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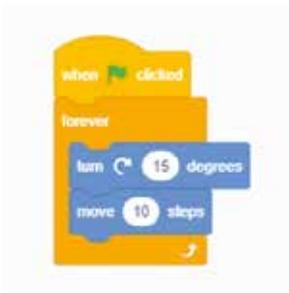
Introducing Scratch

In this chapter, you'll get started with Scratch, including meeting some of the blocks used to give instructions, and creating your first program. You'll also learn how to save your work, and load projects created by others.

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Scratch doesn't cost anything and it works on Windows, Mac and Linux computers, as well as tablet devices. For the latest version of Scratch, the Raspberry Pi Foundation recommends a Raspberry Pi 4 computer (pictured below) with at least 2GB of RAM.



Above: A simple Scratch program, showing how the color-coded commands lock together.

What is Scratch?

Programming is the art of writing instructions to tell a computer what to do. A set of instructions is called a program. The instructions are written in what's known as a programming language, and there are thousands to choose from.

Scratch is a programming language that is perfect for making games, animations, interactive stories and other visually rich programs. It provides a great introduction to programming for people of all ages. It's widely used in schools and colleges, but Harvard University has also used it in higher education at its Summer School. I've led workshops for adults where Scratch provided a friendly introduction to the kind of creative problem solving that programmers do all the time.

Scratch is easier to use than most other programming languages for a number of reasons:

- You don't have to remember or type any commands: they're all on screen, so you can just drag and drop them.
- Commands fit together like jigsaw pieces, so there are strong visual hints about how you can combine them.
- Error messages are rare. Because Scratch commands lock together, programs usually make some kind of sense. It is possible to still write programs with logical errors in, if they don't do what you expected, but Scratch guides you to write things that work, rather than nagging you when they don't.
- The commands are color-coded and categorized, so you can easily find a command when you need it.
- The commands in Scratch simplify common activities in games, such as testing whether a missile has hit an alien (collision detection), or rotating a character on screen.

In short, Scratch is designed for your success. It enables you to quickly see results from your work, and even includes graphics and sounds you can use so you can get started right now. Many other programming languages require you to learn text commands, and have strict rules about how you can use them. Scratch doesn't. That means you can focus your energy instead on the fun stuff: dreaming up ideas for new programs, working out how to build them, designing them, and sharing them with friends.

Creating a Scratch account

Before you begin to program with Scratch, I recommend you create an account for the Scratch website. Here's how:

- 1 Open a web browser, such as Google Chrome
- 2 Enter the website address **https://scratch.mit.edu/** in your address bar, usually at the top of the screen
- 3 Click **Join Scratch** in the top right
- 4 Make up a username. The site advises you to protect your privacy by not using your real name. You can't change your username later, so choose wisely
- 5 Pick a password and enter it twice. The second time is to make sure you've typed it correctly. Use a mixture of uppercase and lowercase, numbers and symbols to make it more secure. Click the **Next** button
- 6 Enter your date of birth, gender, country and email address. This personal information is used to help you recover your password if you forget it, and is used by the Scratch team to understand who uses Scratch. Click **Next**

- 7 Enter an email address so they can confirm your account before you can share projects or post comments. Click **Next** and you will be logged in



The design of websites can change from time to time, so don't worry if you see variations in the sign-up process when you do it.



You can try Scratch by just going to the website and clicking Create at the top of the screen. If you use an account, though, the website will automatically save your work for you.



When you return to the site next time, you can click "Sign in" in the top right to get back to your projects.



