Overview

With the Raspberry Pi 4, you can now program in the latest version of Scratch (https://adafruit.it/DDU), a popular programming language for beginners. Additionally, you can use the new Scratch Raspberry Pi extensions (https://adafruit.it/FRC) to interact with Scratch in a more physical way.

This guide will go through how to set up the Raspberry Pi 4 to program with Scratch 3. Additionally, we will run through a demo showcasing some of the possibilities that this dynamic combo of a powerful microprocessor and intuitive, easy-to-learn programming language allows.

What’s Scratch?

Scratch is a block-based language geared for beginners that lets you create your own interactive stories, animations, games, music, and art.

Scratch is easy to use and requires no prior coding experience!

Parts

Here's what you'll need to get started
1) Raspberry Pi 4 with your choice of RAM (any will do just fine!)

- Raspberry Pi 4 Model B - 4G RAM
  - $55.00
  - IN STOCK
  - Add To Cart

- Raspberry Pi 4 Model B - 2 GB RAM
  - $45.00
  - IN STOCK
  - Add To Cart

- Raspberry Pi 4 Model B - 1GB RAM
  - $35.00
  - IN STOCK
  - Add To Cart

Have a different Pi? Fear not! You can use other versions of Raspberry Pis as well as long as the Raspbian operating system is updated. However without the Pi 4 you will not be able to use the latest version of Scratch (Scratch 3).

2) Pi power supply

USB C power supply (https://adafru.it/FQQ)
or you can use [USB micro B power supply](https://adafru.it/e5A) with an [adapter](https://adafru.it/FQR)

3) Display

You can use any display with an HDMI input.

We also have [some options](https://adafru.it/FQS):
4) Micro HDMI to HDMI Cable

5) Keyboard and mouse

6) 16GB Micro SD card w/ Noobs
7) 1K ohm resistors

8) Female to male jumper wires

9) Breadboard

Already have a 16GB micro sd card but don't have NOOBS pre-installed on it? No worries! Read on to find out how to get it set up with NOOBS.

Through-Hole Resistors - 1.0K ohm 5% 1/4W - Pack of 25

Premium Female/Male 'Extension' Jumper Wires - 20 x 6"
10) Leds

Half-size breadboard

$5.00
IN STOCK
Add To Cart

Diffused 3mm LED Pack - 5 LEDs each in 5 Colors - 25 Pack

$2.95
IN STOCK
Add To Cart
Set up the Pi

We will be using the official Raspberry Pi guide (https://adafru.it/FQT) to set up the Pi 4. Head over there (https://adafru.it/FQT) for instructions on how to get your Pi up and running.

Set up the SD card (https://adafru.it/FQU)

The SD card linked in the "parts" section of the "overview" page has NOOBS pre-installed on it so if you have an SD card with NOOBS installed already, skip ahead to the "Connect your Pi" (https://adafru.it/FQV) section. However if you have another SD card and want to install NOOBS follow the steps in the "Set up the SD card" (https://adafru.it/FQU) section.

Connect your Pi (https://adafru.it/FQV)

- Insert the SD card into the slot on the Pi
- Connect keyboard and mouse via the Pi's USB hubs
- Power up display then connect to Pi via micro-hdmi cable
- Add any other optional connections
Start up your Pi (https://adafruit.it/FQW)

- Power up the Pi via USB C cable
- Download Raspbian via NOOBS
Finish the Setup (https://adafruit.it/FQX)

- Configure country, language and timezone
- Set up password for Pi
- Connect Pi to wifi network
- Install any necessary updates

Update the OS to Raspbian Buster

Follow the instructions via video or text below to update your Pi

First, open a terminal window
Click the black square icon on the top left of the desktop to open a terminal window

In a terminal window type and return:

```bash
sudo apt-get update
```

Next type and return:

```bash
sudo apt-get dist-upgrade
```

When prompted, y/n type y and return.

This will update your Pi's operating system to Rasbpian Buster which may take some time. (10 - 15min)

When the update is complete, restart the Pi by running the command:

```bash
reboot
```

Trouble Shooting

Problem: My screen is not showing any output from the Raspberry Pi.

Potential Solution 1: Make sure all connections are in place before booting up Pi.

Potential Solution 2: Double check that your SD card has NOOBS correctly installed.

Now that we're all set up, it's time to get Scratch up and runnin'!
Using Scratch

What can I do with Scratch?

As mentioned earlier, Scratch is a block-based language geared for beginners that lets you create your own interactive stories, animations, games, music, and art.

For more on the ins and outs of Scratch check out the guide:

Scratch 3 Walkthrough and Demo (https://adafruit.it/FQY)

Connecting to the world

While you do not need a Raspberry Pi to run and use Scratch (there is a web-based editor that can be used on any computer with a browser), the Pi unlocks a whole other set of capabilities for us.

Connecting this powerful programming language to a Raspberry Pi lets us more easily take advantage of the "GPIO (https://adafruit.it/FQP)" pins to have our Scratch program interact with the outer world!
A powerful feature of the Raspberry Pi is the row of GPIO (general-purpose input/output) pins along the top edge of the board. A 40-pin GPIO header is found on all current Raspberry Pi boards (unpopulated on Pi Zero and Pi Zero W). Prior to the Pi 1 Model B+ (2014), boards comprised a shorter 26-pin header.

