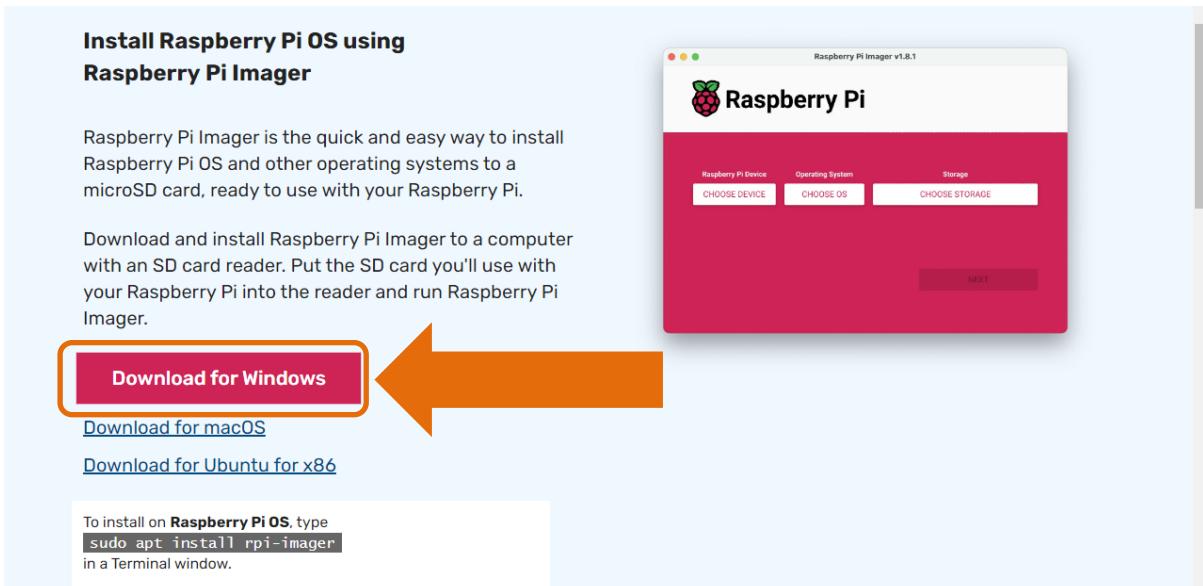
- You can download and install software from the internet onto your computer
- Know your Wi-Fi passwords and can connect new devices.

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

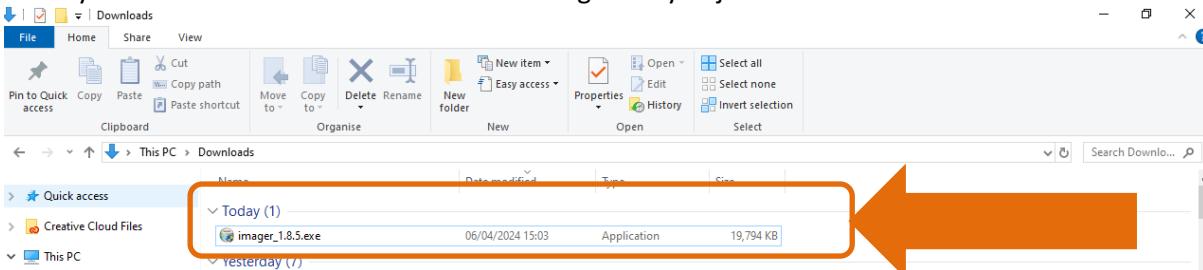
Installing Raspberry Pi OS onto the MicroSD Card

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.

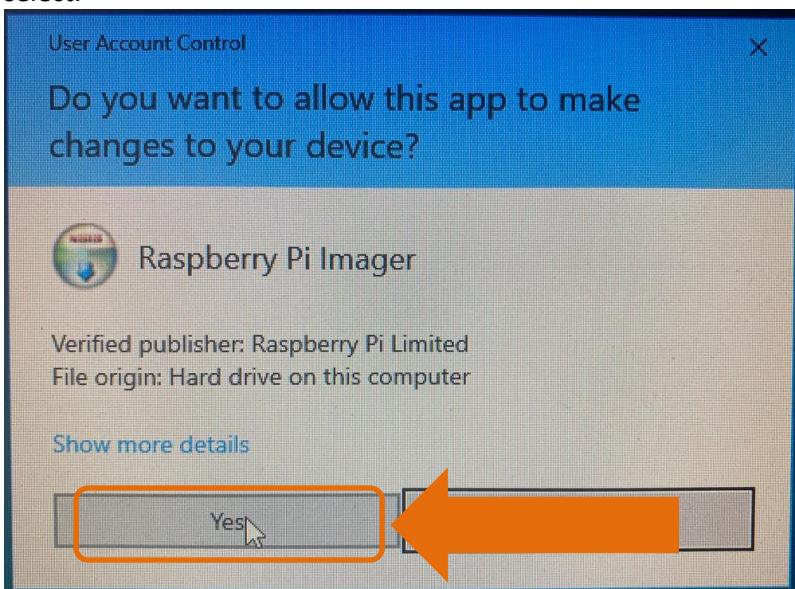


The screenshot shows two parts. On the left, a web browser displays the "Install Raspberry Pi OS using Raspberry Pi Imager" page. It features a "Download for Windows" button highlighted with an orange arrow pointing to it. Below it are links for "Download for macOS" and "Download for Ubuntu for x86". A terminal command box contains the text: "To install on Raspberry Pi OS, type sudo apt install rpi-imager in a Terminal window." On the right, a window titled "Raspberry Pi Imager v1.8.1" is shown with tabs for "Raspberry Pi Device", "Operating System", and "Storage". A "NEXT" button is visible at the bottom right of the window.

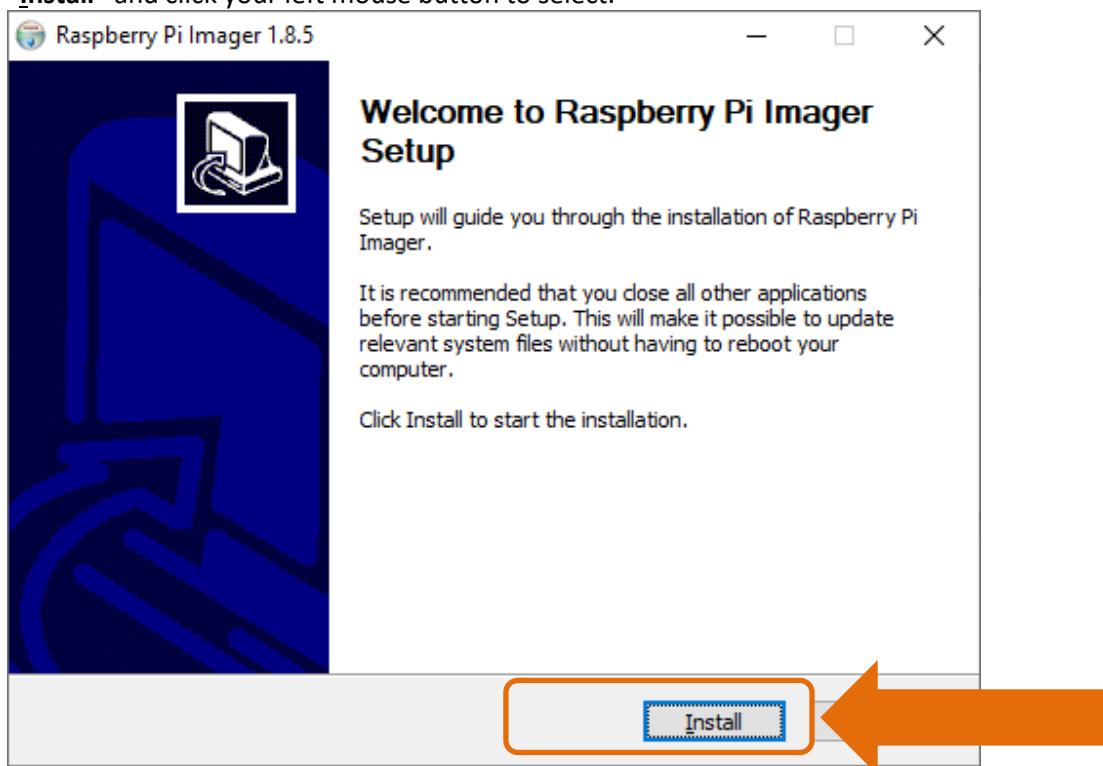
3. Go to your Downloads folder and locate the imager file you just downloaded.



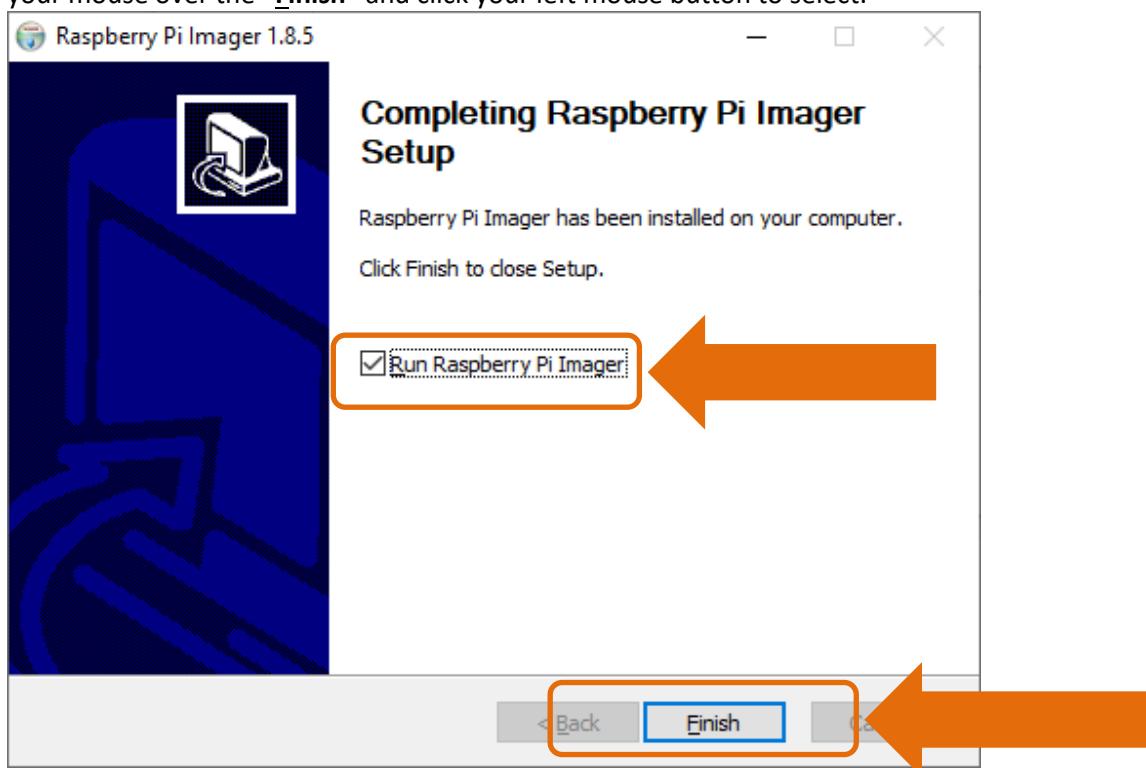
4. Double click on the **imager_x.x.x.exe** file to run and you will be presented with a Windows confirmation screen. Move your mouse over the “Yes” and click your left mouse button to select.



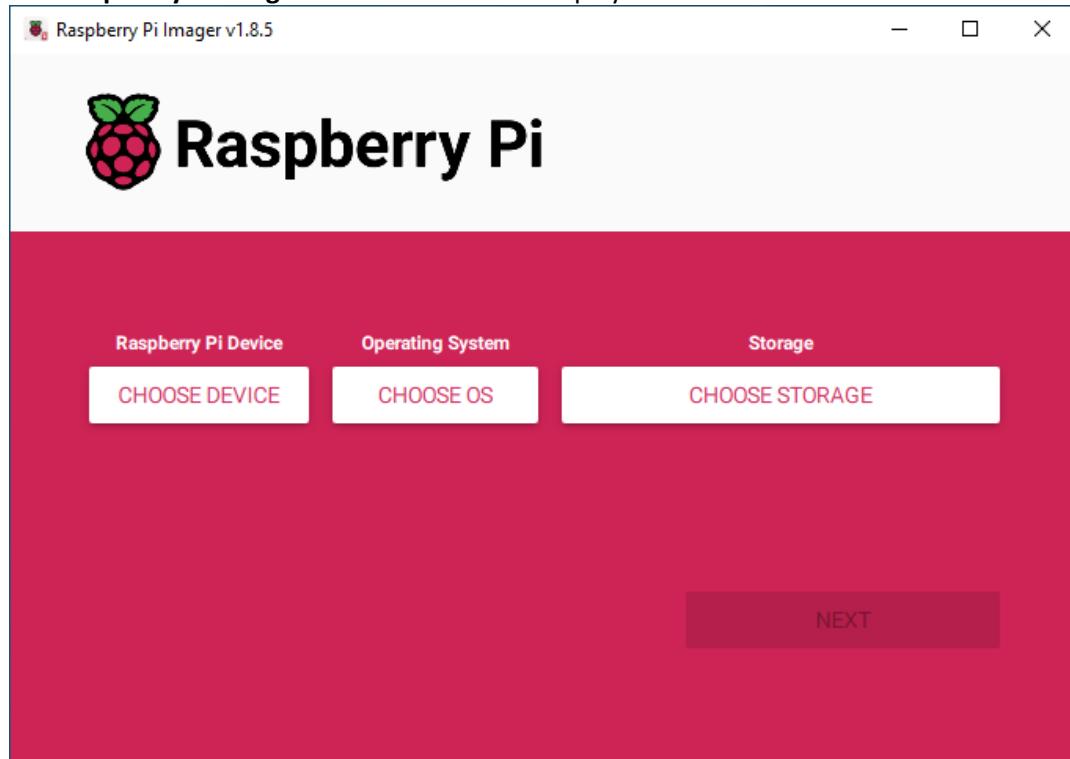
5. You will now have the **Raspberry Pi Imager** installer screen. Move your mouse over the “Install” and click your left mouse button to select.



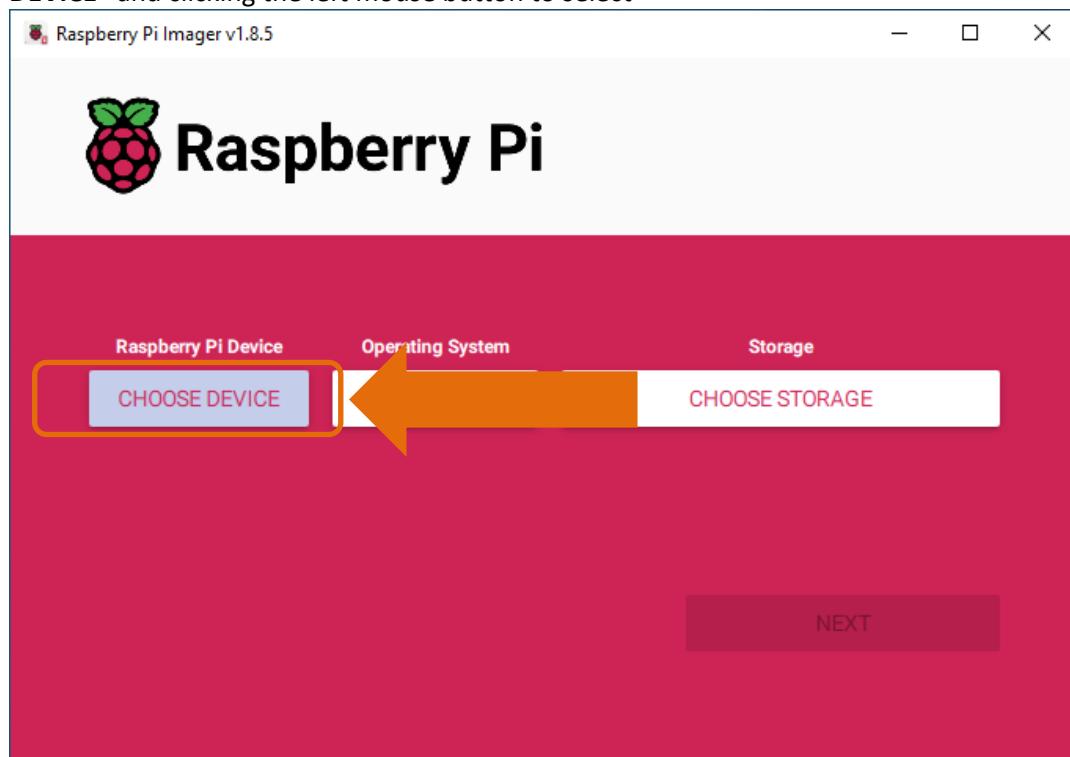
6. When the install is complete, ensure that “**Run Raspberry Pi Imager**” is checked and move your mouse over the “Finish” and click your left mouse button to select.



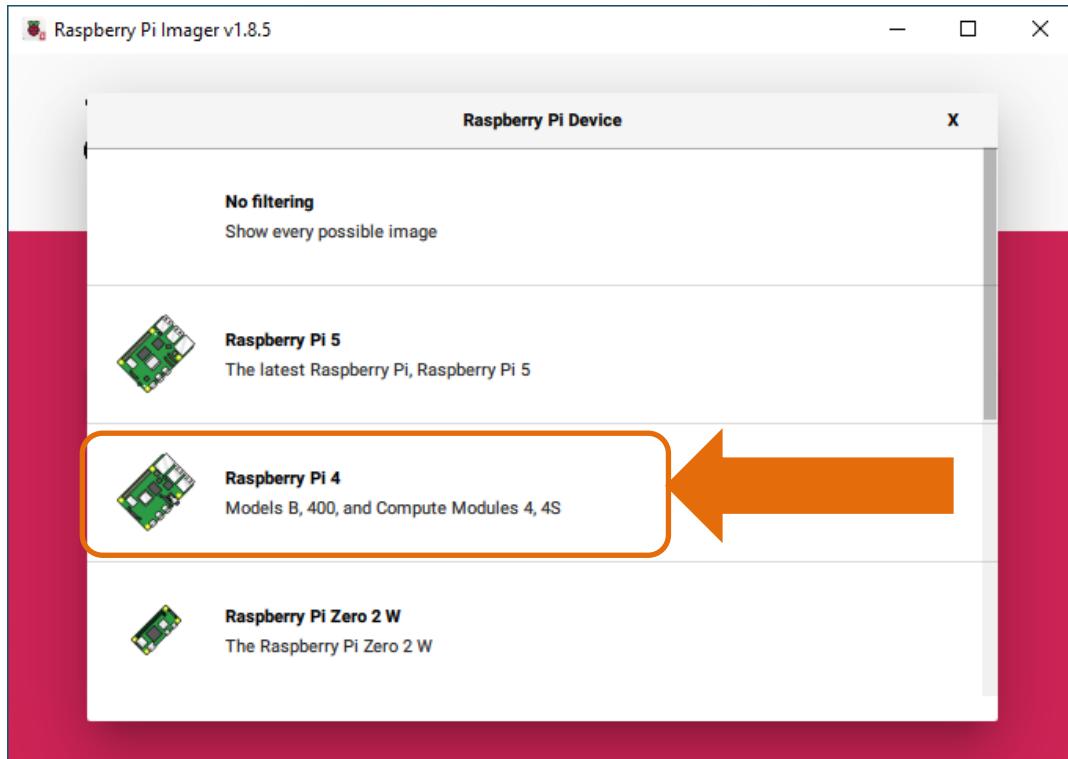
7. The **Raspberry Pi Imager** screen will now be displayed



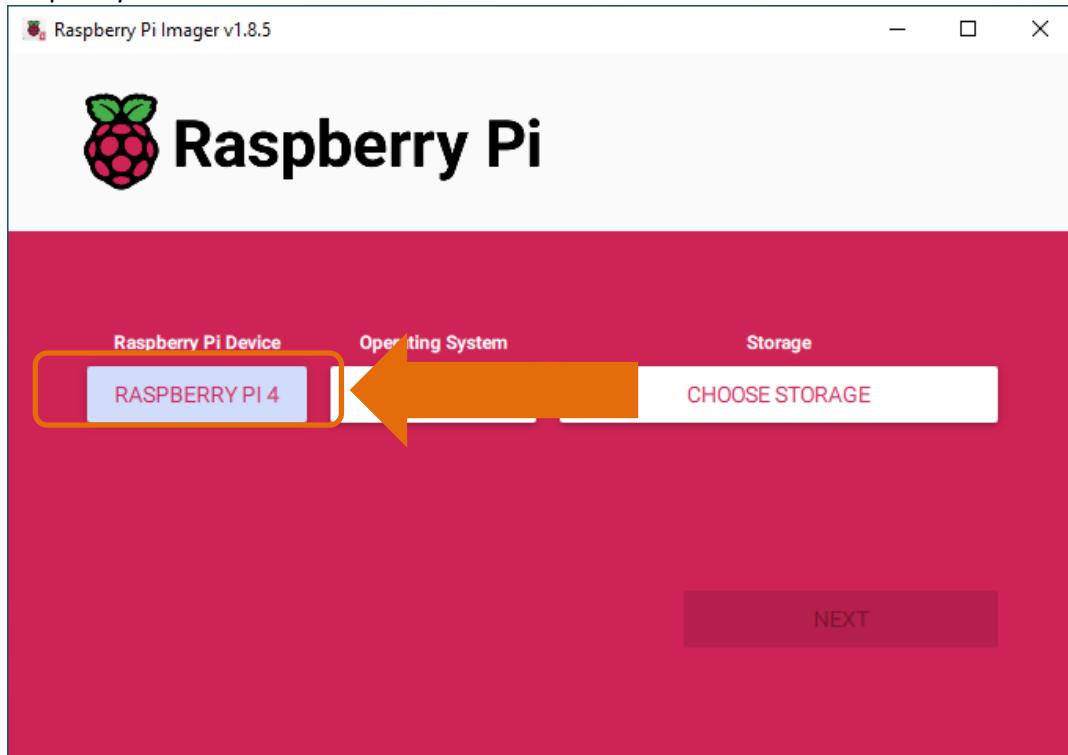
8. We are firstly going to select our **Raspberry Pi Device** by moving our mouse over “**CHOOSE DEVICE**” and clicking the left mouse button to select



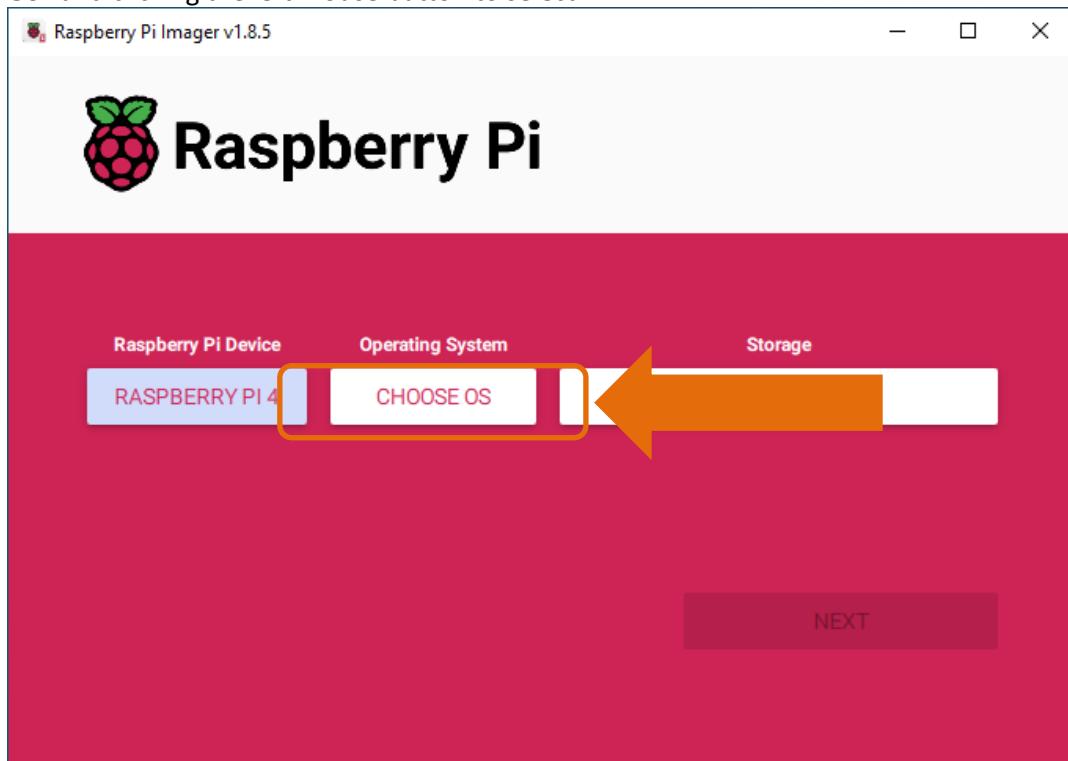
9. We will now have a list of **Raspberry Pi Devices** to select from. We are going to select the “**Raspberry Pi 4**” by moving our mouse over “**Raspberry Pi 4**” and clicking the left mouse button to select.



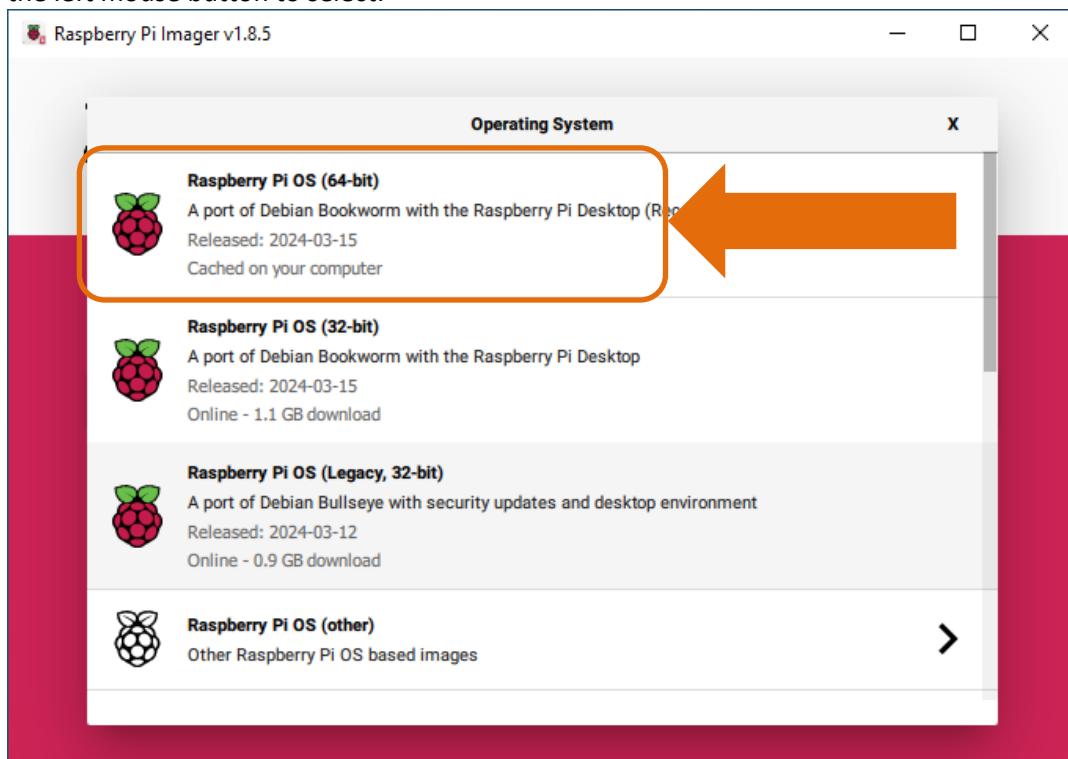
10. This will return us to the **Raspberry Pi Imager** screen, now there is “**RASPBERRY PI 4**” in the Raspberry Pi Device window



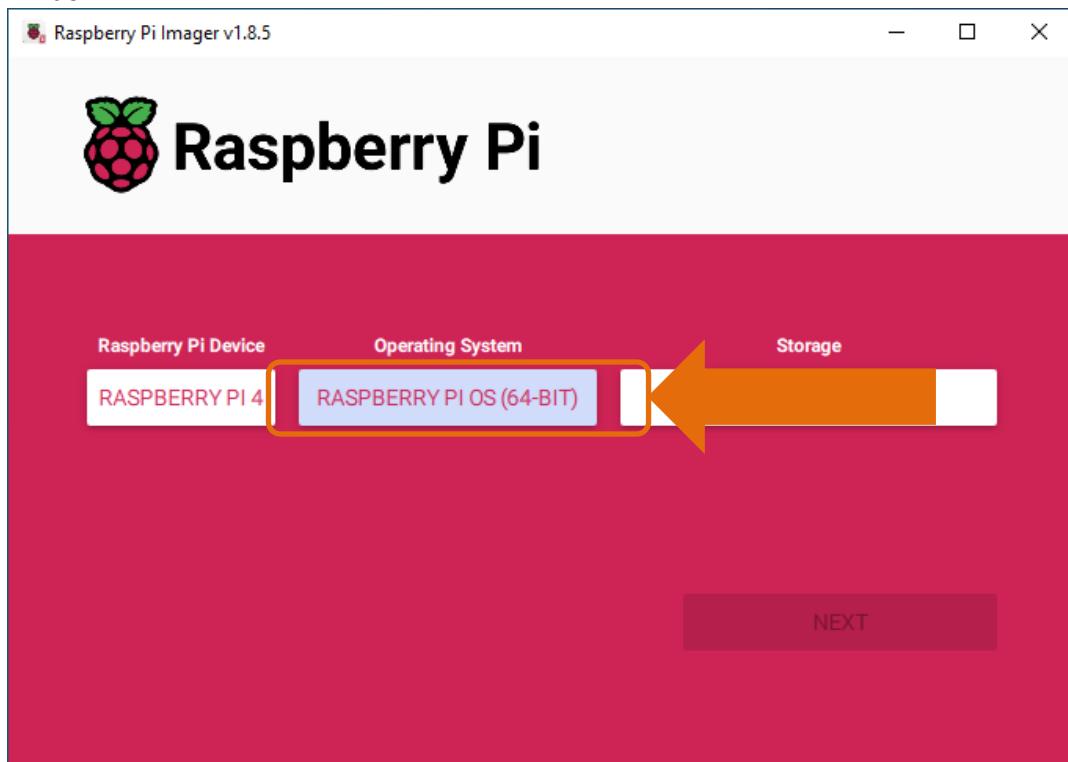
11. We are secondly going to select our **Operating System** by moving our mouse over “**CHOOSE OS**” and clicking the left mouse button to select



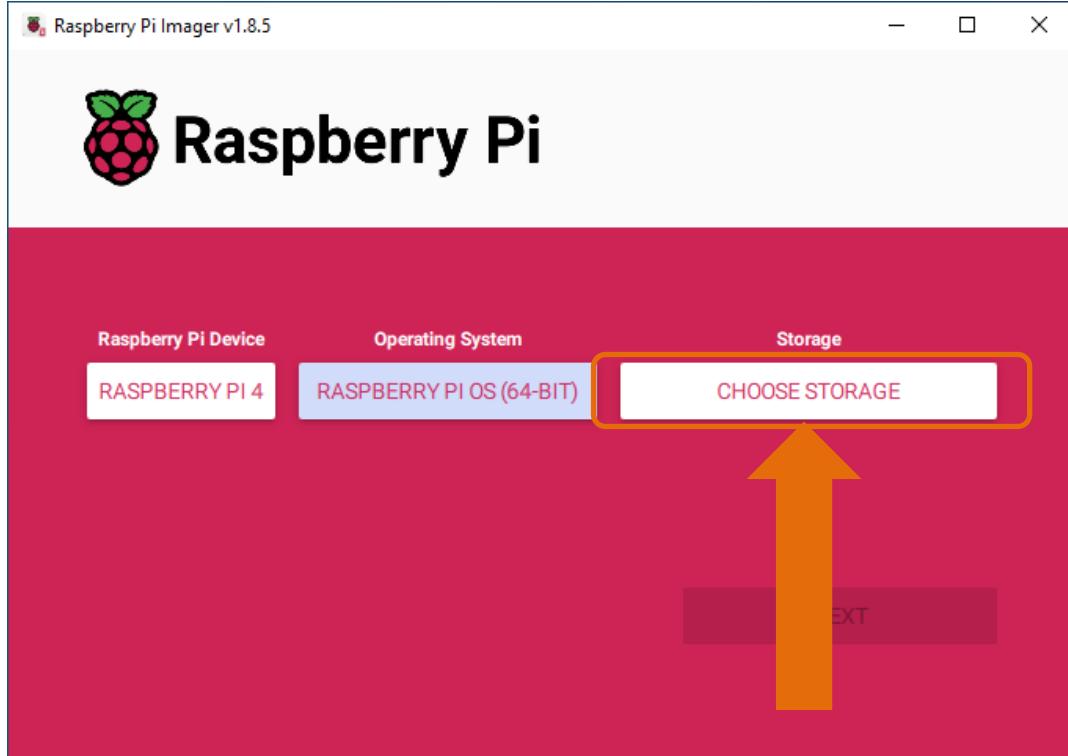
12. We will now have a list of **Operating Systems** to select from. We are going to select the “**Raspberry Pi OS (64 bit)**” by moving our mouse over “**Raspberry Pi OS (64 bit)**” and clicking the left mouse button to select.



