

IoT with MIT App Inventor

Fundamental

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What is IoT?

Bring computing off the screen and into the world of everyday things!

The Internet of Things (IoT) refers to interfaces between everyday objects and the Internet, opening up a universe of new applications, smarter devices, and wider opportunities. With MIT App Inventor IoT, you can enter this universe as a creator, not just a consumer, even if you've never programmed before.

What you can do?

You can develop IoT applications the same way you develop any other MIT App Inventor mobile apps. Now you can program devices, sensors, appliances, instruments, robots— anything that can be connected. Not only that, you can incorporate smartphone capabilities into your IoT creations.

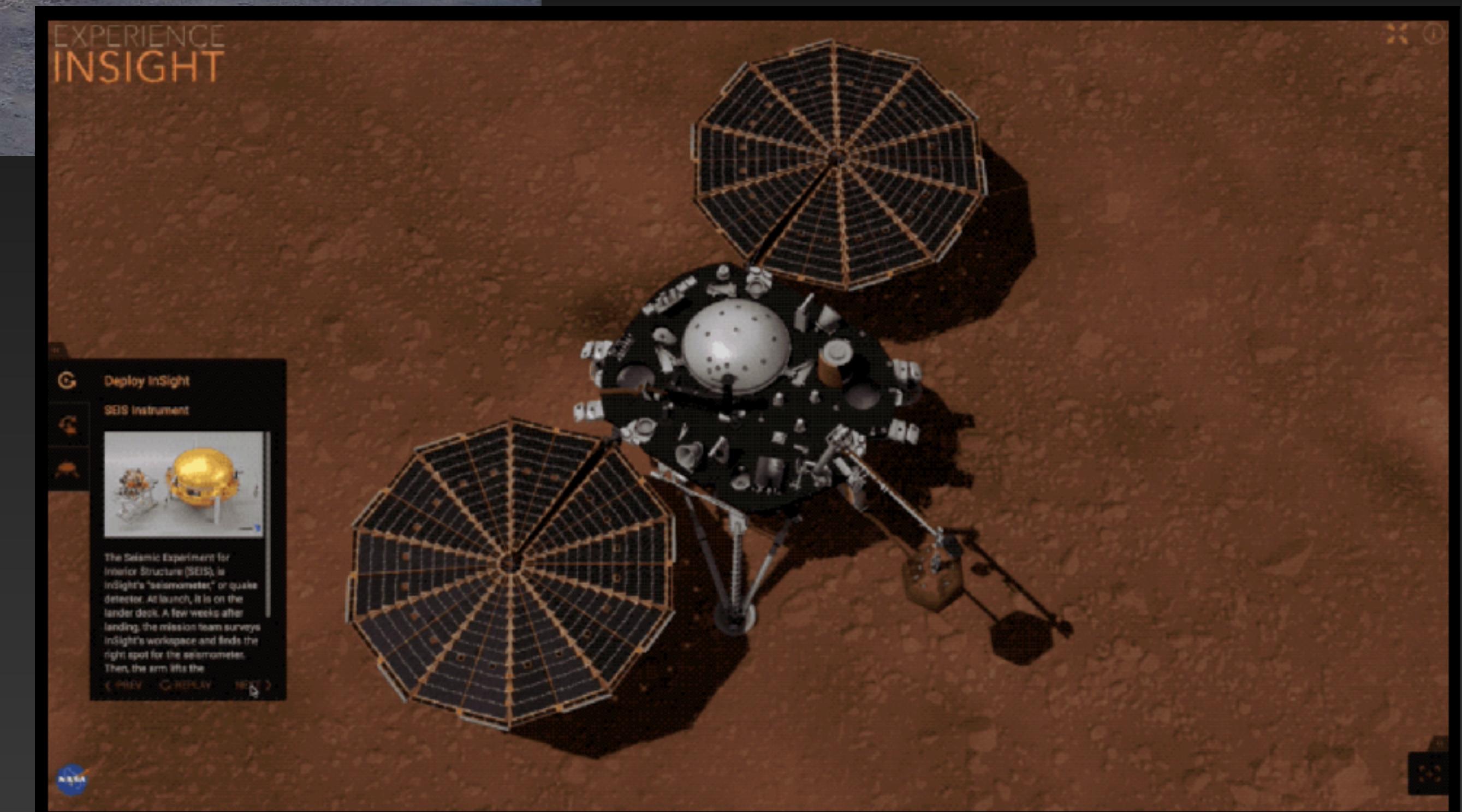
If you build an app that turns a light on and off, you can make the light respond to voice commands.

If you build a heart monitor, you can store the results on the Web or email them to trainers.

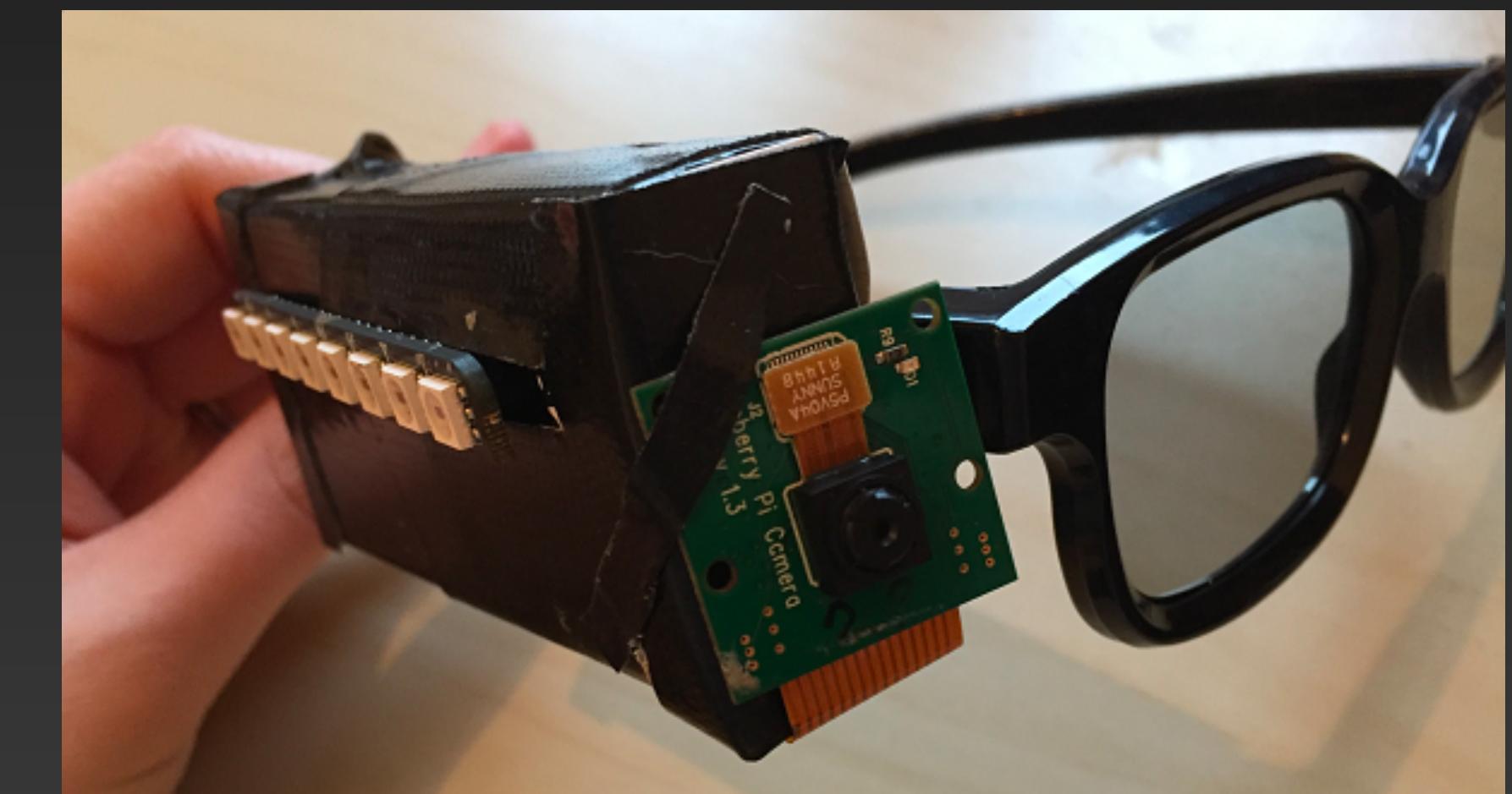
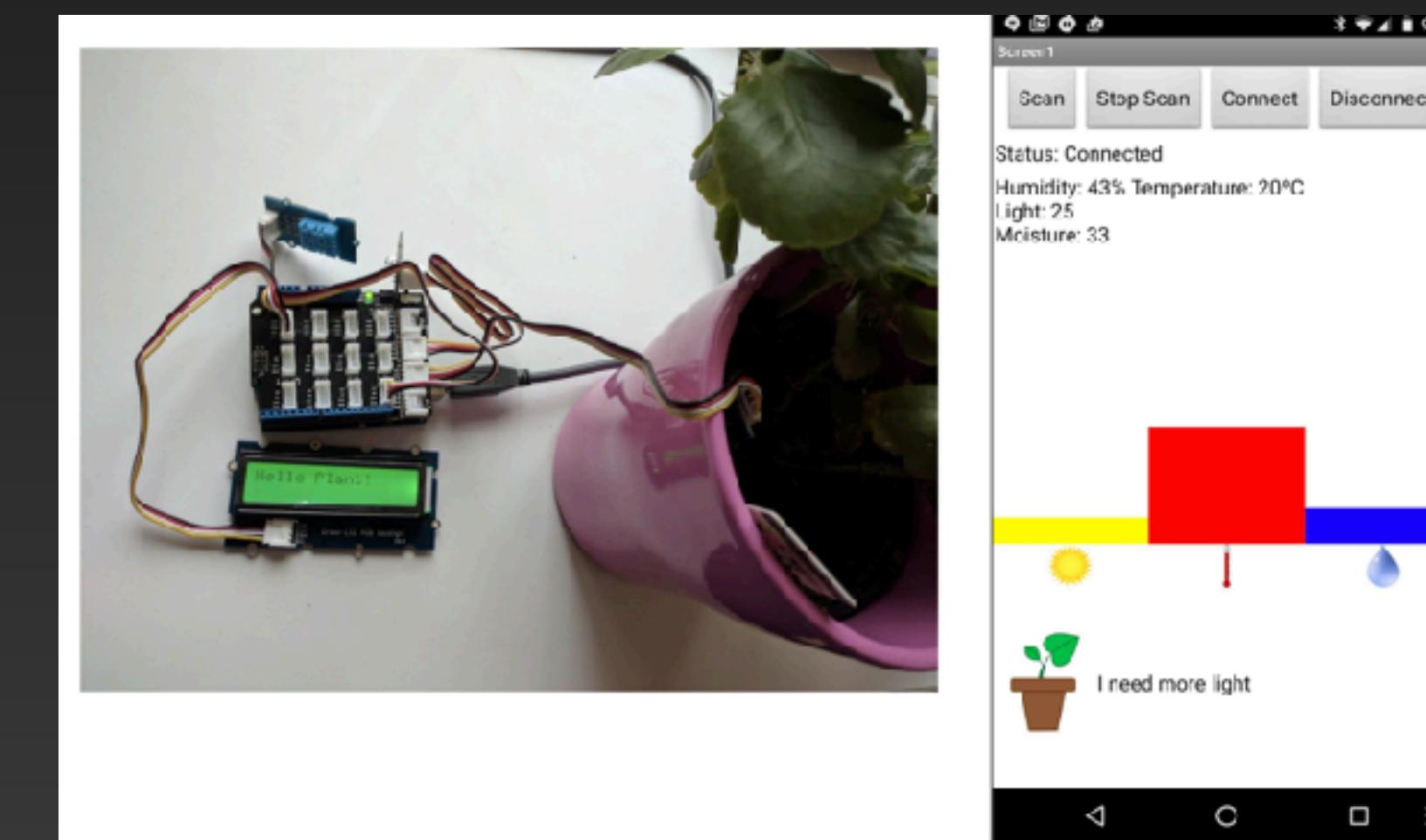
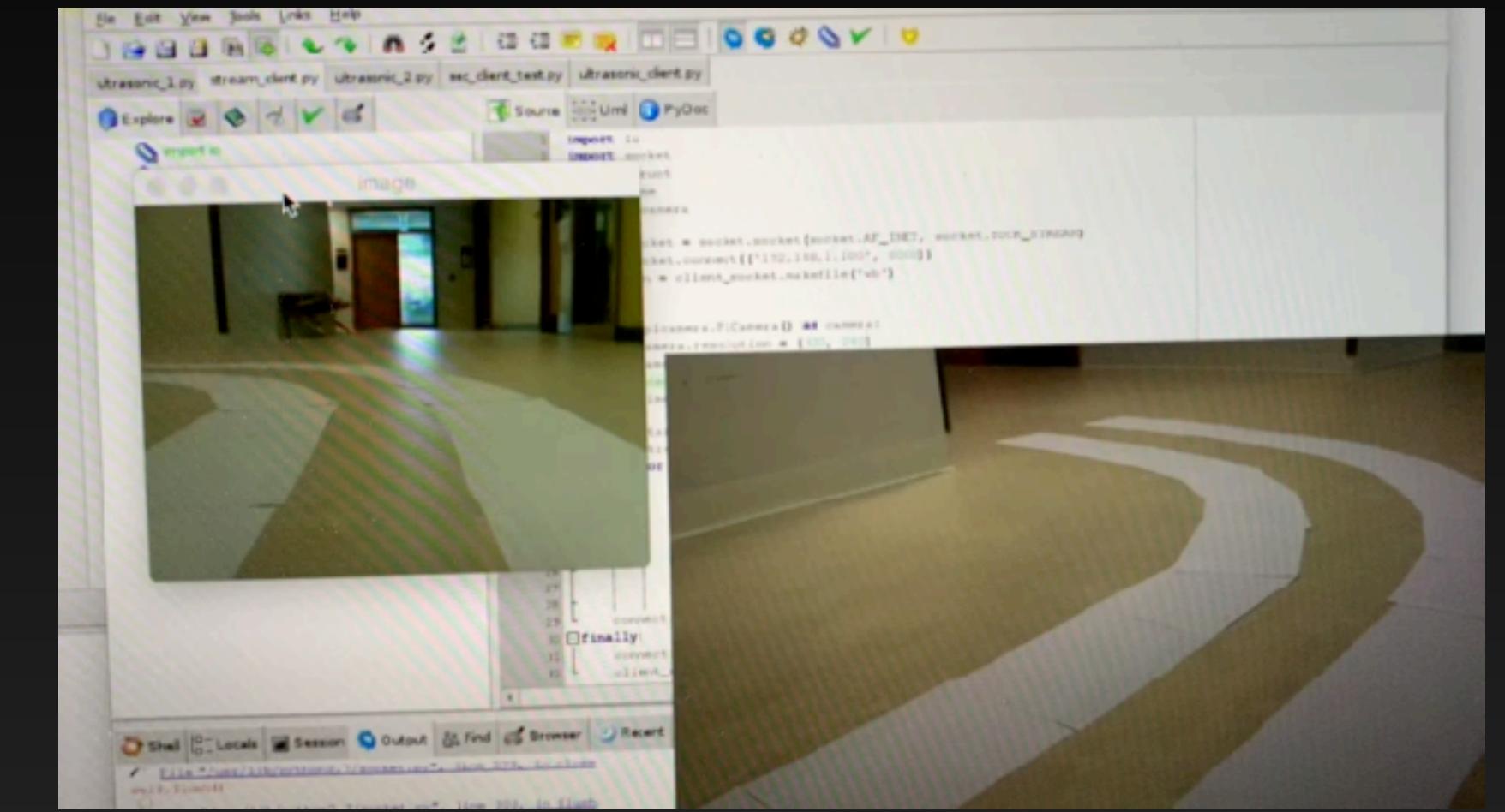
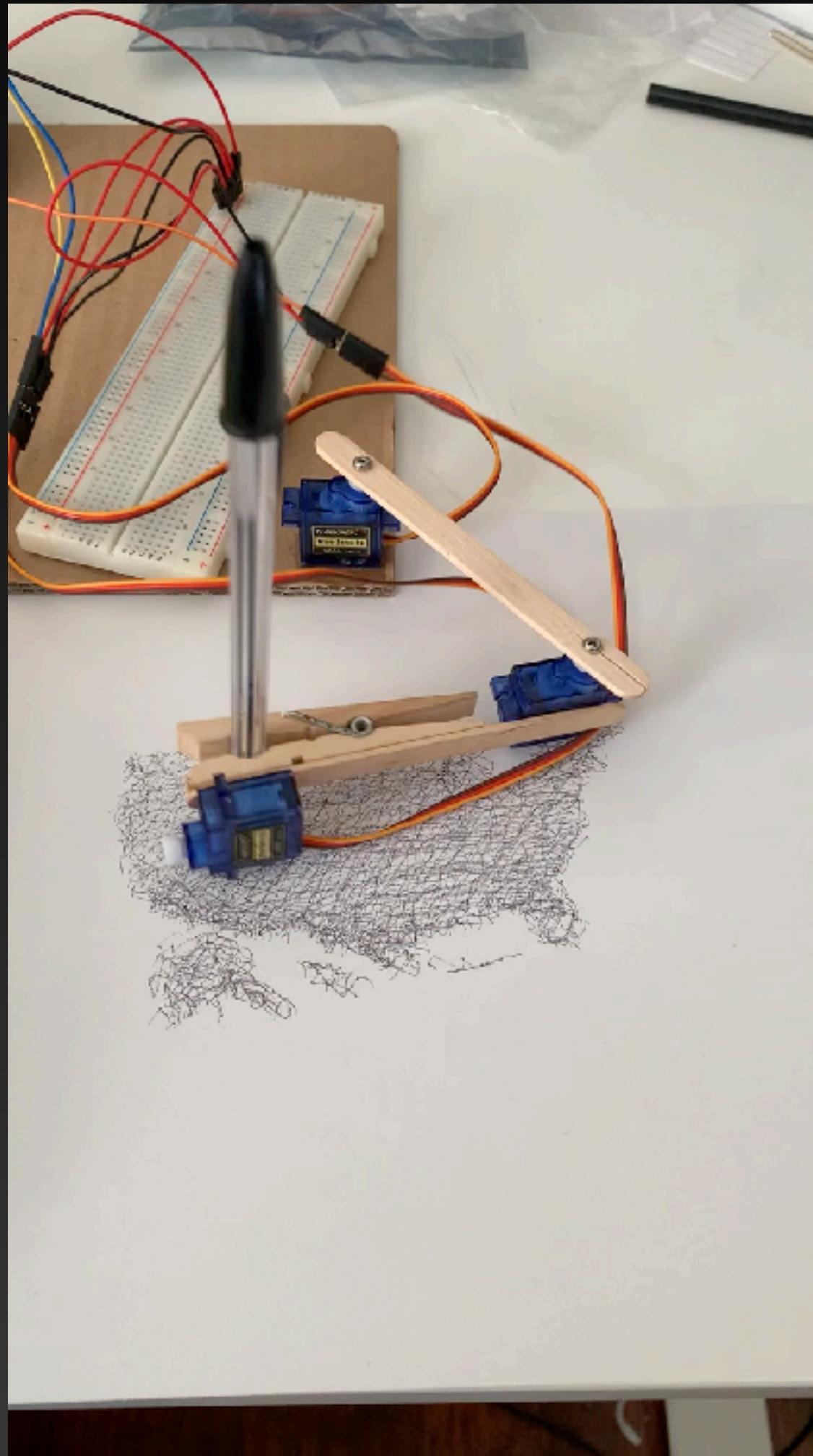
If you program a mobile robot, you can add geolocation to the robot's sensing abilities.

