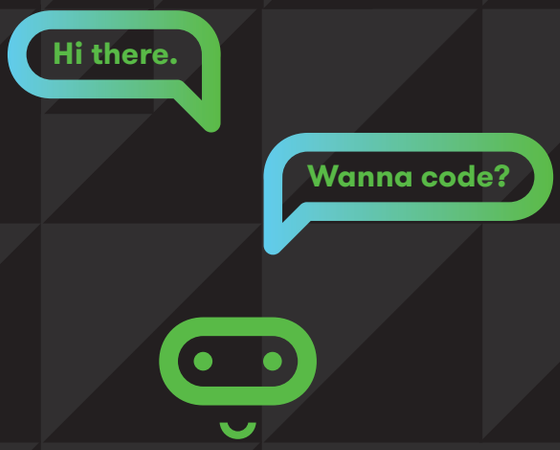
BBC

micro:bit

QUICK START GUIDE FOR TEACHERS



- Tips and advice for getting to grips with the BBC micro:bit
- Step-by-step coding challenges with clear solutions
- Guidance on creating and sharing your own programs and tutorials

Supported by Microsoft

Foreword

Computational thinking is the thought processes involved in formulating a problem and expressing its solution(s) in a way that a computer – human or machine – can carry out effectively. In 2006, I began to advocate that everyone, regardless of profession, of career, or of age, can benefit from learning how to think computationally[1]. With the BBC micro:bit, the BBC and its partners, including Microsoft, catalyze our realization of this dream. Children can learn how to think computationally by first formulating a problem and conceptualizing a solution. Then, by expressing their solution using a code editor, such as Microsoft TouchDevelop, and by compiling and running their programme on the BBC micro:bit, they can see their code come alive!

I commend the BBC and the UK for their leadership in the Make it Digital initiative. Teaching children at an early age the fundamentals of computing helps provide them with the programming skills and the computational thinking skills they will need to function in the 21st Century workforce. Programming the BBC micro:bit will teach children basic coding concepts, such as variables, types, procedures, iteration, and conditionals. Solving problems with the BBC micro:bit will expose children to computational thinking skills, such as abstraction, decomposition, pattern matching, algorithm design, and data representation. Students knowledgeable with these skills will be in high demand by all industrial, government, and academic sectors, not just information technology.

Most importantly, the BBC micro:bit will introduce children to the joy of computing. Making one's personal device do whatever one wants is empowering. Programming the BBC micro:bit will tap into a child's imagination and creativity. The device and programming environment provide a playful way to explore a multitude of computational behaviors.

I am thrilled to see this Quick Start Guide for Teachers, which is rich with examples that show how hands-on coding is easy and natural. Let's have fun together!

Jeannette M. Wing
Corporate Vice President, Microsoft Research
25 May 2015

[1] Jeannette M. Wing, "Computational Thinking," Communications of the ACM 49 (3): 33, 2006.

Contents

Acknowledgements

Written by: Miles Berry and Ray Chambers
Additional material written by: Ross Lowe

Consultants: Roger Davies
Project managed and developed by: Becca Law
Cover and text design: me&him Design

Typeset in GT Walsheim Regular, Bold and Helvetica TT Regular, Oblique, Bold by **me&him Design**.

A catalogue record for this title is available from the British Library.
ISBN: 978-1-471-86382-0

Printed in the UK by
Ashford Colour Press Ltd

Acknowledgements
Thank you to the following people who contributed their ideas and support: Steve Connolly and Debbie Smith, Hodder Education; Ray Chambers, Uppingham Community College; Miles Berry, University of Roehampton; Roger Davies, Queen Elizabeth School; Clare Riley, Jeannette Wing, Thomas Ball, Peli de Halleux, Michal Moskal, Eric Anderson, Jonathan Protzenko, Steve Hodges, Deirdre Quarnstrom, Vardhani Mellacheruvu, Lori Ada Kilty, Darren Gehring and Judith Bishop from Microsoft and the BBC team.

The *Make It Digital* initiative

In March 2015, the BBC launched *Make it Digital* – a major UK-wide initiative to inspire a new generation to get creative with coding, programming and digital technology.

The project aims to put digital creativity in the spotlight like never before, and to help build the nation's digital skills, through an ambitious range of new programmes, partnerships and projects.

These include:

- A major partnership to develop and give a BBC micro:bit coding device to all year 7 children across the UK, for free, to inspire a future generation.
- A season of programmes and online activity involving the BBC's biggest and best-loved brands, including Doctor Who, EastEnders, Radio 1, The One Show, Children in Need, BBC Weather and many more, including a new factual drama about the development of Grand Theft Auto on BBC Two and a documentary on Bletchley Park.
- The Make it Digital Traineeship to create life-changing opportunities for up to 5,000 young unemployed people; the largest traineeship of its kind.
- Partnerships with around 50 major organisations across the UK.
- A range of formal education activities and events, including Bitesize, Live Lessons and School Report.

The BBC micro:bit initiative

Back in the 1980s, the BBC Micro was used extensively in primary and secondary schools and was instrumental in inspiring a generation of technology pioneers. Nowadays, computing and digital technology can be found everywhere, but the emphasis seems to have shifted from the creation of technology to the consumption of it.

As part of the *Make it Digital* initiative, the BBC has collaborated with over 25 organisations to create the BBC micro:bit, a personal programmable device, which will be provided, free of charge, to every child in Year 7 across the UK.

It provides an exciting and accessible introduction to coding on a simple hardware platform. Its purpose is to enthuse, excite and empower a new generation of digitally-creative young people. This is why the BBC micro:bits are specifically designed for young people themselves to own.

The micro:bit device

The BBC micro:bit is a very simple computer. It is programmed by using another device (smart phone, tablet, PC, IPad etc.) to write the program, which is then compiled and downloaded onto the BBC micro:bit. The newly programmed BBC micro:bit can be disconnected and will run the program, just like other embedded devices, such as a digital watch, a GPS device or a pocket calculator.

See section on Coding building blocks on **page 11** and Challenges and Solutions on **pages 12–27**

The device has a display made up of 25 LEDs and some simple input controls that can be used in a number of ways. It is small enough to slip into a pocket or even wear.

The BBC micro:bit offers a gentle introduction to programming and making: switch on, program it to do something fun, wear it, customise it, and put new ideas into action. It can be programmed to show words or shapes, tell the time or play games.

It is designed to be a starting point to get young people interested in coding so they can move on to other, more sophisticated devices in future. The BBC micro:bit has an accelerometer, which can detect movement, and it can connect and communicate with other devices, including Arduino, Galileo and Raspberry Pi.

It offers a natural progression from screen-based programming using visual languages, and can lead on to more complex, text-based programming.

The BBC micro:bit also has Bluetooth Low Energy, allowing it to be part of the 'Internet of Things' – the extension of the internet beyond computers and smartphones to include other embedded systems, from fridges to cars, and even home central heating systems.

Supporting learning

The BBC and its partners recognise that a hands-on learning experience can help young people to grasp the computing curricula in ways that on-screen coding activities and traditional classroom learning cannot.

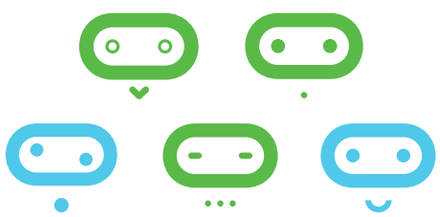
You can share links to tutorials and code with other microbit users via the dedicated BBC micro:bit CAS forum at: **computingatschool.org.uk/**

The BBC micro:bit can help learners to develop their understanding of physical technology and computing, offering the opportunity to apply complex thinking, analytical and problem-solving strategies.

Inspirational content on BBC radio and television will raise awareness of the BBC micro:bit, while teachers, parents and young people will be encouraged and supported to get the most out of the device through a rich range of online resources and real-world events created by the BBC and partners.

Partnerships

More than 25 organisations have been involved in this pioneering partnership. See **live.microbit.co.uk/start-guide/partnerships** for more information.



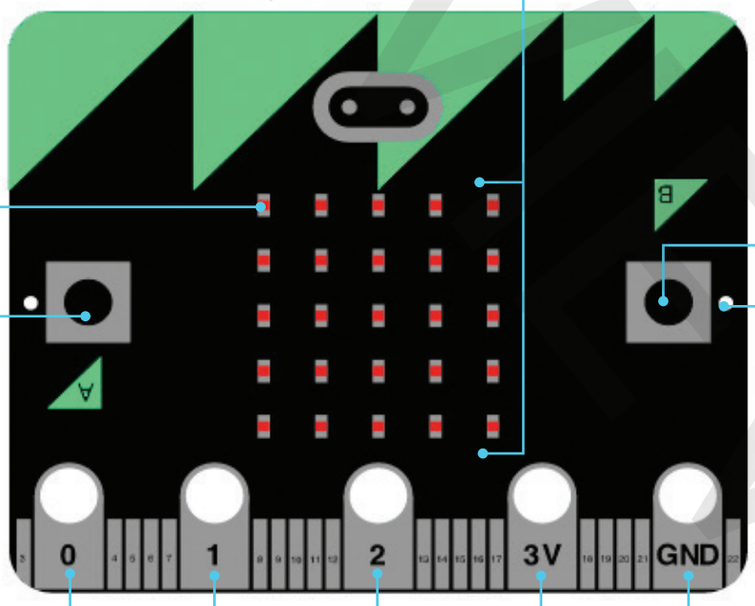
The **BBC micro:bit:** What is it designed to do?

The BBC micro:bit is a very simple computer. A computer is a machine that accepts input, processes this according to stored instructions and then produces output. All three of these elements are present on the BBC micro:bit's printed circuit board.

Front of board

LED
Coordinates start at (0,0) in top left hand corner. In computing, displays start at the top left hand corner so, in coding terms, this is (0,0). This is different from mathematics and graphs where (0,0) is the bottom left corner. It is important to note this is also relative, so if the screen rotates (0,0) is still the top left corner of the screen. See Challenge 3 for the use of coordinates in the Catch the egg game.

LED MATRIX
5 × 5 array of light emitting diodes (LEDs), which can each be set to on / off. The brightness of the set of LEDs as a whole can also be controlled.