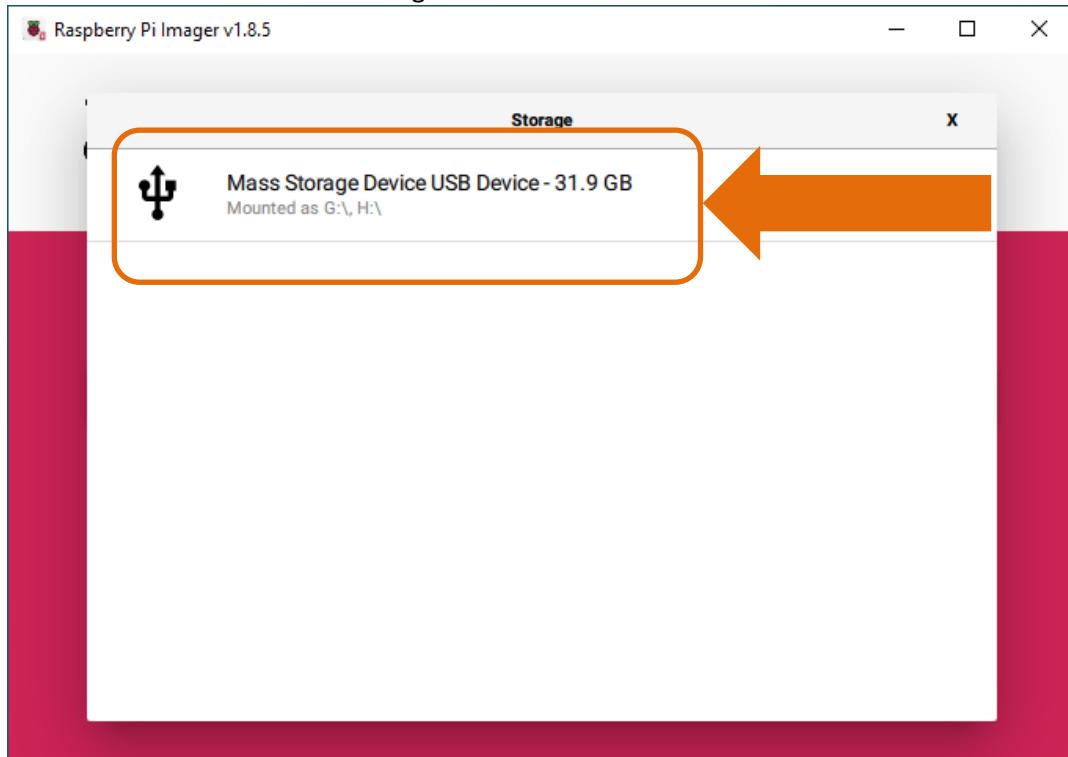
13. This will return us to the **Raspberry Pi Imager** screen, now there is “**RASPBERRY PI 4**” in the **Raspberry Pi Device** window and “**RASPBERRY PI OS (64-BIT)**” in the **Operating System** window



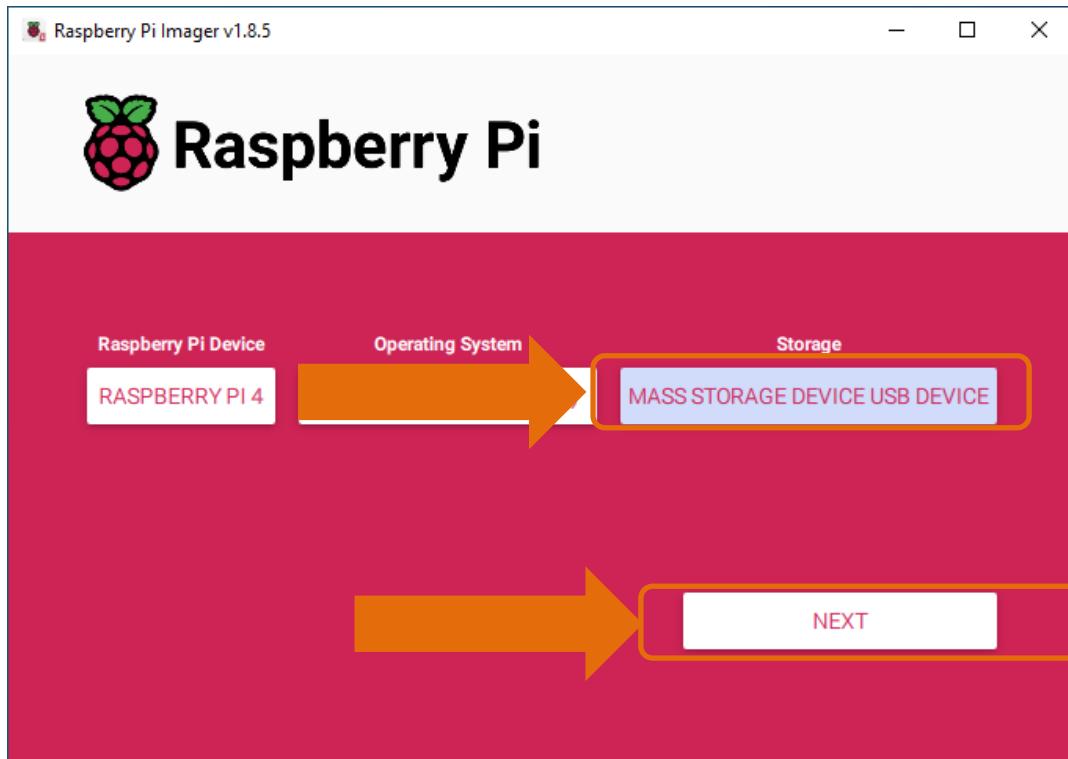
14. Plug your microSD card into your computer using a suitable adapter if needed.
15. We are lastly going to select our **Storage** by moving our mouse over “**CHOOSE STORAGE**” and clicking the left mouse button to select



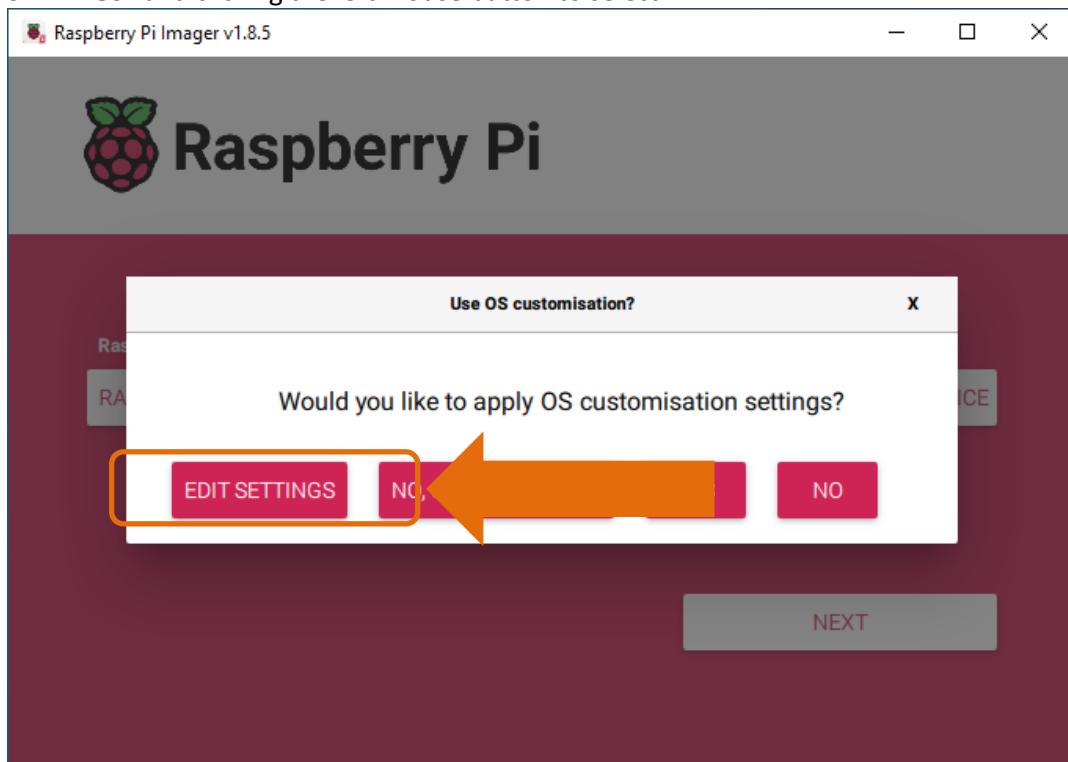
16. We will now have a list of **storage** options to select from. We are going to select the “**Mass Storage Device USB Device – 31.9 GB**” by moving our mouse over “**Mass Storage Device USB Device – 31.9 GB**” and clicking the left mouse button to select.



17. This will return us to the **Raspberry Pi Imager** screen, now there is “**RASPBERRY PI 4**” in the **Raspberry Pi Device** window and “**RASPERRY 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 the "OS Customisation" window with the "GENERAL" tab selected. The window has three tabs at the top: "GENERAL" (highlighted in pink), "SERVICES", and "OPTIONS".

GENERAL Tab:

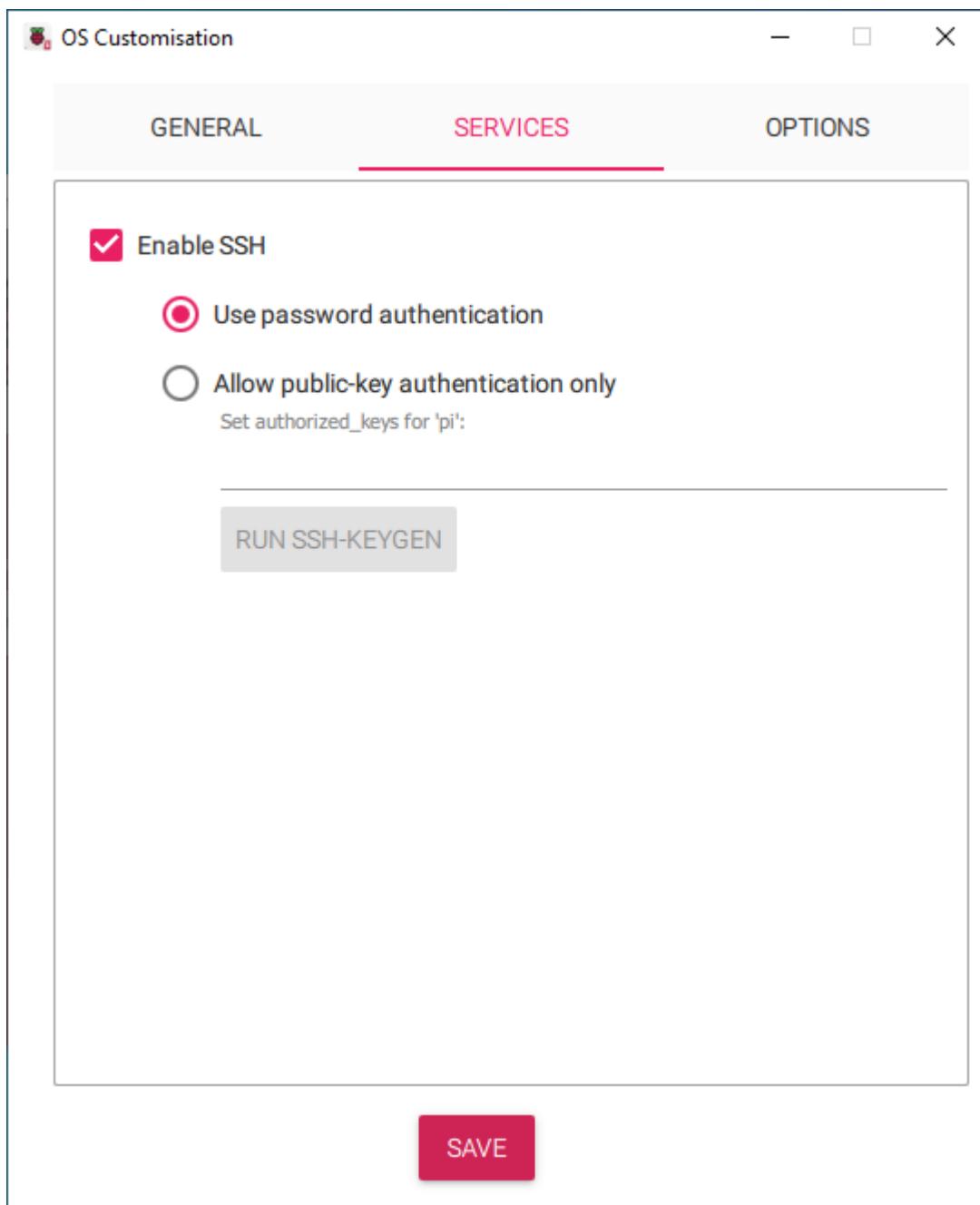
- Set hostname: MuonPi .local
- Set username and password
 - Username: pi
 - Password: [REDACTED]
- Configure wireless LAN
 - SSID: your own wi-fi name
 - Password: your own wi-fi password
 - Show password Hidden SSID
- Wireless LAN country: GB
- Set locale settings
 - Time zone: Europe/London
 - Keyboard layout: gb

Buttons at the bottom:

- SAVE (in a red button)

21. On the second page “**SERVICES**” we are going to use the following options

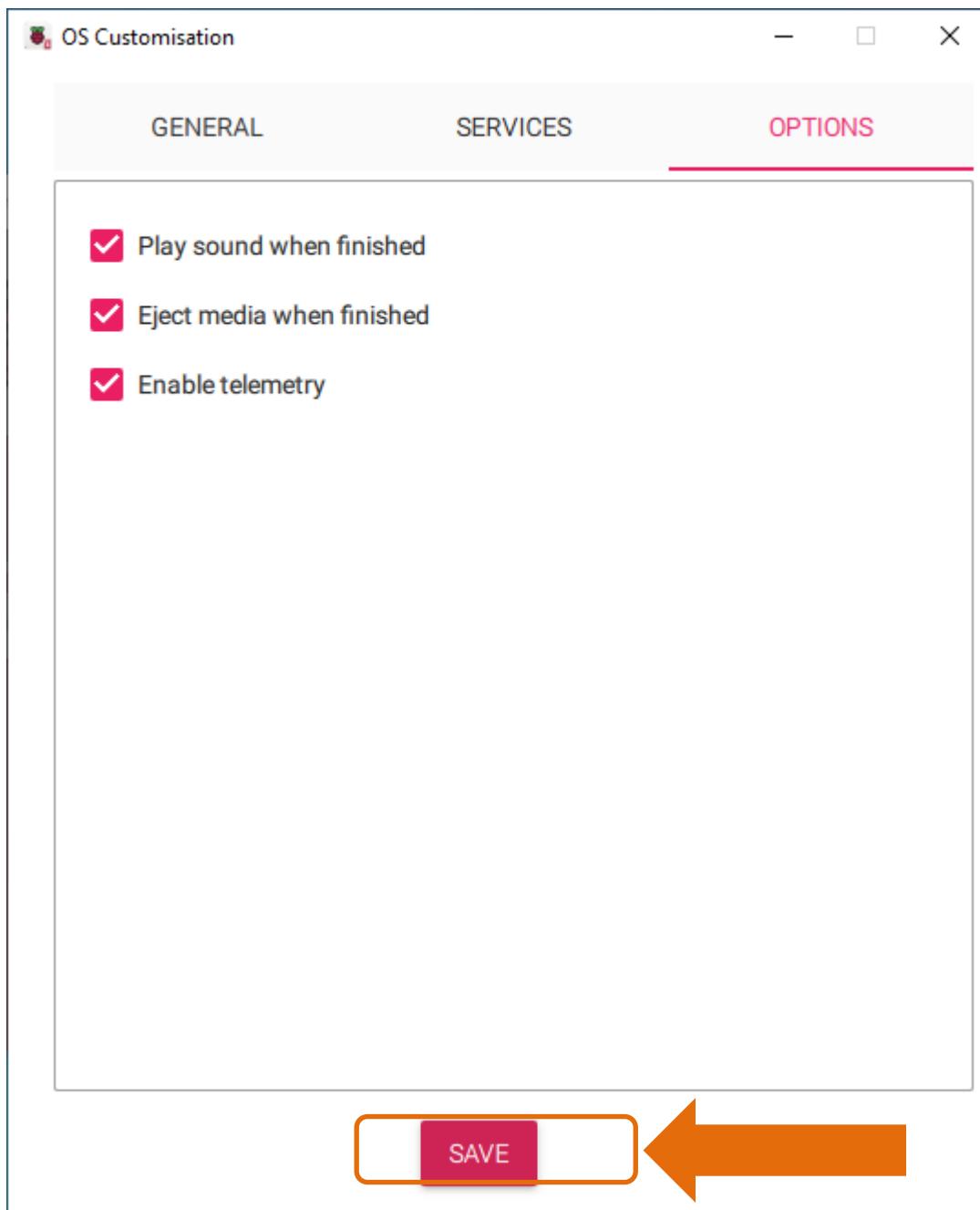
- a. Enable SSH
 - i. Select **Use password authentication**



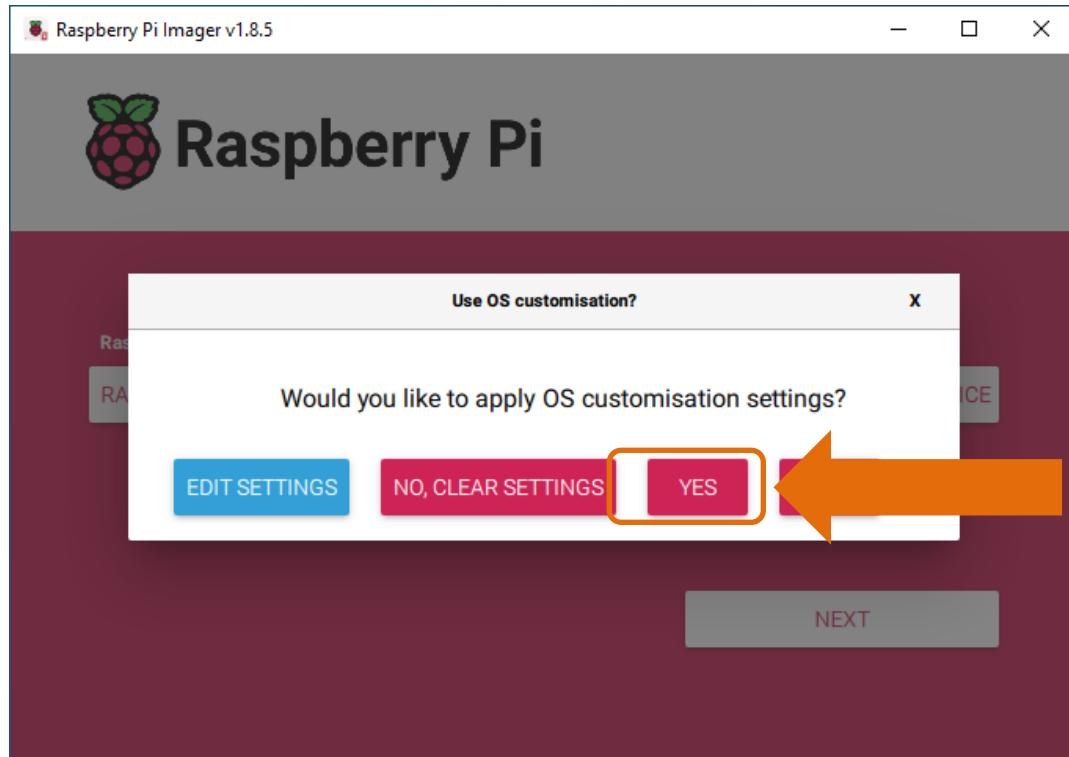
22. On the third page “**OPTIONS**” we are going to use the following options

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

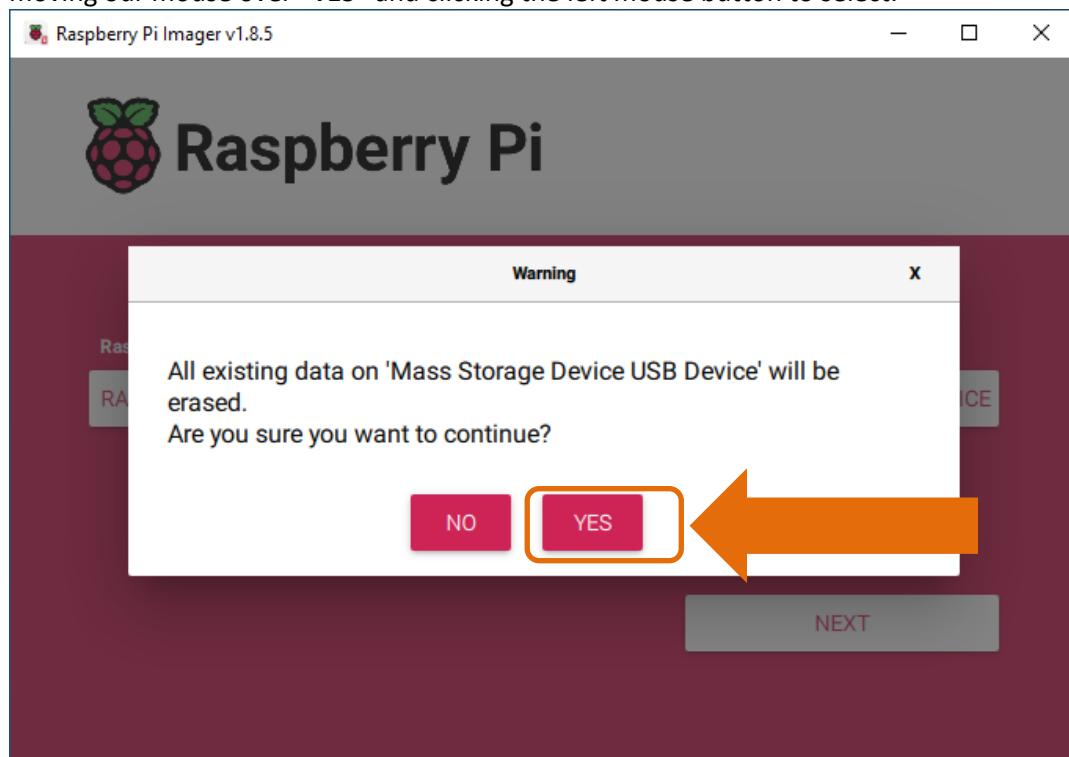
We will now have the option to save the customisations we have made. We do this by moving our mouse over “**SAVE**” and clicking the left mouse button to select.



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.

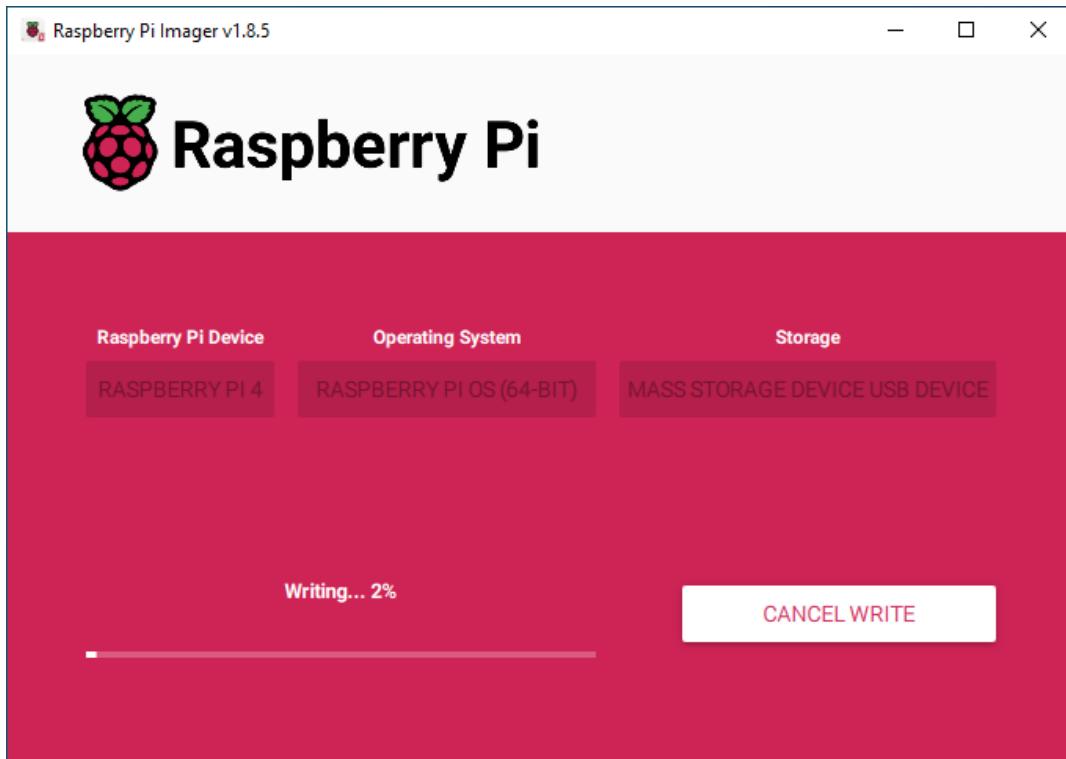


24. We now get a **warning** message about erasing the ‘**Mass Storage Device**’. Make sure you are going to write the Raspberry Pi operating system to the correct device, we do this by moving our mouse over “**YES**” and clicking the left mouse button to select.



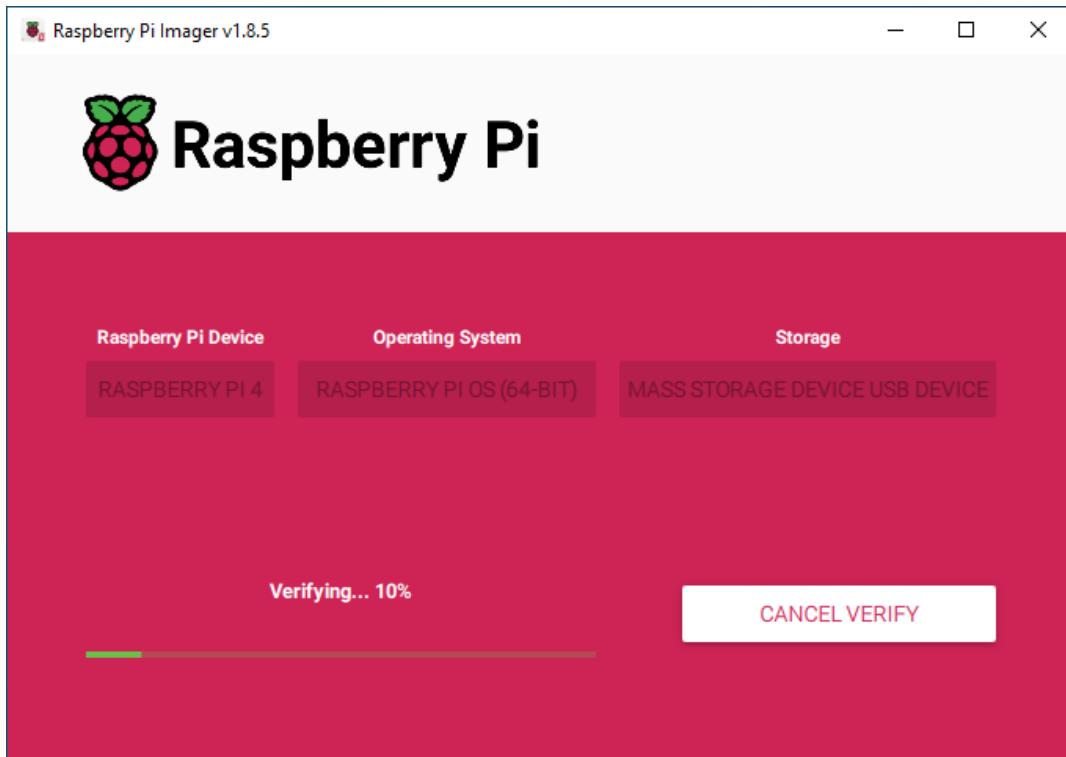
25. The **Raspberry Pi Imager** will now **write** the operating system to the mass storage device.

For a 32GB microSD card this takes about 7 minutes.

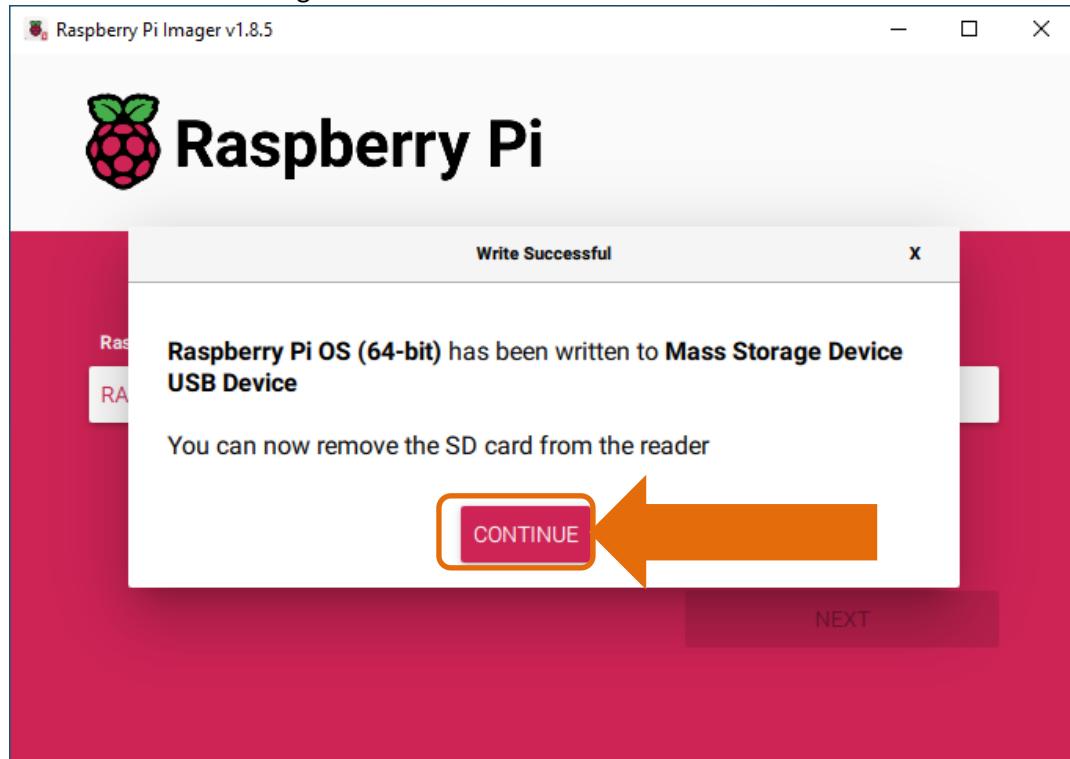


26. The **Raspberry Pi Imager** will now **verify** the operating system on the mass storage device.

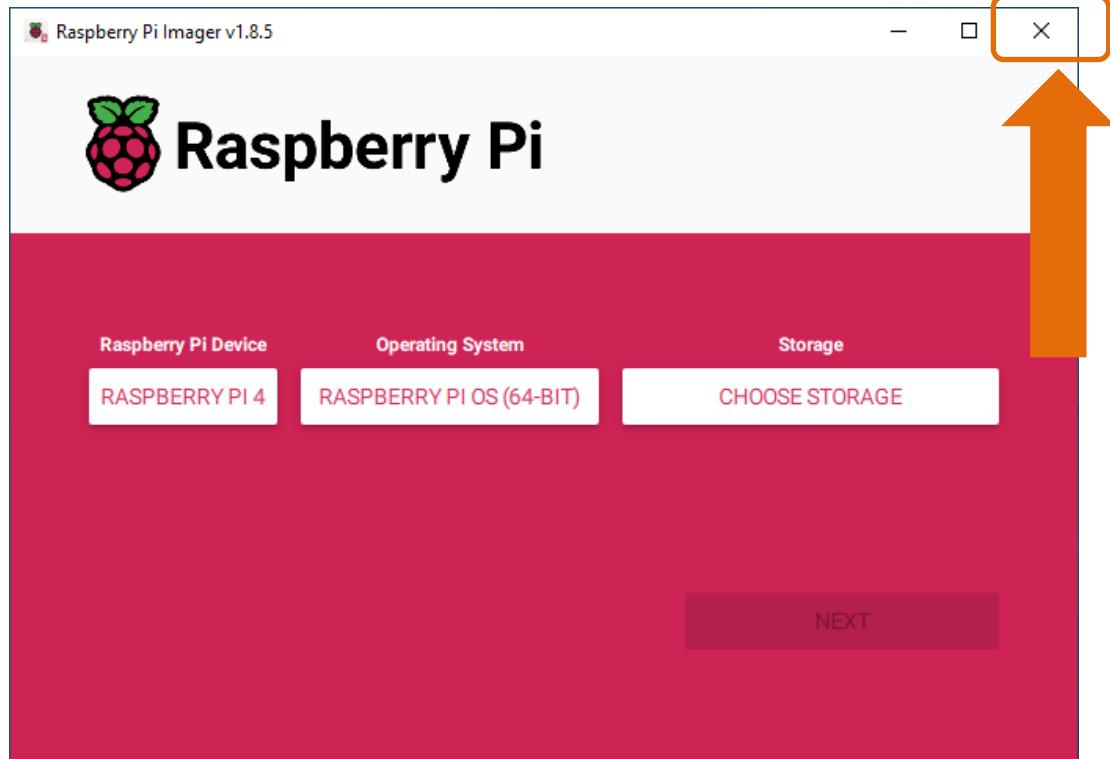
For a 32GB microSD card this takes about 7 minutes.