And many more...

Model 3



Advanced Projects!



Raspberry Pi

Which Raspberry Pi?

There are several models of Raspberry Pi, and for most people Raspberry Pi 4 Model B is the one to choose. Raspberry Pi 4 Model B is the newest, fastest, and easiest to use.

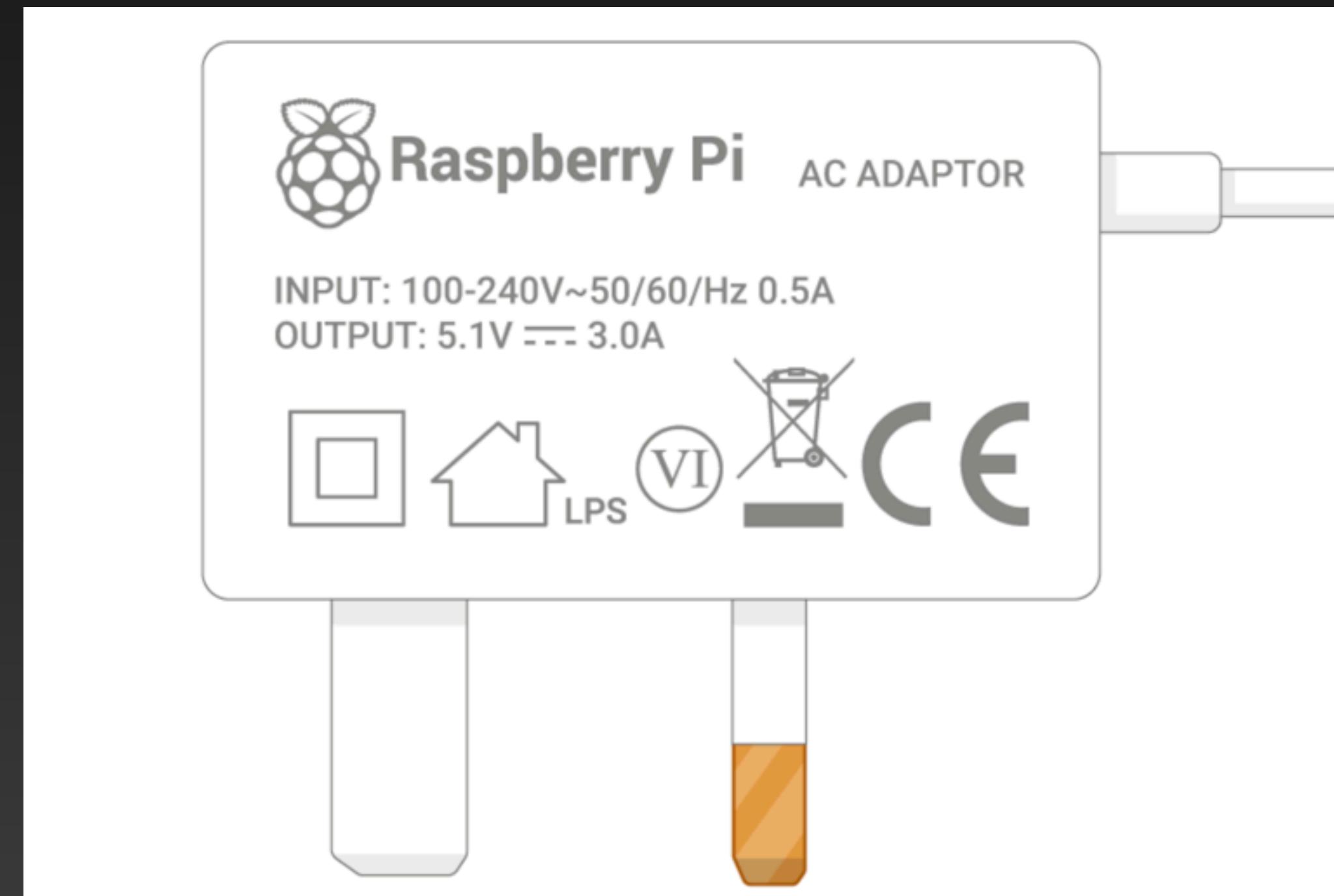
Raspberry Pi 4 comes with 2GB, 4GB, or 8GB of RAM. For most educational purposes and hobbyist projects, and for use as a desktop computer, 2GB is enough.

Raspberry Pi

What you need to get started with Raspberry Pi?

A power supply

To connect to a power socket, all Raspberry Pi models have a USB port (the same found on many mobile phones): either USB-C for Raspberry Pi 4, or micro USB for Raspberry Pi 3, 2, and 1.



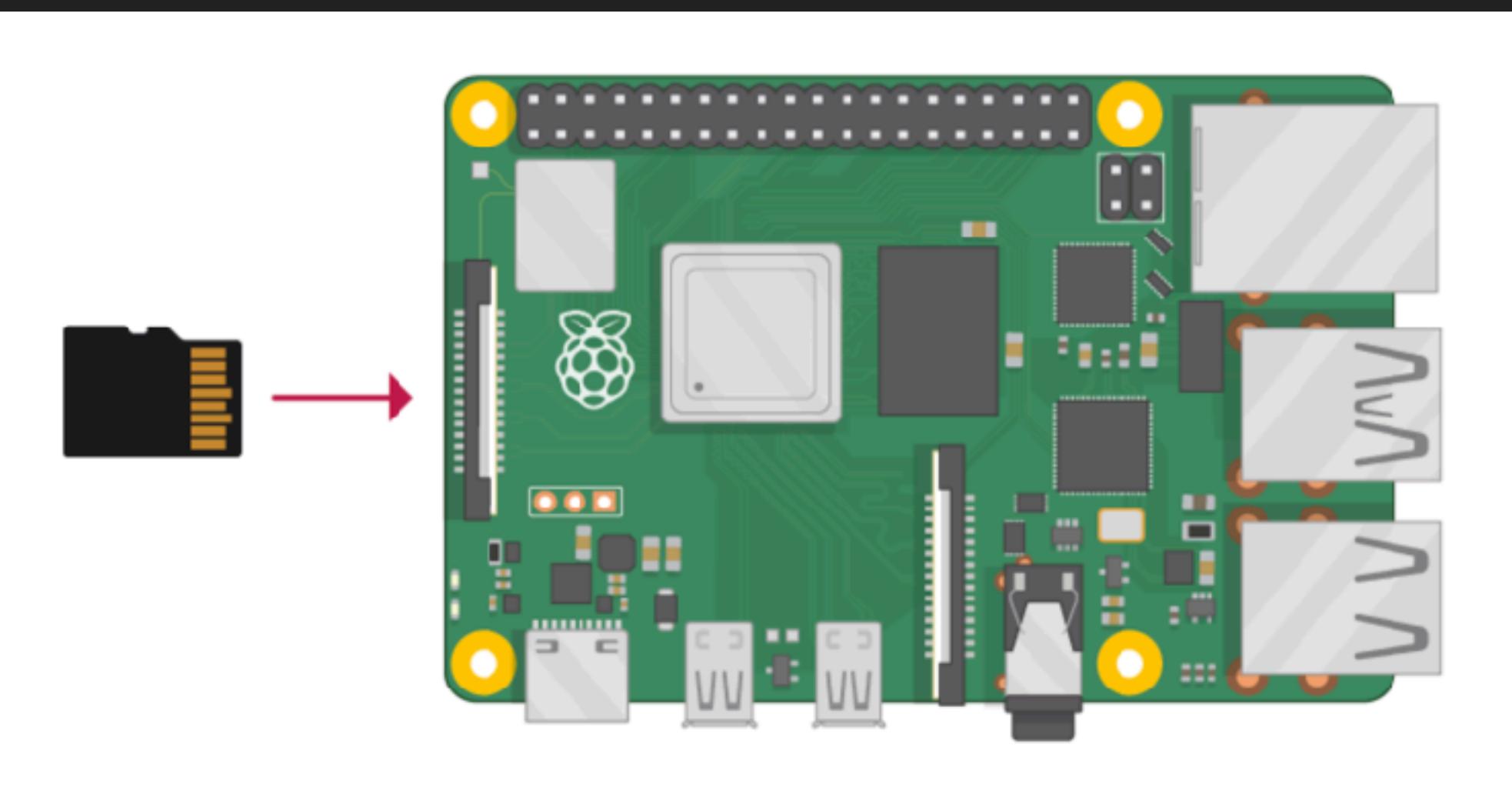
Raspberry Pi

What you need to get started with Raspberry Pi?

A microSD card

Your Raspberry Pi needs an SD card to store all its files and the Raspberry Pi OS operating system. You need a microSD card with a capacity of at least 8GB.

microSD card with OS



Raspberry Pi

What you need to get started with Raspberry Pi?

A keyboard and a mouse

To start using your Raspberry Pi, you need a USB keyboard and a USB mouse.

Once you've set up your Raspberry Pi, you can use a Bluetooth keyboard and mouse, but you'll need a USB keyboard and mouse for the first setup.



Raspberry Pi

What you need to get started with Raspberry Pi?

A TV or computer screen

To view the Raspberry Pi OS desktop environment, you need a screen, and a cable to link the screen and your Raspberry Pi. The screen can be a TV or a computer monitor. If the screen has built-in speakers, Raspberry Pi is able to use these to play sound.



Raspberry Pi

What you need to get started with Raspberry Pi?

