Lancaster University

micro:bit

The BBC micro:bit:

Architecting a digital system for global impact

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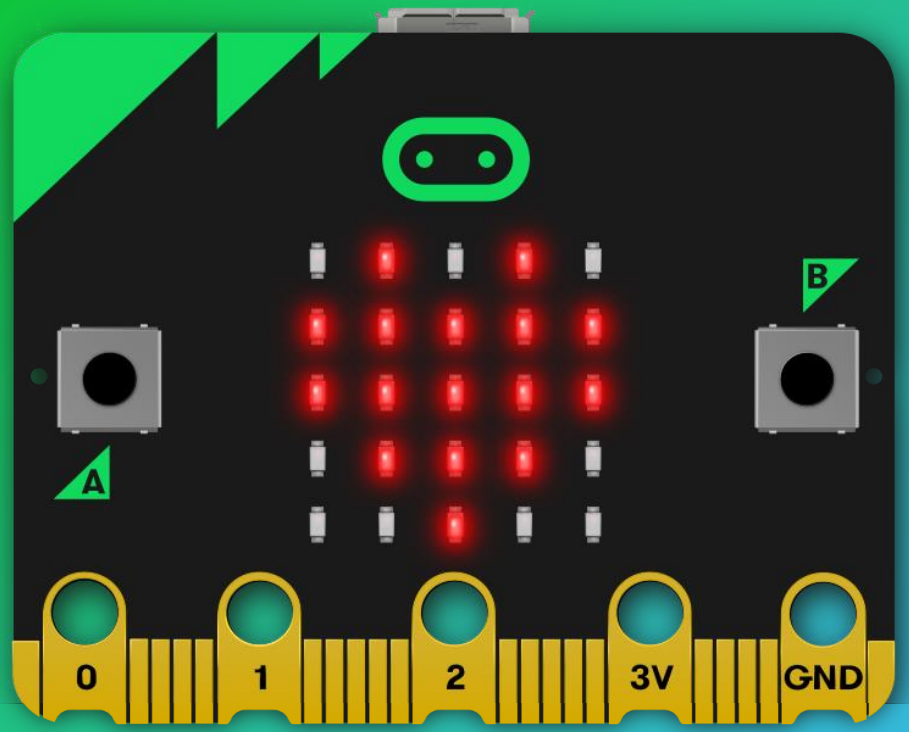
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