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.

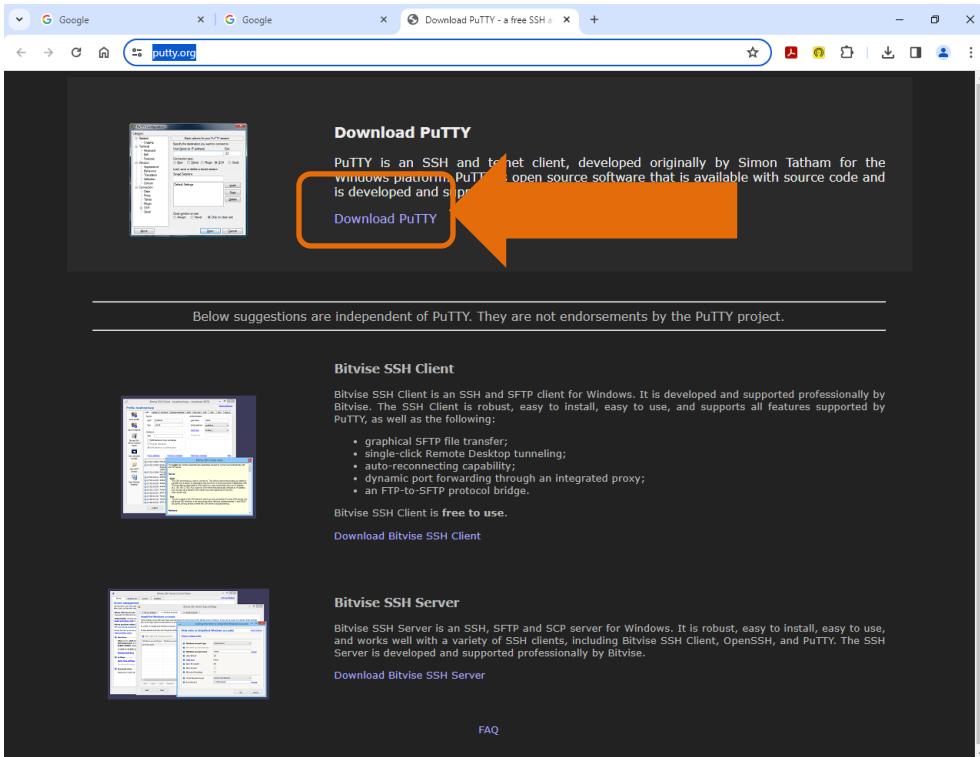


28. And then closing the Raspberry Pi Imager main window with the X button in the top right hand corner

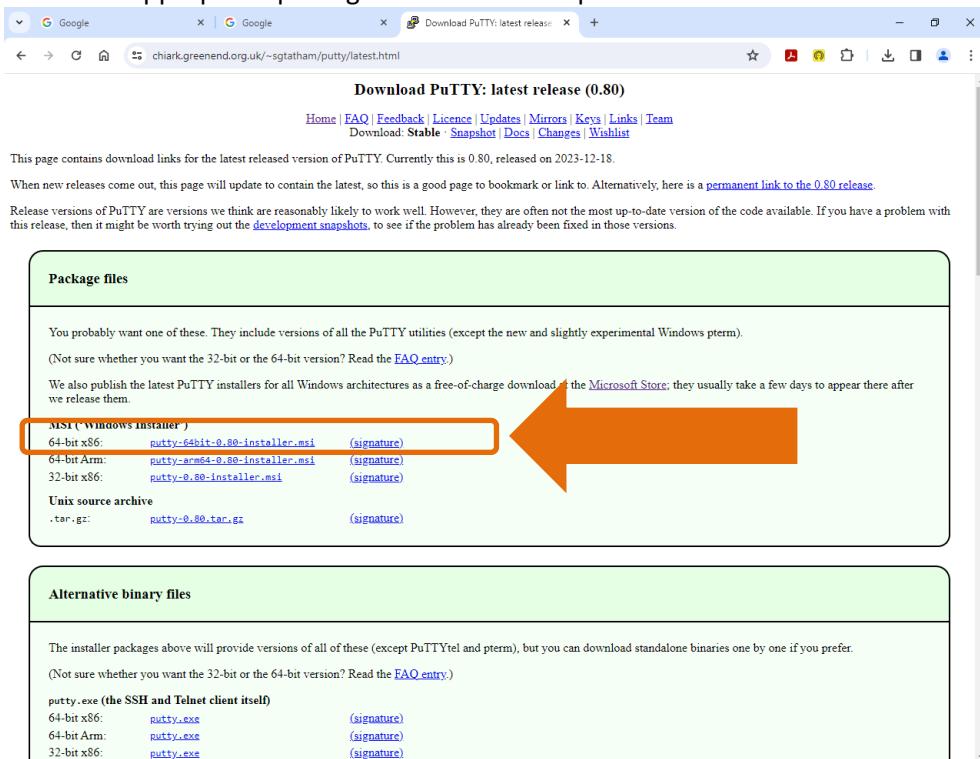


Installing PuTTY on your PC

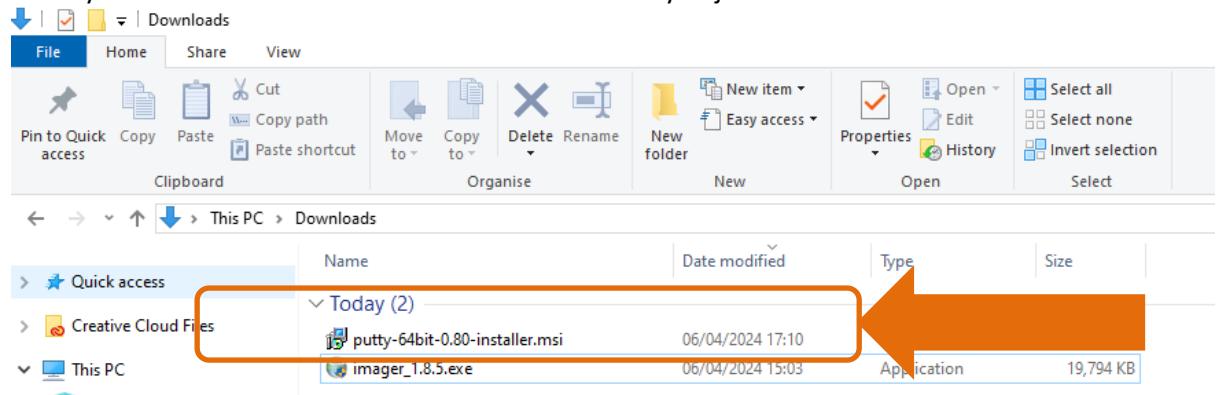
1. Use the following link to access PuTTY: <https://www.putty.org/>.
Click on the link "Download PuTTY"



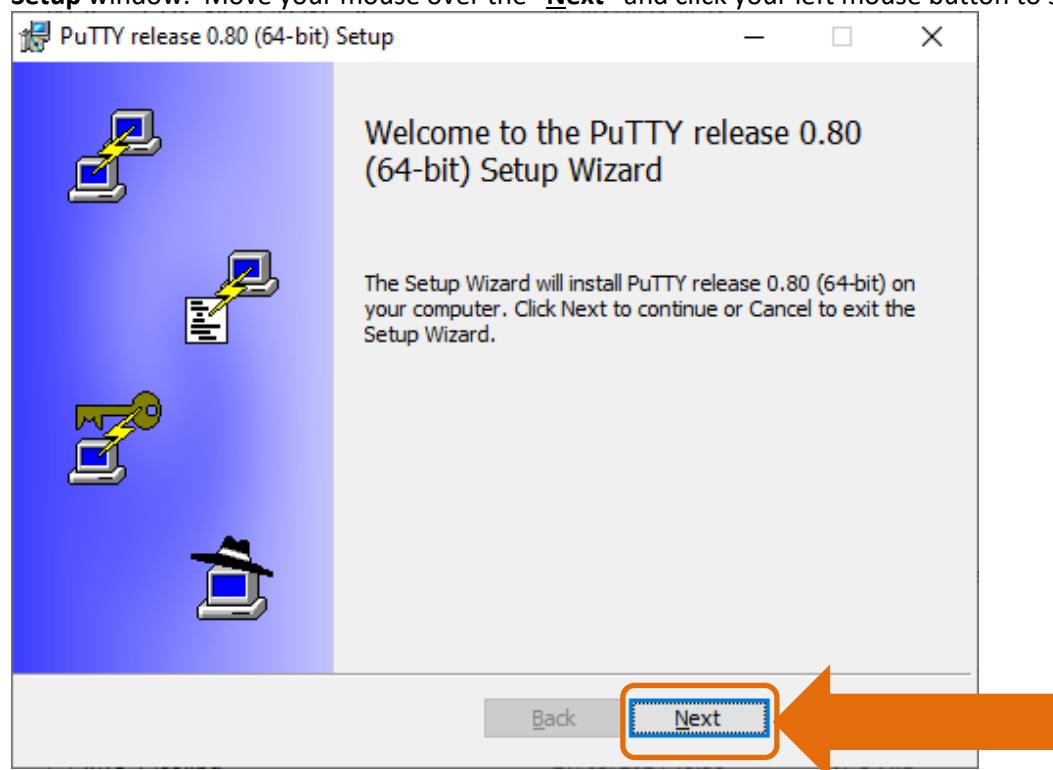
2. Select the appropriate package file from the list provided – in this case 64-bit x86.



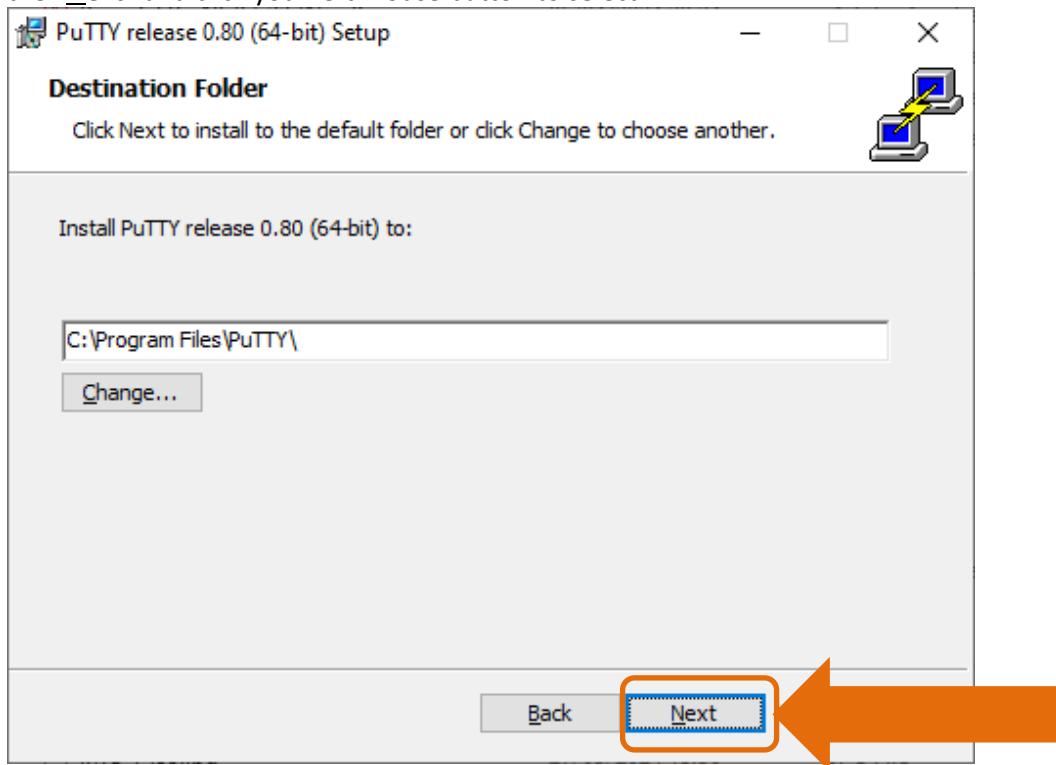
3. Go to your Downloads folder and locate the PuTTY file you just downloaded.



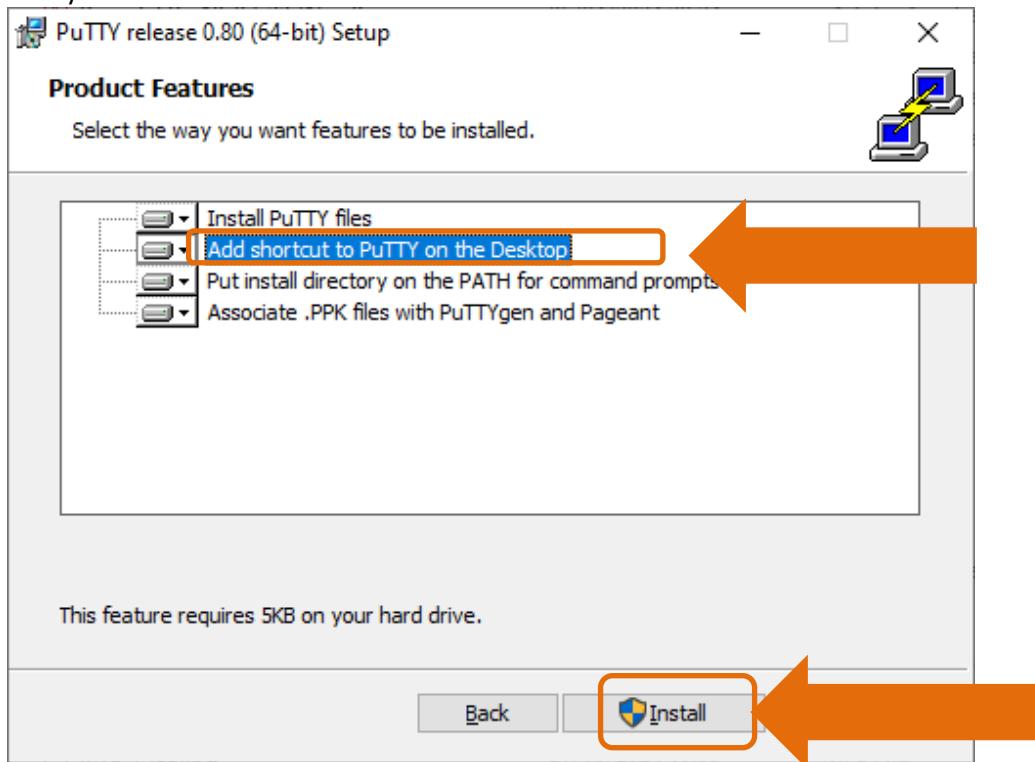
4. Double click on the putty-64bit file to run and you will be presented with a **PuTTY release Setup** window. Move your mouse over the “Next” and click your left mouse button to select



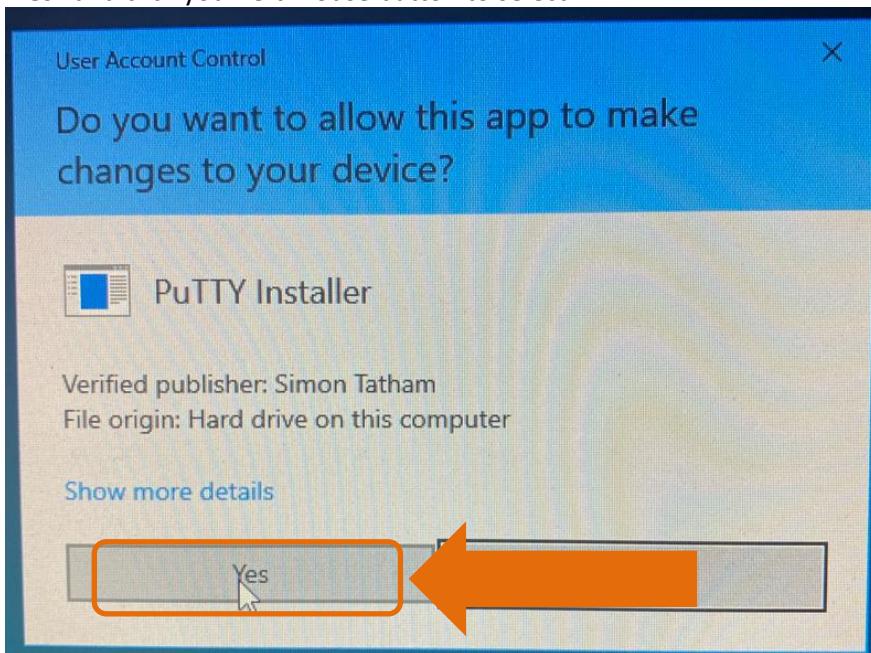
5. You will be asked where you want PuTTY installed – go with default. Move your mouse over the “**Next**” and click your left mouse button to select.



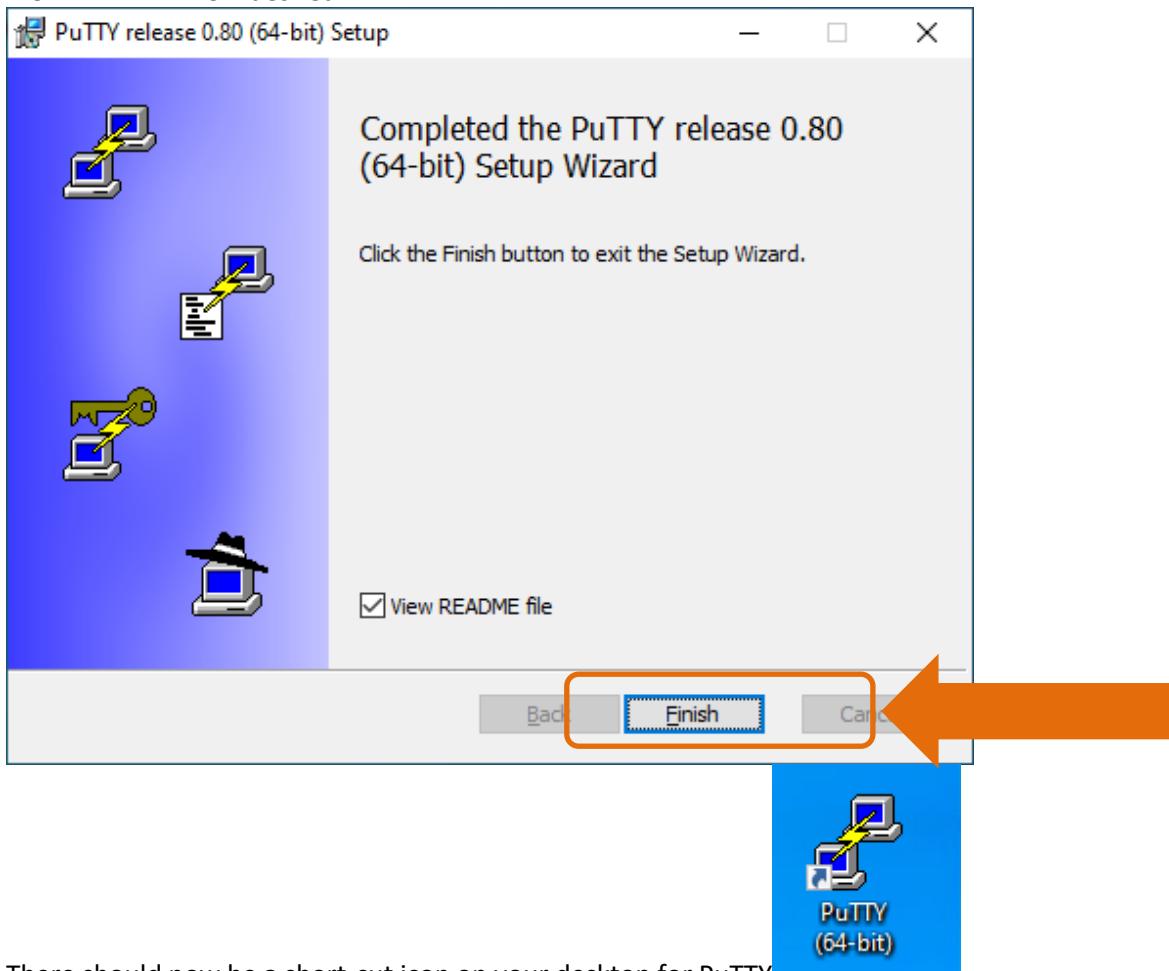
6. You will be asked about **Product Features** for PuTTY. Select “**Add shortcut to PuTTY on the Desktop**” – will be installed on local hard drive. Move your mouse over the “**Install**” and click your left mouse button to select.



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



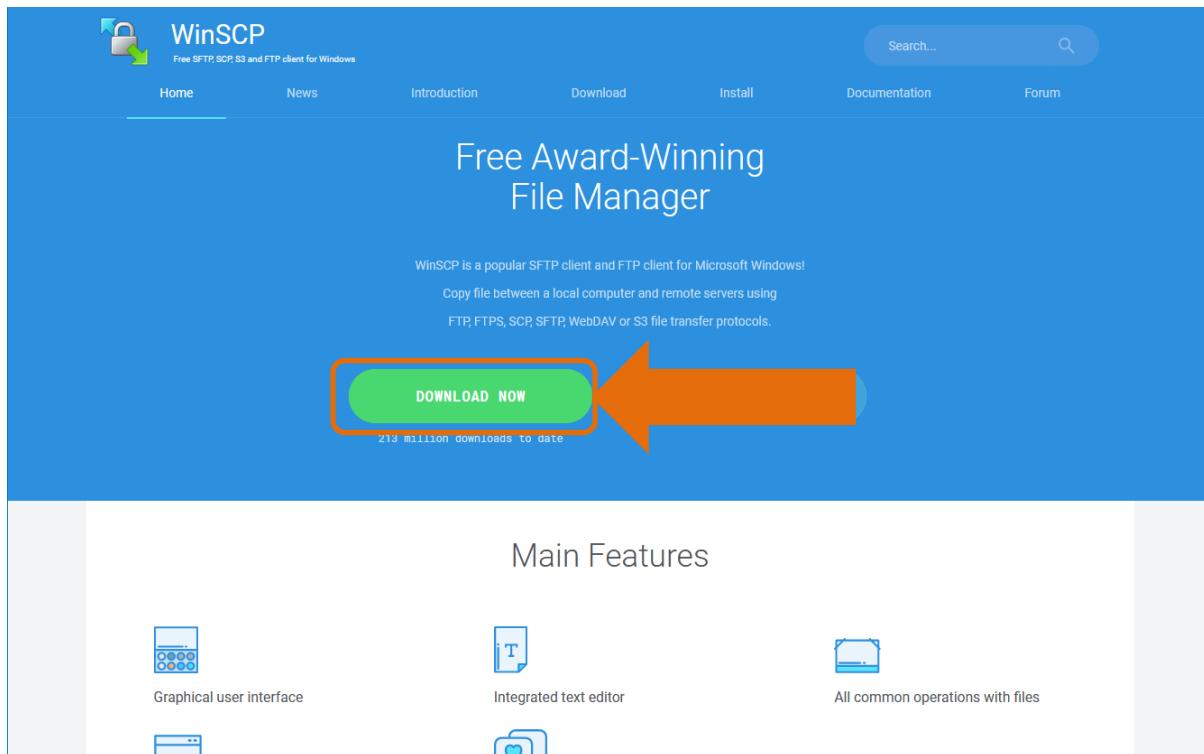
8. PuTTY will finish installing and present the following window when complete. Move your mouse over the “Finish” and click your left mouse button to select. You can deselect the View README file if desired.



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”.



The screenshot shows the WinSCP homepage with a blue header. The title "WinSCP" is at the top left, followed by a lock icon. The header includes links for Home, News, Introduction, Download, Install, Documentation, and Forum, along with a search bar. The main title "Free Award-Winning File Manager" is centered. Below it, a brief description states: "WinSCP is a popular SFTP client and FTP client for Microsoft Windows! Copy file between a local computer and remote servers using FTP, FTPS, SCP, SFTP, WebDAV or S3 file transfer protocols." A large green button labeled "DOWNLOAD NOW" is highlighted with an orange arrow pointing towards it. Below the button, a small note says "213 million downloads to date".

Main Features



Graphical user interface



Integrated text editor

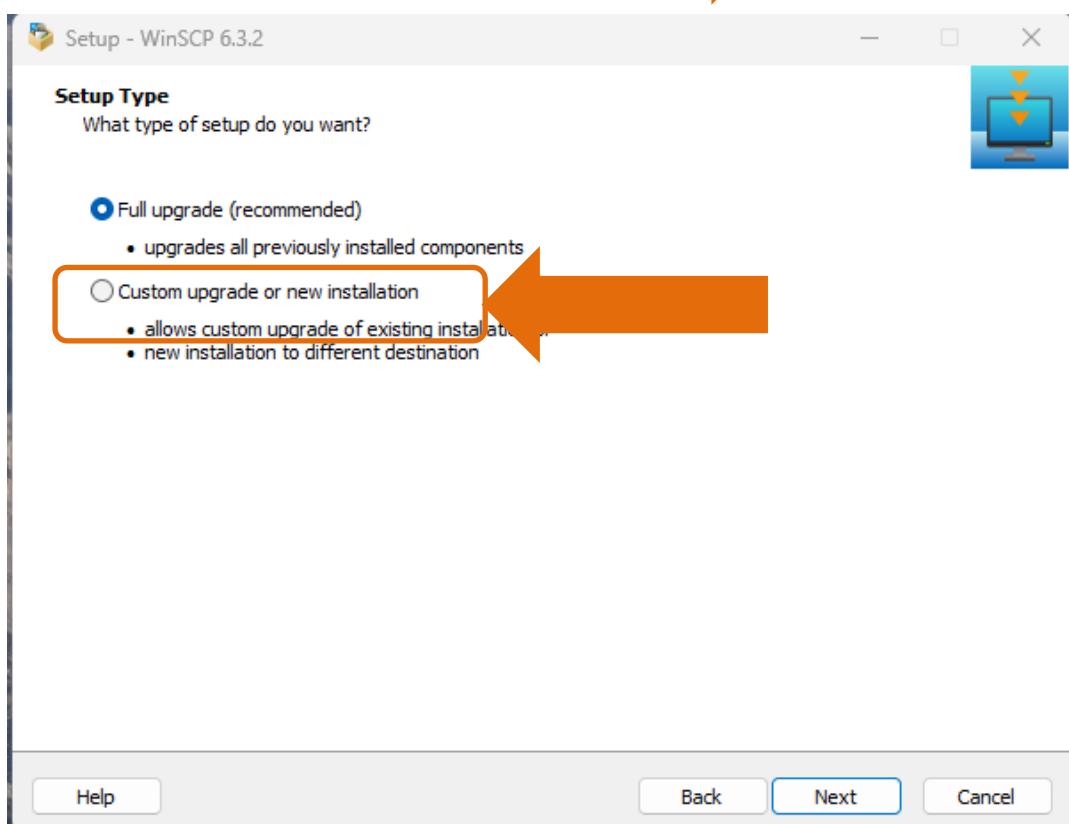
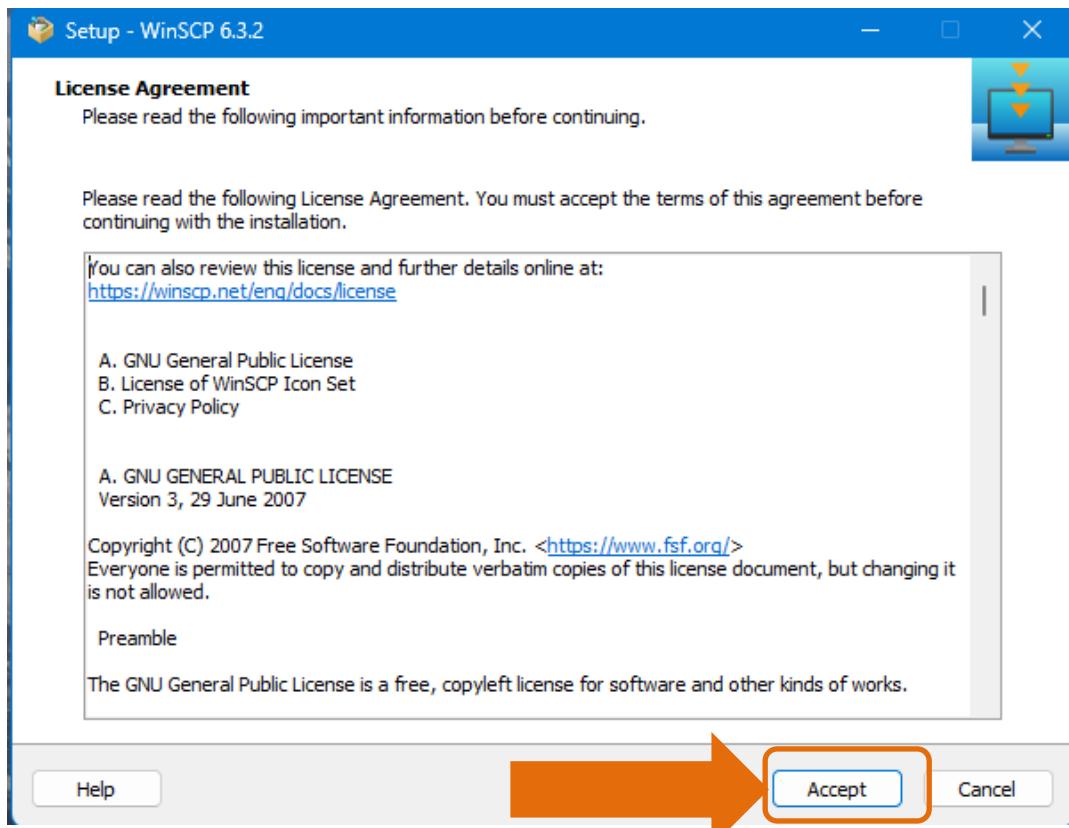


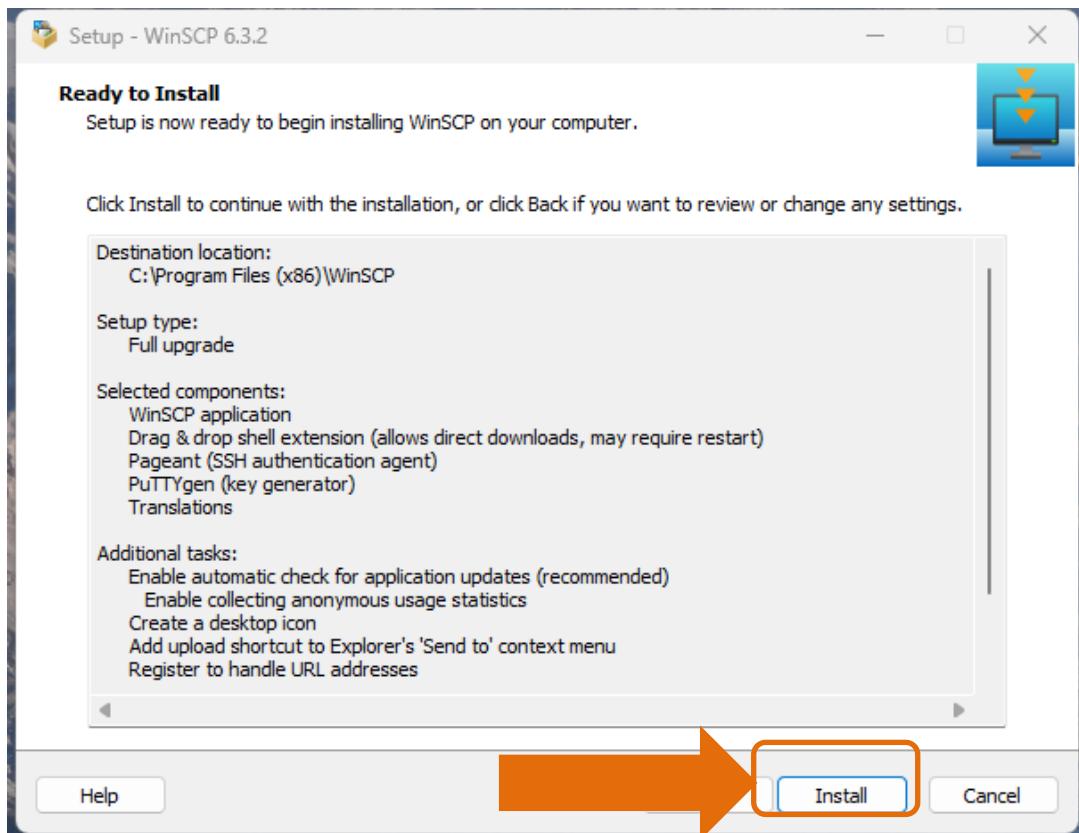
All common operations with files



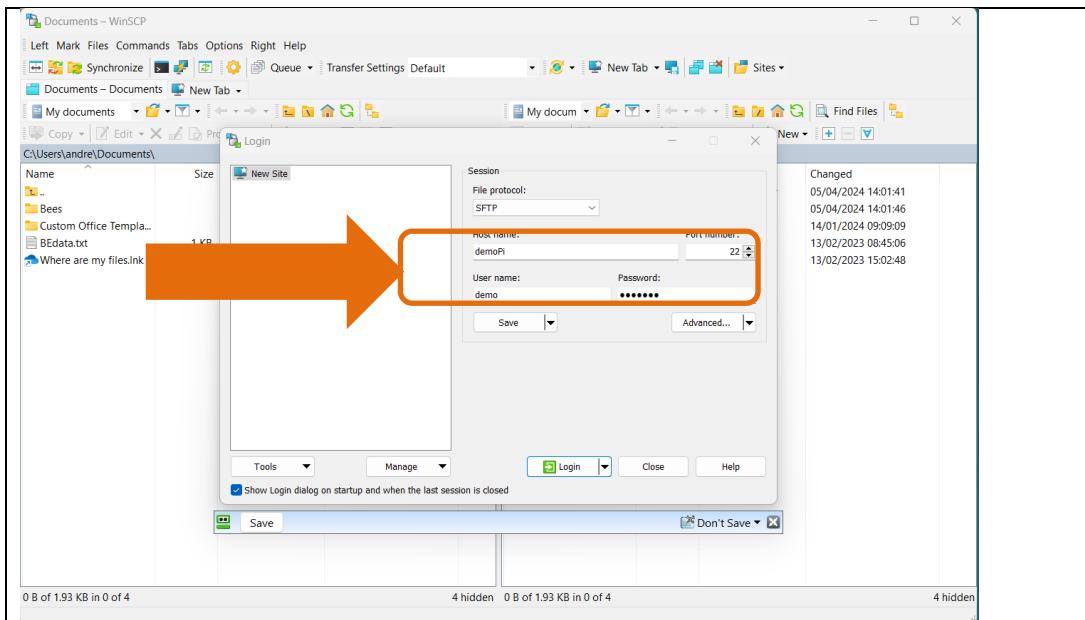
The screenshot shows the "WinSCP 6.3 Download" page. The header and navigation bar are identical to the homepage. The main title is "WinSCP 6.3 Download". Below it, a note says "WinSCP 6.3 is a major application update. New features and enhancements include:". A bulleted list follows, with the last item being a link to "List of all changes". A large green button labeled "DOWNLOAD WINSCP 6.3.2 (11 MB)" is highlighted with an orange arrow pointing towards it. A tooltip "What's this?" is visible near the button. At the bottom, there is a section titled "Main Features" with three icons: a desktop, a text document, and a folder.