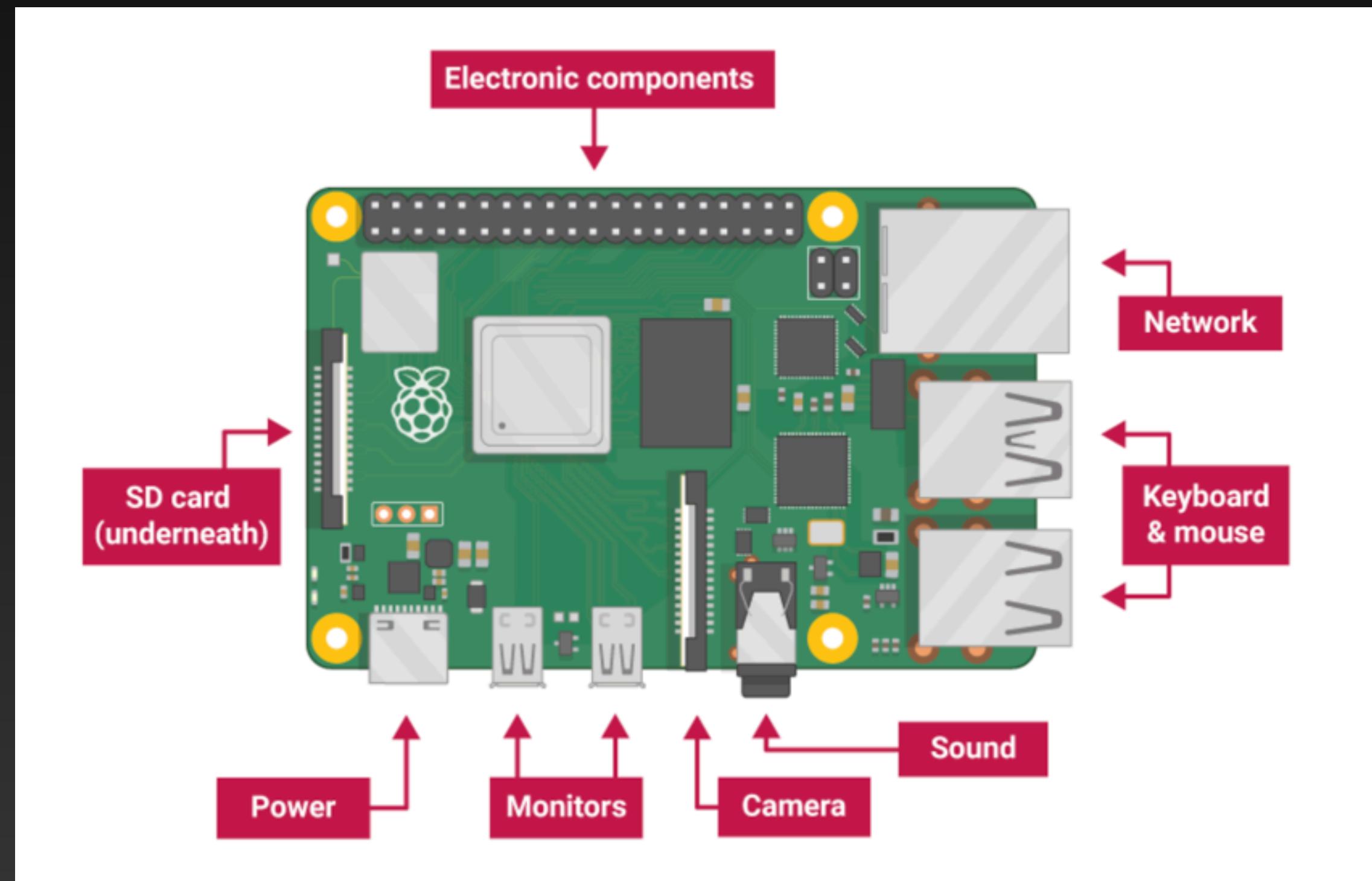
HDMI

Your Raspberry Pi has an HDMI output port that is compatible with the HDMI port of most modern TVs and computer monitors. Raspberry Pi 4 has two micro HDMI ports, allowing you to connect two separate monitors.



Connect your Raspberry Pi

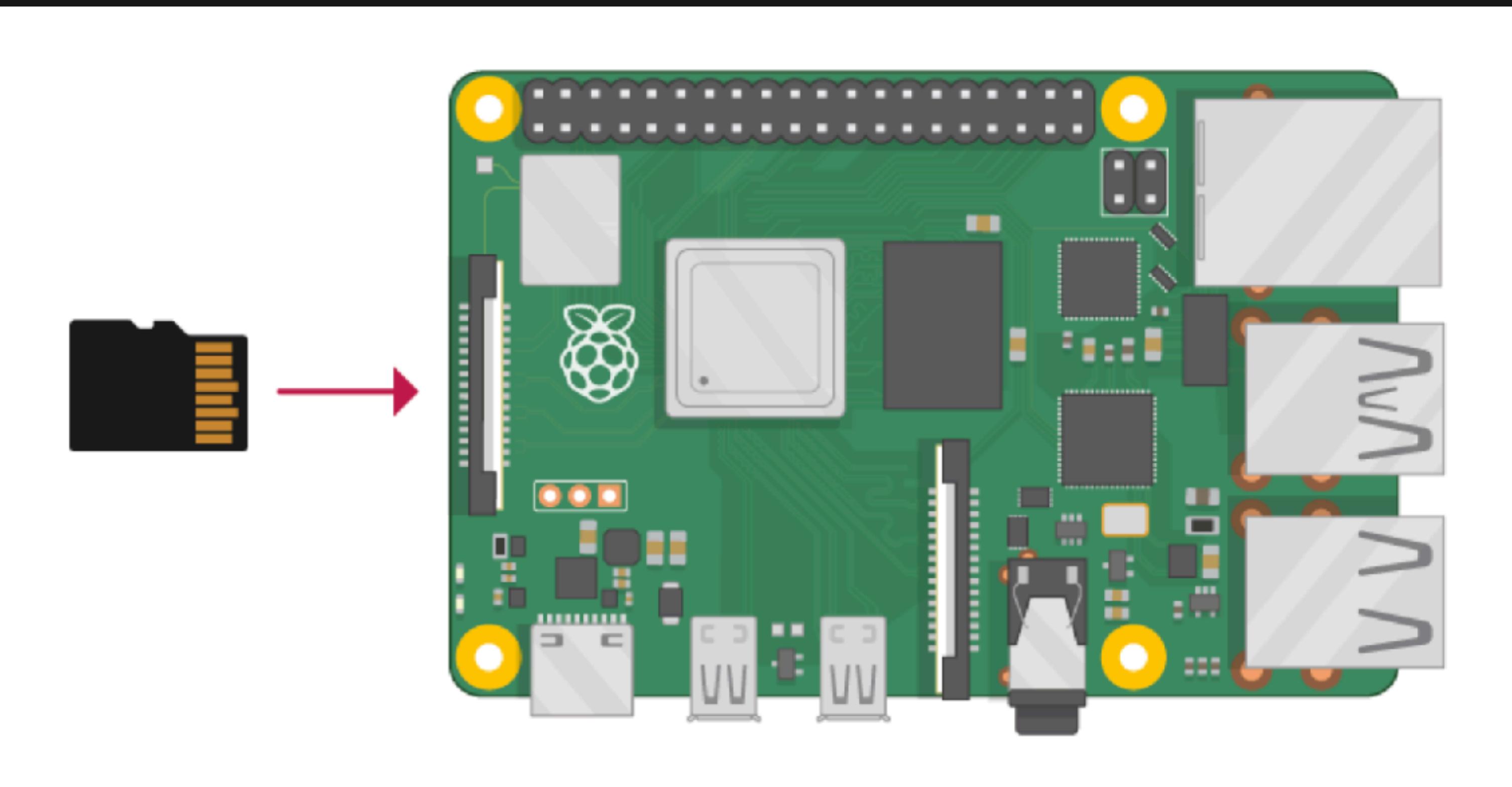
It's important to do this in the right order, so that all your components are safe.



Connect your Raspberry Pi

Insert the SD card you've set up with Raspberry Pi OS into the microSD card slot on the underside of your Raspberry Pi.

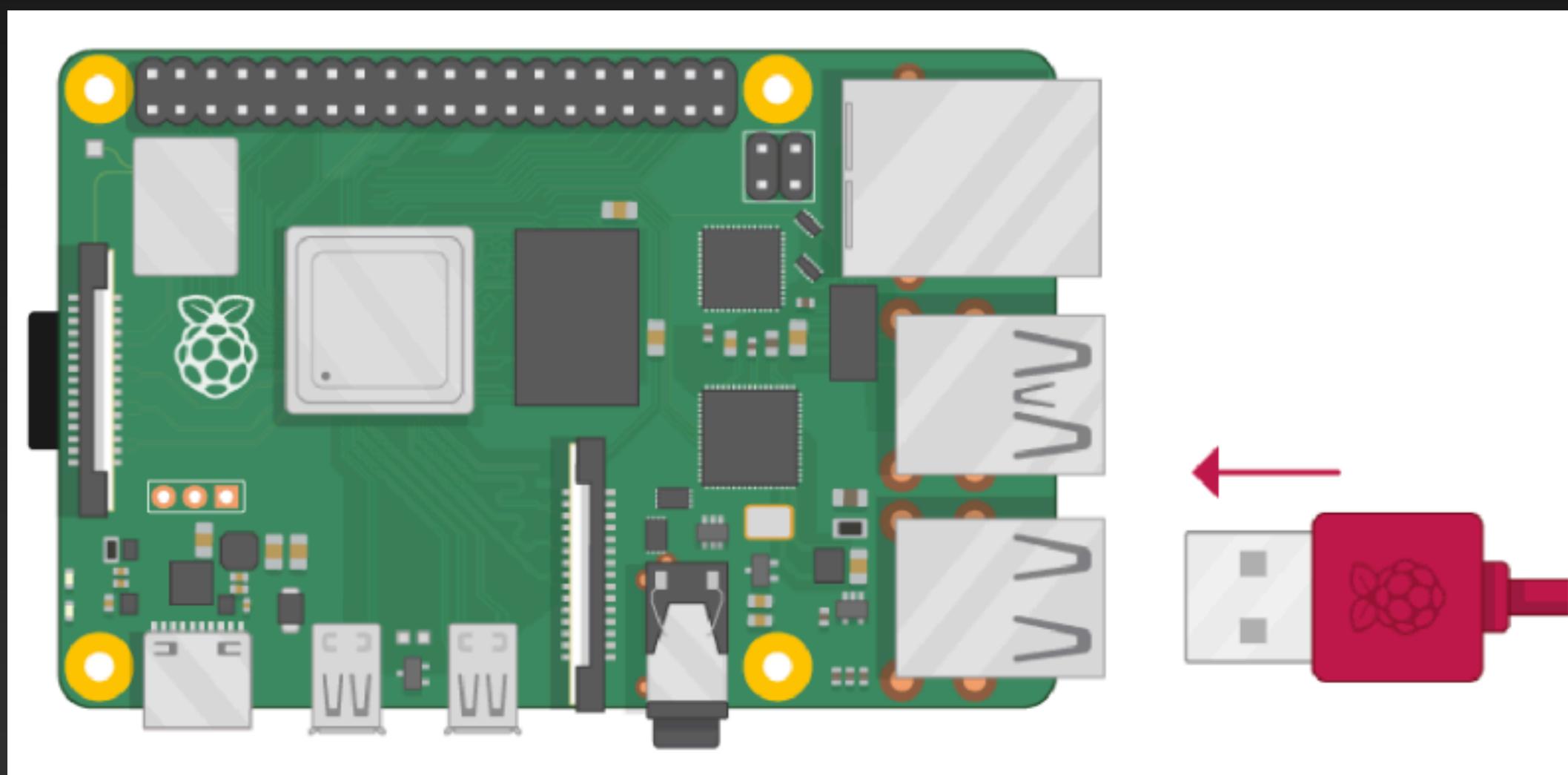
Insert microSD card with OS



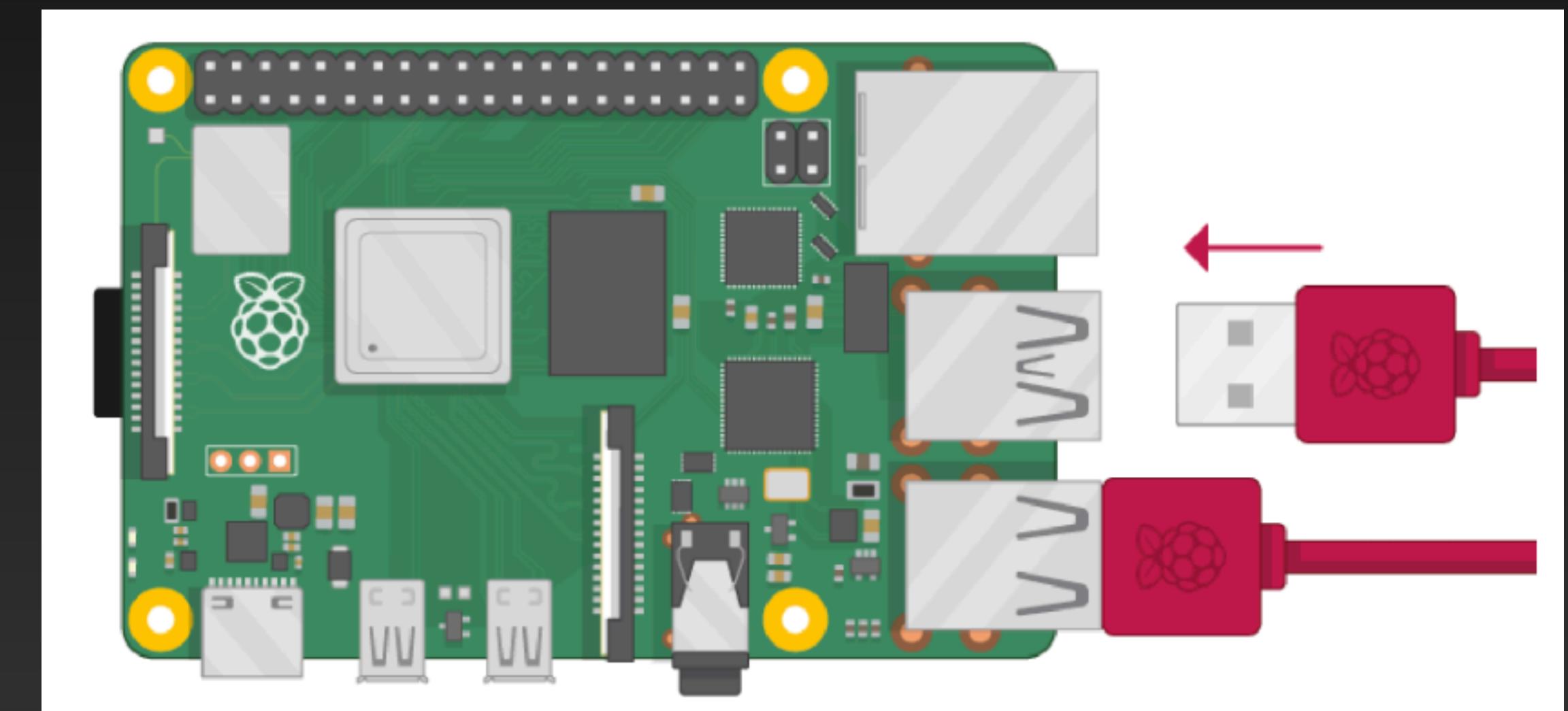
Connect your Raspberry Pi

Find the USB connector end of your mouse's cable, and connect the mouse to a USB port on Raspberry Pi (it doesn't matter which port you use). Do the same for keyboard USB connector.