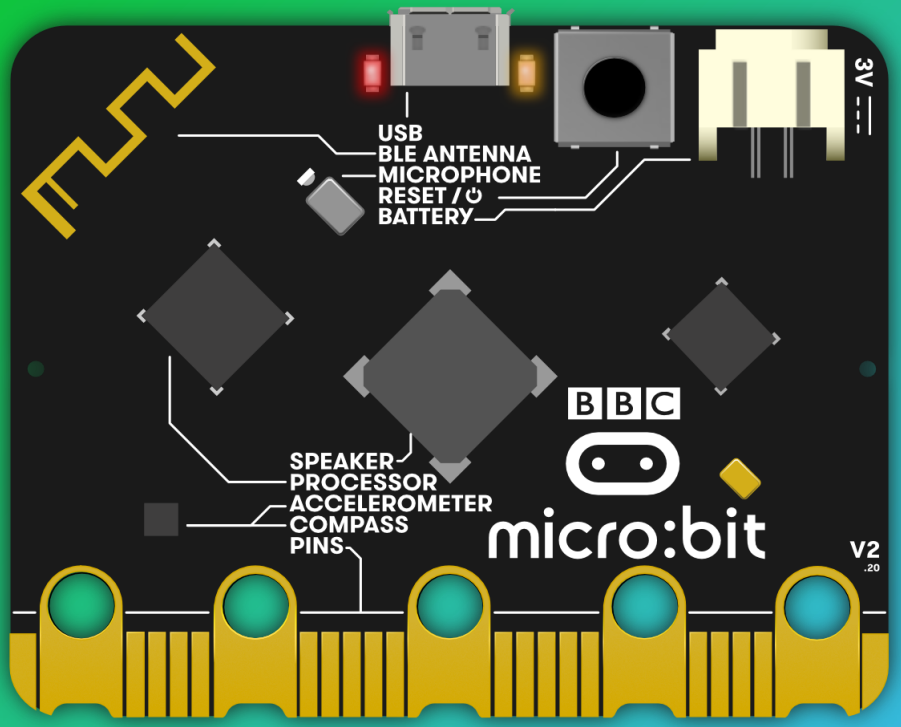
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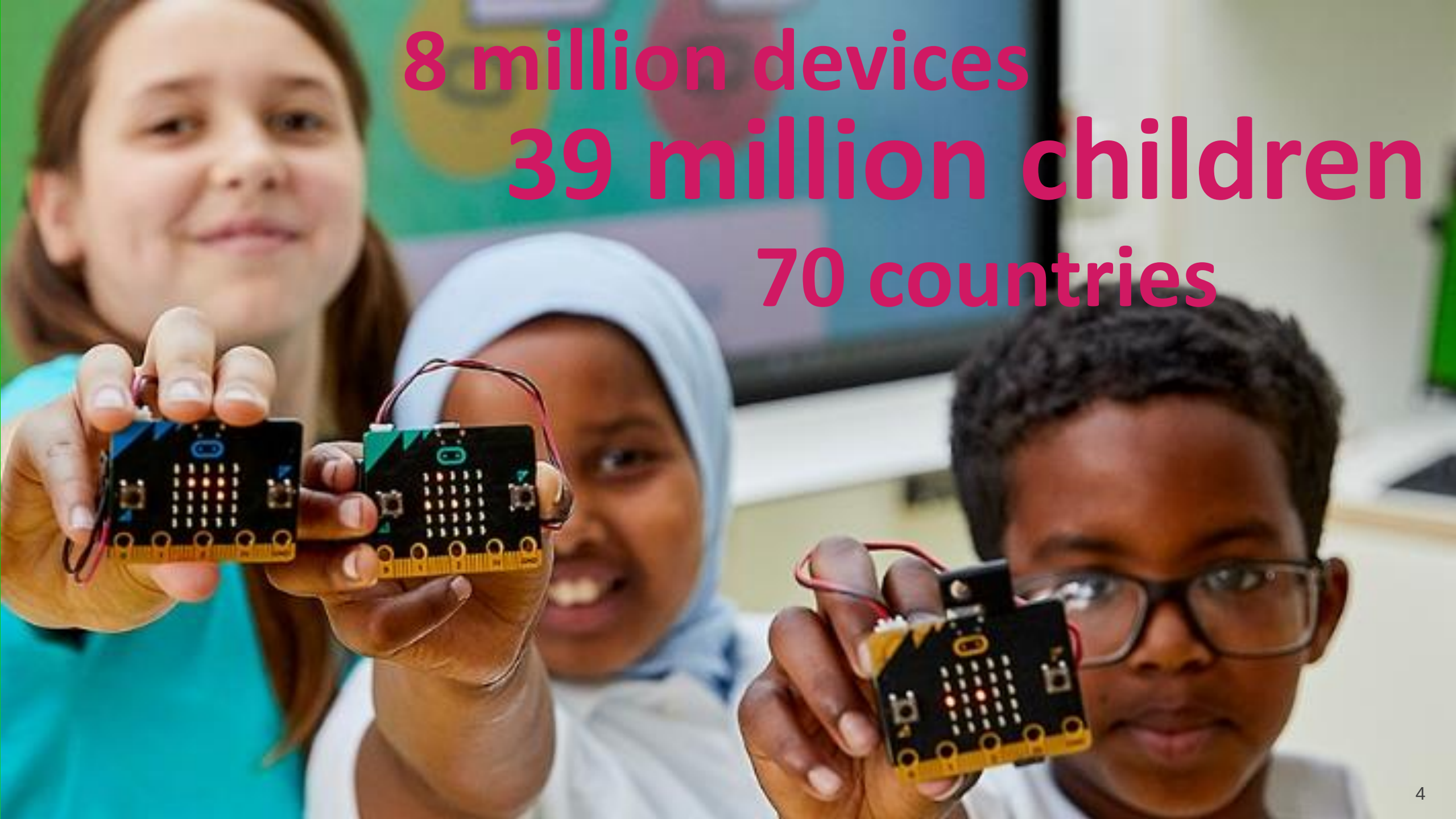
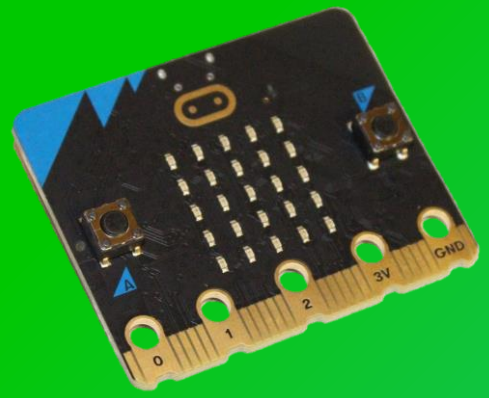
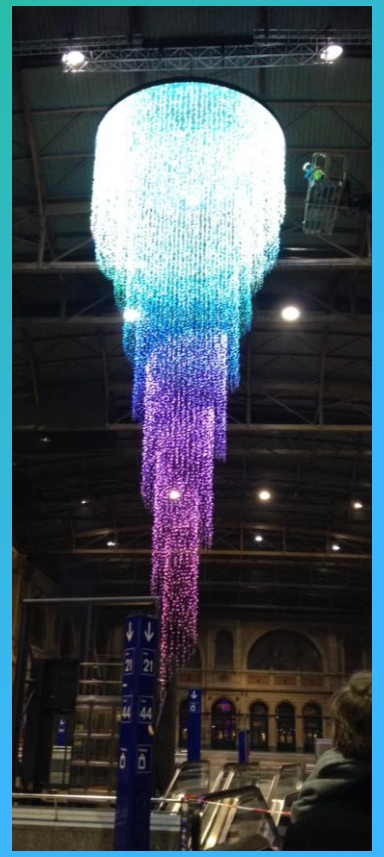

