AstroPi – Workshop

by Anush Manukyan

digital luxembourg

LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Éducation nationale,
de l'Enfance et de la Jeunesse

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Outline

1. What is an Astro Pi?
2. Meet the Sense Hat
3. Coding…
4. Sensing the environment
5. Challenges! (small tasks for teams/mini competition)

What is an Astro Pi?

Astro Pi consists of:

- Raspberry Pi computer
- Set of sensors and gadgets

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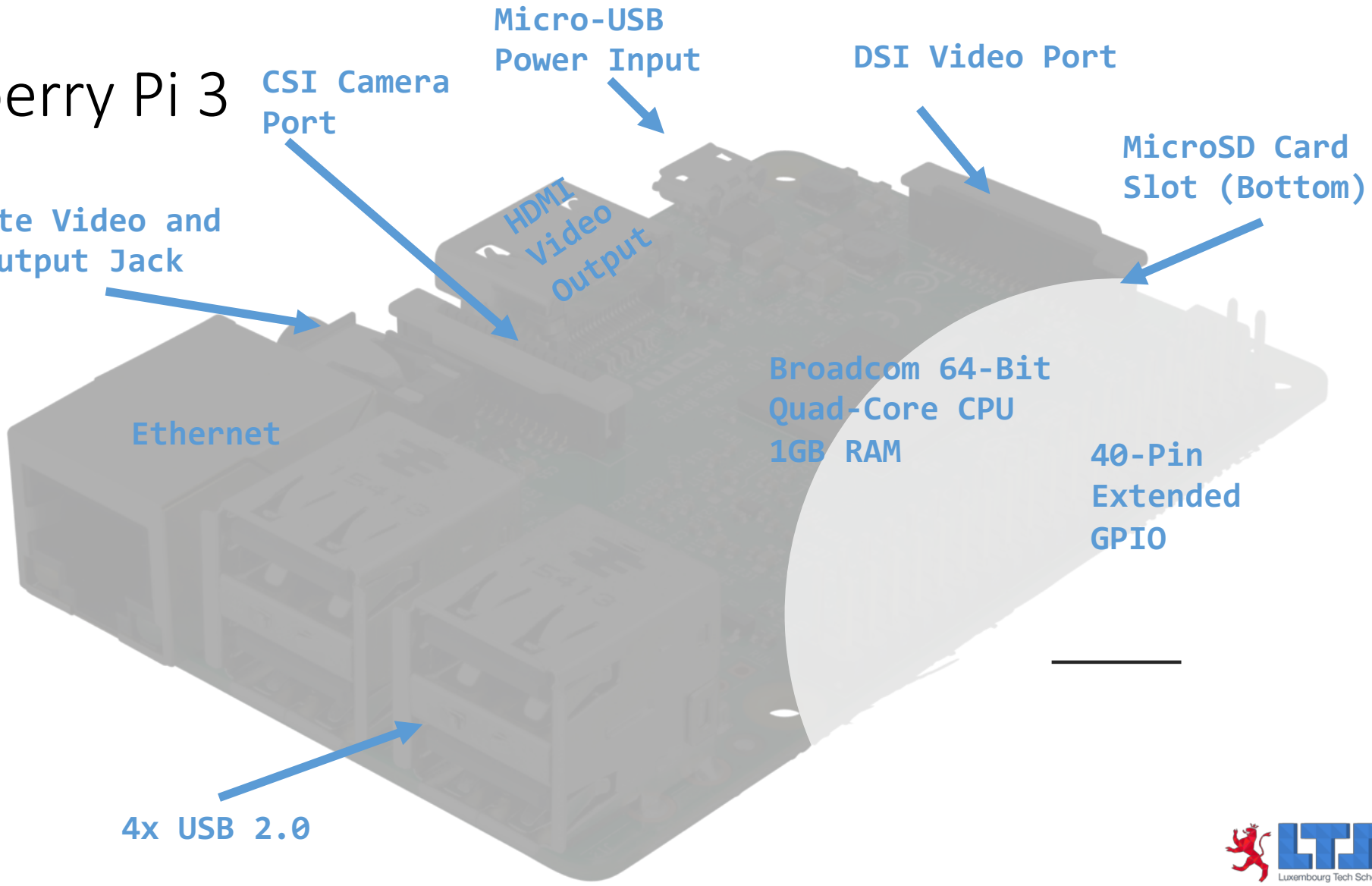
Raspberry Pi 3



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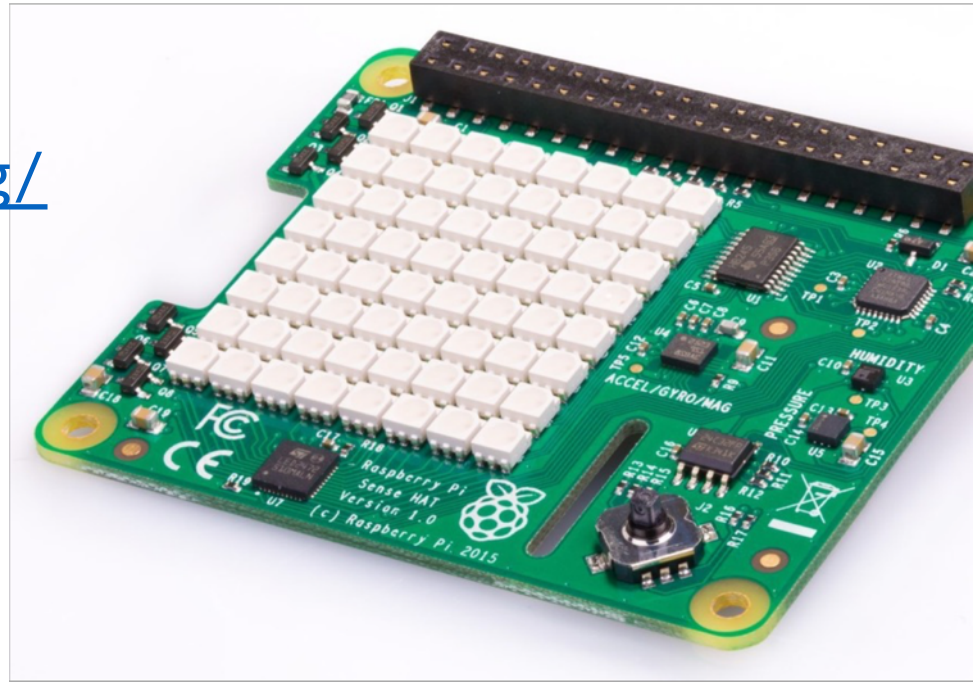
Sense Hat

Build for https://astro-pi.org/

- Gyroscope
- Accelerometer
- Magnetometer
- Temperature
- Barometric pressure
- Humidity



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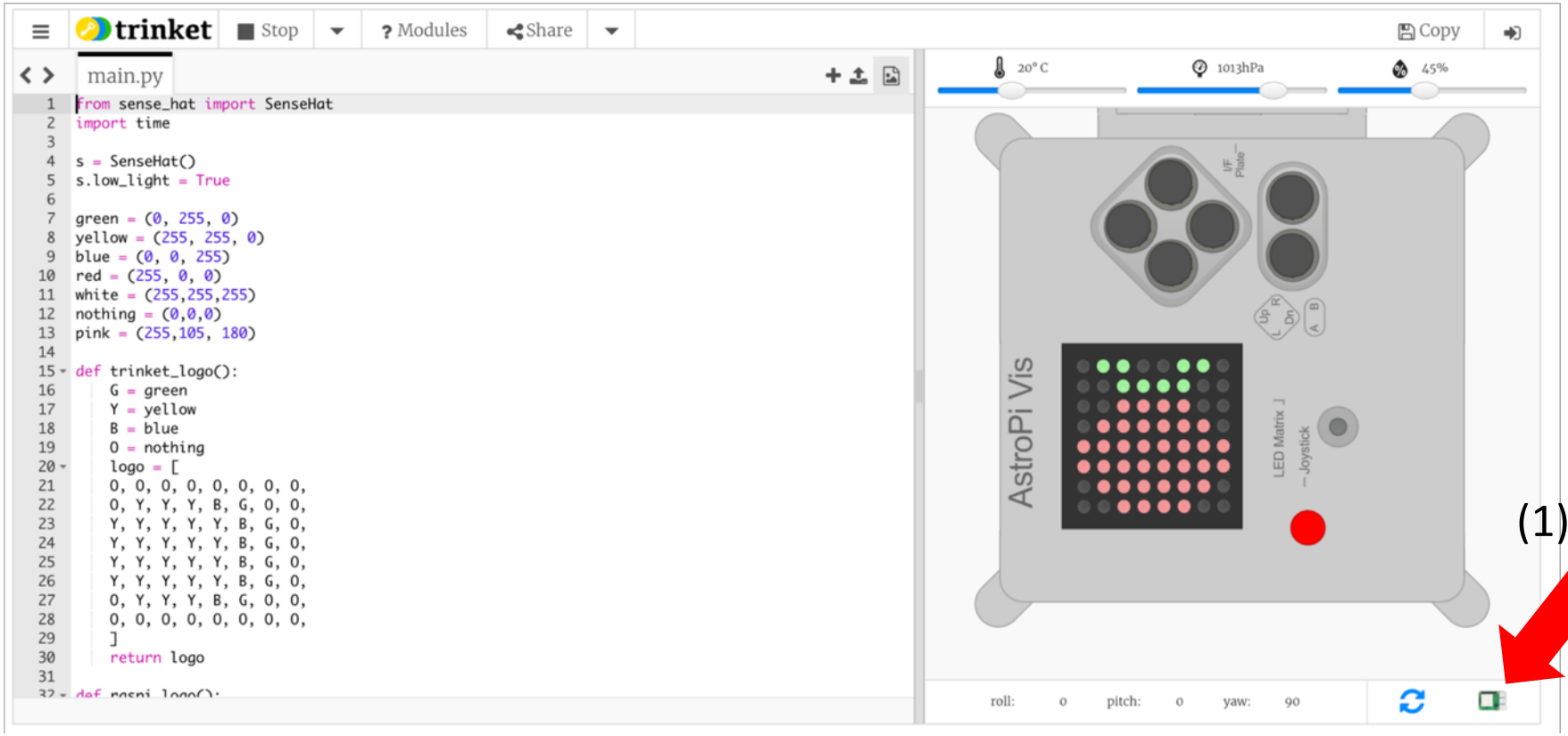
Sense HAT Simulation

- Go to: https://trinket.io/sense-hat



(1) Click here

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Sense HAT Simulation

main.py

```
from sense_hat import SenseHat
import time

s = SenseHat()
s.low_light = True

green = (0, 255, 0)
yellow = (255, 255, 0)
blue = (0, 0, 255)
red = (255, 0, 0)
white = (255,255,255)
nothing = (0,0,0)
pink = (255,105, 180)

def trinket_logo():
    G = green
    Y = yellow
    B = blue
    O = nothing
    logo = [
    O, O, O, O, O, O, O, O,
    O, Y, Y, Y, B, G, O, O,
    Y, Y, Y, Y, Y, B, G, O,
    Y, Y, Y, Y, Y, B, G, O,
    Y, Y, Y, Y, Y, B, G, O,
    Y, Y, Y, Y, Y, B, G, O,
    O, Y, Y, Y, B, G, O, O,
    O, O, O, O, O, O, O, O,
    ]
    return logo

def raspi_logo():
```

(1) CTRL + A

(2) Delete

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Hello LTS

main.py

```
1 from sense_hat import SenseHat
2
3 # Create and instance of SenseHat class
4 sense = SenseHat()
5
6 # display a message on the Sense HAT's LED matrix
7 sense.show_message("Hello LTS")
```

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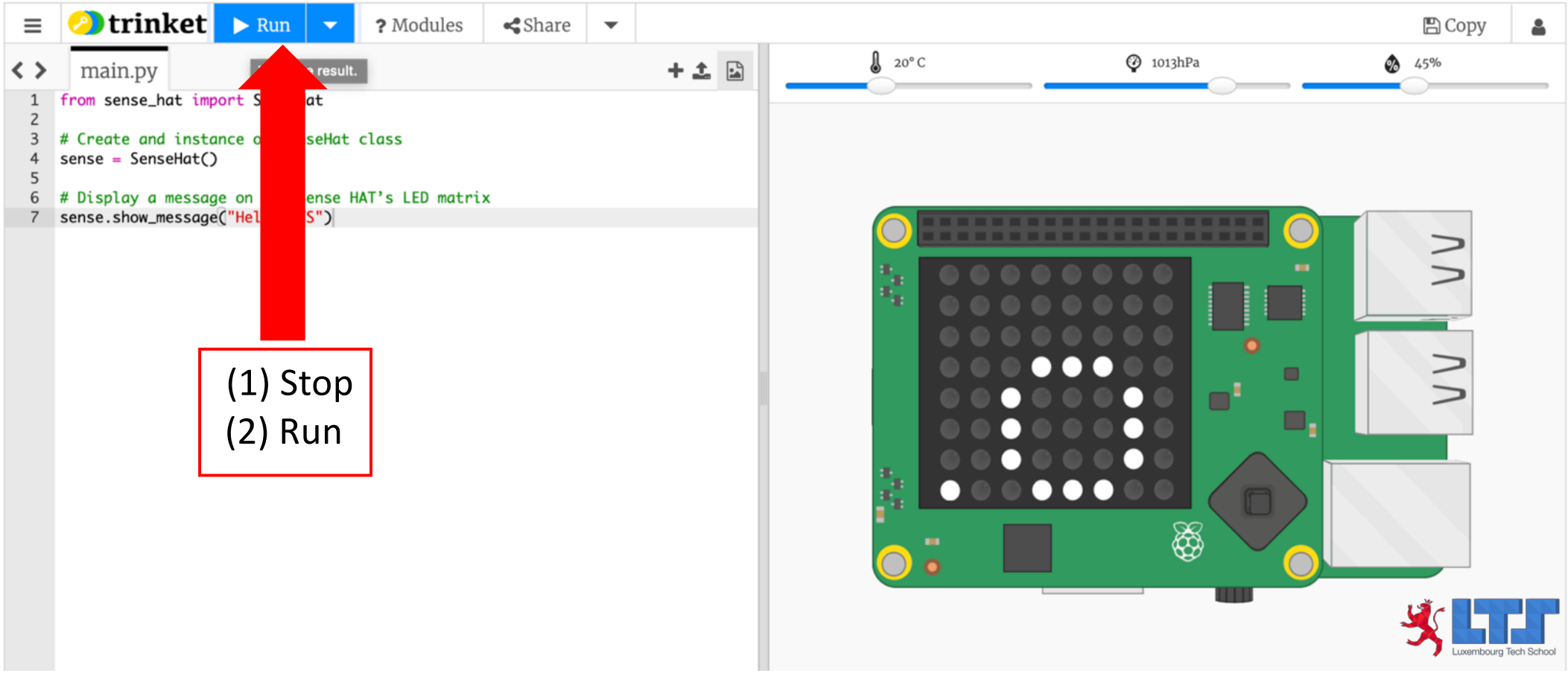
Run the script



Change text & background color

```
1  from sense_hat import SenseHat
2
3  # Create and instance of SenseHat class
4  sense = SenseHat()
5
6  blue = (0, 0, 255)
7  red = (255, 0, 0)
8
9  # Display a message on the Sense HAT's LED matrix
10 sense.show_message("Hello LTS", text_colour=red, back_colour=blue)
```