BUTTON B
See Button A

HOLES
Holes for sewing, mounting and hanging.

BUTTON A
A form of input. The BBC micro:bit detects when this button is being pressed. This is a push-to-make switch (pressing it completes an electrical circuit).

PINS P0, P1, P2
Pins for attaching external sensors, like thermometers or moisture detectors, and actuators, like turning a motor on, so kids can build projects with them like a plant watering alarm. Can be either input or output and either digital or analogue.

3V AND GND
Enable a user to power an external device, like a motor, using the battery or USB. They also enable capacitive touch (using an object as a switch).

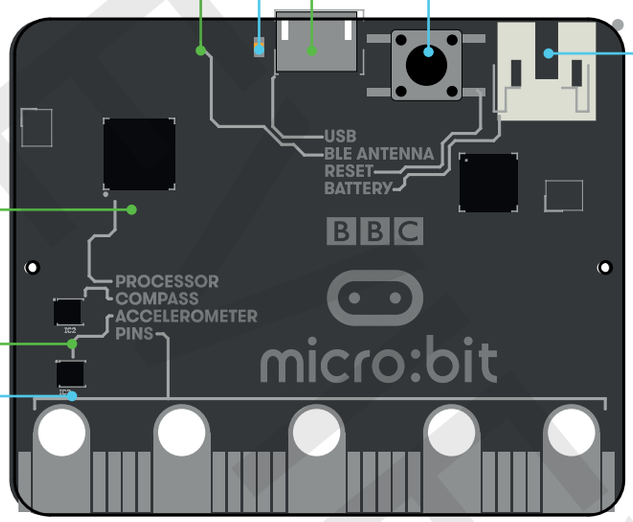
Back of board

BLUETOOTH LOW ENERGY ANTENNA
A messaging service, built for the Internet of Things, so devices can talk to each other. The micro:bit will be a peripheral device and it can talk to a central device like a smartphone or tablet (or a laptop that has BLE). This means the micro:bit can send signals to and receive signals from a central device. BLE will be used to 'flash' new programmes onto the micro:bit and to allow the micro:bit to communicate with a computer or an internet connection.

USB PLUG
Programs can be downloaded from Windows and Macs onto the micro:bit via a USB data connection. The USB connects the micro:bit to a computer. This means the micro:bit can send data to and receive data from the computer. The USB will be used to 'flash' new programmes onto the micro:bit and to allow the micro:bit to communicate with a computer or an Internet connection.

STATUS LED
Flashes yellow when the system wants to tell the user something has happened.

BUTTON R
System button, which has various uses. Has to be pressed to 'flash' new code onto the device over BLE.



PROCESSOR
All the BBC micro:bit's programs and any data are stored on the small silicon-chip micro-controller. This tiny chip designed by ARM has 128kB flash memory and 16kB RAM memory; a tiny fraction of the memory on a smart phone.

BATTERY
This socket connects the external battery pack (containing two AAA batteries) to the board. The battery pack is attached physically to the board with a Velcro patch.

COMPASS
A sensor to detect magnetic fields, like the Earth's, allowing the direction of the micro:bit to be determined and converted to a digital form that can be used in micro:bit programs. Output from the compass is degrees.

ACCELEROMETER
Converts analogue information about how quickly the BBC micro:bit's speed changes to a digital form that can be used in micro:bit programs. Output from the accelerometer is in milli-g. Allows the BBC micro:bit to be used to control movement of on-screen characters such as Kodu (see page 11).

A note about ARM

ARM designs the processors for most mobile phones and embedded systems (such as smart thermostats, car engine controllers and the processors inside digital cameras), and was founded by members of the original BBC Micro team!

BBC micro:bit is based on ARM's mbed platform for embedded systems, but programming the BBC micro:bit is very straightforward.

A note about machine code

Machine code is the language the CPU (central processing unit) of a computer understands, but it isn't very readable by humans as it is made up of numbers.

Machine Code is known as a low level language. High level languages, such as Blocks or TouchDevelop, are readable/understandable by humans. A program written in a high level language, like TouchDevelop, has to be compiled (translated) into machine code that the processor 'understands' (see page 10).

The BBC micro:bit website

The BBC micro:bit website live.microbit.co.uk is the starting point for learning about and programming on the BBC micro:bit. There is extensive help available on the site, including scaffolded, step-by-step tutorials for programming the BBC micro:bit.

01 My Scripts

Sign in to the BBC micro:bit website to:

- save and retrieve scripts,
- compile code and 'flash' it to a micro:bit,
- publish scripts to the micro:bit website
- share code with other BBC micro:bit users
- set up groups, with access codes, for your students to join

To sign in:

- Enter your facilitator code provided (email BBCmicrobit@bbc.co.uk if you don't have one).
- Authenticate your account by entering a username and password from an existing account (Facebook, Google, Microsoft, Office 365)
- Agree to the terms of use.

For more information visit live.microbit.co.uk/help.

02 Create Code

Click here to choose and select an available code editor (see below) to start creating programs for the BBC micro:bit.

All code editors come with a BBC micro:bit simulator, so you can test ideas and code on screen without having to have a BBC micro:bit plugged into the computer to run the code you write. Two key editors are currently available to program the BBC micro:bit.

Blocks

This is a graphical, drag and drop code editor, where coding blocks snap together. It's quite similar to Scratch, which many students may have encountered in primary school. There's support for the main input and output functions of the BBC micro:bit, as well as standard programming constructs such as sequence, selection, repetition and variables.

It's easy to start a project in Blocks and then convert it to a TouchDevelop script.

TouchDevelop

The TouchDevelop editor sits between visual, block-based languages, such as Blockly, and traditional, text-based programming languages, such as Python. The editor is based on the TouchDevelop programming language and comes with a BBC micro:bit library of commands installed.

Like other text-based programming languages, TouchDevelop provides a great deal of flexibility: as well as supporting input, output, sequence, selection, repetition and variables, there's also support for user-defined functions, making this a good choice for developing the ideas of decomposition and abstraction.

Other code editors

A number of other code editors will be available from the Autumn term 2015. See live.microbit.co.uk/create-code for up-to-date information on which code editors are available.

03 Tutorials

The BBC micro:bit site offers different types of coding tutorials. Some tutorials are interactive and lead you through the creation of a program step-by-step with on-screen tips. Others present guided challenges with fewer instructions. Here we provide support by signposting key instructions and routes through projects.

04 Projects

This is a bank of BBC micro:bit projects created by other coders for you to explore, use and adapt.

Some of these projects have been created by the BBC and BBC micro:bit partners, but most will be written by young people themselves and other BBC micro:bit users. These are a great starting point for seeing just what the BBC micro:bit can do, as well as learning how to program it. It's much easier to take someone else's program and edit it to make it work a little (or a lot) differently, than having to start programming from a blank screen.

05 Getting Started

These are video and step-by-step guides for getting started with the BBC micro:bit. These videos and guides walk you through the process of starting to write some code, including switching between the different code editors available, saving projects, installing the loader software on your computer, connecting the BBC micro:bit and uploading code to it via the loader. This content will be continually updated.

06 Teachers and Parents

This introduces the BBC micro:bit in the context of its use in the classroom and at home. It contains useful information for anyone supporting children on their BBC micro:bit journey.

07 Help

Here you will find frequently asked questions and where to go for additional support.

Getting started with the **TouchDevelop** editor

Once you've signed in to the BBC micro:bit website (see details on page 6), you can get started with coding!

01

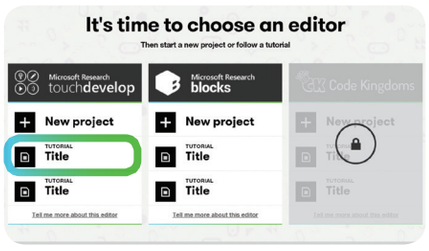
Type **live.microbit.co.uk** into your web browser.

02

Click **Create Code**.

03

In the TouchDevelop section, click the second link down.



04

Have a go at clicking some of the buttons on screen to see what they do.

CODING AREA
This is where all your coding takes place.

RUN
Click to run a program. The simulator on the right-hand side of the screen will show the code in action.

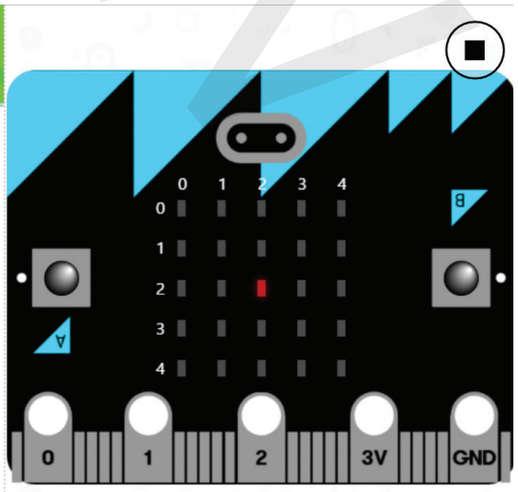
UNDO
Click to undo any changes to your code.

MY SCRIPTS
Click to return to any previous scripts you've written in the TouchDevelop editor.

COMPILE
Click to compile your program to allow it to run on the BBC micro:bit (see page 10 for more information about the compilation process).

SCRIPT
Click to display all the functions you're working with, any libraries you're using as part of your code (these are sets of functions developed by other people that you can use in your script) and any global data.


```
function main ()
    while true do
        micro:bit → plot(2, 2)
        micro:bit → pause(200)
        micro:bit → clear screen
        micro:bit → pause(200)
    end while
end function
```



05

Click on the micro:bit->plot(2,2) instruction that's already in the script. A code keyboard will appear at the bottom of the screen.

+
Click to add instructions above or below the selected line.