8 million devices
39 million children
70 countries

About Us… Steve

I make computers more useful, engaging and inclusive with novel hardware

About Us… Joe





I create new technologies and experiences that span hardware and software

Requirements

Demo

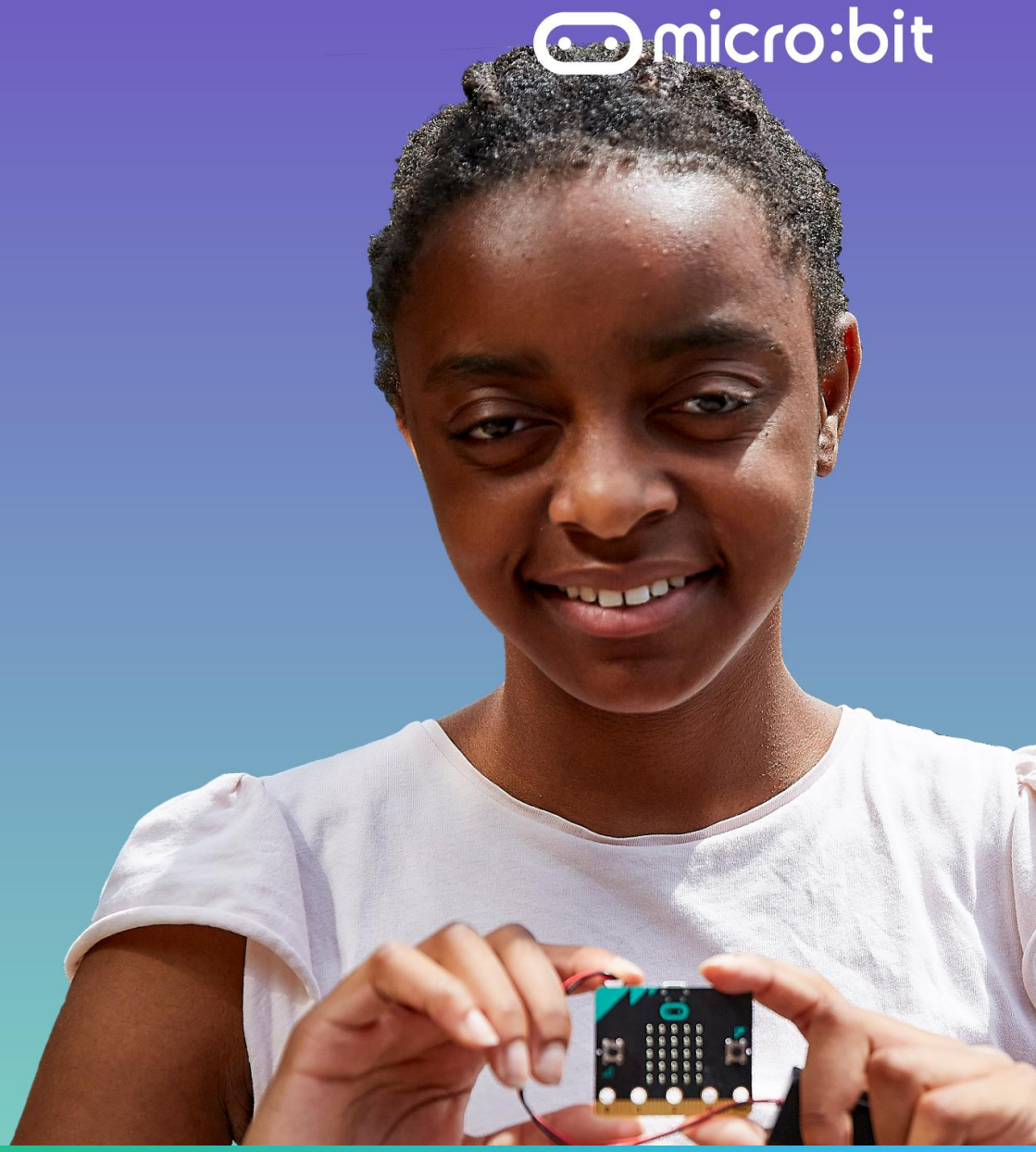
Architecture

Wrap-up

Requirements

The core goals are for the micro:bit and its ecosystem to:

- Be simple and easy to use
- Be the most effective tool for teaching digital skills and creativity
- Inspire a diverse range of students



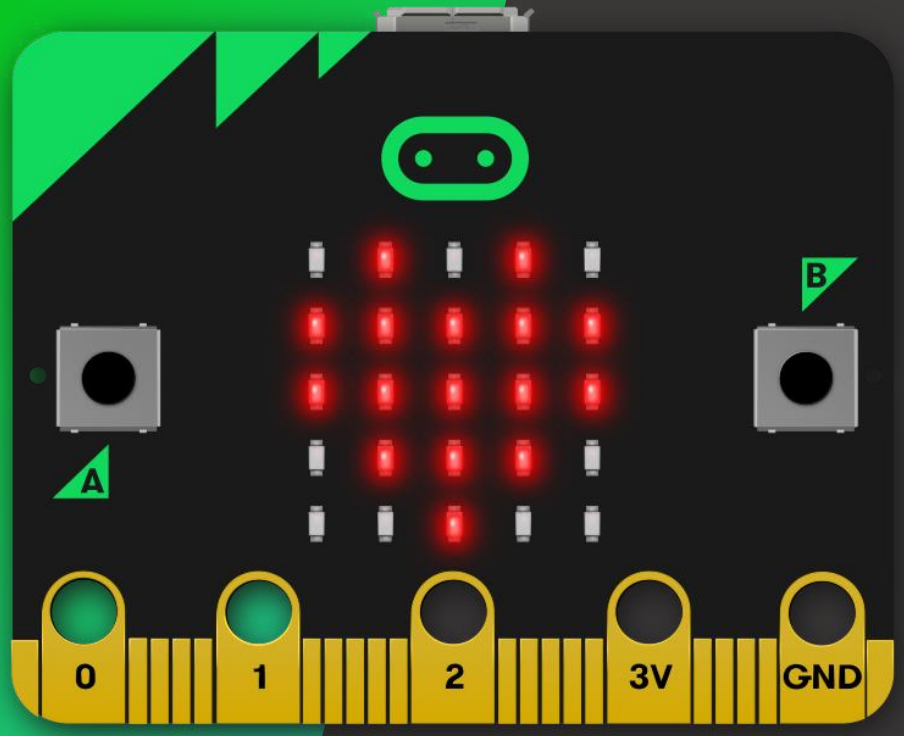
What requirements do the core goals result in?