(1) Add this

(2) And this

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Find the color you want

- Go to https://www.w3schools.com/colors/colors_rgb.asp

(2) Use these values

(1) Change these lines

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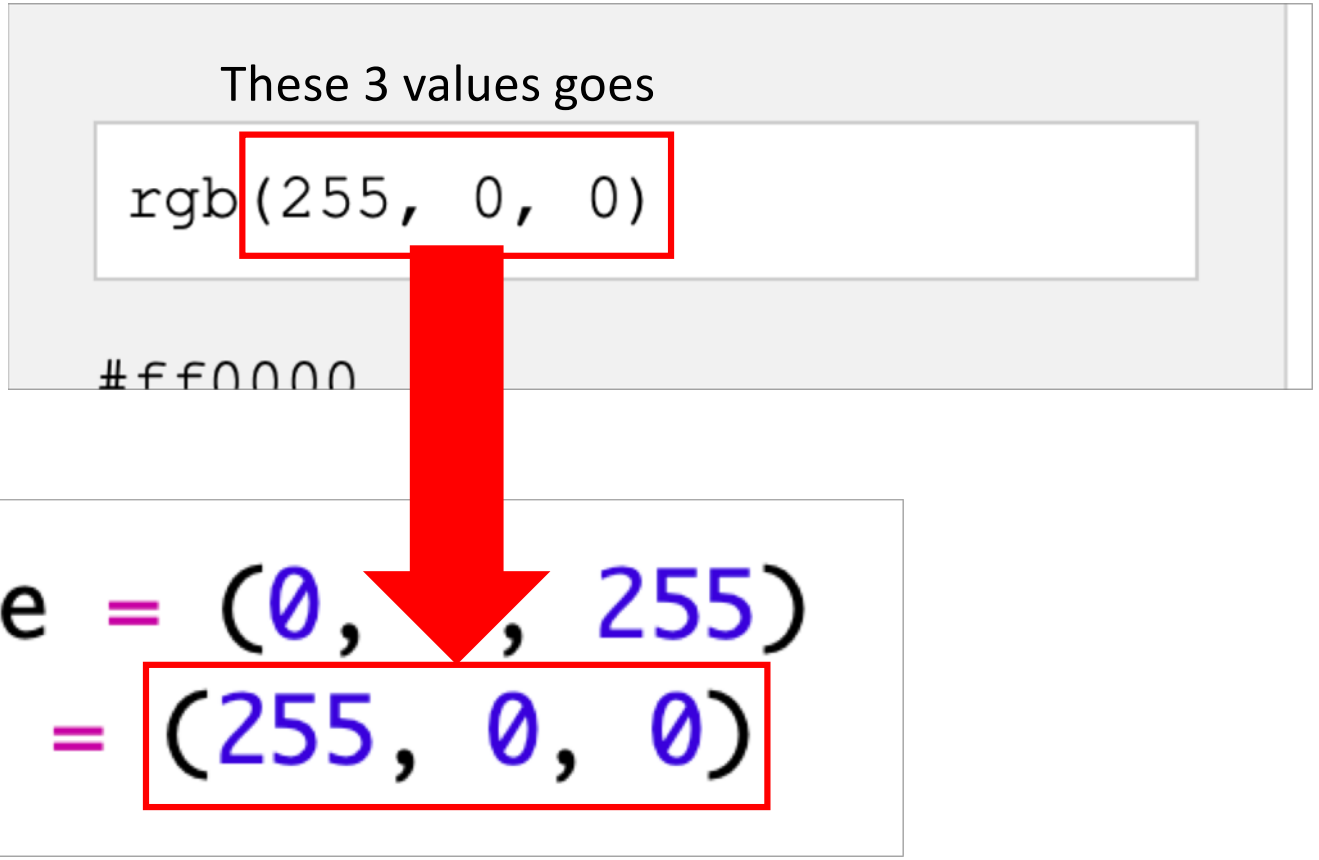
Change RGB



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Run the script

Change the speed

- Add **scroll_speed** parameter to **show_message** command
- By default speed is set 0.1
- Bigger is the number slower is the text

```
sense.show_message("Hello LTS!", text_colour=red,
                   back_colour=blue, scroll_speed=0.05)
```

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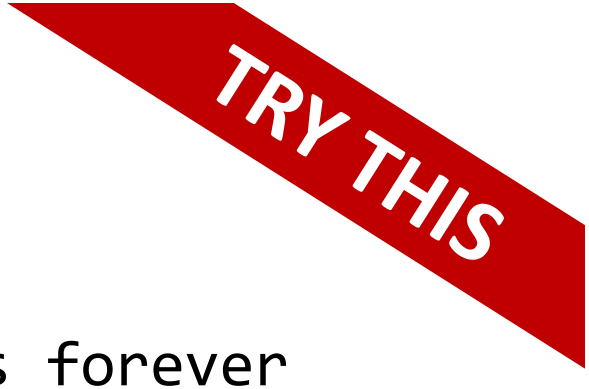
Repeat it forever



- Put your **message** in a **loop** so it repeats forever

- Hint: you can use **while** loop

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Should look like this

SOLUTION

```
while True:
    sense.show_message("Hello LTS!", text_colour=red,
                       back_colour=blue, scroll_speed=0.05)
```

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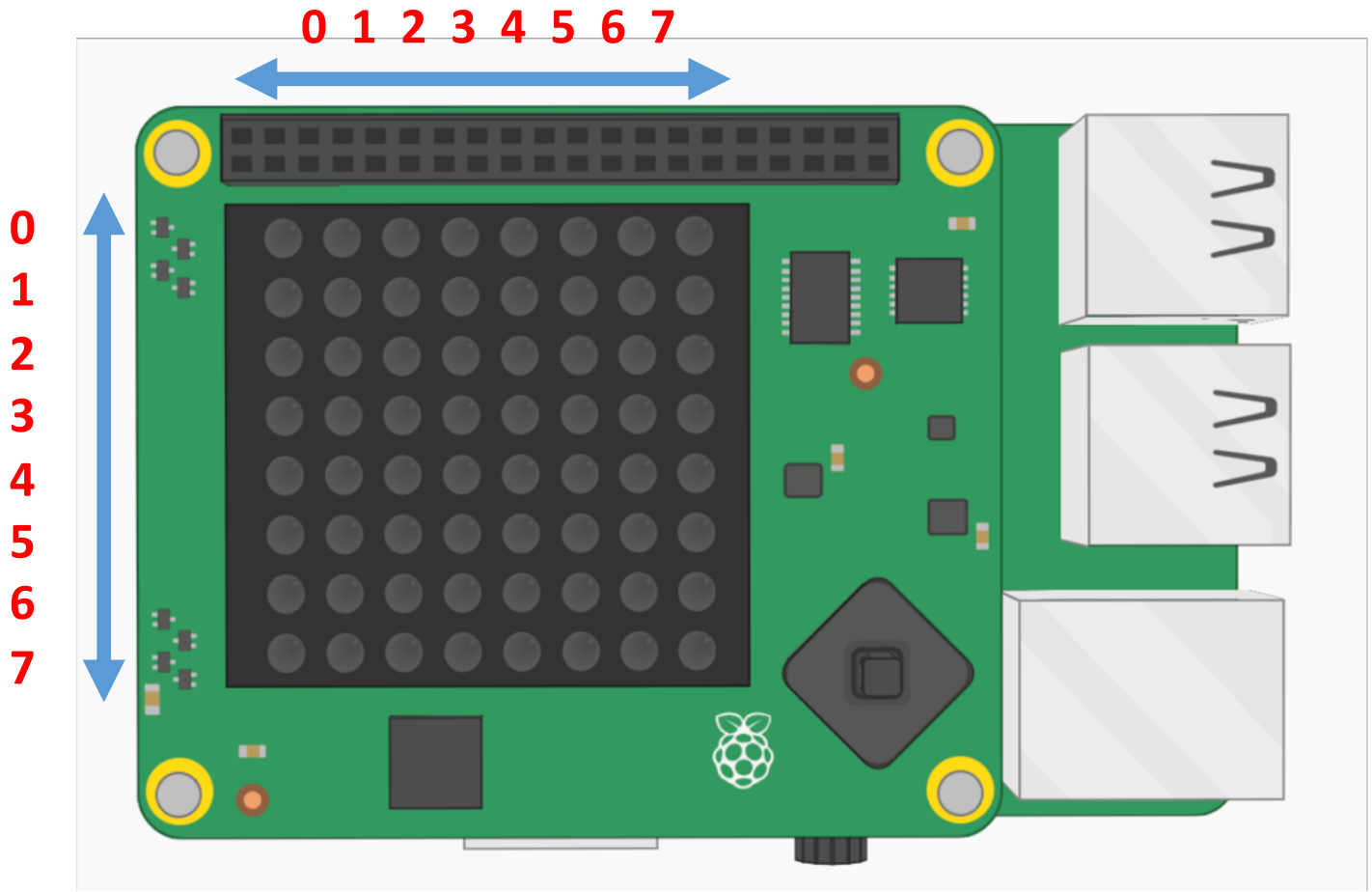
Working with pixels **set_pixel()**



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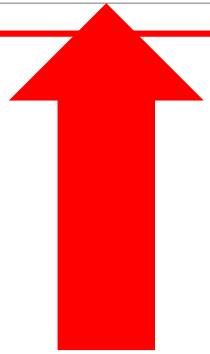
```
1  from sense_hat import SenseHat
2  from time import sleep
3  sense = SenseHat()
4
5  blue = (0, 0, 255)
6  red = (255, 0, 0)
7
8
9  #while True:
10 #  sense.show_message("Hello LTS!", text_colour=red,
11 #                     back_colour=blue, scroll_speed=0.05)
```



Comment out these lines.
(Don’t delete you might need them later)

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Working with pixels **set_pixel()**

1. Let’s add a pixel on the matrix [0, 0]
2. Add:

```
sense.set_pixel(0, 0, (255, 0, 0))
```

3. Run

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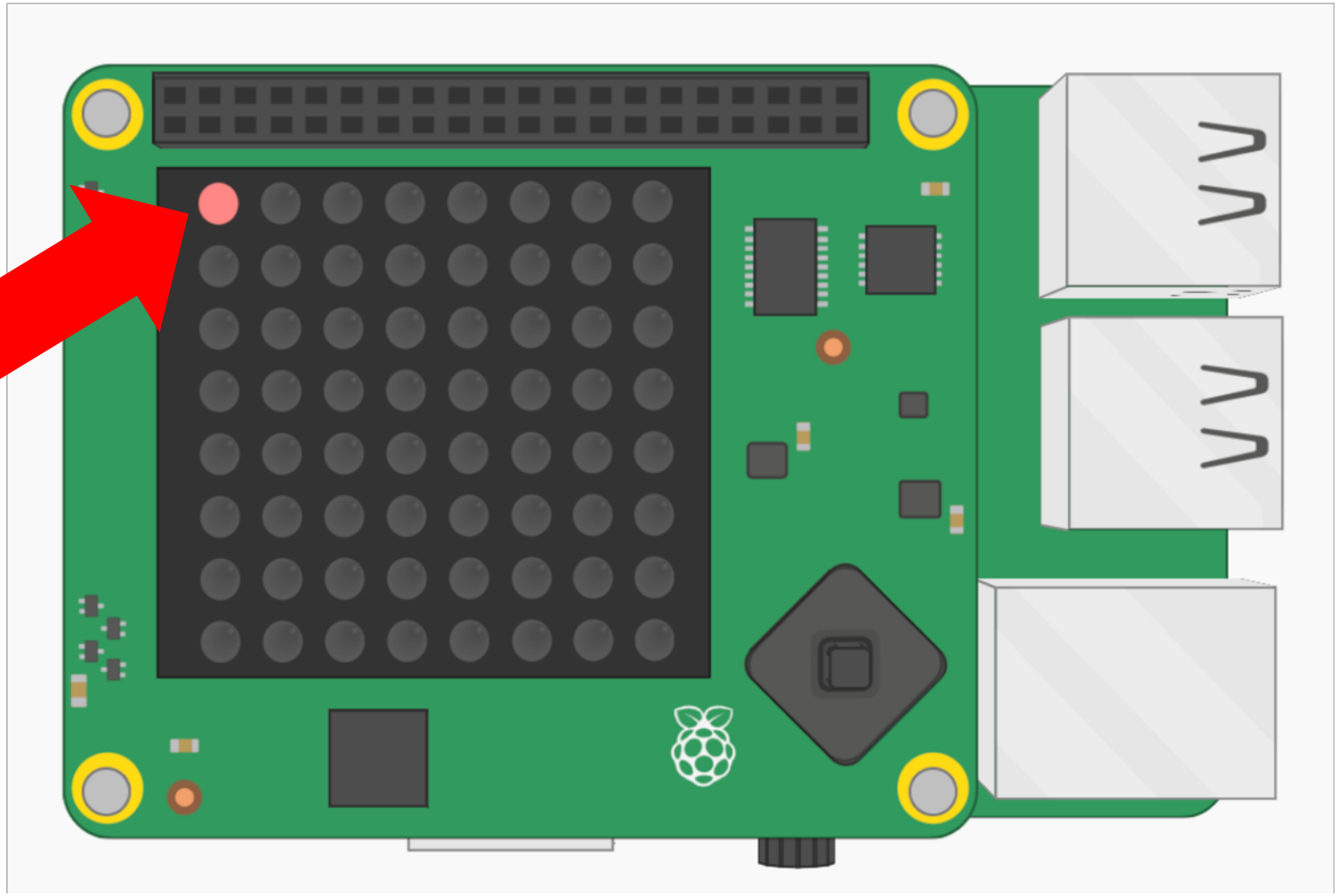
sense.clear()

1. To clean the old text from the matrix write:

```
19
20 sense.clear()
21
22
```

2. Run again

You should have



Random colors for each pixel

```
24 for i in range(8):
25   for j in range(8):
26     red = random.randint(0,250)
27     green = random.randint(0,250)
28     blue = random.randint(0,250)
29     sense.set_pixel(i, j, (red, green, blue))
```

Remember to add **random** library!