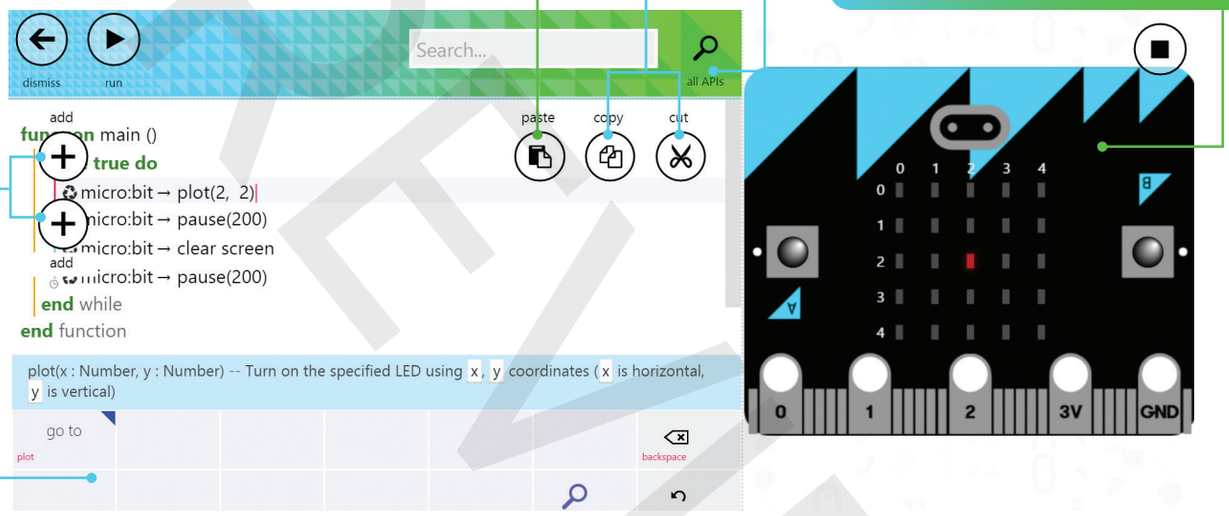
CUT / COPY
Click to cut or copy selected code.

SIMULATOR
All BBC micro:bit code editors include a simulator, which shows how your program will execute.

This means you can:
- start writing code for the BBC micro:bit even if you don't have the actual device.
- test programs on the simulator to ensure they work before downloading the code to the BBC micro:bit.

PASTE
Click to paste in cut or copied code.

ALL APIS
Search for appropriate code / functions to add to your programs.



CODE KEYBOARD
The keyboard makes it easy to edit your code on a touch screen device or just using a mouse. If you're working with a normal keyboard, you can enter language commands by just typing, and you'll see the possible command completions appear automatically.

Where next?

To try out some simple programs to use with the BBC micro:bit, see *Coding building blocks* on page 11. To start working through step-by step BBC micro:bit programming challenges, see pages 12-26. Once you've completed all three challenges, visit **live.microbit.co.uk/start-guide/certificate** to pick up your certificate!

Learning more about TouchDevelop

There's much more to TouchDevelop than the BBC micro:bit. Because of its touch-based interface, it's a great coding platform to use on tablets or even smartphones. Typically, it's used to produce web-based apps that can run online on any platform, so it's also a good tool to use when teaching students to develop apps for smartphones or tablets, without having to worry about platform-specific details.

The main TouchDevelop website, **touchdevelop.com/**, has all the details, the online editor itself, plenty of shared examples and a number of interactive, step-by-step tutorials.

Uploading programs to the BBC micro:bit

How does my program get onto the BBC micro:bit?

For your program to work on the BBC micro:bit, first it has to be compiled. Compiling means to translate a program into a more efficient computer language.

When you hit the compile button on the TouchDevelop editor interface, your program is actually compiled twice.

First, your program is translated into a C++ program. C++ is a very popular language for programming software systems, both large (like Microsoft Windows) and small (like the BBC micro:bit).

Second, the C++ program is translated into a binary file that contains the machine code in the instruction set used by the ARM processor that is on your BBC micro:bit. Compiling to C++ actually happens in the web browser itself, and then the C++ code is sent over the internet to a server (at developer.mbed.org) which compiles the C++ code to the ARM machine code (the hex file), which then gets sent back to your browser. When you drag the hex file over to the drive for your BBC micro:bit, your ARM binary program is installed and begins to run.

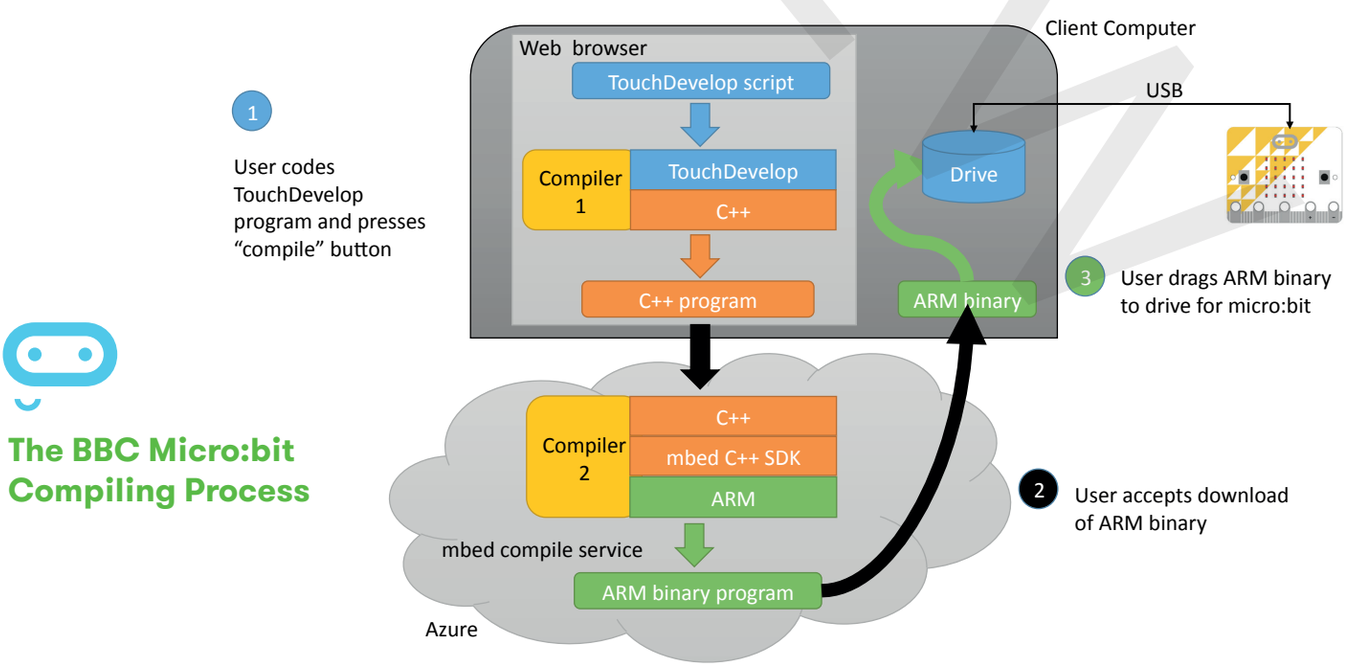
The BBC micro:bit hardware is built using ARM's open source mbed platform. This means that as well as using TouchDevelop and the other editors on the BBC micro:bit site, it is possible for more confident coders to program the BBC micro:bit using industry-standard development tools, including ARM's online C++ compiler at developer.mbed.org.

Getting your programs onto the BBC micro:bit

The last stage – getting your program onto the micro:bit itself – is quite easy.

- Hit the compile button in the code editor. A .hex file will be created.
- Assuming there aren't any error messages at this stage, download the '.hex' file.
- Plug the BBC micro:bit in to your computer's USB port using a standard micro USB cable (supplied). The BBC micro:bit should show up as a USB storage device.
- Drag the .hex file onto the drive that corresponds to the BBC micro:bit. Once the system LED has stopped flashing, press the reset button on the back of the BBC micro:bit to start the program.

Once a program is uploaded to the BBC micro:bit, the device can be unplugged and will run independently, as long as the user has attached a battery pack.

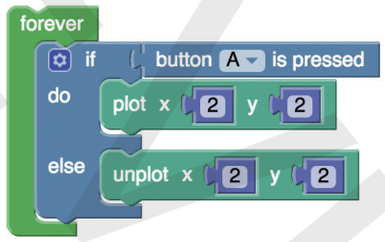


The BBC Micro:bit Compiling Process

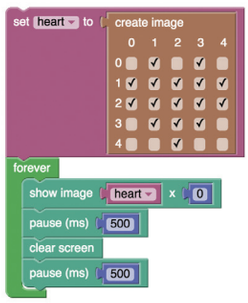
Coding **building blocks**

It's easy to get started with coding on the BBC micro:bit. The images below show the code you need (both in the Blocks and TouchDevelop editors) to make your BBC micro:bit do simple things. These could be used to kick off your first BBC micro:bit coding sessions with your students and can also be used in more complex projects.

Activity	Code in **Blocks**	Code in **TouchDevelop**

Press a button to turn on a light		Online tutorial:
		live.microbit.co.uk/td/tutorials/button-light
		`function main ()`
		`  while true do`
		`  if ♻micro:bit→ button is pressed("A") then`
		`  ♻micro:bit→ plot(2, 2)`
		`  else`
		`  ♻micro:bit→ unplot(2, 2)`
		`  end if`
		`  end while`
		`end function`

Scrolling text		Online tutorial:
		live.microbit.co.uk/td/tutorials/scroll-text
		`function main ()`
		`  while true do`
		`  ♻micro:bit→ show string("Hello, World!", 100)`
		`  end while`
		`end function`

Flashing heart image		Online tutorial:
		live.microbit.co.uk/td/tutorials/flashing-heart
		`function main ()`
		`  heart := ♻micro:bit→ create image("0 1 0 1 0\n1 1 1 1 1\n1 1 1 1 1\n...")`
		`  while true do`
		`  heart→ show image(0)`
		`  ♻micro:bit→ pause(500)`
		`  ♻micro:bit→ clear screen`
		`  ♻micro:bit→ pause(500)`
		`  end while`
		`end function`

Challenge 1: Digital key chain

Programming a Minecraft Creeper face using the image editor within TouchDevelop

Outcome

Display of a Creeper face (similar to the character seen in Minecraft) on the BBC micro:bit LED display:

- By default, all of the lights are off.
- There will be a single state (Minecraft Creeper face).
- The image will turn off after 3 seconds.