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

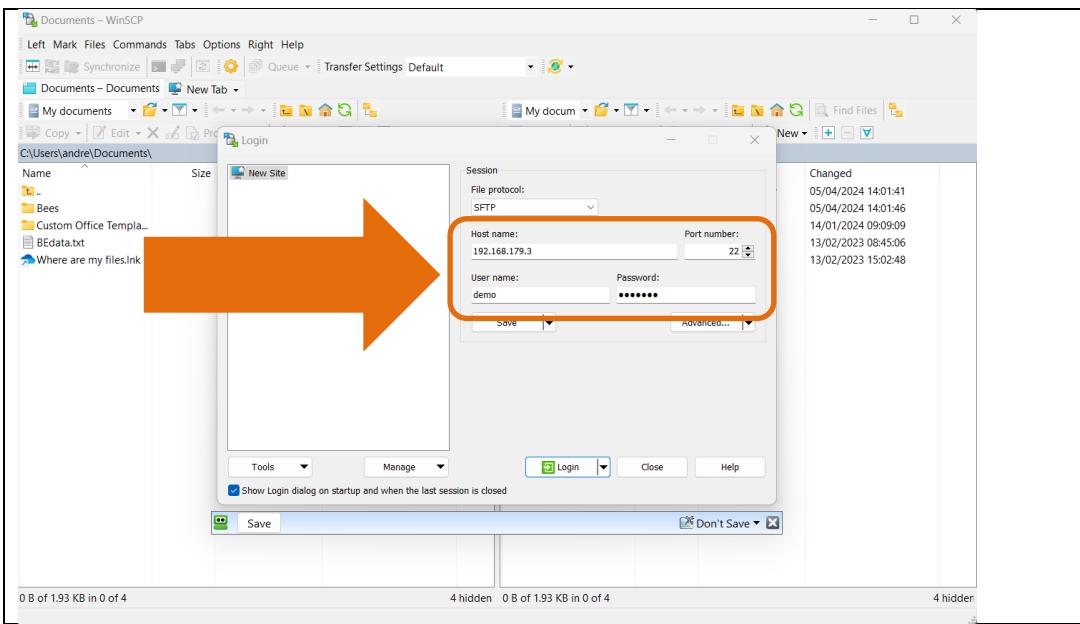




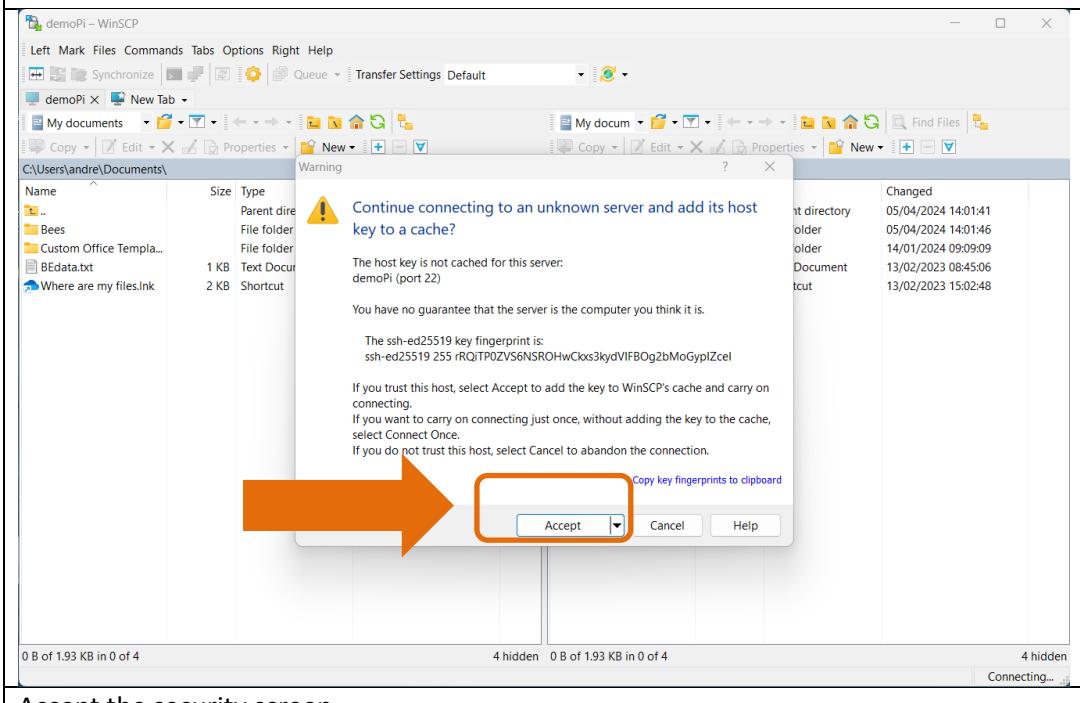
Next Launch the installed WinSCP programme. The next screenshots are a brief introduction to WinSCP and show how to connect to a RaspberryPi.



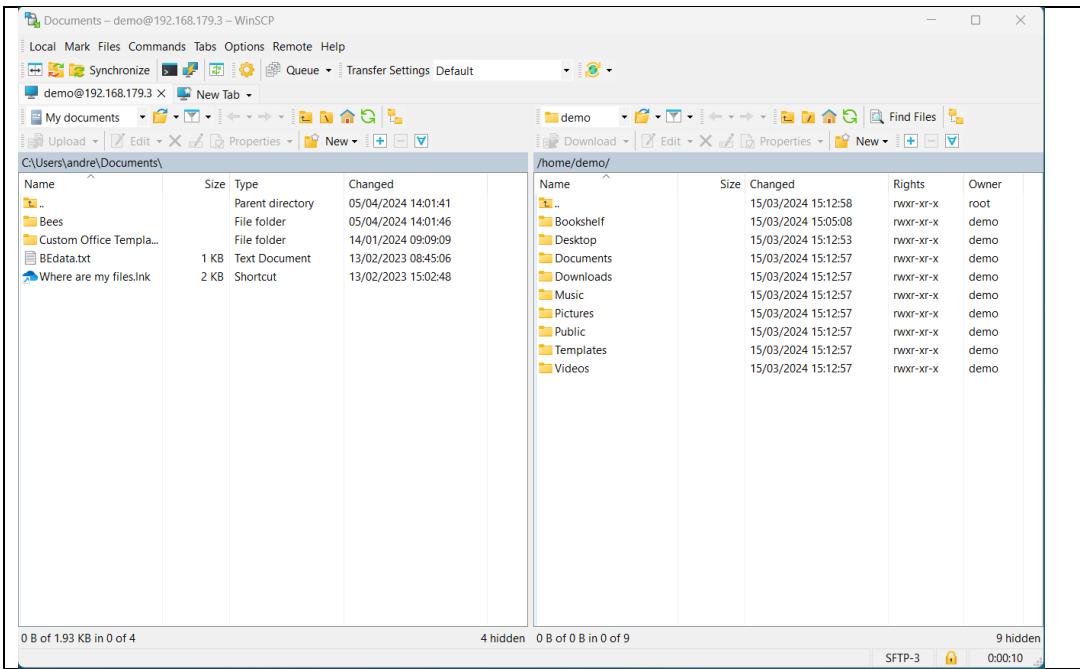
Enter the host name, user name and password. This is either be the host name configured on the microSD card or the RaspberryPi's ip address. This screen uses the device's host name.



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.

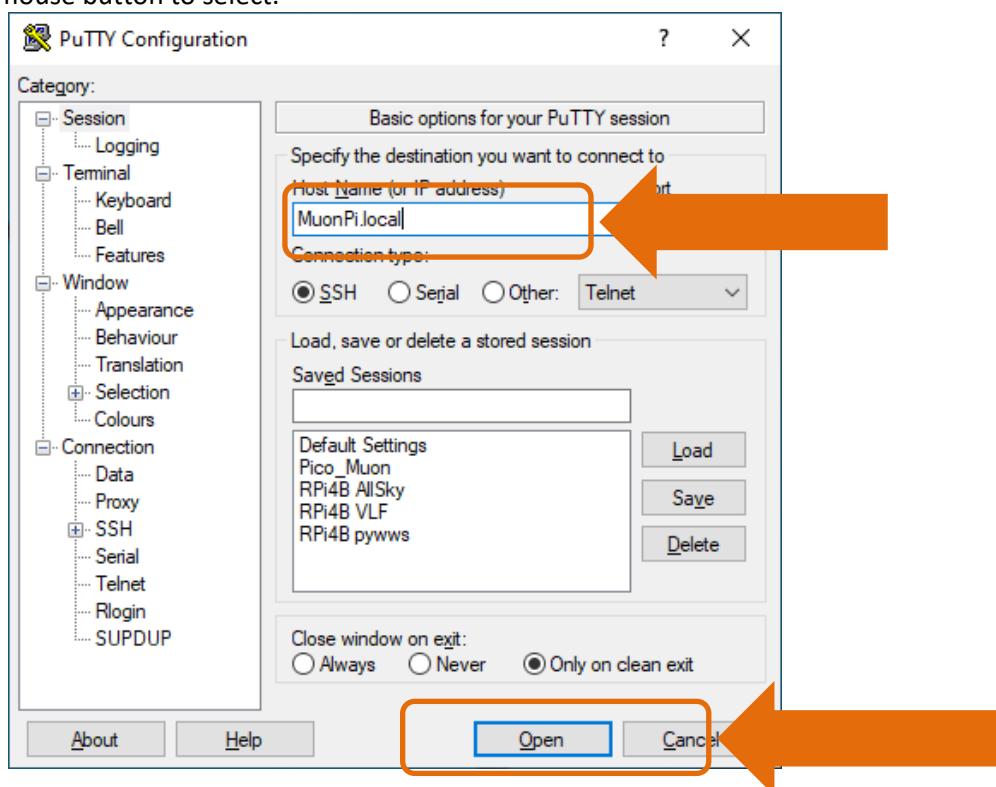
The right panel is the home directory on the RaspberryPi. Navigation is similar to Windows Explorer.

Turn on your Raspberry Pi and connect to it with PuTTY

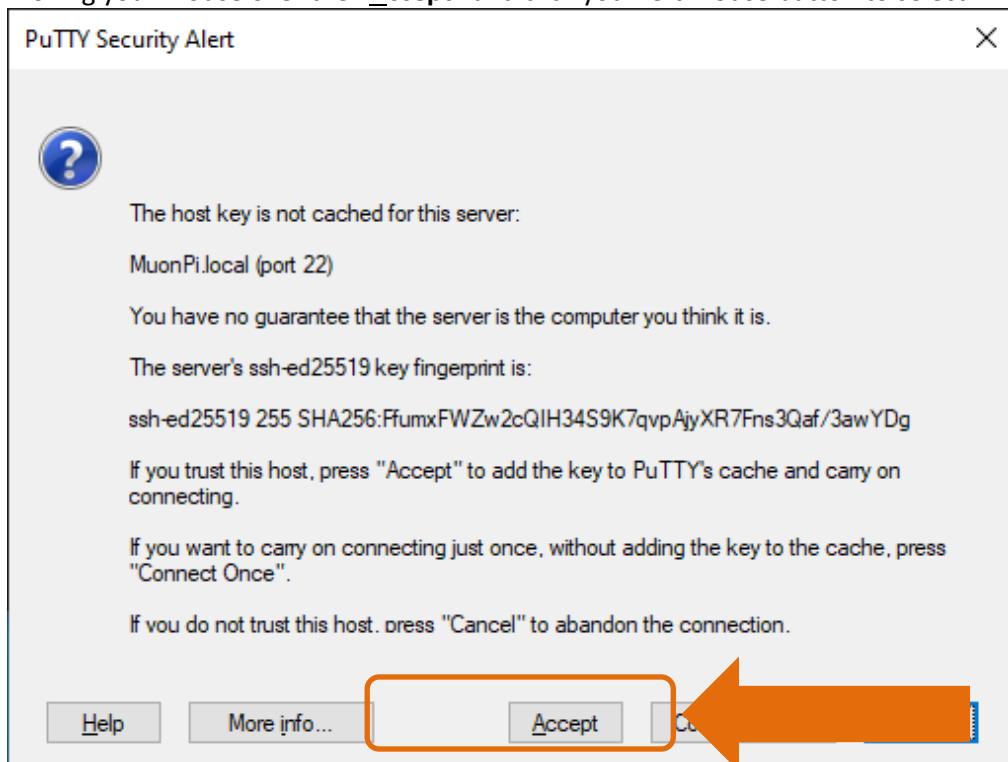
1. Insert the microSD card into your Raspberry Pi
2. If using Ethernet – connect CAT5 cable from your home network to the Raspberry Pi.
3. Connect suitable power supply to your Raspberry Pi.
4. Turn power on – we should see solid red LED on Raspberry Pi illuminated (correct power) as well as flashing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



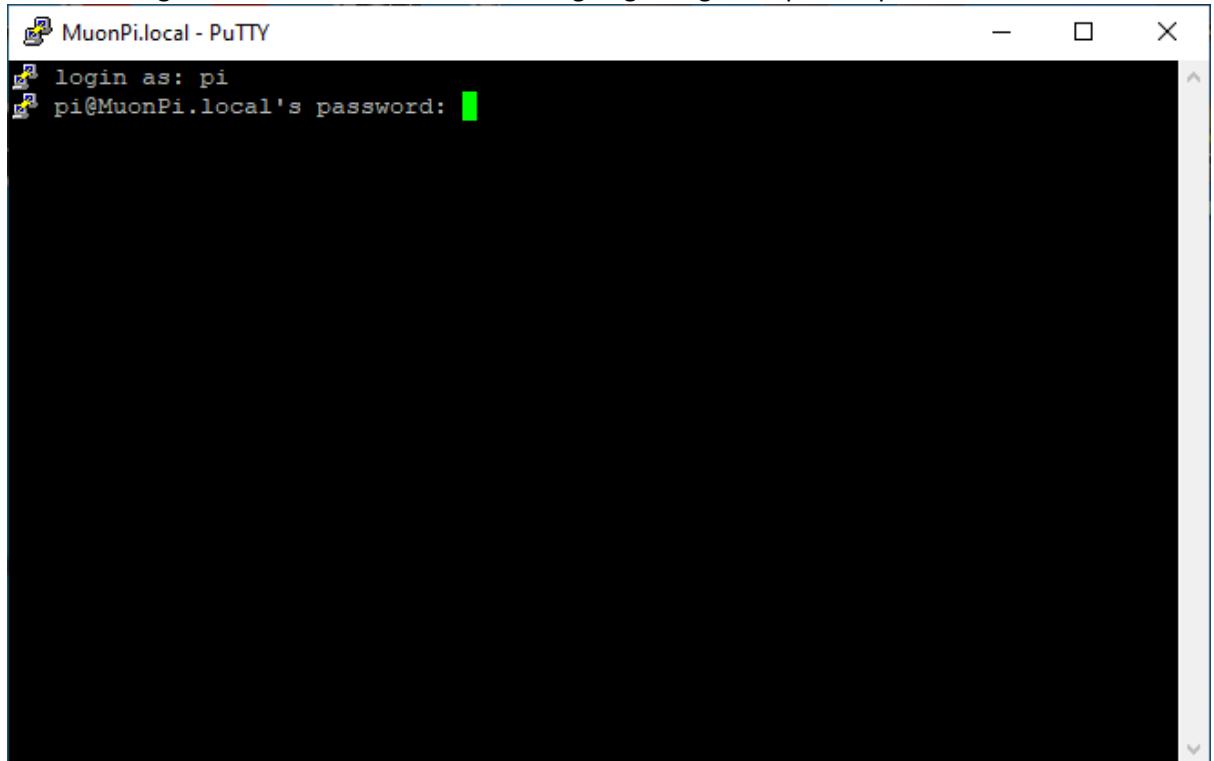
6. Open PuTTY using the desktop shortcut
7. We see the **PuTTY Configuration** window. We are going to enter the name we gave to the Raspberry Pi into the Host Name box – for us it was **MuonPi.local**, next we are going to connect to the Raspberry Pi by moving your mouse over the "Open" and click your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



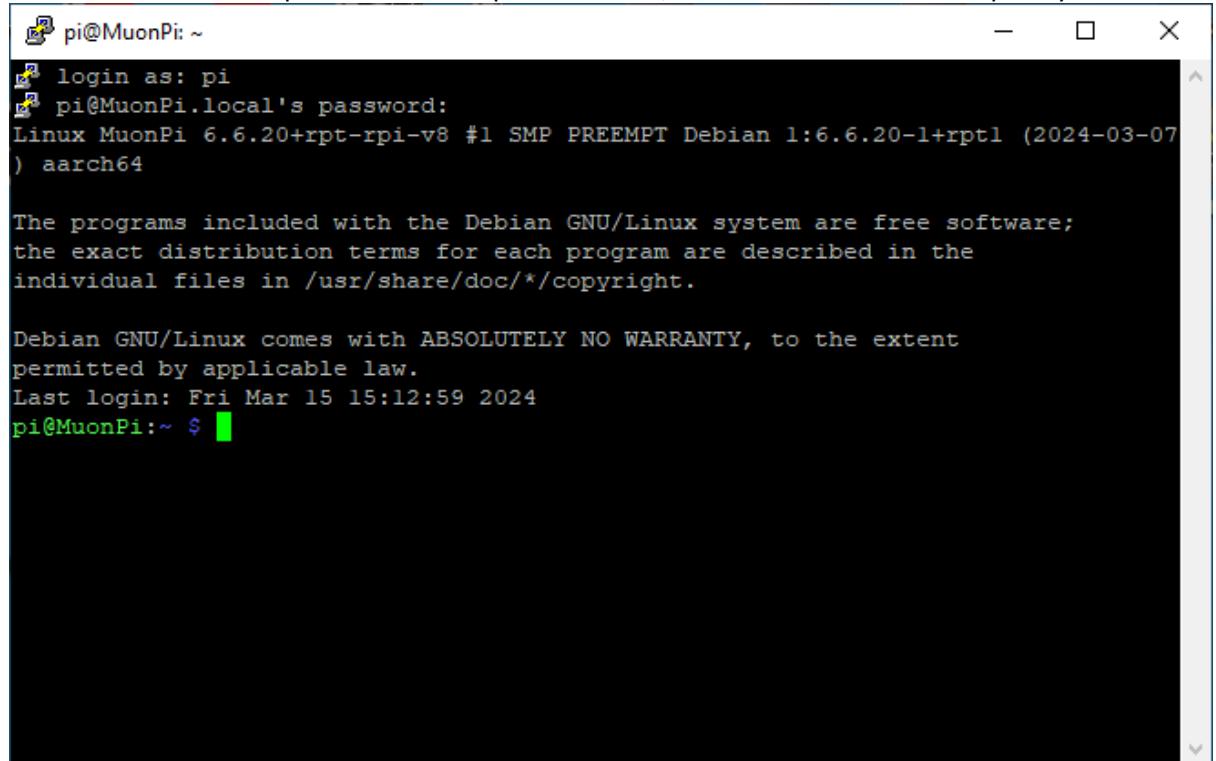
8. We will now get a **PuTTY Security Alert** window, as this is the first time we have accessed the Raspberry Pi. We are going to accept the notice and connect to the Raspberry Pi by moving your mouse over the “Accept” and click your left mouse button to select.



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.



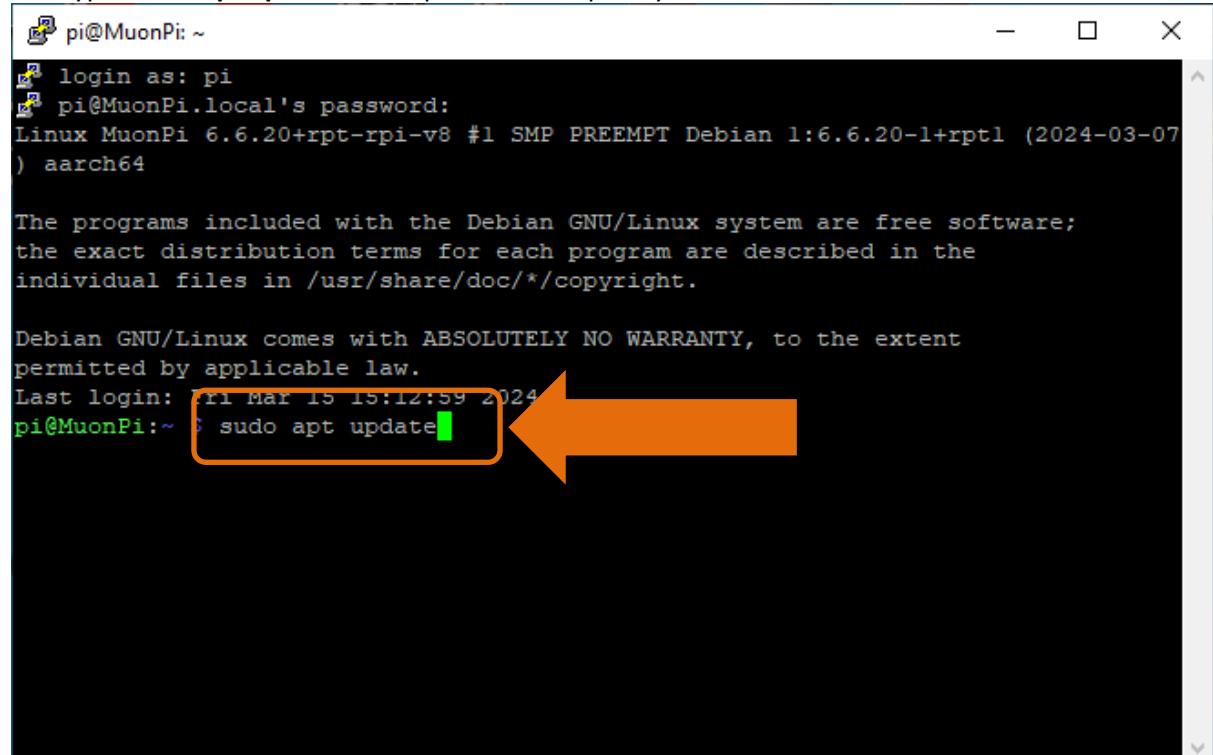
```
pi@MuonPi: ~
[pi] login as: pi
[pi] pi@MuonPi.local's password:
Linux MuonPi 6.6.20+rpt-rpi-v8 #1 SMP PREEMPT Debian 1:6.6.20-1+rpt1 (2024-03-07)
) aarch64

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

- Type “sudo apt update” – to update the Raspberry Pi



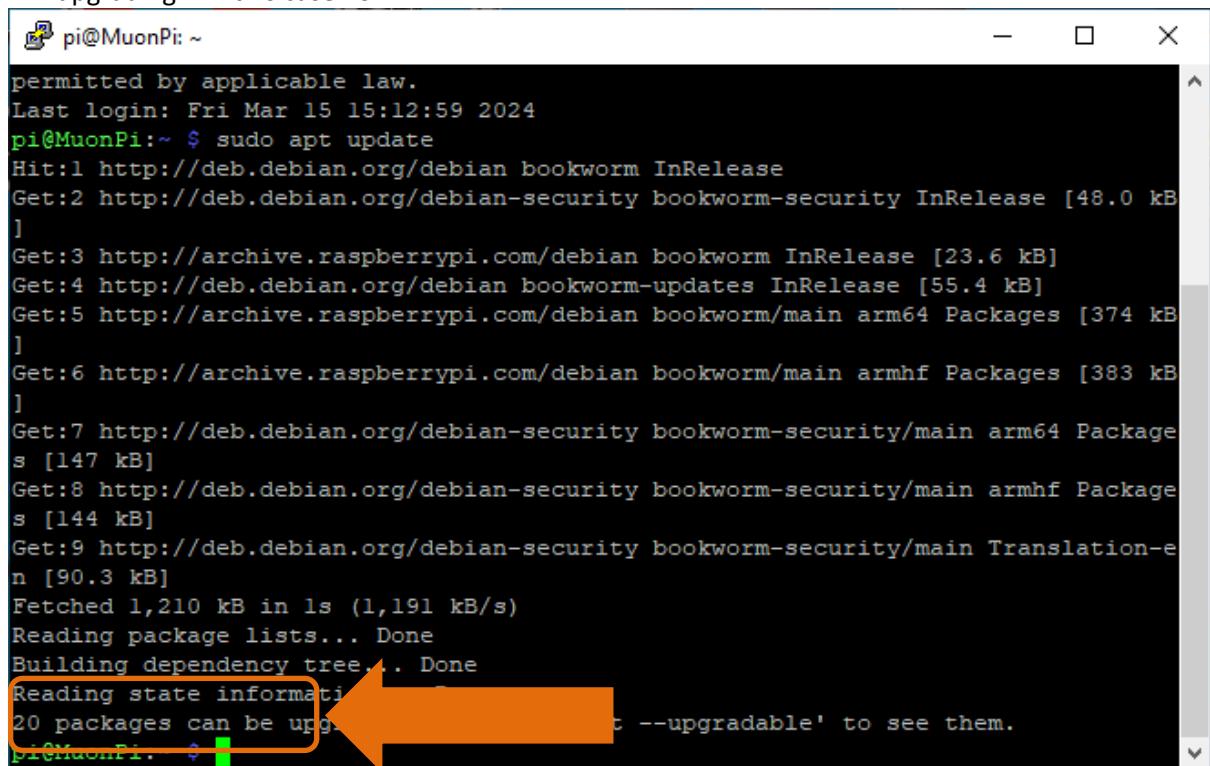
```
pi@MuonPi: ~
[pi] login as: pi
[pi] pi@MuonPi.local's password:
Linux MuonPi 6.6.20+rpt-rpi-v8 #1 SMP PREEMPT Debian 1:6.6.20-1+rpt1 (2024-03-07)
) aarch64