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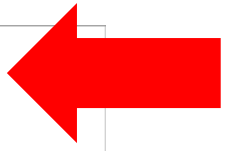
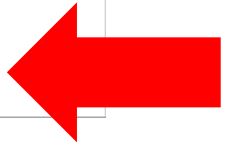
Easy way to draw images

1. Define the colors

```
24  w = (255, 255, 255)
25  b = (0, 0, 0)
```



White



Black

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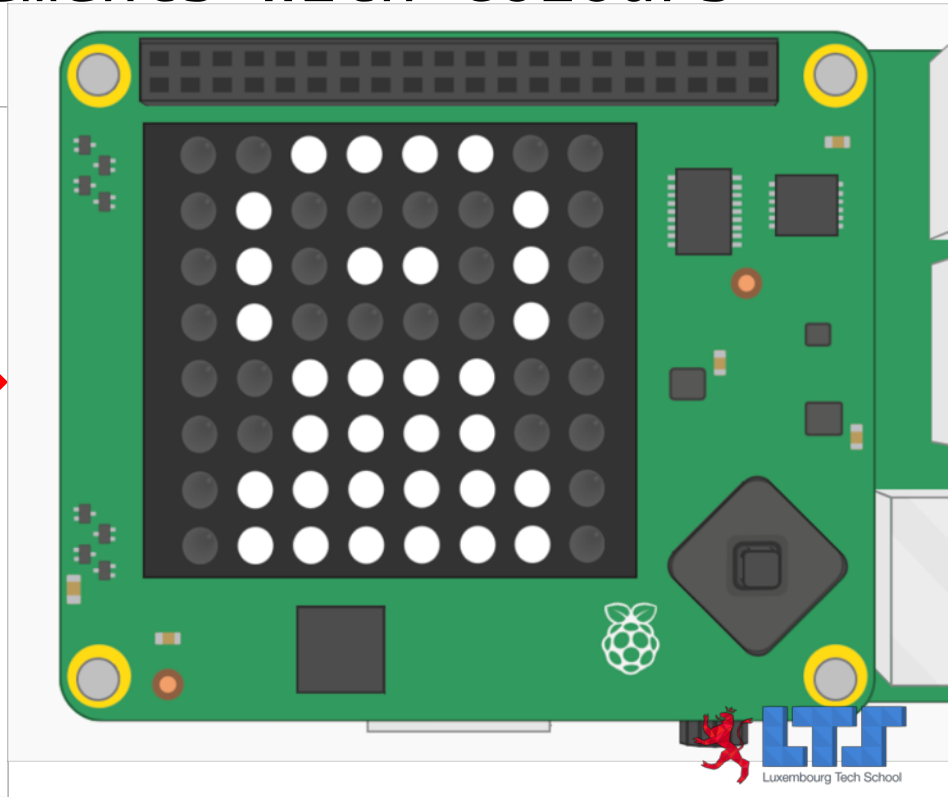
Lets draw an astronaut

1. Create a list of 8x8 elements with colours

```
29 pixels = [
30     b, b, w, w, w, w, b, b,
31     b, w, b, b, b, b, w, b,
32     b, w, b, w, w, b, w, b,
33     b, w, b, b, b, b, w, b,
34     b, b, w, w, w, w, b, b,
35     b, b, w, w, w, w, b, b,
36     b, w, w, w, w, w, w, b,
37     b, w, w, w, w, w, w, b,
38 ]
39
40 # Display these colours on the LED matrix
41 sense.set_pixels(pixels)
```

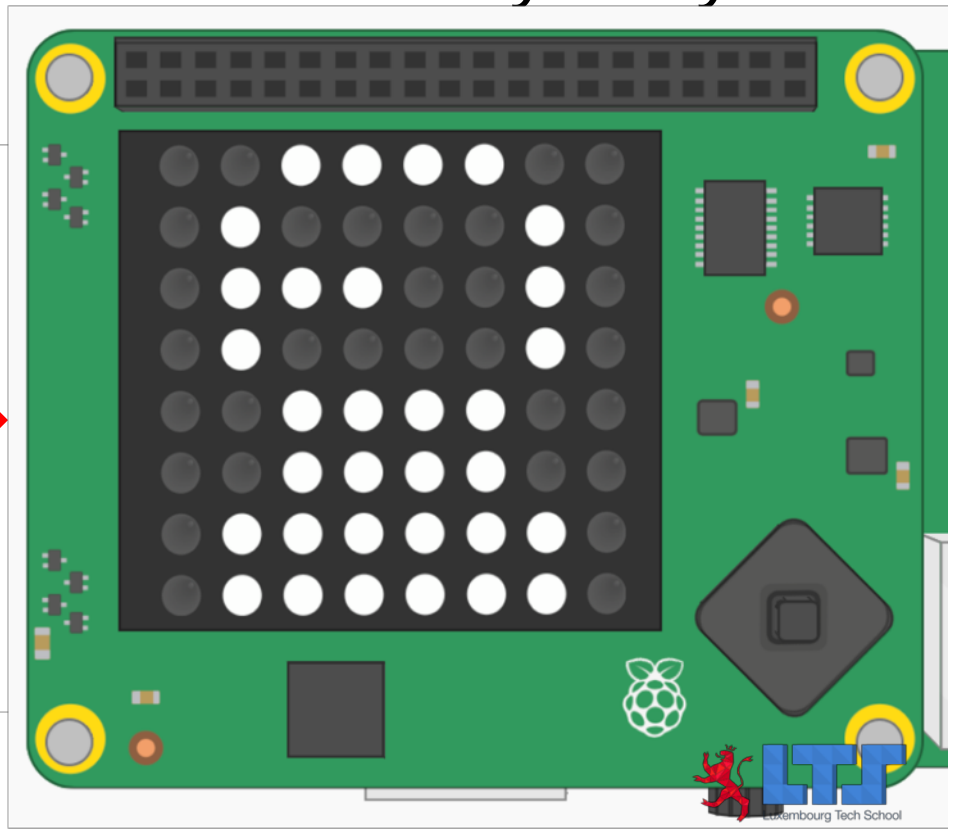


Lets animate our astronaut

1. First lets change the position of the eyes by modifying the 3rd line

```
29 pixels = [
30     b, b, w, w, w, w, b, b,
31     b, w, b, b, b, b, w, b,
32     b, w, b, w, w, b, w, b,
33     b, w, b, b, b, b, w, b,
34     b, b, w, w, w, w, b, b,
35     b, b, w, w, w, w, b, b,
36     b, w, w, w, w, w, w, b,
37     b, w, w, w, w, w, w, b,
38 ]
39
```

b, w, w, w, b, b, w, b,



1. After **set_pixels()**

```
42 sense.set_pixels(pixels)
```

2. Add **flip_h()**

```
45 while True:
46     sleep(1)
47     sense.flip_h()
```

3. Run

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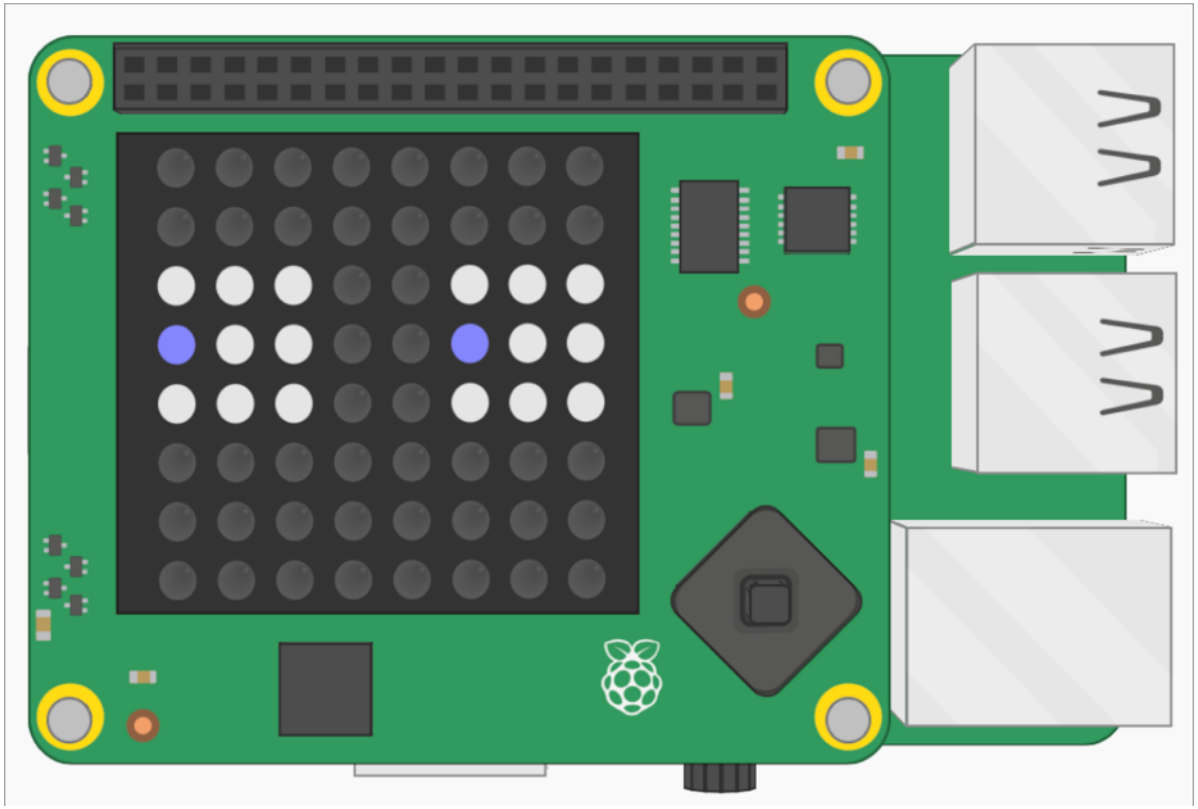
Try yourself

TRY THIS

- Animate the eyes to go from right to left



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SOLUTION

1. Adding blue color

```
26 B = (0, 0, 255)
```

2. Build up the matrix

```
30 pixels = [
31   b,b,b,b,b,b,b,b,
32   b,b,b,b,b,b,b,b,
33   w,w,w,b,b,w,w,w,
34   w,w,B,b,b,w,w,B,
35   w,w,w,b,b,w,w,w,
36   b,b,b,b,b,b,b,b,
37   b,b,b,b,b,b,b,b,
38   b,b,b,b,b,b,b,b
39 ]
```

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Comment out all the code

```
'''
w = (255, 255, 255)
b = (0, 0, 0)
B = (0, 0, 255)


# Set up where each colour will display
pixels = [
  b,b,b,b,b,b,b,b,
  b,b,b,b,b,b,b,b,
  w,w,w,b,b,w,w,w,
  w,w,B,b,b,w,w,B,
  w,w,w,b,b,w,w,w,
  b,b,b,b,b,b,b,b,
  b,b,b,b,b,b,b,b,
  b,b,b,b,b,b,b,b
]

# Display these colours on the LED matrix

sense.set_pixels(pixels)


while True:
    sleep(1)
    sense.flip_h()

'''
```

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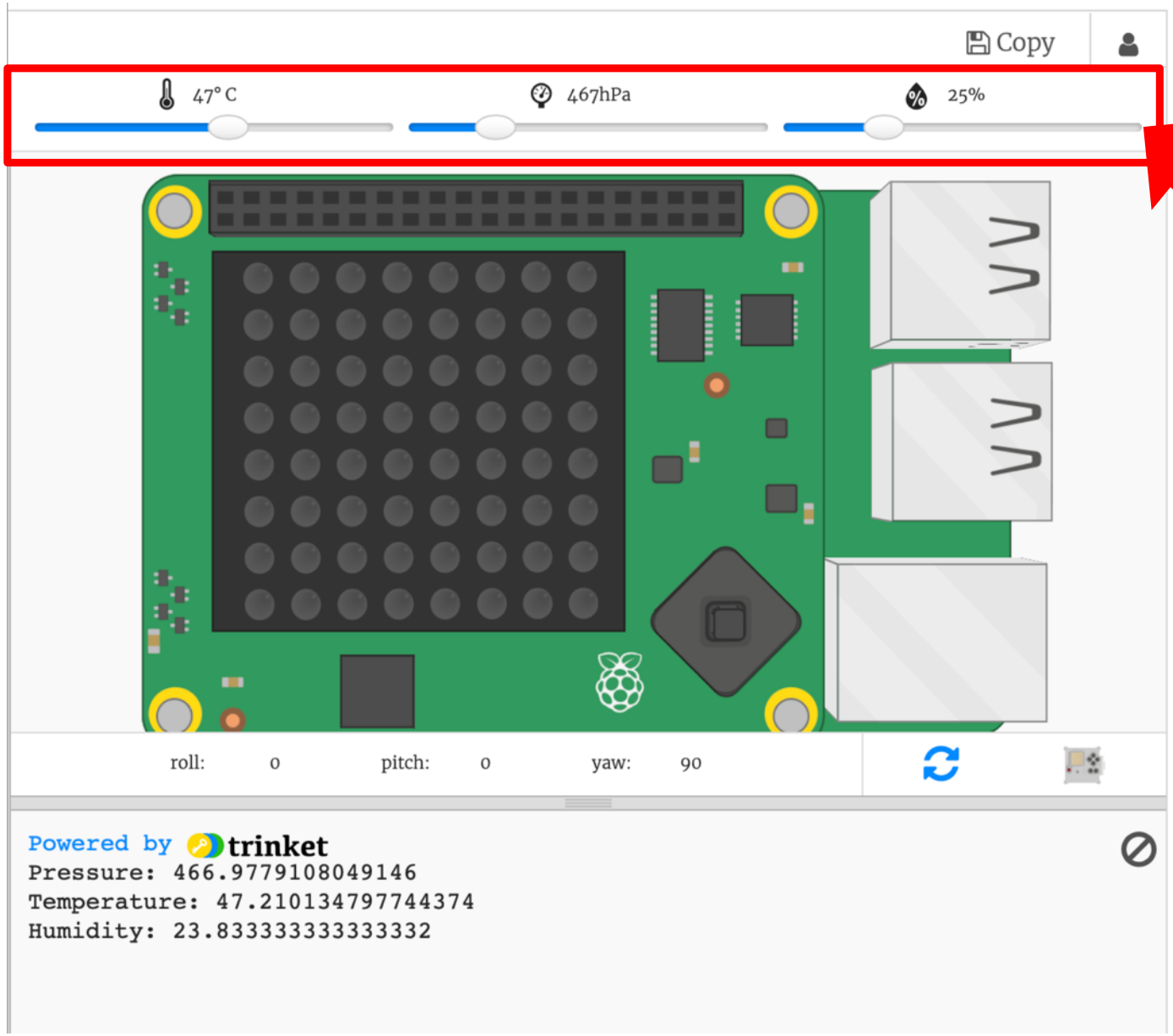
Working with sensors

```
1 from sense_hat import SenseHat
2 from time import sleep
3 import random
4 sense = SenseHat()
5
6 sense.clear()
```

```
56 pressure = sense.get_pressure()
57 temp = sense.get_temperature()
58 humidity = sense.get_humidity()
59
60 print("Pressure: {}".format(pressure))
61 print("Temperature: {}".format(temp))
62 print("Humidity: {}".format(humidity))
```



Change the values and **run** again

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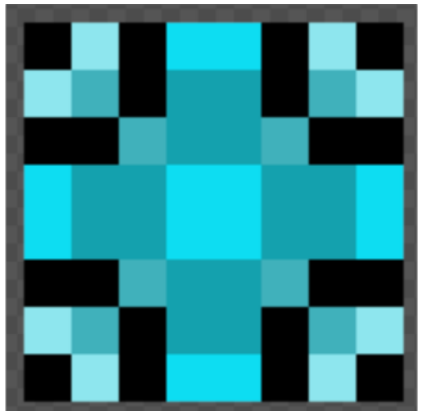
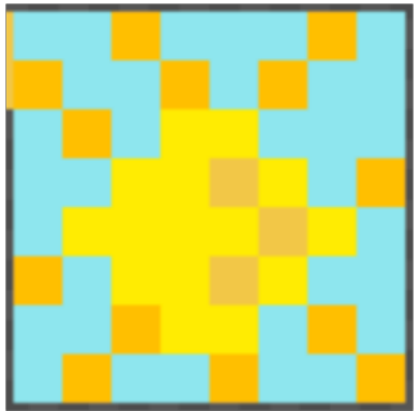
Try yourself

TRY THIS



- **IF** the temperature is less than 10 degrees, **THEN** draw a snowflake



- **ELSE IF** the humidity is less than 40 **AND** temperature is bigger than 15, **THEN** draw a sun

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Detecting movement – IMU data

- **A gyroscope:** measures momentum and rotation
- **An accelerometer:** measures acceleration forces, can be used to find the direction of gravity
- **A magnetometer:** measures the Earth's own magnetic field, a bit like a compass