Connect mouse cable



Connect keyboard



Connect your Raspberry Pi

Make sure your screen is plugged into a wall socket and switched on.

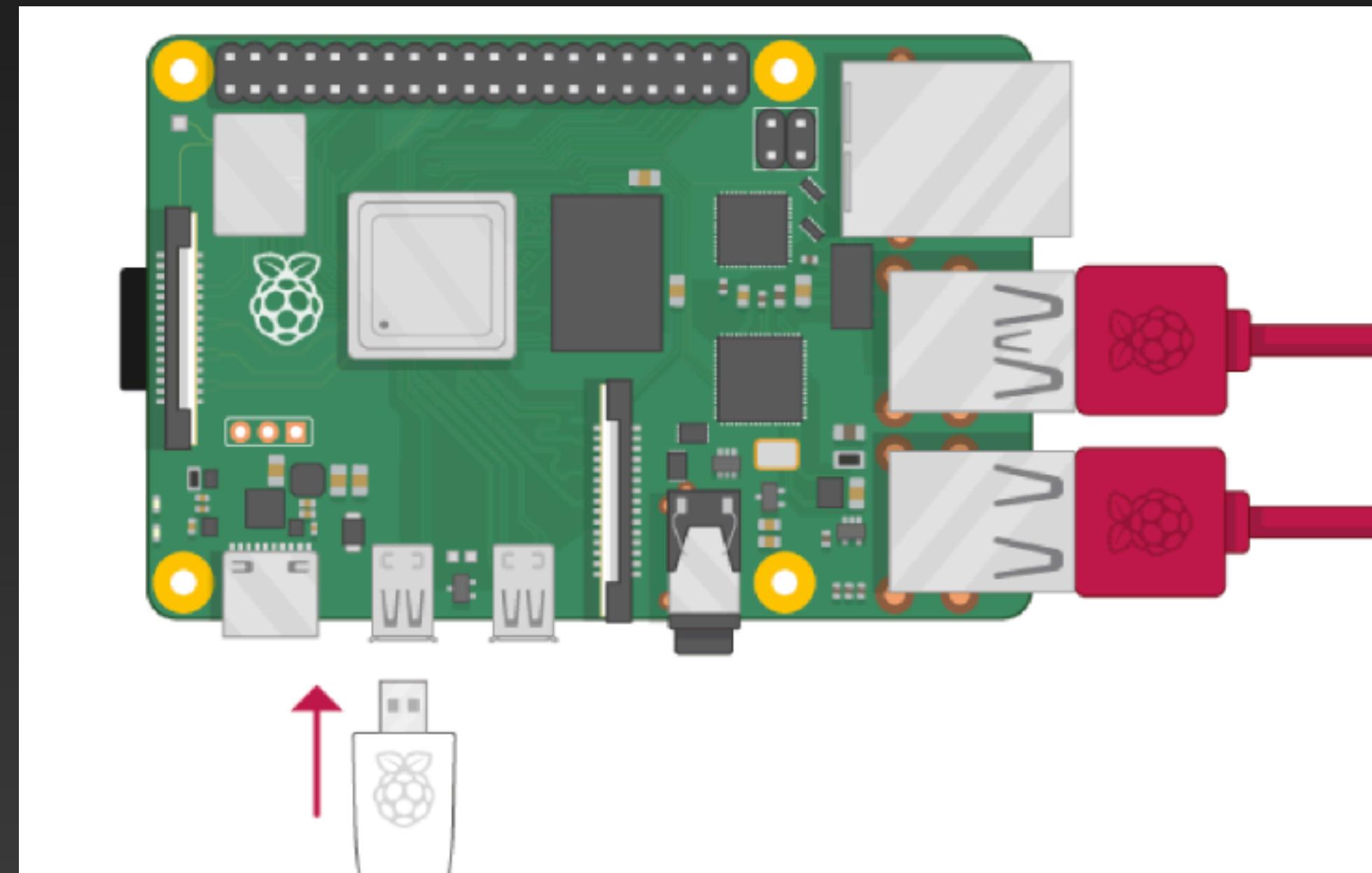
Look at the HDMI port(s) on your Raspberry Pi — notice that they have a flat side on top.

Use a cable to connect the screen to Raspberry Pi's HDMI port — use an adapter if necessary.

Connect your screen to the first of Raspberry Pi 4's HDMI ports, labelled HDMI0.

Note: Make sure you have used HDMI0 (nearest the power in port) rather than HDMI1.

Connect HDMI

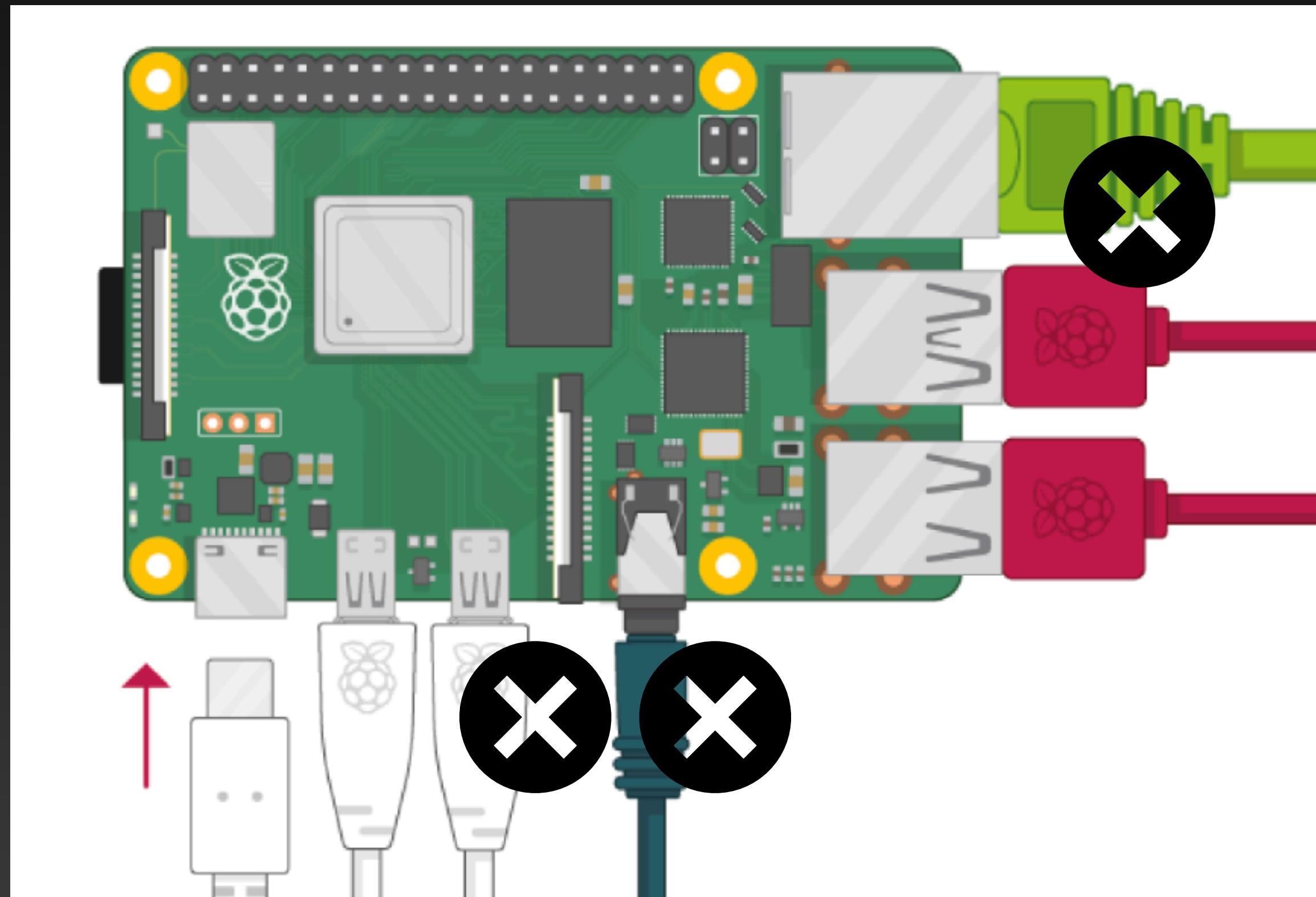


Connect your Raspberry Pi

Your Raspberry Pi has a power switch. As soon as you connect it to a power outlet and press switch to on, it will turn on.

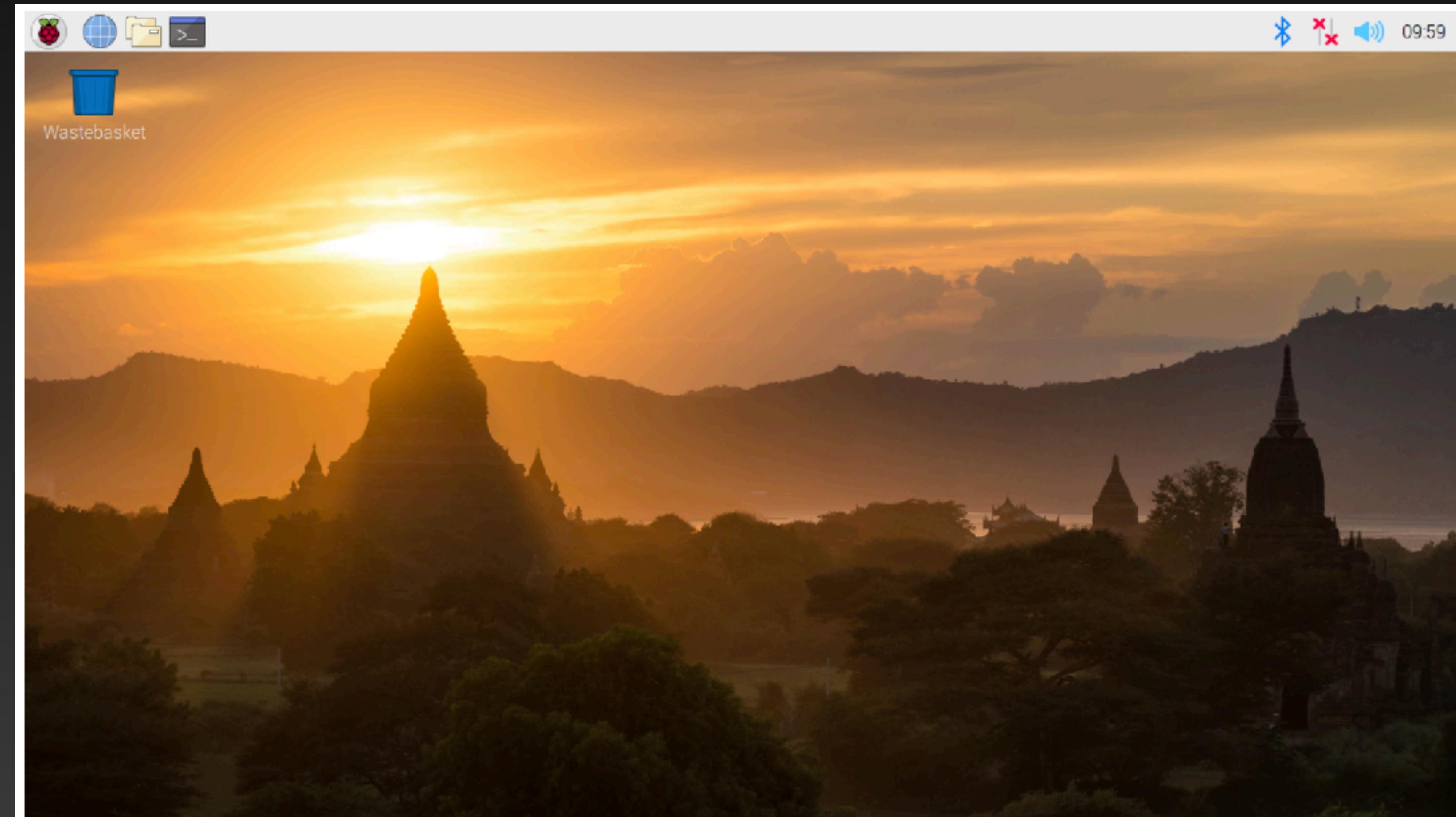
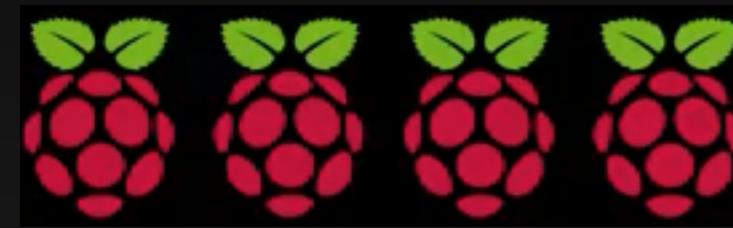
Plug the power supply into a socket and connect it to your Raspberry Pi's power port.

Connect Power



Initial setup

You should see a red LED light up on the Raspberry Pi, which indicates that Raspberry Pi is connected to power. As it starts up (this is also called booting), you will see raspberries appear in the top left-hand corner of your screen.



After a few seconds
the Raspberry Pi OS
desktop will appear.

Initial setup

When you start your Raspberry Pi for the first time, the Welcome to Raspberry Pi application will pop up and guide you through the initial setup.



Initial setup

Click on Next to start the setup.

Set your Country, Language, and Timezone, then click on Next again.



