Micro:bit Magic
Engaging K-12, CS1/2, and non-majors with IoT & Embedded

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Outline

• Intros: Us, You, the micro:bit
★ Setup
★ “Hello, World!”: First Program
★ Programming: Logic & Action
★ Broadcast Basics
★ Awesome Audio & Motor Mayhem
★ Bluetooth Basics & Phone Phun
★ Extensions & Graphing
★ Cutting the Cord
• Conclusions
Intros: Us & You
Intros: Us & You

• Us
• Intros: Us & You

  • Us
  • You: Roll Call & Intros
• Intros: Us & You

• Us
• You: Roll Call & Intros
  • Who has Chrome? Who has an iOS Device with the App?
Intros: Us & You

• Us
• You: Roll Call & Intros
  • Who has Chrome? Who has an iOS Device with the App?
  • Pair programming — pair up!
Intros: the micro:bit
Small

5cm x 4cm
LED Grid

5cm x 4cm
Buttons

Artwork source: http://microbit.org/images/microbit-features-buttons.png
Connectors

Artwork source: http://microbit.org/images/microbit-features-pins.png
Light Sensor

Artwork: http://microbit.org/images/microbit-features-light.png
Within about 2 degrees C (die temperature)
Accelerometer

Detect/respond to tilt/tip/shake/etc.
Artwork source: http://microbit.org/images/microbit-features-accelerometer.png
Compass

Artwork source: http://microbit.org/images/microbit-features-compass.png

5xm x 4cm
Radio

5cm x 4cm
Artwork source: http://microbit.org/images/microbit-features-radio.png
Bluetooth: It can talk to mobile devices!!
Artwork source: http://microbit.org/images/microbit-features-bluetooth.png
Low Cost: ~$13 US

Artwork source: http://microbit.org/images/microbit-features-temp.png
Thanks: Micro:bit Educational Foundation
and Hal Speed

Thanks to The Micro:bit Educational Foundation and Hal Speed for the following slides. (Hal is Chief of Global Engagement; Micro:bit foundation is a non-profit)
2015

- BBC Make It Digital
- 29 partners
- 1 million micro:bit devices
- 11-12 year olds
- Across the U.K.
90% of students said it helped show that anyone can code

Source: BBC
70% increase in the number of girls that said they would definitely choose computing.

Source: BBC
To empower children, parents and teachers around the globe to learn and innovate using the micro:bit
2017

micro:bit available in the U.S.

10 New & Innovative EdTech Products Announced at ISTE 2017

Lessons Aligned to Code.org CS Fundamentals

- Lessons extend the concepts taught in the Code.org curriculum by using micro:bit and MakeCode
  - Course E – Loop and Functions
  - Course F – Variables and Conditionals

<table>
<thead>
<tr>
<th>4th Grade</th>
<th>5th Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course E</td>
<td>Course F</td>
</tr>
</tbody>
</table>

http://microbit.org/teach/code-org-fundamentals/
Third-Party Curricula

Microsoft MakeCode Intro to CS
https://aka.ms/intro2cs

1. Making
2. Algorithms
3. Variables
4. Conditionals
5. Iteration
6. Review/Mini-Project
7. Coordinate Grid System
8. Coordinate Grid System
9. Booleans
10. Music and Arrays
11. Bits, Bytes, and Binary
12. Radio
13. Arrays
14. Independent Final Project

PLTW Gateway:
Computer Science for Innovators and Makers
https://www.pltw.org/our-programs/pltw-gateway-curriculum#curriculum-4
Let’s Play
Environment: Palette, Color & Icon coded; Most used features are prominent, others are on “…more” menu.
Simulator
Block area
“Hello, World!”: First Program

- Block-based editor

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“Hello, World!”: First Program

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- Built-in simulator

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- Deployment to Micro:bit

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Environment: Palette, Color & Icon coded; Most used features are prominent, others are on “…more” menu.
Simulator
Block area
Blocks are just the beginning...
Blocks are just the beginning...

- JavaScript
Blocks are just the beginning...

- JavaScript
- Python w/ REPL
Blocks are just the beginning...

- JavaScript
- Python w/ REPL
- Arduino / C++
Blocks are just the beginning...

- JavaScript
- Python w/ REPL
- Arduino / C++
- Commercial IDEs / C++
Workshop Format
Workshop Format

• Moderate pace with small examples
Workshop Format

- Moderate pace with small examples
- Only covering blocks-based approach
Workshop Format

- Moderate pace with small examples
- Only covering blocks-based approach
- Will cover many “building blocks”, but not much depth
Workshop Format

- Moderate pace with small examples
- Only covering blocks-based approach
- Will cover many “building blocks”, but not much depth
  - Putting pieces together for awesome projects left as an exercise for you…
Setup

• Hardware Handout
  1. Open Box
  2. Pull out micro:bit
  3. Pull out micro USB cable (under cardboard)
  4. Connect via USB cable
Setup

• Browser
  1. Open microbit.org
  2. Select “Let’s Code”
  3. Click “Let’s Code” button on MakeCode
  4. Select “New Project”
Personalization!
Personalization!

• Hello Bill / Hello Michael / Hello ....
Personalization!