Tutorials

For a video tutorial go to **live.microbit.co.uk/start-guide/video-tutorials/digital-key-chain**

For a guided coding tutorial go to **live.microbit.co.uk/td/tutorials/digital-key-chain**

Decomposing the problem

This challenge can be decomposed into four parts:

1. Design how our single state will look (which LEDs will be switched on to display our Creeper face).
2. Use the image editor to turn on the required LEDs.
3. Create a timer to pause the image for 3 seconds.
4. Reset the display to its original state: OFF.

Design how each **state** will look

Before we start to code, we need to plan what our single state will look like.

01

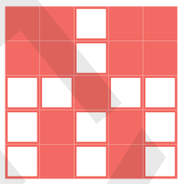
Draw a 5 × 5 grid and colour in the boxes to show what the Minecraft Creeper face will look like.

You don't have to program a Creeper face. The image could be anything you like.

Key

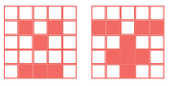
LED on =

LED off =



CREEPER FACE

Why not try out different images?



Use the image editor to **turn on** the required LEDs

We need to specify which LEDs will be ON to display the Creeper face.

02

Start by opening a new browser window and typing **live.microbit.co.uk** in the address bar.

Click on **Create Code**. In **Blocks**, click **New project**. Type in a name for your script, such as `Creeper`. Click on **create**.

03

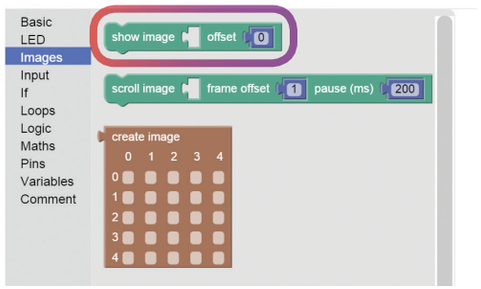
A blank coding environment will appear (see screenshot).

Select the **Images** button from the menu on the left.

04

The **Images** section includes blocks that control the creation and display of an image on the BBC micro:bit through LEDs.

Select the **show image** block.



05

You will notice that an offset value of 0 is displayed.

Changing this allows you to display your image in different positions on the BBC micro:bit display.

06

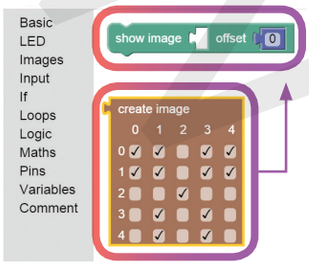
We now want to select which LEDs will be ON for our Creeper face.

Select the Images button then the **create image** block. Tick the boxes in the block to make the shape of the Creeper face, as shown in the image.

07

Drag the **create image** block into the empty position on the **show image** block.

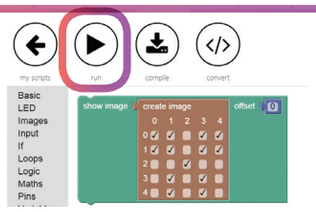
This will make sure that the Creeper face appears when you press the **run** button.



It's important that we test our programs regularly. This allows us to debug the program and fix any errors.

08

Press the **run** button to test your program.
What does it look like on the simulator?
If it doesn't work as expected, go back and try to find and correct the problem.



Create a timer to **pause** for 3 seconds

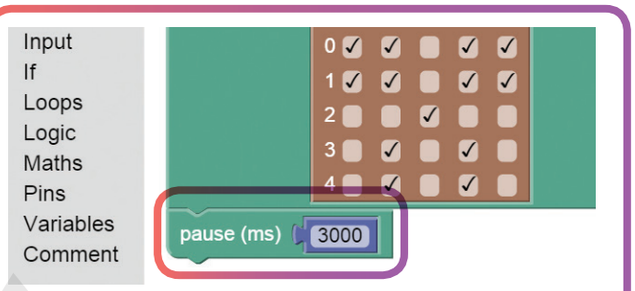
To display the Creeper face for a short period of time, we need to add a timer.

09

From the **Basic** menu, select the **pause** block. The BBC micro:bit uses milliseconds as input, so 1000 is equivalent to 1 second.

We want to pause for 3 seconds, so change the number to **3000**.

Drag the block upwards so it snaps into place below the **show image** block.

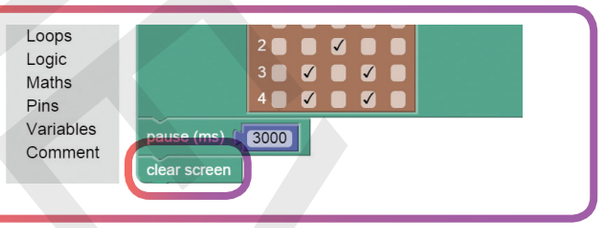


Reset the display to its original state: **OFF**

To finish our program, we're going to turn all of the LEDs off. This will help to prolong the battery life of the BBC micro:bit.

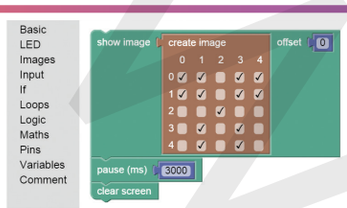
10

Click on the **LED** menu. Select the **clear screen** block and snap it under the **pause** block. This will make sure that all of the LEDs are turned off after the Creeper face has displayed for 3 seconds.



11

You should now have a finished program which will display a Creeper face.



Do your own thing!

- Change the pattern in the **create image** block to show your own design.
- Instead of clearing the display, add another **show image** and **pause** block to create a simple two-state animation. Can you experiment with the brightness of the Creeper image between face changes?

A solution for the complete digital keyring code can be found on page 27. The working code can be found at **live.microbit.co.uk/start-guide/solutions/digital-key-chain**.

Challenge 2: **Digital pet**

Programming an animated pet using variables and functions

Outcome

A digital pet (similar to Tamagotchis from the 90s) with different states that can be controlled by pressing buttons A and B (our input). The idea is that our digital pet has demands for attention. In this example our different states will represent some of these demands:

- The default state of the pet is AWAKE.
- Button A will stroke the pet, causing it to fall ASLEEP.
- Button B will feed the pet, so it is EATING.

Tutorials

For a video tutorial go to **live.microbit.co.uk/start-guide/video-tutorials/digital-pet**

For a guided coding tutorial go to **live.microbit.co.uk/td/tutorials/digital-pet**

Decomposing the problem

This challenge can be decomposed into four parts:

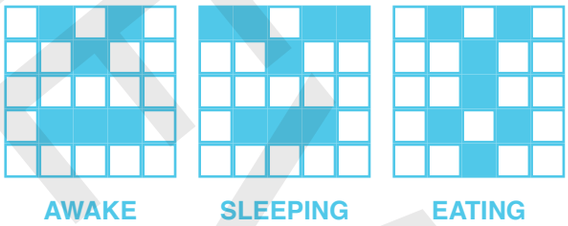
1. Design how each state will look (which LEDs will be switched on).
2. Create a function which tells our BBC micro:bit which LEDs to turn on for each state.
3. Create a while loop to continue showing a state until a different button is pressed.
4. Create conditional statements to specify which function to run if a particular button is pressed, e.g. if input A pressed then go to ASLEEP state.

Design how each **state** will look

Before we start to code, we need to plan out what our pet will look like for each state.

01

Draw a 5 × 5 grid and colour in the lights to show what your pet will look like at different times, for example: **AWAKE, ASLEEP, EATING** (as shown right).



02

Start by opening a new browser window and typing **live.microbit.co.uk** in the address bar. Click on **Create Code**. In **TouchDevelop**, click **New project**. Type in a name for your script, such as **`Digital pet`**. Click on **create**.

Create a function for each **state**

We're going to start by programming a function for the different states of our digital pet (e.g. which LEDs are ON and which are OFF for each state). We're going to do this first because we will want to call on these functions later, without having to leave the main process.

03

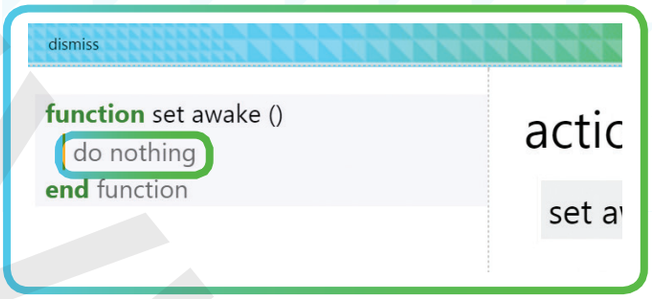
To create the first function (for our AWAKE face), select the **script** button from the top of the screen. Click on the **+** button to bring up your resources menu.

04

Select **function** from the menu. This will bring you to a coding area (as shown right). Notice that it will say **do stuff** at the top. This is the current name of the function. Click on **do stuff** and rename your function **`set awake`**. Click **OK**.

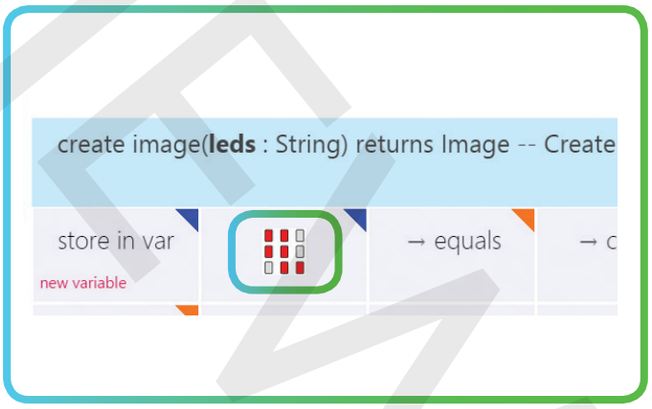
05

Now that we have named our function, we need to specify which LEDs should be turned on within the function. We can do this using the image editor. Click **do nothing** in the coding area. A keyboard will pop up at the bottom of the screen. Select **micro:bit**. Notice how the keyboard changes. Select **create image**.