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
```

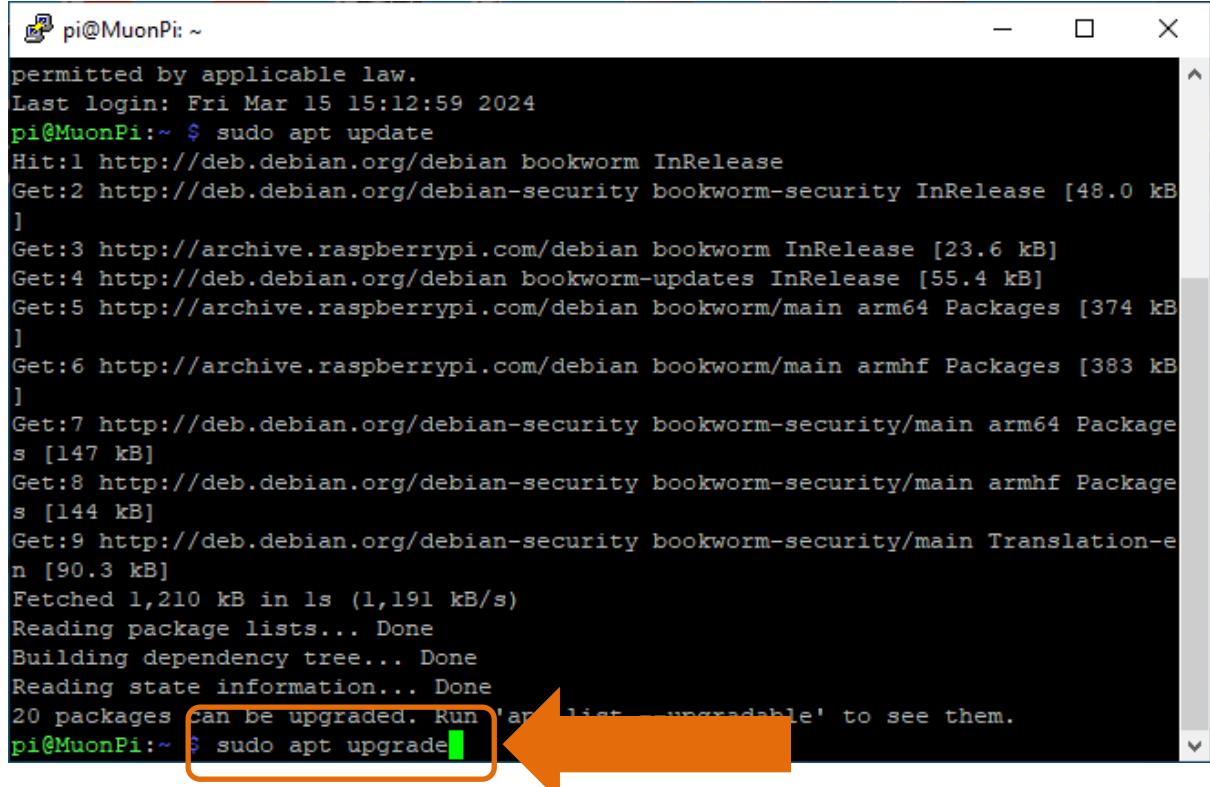
An orange arrow points from the text "pi@MuonPi:~ \$ sudo apt update" towards the left side of the screen, indicating where the user should click to execute the command.

- 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



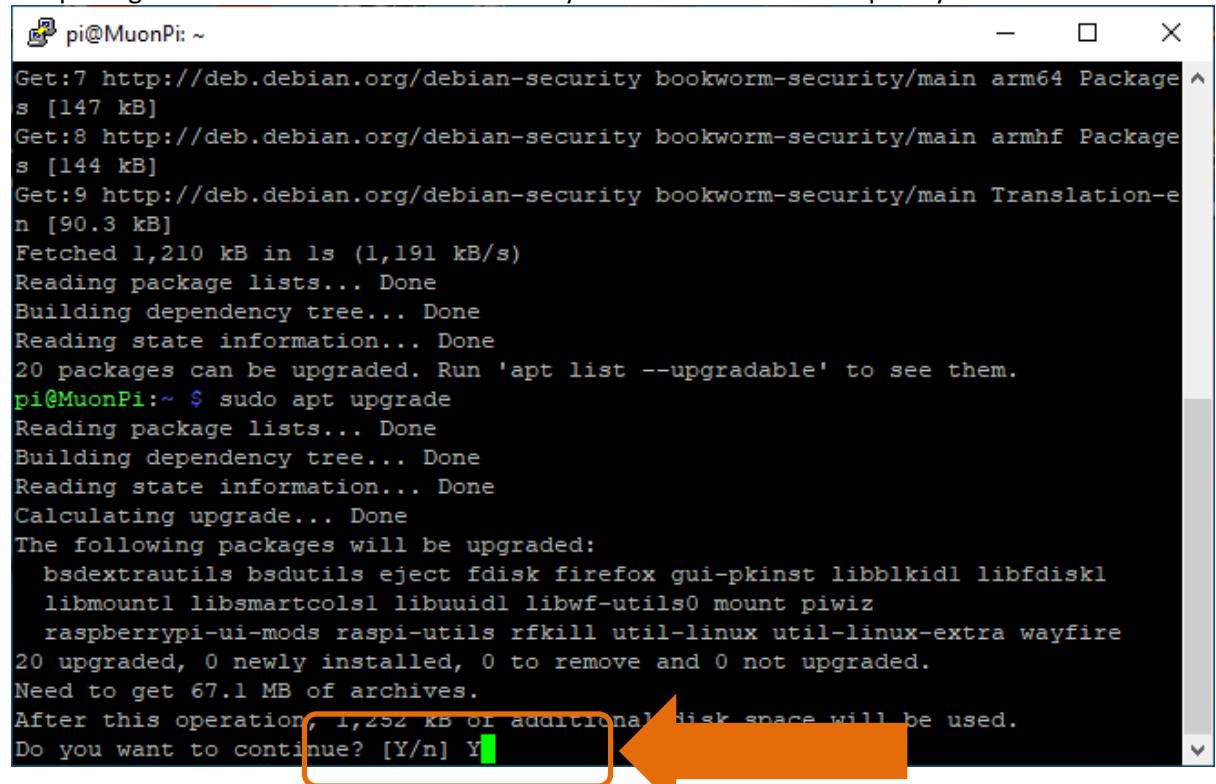
```
pi@MuonPi: ~
permitted by applicable law.
Last login: Fri Mar 15 15:12:59 2024
pi@MuonPi:~ $ sudo apt update
Hit:1 http://deb.debian.org/debian bookworm InRelease
Get:2 http://deb.debian.org/debian-security bookworm-security InRelease [48.0 kB]
]
Get:3 http://archive.raspberrypi.com/debian bookworm 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



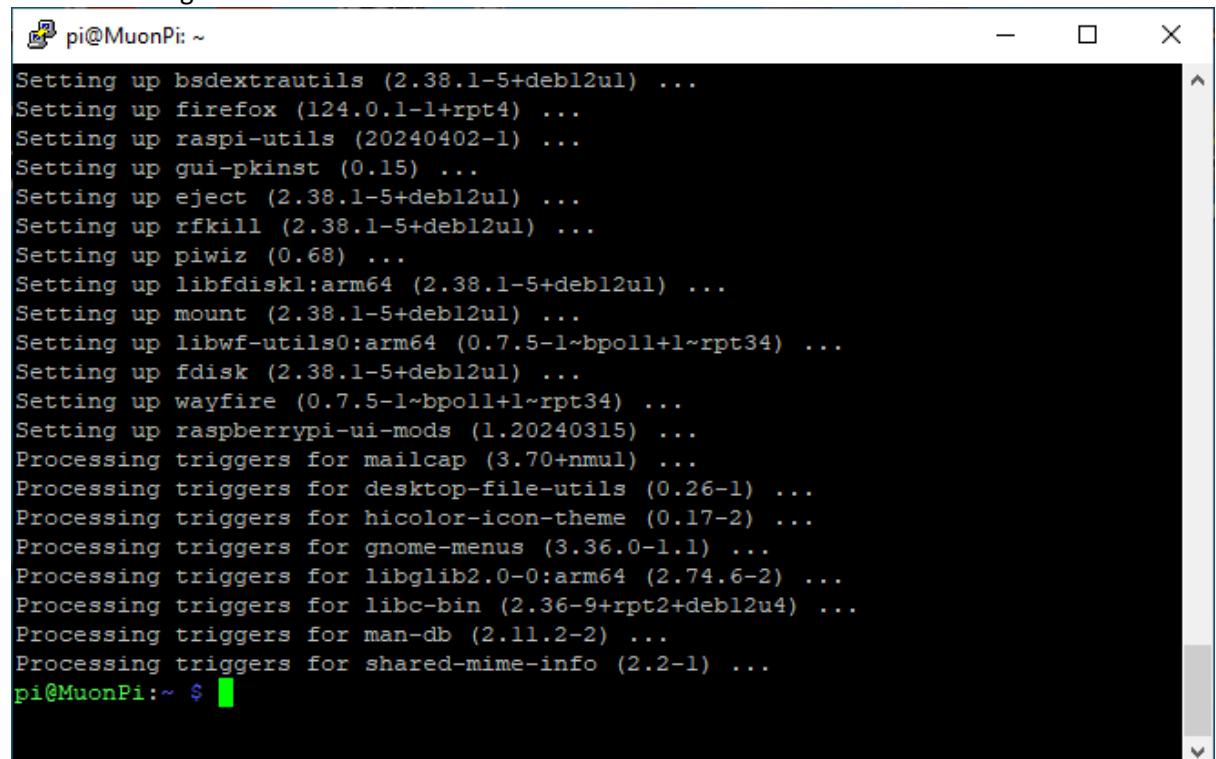
```
pi@MuonPi: ~
permitted by applicable law.
Last login: Fri Mar 15 15:12:59 2024
pi@MuonPi:~ $ sudo apt update
Hit:1 http://deb.debian.org/debian bookworm InRelease
Get:2 http://deb.debian.org/debian-security bookworm-security InRelease [48.0 kB]
]
Get:3 http://archive.raspberrypi.com/debian bookworm 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 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
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
Calculating upgrade... Done
The following packages will be upgraded:
  bsdextrautils bsutils eject fdisk firefox gui-pkinst libblkid libfdiskl
  libmount libsmartcols1 libuuid libwfirmount piwiz
  raspberrypi-ui-mods raspi-utils rfkill 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
```

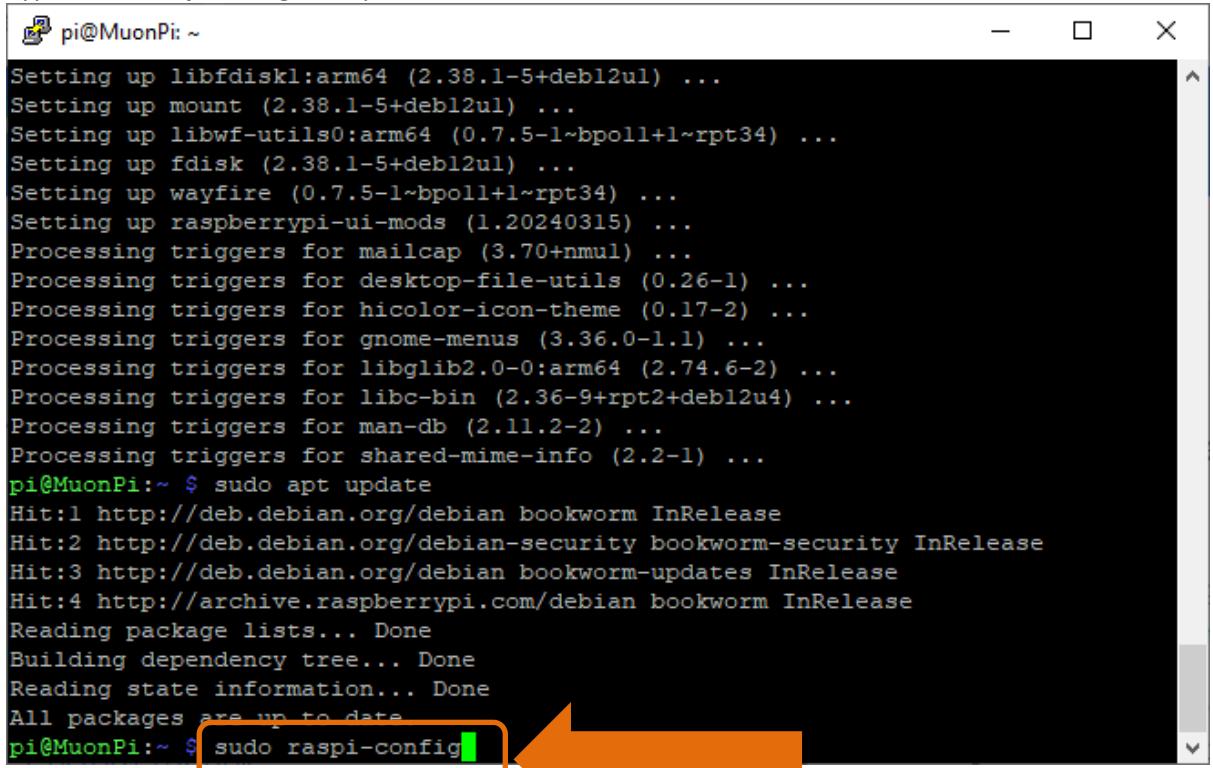
- e. When upgrade has finished you may be informed that there are some packages that are no longer needed – in this case none



```
pi@MuonPi: ~
Setting up bsdextrautils (2.38.1-5+deb12ul) ...
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+deb12ul) ...
Setting up rfkill (2.38.1-5+deb12ul) ...
Setting up piwiz (0.68) ...
Setting up libfdiskl:arm64 (2.38.1-5+deb12ul) ...
Setting up mount (2.38.1-5+deb12ul) ...
Setting up libwfirmount:arm64 (0.7.5-1~bpoll+1~rpt34) ...
Setting up fdisk (2.38.1-5+deb12ul) ...
Setting up wayfire (0.7.5-1~bpoll+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

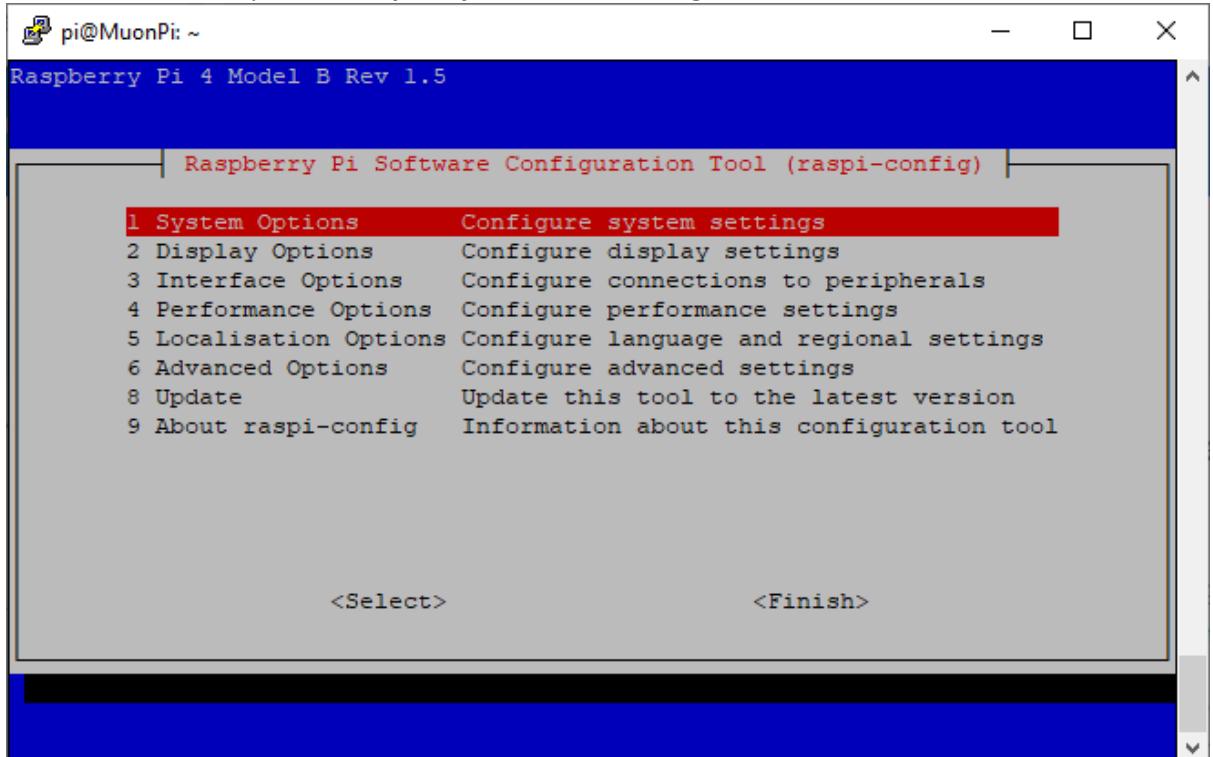
13. Type “**sudo raspi-config**” and press enter



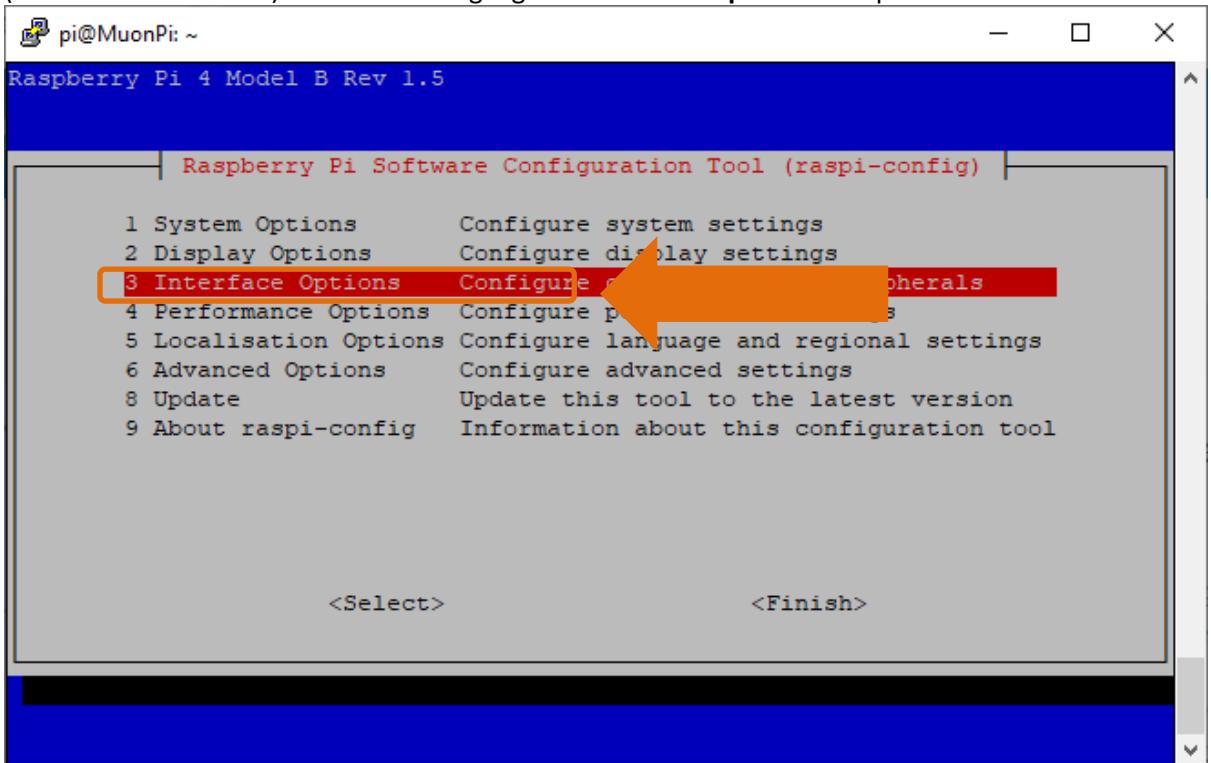
```
pi@MuonPi: ~
Setting up libfdisk1:arm64 (2.38.1-5+deb12u1) ...
Setting up mount (2.38.1-5+deb12u1) ...
Setting up libwfw-utils0:arm64 (0.7.5-1~bpoll+l~rpt34) ...
Setting up fdisk (2.38.1-5+deb12u1) ...
Setting up wayfire (0.7.5-1~bpoll+l~rpt34) ...
Setting up raspberrypi-ui-mods (1.20240315) ...
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:~ $ 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 text "This command will open the Raspberry Pi Software Configuration Tool" to the "raspi-config" command in the terminal.

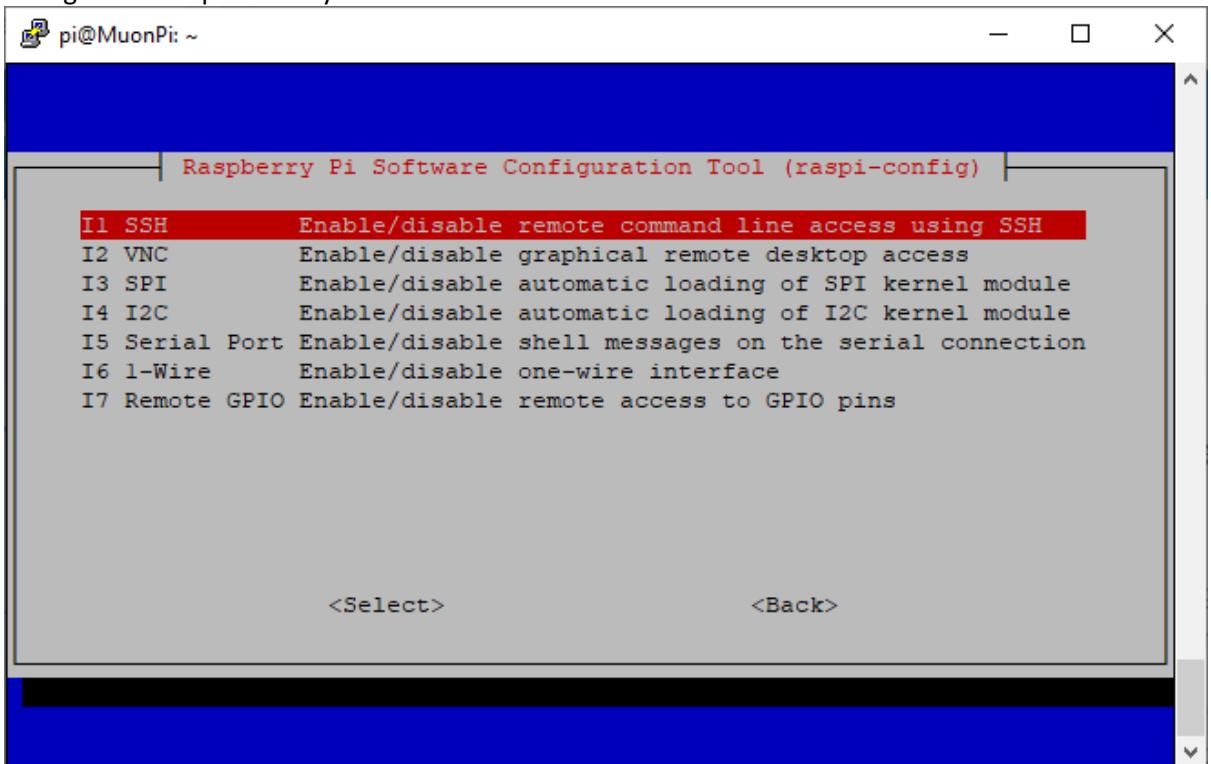
14. This command will open the **Raspberry Pi Software Configuration Tool**



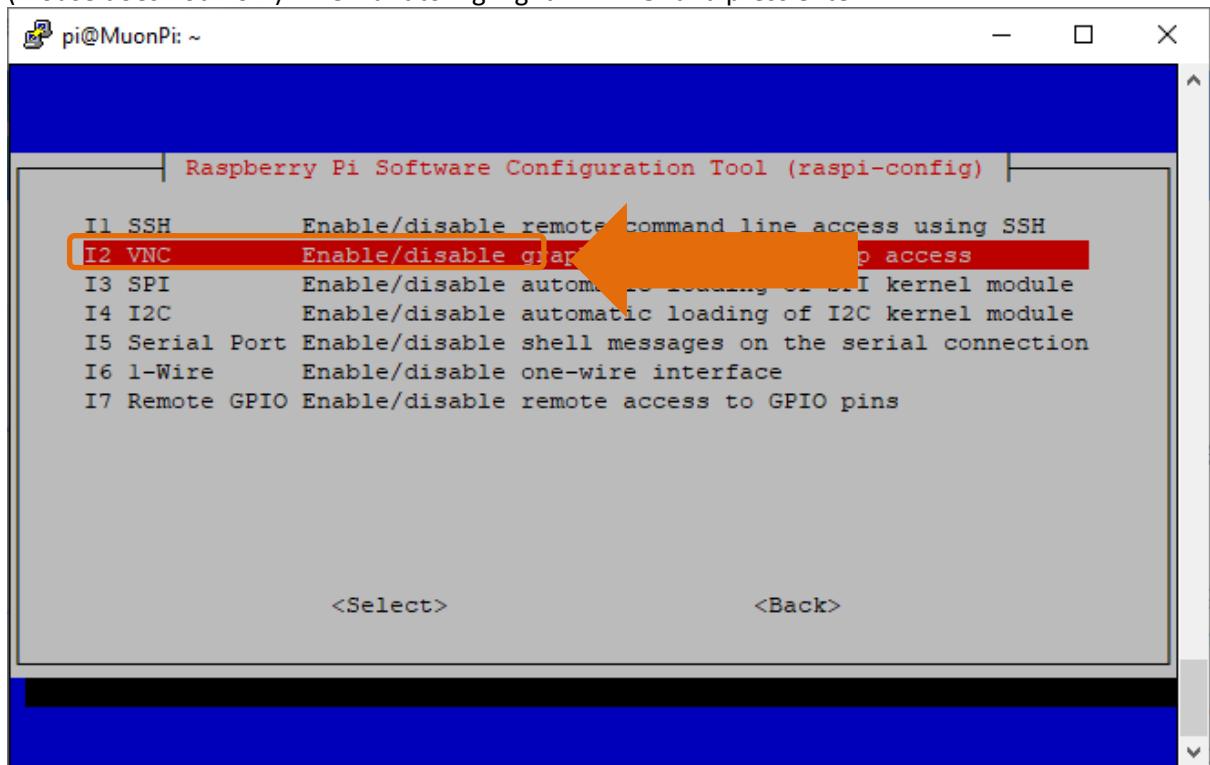
15. We can use the arrow keys on the keyboard to move the red highlighted cursor up or down (mouse does not work). We want to highlight “**3 Interface Options**” and press enter



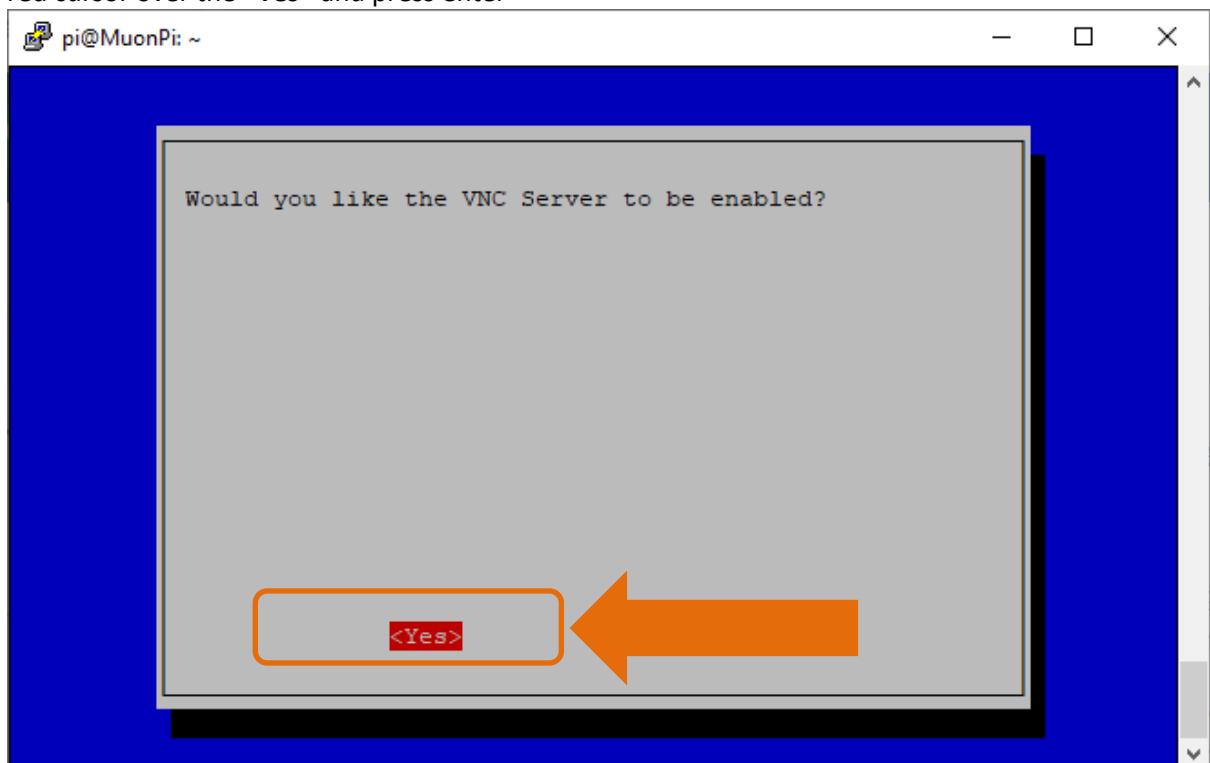
16. We now see the various interfaces available on the Raspberry Pi. We enabled SSH when we configured the operation system on the microSD card. We now need to enable VNC.



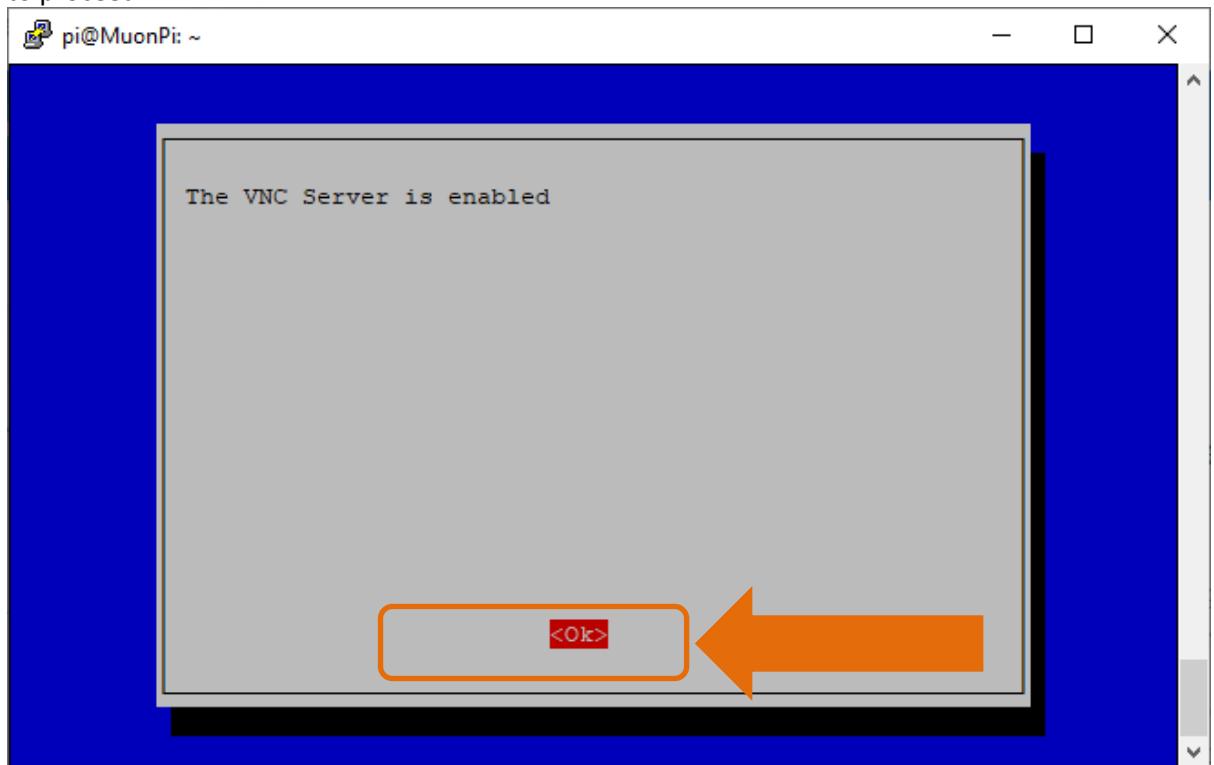
17. We can use the arrow keys on the keyboard to move the red highlighted cursor up or down (mouse does not work). We want to highlight “I2 VNC” and press enter



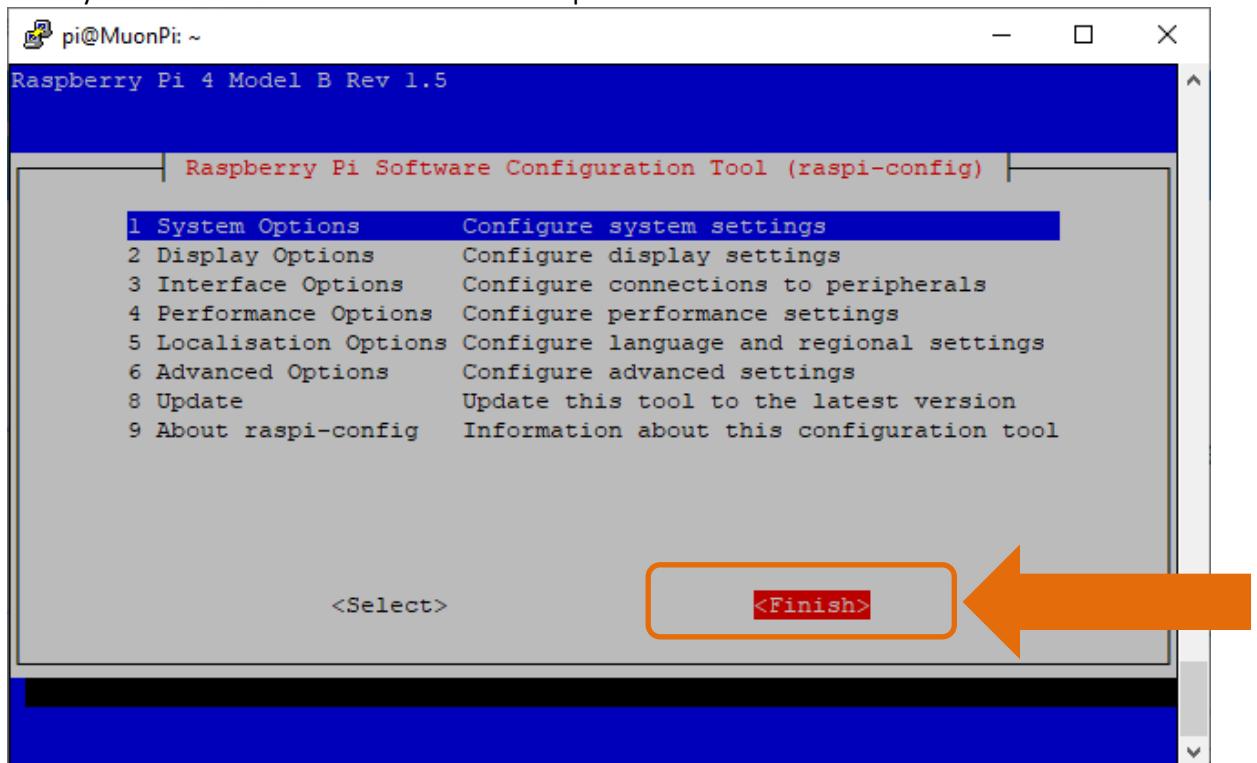
18. You will then be asked if you wish to enable VNC Server – press the “tab” key to move the red cursor over the <Yes> and press enter



