1 Introducing Scratch

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

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.

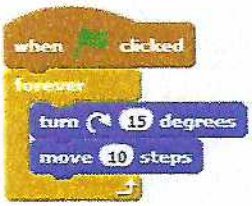
Scratch is a programming language that is perfect for making games, animations, interactive stories and other visually rich programs. It provides a great introduction to programming for people of all ages. It's widely used in schools and colleges, but Harvard University has also used it in higher education 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.

Hot tip

Scratch doesn't cost anything and it works on Windows, Mac and Linux computers.

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 always 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.



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

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 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.

Which version of Scratch?

There are two versions of Scratch that are in popular use. In this book, I'll tell you about both.

Scratch 2.0

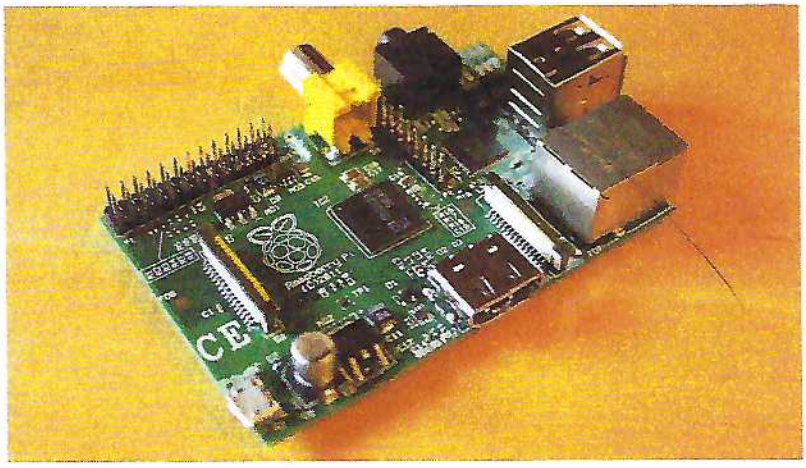
Scratch 2.0 is the latest version of Scratch, which was introduced in May 2013. I recommend you use Scratch 2.0 if you can. This version makes it easier for people to share their projects, take a look at each other's projects, and adapt them (or "remix" them).

You don't need to install any software to use Scratch 2.0: it runs inside your browser, using an Internet connection. Scratch 2.0 needs a computer that can run the Adobe Flash Player, though, so it doesn't work on some mobile devices (including the iPhone and iPad) and some lower-powered devices (including the Raspberry Pi). Most other computers run Scratch 2.0 fine.

There is also a version of Scratch 2.0 that you can download from the Scratch website and install on your computer, so you can use it without an Internet connection. There are no official plans to bring Scratch 2.0 to the Raspberry Pi, though.

Scratch 1.4

Scratch 1.4 is the previous version of Scratch, and it is software you install on your computer. You can download it for Windows, Mac and Linux at **http://scratch.mit.edu/scratch_1.4/**
This version of Scratch found a whole new audience with the meteoric rise of the Raspberry Pi, the stripped-down Linux-based computer for hobbyists and education (see photo).



Beware

If you're using the Scratch 2.0 website, I recommend using the Google Chrome browser with it. I experienced some bugs using Internet Explorer, which disappeared when I started using Chrome. You can download Chrome for free at **www.google.com/chrome**

Hot tip

ScratchJR is a younger cousin of Scratch, designed for iPads and Android tablets. There is also an unofficial version of Scratch 1.4 on the iPad called Pyonkee.

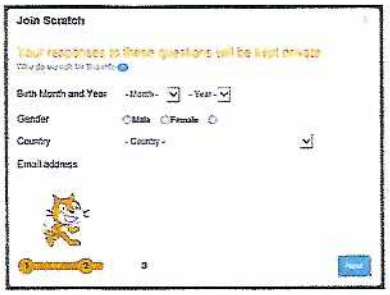
Hot tip

If you have a weak Internet connection, or none at all, you might prefer to use the downloadable version of Scratch to the browser-based version.

Creating a Scratch account

Before you begin to program with Scratch 2.0, 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 **http://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. Scratch is used by young people (among others), so the site advises members to protect their privacy by not using real names. 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 upper and lower case, 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. It doesn't appear on the website anywhere. Click the **Next** button



7. Click **OK Let's Go!** and you will be logged in. Simply click **Create** on the navigation bar at the top of the screen, and you're ready to start programming!

Hot tip

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.

Hot tip

You can try Scratch 2.0 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.