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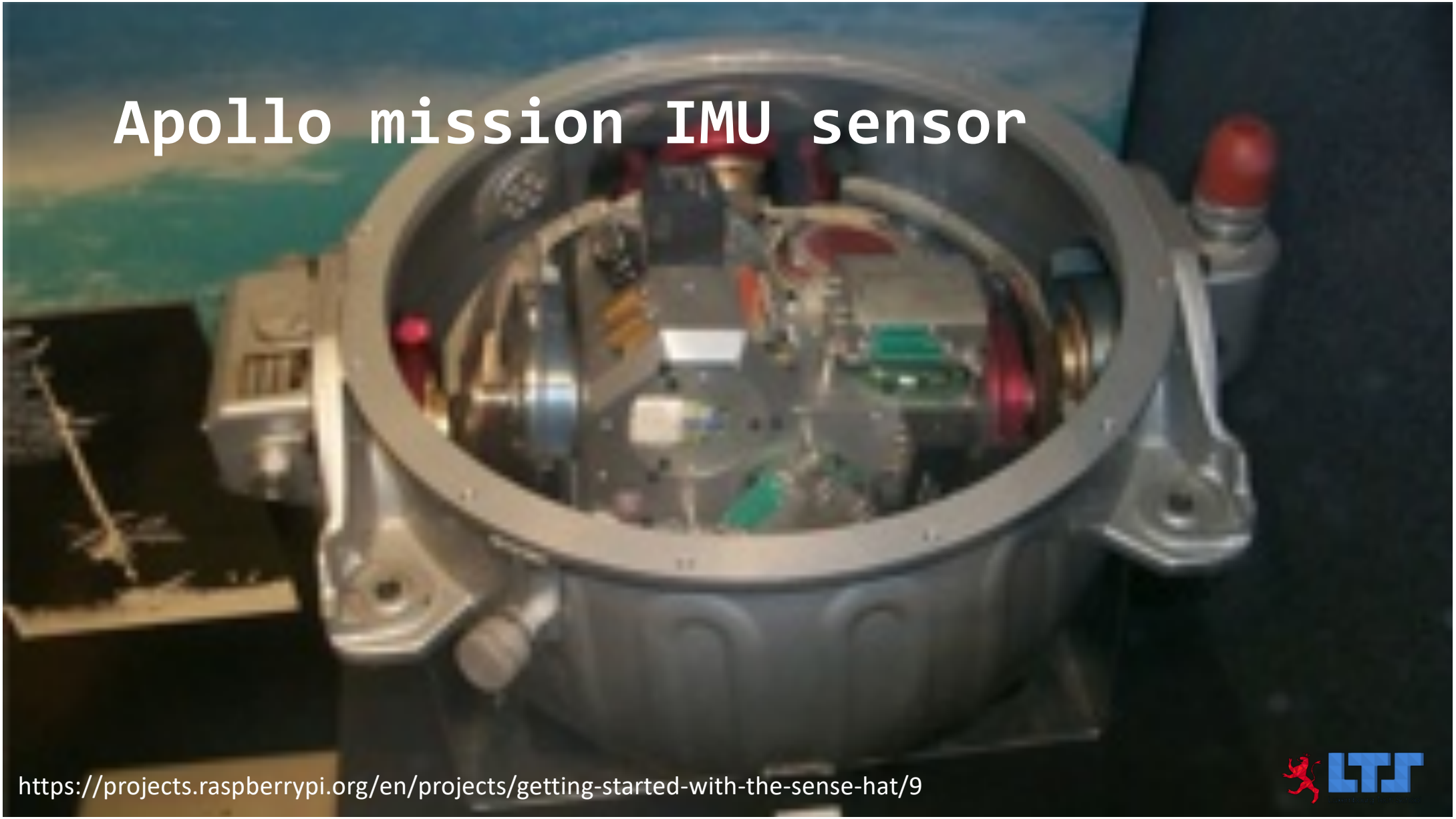
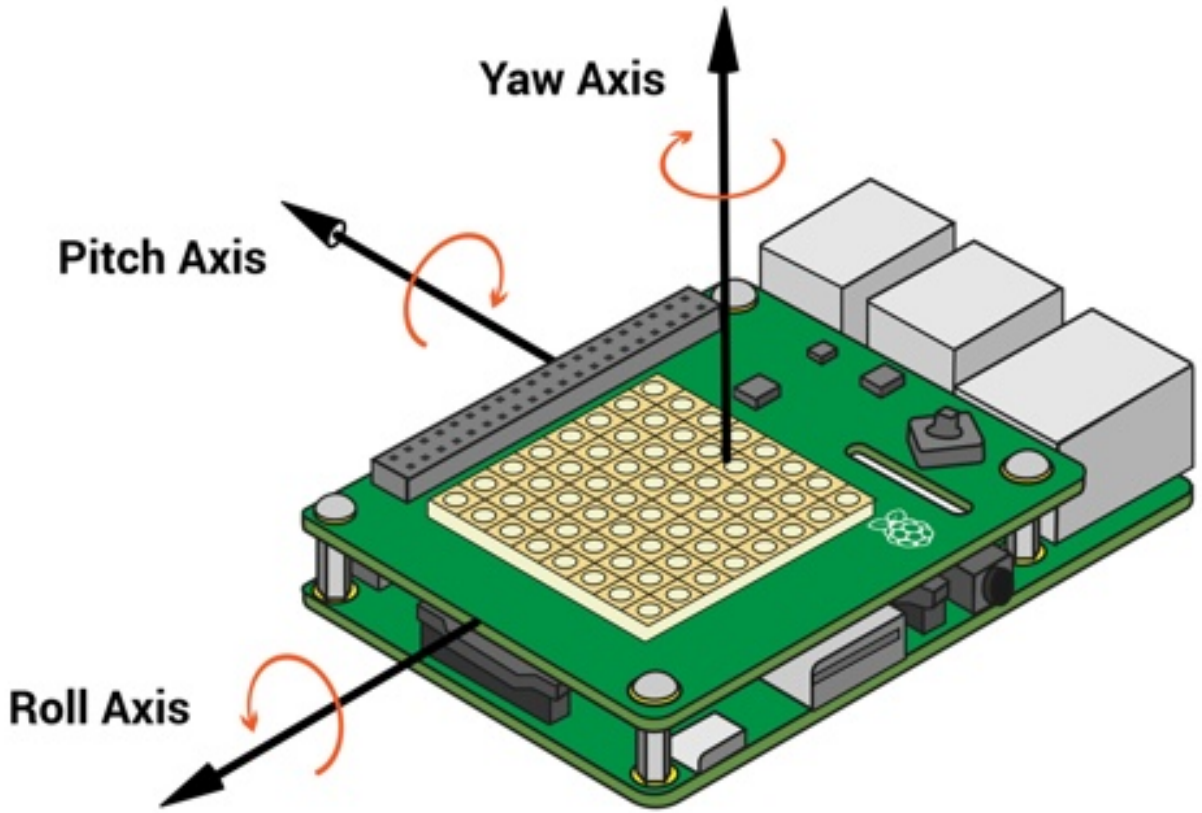
Apollo mission IMU sensor



https://projects.raspberrypi.org/en/projects/getting-started-with-the-sense-hat/9

Detecting movement – IMU data

- **Pitch**
- **Roll**
- **Yaw**



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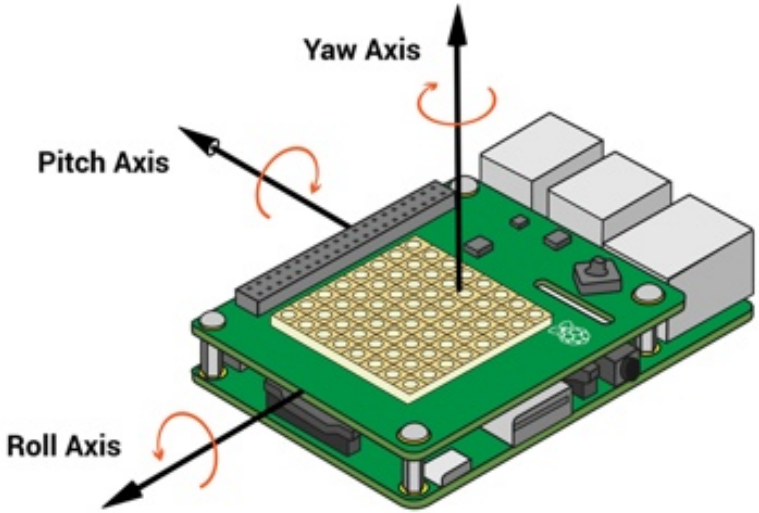
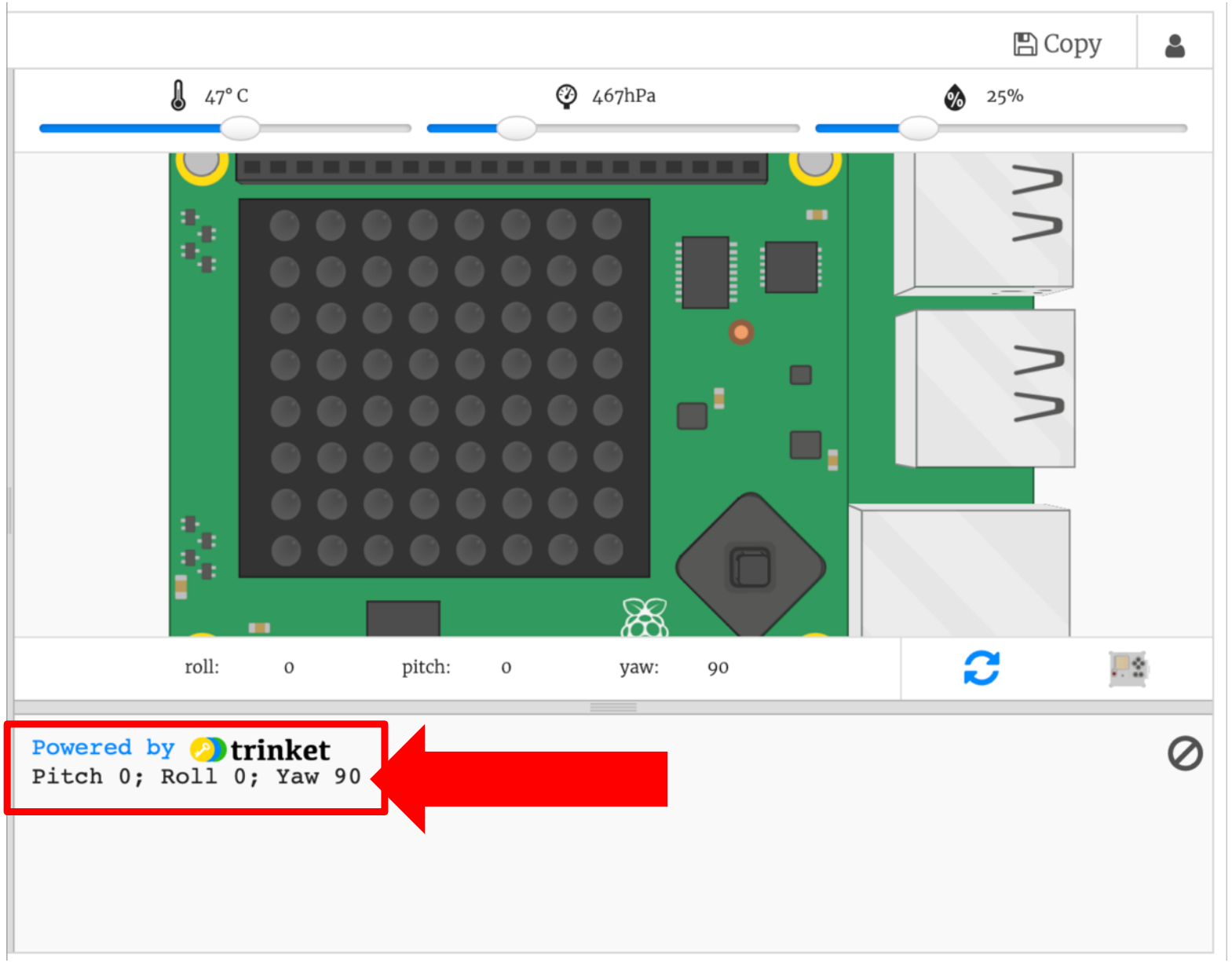
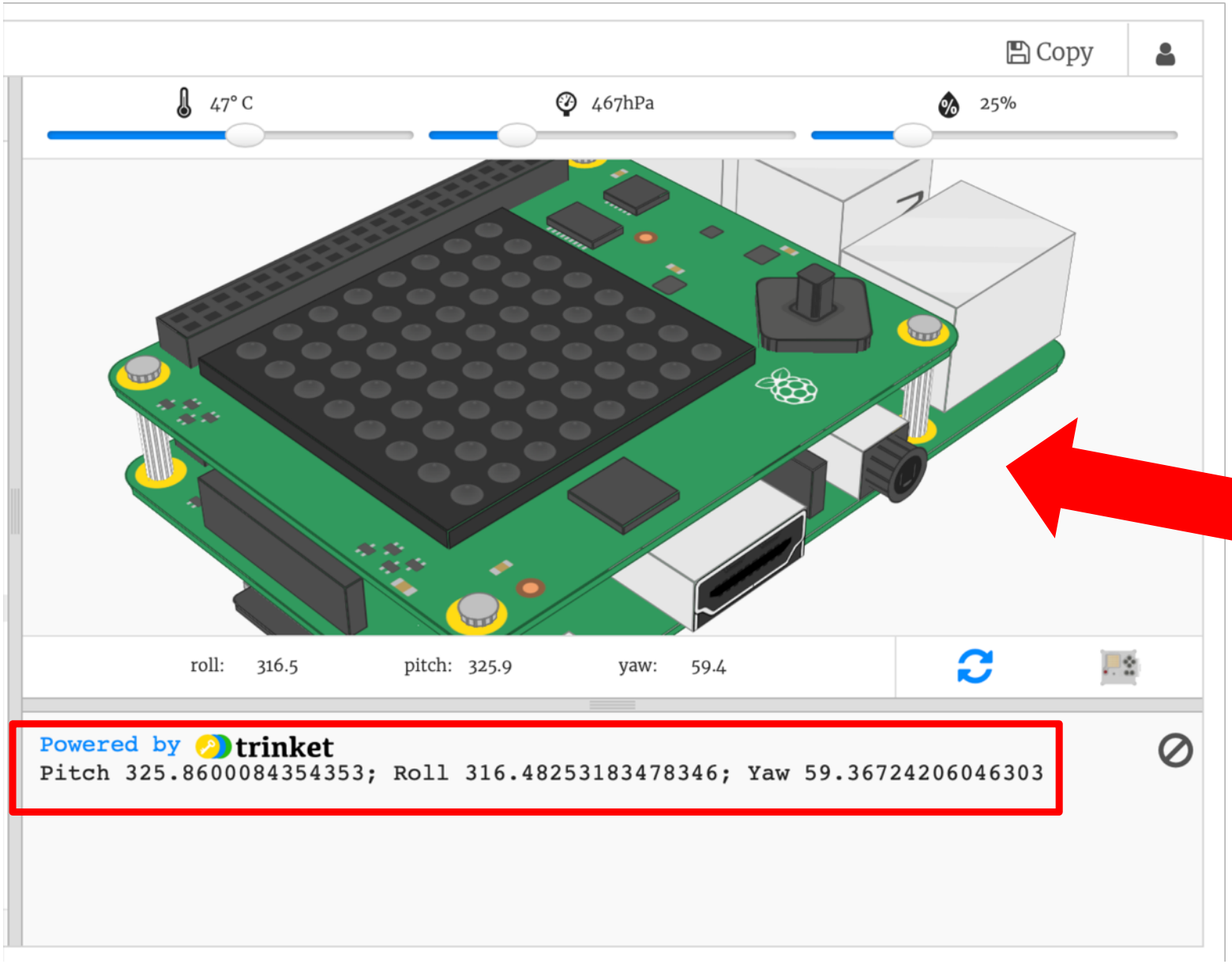



```
64 orientation = sense.get_orientation()
65 pitch = orientation["pitch"]
66 roll = orientation["roll"]
67 yaw = orientation["yaw"]
68
69 print("Pitch {}; Roll {}; Yaw {}".format(pitch, roll, yaw))
```