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

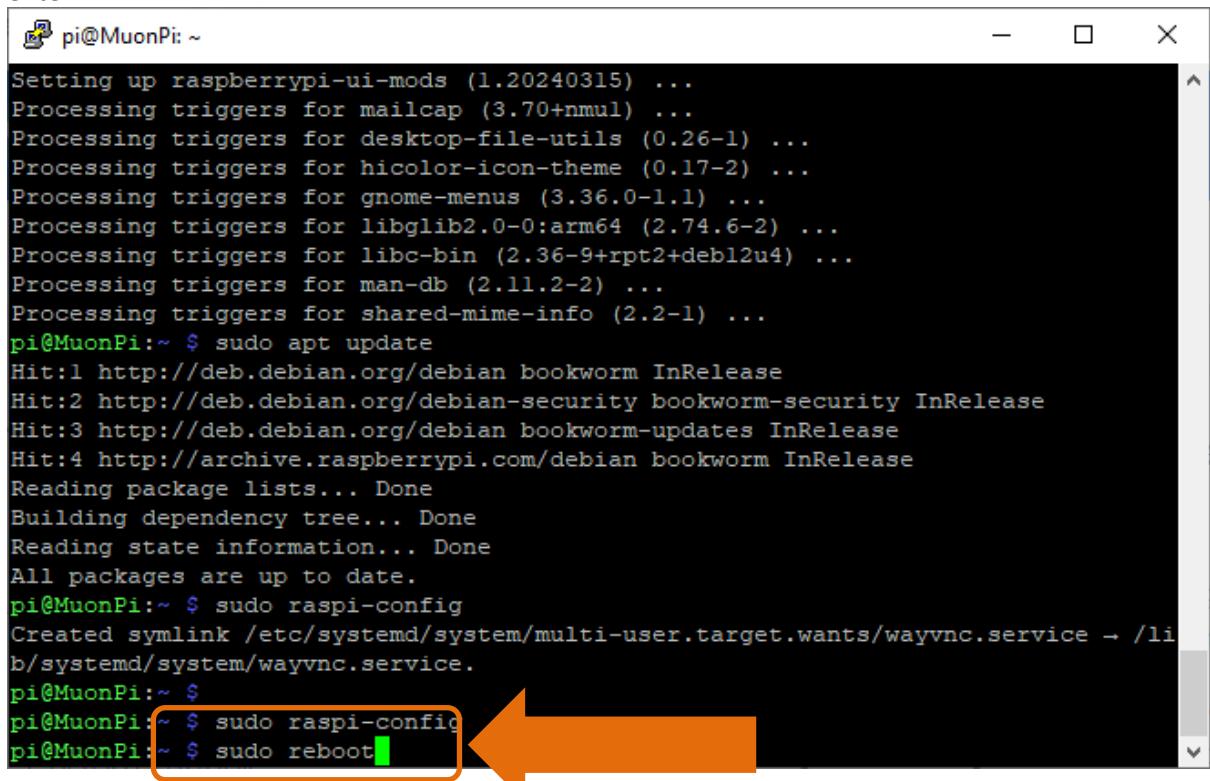


20. This takes you back to the **Raspberry Pi Software Configuration Tool** main menu – use the tab key to move the red cursor to <Finish> and press enter



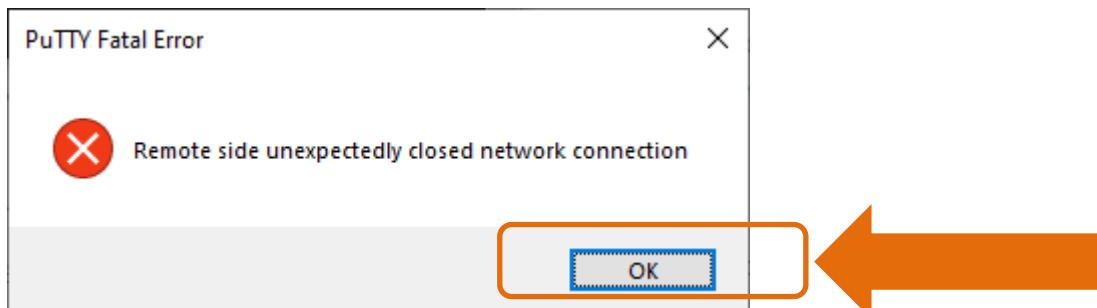
21. We have now finished with PuTTY.