- Easy for students
- Easy for teachers
- No installation, no setup, no internet
- Appeal to a range of ages
- Support a range of languages
- Leverage systems developed by different companies
- Resource constrained
- Millions of devices, tens of millions of users

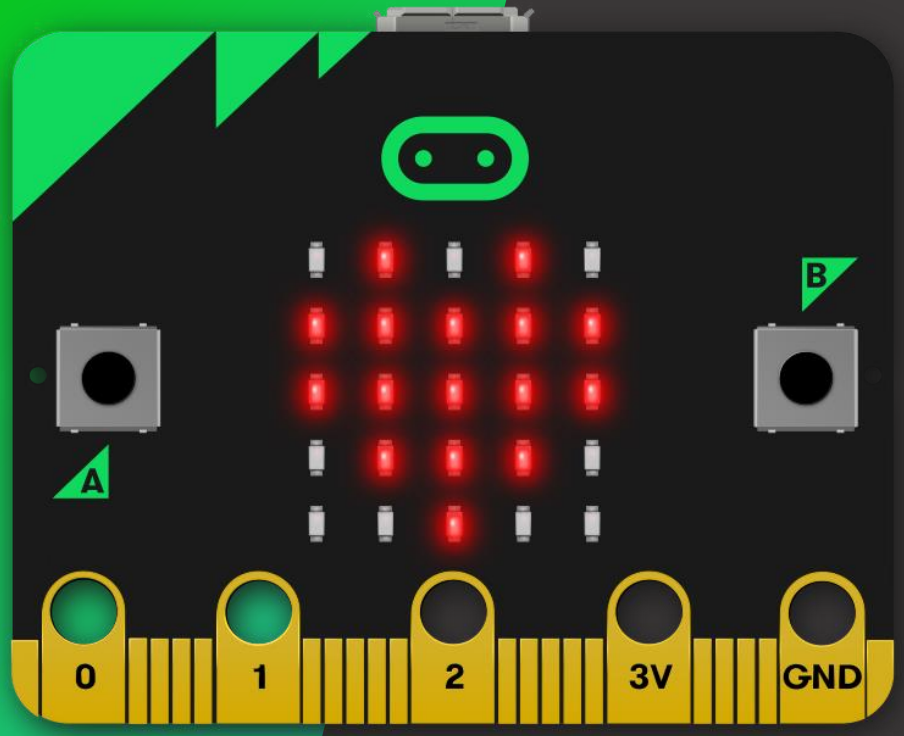
A quick demo…

Architecture

Present simple analogs of complex and “magical” technology that give students confidence and control

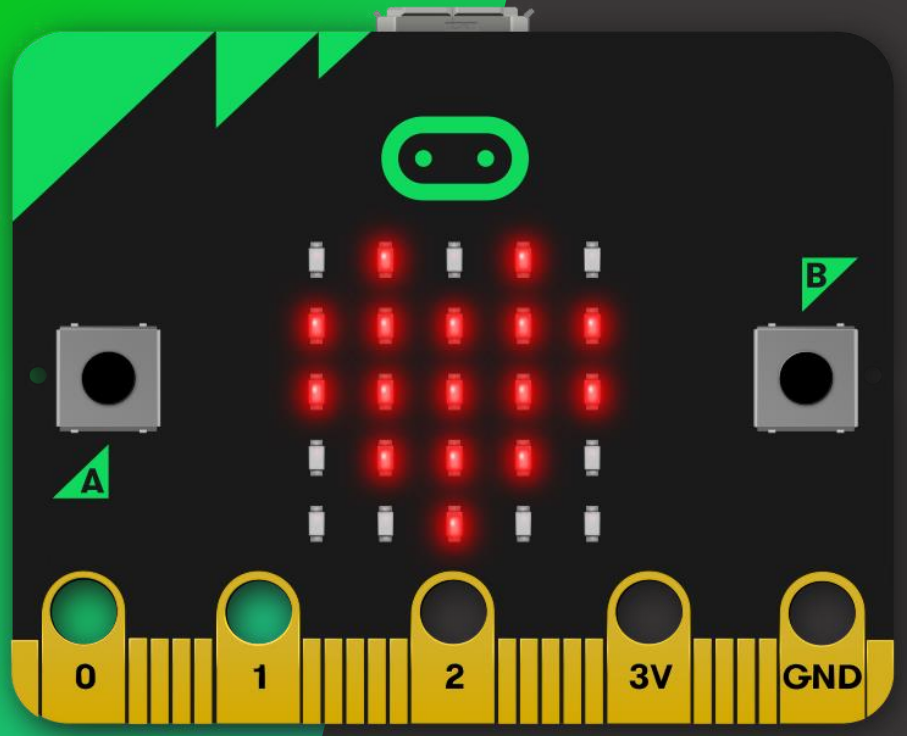


Present simple analogs of complex and “magical” technology that give students confidence and control