Copy
47° C
467hPa
25%
roll: 0
pitch: 0
yaw: 90
Powered by trinket
Pitch 0; Roll 0; Yaw 90



1. Rotate
2. Run

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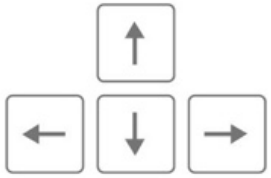
Program the joystick

```
5 while True:
6     for event in sense.stick.get_events():
7         print(event.direction, event.action)
```

1. Run
2. Use 
3. Check the printed values

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```
3  from time import sleep
```

```
9  while True:
10   for event in sense.stick.get_events():
11     # Check if the joystick was pressed
12     if event.action == "pressed":
13
14       # Check which direction
15       if event.direction == "left":
16         sense.show_letter("L")      # Left arrow
17       elif event.direction == "right":
18         sense.show_letter("R")      # Right arrow
```

```
20       # Wait a while and then clear the screen
21       sleep(0.5)
22       sense.clear()
```

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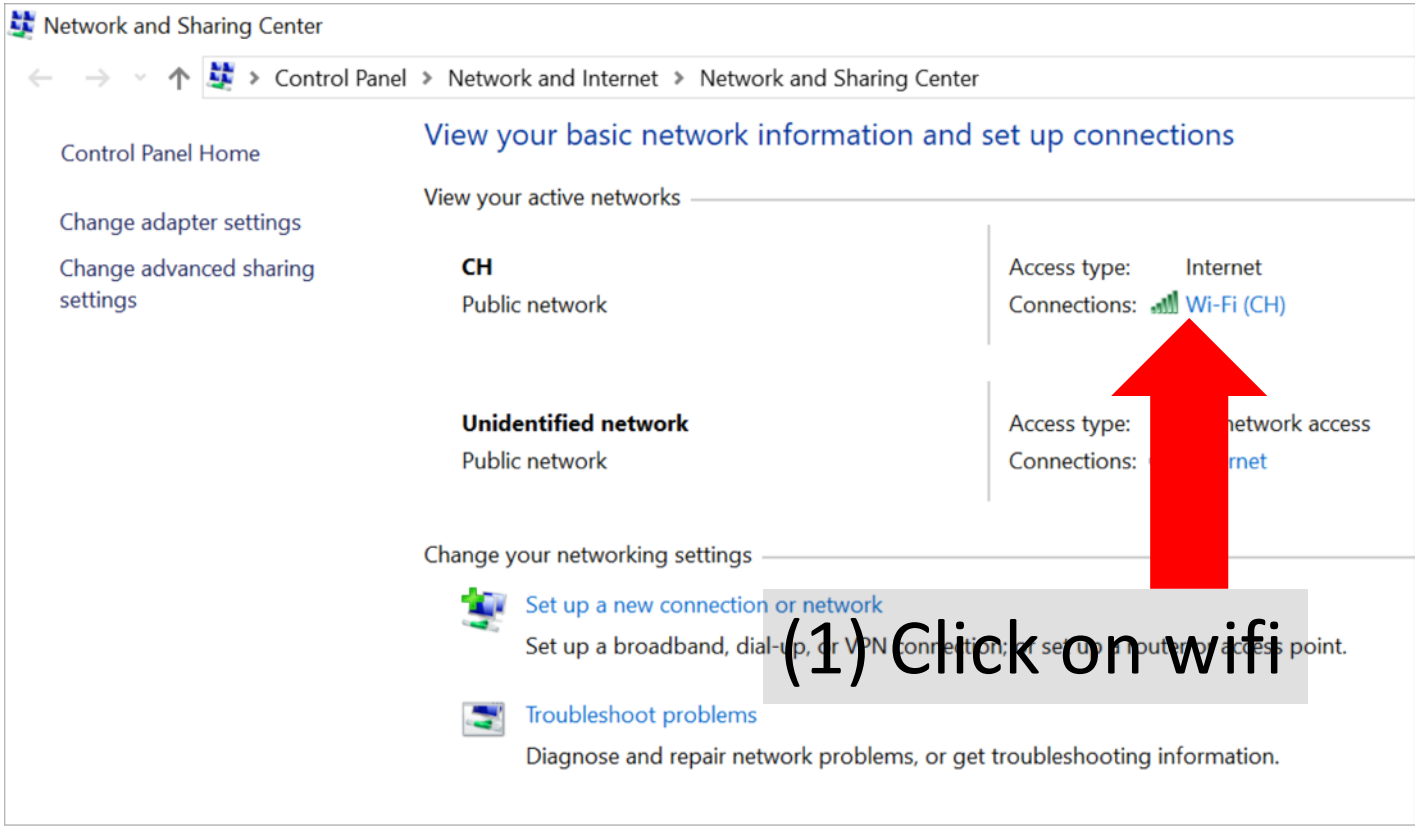
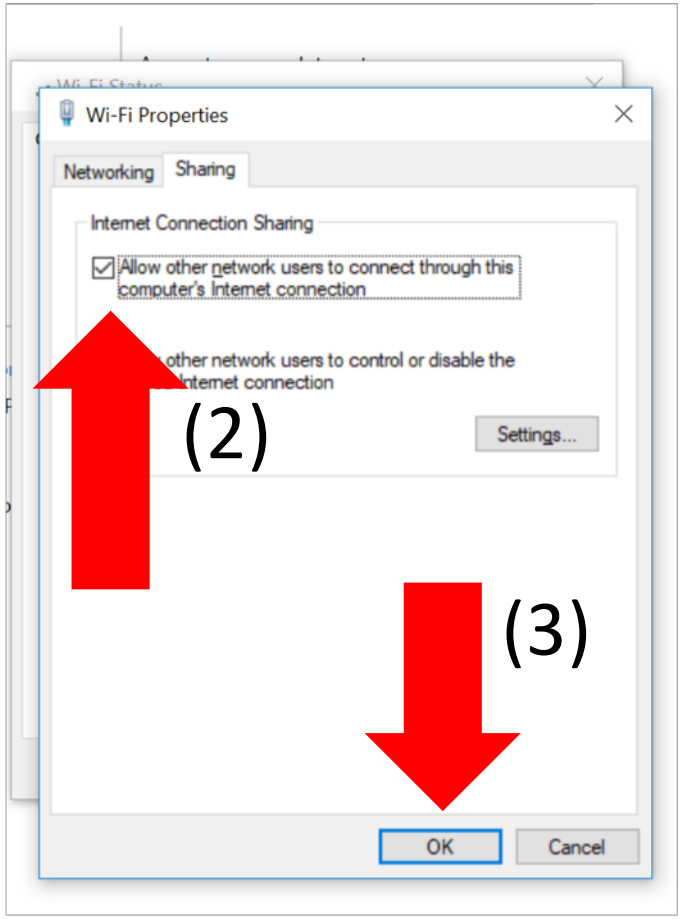
Building up teams

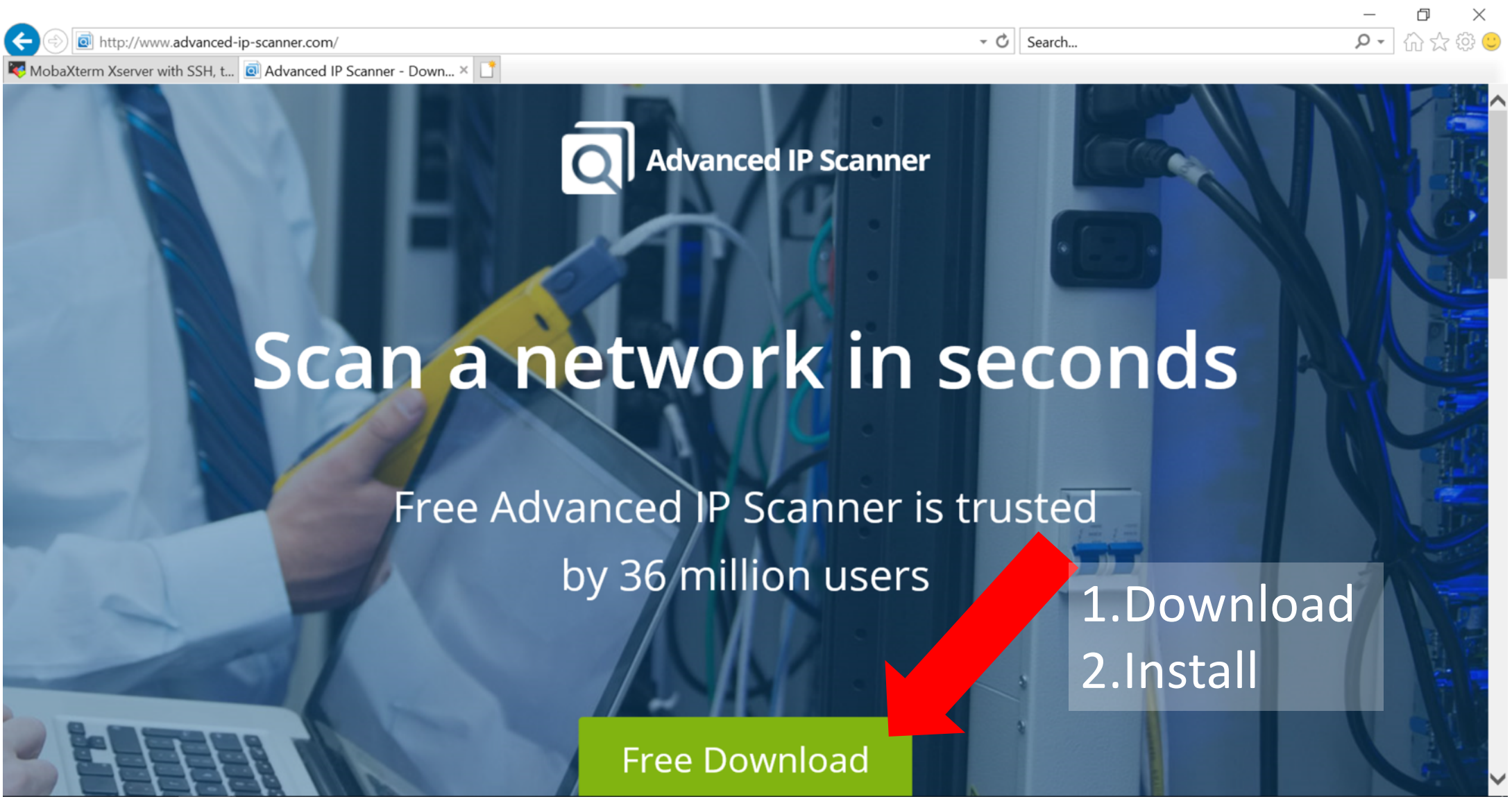
~8 team of ~3/4 people

Network setup

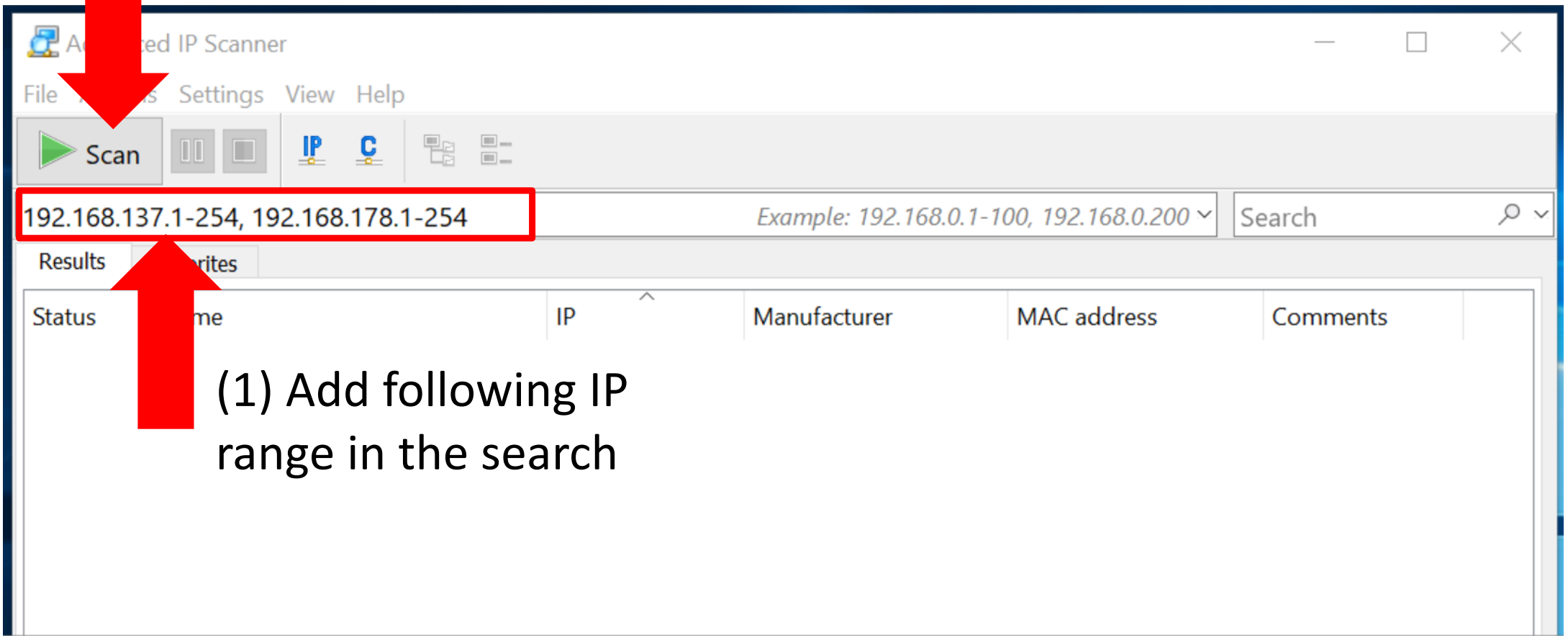




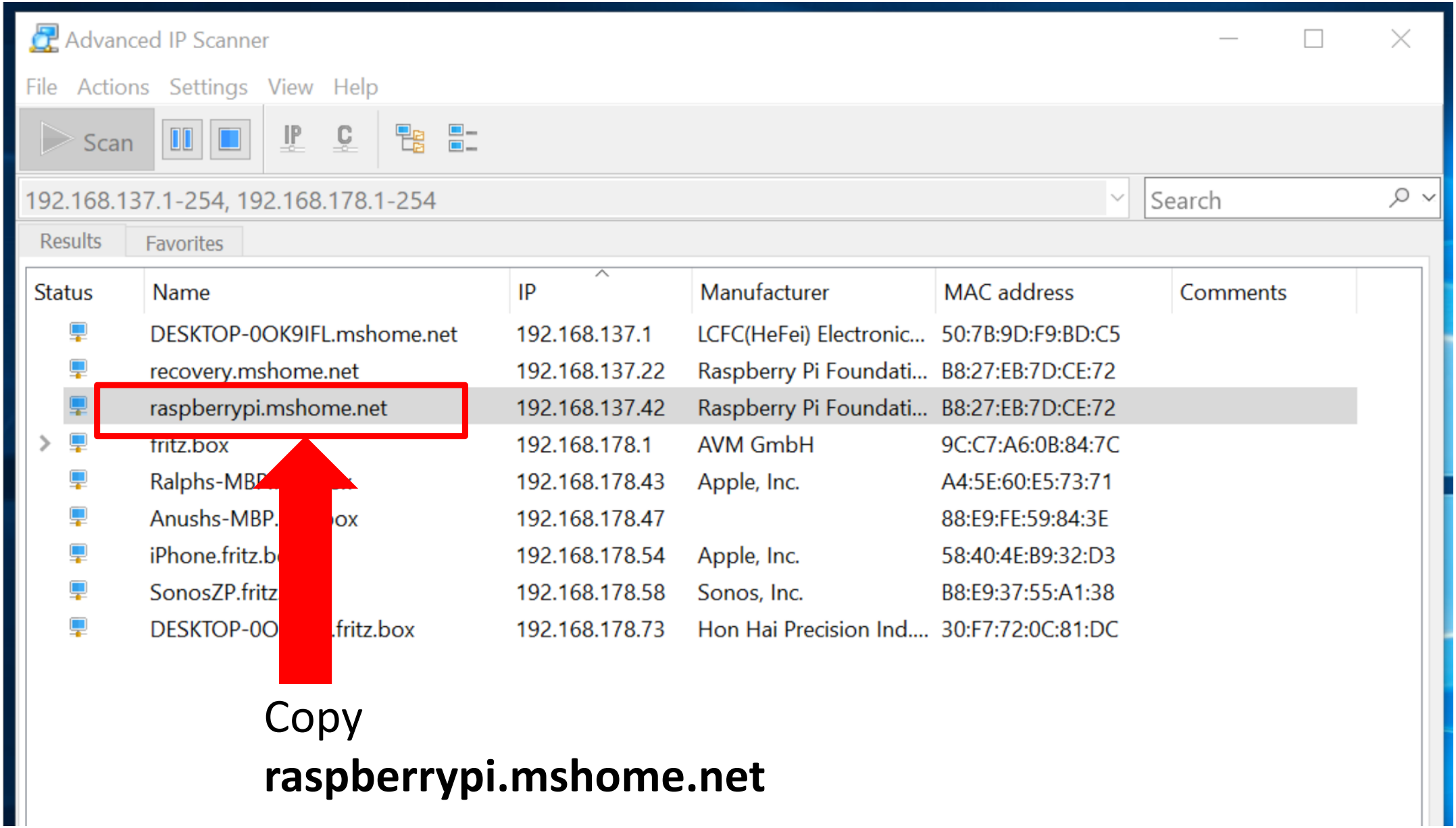
https://www.advanced-ip-scanner.com

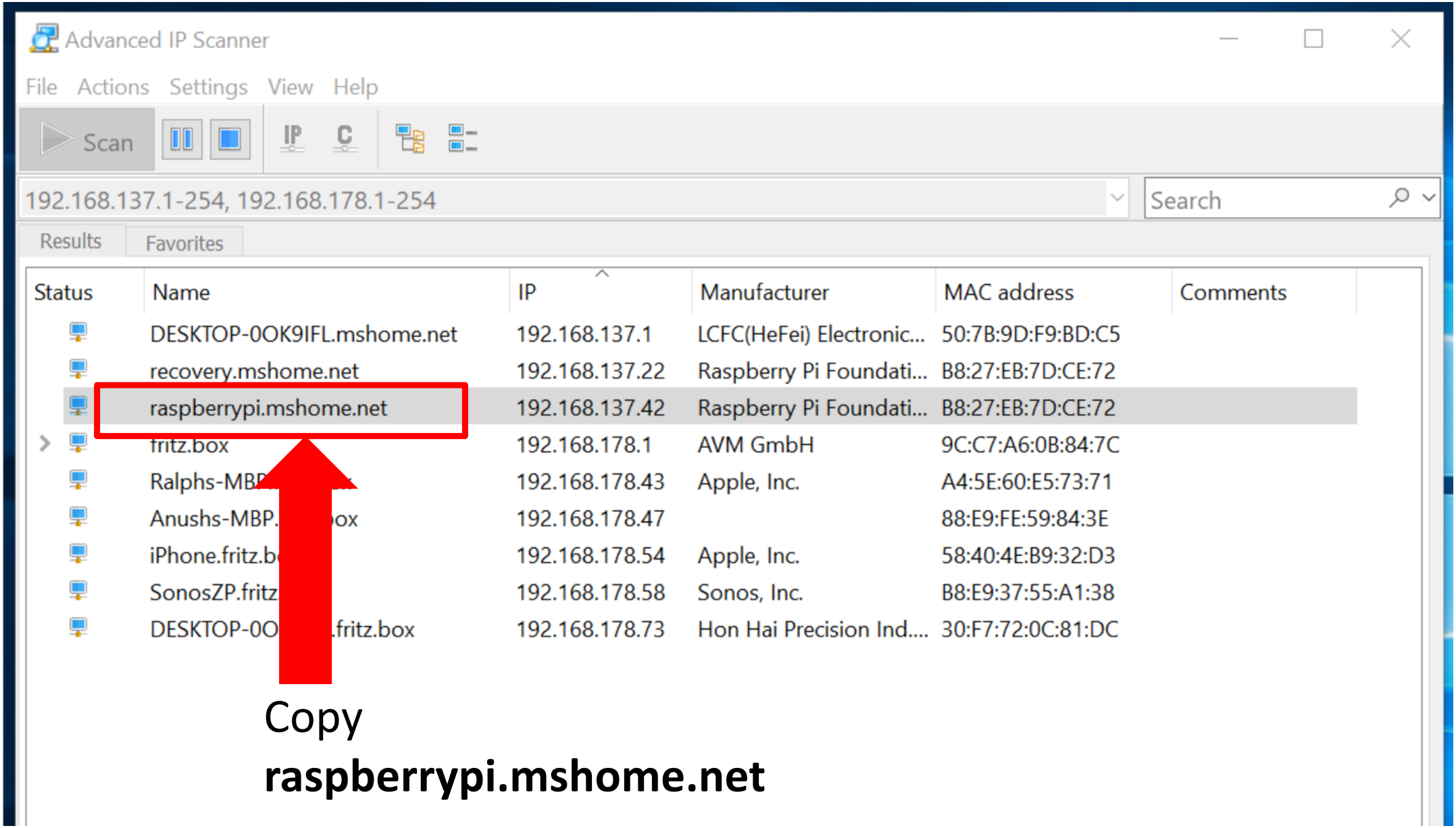


(2) Click on **Scan**

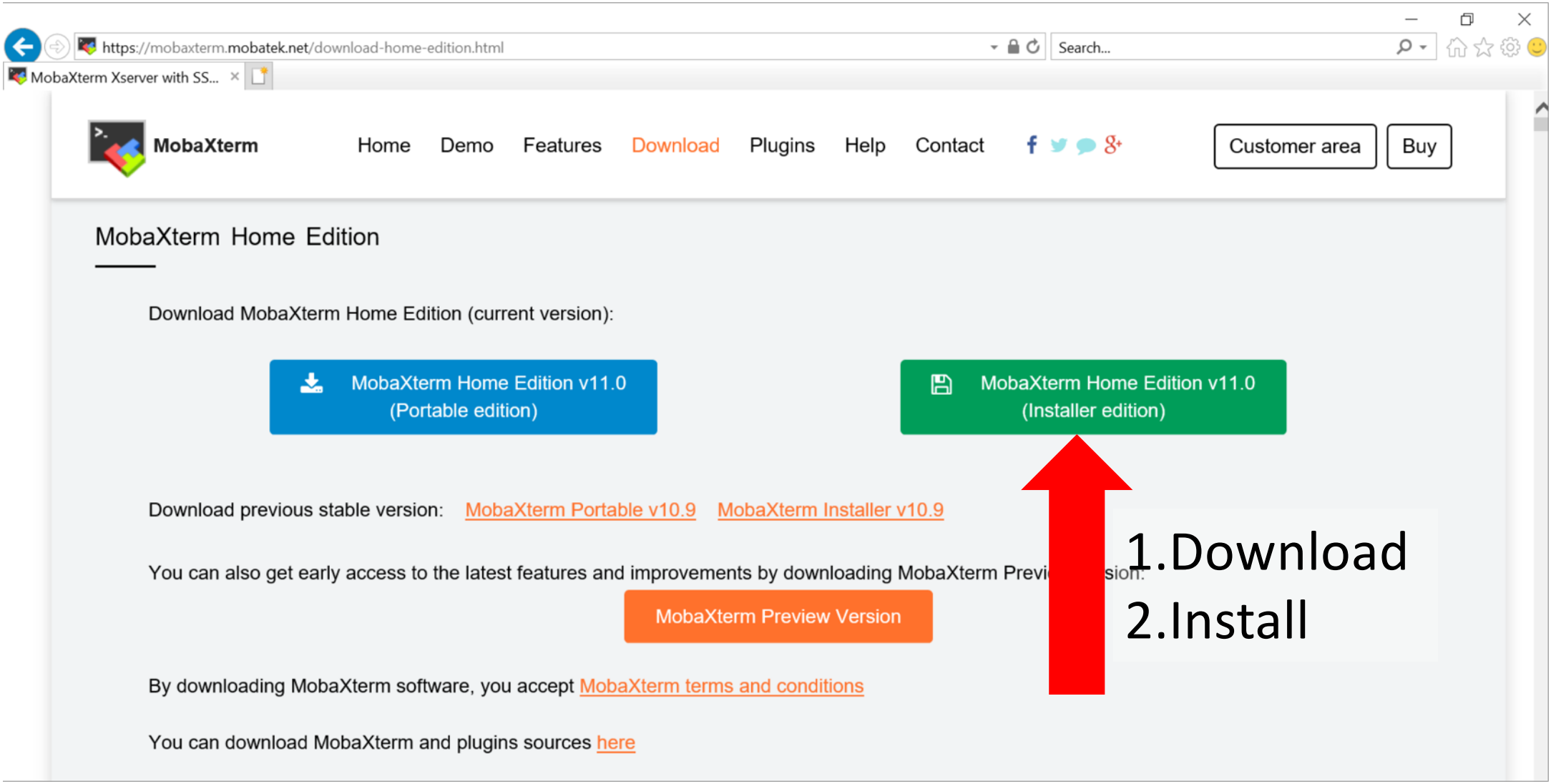


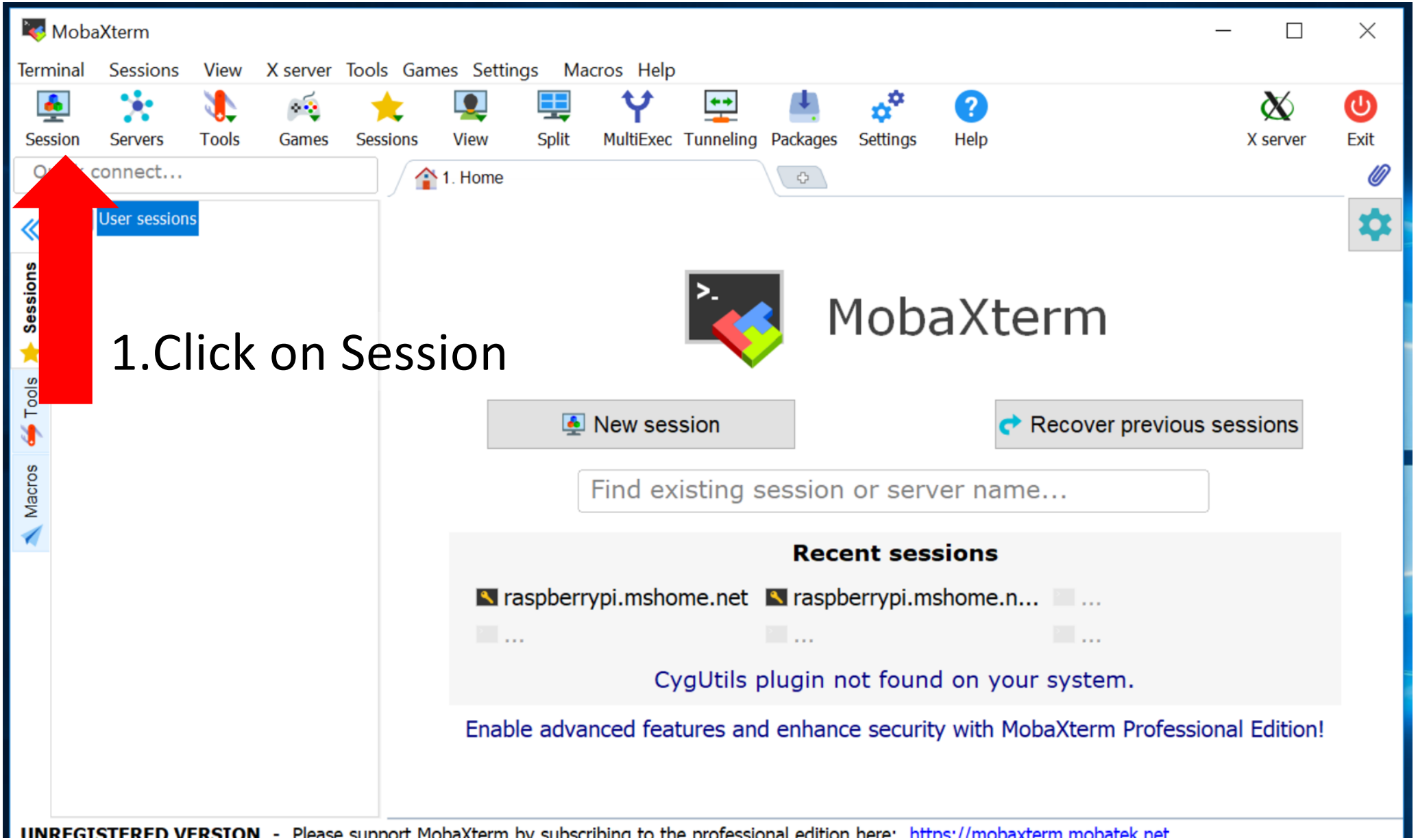
(1) Add following IP range in the search


Advanced IP Scanner
File Actions Settings View Help
Scan
192.168.137.1-254, 192.168.178.1-254
Search
Results Favorites
Status Name IP Manufacturer MAC address Comments
DESKTOP-0OK9IFL.mshome.net 192.168.137.1 LCFC(HeFei) Electronic... 50:7B:9D:F9:BD:C5