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



```
pi@MuonPi: ~
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
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

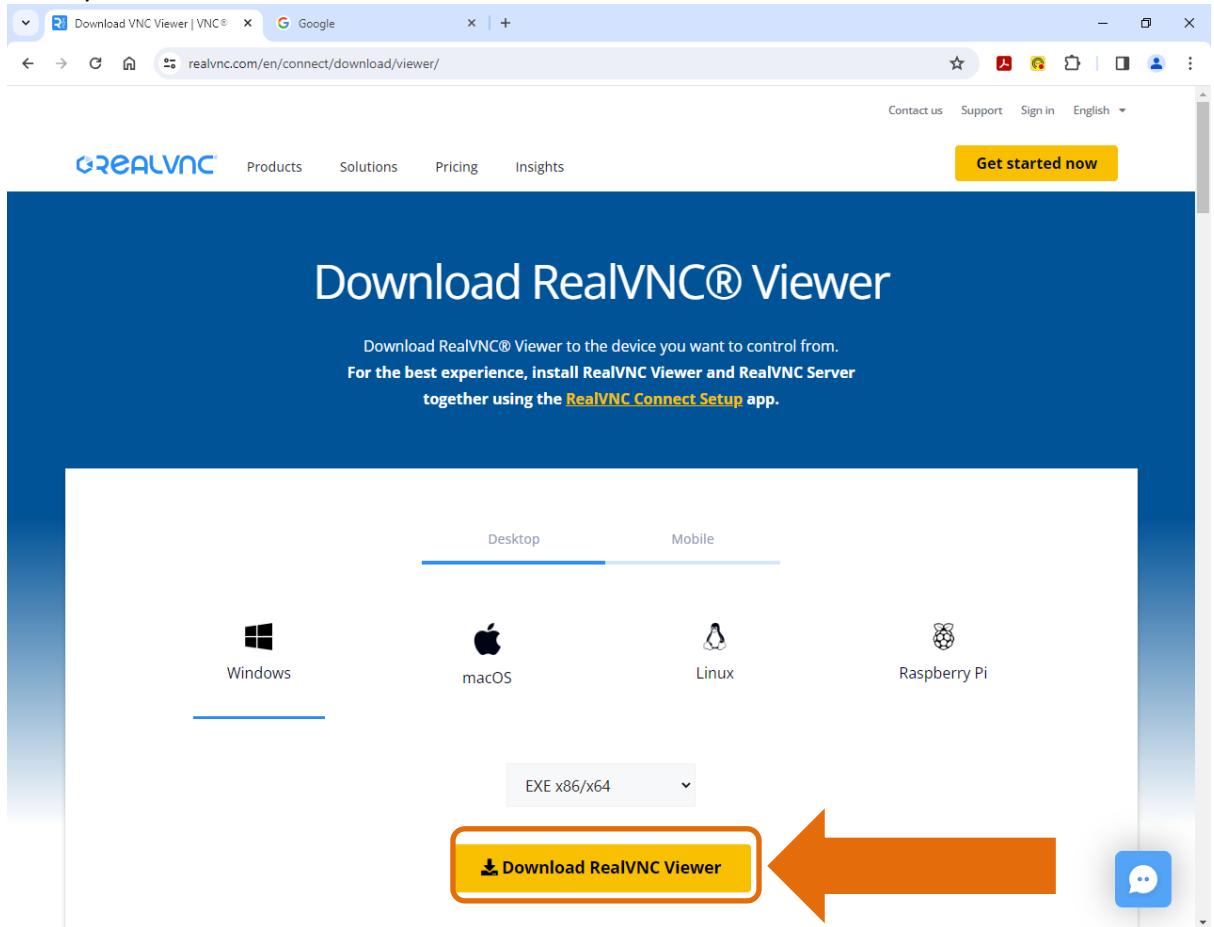


moving your mouse over the “OK” and click your left mouse button to select

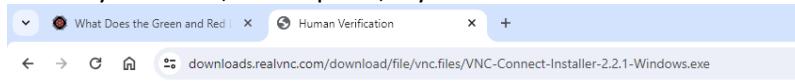
24. You can also close the open PuTTY terminal window as this is no longer needed.

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



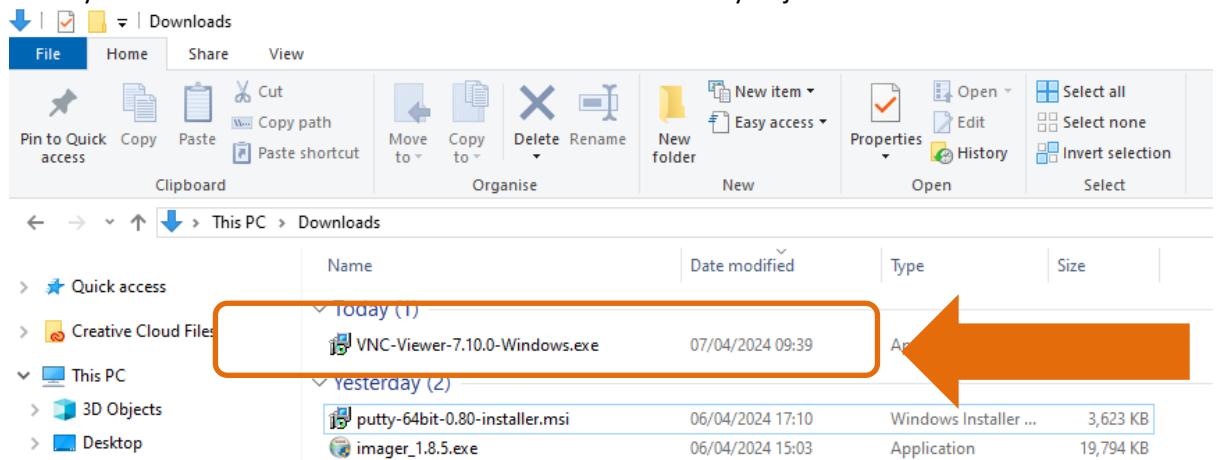
Let's confirm you are
human

Complete the security check before
continuing. This step verifies that you are not
a bot, which helps to protect your account
and prevent spam.

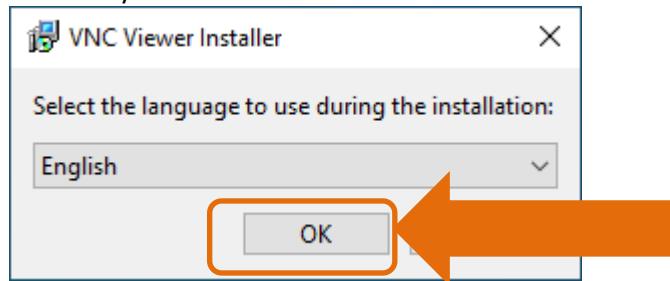
Begin >

English ▾

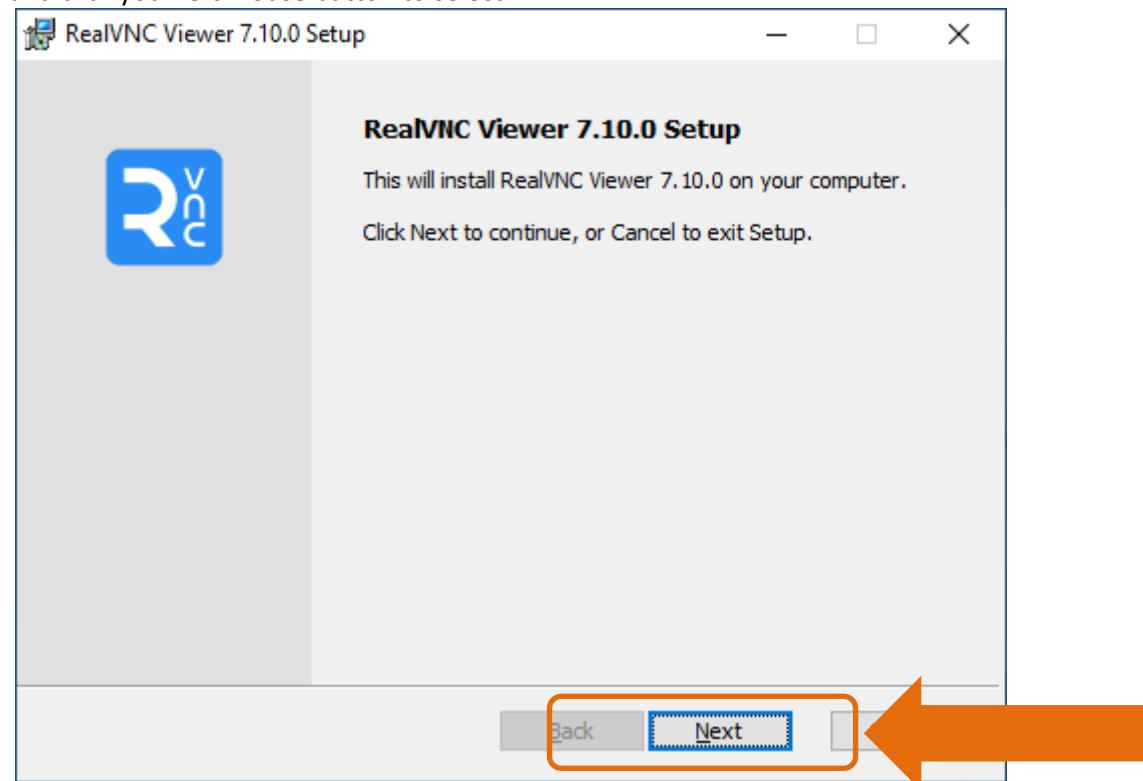
4. Go to your Downloads folder and locate the **VNC-viewer** file you just downloaded.



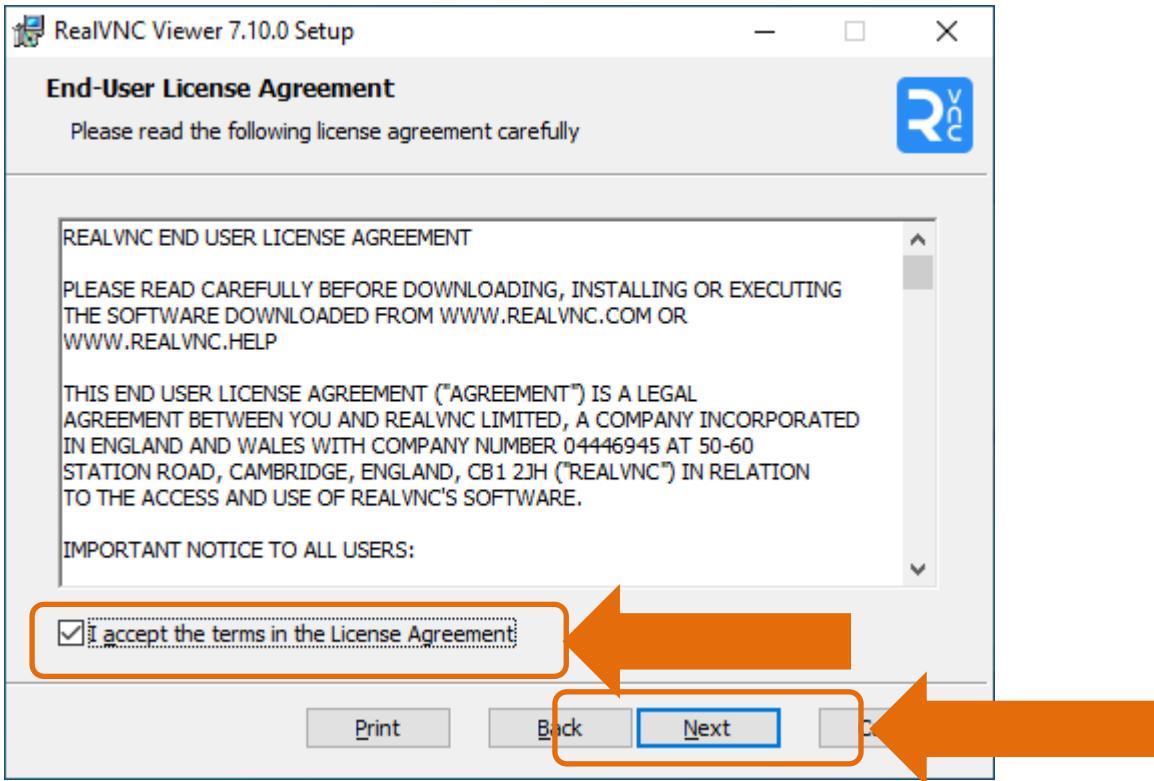
5. Double click on the **VNC-Viewer** file to run and you will be presented with a VNC Viewer Installer window. Select your appropriate language then move your mouse over the “**OK**” and click your left mouse button to select



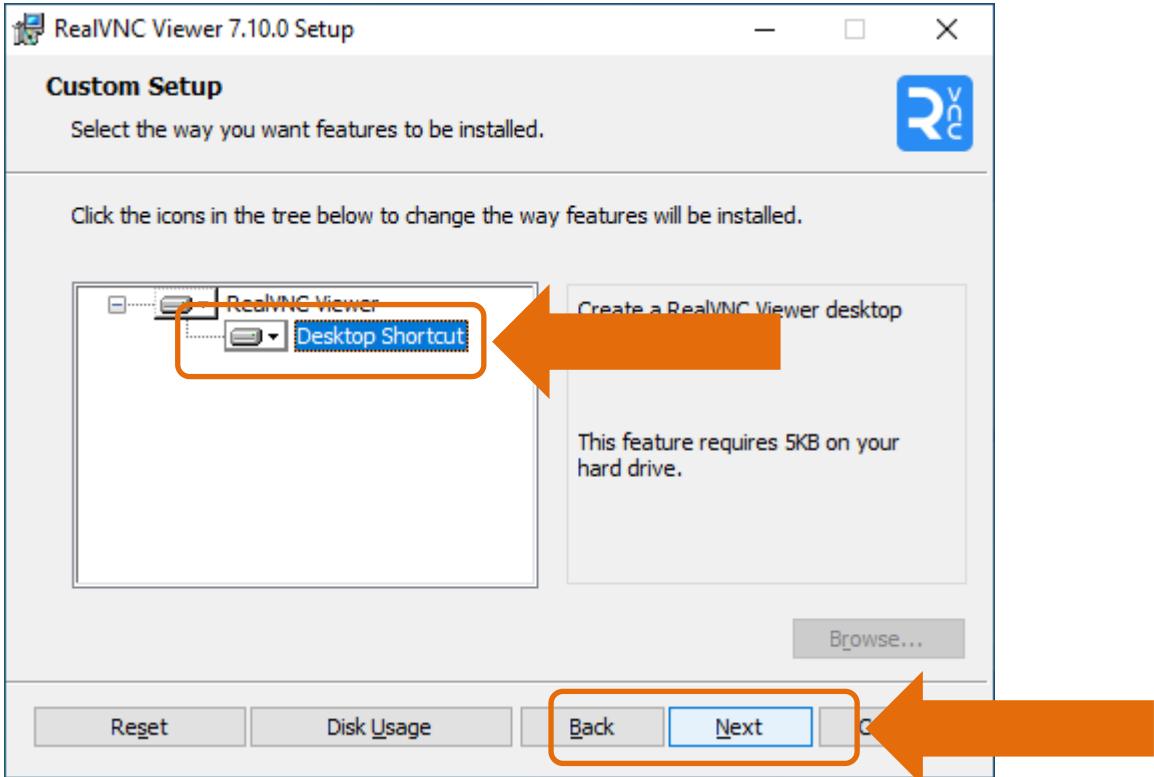
6. You will be presented with a **VNC Viewer Setup** window. Move your mouse over the “**Next**” and click your left mouse button to select.



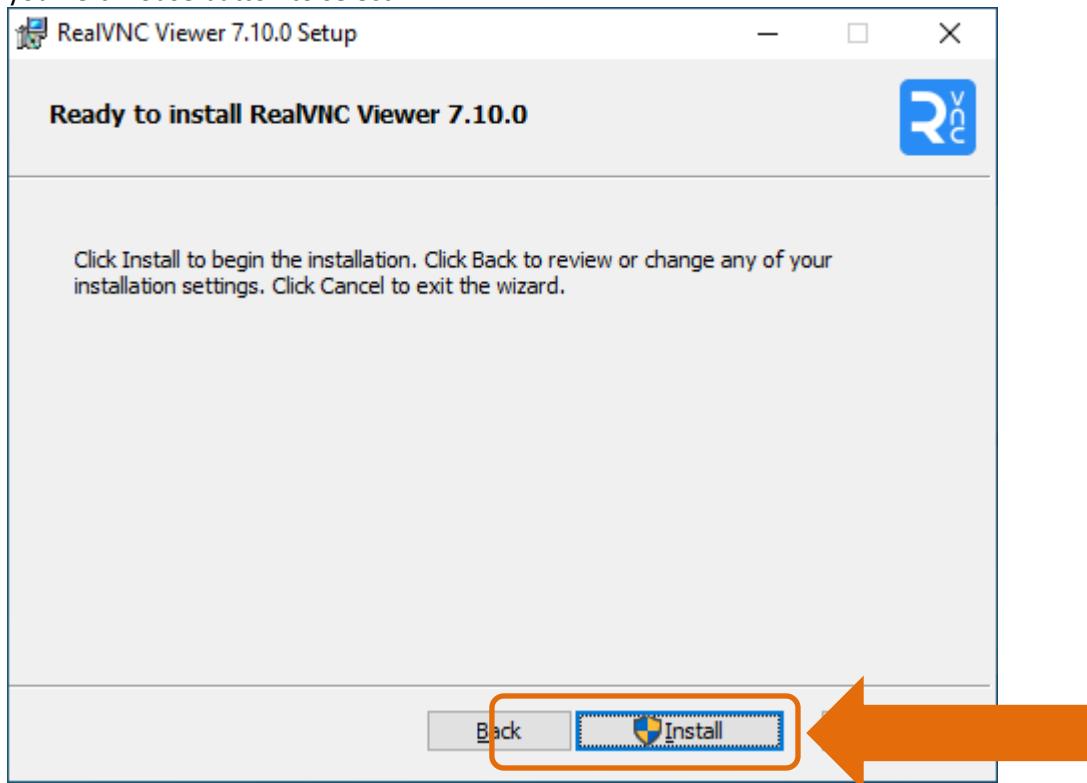
7. You will be presented with another **VNC Viewer Setup** window. Confirm you accept the **End License Agreement** then move your mouse over the “Next” and click your left mouse button to select.



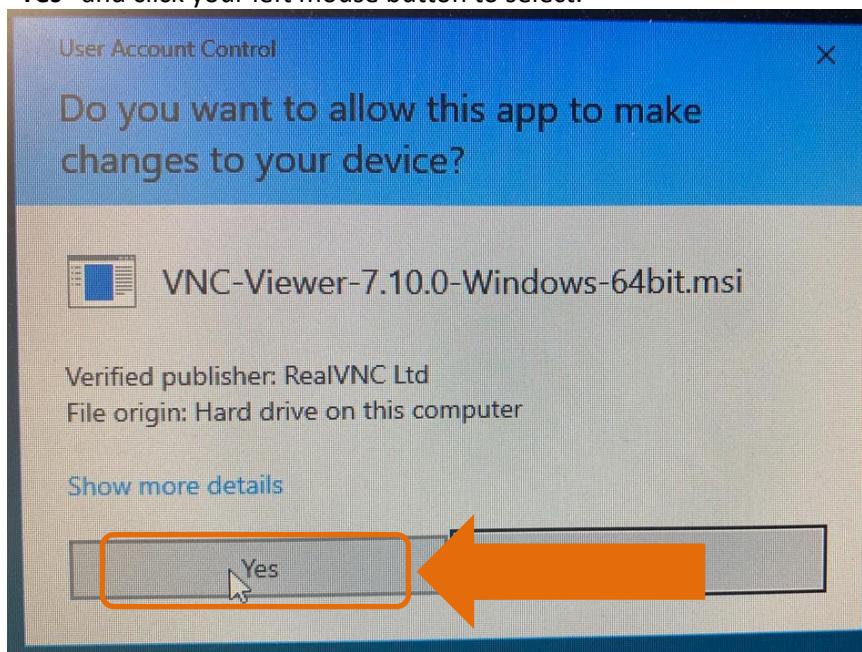
8. You will be presented with another **VNC Viewer Setup** window. To install a **Desktop Shortcut**, move your mouse over the red “X”click your left mouse button and select “**Will be installed on local harddrive**”, then move your mouse over the “Next” and click your left mouse button to select.



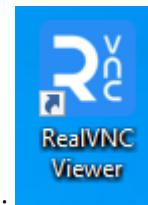
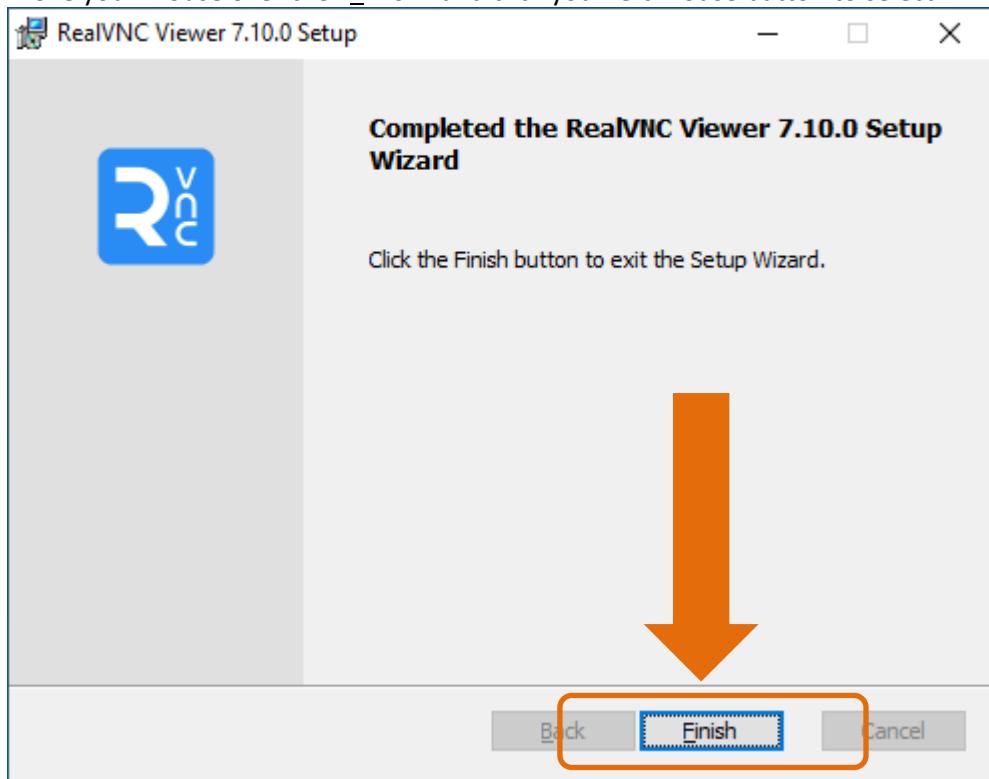
9. You will then be asked to confirm installation, move your mouse over the “Install” and click your left mouse button to select.



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



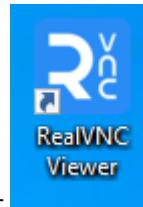
11. **VNC Viewer Setup** will finish installing and present the following window when complete.
Move your mouse over the “**Finish**” and click your left mouse button to select.



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

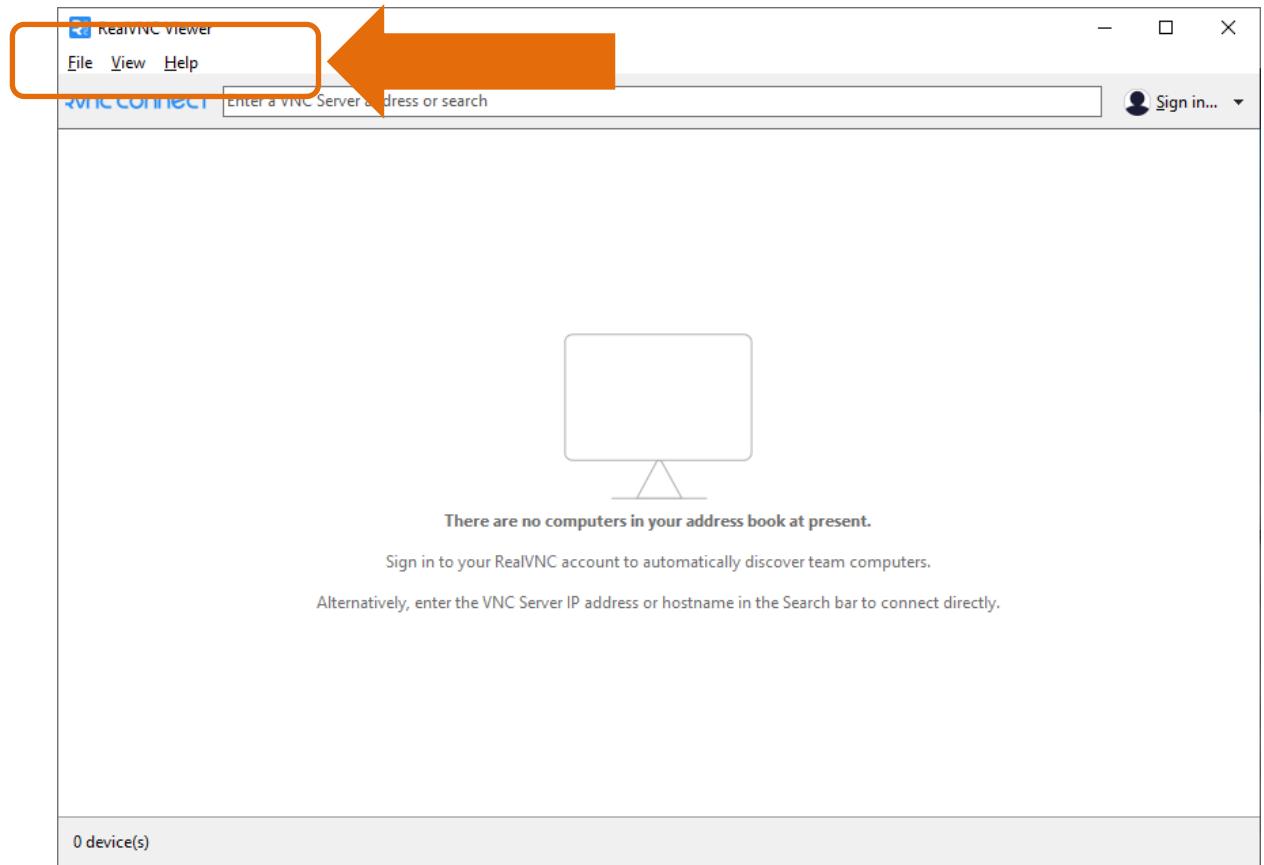
Connecting to your RPi using VNC Viewer

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

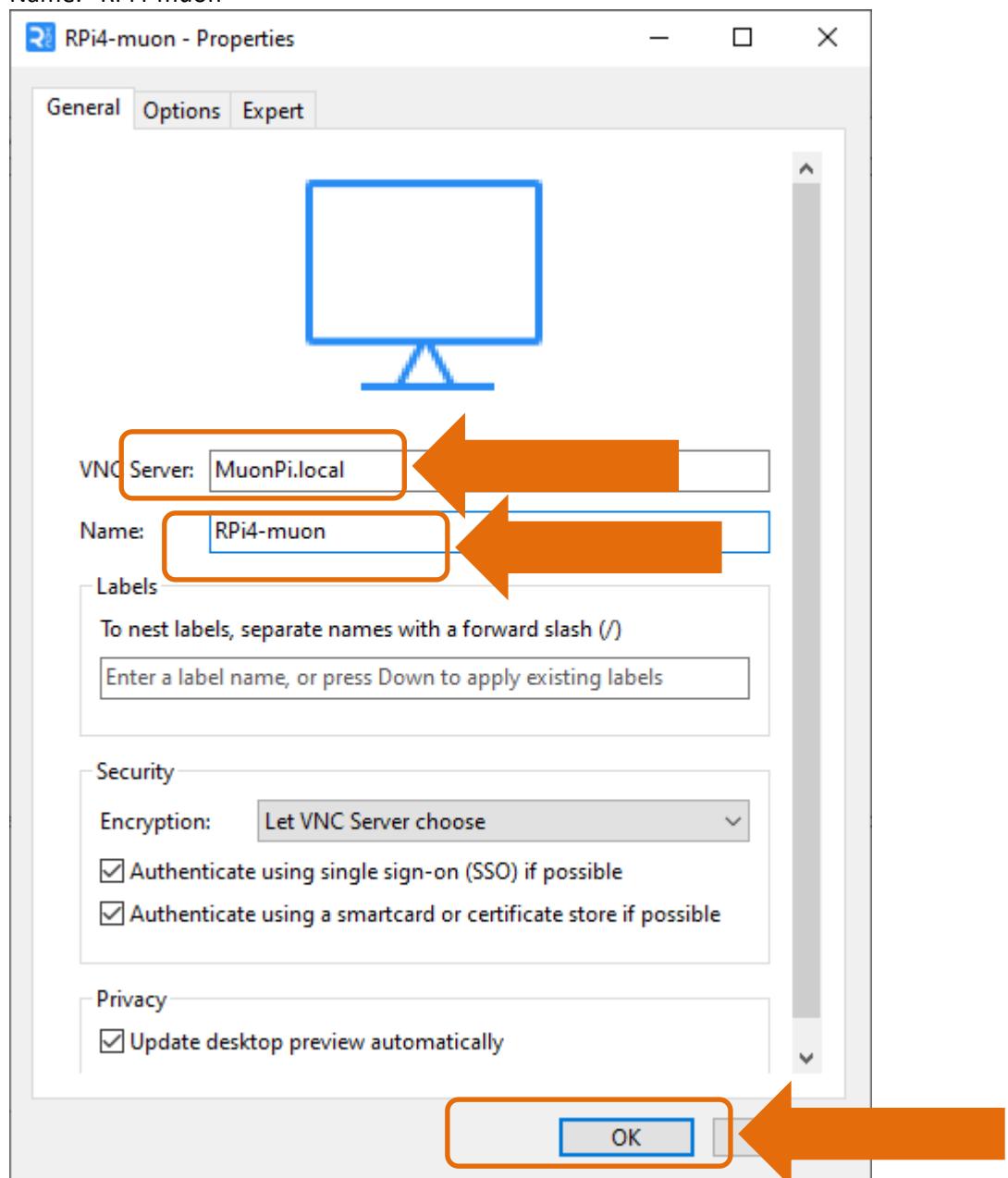


2. Open VNC Viewer using the desktop shortcut

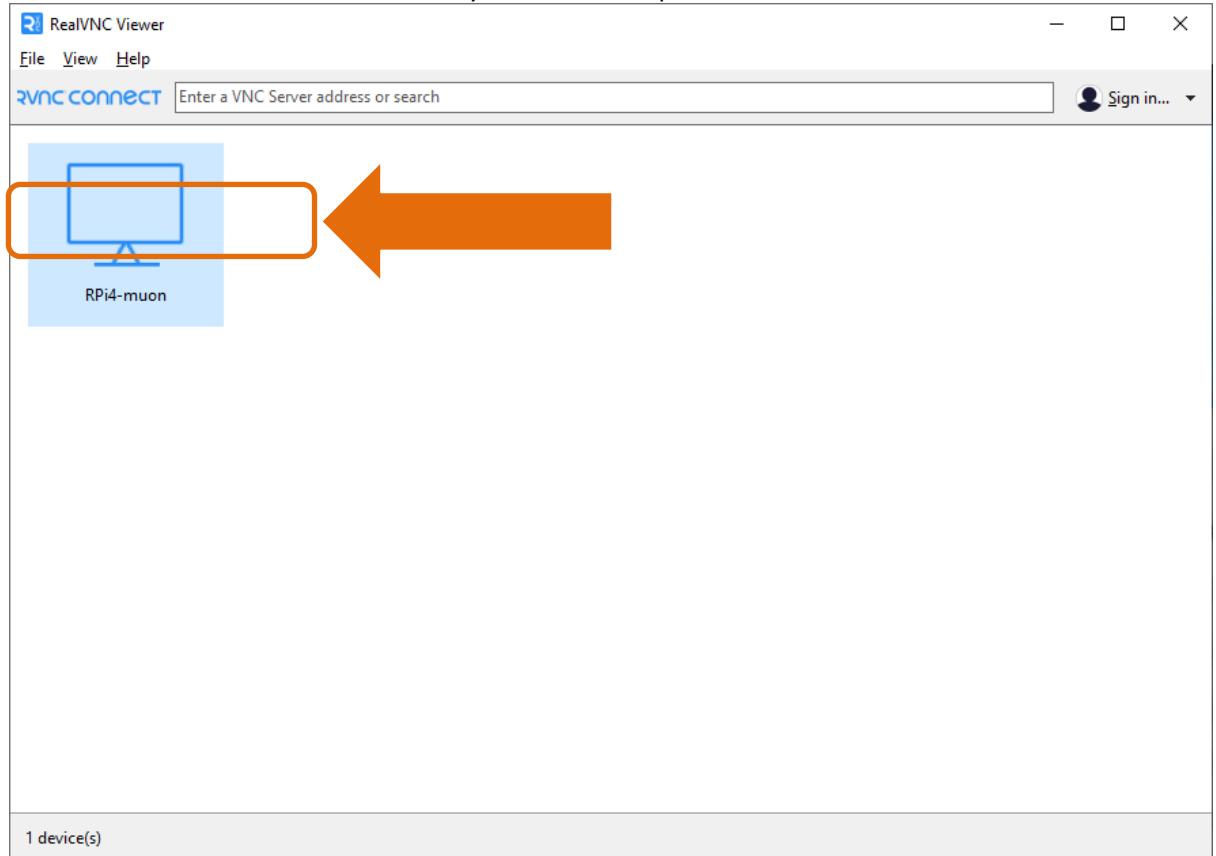
3. We now have the **VNC Viewer** home page – we want to make a new connection so we select “File” then “New Connection” or Ctrl-n short-cut



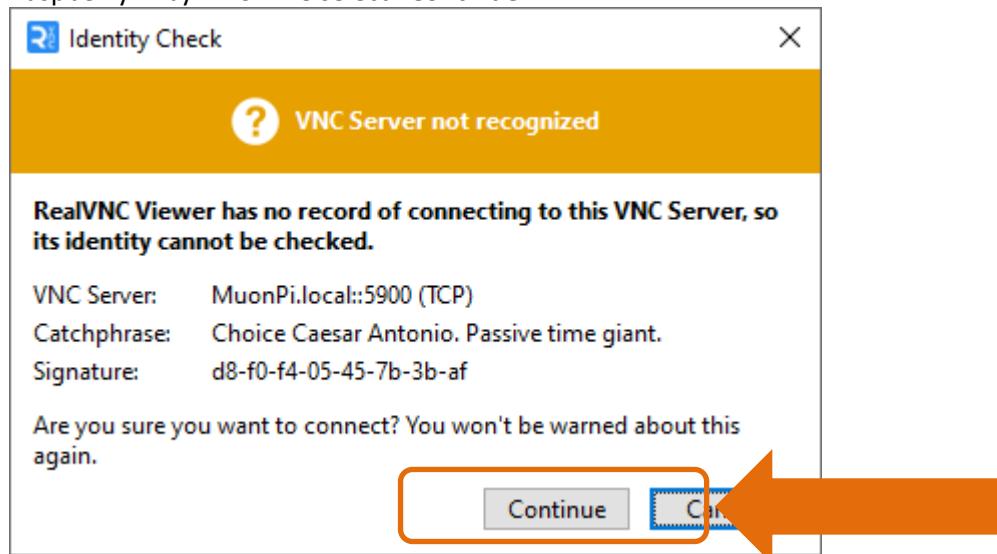
4. This will bring up the following properties window- we are only going to enter information in the “General” tab
- VNC Server: MuonPi.local
 - Name: “RPi4-muon”



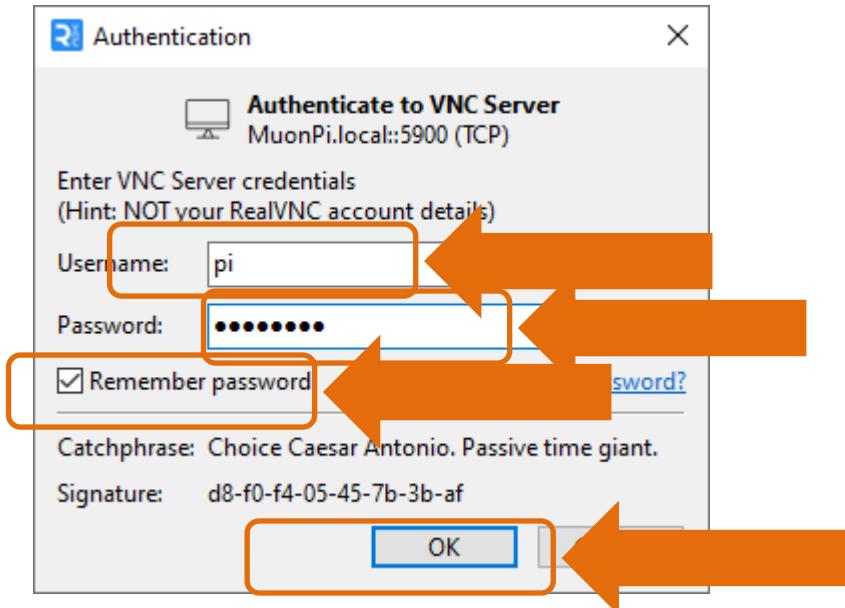
5. You should now have a connection on your VNC workspace. Double click the icon



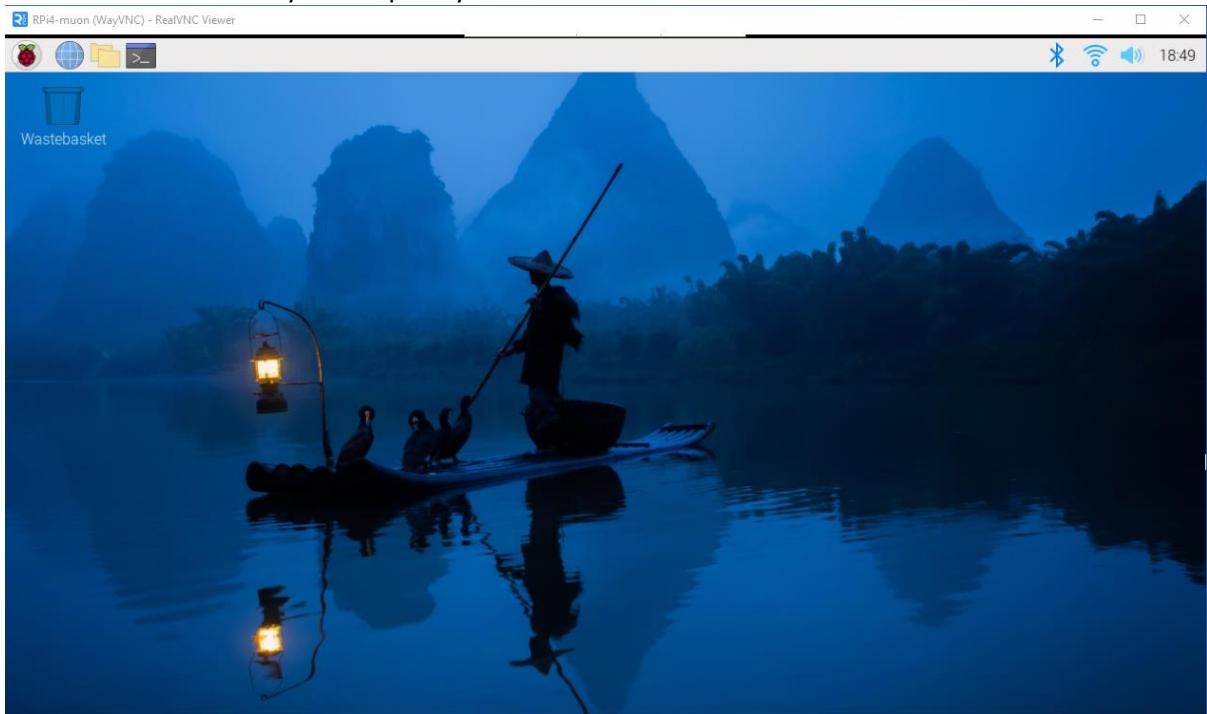
6. Similar to PuTTY – we now get an **Identity Check** message for our first connection to the Raspberry Pi by VNC. We select “Continue”



7. We now have to enter the Raspberry Pi
 - c. Username: "pi"
 - d. Password: "PassWord"
 - e. Select "Remember password"
 - f. Select "OK"



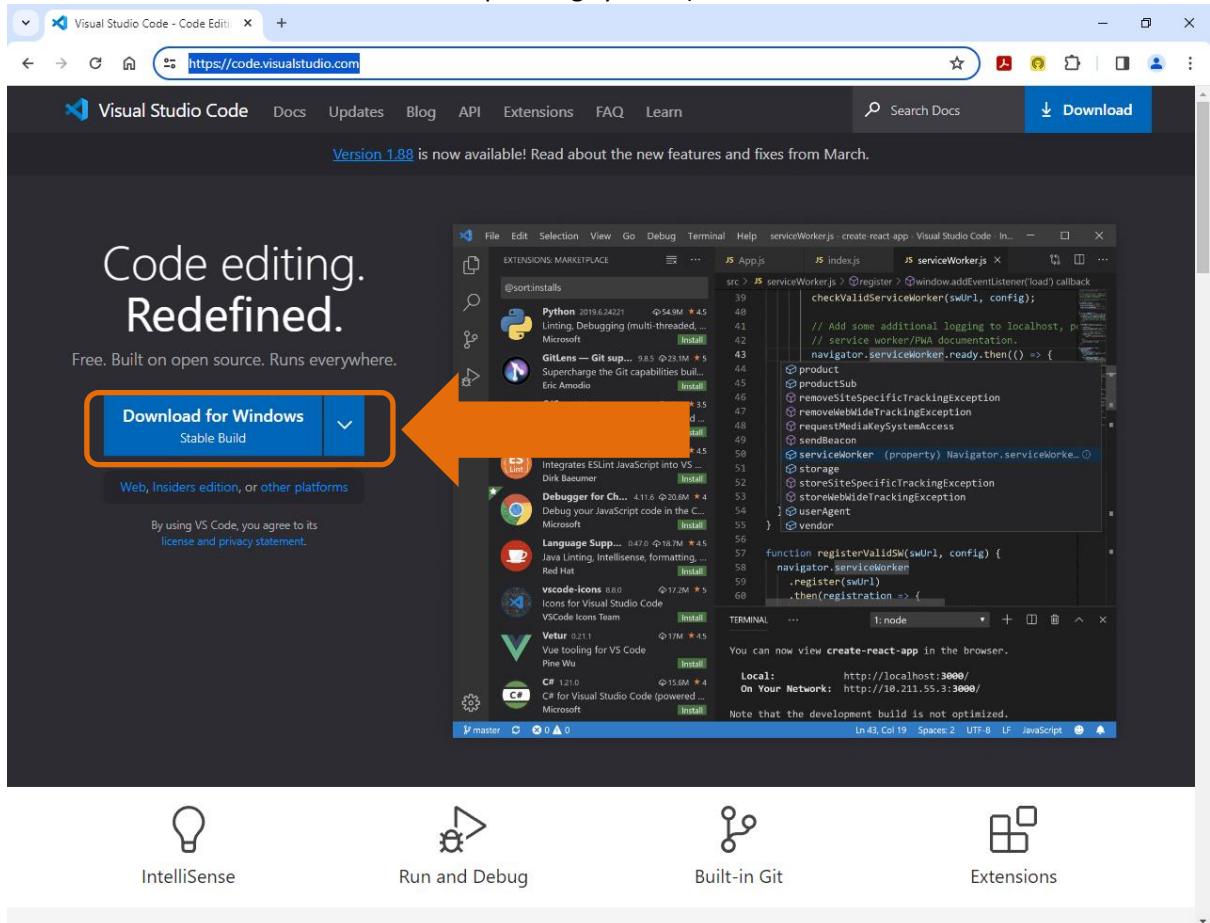
8. You are now in your Raspberry Pi



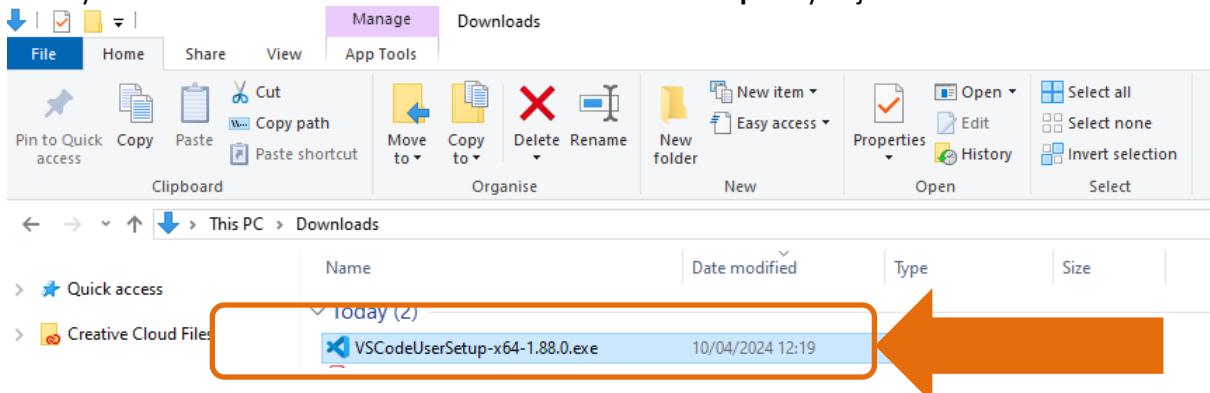
9. Time to explore
10. To end VNC session – there are controls that appear when your mouse is moved to the top of the screen. Selecting "X" will close the VNC session.
11. To get back to the pi, just double click on the shortcut in VNC workspace

Installing Visual Studio Code on your PC

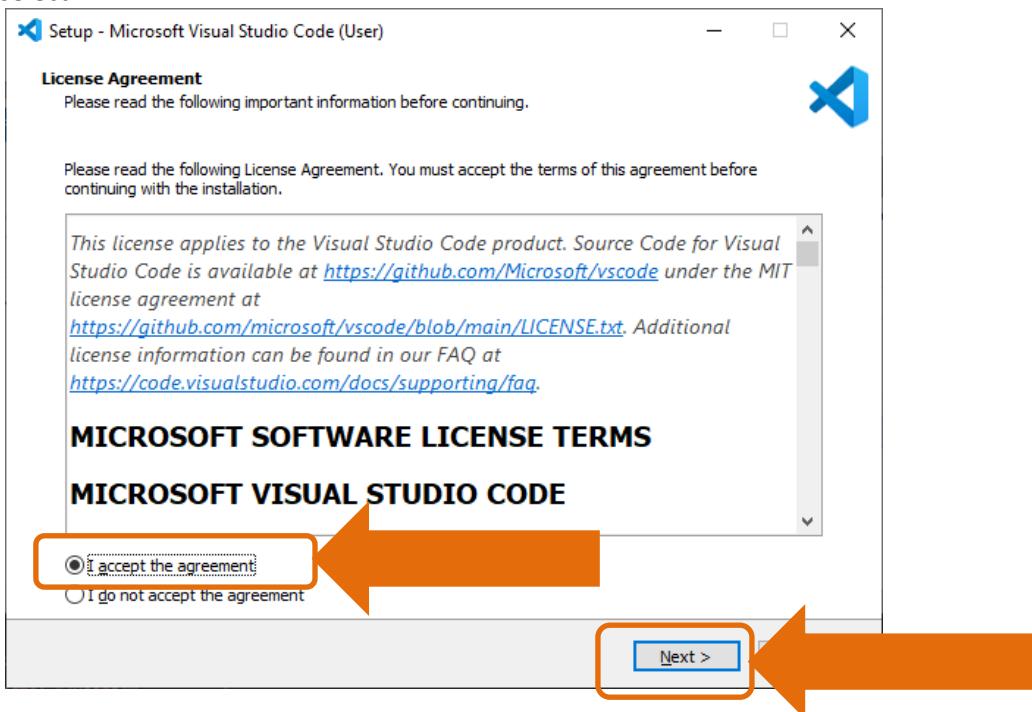
1. Use the following link to access Visual Studio Code: <https://code.visualstudio.com/>
2. Move your mouse over “Download for Windows Stable Build” and double click (use the down arrow head to select alternative operating systems)



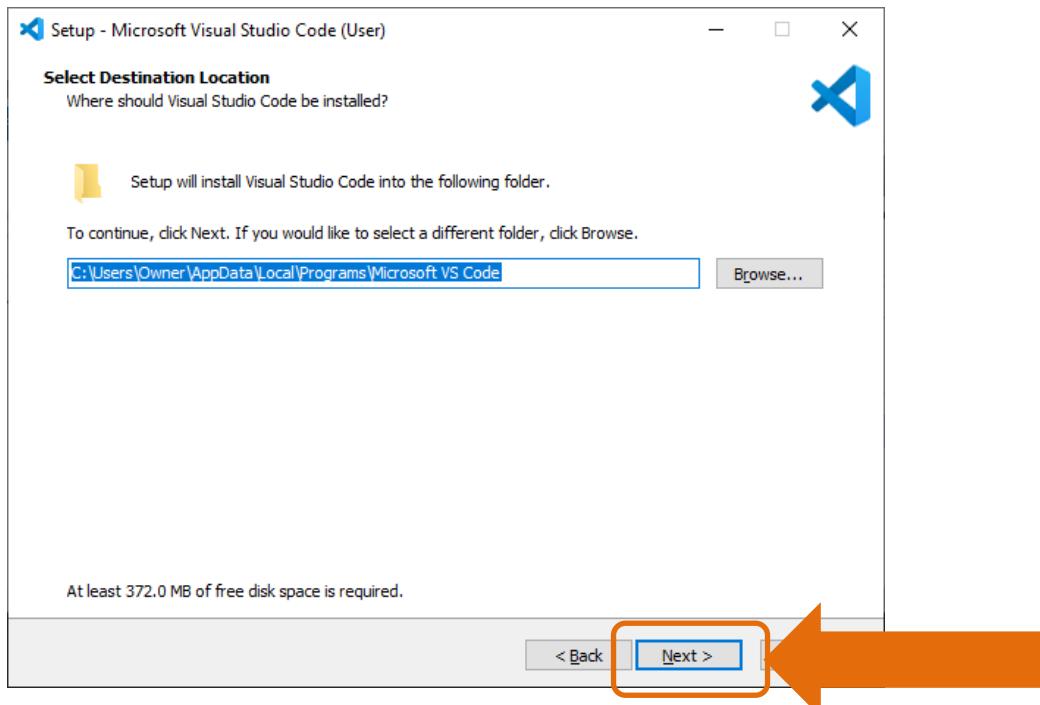
3. Go to your Downloads folder and locate the **VSCodeUserSetup** file you just downloaded.



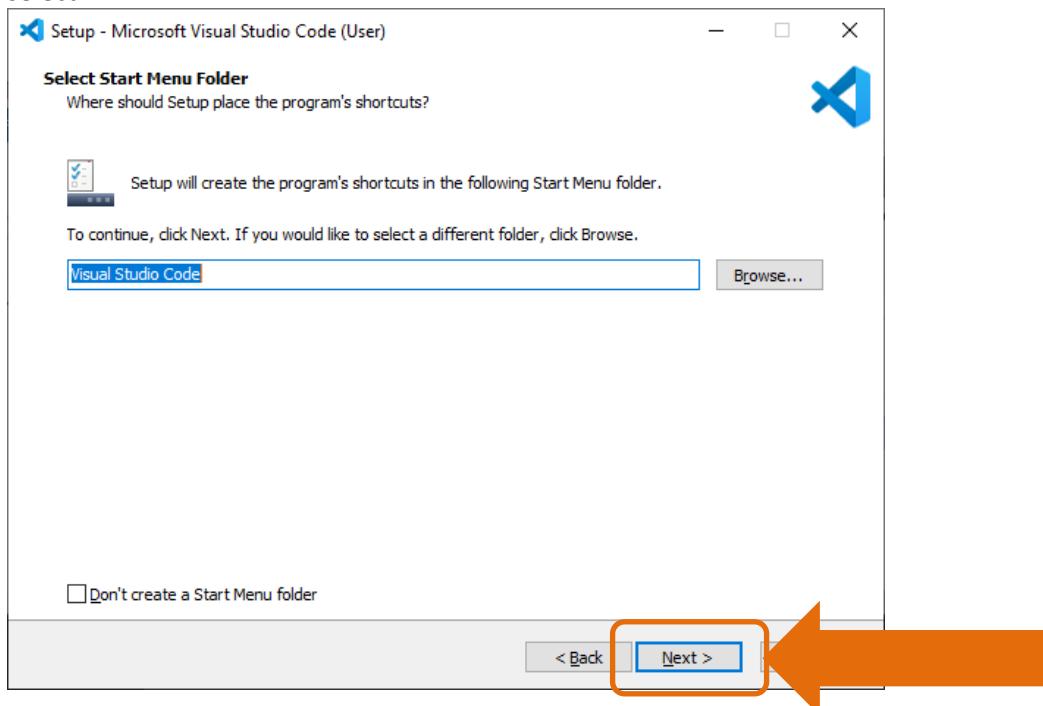
- Double click on the **VSCodeUserSetup** file to run and you will be presented with a **Microsoft Visual Studio Code (User) License Agreement** window. Click the radial button “I accept the agreement” then move your mouse over the “Next” and click your left mouse button to select



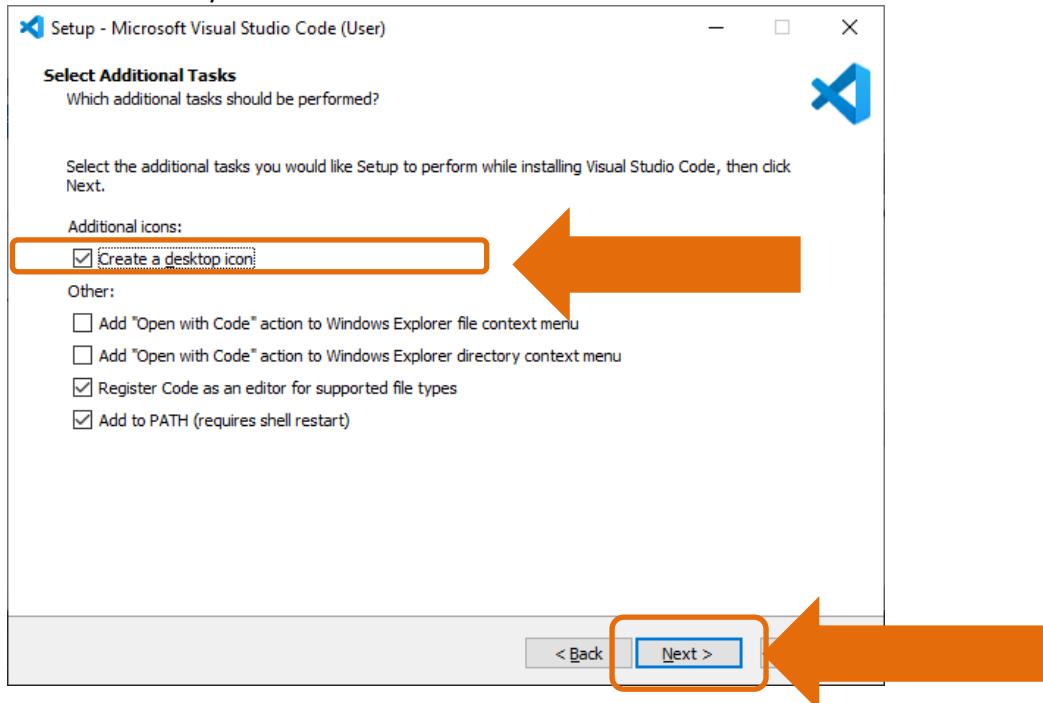
- You will be presented with a **Microsoft Visual Studio Code (User) Select Destination Location** window. Move your mouse over the “Next” and click your left mouse button to select.



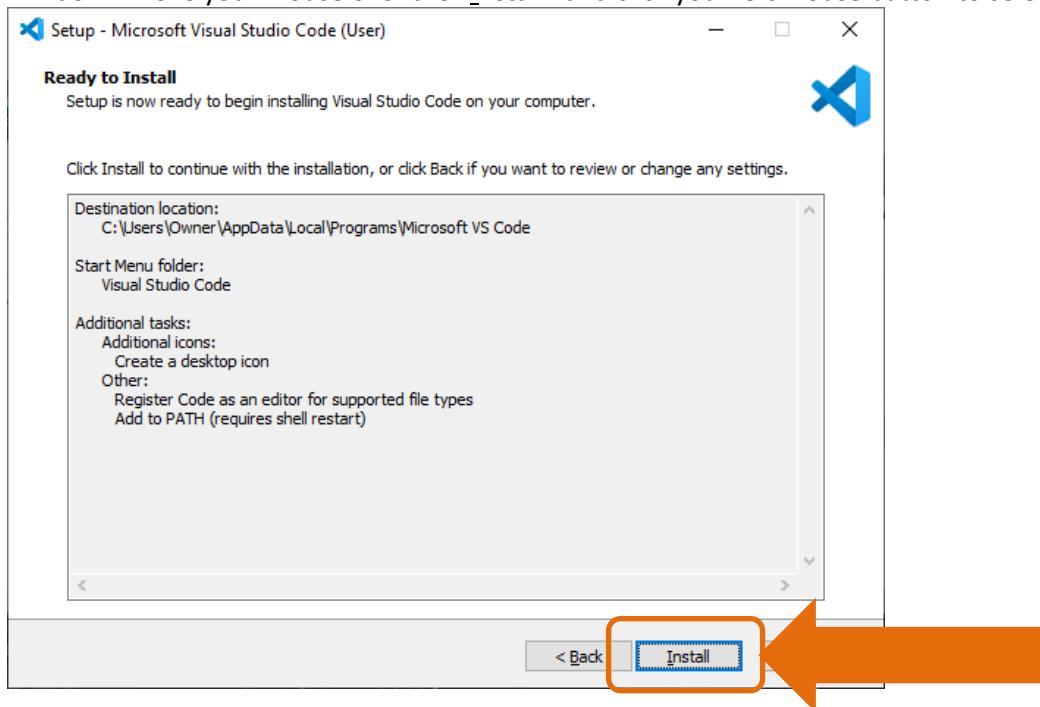
6. You will be presented with a **Microsoft Visual Studio Code (User) – Select Start Menu Folder** window. Move your mouse over the “**Next**” and click your left mouse button to select.



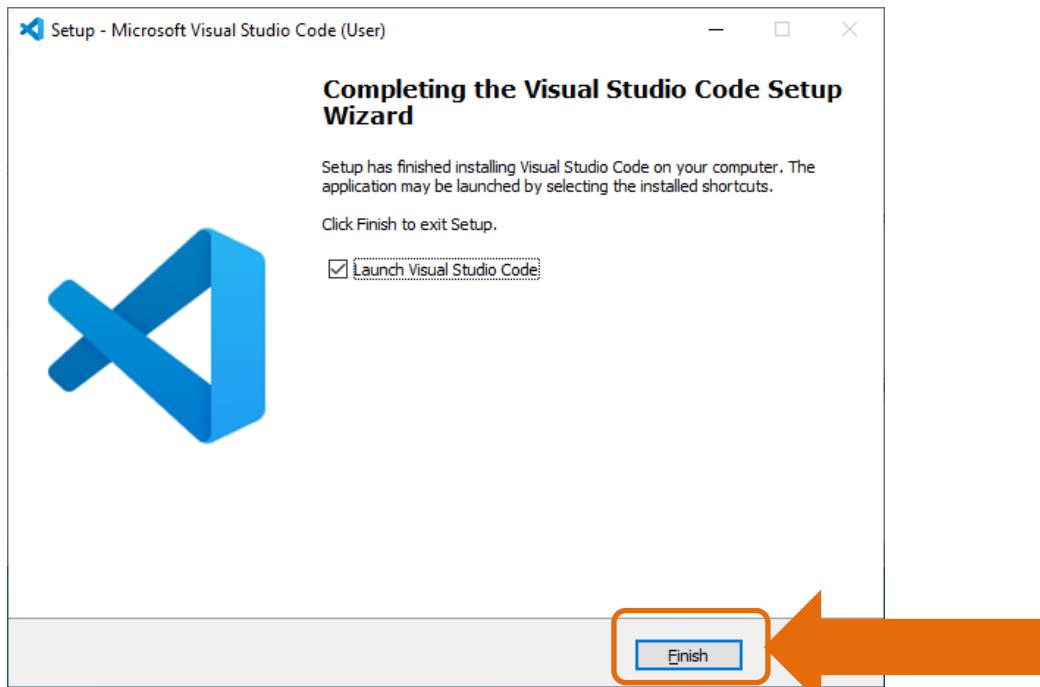
7. You will be presented with a **Microsoft Visual Studio Code (User) – Select Additional Tasks** Window. Check the square “**Create a desktop icon**” then move your mouse over the “**Next**” and click your left mouse button to select.



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.



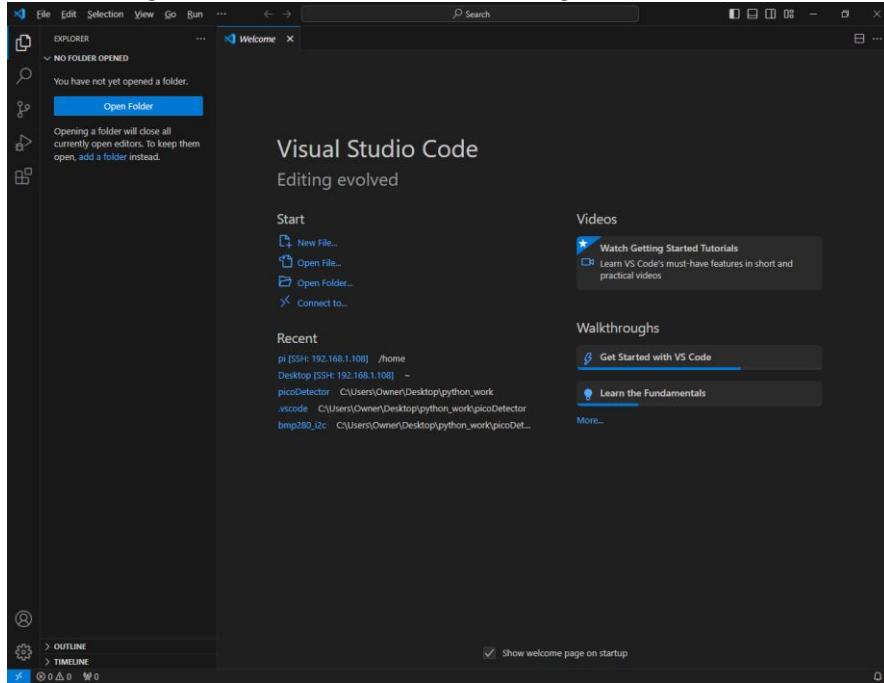
10. You can also run VS Code by double clicking on the desktop icon



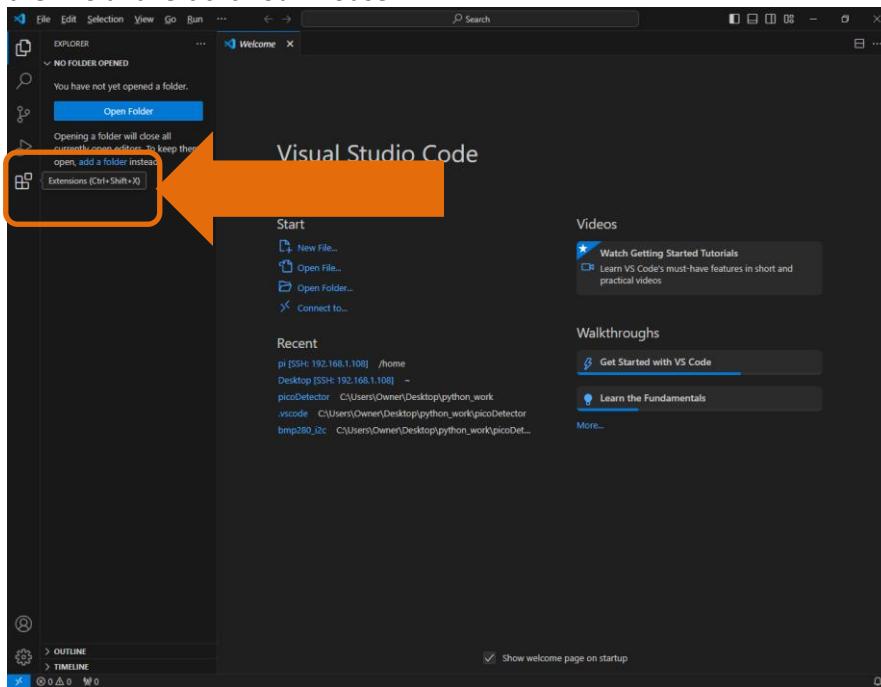
Simple configuration of Visual Studio Code on your PC



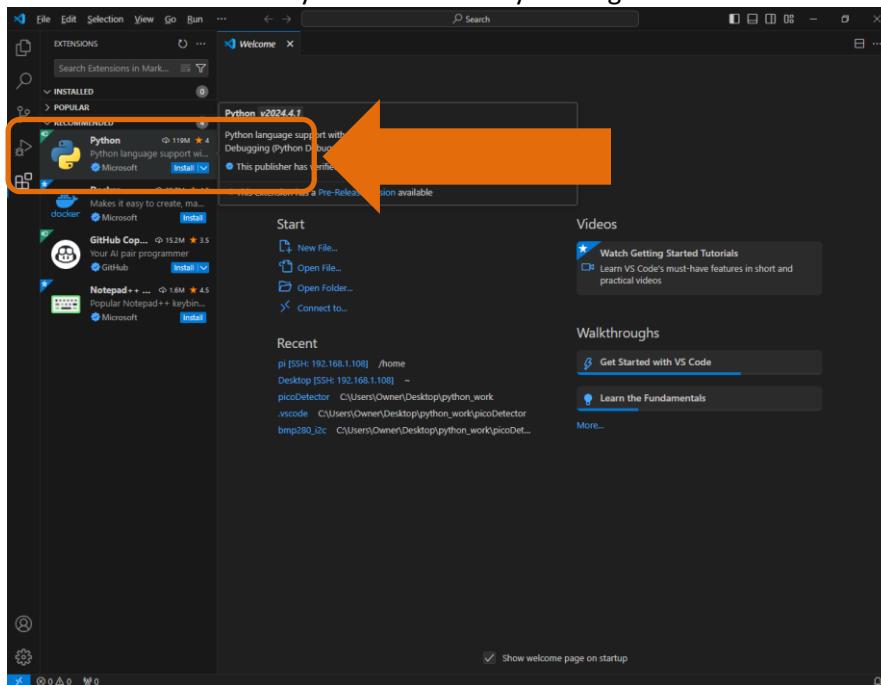
1. double clicking the VS Code icon on your desktop
2. You should get a screen similar to the following



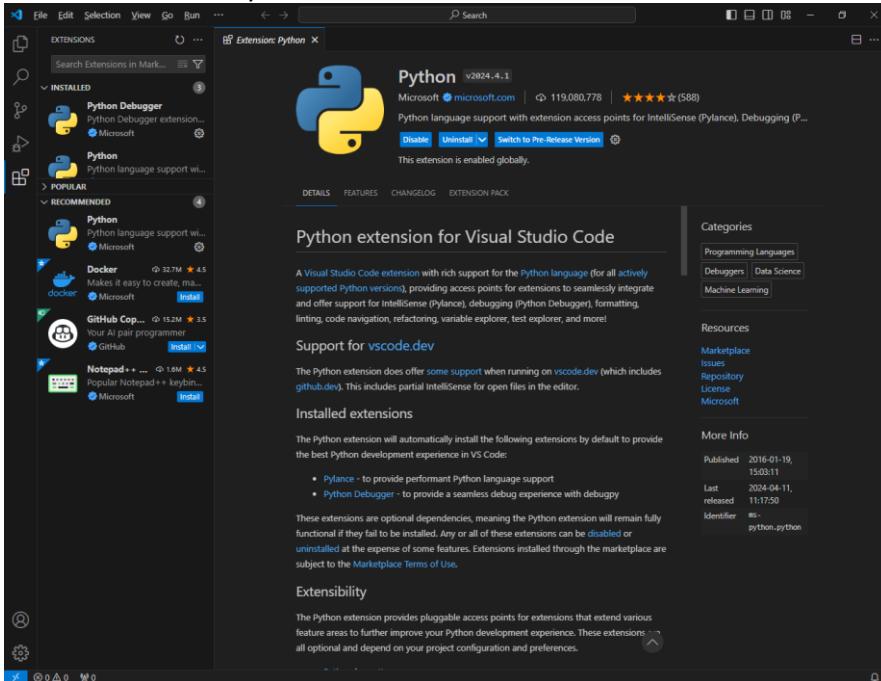
3. We want to add Python to Visual Studio, so we move our mouse over the extension icon on the LHS and left click our mouse



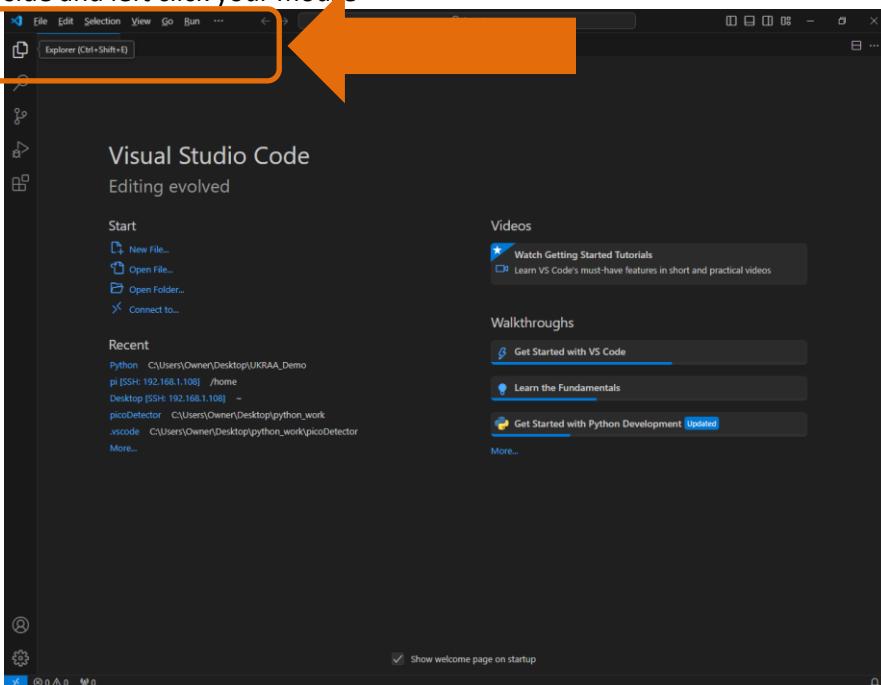
4. You can type the name into the Search bar – for me Python is already showing – I am going to select the Microsoft Python extension by moving the mouse over it and left click mouse.



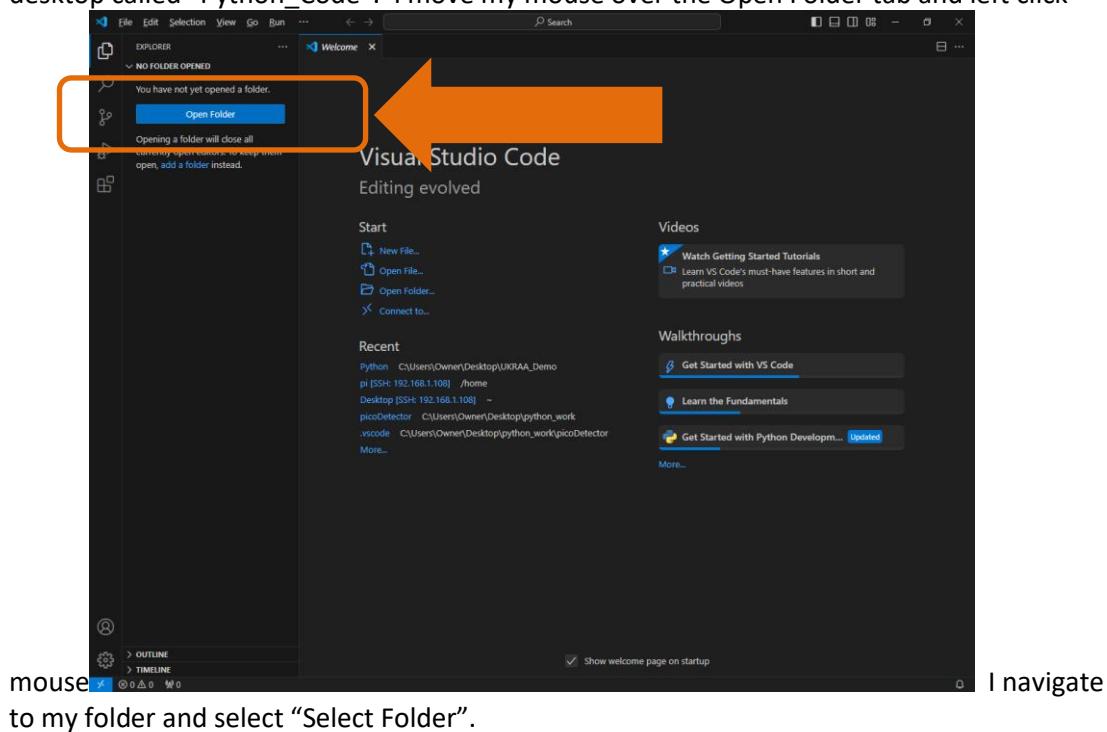
5. This will install the Python extension



6. I now need to set up a workspace. Move your mouse over the Explorer icon on the left hand side and left click your mouse

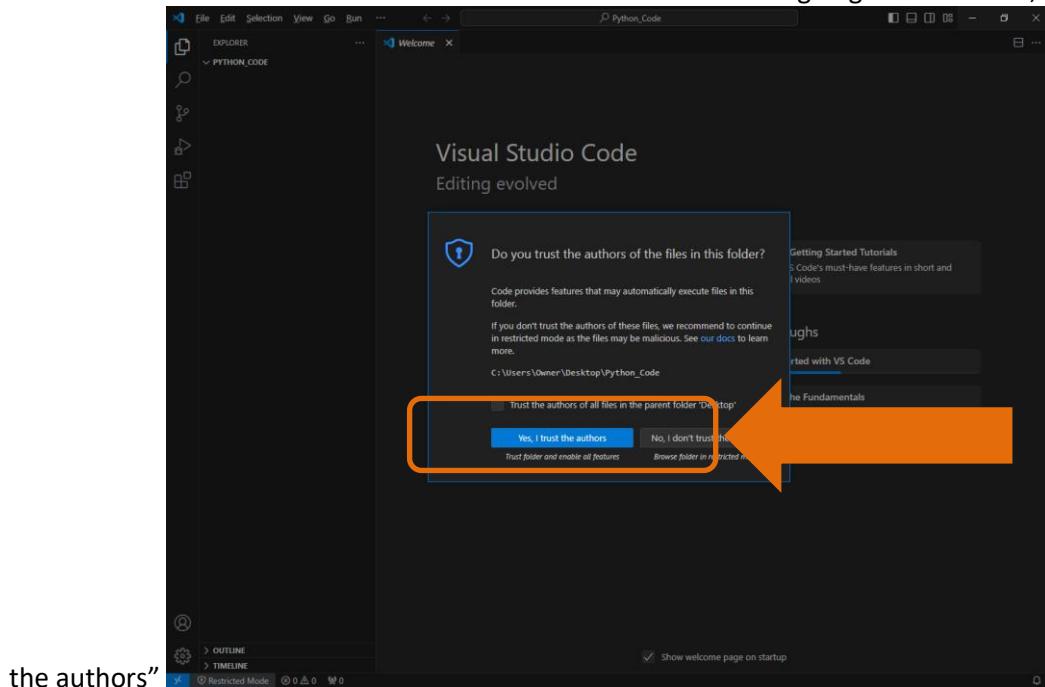


7. I now want to open a folder where I will have my python code. I have a folder on my desktop called “Python_Code”. I move my mouse over the Open Folder tab and left click



mouse to my folder and select “Select Folder”.

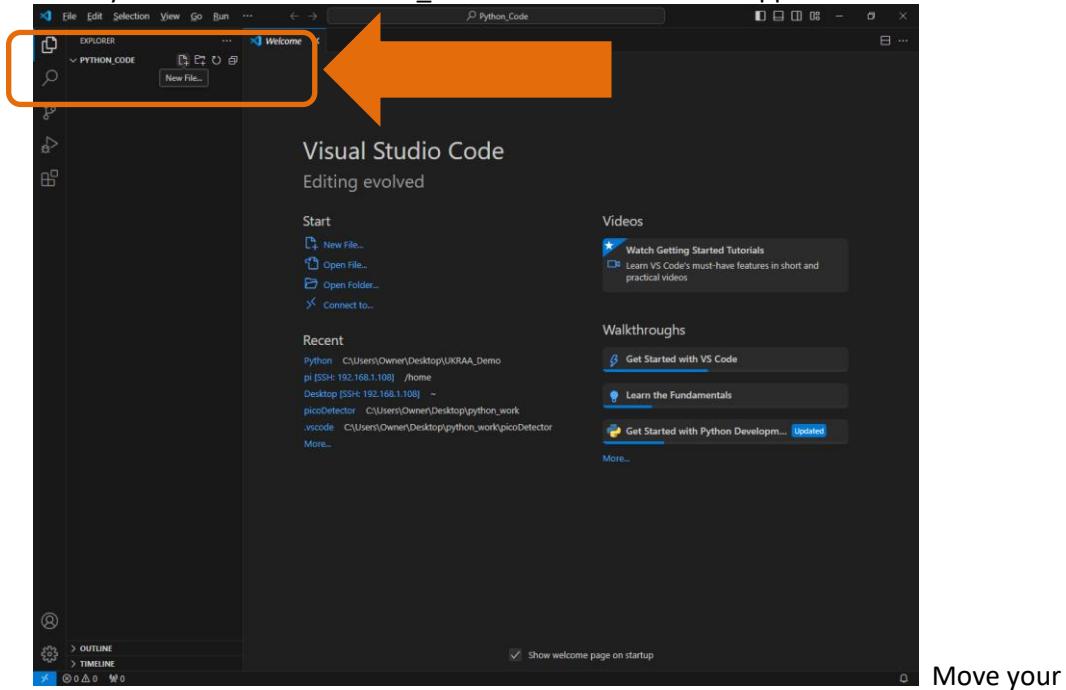
8. I will be asked if I trust the authors of the files in this folder – I am going to select “Yes, I trust



9. I am now ready to start programming in python.

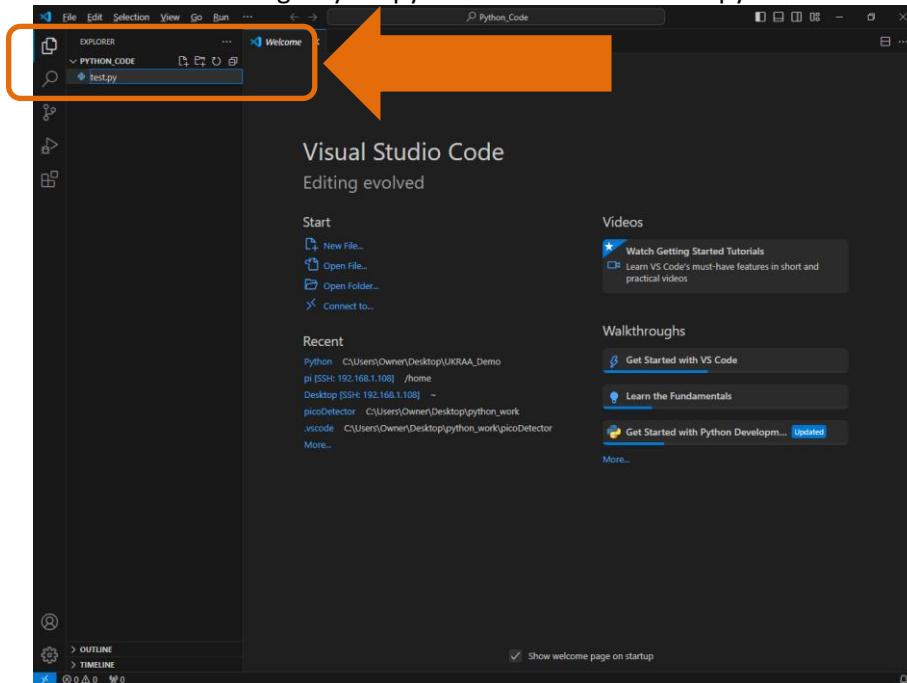
First python code on your PC

1. Move your mouse over PYTHON_CODE and some icons will appear

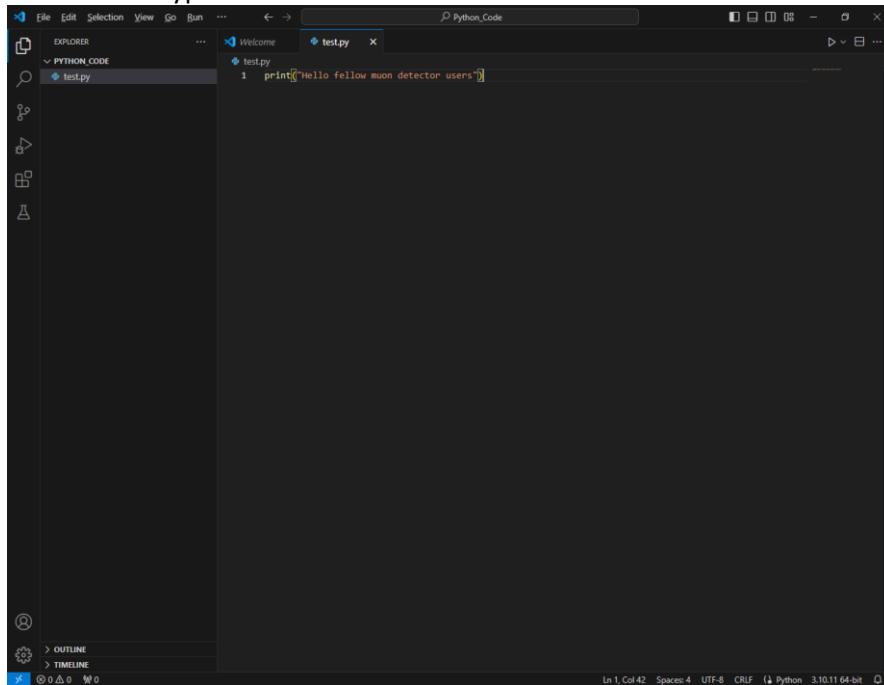


Move your mouse over the New File icon and left click your mouse.

2. You will be asked to give your python code a name – test.py

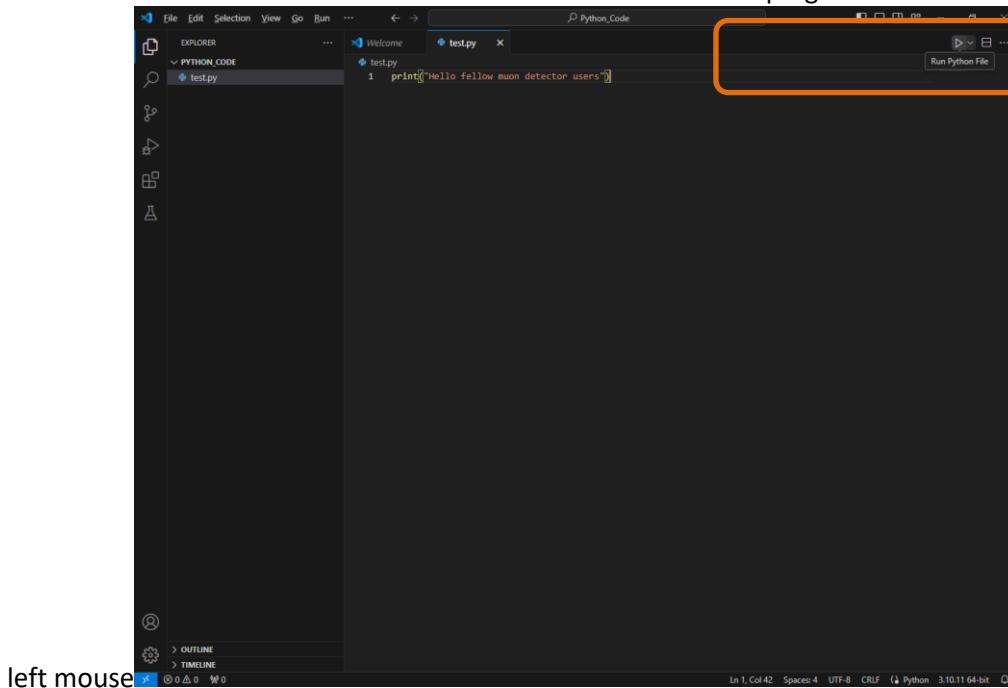


3. We can now type some code into the new window and Ctrl S to save it.