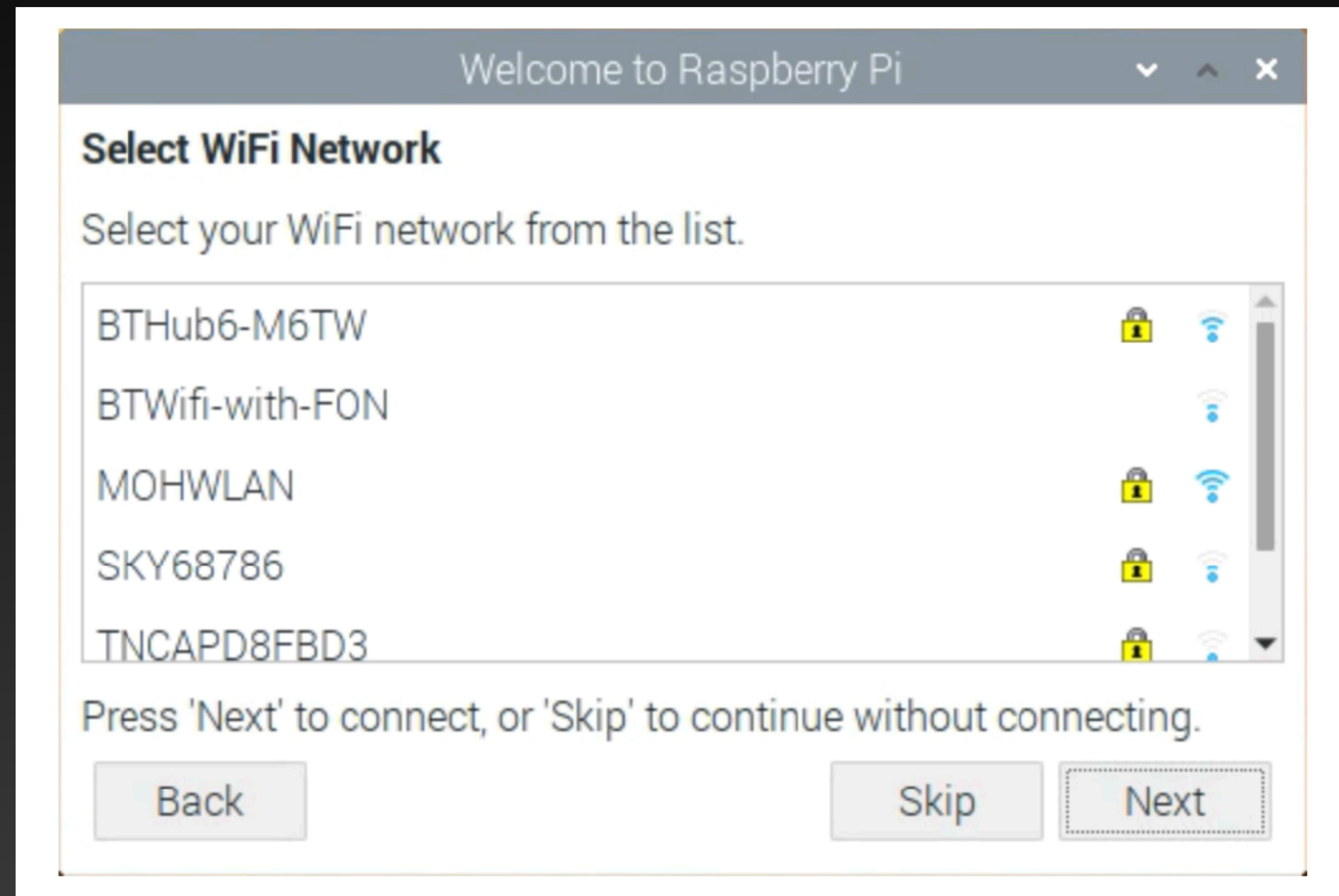
Initial setup

Enter a new password for your Raspberry Pi and click on Next.



Initial setup

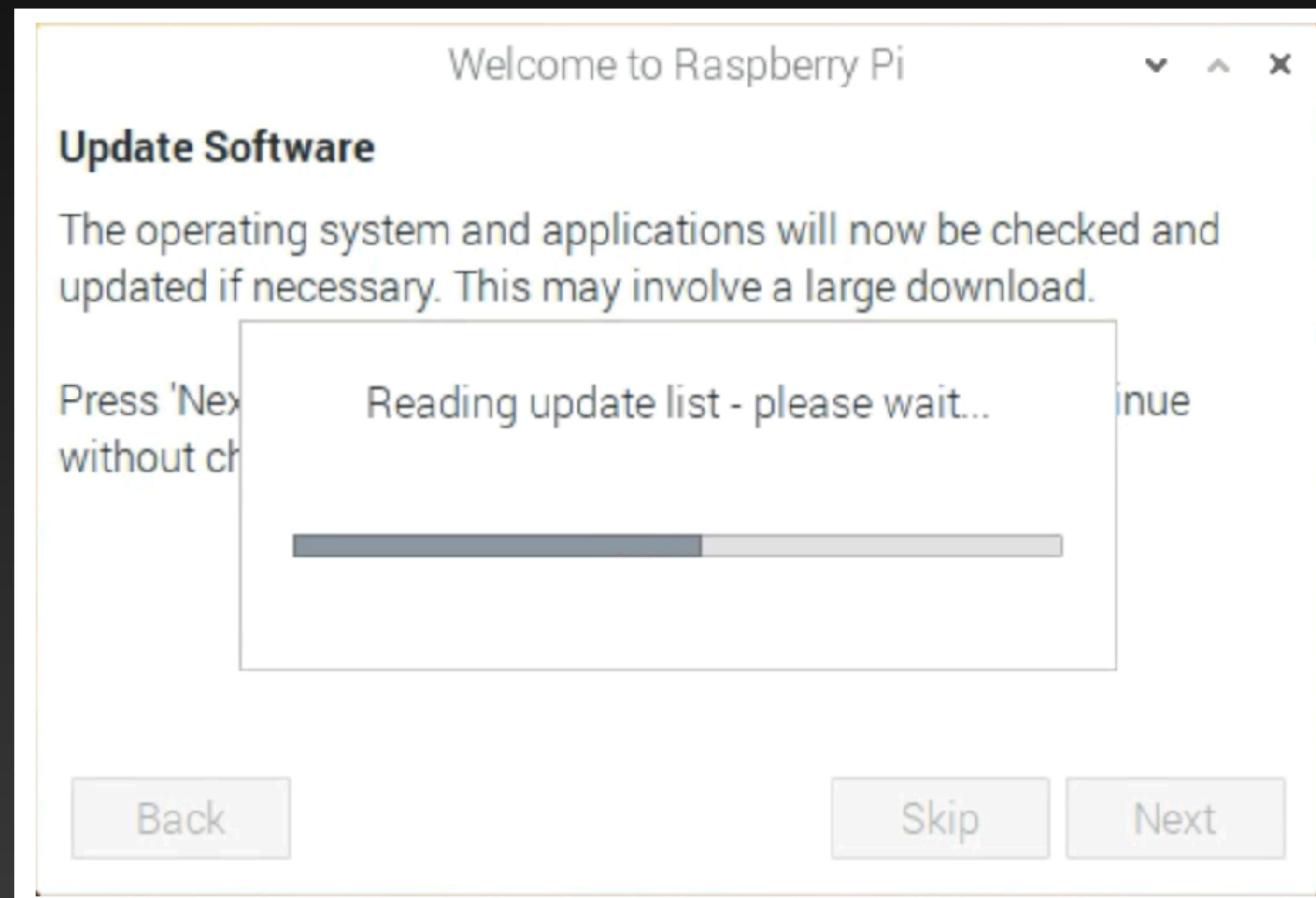
Connect to your wireless network by selecting its name, entering the password, and clicking on Next.



Initial setup

Note: Wait until the wireless connection icon appears and the correct time is shown before trying to update the software.

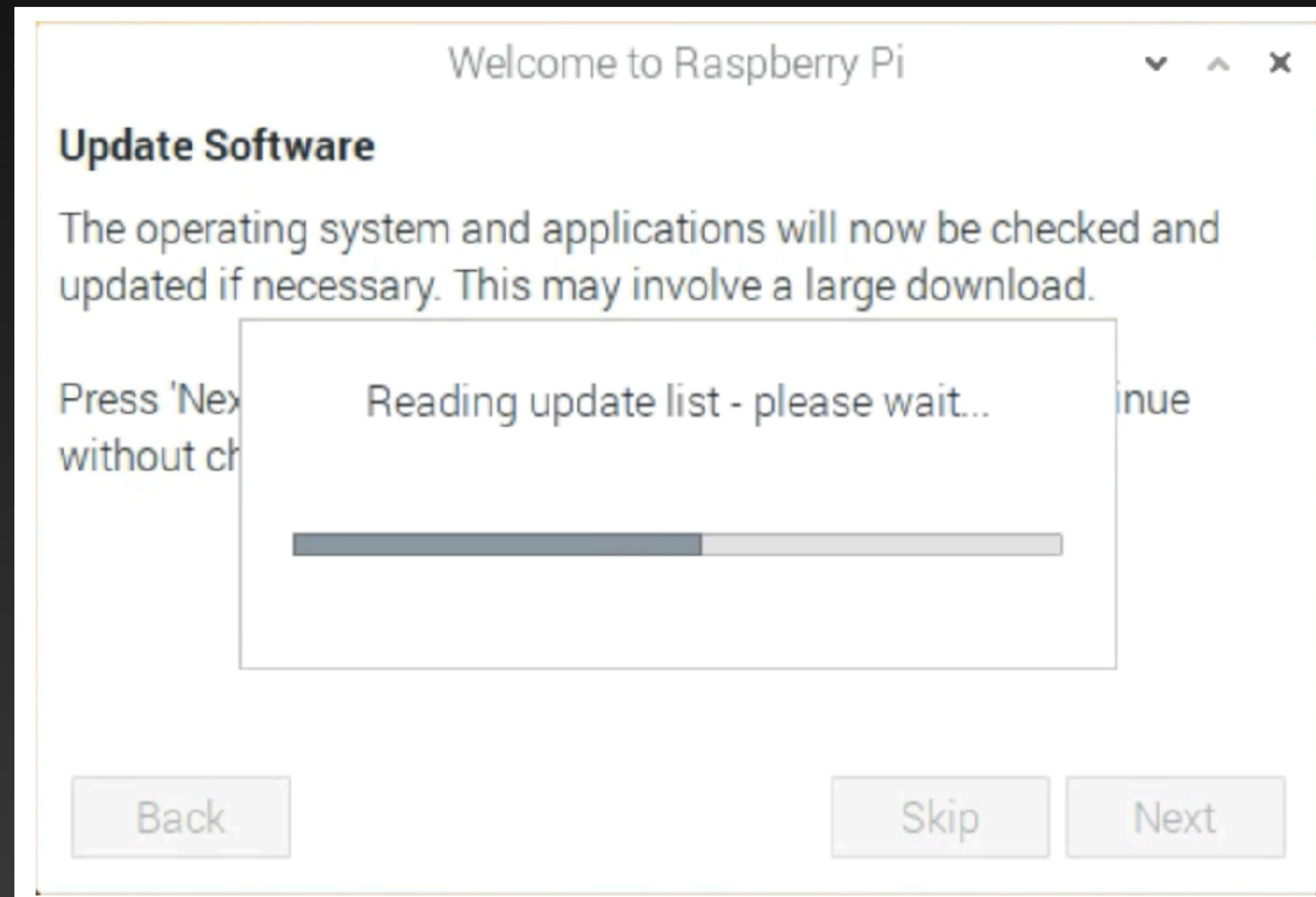
Click on Next, and let the wizard check for updates to Raspberry Pi OS and install them (this might take a little while).



Initial setup

Note: Wait until the wireless connection icon appears and the correct time is shown before trying to update the software.

Click on Next, and let the wizard check for updates to Raspberry Pi OS and install them (this might take a little while).



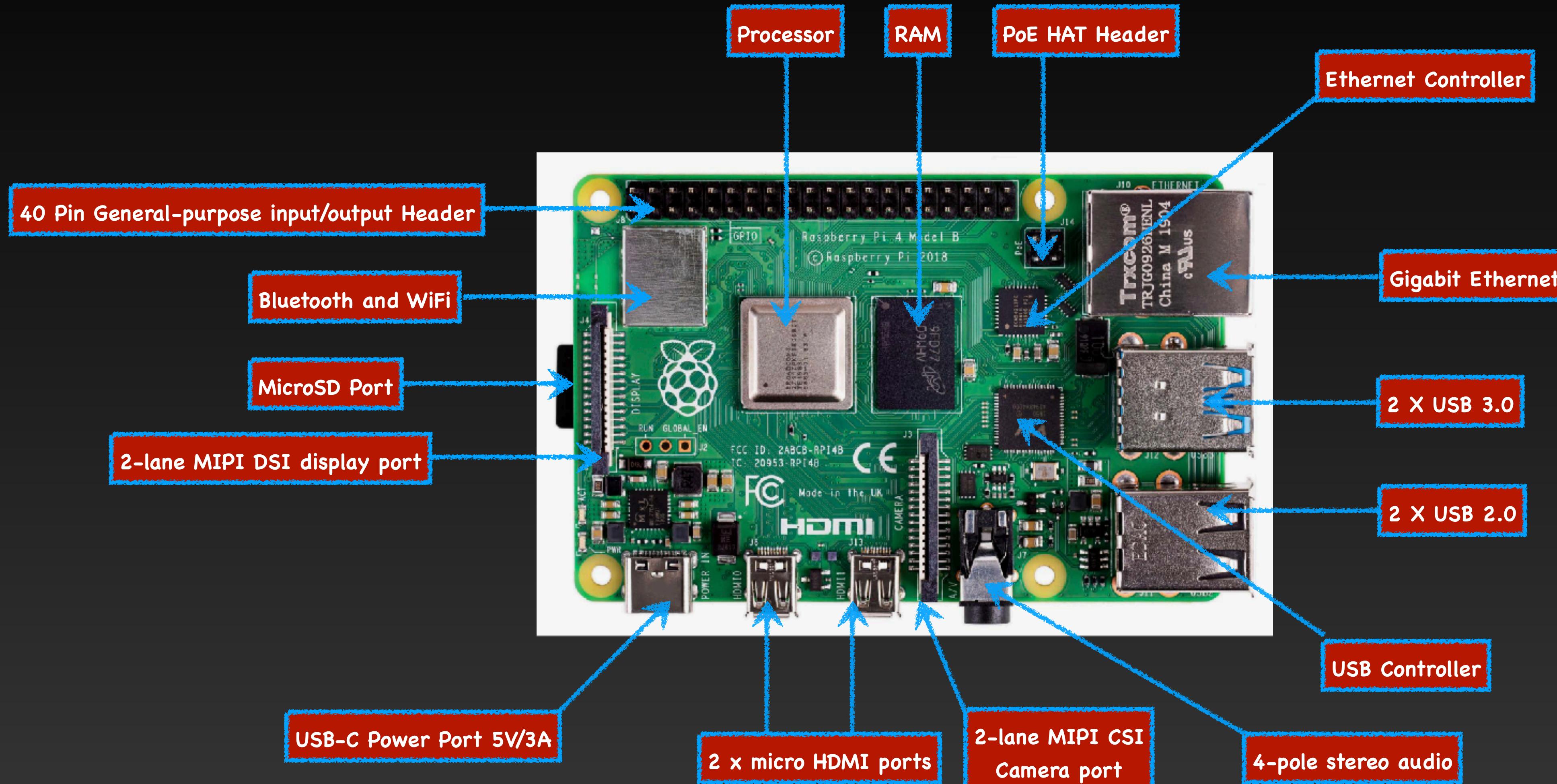
Initial setup

Click on Restart to finish the setup.

Note: You will only need to reboot if that's necessary to complete an update.



Parts of Raspberry Pi 4



Parts of Raspberry Pi 4

Processor: Broadcom BCM2711, quad-core Cortex-A72
(ARM v8) 64-bit SoC @ 1.5GHz

Memory: 1GB, 2GB or 4GB LPDDR4 (depending on model)

Connectivity:

2.4 GHz and 5.0 GHz IEEE 802.11b/g/n/ac wireless LAN

Bluetooth 5.0, BLE Gigabit Ethernet

2 × USB 3.0 ports

2 × USB 2.0 ports.