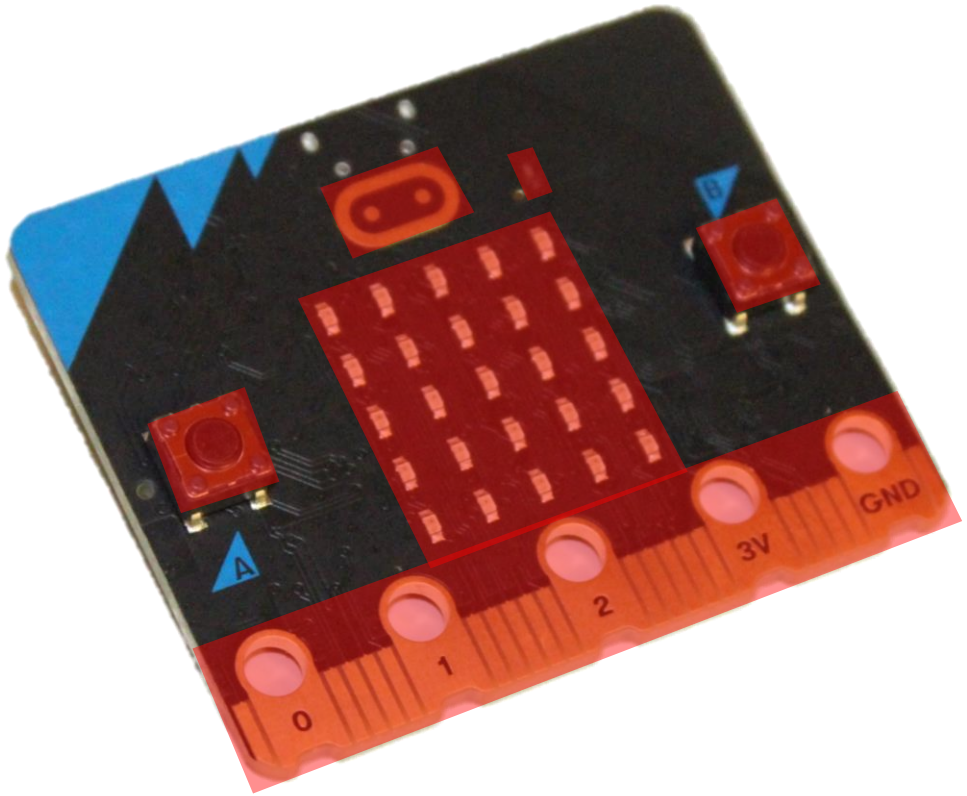
Apply technology to make the experience of physical computing easy, fun and intuitive – “magical”

Over time we've learned to embrace this tension!



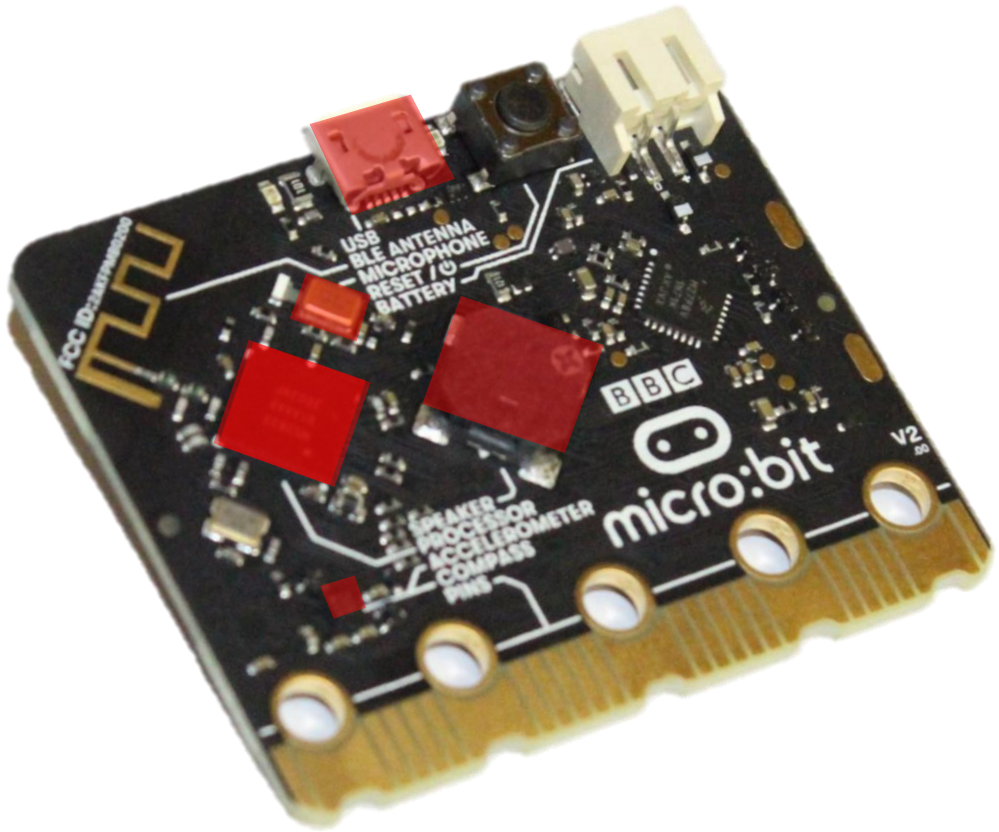
We aim to design in collaboration with teachers, partners and educators to make sure we're getting the balance right

What does a micro:bit contain?



- 25 LED matrix screen
- Light sensor
- User definable buttons
- Touch sensitive logo
- Privacy indicator
- 17 digital input/output
- 3 analog input
- 3 PWM output
- 3 touch sensitive pins
- I2C, SPI, UART

What does a micro:bit contain?