06

Select the button on the code keyboard that looks like a grid. This will bring up your image editor. Each box represents one of the LEDS on the BBC micro:bit display. Select the appropriate boxes (to match your grid from step 1) to create your AWAKE face. Click off the editor to return to your code. Click **store in var** (to store this data in a variable). Press the **+** button to add a new line of code. In the code keyboard click **img** (this is the variable you have just created). Click **show image**.

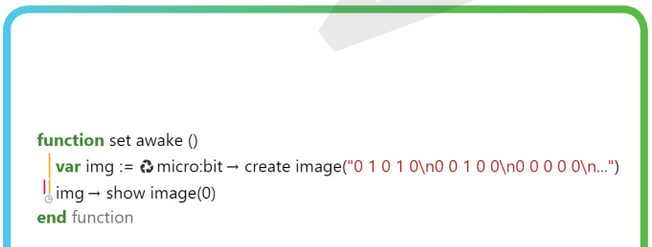


07

You have now completed your first function. It should look something like this.

Use what you've learnt so far to create the other two functions for the **ASLEEP** and **EATING** states of your digital pet.

Name your **A** function **`set sleep`** and your **EATING** function **`set eat`**.



Creating a **while loop**

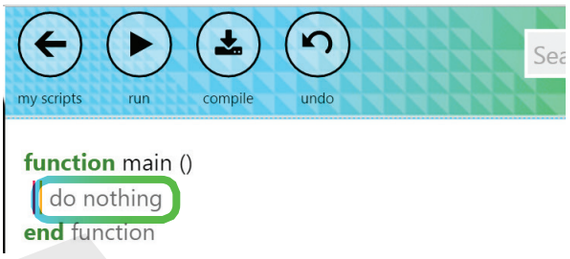
We want each state of your digital pet to continue playing until a button is pressed. We therefore need to add a **while loop**. A while loop will continue running a piece of code until a certain condition is met.

08

Before you continue, click on **script**. Underneath **code** you will see your **main** program. Main is like your 'home' code; all the other functions you create will run from this. You should see all the functions you have created underneath **main**. Click **main** to select it.

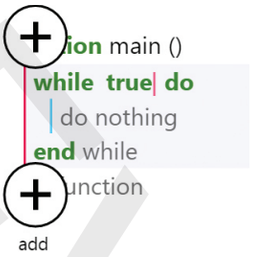
09

Select **do nothing** within the main function to start writing your code. Select **while** from the keyboard.



10

Your while loop will appear as shown right. This will make our program loop indefinitely.



11

Running this program at this stage would burn the battery. To fix this, add a pause instruction at the end of the loop. Click **do nothing** in the code, then on the code keyboard click **micro:bit**, **more**, then **pause**. Any pause duration will work; in this case, we can even pick 0.

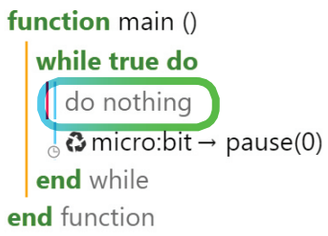
```
function main ()
    while true do
        micro:bit → pause(0)
    end while
end function
```

Test your **program** and **debug**

It's important that we test our programs regularly. This allows us to debug the program and fix any errors. Emphasise this point with students.

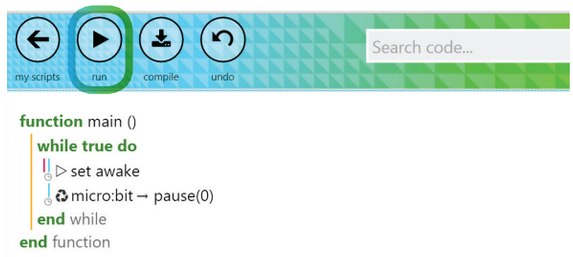
12

Select the do nothing block within the **while loop**. Click the **code** button on the keyboard.



13

Select the **set awake** function that you created previously. Now press the **run** button. You should see your digital pet come to life in the simulator!

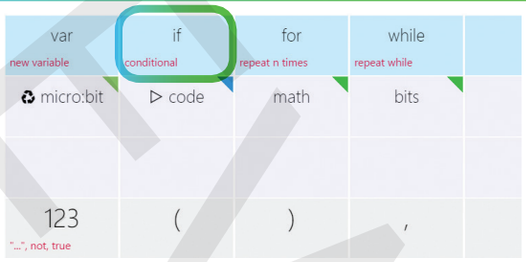


Create **conditional (if) statements** to specify which functions to run

When coding, we can use a **conditional (if) statement** to control the outcome of a program. In this program, we want to create conditional statements to specify *which* function to run if a particular button is pressed, e.g. *if* input A (Button A) is pressed, *then* go to **ASLEEP** state; *if* input B (Button) is pressed *then* go to **EATING** state.

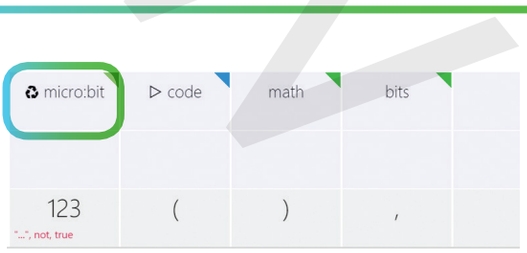
14

Remove the **set awake** function you used to test your program in the previous step. Now select the if button from the keyboard. This will insert a piece of IF code.



15

You now need to specify the condition for your IF code (e.g. *If* button A is pressed, then…). Select **micro:bit** from the keyboard. Now click on **button is pressed** on the keyboard. This code allows the BBC micro:bit to detect when button A or B is pressed.



Test your **code**

Try testing your code at this point. If you press button A, you might notice that your digital pet only sleeps for one millisecond. This is because you haven't specified how long you want your pet to sleep for when you press button A. We will need to pause the state.

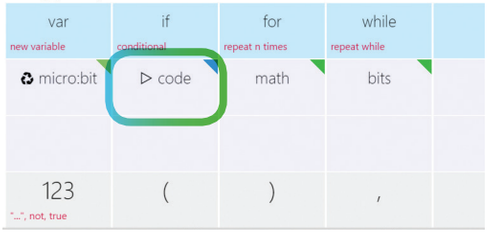
16

Button A is always selected by default.
Button A is what we want to press to activate the **ASLEEP** state so you don't need to change anything in the code here.

```
function main ()
  while true do
    if micro:bit → button is pressed("A") then
      do nothing
    else do nothing end if
    micro:bit → pause(0)
  end while
end function
```

17

We now need to add our **set sleep** function inside the IF statement. Select **do nothing** within the IF code. On the keyboard press **code** and then select your function for sleep.



18

We now need to tell our pet what to do when we're not pressing button A. Select the **else do nothing code**. On the keyboard, click **code** and then your **set awake** function.

```
function main ()
  while true do
    if micro:bit → button is pressed("A") then
      set sleep
    else
      set awake
    end if
    micro:bit → pause(0)
  end while
end function
```

19

For the purpose of testing, let's include a pause for 5000 milliseconds (5 seconds). In your code, click on your **set sleep** function. Click on the **+** button below it. Now click on **micro:bit** on the keyboard and select the **pause** button. Replace **100** with **5000**.

```
function main ()
  while true do
    if micro:bit → button is pressed("A") then
      set sleep
      micro:bit → pause(5000)
    else
      set awake
    end if
    micro:bit → pause(0)
  end while
end function
```

Do your own thing!

- Can you add in another IF condition which will feed your pet?
- Try using the image editor to create key frames which make your digital pet's mouth move when it is EATING.
- Can you make use of the scrolling text so that you know when your digital pet is going to wake up? Try **micro:bit->show string**.
- Can you program your pet to say that he is hungry after 60 seconds?
- Can you use a variable to count how many times you've fed your pet? Use the buttons to check your total.

A solution for the complete digital keyring code can be found on page 27. The working code can be found at **live.microbit.co.uk/start-guide/solutions/digital-pet**.

Challenge 3: **Catch the egg game**

Programming a game of 'catch the egg' using the accelerometer in TouchDevelop

Outcome

A 'catch the egg' game in which an egg (represented by a single LED) 'falls' from the top of the BBC micro:bit display and can be caught in a moveable basket at the bottom of the display. The script includes code for the accelerometer, which allows a user to control the position of the basket when the device is tilted:

- By default, the first 'egg' LED starts to drop from the centre of the top line of the display
- The subsequent 'eggs' will then fall from random positions at the top of the display.
- The 'basket' will be moved by tilting the BBC micro:bit.

Tutorials

For a video tutorial go to **live.microbit.co.uk/start-guide/video-tutorials/catch-the-egg**

For a guided coding tutorial go to **live.microbit.co.uk/td/tutorials/catch-the-egg**

Decomposing the problem

This challenge can be decomposed into six parts:

1. Create the **global variables** for the game.
2. Assign initial values to each of the global variables.
3. Plot the starting positions of the LEDs.
4. Create a **forever loop** to update the display regularly.
5. Get the 'egg' to drop down the LED display.
6. Change the position of the basket using the accelerometer functionality.
7. Use IF conditions to check the final position of the egg.

Create the **global variables** for the game

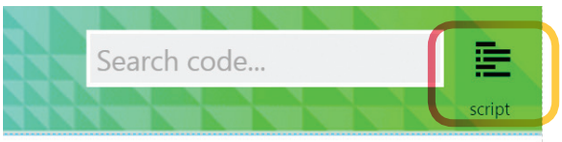
Global variables are different to local variables (which only work inside a single loop). Global variables are accessible from any part of our program.

01

Start by opening a new browser window and typing **live.microbit.co.uk** in the address bar. Click on **Create Code**. In **TouchDevelop**, click **New project**. Type in a name for your script, such as **`Catch the egg`**. Click on **create**.

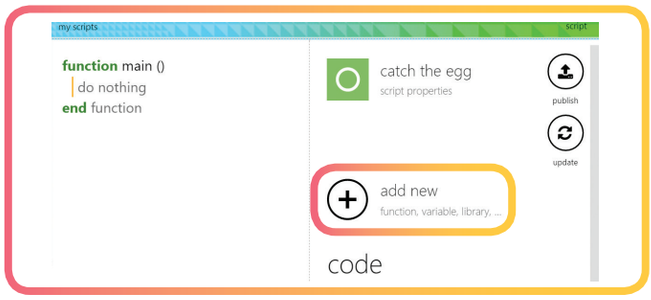
02

We're going to start by creating a number of **global variables** that will be accessible from any part of our program. To begin, click on the **script** button in the top-right corner.