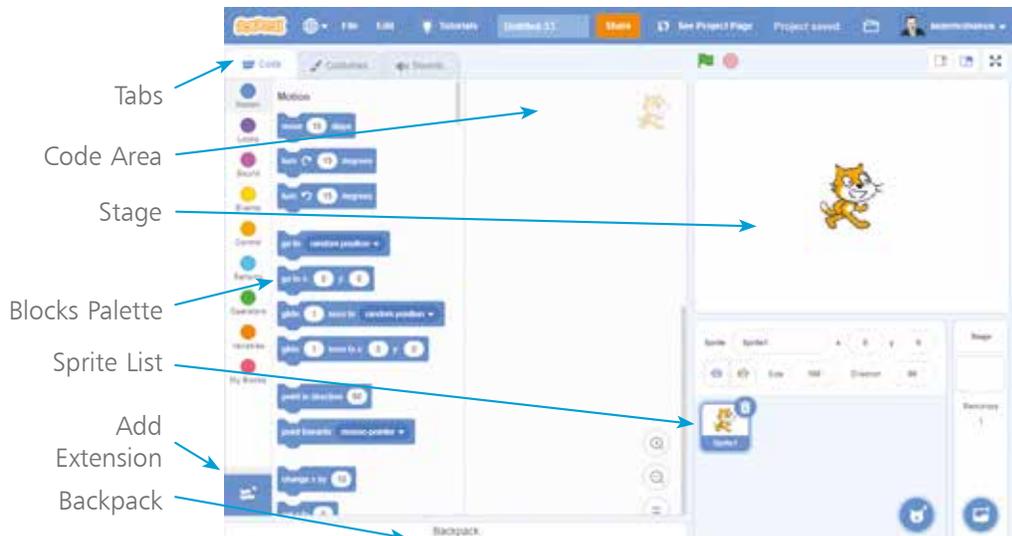
Scratch 3 adds new features for making projects, a streamlined user interface, and compatibility with more devices.

Meet Scratch 3

Scratch 3 is the latest version of Scratch, launched in January 2019. It runs in your web browser and is based on standard web technologies (HTML5). That means it is compatible with many different types of computer. Scratch 3 introduced several new features, including:

- **Tablet support.** You can now build and use projects on a tablet device, and can play (but not build) projects on a mobile phone. Games that require keyboard controls to move a character on screen may not work. You can use your tablet's onscreen keyboard to type information into a project, though.
- **New extensions.** There are new capabilities to work with the micro:bit and Sense HAT devices, to speak out loud, to translate text, and to work with the Lego WeDo 2.0 and Lego Mindstorms EV3 kits. To add an extension, click the button in the bottom left of the screen.
- **Simplified Blocks Palette.** The menu of instructions has been streamlined by moving the music and drawing (Pen) blocks into the extensions section. If you're familiar with Scratch and are wondering where they went, you can find them there!

Older versions of Scratch (Scratch 2, and Scratch 1.4) are still available to download. There's an offline version of Scratch 3 too. Find them all at <https://scratch.mit.edu/download>



Using the Scratch screen

The main parts of the Scratch screen, as shown on the facing page, are:

- **Stage:** This is where you can see your animations and games in action. When Scratch starts, there's a large orange cat in the middle of the Stage.
- **Sprite List:** The cat is a "sprite", which is like a character or object in a game. Your project might include lots of sprites, such as the player's spaceship, invading aliens and a missile. In the Sprite List, you can see all the sprites that are in your project, and click them to switch between them. The Sprite List is underneath the Stage.
- **Blocks Palette:** In Scratch, you give the computer commands by using blocks, which are instructions that fit together like jigsaw pieces. The Blocks Palette presents you with all the blocks you can use. When you start Scratch, you can see the Motion blocks, which are color-coded in dark blue, and are used for moving sprites around the Stage. You can browse a different set of blocks in the Blocks Palette by clicking one of the buttons, such as the **Looks** button or the **Sound** button. You can also scroll through all the blocks in the different categories in the Blocks Palette.
- **Code Area:** The Code Area (previously known as the Scripts Area in older versions of Scratch) is where you make your programs, by joining instruction blocks together. When you join blocks together, the result is called a script. The Code Area expands to fill the screen space available, so if you use a larger monitor, the Code Area will be bigger.
- **Backpack:** The Backpack at the bottom of the screen is handy for copying sprites and scripts between different projects. Click the Backpack at the bottom of the screen to open it. You can then drag sprites or scripts into it, or drag them out into your current project.