Hot tip

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

Using the Scratch screen

Don't forget

If you're using a Raspberry Pi, you're using Scratch 1.4. If you're using Scratch in a browser, you're using Scratch 2.0.

To start using Scratch 2.0, visit **http://scratch.mit.edu/** in your web browser and click **Create** at the top of the screen. To start using Scratch 1.4, double-click its icon on your desktop.

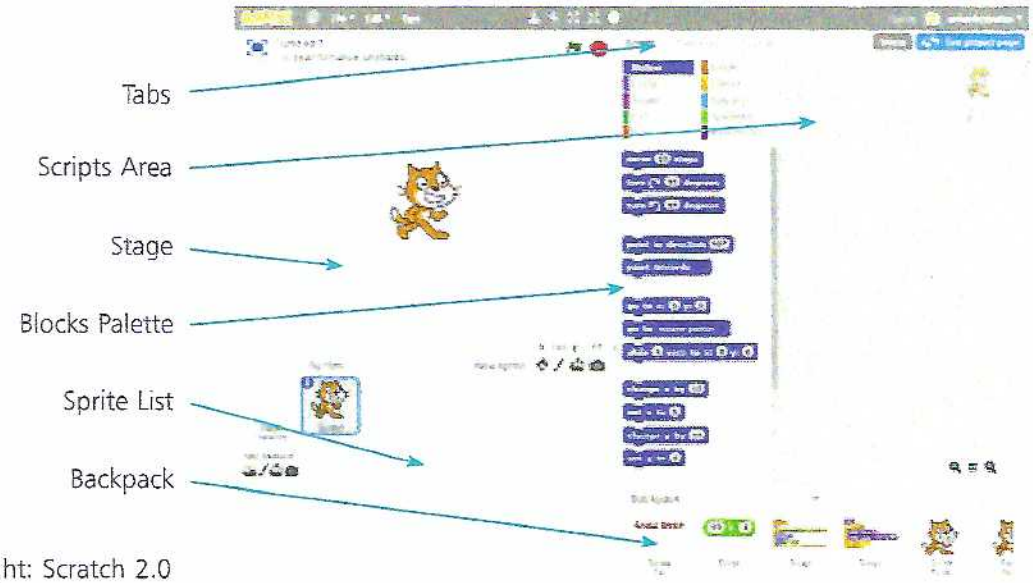
The most obvious difference between the two versions of Scratch is the way the screen is laid out. With the exception of the Backpack (a new feature in Scratch 2.0), all the same elements are there, but they've been juggled around a bit. The background colors have been lightened in Scratch 2.0 too. This page shows the screen layout in Scratch 2.0, and the facing page shows the screen layout in Scratch 1.4.

Hot tip

Use the tabs above the Blocks Palette (in Scratch 2.0) or above the Scripts Area (in Scratch 1.4) to switch between the scripts, costumes and sounds on a sprite. You'll learn all about how to use these later!

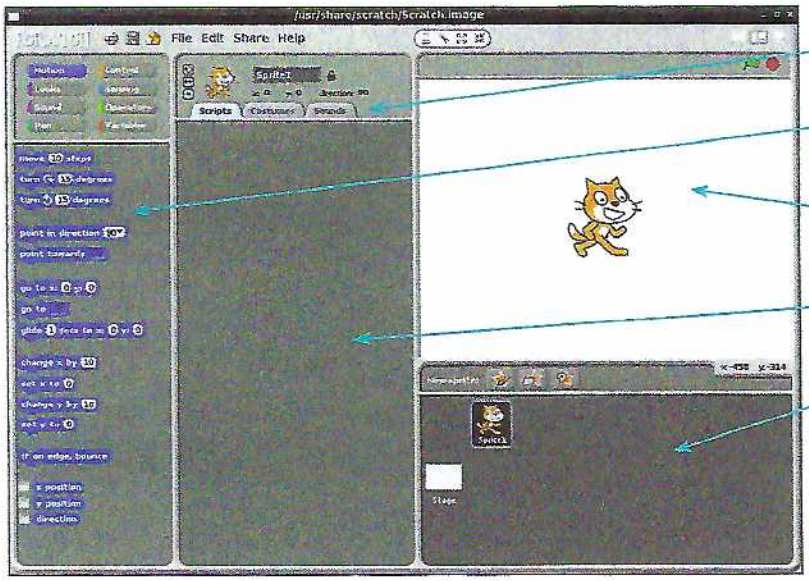
The main parts of the screen are:

- **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. In Scratch 2.0, the Stage is on the left, whereas in Scratch 1.4, the Stage is on the right.
- **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. In both versions of Scratch, the Sprite List is underneath the Stage.