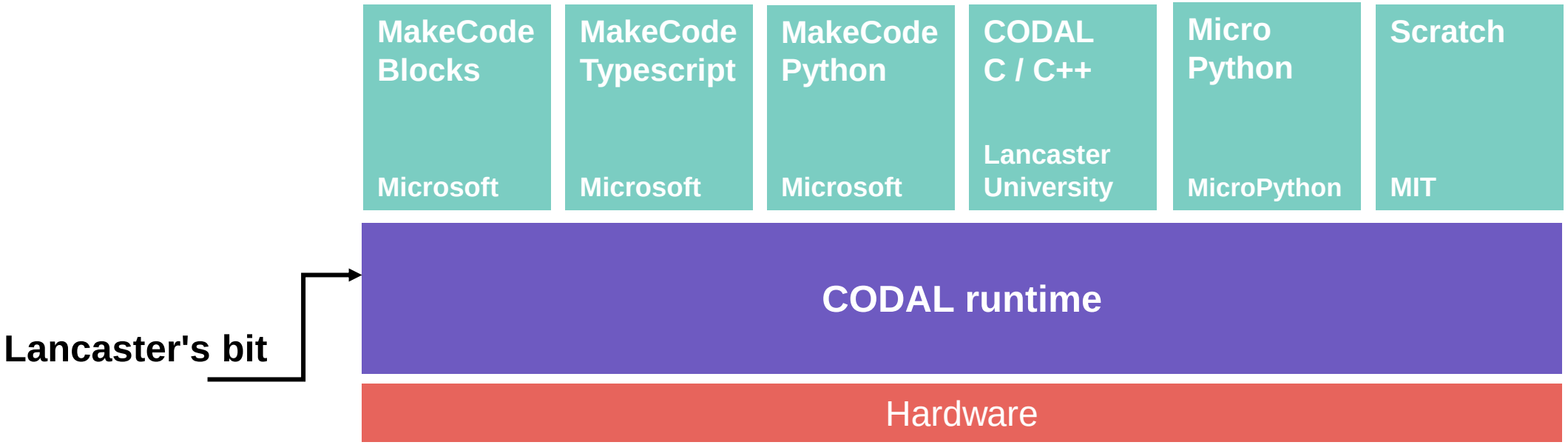
- 64MHz ARM Cortex M4
- 128kB RAM, 512kB FLASH

- USB storage/programming/debug
- Microphone
- Magnetic speaker
- 3 axis magnetometer
- 3 axis accelerometer
- Temperature sensor
- Bluetooth / 2.4GHz Radio

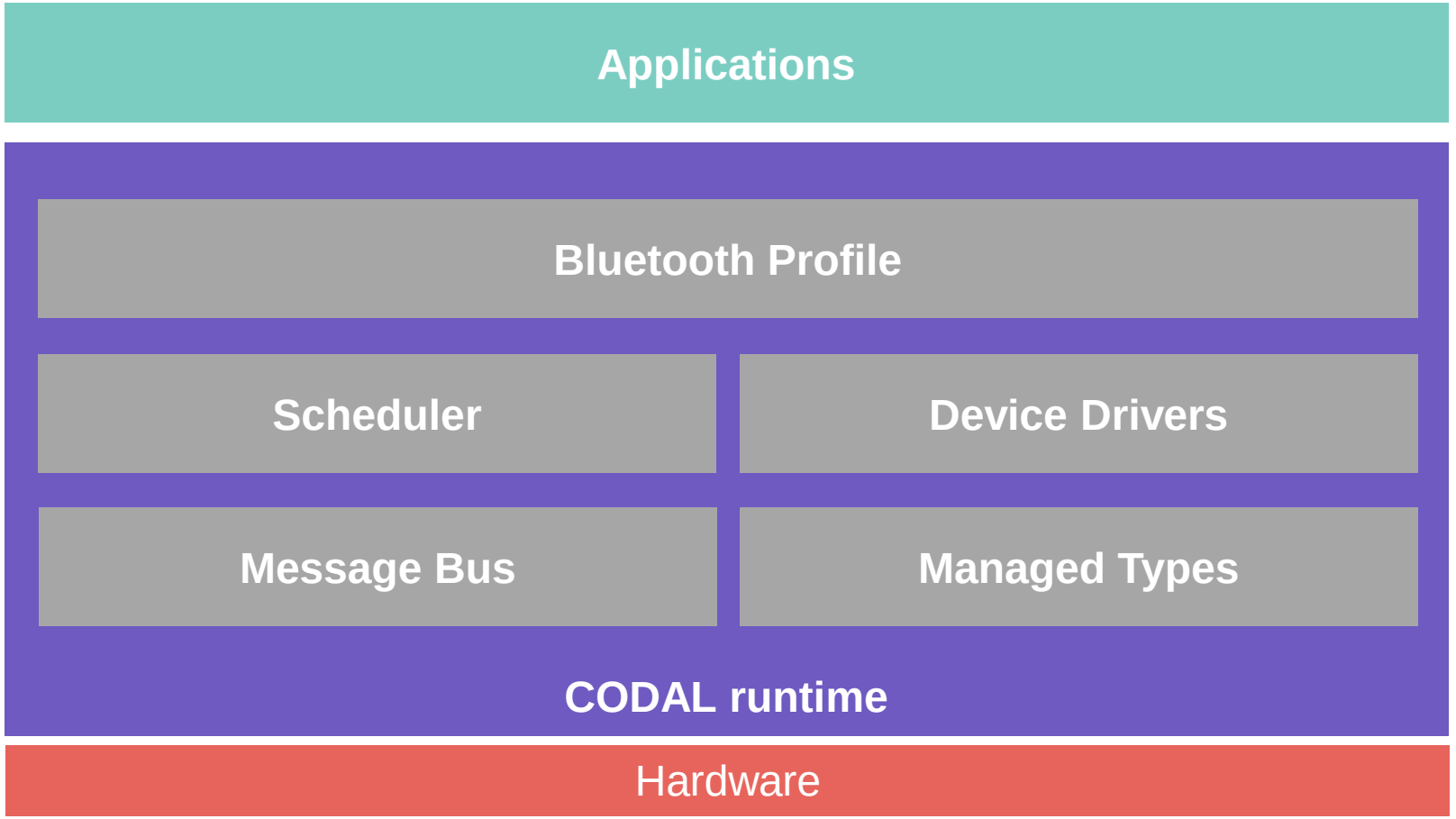
What do you notice about the micro:bit's capabilities?