The blue stripe across the top of the screen is used for managing your projects. You can use the File menu to save your work, including downloading it to your computer. The online version of Scratch saves your updates automatically, so you won't need this often. The box containing "Untitled" is where you rename your project. Click the folder in the top right to find all your projects.



You'll see all these elements in action soon, so don't worry about memorizing the screen layout. This section is just to help you get your bearings. Remember that you can refer to the screenshot on the facing page at any time.



Use the tabs above the Blocks Palette to switch between the scripts, costumes and sounds on a sprite.



With the launch of Scratch 3, touch devices are more widely supported. The previous version of Scratch was based on Flash, which didn't work on iPads. The latest version has redesigned blocks that are easier to move by hand.



If you have a PC with a touchscreen, you might want to use the keyboard and touchscreen together to create your projects. Some people find it easier to use the touchscreen than the mouse.

Using Scratch on tablets

You can now use Scratch on a tablet, such as an Apple iPad. Simply visit the Scratch website in your browser. You may find that Scratch runs more slowly than it does on a PC, but you should still be able to enjoy building and using many Scratch projects. If you're using a tablet, make sure you log in to the Scratch website, because you can't save projects to your device.

You can't use projects that require the keyboard, such as games that use keys to move a sprite. If the project includes **key [space] pressed?** or **when [space] key pressed** blocks (to detect any key), the project is unlikely to work well without a real keyboard. From this book, you can't play games like Super Dodgeball or Shop Cat (although they are fine to build). But you can play Spiral Rider, Space Opera, Quiz Break, Evil Robot, Photo Safari and more. I'll warn you at the start of a chapter if a project won't work on a touch-based device.

Using gestures

You'll find the touch gestures feel natural and are easy to remember. Here's how to use a touch-based device instead of a mouse:

- To “click” something, **tap** it on the screen. For example, tap to use a button or start a script.
- To “right-click” something, **tap and hold** it on the screen – for example, to duplicate a sprite in the Sprite List.
- To “hover” over a button, simply **tap** it – for example, to open the menu to add a sprite.
- You can “drag” blocks and sprites by touching them and **dragging your finger** across the screen.
- To scroll through the Blocks Palette, **swipe** it up or down.
- To move around the Code Area, **drag** its background up, down, left or right.
- To scroll in the Paint Editor (see Chapter 4), **drag the scrollbars** at the bottom and side of the canvas.
- To change the values in a block, or type something in response to an **ask** block on the Stage, **tap the box to make your virtual keyboard appear**.

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Scrolling around the Scratch screen

If Scratch doesn't fit in your tablet's screen, you can scroll left and right by dragging the blue bar at the top. To scroll up and down, drag part of the light blue background – for example, an empty space in the Sprite List.

Using Scratch in portrait mode

If you want to see all of the Stage and the keyboard at the same time – for example, to play *Quiz Break* in this book – use your tablet in portrait orientation.



Using Scratch apps

At the time of writing, MIT is creating apps for Scratch 3. There is an unofficial app based on Scratch 1.4, called Pyonkee. It's a fun way to tinker with Scratch, but it doesn't have the cat or certain other sprites, and doesn't have newer Scratch features such as sprite cloning, extensions, and sound effect blocks.



In the rest of this book, I'll mostly assume readers are using a keyboard and mouse, so refer back here if you need a reminder of how to use your touchscreen.



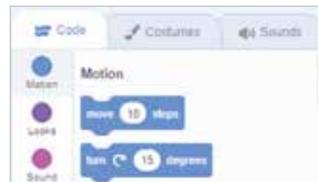
MIT has also created ScratchJr, a reinvention of Scratch for younger children, designed for iPads and Android tablets. For tips on using ScratchJr, see our book [Cool Scratch Projects in easy steps](#).