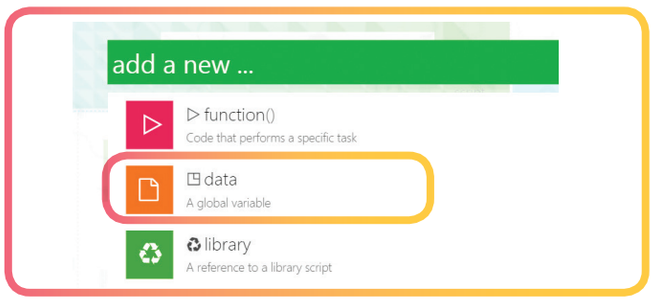
03

A menu will pop up, which allows you to add other features to your program. In this case, we're going to add in a global variable by clicking on the **+** button.



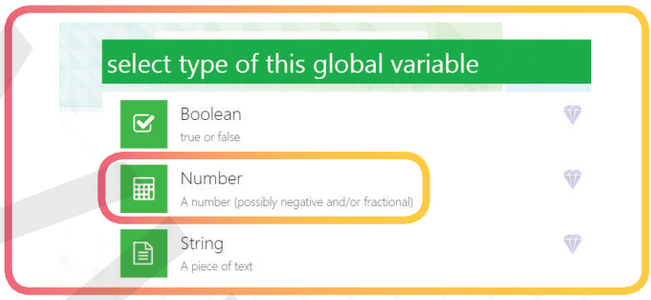
04

Select the **data** button from the menu that appears.



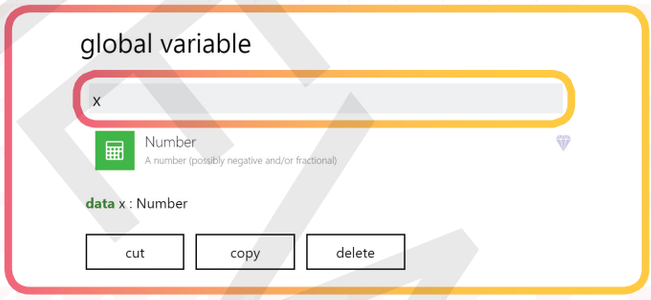
05

Now it's time to select your data type. For this program we're going to use **Number** for our variables. This is because we're going to be using x and y coordinates (to designate the position of our falling eggs and the basket to catch them in), which are usually stored as numbers.



06

We're going to start by creating a score variable which will track how many times we catch our egg in the basket. Type in **`score`**, then click the **ok** button. You should see your **score** variable in **vars**.



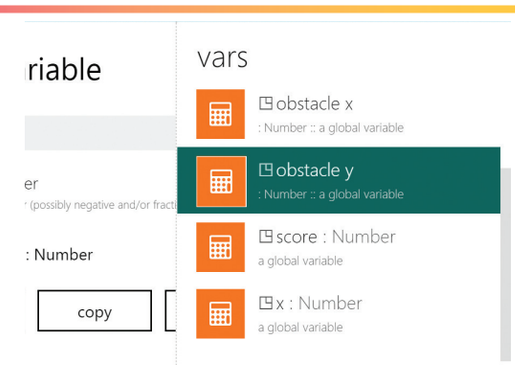
Naming **variables**

Explain, or remind students, to be as descriptive as possible when naming variables (e.g. **`score`**, **`timer`**, etc.) rather than using generic names (e.g. **`variable 1`**, **`variable 2`**, etc.). It's much easier to find and fix problems with variables when you can easily work out which one isn't working.

07

Repeat steps 2–6 to create all the variables for your game. You will need to create four variables in total: **`score`**, **`x`** (to control the position of the basket), **`obstacle x`** (to control the horizontal position of the egg) and **`obstacle y`** (to control the vertical position of the egg.)

Once you have finished setting up each of the variables, you should have something which looks like the following.

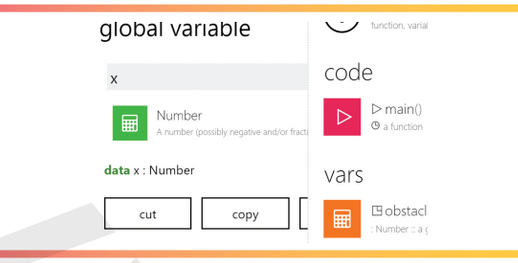


Assign initial values to each of the **global variables**

As with any programming language, when you declare your variables, you need to set them to a value. This value can be manipulated and changed later on.

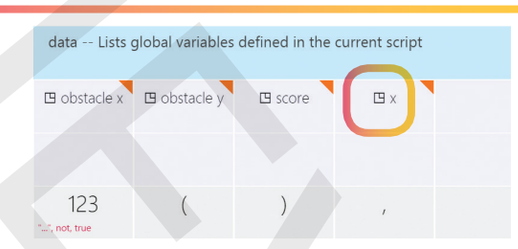
08

Return to your **main** script. Click **do nothing** below the **main** function, then select the **data** button from the keyboard.



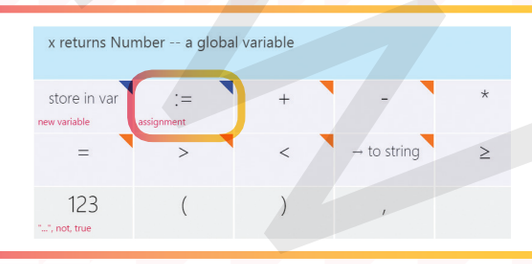
09

Select the variable **x** to begin with. Remember: **x** controls the position of the basket.



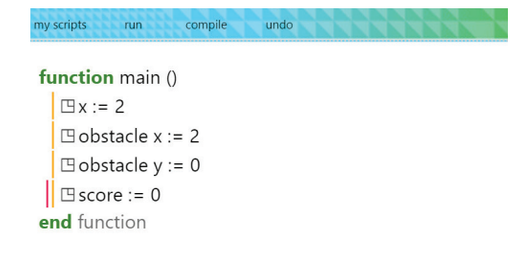
10

To assign a value to the **x** variable, select the **assignment** button (**:=**) from the keyboard. We want the basket to sit in the centre of the bottom row of the display, so type in **2**. Click on the + button below the **x** variable to add lines for the other three variables.



11

Assign values to the remaining three variables by following the steps above. We want the egg to start falling from the top centre of the display at the beginning of our program, so set **obstacle x** to **2** (middle) and **obstacle y** to 0 (top). Set the score to **0** (because we haven't scored anything yet).



Plot the starting positions of the **LEDs**

All LEDs on the BBC micro:bit display are OFF by default. We're going to set the BBC micro:bit to plot our first lights.

12

Click the **+** button to add another line of code below your assigned variables. Select the **micro:bit** library from the keyboard and then select the **plot** button (on screen 2 of the keyboard). You should now have something which looks like the image shown on the right.

```
function main ()
    x := 2
    obstacle x := 2
    obstacle y := 0
    score := 0
    micro:bit → plot(0, 0)
end function
```

13

The code shown above will only turn on a LED at position 0,0. We need to remove each of these values and replace them with our **obstacle x** and **obstacle y** value. Delete the first 0 and then select **obstacle x**. Repeat this process to enter **obstacle y**.

```
    x := 2
    obstacle x := 2
add
    obstacle y := 0
+   score := 0
    micro:bit → plot(obstacle x, )
    the operator needs something after it [TD154]
+   unction
```

14

We now need to plot the starting position of the basket (**x**). Click the **+** button to add a new line of code. Then select the **micro:bit** library from the keyboard and then **plot**. Change the first 0 to the **x** variable and the second **0** to **4**.

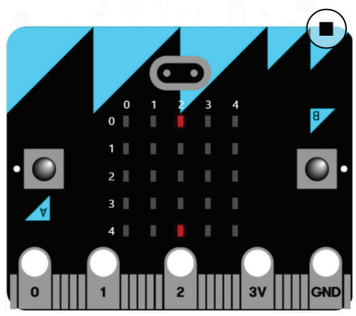
```
function main ()
    x := 2
    obstacle x := 2
    obstacle y := 0
    score := 0
    micro:bit → plot(obstacle x, obstacle y)
    micro:bit → plot(x, 4)
end function
```

Test your **code**

It's important to test that our code is working correctly so we can debug any errors. Regularly remind students of the importance of testing.

15

At this point in the program we're going to run it by selecting the **run** button. You should see something similar when you run your program.

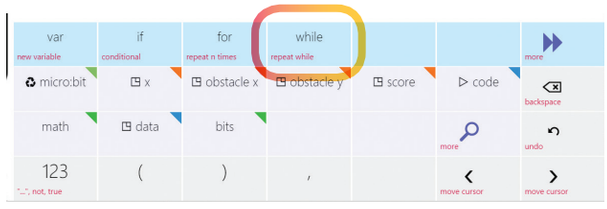


Create a **forever loop** to update the display regularly

Our next section of code requires you to get the display to update regularly. We do this by using a forever loop. This is to make sure that the program is always running. If we didn't use a **forever loop**, then we would have to write lots of lines of code to simulate our outcome.

16

Add a new line of code by pressing the **+** button. Select **while**. Running this program at this stage would burn the battery. To fix this, add a pause instruction at the end of the loop. Click **do nothing** in the code, then on the code keyboard click **micro:bit**, **more**, then **pause**. Any pause duration will work; in this case, we can even pick 0.



Get the '**egg**' to drop down the LED display

We now want to get the egg to look like it is dropping down the display.