Micro:bit CODAL runtime

- **The micro:bit community encourages many languages…**
  - **What language do you think CODAL is written in? and WHY?**
  - **What principle of CS is this a good example of?**

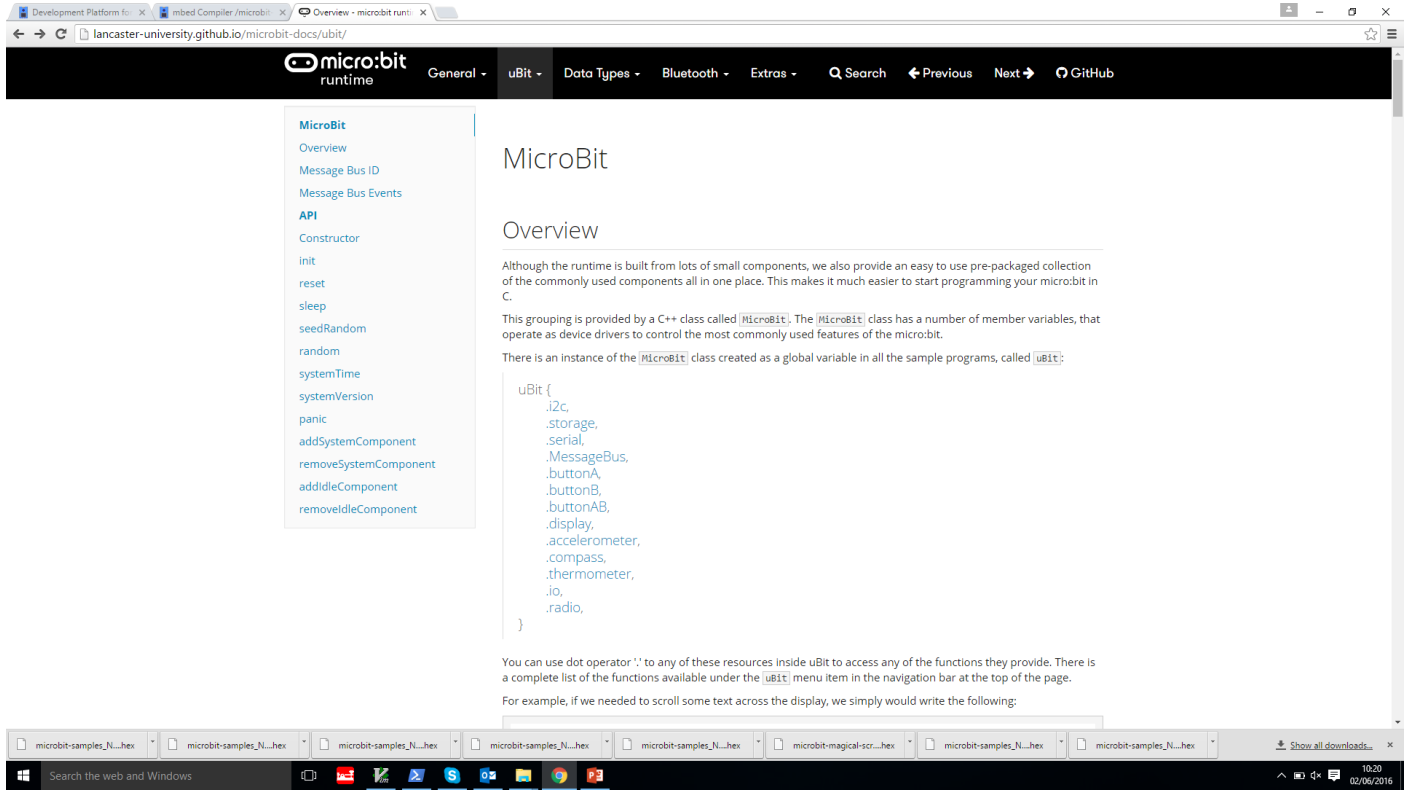


Micro:bit CODAL runtime architecture



Micro:bit CODAL device drivers

- Each hardware component is supported by a corresponding C/C++ software component:
  - MicroBitAccelerometer
  - MicroBitButton
  - MicroBitMultiButton
  - MicroBitCompass
  - MicroBitDisplay
  - MicroBitIO
  - MicroBitLightSensor
  - MicroBitRadio
  - MicroBitSerial
  - MicroBitStorage
  - MicroBitThermometer