Right: Scratch 2.0

- **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 above it, such as the **Looks** button or the **Sound** button.
- **Scripts Area:** The Scripts Area is where you make your programs in Scratch, by assembling blocks there. This area expands to fill the screen space available, so if you use a larger monitor, the Scripts Area will be bigger.
- **Backpack:** The Backpack is a new feature in Scratch 2.0, which you can find underneath the Blocks Palette and Scripts Area. Click it to open it. It works a bit like a clipboard. You can copy scripts or sprites to it by dragging them there and dropping them. If you want to use them, just drag them from the Backpack back into your project. Your Backpack works across all your projects, so it's a great way to copy sprites or bits of program between different projects.



Tabs

Blocks Palette

Stage

Scripts Area

Sprite List

Left: Scratch 1.4

Don't forget

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 these pages are here to refer to at any time.

Exploring the blocks

Before we start making a program, try experimenting with a few blocks to see what they do:

Hot tip

Sometimes I'll show you what something looks like in both Scratch 2.0 and Scratch 1.4. The picture on the left, or top, will be Scratch 2.0. The one on the right, or bottom, will be Scratch 1.4.

1. Click the **Motion** button above the Blocks Palette to show the Motion blocks. This button is selected when you first start Scratch

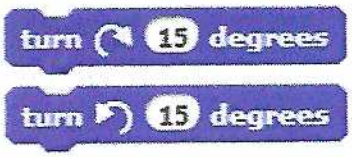
2. In the Blocks Palette, click the **move 10 steps** block. The cat on the Stage moves in the direction it's facing, to the right. Each time you click the block, the cat moves once. This block only changes the cat's position, though: you won't see its legs move

Hot tip

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.

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

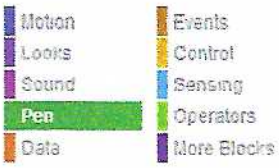
4. Rotate the cat by clicking the **turn clockwise 15 degrees** block. To change the angle of the turn, change the number. Remember to click the block to actually make the cat turn. When you click the **move 10 steps** block next time, the cat walks in its new direction



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

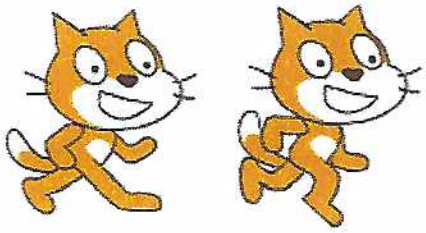
6 Click the **Pen** button above the Blocks Palette



7 Click the **pen down** block. Now, if you click the Motion button and click the blocks to move the cat around, it will leave a line behind it wherever it goes. There is also a **pen up** block you can use to turn this effect off again

8 Click the **Looks** button above the Blocks Palette

9 Click the **next costume** block to see the cat's legs move, so it appears to run on the spot. Costumes are just different pictures a sprite can have, and the cat has two that show its legs in different positions (see below)



Hot tip

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.

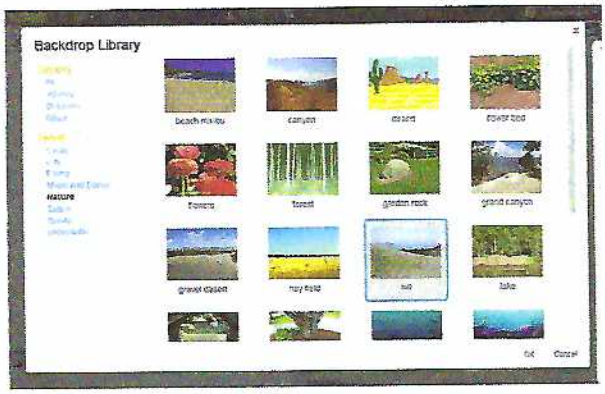
Changing the backdrop

Before we make our first program, let's change the background of the Stage to something more inspiring. The way you do this is different in Scratch 2.0 and Scratch 1.4.

Choosing a backdrop in Scratch 2.0

1. To the left of the Sprites List, there is a panel for the Stage. Underneath the heading New Backdrop, click the first icon to choose a backdrop from the library. The other icons enable you to paint a backdrop, upload a picture from your computer, or use your webcam to take a photo

2. When the library opens, click the themes and categories on the left to view different backdrops available, and use the scrollbar on the right to see more designs. Click the Nature theme



3. Click the hill image, and then click the **OK** button

4. Your backdrop is added to the Stage, behind the cat, and the Paint Editor opens on the right so you can edit the background if you want to. We'll look at the Paint Editor in Chapter 4

Hot tip

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 2.0 and you can't see the File menu, click Create instead at the top of the screen.