```
test.py
1 print("Hello fellow muon detector users")
```

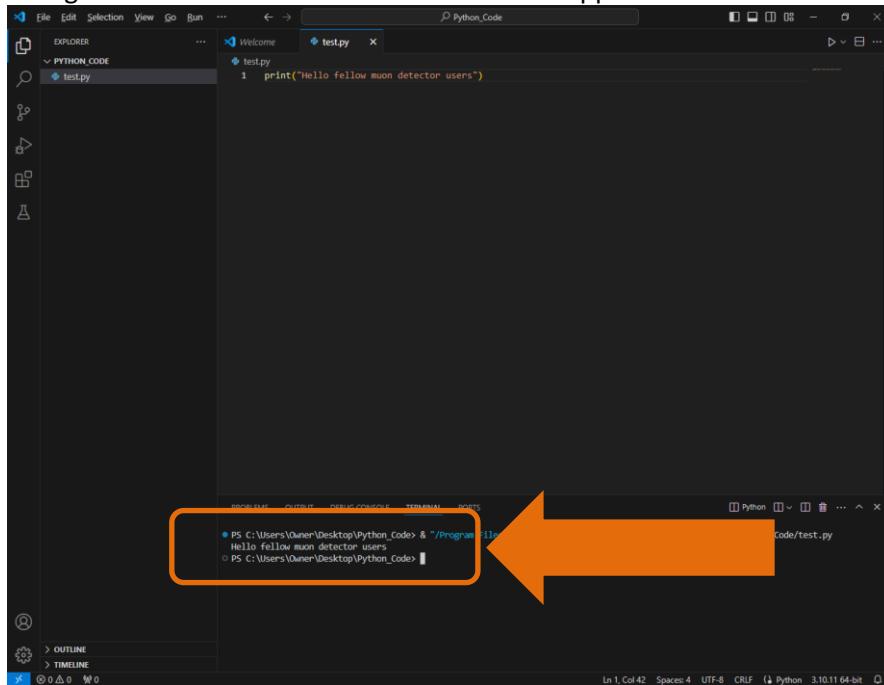
4. To run the code we move our mouse over the run icon at the top right hand side and press



left mouse

Run Python File

5. If all goes well we will have a terminal window appear with the results of our python code



A screenshot of the Visual Studio Code (VS Code) interface. On the left is the Explorer sidebar with a 'PYTHON_CODE' folder containing a 'test.py' file. The main area shows the code for 'test.py':

```
1 print("Hello fellow muon detector users")
```

. Below the code editor is the Terminal panel, which displays the output of running the script:

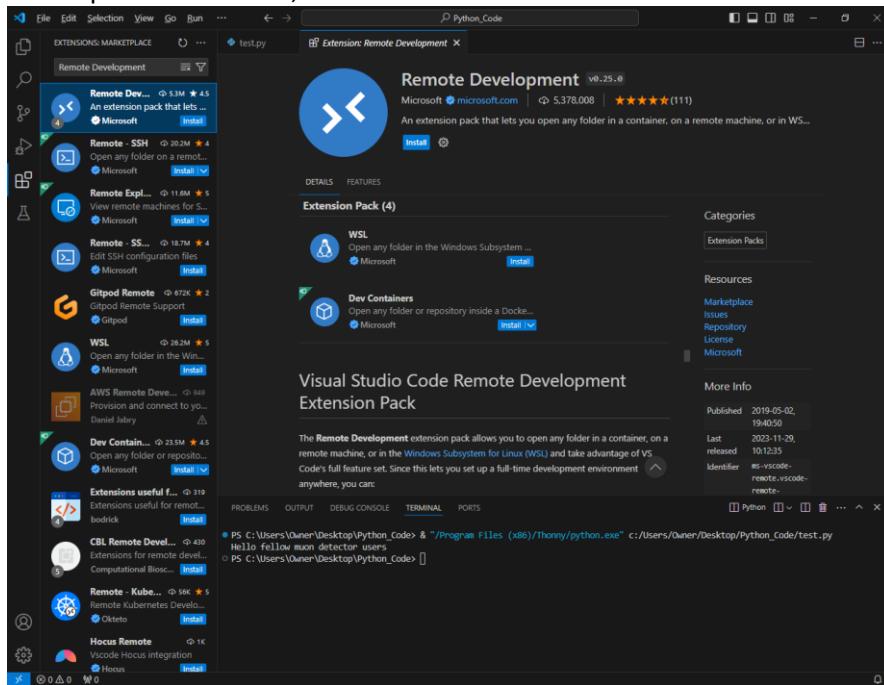
```
PS C:\Users\Owner\Desktop\Python_Code> & "/Programs/Python/Python 3.10.1 64-bit/python.exe" "code/test.py"
Hello fellow muon detector users
PS C:\Users\Owner\Desktop\Python_Code>
```

. An orange arrow points from the terminal output back towards the code editor.

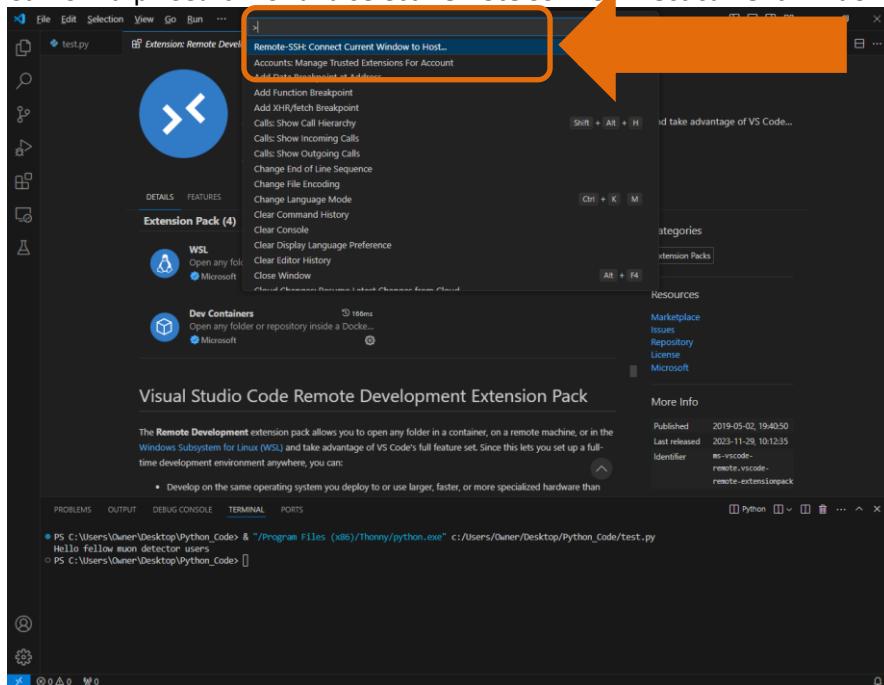
6. First program done.

Connecting Visual Studio Code on your Raspberry Pi

1. We need to install an additional extension to enable us to remotely connect to our Raspberry Pi over our home network.
2. From inside VS Code, we need to install the Remote SSH extension. Select the Extension tab from the sidebar menu, then search for Remote development. Select the Remote Development extension, and select the Install button



3. Next we can connect to our Raspberry Pi. Launch the VS Code command palette using **Ctrl+Shift+p**. Search for and select **Remote SSH: Connect current window to host**.



4. Enter the SSH connection detail, using user@host – e.g. pi@MuonPi.local. The first time you connect, it will validate the fingerprint to ensure you are connecting to the correct host. Select “Linux” and press enter.
5. Enter your Raspberry Pi’s password when prompted.
6. VS Code will then install relevant tools on the Pi and configure the remote SSH connection.
7. You should now be set up and ready to go