Micro:bit CODAL uBit object…

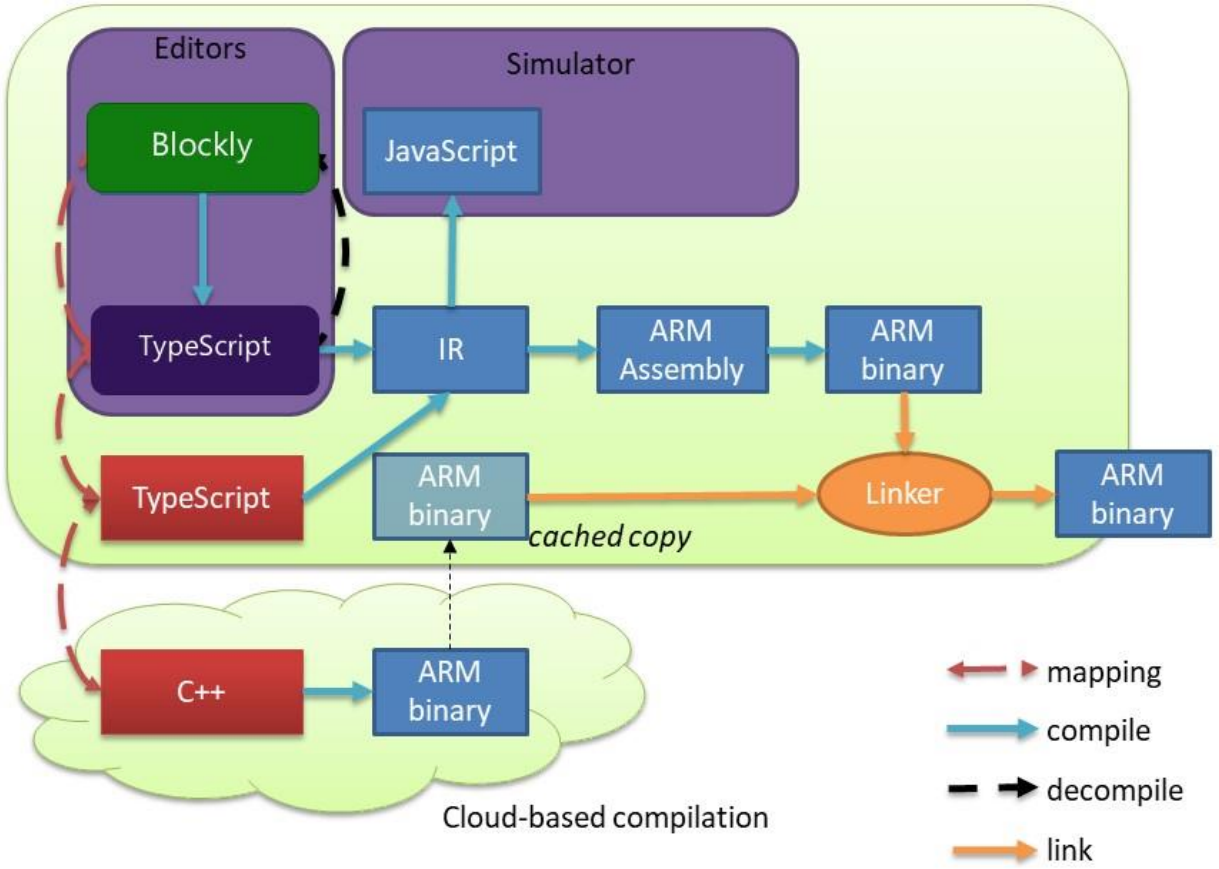
- Complexity of fine grained initialization too great for most high level languages…
- So we wrap the common set of components together to form an easy API:

```
MicroBit uBit;

int main()
{
    // initialise runtime
    uBit.init();

    // code!
    uBit.display.scroll("Hello World!");
}
```

Putting the pieces together…



- CODAL is integrated into higher level language through **foreign function interfaces**.
- This is very common way to combine advantages of high and low level languages…
- **You think all those popular python libraries are written in *python*?**

Wrap-up

Non-technical challenges

- Easy for students
- Easy for teachers
- No installation, no setup, no internet
- Appeal to a range of ages
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  tens of millions of users

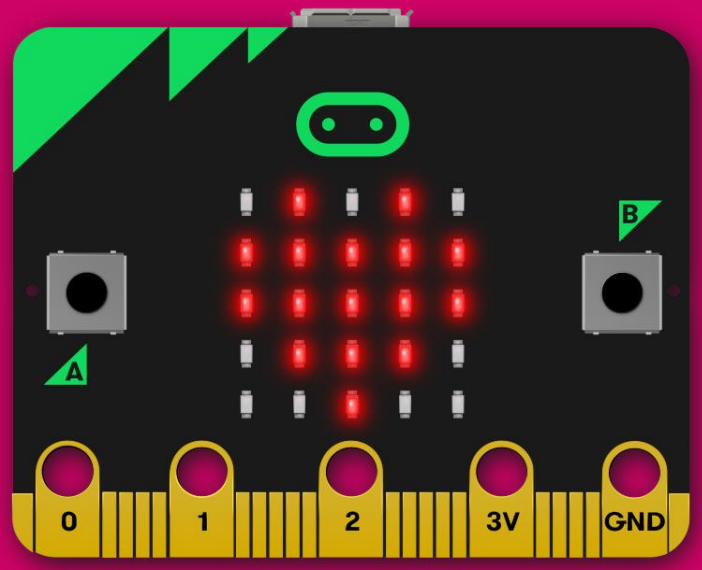
A new perspective on micro:bit

- All the elements of a digital system
- Built from C code and digital logic
- A perfect learning platform

Lancaster University

micro:bit

Thank you for listening…



…please do reach out