recovery.mshome.net 192.168.137.22 Raspberry Pi Foundati... B8:27:EB:7D:CE:72
raspberrypi.mshome.net 192.168.137.42 Raspberry Pi Foundati... B8:27:EB:7D:CE:72
fritz.box 192.168.178.1 AVM GmbH 9C:C7:A6:0B:84:7C
Ralphs-MB 192.168.178.43 Apple, Inc. A4:5E:60:E5:73:71
Anushs-MBP. ox 192.168.178.47 88:E9:FE:59:84:3E
iPhone.fritz.b 192.168.178.54 Apple, Inc. 58:40:4E:B9:32:D3
SonosZP.fritz 192.168.178.58 Sonos, Inc. B8:E9:37:55:A1:38
DESKTOP-0O .fritz.box 192.168.178.73 Hon Hai Precision Ind.... 30:F7:72:0C:81:DC
Copy
raspberrypi.mshome.net


Advanced IP Scanner
File Actions Settings View Help
Scan
192.168.137.1-254, 192.168.178.1-254
Search
Results Favorites
Status Name IP Manufacturer MAC address Comments
DESKTOP-0OK9IFL.mshome.net 192.168.137.1 LCFC(HeFei) Electronic... 50:7B:9D:F9:BD:C5
recovery.mshome.net 192.168.137.22 Raspberry Pi Foundati... B8:27:EB:7D:CE:72
raspberrypi.mshome.net 192.168.137.42 Raspberry Pi Foundati... B8:27:EB:7D:CE:72
fritz.box 192.168.178.1 AVM GmbH 9C:C7:A6:0B:84:7C
Ralphs-MB 192.168.178.43 Apple, Inc. A4:5E:60:E5:73:71
Anushs-MBP. ox 192.168.178.47 88:E9:FE:59:84:3E
iPhone.fritz.b 192.168.178.54 Apple, Inc. 58:40:4E:B9:32:D3
SonosZP.fritz 192.168.178.58 Sonos, Inc. B8:E9:37:55:A1:38
DESKTOP-0O .fritz.box 192.168.178.73 Hon Hai Precision Ind.... 30:F7:72:0C:81:DC
Copy
raspberrypi.mshome.net

https://mobaxterm.mobatek.net/download-home-edition.html

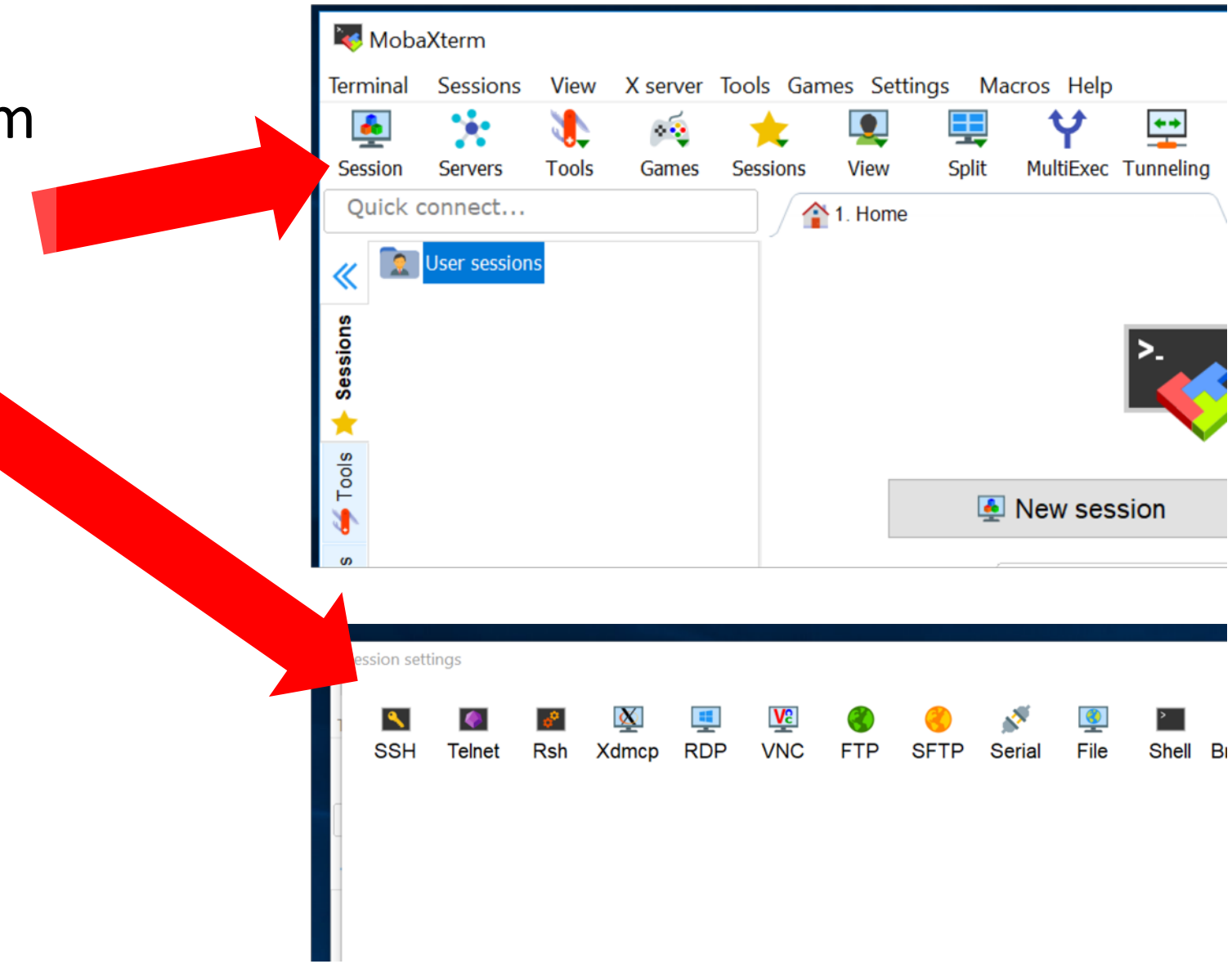


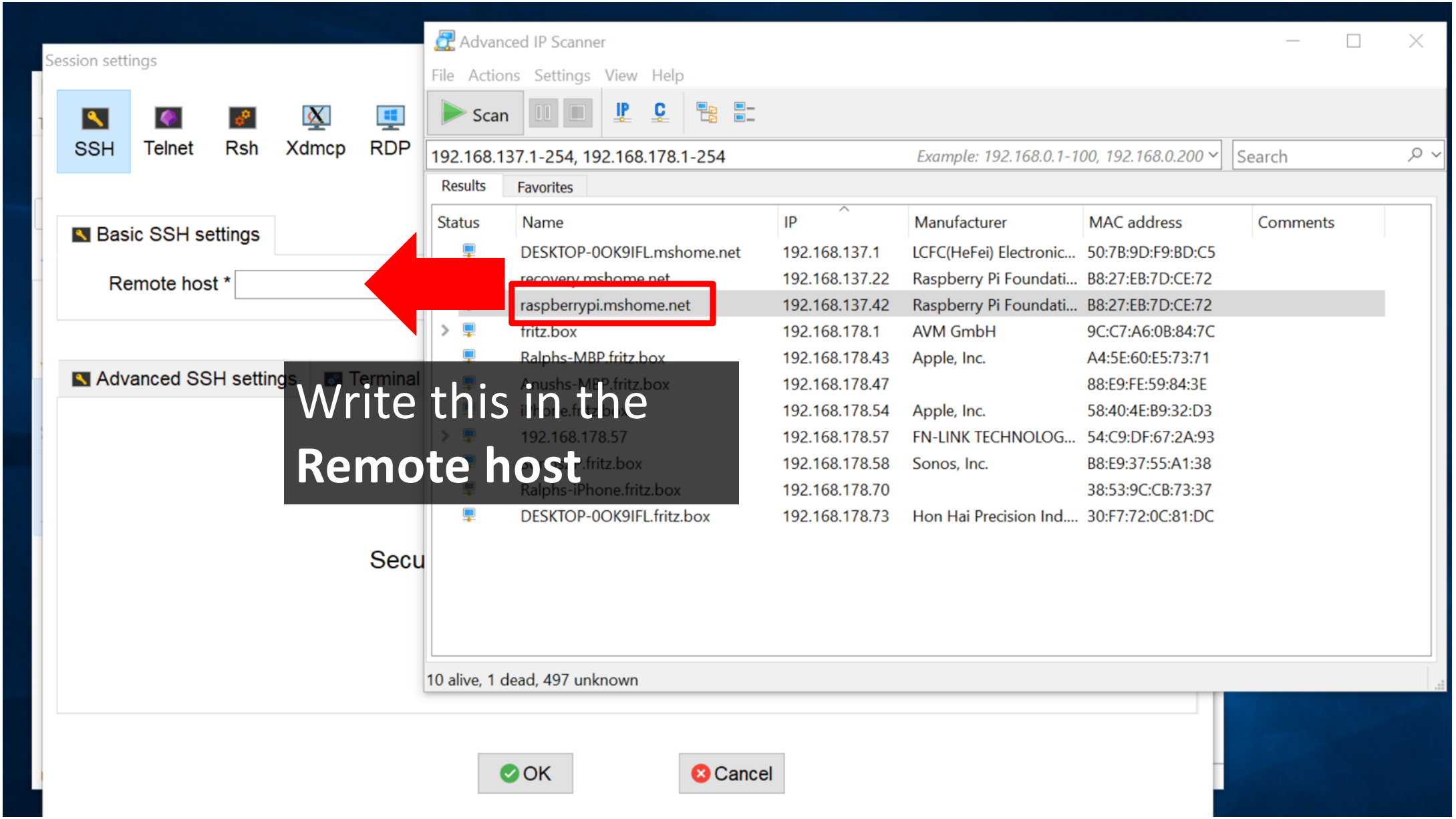

MobaXterm
Terminal Sessions View X server Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help X server Exit
connect...
1. Home
User sessions
Sessions
Tools
Macros
1.Click on Session
MobaXterm
New session
Recover previous sessions
Find existing session or server name...