GPIO: Standard 40-pin GPIO header (fully backwards-compatible with previous boards)

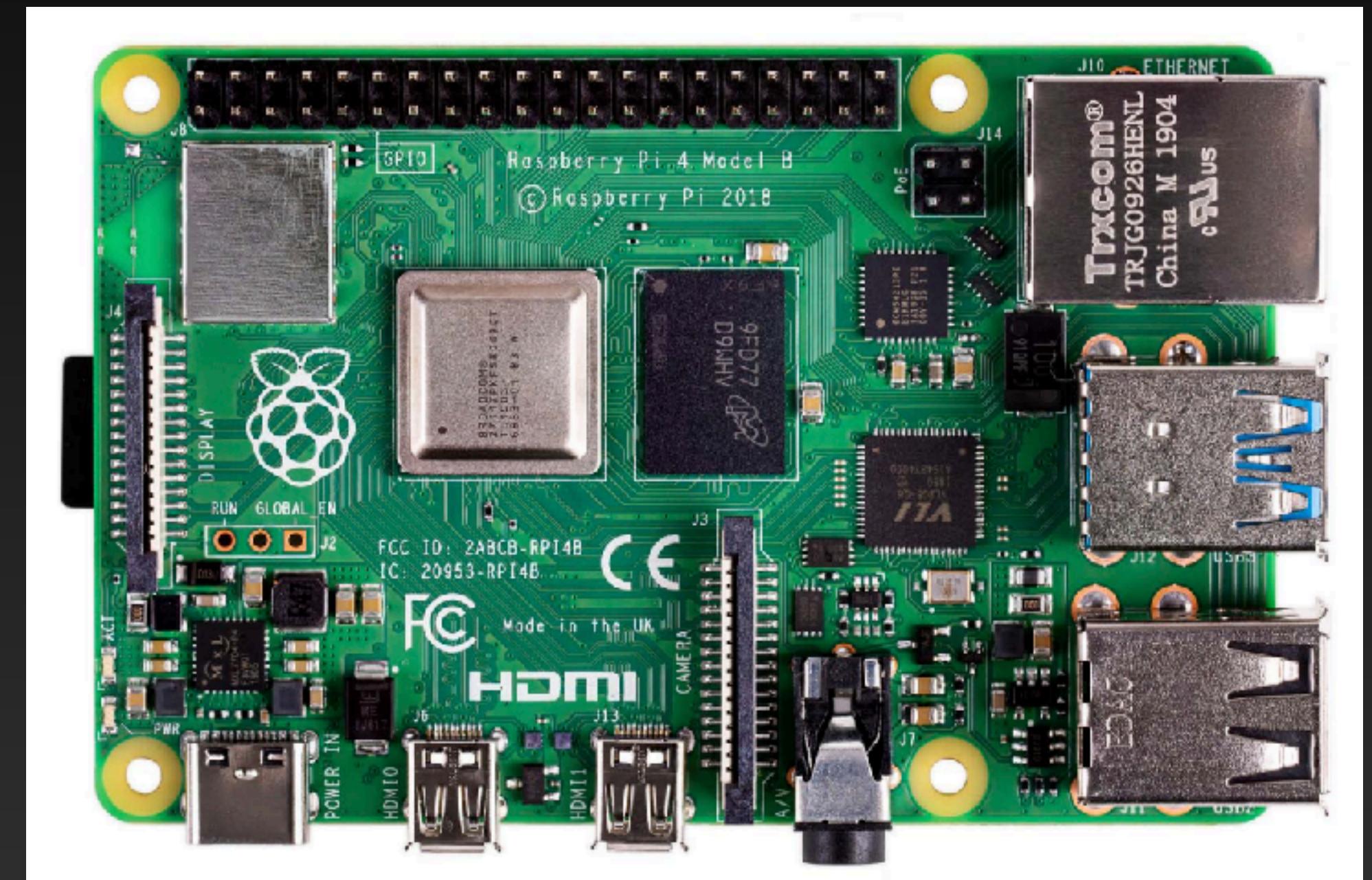
Video & sound:

2 × micro HDMI ports (up to 4Kp60 supported)

2-lane MIPI DSI display port

2-lane MIPI CSI camera port

4-pole stereo audio and composite video port



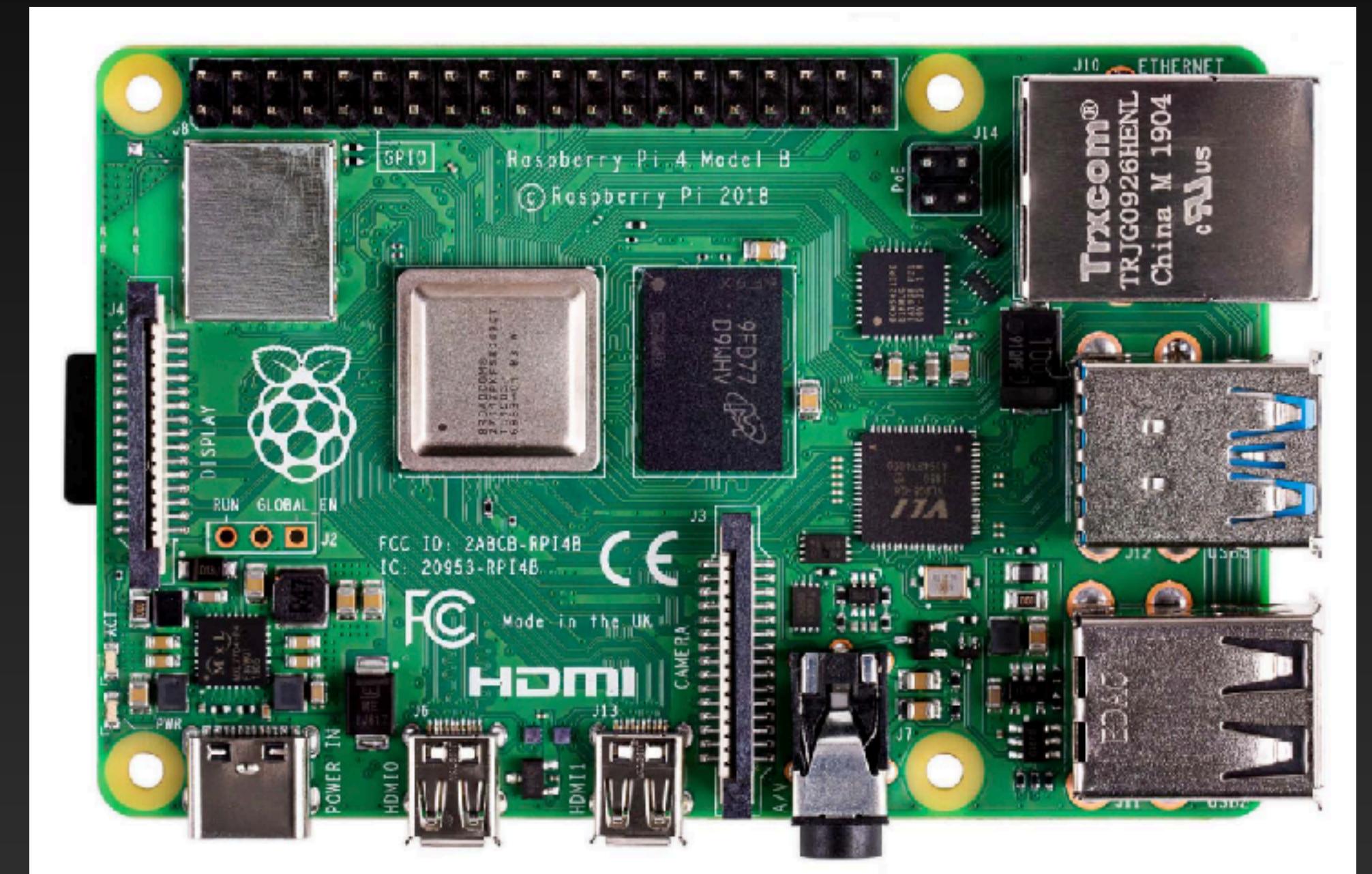
Parts of Raspberry Pi 4

Multimedia: H.265 (4Kp60 decode);
H.264 (1080p60 decode, 1080p30 encode);
OpenGL ES, 3.0 graphics

SD card support: Micro SD card slot for loading operating system and data storage

Input power:
5V DC via USB-C connector (minimum 3A1)
5V DC via GPIO header (minimum 3A1)
Power over Ethernet (PoE)–enabled (requires separate PoE HAT)

Environment: Operating temperature 0–50°C



Test your circuit! An LED Game

Introduction

In this project, you'll take your first step in using the Raspberry Pi's GPIO pins to make machines! You'll be connecting wires and lights to your Pi to create simple electrical circuits, then linking it up to a computer game so that you can find the hidden hedgehog!

What you will make

View a 'virtual' version of the finished Physical Computing Project. Move your character around the screen using the arrow keys. When you are close to the hedgehog, the LED will appear.

Test your circuit! An LED Game

Hardware

- A Raspberry Pi computer
- 3x F-F jumper cables
- an LED
- a resistor (the lower resistance, the better!)

Software

Scratch 3 Desktop - This project can not be completed using the online Scratch editor, and must be completed using a Raspberry Pi with the desktop version installed.

What you will learn?

Connecting a simple circuit to your Raspberry Pi

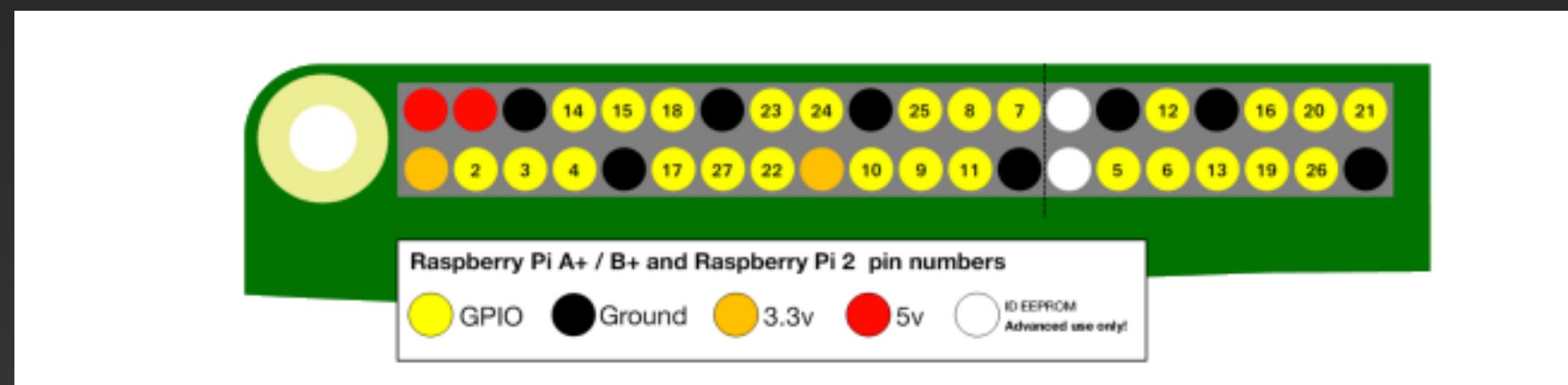
How to use an LED with the Raspberry Pi and Scratch

Test your circuit! An LED Game

In this step, you will connect an LED and resistor to the Raspberry Pi's GPIO pins to test your circuit.

GPIO stands for General Purpose Input/Output. GPIO pins allow you to create simple machines by sending a small electrical signal out of a pin, down a wire, through an output or input, and back into a ground pin on the Raspberry Pi to create a circuit. The circuits you make can be programmed and controlled by you, through programs written using Scratch!

GPIO Basic on Raspberry Pi

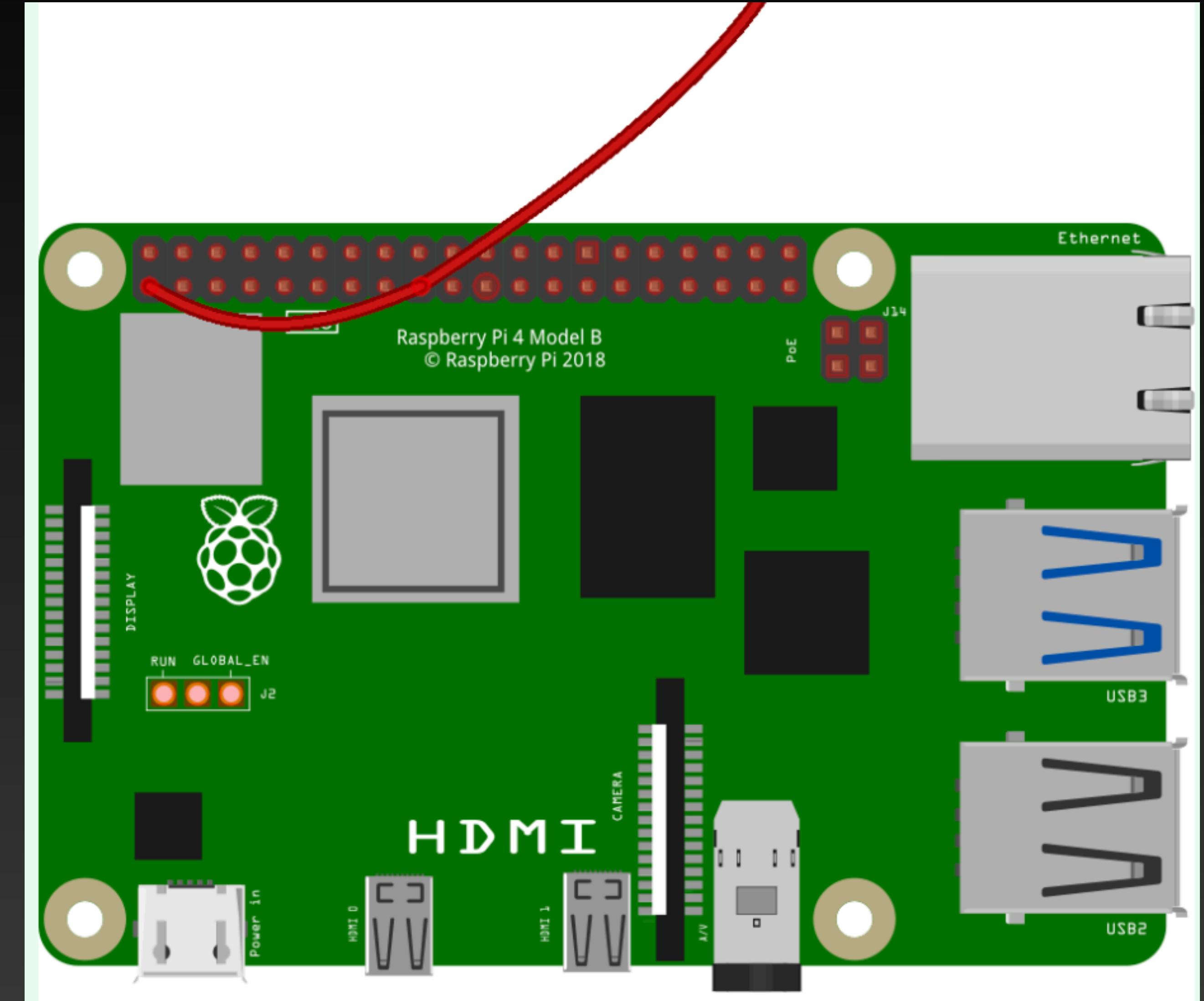


3V3	3.3 volts	Anything connected to these pins will always get 3.3V of power
5V	5 volts	Anything connected to these pins will always get 5V of power
GND	ground	Zero volts, used to complete a circuit
GP2	GPIO pin 2	These pins are for general-purpose use and can be configured as input or output pins
ID_SD/ ID_SD/ DNC	Special purpose pins	