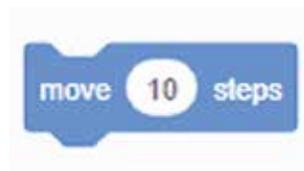
Exploring the blocks

Try experimenting with a few blocks to see what they do:

- 1 Click the round, blue **Motion** button to the left of the Blocks Palette to show the Motion blocks. This button is selected when you first start Scratch



- 2 In the Blocks Palette, click (or tap) the **move 10 steps** block. The cat on the Stage moves in the direction it's facing, to the right. Each time you click the block, the cat moves once. This block only changes the cat's position, though: you won't see its legs move



- 3 The number of steps is how far across the screen you want the cat to move. Click the number 10 and change it to something else. Try 50 and when you click the block, the cat moves five times as far. Whenever you see a white hole in a block, you can change what's in it



- 4 Rotate the cat by clicking the **turn clockwise 15 degrees** block. To change the angle of the turn, change the number. Remember to click the block to actually make the cat turn. When you click the **move 10 steps** block next time, the cat walks in its new direction



Scratch won't let the cat disappear off the screen completely. If you use numbers that are too big, the sprite will stay at the edge of the screen.



Above: The cat on the Stage, after I clicked "turn clockwise 15 degrees".

5 If the cat gets to the edge of the Stage, drag it back again with your mouse pointer. Click the cat, hold the mouse button down, move the cat, and then release the mouse button to drop it in place

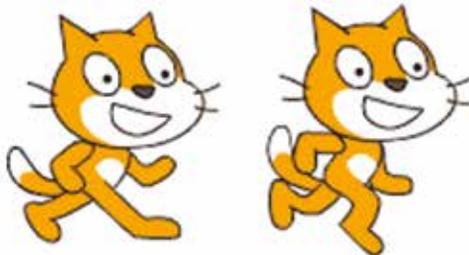
6 Click the round, pink **Sound** button beside the Blocks Palette



7 Click the **play sound Meow until done** block. You should hear the cat make a meow sound if you have speakers on

8 Click the round, purple **Looks** button. It's beside the Blocks Palette. You can see it in the picture above

9 Click the **next costume** block to see the cat's legs move, so it appears to run on the spot. Costumes are different pictures a sprite can have, and the cat has two that show its legs in different positions (see below). In Scratch, the sprites are like the actors; they wear the costumes (different images), and they move on the Stage



All these blocks are explained later in the book, but for now it's worth spending a few minutes exploring some of the commands you can give the cat.



Scratch 3 includes new blocks to change the pitch of the sound. Try changing the numbers in the "change [pitch] effect by 10" block, clicking it, and then clicking the "play sound Meow until done" block again.



If you're using a tablet, you can tap things instead of clicking them.



Before you begin building each program in this book, it's a good idea to start a new project. Click the File menu and then click New. If you're using Scratch 3 and you can't see the File menu, click Create instead at the top of the screen.



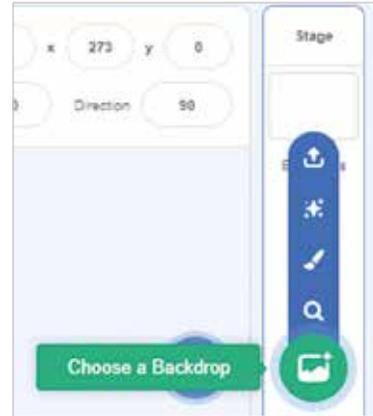
Scratch 3 adds some new backdrops, including some great space cities, illustrated sports fields, and a Jurassic skyline.

Changing the backdrop

Before we make our first program, let's change the background of the Stage to something more inspiring. The background is called a backdrop in Scratch.