Recent sessions
raspberrypi.mshome.net
raspberrypi.mshome.n...
CygUtils plugin not found on your system.
Enable advanced features and enhance security with MobaXterm Professional Edition!
UNREGISTERED VERSION - Please support MobaXterm by subscribing to the professional edition here: https://mobaxterm.mobatek.net

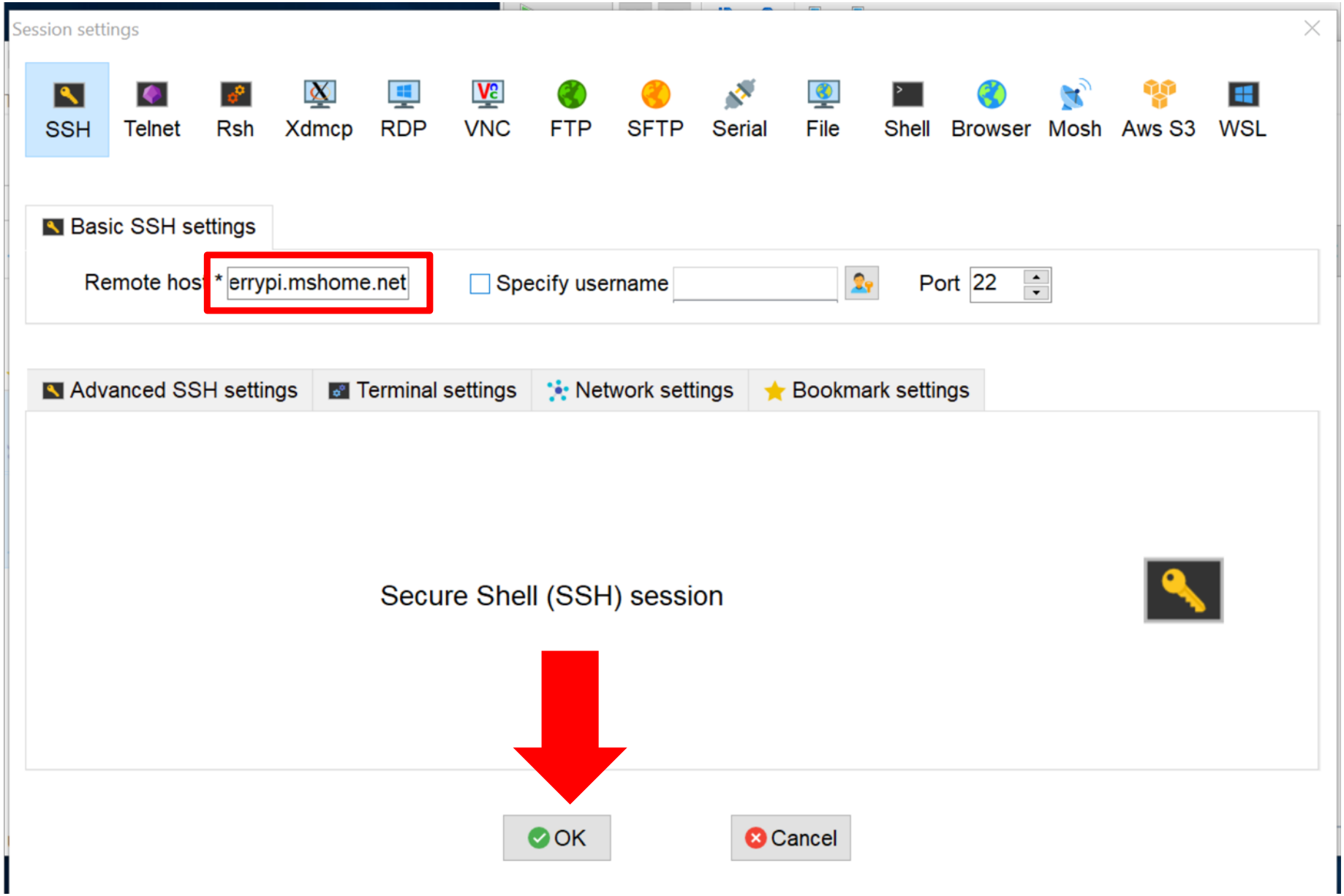
1.Open MobaXterm

2.Click on Session

3.Click on SSH

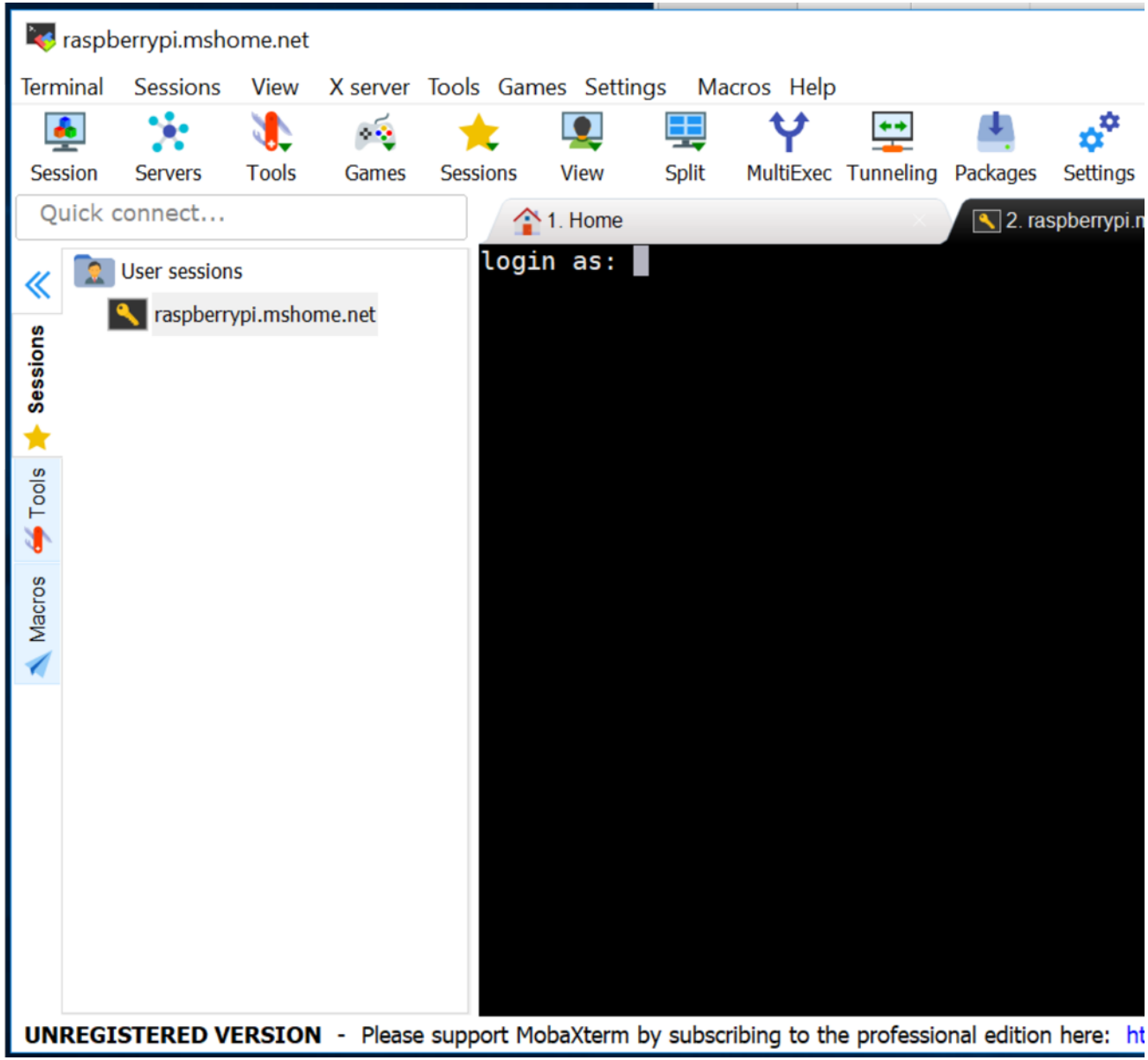


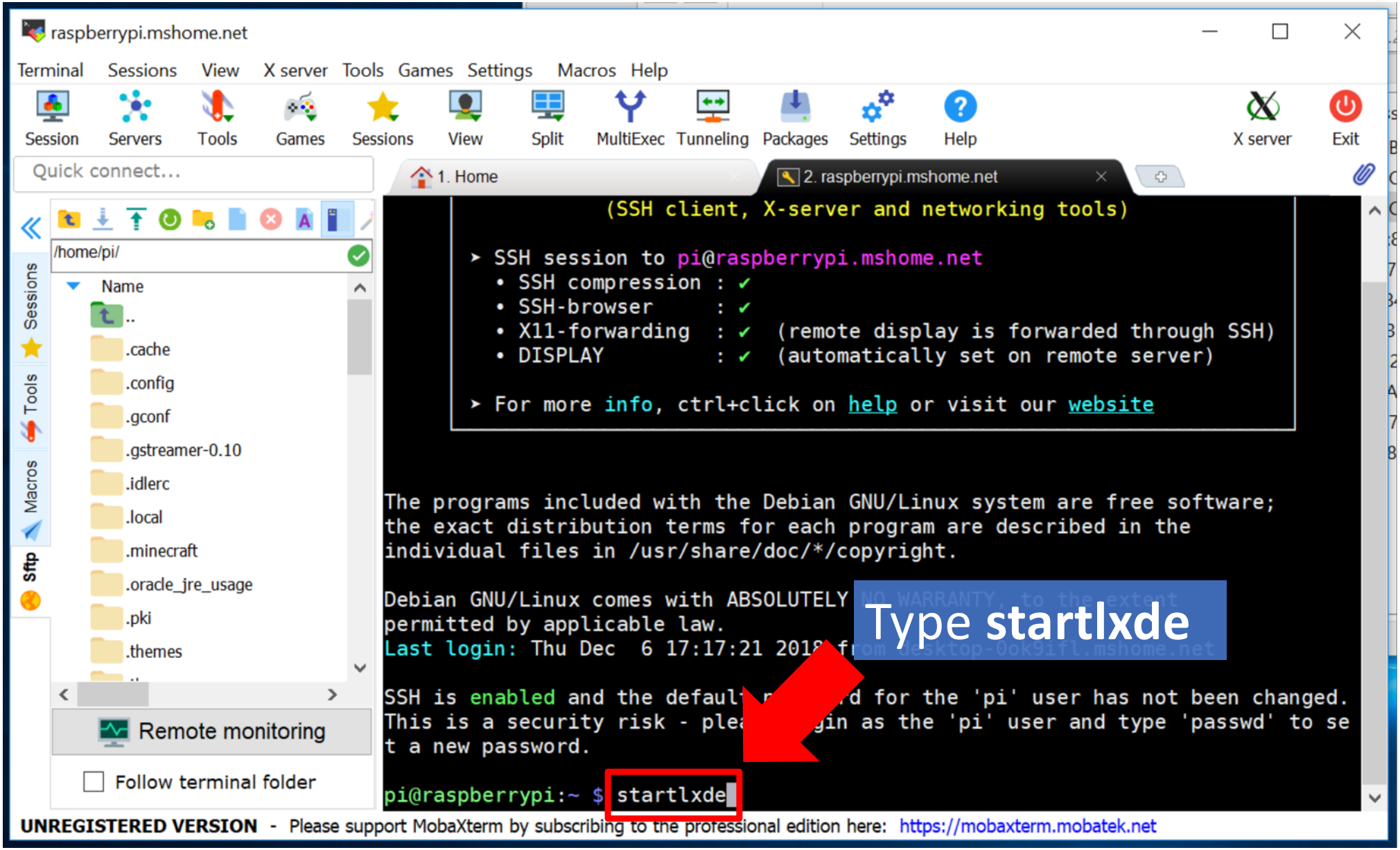

Session settings
SSH
Telnet
Rsh
Xdmcp
RDP
Basic SSH settings
Remote host *
Advanced SSH settings
Terminal
Secu
OK
Cancel
Advanced IP Scanner
File Actions Settings View Help
Scan
192.168.137.1-254, 192.168.178.1-254
Example: 192.168.0.1-100, 192.168.0.200
Search
Results
Favorites
Status
Name
IP
Manufacturer
MAC address
Comments
DESKTOP-0OK9IFL.mshome.net 192.168.137.1 LCFC(HeFei) Electronic... 50:7B:9D:F9:BD:C5
192.168.137.22 Raspberry Pi Foundati... B8:27:EB:7D:CE:72
raspberrypi.mshome.net 192.168.137.42 Raspberry Pi Foundati... B8:27:EB:7D:CE:72
fritz.box 192.168.178.1 AVM GmbH 9C:C7:A6:0B:84:7C
192.168.178.43 Apple, Inc. A4:5E:60:E5:73:71
192.168.178.47 88:E9:FE:59:84:3E
192.168.178.54 Apple, Inc. 58:40:4E:B9:32:D3
192.168.178.57 192.168.178.57 FN-LINK TECHNOLOG... 54:C9:DF:67:2A:93
192.168.178.58 Sonos, Inc. B8:E9:37:55:A1:38
192.168.178.70 38:53:9C:CB:73:37
DESKTOP-0OK9IFL.fritz.box 192.168.178.73 Hon Hai Precision Ind.... 30:F7:72:0C:81:DC
10 alive, 1 dead, 497 unknown
Write this in the
Remote host


Session settings
SSH
Telnet
Rsh
Xdmcp
RDP
VNC
FTP
SFTP
Serial
File
Shell
Browser
Mosh
Aws S3
WSL
Basic SSH settings
Remote hos
* errypi.mshome.net
Specify username
Port
22
Advanced SSH settings
Terminal settings
Network settings
Bookmark settings