Test your circuit! An LED Game

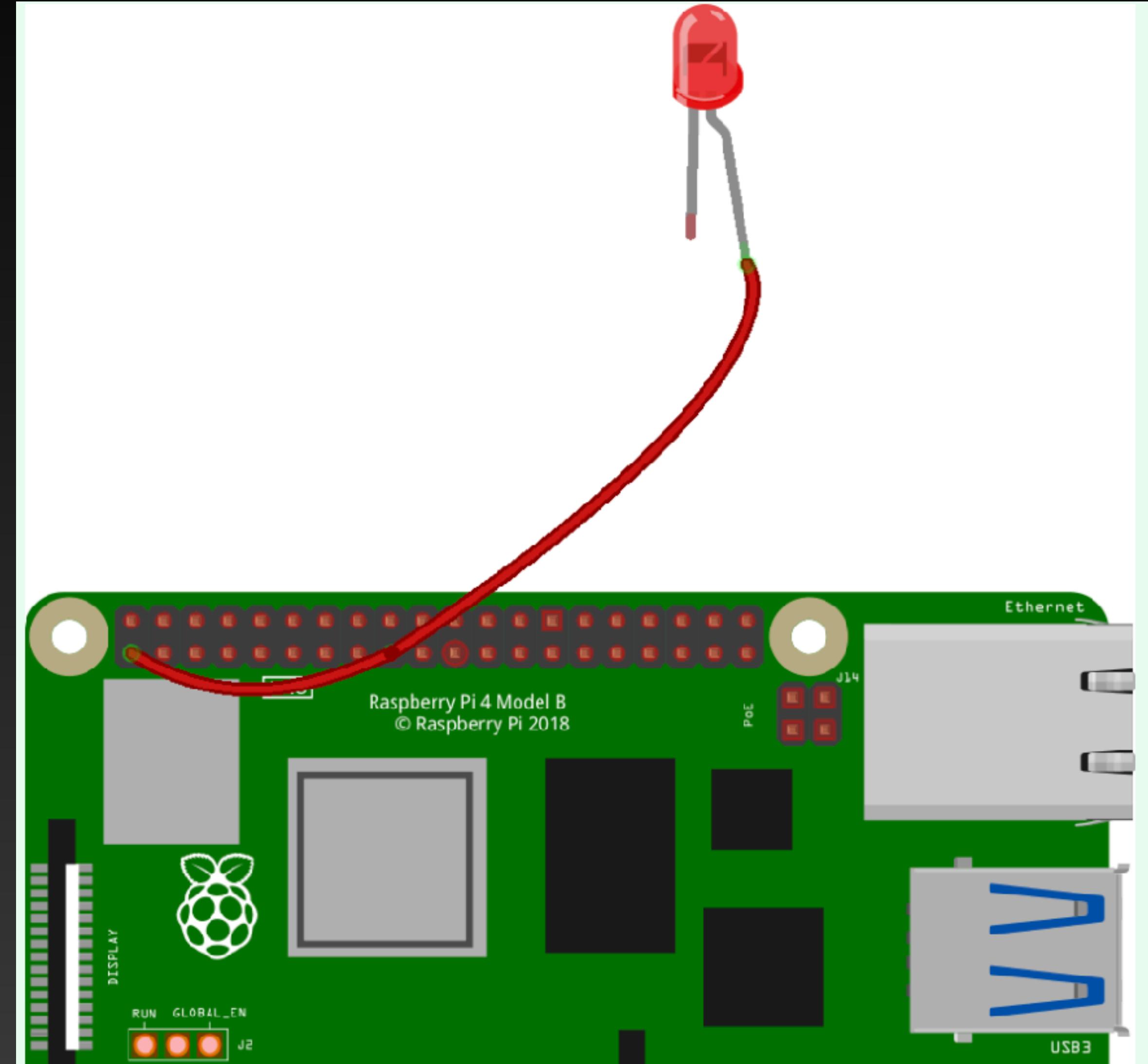
Your jumper wires should all have hollow 'F' ends that fit over the pins.

Connect a jumper wire to Pin 1 (make sure it's an F-F wire). Pin 1 is always on and provides 3 V of power to whatever you connect to it.



Test your circuit! An LED Game

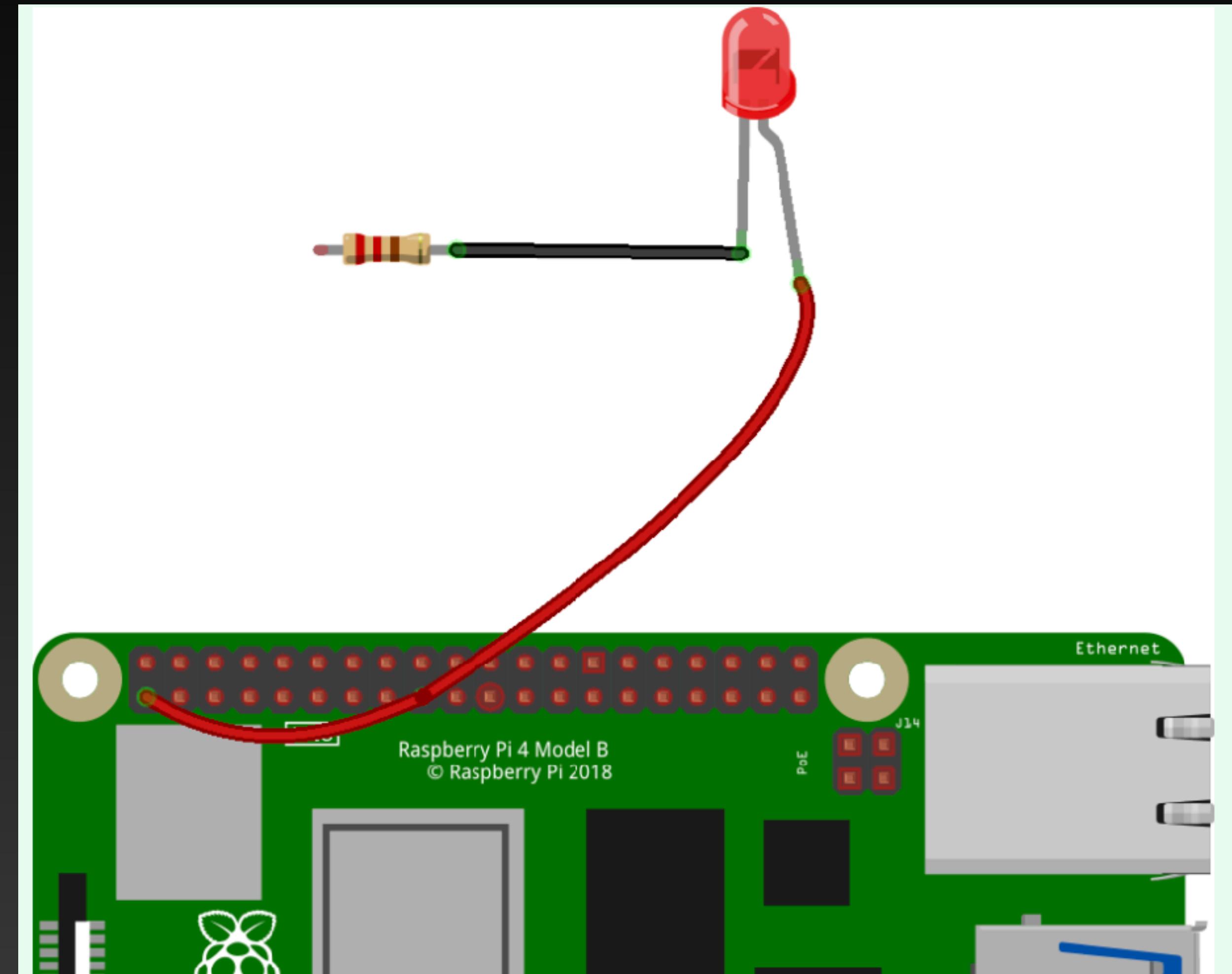
Insert the long leg of your LED into the other end of this jumper wire. Take a second F-F jumper wire and attach it to the short leg of your LED.



Test your circuit! An LED Game

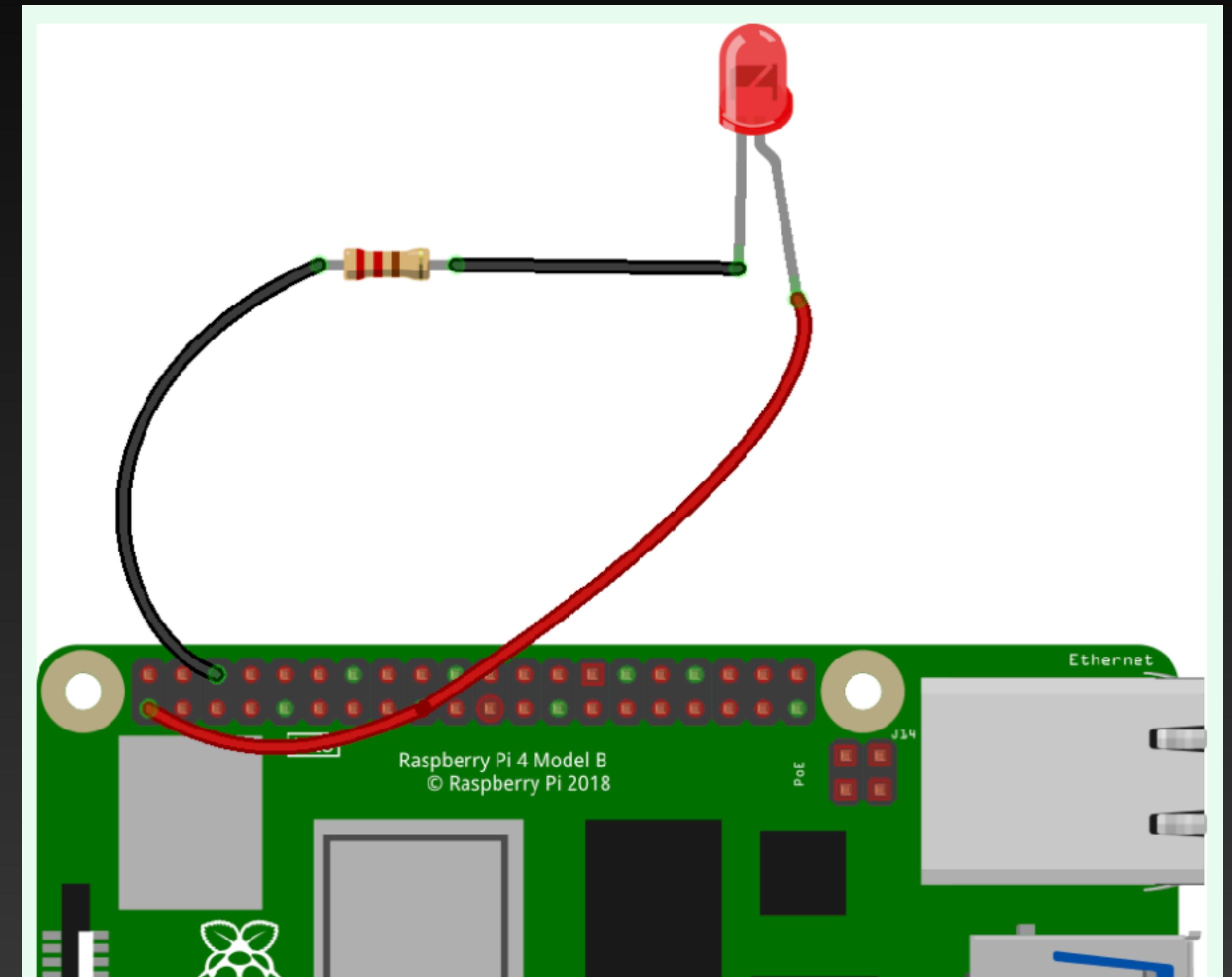
Take a resistor and insert one of its legs into the free end of the second jumper wire. Insert the other leg into another F-F jumper wire.

Adding the resistor to your circuit controls the electrical current passing through the circuit; this will protect the LED from burning out.



Test your circuit! An LED Game

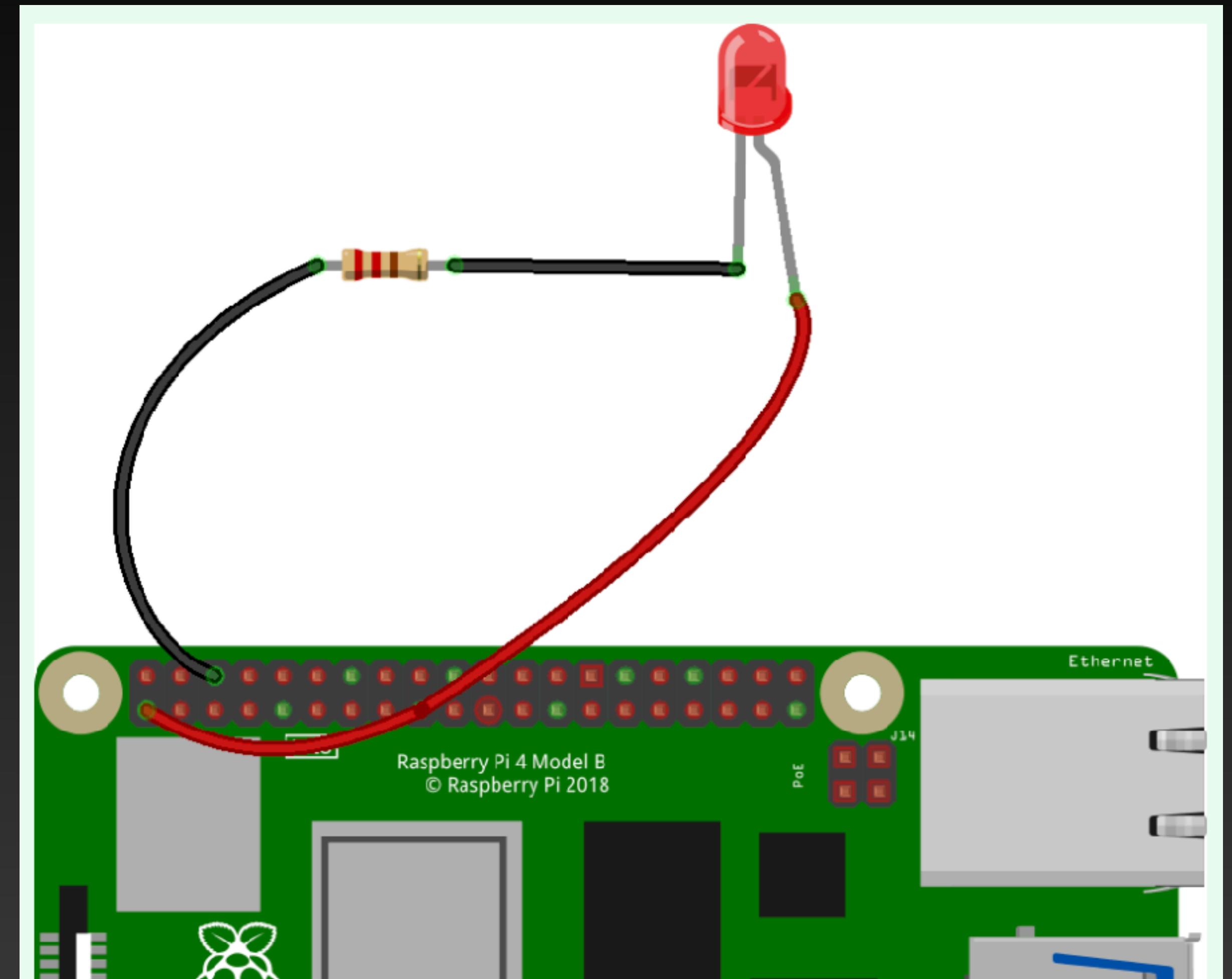
Now, connect your circuit back to Pin 6 using the loose end of the F-F jumper wire. As soon as you close the circuit by connecting it back to your ground pin, your LED should light up!