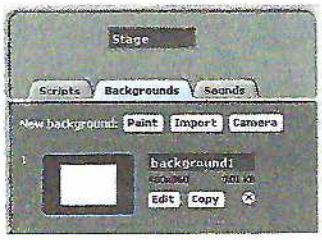
Don't forget

In Scratch 2.0, the picture on the Stage is called a backdrop. In Scratch 1.4, it's called a background.

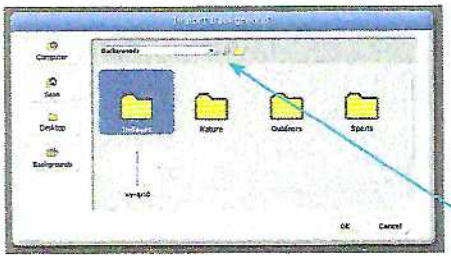
Choosing a background in Scratch 1.4

1. To the left of the Sprite List is a white icon that represents your blank Stage. Click it to start

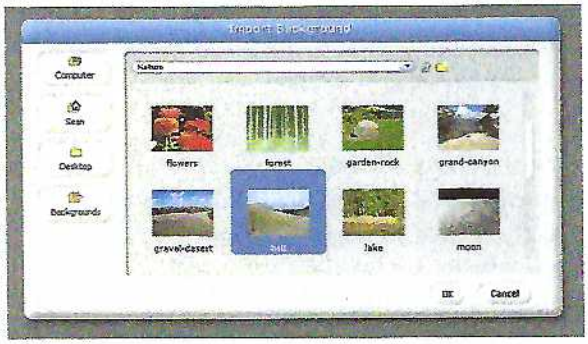
2. Click the **Backgrounds** tab above the Scripts Area, then click the **Import** button



3. Use the file browser to explore the backgrounds available. Double-click a folder icon to look inside that folder. To go back to the previous folder, click the **up arrow** indicated below



4. Go into the Nature folder and use the scrollbar on the right to find the hill picture. Click it and then click **OK**



5. Your background is added to the Stage, behind the cat

Hot tip

You can also use the file browser in Scratch 1.4 to find your own files on your computer to use as backgrounds. In the left of the file browser, Click Computer, your username or Desktop to start browsing your computer. To get back to the Scratch backgrounds again, click Backgrounds.

Creating your first program

Hot tip

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

Beware

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

Don't forget

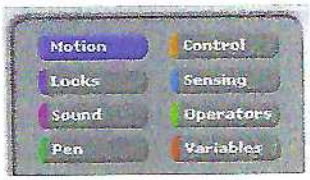
Make sure the blocks snap together, otherwise they won't work as one script. If they don't snap together, they're not close enough.

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 Scripts Area is open. If the Scripts Area is empty, you're ready. If it shows costumes or sounds instead, click the **Scripts** tab. In Scratch 2.0, the **Scripts** tab is above the Blocks Palette. In Scratch 1.4, it's above the Scripts Area

3. Click the **Motion** button above the Blocks Palette

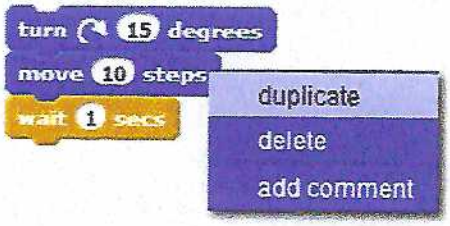


4. You make a program by dragging blocks into the Scripts Area from the Blocks Palette. To do this for your first block, click the **turn clockwise 15 degrees** block in the Blocks Palette, hold the mouse button down, move the mouse pointer into the Scripts Area and then release the mouse button. This 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 Scripts 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

6 Click the **Control** button above the Blocks Palette. Control blocks are used to decide when things should happen. Drag the **wait 1 secs** block into the Scripts Area and snap it underneath the other two blocks. This block adds a 1 second delay. Without it, our cat will move so fast, it'll appear to just jump from the start of his walk to the end. Slowing him down enables us to see what's going on. You can make him 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 him finish his walk with a exclamation of 'Phew!' in a speech bubble. Click the **Looks** button above the Blocks Palette, and drag the **say Hello! for 2 secs** block into the Scripts Area and join it to your program. Click Hello! to edit what the cat says to Phew!