17

Before we can light up the LED beneath the first LED, we need to unplot the original LED. This will ensure a smooth change from one lit LED to another, as if the egg is falling downwards. Select micro:bit from the keyboard and **unplot**. Unplot both your basket position (**x**) and your egg position (**obstacle x**, **obstacle y**), as shown in the picture.

```
while true do
    micro:bit → pause(0)
    micro:bit → unplot(x, 4)
    micro:bit → unplot(obstacle x, obstacle y)
end while
```

18

To get the egg to move down the display, we need to change the vertical position of the egg (**obstacle y**). We can do this by adding 1 to the value of **obstacle y**, each second. Select **obstacle y**. Select the **assignment** (:=) button, **data** and **obstacle y** + **1**.

```
    while true do
        micro:bit → pause(0)
        micro:bit → unplot(x, 4)
        micro:bit → unplot(obstacle x, obstacle y)
        obstacle y := obstacle y + 1
    end while
    do nothing
end function
```

19

You now need to plot the new obstacle, using **plot** as previously. We will need to make sure that we slow down the board. Select **micro:bit** and **pause** for **300** milliseconds. This will allow you to see the lights fall down the screen at a slower pace.

```
while true do
    micro:bit → pause(0)
    micro:bit → unplot(x, 4)
    micro:bit → unplot(obstacle x, obstacle y)
    obstacle y := obstacle y + 1
    micro:bit → plot(obstacle x, obstacle y)
    micro:bit → pause(300)
end while
```

Preview your program, you should notice the 'egg' fall down the board.

Change the position of the basket using the **accelerometer functionality**

It's now time to change the position of the basket. You can do this by using the accelerometer within the BBC micro:bit. You may have used an accelerometer in your smartphone when playing games previously. Have you ever had to play a maze game where you escort the ball into the hole?

20

We're going to add the next line of code above the pause. Select **micro:bit** from the keyboard. To use the accelerometer you will need to select the **acceleration** button. Now select **store in var**. The program sets the acceleration to left and right. This is the default position (x); you can also control up and down (y). You should have something like this:

```
    obstacle y := obstacle y + 1
    micro:bit → plot(obstacle x, obstacle y)
  var millig := micro:bit → acceleration("x")
    micro:bit → pause(300)
```

21

We now need to work out the position of the accelerometer and then turn the LED on. Select the **x** variable from the **data** menu in the keyboard. Select the **assignment** (**:=**) button.

```
  micro:bit → plot(obstacle x, obstacle y)
  millig := micro:bit → acceleration("x")
  x :=
  the operator needs something after it [TD154]
  micro:bit → pause(300)
end while
```

22

Type in number **2**, + and then select the **math** library from the menu at the bottom. We need the math library in TouchDevelop so that we can do our rounding and work out the position of the accelerometer.

```
  micro:bit → plot(obstacle x, obstacle y)
  millig := micro:bit → acceleration("x")
  x := 2 + math
  '+' expects Number here, got Math [TD103]
  micro:bit → pause(300)
end while
```

23

Select the **min** button. Replace the first number with **2** and then **math** and then **max**. This code is finding the highest and lowest values that the board could move to the left and right. You should have something like the picture, right.

```
  micro:bit → plot(obstacle x, obstacle y)
  millig := micro:bit → acceleration("x")
  x := 2 + math → min(2, math → max(0, 0))
  micro:bit → pause(300)
end while
add
```

24

To finish, we need to replace the maximum values with **–2** and then the variable we created. In this case it's called **millig**. Divide it by **200**.

```
  x := 2 + math → min(2, math → max( - 2, millig / 200))
  micro:bit → pause(300)
end while
do nothing
end function
```

25

You now need to add a line above the pause line to plot the basket. To do this you need to select **micro:bit** and **plot**. Select data to use the **x** variable we have been using for our basket.

```
var millig := micro:bit → acceleration("x")
x := 2 + math → min(2, math → max( - 2, millig / 200))
micro:bit → plot(x, 4)
micro:bit → pause(300)
```

Test your program on the **device**

Before you run the program on your device, use the simulator to test that it works on screen. Use the mouse to simulate accelerometer input. You should now notice that the lights change when you move the BBC micro:bit left and right. You should also notice that the 'egg' falls from the top of the display.

Use **IF** conditions to check the final position of the 'egg'

We now want to make sure that the 'egg' moves back to the top of the screen when it gets to the bottom of the board. We will need to use an IF condition to do this.

26

Select **IF** from the menu and select the **condition**. Select **obstacle y** from the variables and say if it's greater than **4** (4 is the bottom of the board).

```
micro:bit → plot(x, 4)
if obstacle y > 4 then
    do nothing
else do nothing end if
micro:bit → pause(300)
```

27

Inside this IF condition, we're going to tell the 'egg' to find a new position at the top of the screen. We're going to set the value to **–1** so that the 'egg' is hidden just above the board before it appears at zero. We're then going to set the position of **obstacle x** using the math library to find a random value. Can you repeat the code shown? If you test your program now, you will notice that the 'egg' keeps falling down the screen in random positions.

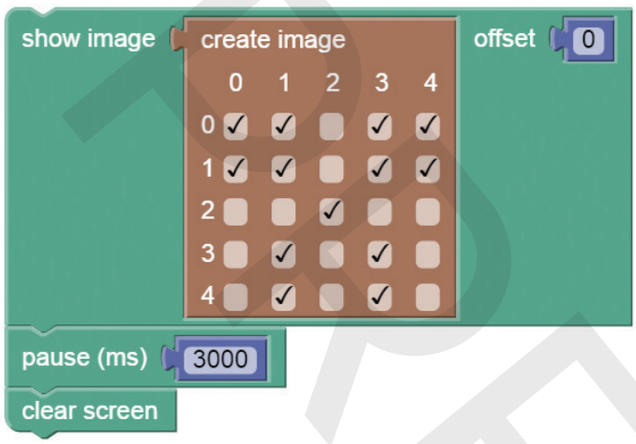
```
    micro:bit → plot(x, 4)
    if obstacle y > 4 then
        obstacle y := - 1
        obstacle x := math → random(5)
    else do nothing end if
    micro:bit → pause(300)
end while
do nothing
end function
```

Do your own thing!

- Now that the 'egg' falls down the display, use an IF statement to detect if the egg and the basket are lined up (i.e. did you catch the egg in the basket).
- You will need to detect the position of the basket first (you could store this position in a variable). Once you've detected the position of the basket, you will need to detect the position of the egg (IF it's reached the bottom of the screen). Store this information as a variable, too. You can use an IF statement to compare the two positions.
- Try to work out what you need to do to finish the game. If you get stuck, take a look at the online video tutorial, guided coding tutorial, or the solution on page 27.

Challenges and solutions

Challenge 1



Challenge 2

```
function main ()
    while true do
        if micro:bit → button is pressed("A") then
            set sleep
            micro:bit → pause(5000)
        else
            set awake
        end if
        if micro:bit → button is pressed("B") then
            set eat
            micro:bit → pause(5000)
        else
            set awake
        end if
        micro:bit → pause(0)
    end while
    do nothing
end function
```

Challenge 3

```
function main ()
    x := 2
    obstacle x := 2
    obstacle y := 0
    score := 0
    micro:bit → plot(obstacle x, obstacle y)
    micro:bit → plot(x, 4)
    while true do
        micro:bit → pause(0)
        micro:bit → unplot(x, 4)
        micro:bit → unplot(obstacle x, obstacle y)
        obstacle y := obstacle y + 1
        micro:bit → plot(obstacle x, obstacle y)
        var millig := micro:bit → acceleration("x")
        x := 2 + math → min(2, math → max( - 2, millig / 200))
        micro:bit → plot(x, 4)
        if obstacle y > 4 then
            obstacle y := - 1
            obstacle x := math → random(5)
        else do nothing end if
        micro:bit → pause(300)
    end while
end function
```

Creating your own **tutorials**

Using TouchDevelop to create an interactive tutorial for your students

Once you've tried out some of the BBC micro:bit challenges with your students, you'll probably be looking for ways to challenge them further. One way of doing this is to create guided coding tutorials using the tutorial editor.

Once they've worked through a tutorial, why not challenge them to adapt their programs to make them work differently, or to add new code to make them more complex?

Outcome

A tutorial that guides the user to create a script that scrolls text across the screen if button A is pressed.

- By default, all of the lights are off.
- There will be a single state.
- The text will scroll to the left.

Decomposing the problem

This challenge can be decomposed into three parts:

1. Create code for the function you wish the BBC micro:bit to perform.
2. Publish the script and convert it into a tutorial.
3. Check that the tutorial works.

Create code for the function you wish the BBC micro:bit to perform

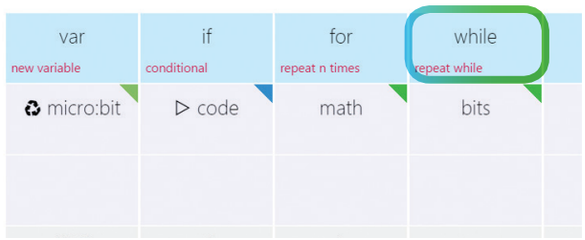
You will need to create the code you wish your students to reproduce before you can create your tutorial.

01

Start by opening a new browser window and typing live.microbit.co.uk in the address bar. Click on **Create Code**. In **TouchDevelop**, click **New project**. Type in a name for your script, such as **`Scrolling text`**. Click on **create**. You will notice an empty function named **main**. Click on the **do nothing** statement to position the edit cursor inside the function.

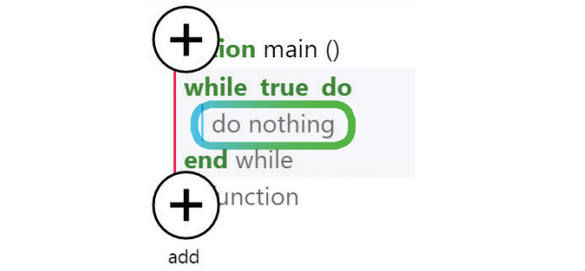
02

We're going to start by adding code that will check for the input of the buttons.
Click on the **while** button in the on-screen keyboard, which will create a **while true** loop.



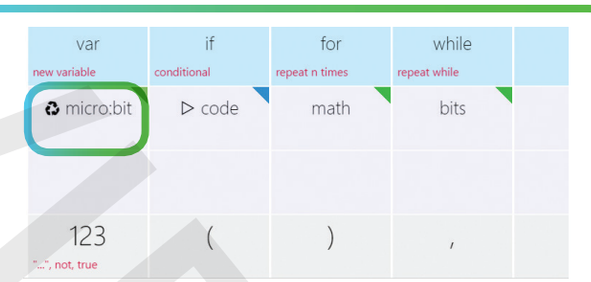
03

Click on the **do nothing** statement inside the **while** loop. Then click on the **if** button in the code keyboard to create an **if-then-else** statement. Select the **condition** (this is displayed in red).