1

To the right of the Sprite List, there is a panel for the Stage. At the bottom, hover over the round button to open the backdrop options. Use the magnifying glass icon to choose a backdrop from the library. (You can also just click the round button to choose from the library.) The other options enable you to paint a backdrop, get a surprise backdrop, or upload a picture from your computer



2

When the library opens, click the categories at the top to view the different backdrops available, and use the scrollbar on the right to see more designs. Select the Outdoors category



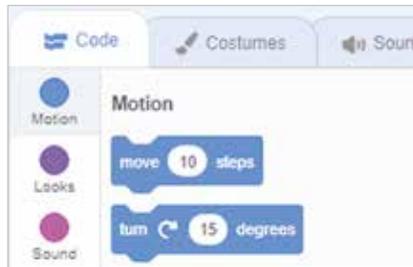
3

Scroll to find, and then select, the Hill image

Creating your first program

When you click blocks in the Blocks Palette, the cat moves immediately, so this is good for testing what blocks do, but not useful for making a program. A program is a set of repeatable instructions that you can store up to carry out later. For our first Scratch program, let's make the cat walk down the hill:

- 1 We're going to write a program for the cat, so click the cat in the Sprite List
- 2 Next, check that the Code Area is open. If the middle pane shows costumes or sounds instead, click the **Code** tab above the Blocks Palette
- 3 Click the **Motion** button to the left of the Blocks Palette (see screenshot, right)
- 4 You make a program by dragging blocks into the Code Area from the Blocks Palette. To do this for your first block, click the **turn clockwise 15 degrees** block in the Blocks Palette, hold the mouse button down, move the mouse pointer into the Code Area and then release the mouse button. This first block will point our cat downhill, ready for its walk



- 5 Click the **move 10 steps** block in the Blocks Palette, drag it into the Code Area and drop it underneath the **turn clockwise 15 degrees** block. They will snap together. When blocks are joined like this they make what's known as a "script". A sprite can have more than one script, and a program might include lots of sprites with several scripts



If you click and drag a block that's joined to other blocks above it in the Code Area, it will break away from them, and carry all the blocks underneath it with it.



You can move blocks around the Code Area, but if you drag them into the Blocks Palette, they'll be deleted.



Make sure the blocks snap together, otherwise they won't work as one script. If they don't snap together, they're not close enough.



I wouldn't usually recommend you add the same blocks repeatedly, but we're right at the beginning of learning Scratch here. There is a more readable and elegant solution you'll discover in Chapter 2.

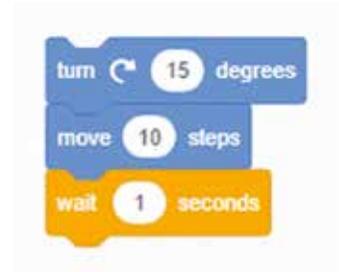


To right-click on a touchscreen device, tap and hold. When you duplicate a script, the copy is placed in the Code Area. You can drag it to the bottom of your script.

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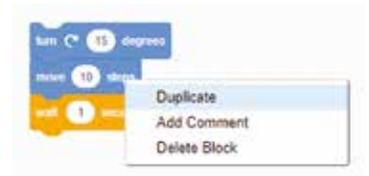
6

Click the **Control** button beside the Blocks Palette. Control blocks are used to decide when things should happen. Drag the **wait 1 seconds** block into the Code Area and snap it underneath the other two blocks. This block adds a 1-second delay. Without it, our cat would move so fast, it would appear to just jump from the start of its walk to the end. Slowing it down enables us to see what's going on. You can make it walk a bit faster by changing the delay from 1 second to 0.5 seconds



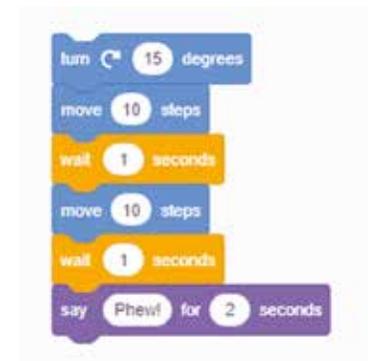
7

Right-click the **move 10 steps** block, and when the menu opens, choose **Duplicate**. This copies the block plus any blocks underneath it in your script. In our example, it copies the **move** and the **wait** blocks. Move the copy to the bottom of your program, and click to place the blocks there. You can repeat this step several times to make the cat walk further