Beware

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.

Hot tip

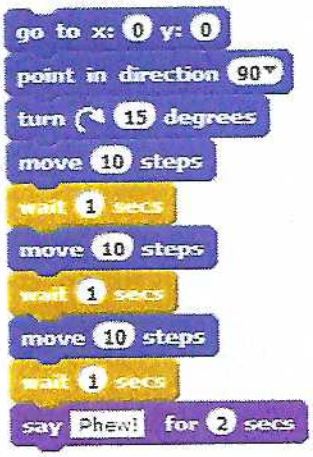
If right-clicking doesn't work for you (or your mouse doesn't have a second button), hold down the Control key on your keyboard and click, or try holding down the Shift key and clicking. This tip applies anywhere you're asked to right-click later in the book.

Hot tip

You can insert blocks into an existing script. Instead of dropping a block at the end of your script, drag your block over it and a white line will show you where the block will be dropped. When it's in the right place, release the mouse button.

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 Scripts 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 above the Blocks Palette and drag in the **point in direction 90** block and the **go to x:0 y:0** blocks. 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



Hot tip

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?

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

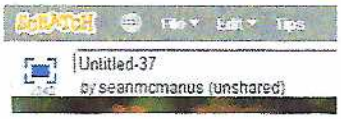
Saving your project

A Scratch project includes all the sprites, scripts and backgrounds 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.

Saving projects in Scratch 2.0

In Scratch 2.0 (web version), your work is automatically saved for you as you make changes to your project. In the top-right corner of the screen, you can see whether your latest changes have been saved. If they haven't, there will be a link here to **Save Now**.

Your project is saved with the name Untitled plus a number. You can choose a more useful name by editing the box above the Stage.



There are additional options for saving your work in the File menu, also above the Stage, see below. These 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 program without losing a working version of it.
- **Download to your computer**: This enables you to save your project as a file on your computer. You can open it using the downloadable version of Scratch 2.0. If your Internet connection fails, use this option straight away to save your work!
- **Upload 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 2.0 website.

- **Revert**: This throws away all the changes you've made to the project since you opened it this time.

Beware

You can't use projects made using Scratch 2.0 in Scratch 1.4. You can use Scratch 1.4 projects in 2.0, though.

Hot tip

In the downloadable version of Scratch 2.0, your work isn't automatically saved for you. Use the Save option in the File menu to save your work. Use the Save As option to save your project with a new filename, so you don't overwrite the previous version.

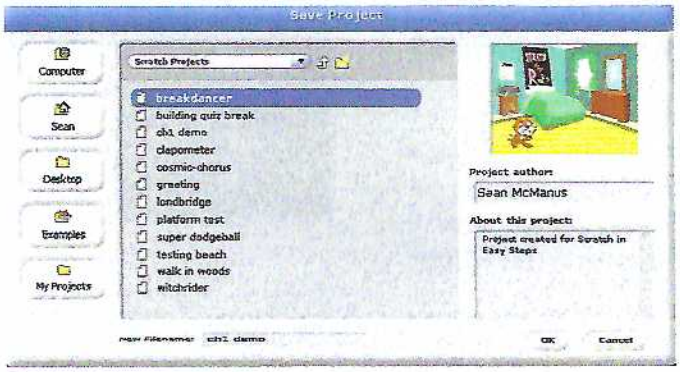
...cont'd

Saving and opening your project in Scratch 1.4

Click the File menu above the Blocks Palette at the top of the screen. This menu's options include:

- **Open**: Opens a previously saved file.
- **Save**: Use this to save a new project, or an old project you've been editing. If you're saving a new version of a saved project, you'll replace the old saved version.
- **Save as a copy**: If you want to keep the previous version of a project, use this option. It will save a new file containing your project, and leave the previous file untouched.
- **Import Project**: This enables you to open a project, and combine its sprites, scripts and backgrounds with the project that's currently open.
- **Export Sprite**: This option enables you to save a sprite as a costume you can use in other projects. You'll learn about costumes in Chapter 5.

When you save a new project or a new copy of a project, the file browser opens, as shown below. The buttons down the left are used to choose where to save your file. Click the folder name at the top (Scratch Projects in the screenshot) to choose another drive or folder, and click the up arrow beside it to go up a folder. Type the filename in the box at the bottom and click **OK**.