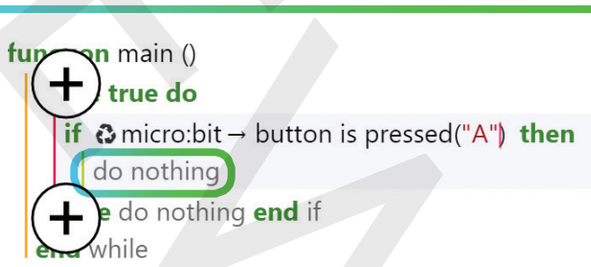
04

Click **micro:bit** in the on-screen keyboard and select **button is pressed**. This will automatically default to button A. If you test your program at this point, nothing will happen.



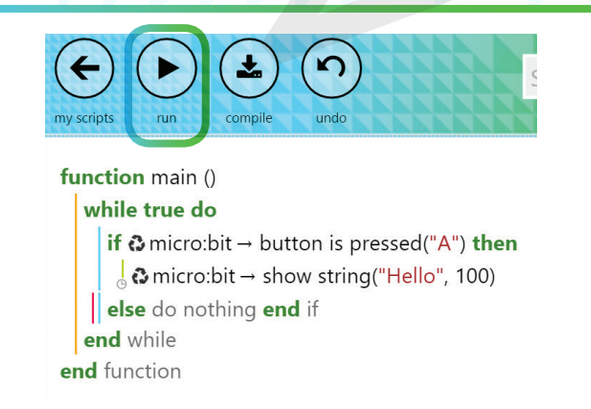
05

Click the **do nothing** statement under **if-then**. Select **micro:bit** in the on-screen keyboard and then find the **show string** button. Click after the speech marks in the code, and then click **edit** in the code keyboard. Type in the scrolling text you wish to appear and click the tick button.



06

Your code should now scroll the text when you push button A. Test your program to see if it works.

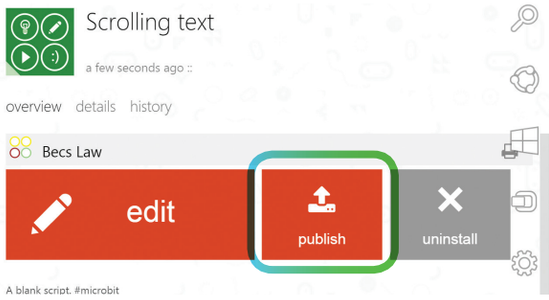


Publish the **script** and convert it to a tutorial

Now that you've created a script, you need to convert this into a tutorial.

07

Click **my scripts** to return to the script overview page. Publish your script by clicking on the publish button. Next press on the details tab then convert to tutorial button. This button will generate a tutorial that produces your script.

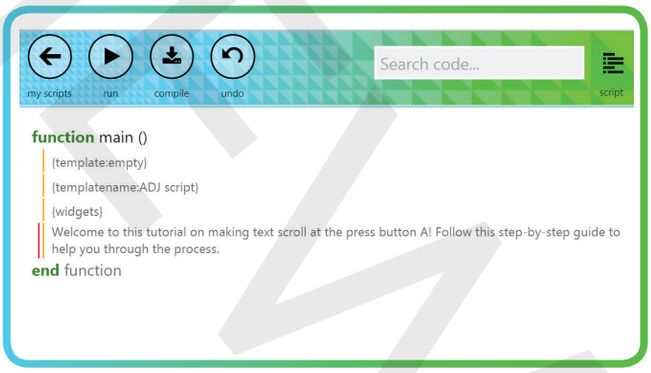


08

At this point, you will be editing a new script. Notice the **TODO** sections of your code. The TODOS allow you to describe each step in your program. Navigate to the **function main** (see right).

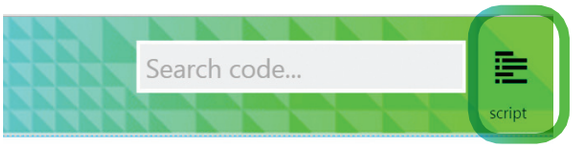
09

The example in the picture, right, shows how you might change the first line of text to act as an introduction to the tutorial for your students.



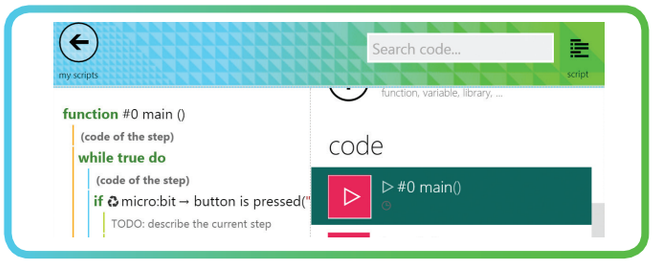
10

To edit the text which will support, or explain, individual steps of the tutorial, click on the **script button** at the top of the screen.



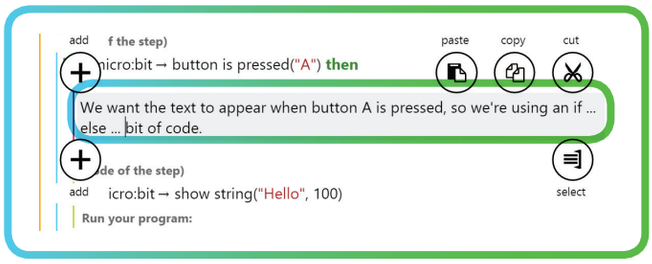
11

Select **#0 main** () from the list. Notice the TODOs for you to describe. It is important to explain the steps in this picture to your students.



12

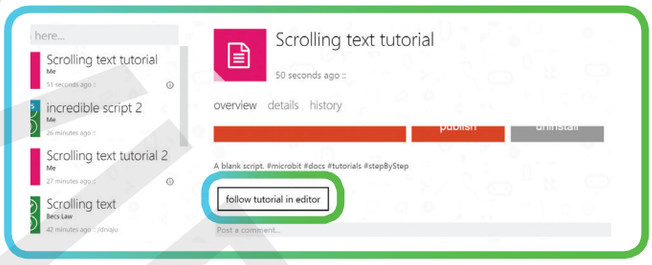
You should aim to explain each of the TODO steps in as much detail as you can. It will help the students to understand the theory behind the step.



Check the tutorial works

13

Click the **my scripts** button (left arrow) to return to the script overview page. Press the **follow tutorial in editor** button to check if your tutorial runs in the correct order.



14

The following image shows an example of what you might see on the screen.

15

Once you're happy with your tutorial, click **my scripts** and publish your tutorial.

If you are interested in becoming more advanced in tutorial creation, visit **touchdevelop.com/docs/creatinginteractivetutorials.** This detailed guidance includes instructions for the addition of avatars, which can explain the step-by-step process to your students.

The **BBC micro:bit** and the **curriculum**

Although the BBC micro:bit has been designed with young people's own independent use in mind, for schools in England following the new computing curriculum, BBC micro:bit has the potential to be a really interesting platform for exploring lots of the required content.

KS3 Computing PoS Subject content	**BBC micro:bit** contexts
design, use and evaluate computational abstractions that model the state and behaviour of real-world problems and physical systems	Students can learn much about the idea of abstraction by thinking about the different layers of systems that have to operate together to make the BBC micro:bit work, as illustrated by the relationship of TouchDevelop or Blockly to C++ and to the ARM mbed machine code that runs on the chip itself.
understand several key algorithms that reflect computational thinking [for example, ones for sorting and searching]; use logical reasoning to compare the utility of alternative algorithms for the same problem	There's scope here to get students thinking algorithmically, carefully planning their programs before they write any code. Some key algorithms could be implemented on the BBC micro:bit too, from finite state machines (Challenge 2: Digital pet) to 'guess my number' games using binary search.
use two or more programming languages, at least one of which is textual, to solve a variety of computational problems; make appropriate use of data structures [for example, lists, tables or arrays]; design and develop modular programs that use procedures or functions	Students could compare programming the same algorithm in both the Blocks and TouchDevelop code editors. They can also learn to design and develop modular programs using user-defined functions in TouchDevelop.
understand simple Boolean logic [for example, AND, OR and NOT] and some of its uses in circuits and programming; understand how numbers can be represented in binary, and be able to carry out simple operations on binary numbers [for example, binary addition, and conversion between binary and decimal]	There's chance to explore Boolean logic using the AND, OR and NOT operators built in to the language and the A and B input buttons on the BBC micro:bit. The 25-pixel display lends itself to investigating binary representation, both for images, creating simple bitmap sprites, and for numbers, using it to display numbers up to 2^{25} using binary place value! Why not create a binary counter or even a clock using the BBC micro:bit?
understand the hardware and software components that make up computer systems, and how they communicate with one another and with other systems	As it's a simple system, the BBC micro:bit provides a more accessible way for students to grasp complex ideas of how hardware and software systems behave and communicate.
understand how instructions are stored and executed within a computer system; understand how data of various types (including text, sounds and pictures) can be represented and manipulated digitally, in the form of binary digits	The use of compiled machine code here might be part of a unit of work exploring how instructions are stored and executed in computers.
undertake creative projects that involve selecting, using, and combining multiple applications, preferably across a range of devices, to achieve challenging goals, including collecting and analysing data and meeting the needs of known users	There's ample scope for creative projects here, achieving challenging goals and meeting the needs of known users. The limitations of the BBC micro:bit interface make it a great way to think creatively about design and usability.
create, re-use, revise and re-purpose digital artefacts for a given audience, with attention to trustworthiness, design and usability	Remixing code via the BBC micro:bit site provides some great opportunities for working with 'digital artefacts' produced by others.
understand a range of ways to use technology safely, respectfully, responsibly and securely, including protecting their online identity and privacy; recognise inappropriate content, contact and conduct and know how to report concerns	Participating in the BBC micro:bit online community provides an opportunity to emphasise the need for respect and responsibility when working online.