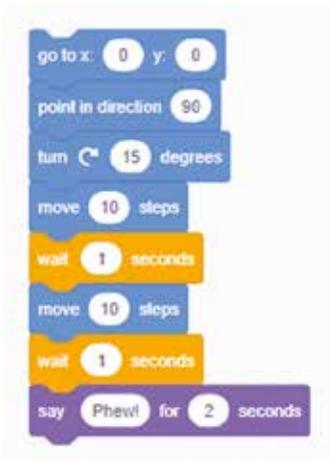
8

It's a long walk for a tiny cat, so let's make it finish its walk with an exclamation of "Phew!" in a speech bubble. Click the **Looks** button beside the Blocks Palette. Drag the **say Hello! for 2 seconds** block into the Code Area and join it to your program. Click Hello! to edit what the cat says to Phew!



9 When you start a script's commands, it's called "running" the script. To run your script, click any of the joined-up blocks in the Code Area. Scratch carries out all the joined-up instructions in order, starting at the top and working its way down the blocks

10 What happens if you click the script to run it again? The cat turns again and walks from where it finished last time. Eventually, it'll be walking on its head. Let's add some blocks to put it in the right starting position. Click the **Motion** button beside the Blocks Palette and drag in the **point in direction 90** block and the **go to x:0 y:0** block. If the **go to** block has different numbers in it, edit them both to make them zero. Add these blocks to the top of your script. Can you make the cat's walk longer?



You can insert blocks into an existing script. Instead of dropping a block at the end of your script, drag your block over it. The blocks in the script will make room to let the new blocks in. When the blocks are in the right place, release the mouse button or your finger.



Experiment! If you use a negative number of steps in the "move 10 steps" block, the sprite moves backwards. Why not see if you can make the cat walk backwards up the hill again?

Left: A few blocks and one exhausted cat later, here's your first program.

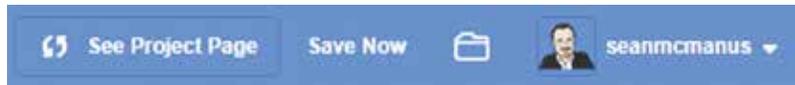


You can't use your projects in an older version of Scratch than you used to create them. You can use projects with a newer version, though.

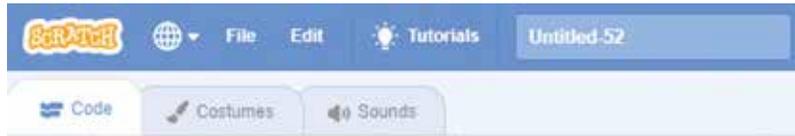
Saving your project

A Scratch project includes all the sprites, scripts and backdrops that are used in it. It's a good idea to save your projects so you can come back to them later to reuse them or modify them.

In Scratch 3 online, your work is automatically saved for you. If your latest changes have not been saved, there will be a link to **Save Now** in the blue bar at the top of the screen, beside the folder icon that gives you access to your projects.



Your project is saved with the name Untitled plus a number. You can choose a more useful name by editing the box in the blue bar, above the Code Area, and to the right of the tabs.



In the downloadable versions of Scratch, your work isn't automatically saved for you. Use the **Save to your computer** option in the File menu to save your work.

There are additional options for saving your work in the File menu. You can find it above the Blocks Palette, as shown above. These options include:

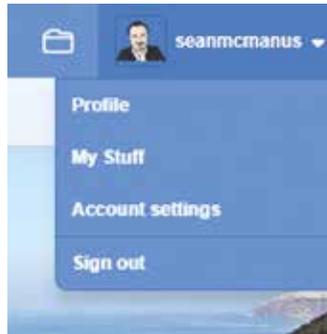
- **Save as a copy:** This makes a copy of your project with a new name. The previously saved version of your project is left untouched. Use this if you want to experiment with your project without losing a working version of it.
- **Save to your computer:** This enables you to save your project as a file on your computer. If your internet connection fails, use this option straight away to save your work!
- **Load from your computer:** If you previously downloaded a Scratch project to your PC, or used a downloadable version of Scratch to create it, use this option to upload it to the Scratch website, so you can edit and share it there.