Hot tip

Click Examples on the left of the file browser to find some demo projects.

Hot tip

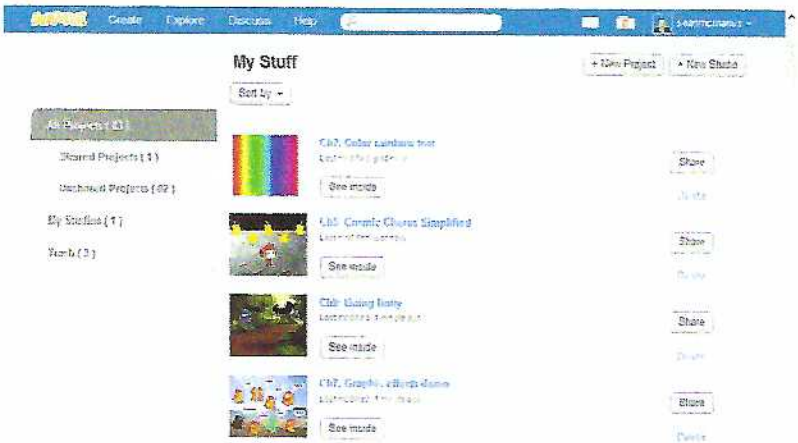
You can add the project author name and a short description of the project in the boxes on the right in the file browser.

Don't forget

If you are using Scratch 1.4, remember to save regularly to make sure you don't lose any of your work.

Opening projects

In the downloadable version of Scratch 2.0, you open projects through the File menu at the top of the screen. The website is a bit more complicated. To find your projects there, click your username in the top-right of the screen 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. Take a look at my projects in the screen below:



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. If no more projects load when you click the button, that's all of them. To open a project, click its **See inside** button.

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.

Beware

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.

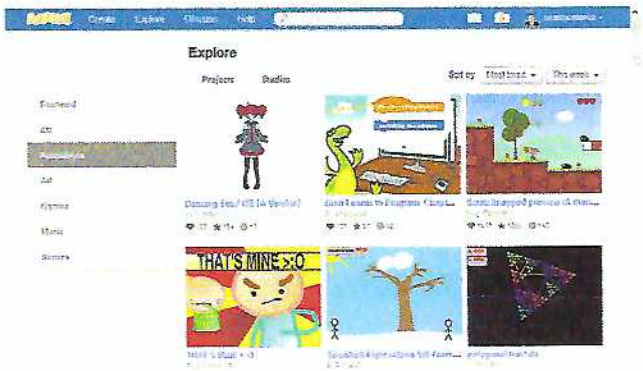
Don't forget

In Scratch 1.4, you open projects by clicking to open the File menu at the top of the screen and then choosing Open.

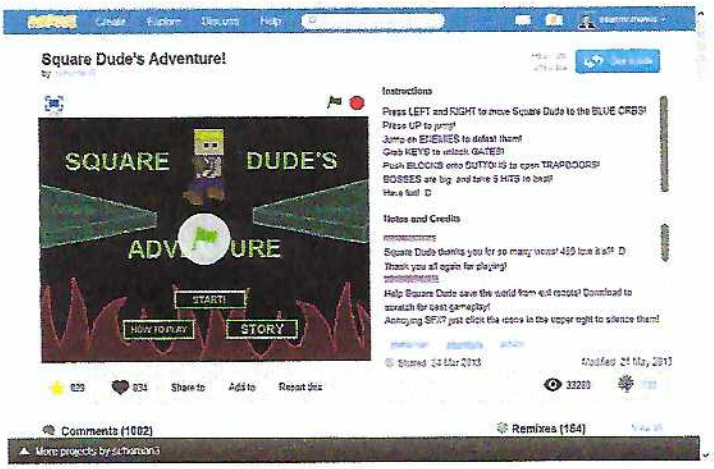
Opening shared projects

You can open the projects that other people have shared on the Scratch website too. Visit the website at **http://scratch.mit.edu** and click **Explore** at the top of the screen. Use the options on the left to choose a category.

The menus in the top right enable you to sort by the most loved, most remixed and most recent, and to choose how new you want the projects to be.



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 in the middle of the player to run it. 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 scripts, sprites and backgrounds that make it work.



Hot tip

When you open somebody else's project in the editor, you can click the Remix button in the top right to create your own version of it. All the projects on the Scratch website are shared on the understanding that others can learn from them, and create adaptations of them.

Beware

At the time of writing, there isn't a way to download shared projects from the website to use in Scratch 1.4.