Test your circuit! An LED Game

If your LED isn't lighting up, make sure you have the long leg connected to the output pin (Pin 1) and the short leg connected to the ground pin (Pin 6). LEDs only work one way round!

If your LED still isn't lighting up, check all your connections are secure and fit properly, then swap your LED for another one if it still won't work (this one might be broken).



Test your circuit! An LED Game

Code your circuit

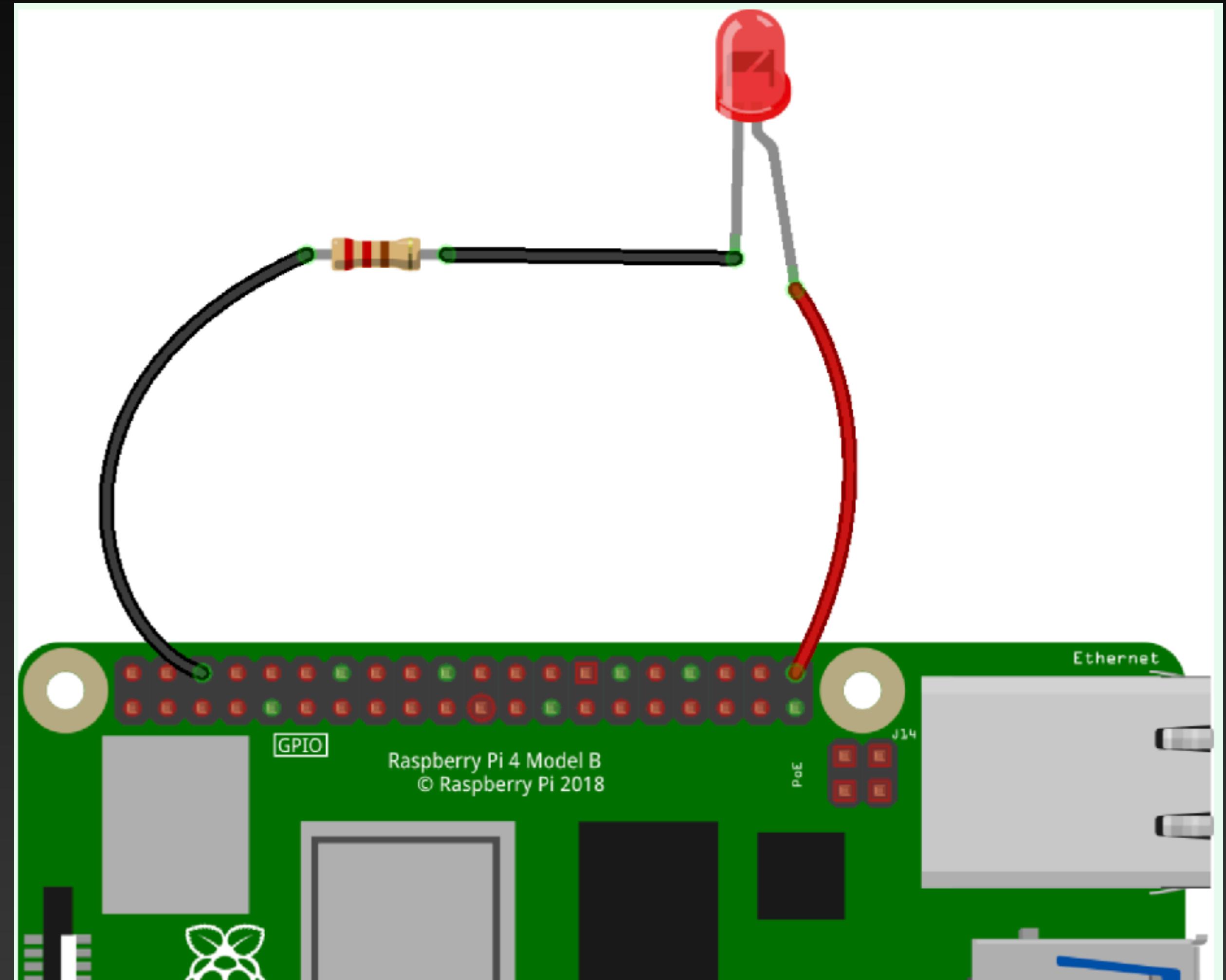
In this step, you will connect your completed circuit to an output pin on the Raspberry Pi and control it using the [Simple Electronics](#) extension.

Currently, your circuit is tested and working, and your LED is on; but you want it to light up when something happens in your Scratch program.

To do that, you need to connect your LED circuit to an output pin on the Raspberry Pi.

Test your circuit! An LED Game

Take the jumper wire off of Pin 1 and attach it to any other numbered pin. In this example, I've used Pin 21 (because it's easy to get to) but you can use any numbered general purpose (GP) pin on your Raspberry Pi.

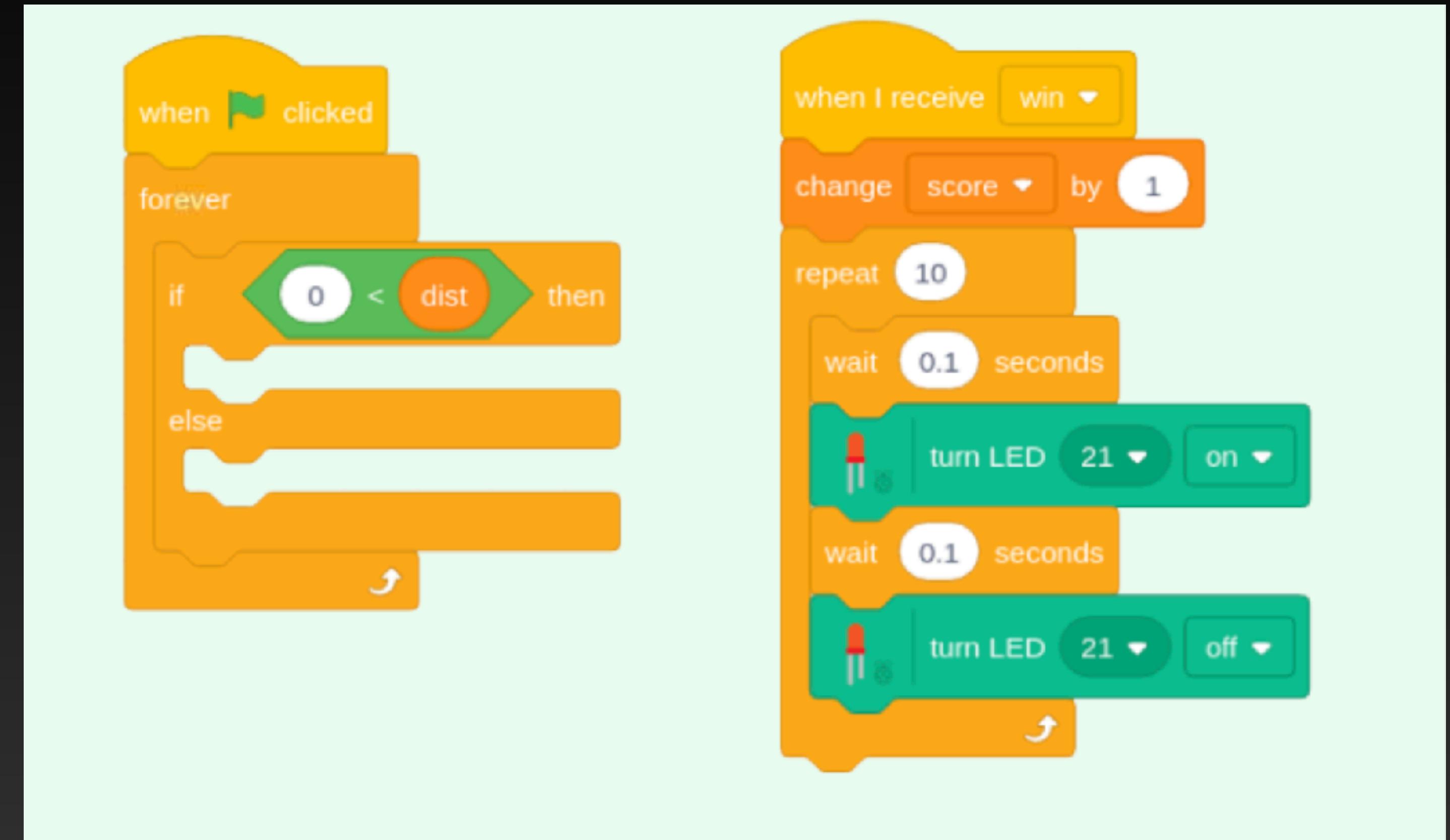


Test your circuit! An LED Game

Download and open the starter project [available here](#).

<https://rpf.io/p/en/scratch-led-game-get>

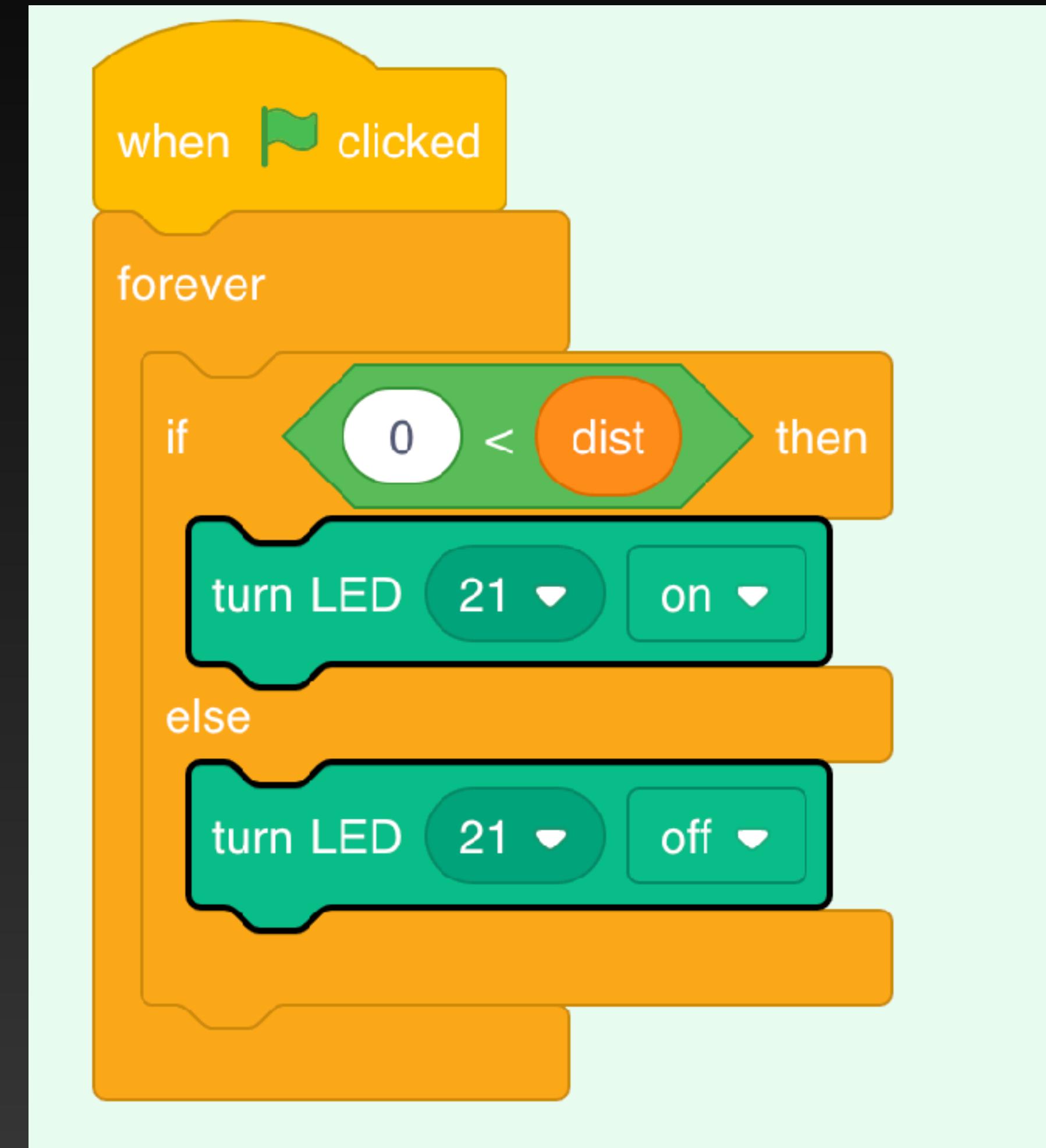
Make sure you have the Stage selected and you can see the following scripts:



Test your circuit! An LED Game

Using the **Simple Electronics** extension, add the following blocks into the **if** block so that if **distance** is less than **10**, the LED comes on — **else** it turns off.

Now click on the green flag, and see if you can hunt the hedgehog!



Test your circuit! An LED Game

Menti In Class QUIZ

Test your circuit! An LED Game

Home project

Try to use different resistors to test your LED and see what's the differences with the setup in class?

- 10k
- 220R

Try to provide power through 5 volt(First row, first pin) to LED, what can you see?

IoT with MIT App Inventor

Office hour