Opening projects

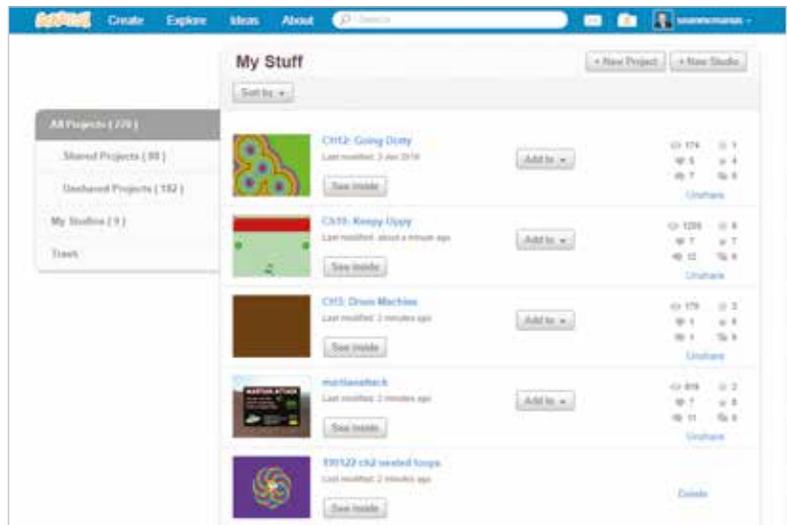
To find your projects on the Scratch 3 website, click the folder icon beside your username in the top right of the screen. You can also click your username and then click **My Stuff**.

If it says “Sign in” in place of your username, click it to sign in first.

The My Stuff section shows all your projects, with those you most recently edited nearer the top. You can see some of my projects in the screenshot below:



If you click the Share button on a project, it will be available for anyone to see, use and reuse. See Chapter 11 for more on sharing your projects.



Use the scrollbar at the right edge of your browser window to find more projects and click the **Load More** button when you get to the bottom of the list. To open a project for editing, click its **See inside** button. To simply run the project, click its screenshot.

Because projects are saved automatically, your My Stuff area quickly fills up with untitled projects. To tidy up, delete unwanted projects by clicking their **Delete** links on the right. If you delete a project by mistake, click the **Trash** folder on the left, and then click the **Put back** button to recover the project. You can't delete a shared project without unsharing it first (see page 209 in Chapter 11).



In downloaded versions of Scratch, you open projects by clicking to open the File menu at the top of the screen and then choosing Open.

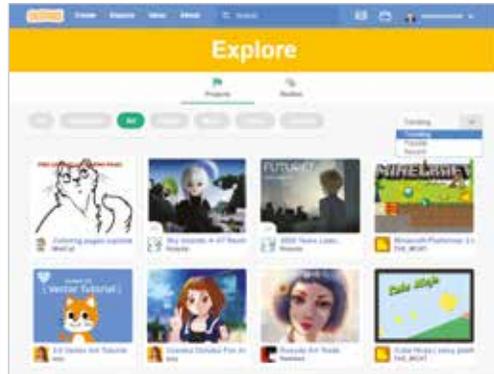


If you are logged in, you can click the Remix button to create your own version of a project shared on the Scratch website. All the projects on the Scratch website are shared on the understanding that others can learn from them, and create adaptations of them. You can find a Remix button on the project's page, and another in the blue bar at the top of the screen when you look inside the project.

Opening shared projects

You can open the projects that other people have shared on the Scratch website too. Visit the website at <https://scratch.mit.edu> and click **Explore** at the top of the screen.

Use the buttons to choose a category of projects to explore. The triangle to the right of the project categories opens a menu that you can use to find projects that are trending, popular, or recent.



Click a project to go to its page. The instructions on the right tell you how to use the project, and you click the **green flag** button to run it, either the one in the middle of the project or the one above the project's display. If you like what you see, and you want to know how it was done, click the **See inside** button in the top right to go into the editor and see the code.