Any of the GPIO pins can be designated (in software) as an input or output pin and used for a wide range of purposes.
How to install Scratch 3 using the Recommended Software app

Open up the menu, click on **Preferences > Recommended Software**, and then select **Scratch 3** and click on **OK**.

![Recommended Software window](image)

How to install Scratch 3 using the terminal

Open a terminal window, and type in and run the following commands:

```
sudo apt-get update
sudo apt-get install scratch3
```

Add the Extension

Once Scratch 3 is installed on the Pi, go ahead and open up Scratch 3 by clicking the Raspberry Pi icon on the top left of the desktop, then Programming>Scratch3
Add the Raspberry Pi GPIO extension
Click the blue icon at the bottom left of the application to open the extensions.

Select the extension entitled "Raspberry Pi GPIO"

Now we have access to some awesome GPIO functionality which we'll get to next!
Read more about the different Raspberry Pi extensions for Scratch [here](https://adafruit.it/FRC)!
Scratch 2

Which version of Scratch to use?

While you can use any version of Scratch, if you have a Raspberry Pi 4, we recommend using Scratch 3. Follow the instructions on the next page to get Scratch 3 on your Pi 4.

If you have an older Pi however such as a Pi 3 or older, you may not be able to run Scratch 3 because of the memory requirements of the program.

You can however run Scratch 2 which still has Raspberry Pi GPIO functionality, so skip to the section "Scratch 2" to find out how.

How to open Scratch 2 on the Pi

Once you are in the Raspbian desktop, you will open up Scratch 2 which comes preinstalled on the Pi.

To Open Scratch 2:

Click the Raspberry Pi icon on the top left of the desktop, then Programming>Scratch2

And that's it! Scratch is ready to go!
Adding the Pi Plugin

Open the More Blocks panel, click Add an Extension, and select Pi GPIO. You should then see two new blocks appear:

You can use these two purple blocks to control output pins or read input pins by entering the pin number into the field, or using a variable containing the pin number.

Next up, putting the spiffy new blocks to work.
Wiring

Blinky LED demo

We will now put together a small demo using the Pi and some components. In this simple demo we will use Scratch to program the Pi to blink an LED.

Wiring

First, let's wire things up.

You will need handy:

- one led (any color)
- one resistor that is 1K or less (click here for more on how to determine resistor values)
- 2 female to male jumper wires
Connect one female to male jumper wire from GPIO pin 2 on the pi to any spot on a bread board. Next, connect the resistor (1K or less will do) from the GPIO 2 jumper wire to another spot on the breadboard. Now take the LED and determine which leg is longer, and connect that leg to the other end of the resistor with the opposite end going to another spot on the bread board. Lastly, connect male to female jumper wire from the unconnected end of the led to a ground pin on the Pi.

Next we'll program the Pi in scratch to blink the LED. 

The above photo from Fritzing is a Raspberry Pi 3 because at the time of this guide writing, there is no Pi 4 Fritzing object, but the pinout is identical.
Going Further

What else can you think of to use with Scratch and Raspberry Pi?

Some ideas:

- Add buttons ([https://adafruit.it/FQ-](https://adafruit.it/FQ-)) and other components.
- Create a custom interactive game by connecting buttons, leds and other components. Then program these components to control and react to game elements like sprites ([https://adafruit.it/DDW](https://adafruit.it/DDW)) and backdrops ([https://adafruit.it/FR0](https://adafruit.it/FR0)).
- Add a CRICKIT HAT ([https://adafruit.it/DwH](https://adafruit.it/DwH)) to make things move!
Next we'll program the Pi in Scratch to blink the LED.

- Click the yellow "events" block group, then drag and drop the "when (flag) clicked" block over to the "script area" on the right side of the program's interface.
- Next click the orange "control" block group section and drag in a "forever" loop.
- Also from the "control" section, drag in two `wait 1 seconds` blocks.
- Then click on the "Raspberry Pi GPIO" block section and drag in two `set gpio to output` blocks. Set one block to `set gpio 2 to output high`. Set the other to `set gpio 2 to output low`.
- Lastly rearrange the blocks in the order as shown.

Now click the green flag and see what happens!
Scratch 2 Blinky

Use Scratch 2 to program the Pi to blink the LED.

- Click the orange "events" block group, then drag and drop the "when (flag) clicked" block over to the "script area" on the right side of the program's interface.
- Next click the yellow "control" block group section and drag in a "forever" loop.
- Also from the "control" section, drag in two wait 1 secs blocks.
- Then click on the "more blocks" block section and drag in two "set gpio to" blocks. Set one block to set gpio 2 to output high. Set the other to set gpio 2 to output low.
- Lastly rearrange the blocks in the order as shown above.

Now click the green flag and see what happens!
Going Further

What else can you think of to use with Scratch and Raspberry Pi?

Some ideas:

- Add buttons (https://adafruit.it/FQ-) and other components.
- Add a CRICKIT HAT (https://adafruit.it/DwH) to make things move!
- Use the Sense HAT (https://adafruit.it/FRD) extension to sense tilting, shaking, orientation, use a joy stick, measure temperature, pressure humidity, display text and more.
- Create a custom interactive game by connecting buttons, leds and other components. Then program these components to control and react to game elements like sprites (https://adafruit.it/DDW) and backdrops (https://adafruit.it/FR0).

Click below for some more resources and ideas of what else you can do with Raspberry Pi and Scratch!

https://adafruit.it/FRC
https://adafruit.it/FRC