Secure Shell (SSH) session
OK
Cancel

1. Login: **pi**

2. Password: **raspberry**




raspberrypi.mshome.net
Terminal Sessions View X server Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help X server Exit
Quick connect...
1. Home
2. raspberrypi.mshome.net
(SSH client, X-server and networking tools)
➤ SSH session to pi@raspberrypi.mshome.net
• SSH compression : ✔
• SSH-browser : ✔
• X11-forwarding : ✔ (remote display is forwarded through SSH)
• DISPLAY : ✔ (automatically set on remote server)
➤ For more info, ctrl+click on help or visit our website
/home/pi/
Name
..
.cache
.config
.gconf
.gstreamer-0.10
.idlerc
.local
.minecraft
.oracle_jre_usage
.pki
.themes
Sessions
Tools
Macros
Sftp
Remote monitoring
Follow terminal folder
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: Thu Dec 6 17:17:21 2018 from desktop-0ok9ifl.mshome.net
SSH is enabled and the default password for the 'pi' user has not been changed.
This is a security risk - please login as the 'pi' user and type 'passwd' to set a new password.
pi@raspberrypi:~ $ startlxde
Type startlxde
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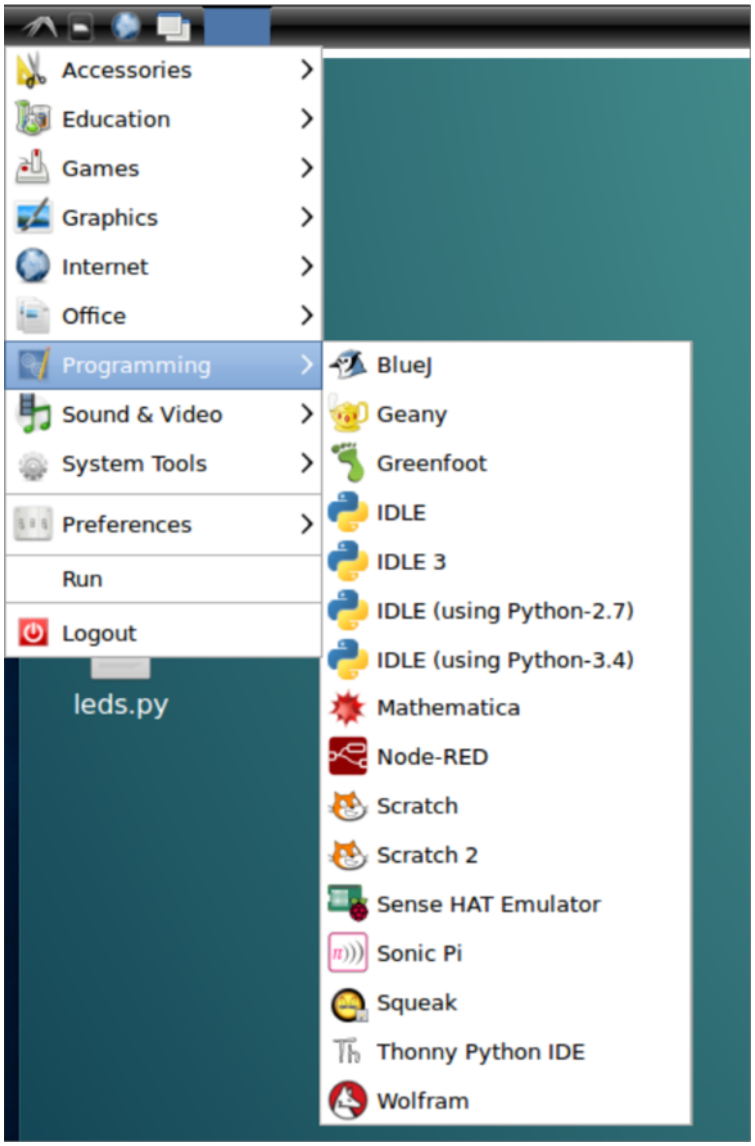
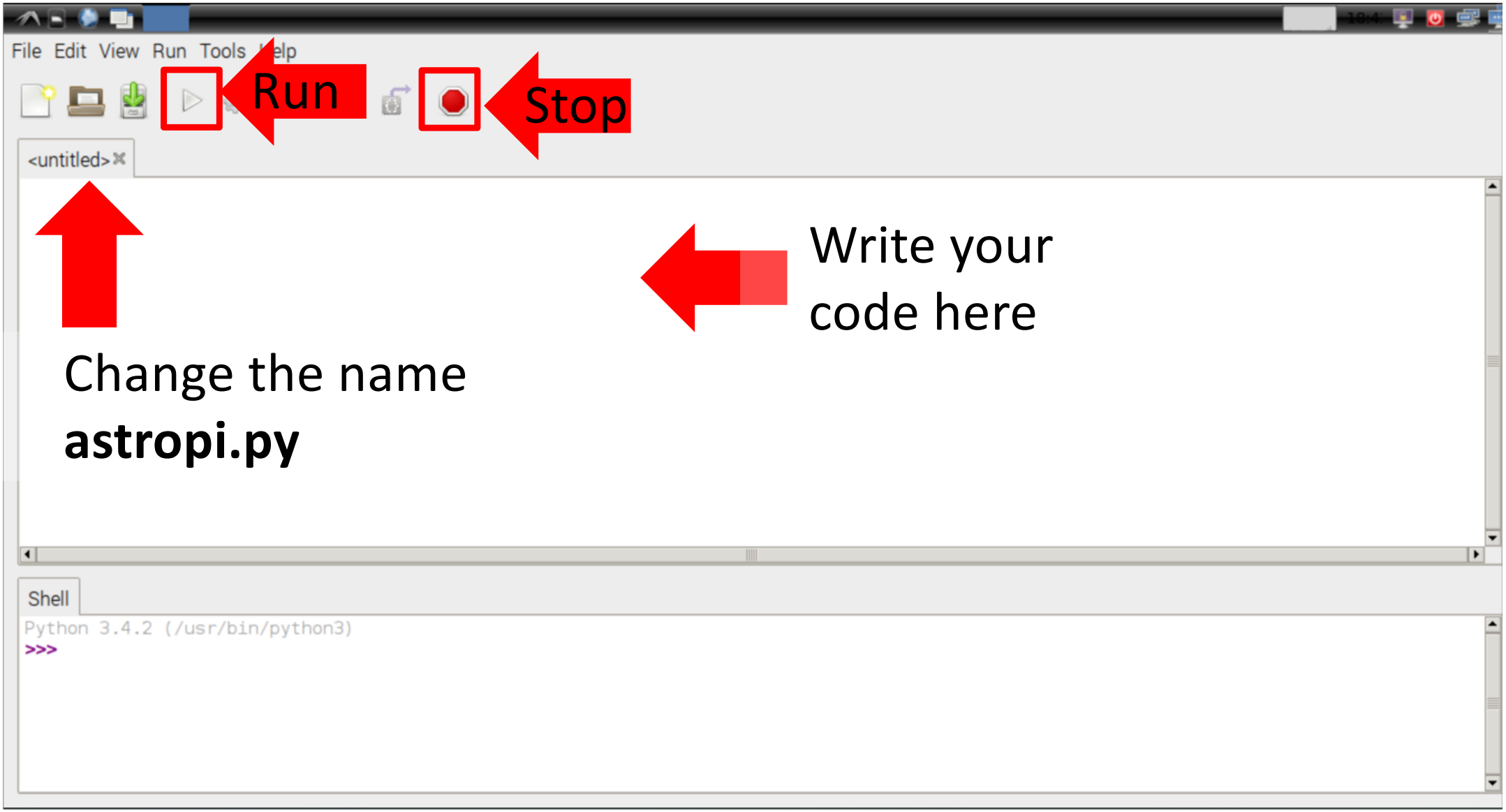


Inside **AstroPi**

1. Go **Start**

2. Thonny Python IDE


File Edit View Run Tools Help
Run
Stop
<untitled>
Change the name
astropi.py
Write your
code here
Shell
Python 3.4.2 (/usr/bin/python3)
>>>

3 CHALLENGES

WEATHER CHALLENGE

REAL ASTROPI

Forever display the
Temperature and humidity.

CREATIVE CHALLENGE

REAL ASTROPI

Use Joystick to play with the pixels.

REAL ASTROPI

BORED ASTRONAUT CHALLENGE

Animate a Pong Game.

Challenge 3/3

AstroPi

– Workshop

digital luxembourg

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