- Hello Bill / Hello Michael / Hello ....

```
forever
show string "Hello SIGCSE!"
```
Aside: Text-based Languages
Aside: Storage
Aside: Storage

- Projects are stored in the cloud
Aside: Storage

- Projects are stored in the cloud
- No accounts (by default, but GitHub repositories can be used)
Aside: Storage

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- Based on *machine you’re on!*
Aside: Storage

- Projects are stored in the cloud
- No accounts (by default, but GitHub repositories can be used)
- Based on *machine you’re on!*
- But…Downloaded files can be restored via Drag & Drop!
WebUSB
WebUSB

- Why: Get rid of Files!
WebUSB

• Why: Get rid of Files!
• Faster programming
WebUSB

- Why: Get rid of Files!
- Faster programming
- Additional Features: a Console!
WebUSB

- Why: Get rid of Files!
- Faster programming
- Additional Features: a Console!
- How: Chrome 65+ & Setup
1. Go to Gear Menu
2. Select Pair Device
3. Select Pair Device
4. Connect
Try It!

Download
New Project: Home > New Project...
New Project: Home > New Project...
Programming: Logic & Action

• Picking between *three* tough choices
  • Cookie, Cake, Pie
  • Super Strength, Invisibility, Telekisis
  • ...

CS...Int division; Mod; Etc.
Obvious Solution...

https://openclipart.org/detail/17370/a-die
https://openclipart.org/detail/19632/scissors
Obvious Solution...

https://openclipart.org/detail/17370/a-die
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Obvious Solution...

https://openclipart.org/detail/17370/a-die
https://openclipart.org/detail/19632/scissors
1. Color indicates Palette
2. Incremental Development:
   - Try parts in Simulator
3. Play...Start with showing 0/1
Let's play...

Get started w/ Shake & Show Random Number
A solution

Full Program: 03-Roll.hex
Concepts
Concepts

- Event driven programming
Concepts

- Event driven programming
- Bitmapped Graphics
Concepts

- Event driven programming
- Bitmapped Graphics
- Ranges & Representations
Concepts

- Event driven programming
- Bitmapped Graphics
- Ranges & Representations
- Boolean Logic
Great…but all concepts can be done with scratch.
New Project: Home > New Project...
Broadcast Basics

- Radio Palette: Broadcast Based Radio Transmissions
- String, Number, Key/Value Pairs, ...
Receiver

on start
  radio set group 1

on radio received
  receivedNumber
  change score by 1
Receiver

“Game” blocks in “Advanced” Section of Palette
Full Program: 04-FullAutoBroadcaster.hex
Broadcasting can be done with Scratch
Broadcasting can be done with Scratch
Broadcasting can be done with Scratch
Broadcasting can be done with Scratch
★

& Firefly Fun
★ & Firefly Fun
Broadcasting can be done with Scratch
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Broadcasting can be done with Scratch
New Project: Home > New Project...
New Project: Home > New Project...
Show an example of playing a note / Using Clips to connect to headphones
Parts: 2 Clips + Headphone
Concepts

• I/O
Concepts

- I/O
- Basic Electric Circuits/Electronics
Motor Mayhem

An Intro to Servos
Program
These servos are limited to 0-120°
Testing...

• Test in Simulator

TODO: Add picture
Connect them...
Add a Horn

Pic Source: https://www.amazon.com/gp/product/B07CM87WBQ/ref=ppx_yo_dt_b_asin_title_o03_s00?ie=UTF8&psc=1
Clip to micro:bit

- Match color on Servo to pad name on micro:bit (clip colors don’t matter)
- Brown on Servo to GND on micro:bit
- Red on Servo to 3V on micro:bit
- Orange on Servo to 0 on micro:bit
Inchworm Insanity

https://makecode.microbit.org/projects/inchworm
Break

1. Firmware Update
   A. Go to https://tinyurl.com/uBitUpdate
   B. Follow Instructions to Upgrade

2. App Install
   A. Open Browser on phone to http://microbit.org/code
   B. Scroll to Apps and Select
Bluetooth Background

• Uses different protocol than radio

• Not a group broadcast
Bluetooth Background
Bluetooth Background

Central
Bluetooth Background

Central

Peripheral
Bluetooth Background
Bluetooth Background

Central
Bluetooth Background

Central

[Diagram of Bluetooth connections]
Bluetooth Basics

- Bluetooth has various levels of security
- “Pairing” — Forming a “permanent” bond
  (Exchanging security info. once and storing it)
- Block editor supports three types
  - No pairing (“insecure” - we’ll use this)
  - Just Works (default; pretty safe)
  - Passkey Pairing (more secure)
Follow instructions to pair. NOTE THE NAME of your Micro:bit!!! Will need it later
Pairing

Follow instructions to pair. NOTE THE NAME of your Micro:bit!!! Will need it later.
New Project: Home > New Project...
New Project: Home > New Project...
Add Bluetooth
(& remove Radio)
Add Bluetooth
(& remove Radio)

FIXME
Pairing only works prior to installing a bluetooth sketch.
May need to re-load a blank sketch and then start pairing process.
Each sketch will need this setting.
Need to know name of YOUR microbic
Pairing only works prior to installing a bluetooth sketch.  
May need to re-load a blank sketch and then start pairing process.  
Each sketch will need this setting.  
Need to know name of YOUR microbic
Phone Phun: Program

Use right-click "duplicate"
Full Program: 07-BluetoothControl.hex
Phone Phun: Program

on start
set character x to create sprite at x: 2 y: 2
bluetooth led service
bluetooth button service

on gamepad button B down
character change y by -1

on gamepad button A down
character change y by 1

on gamepad button C down
character change x by -1

on gamepad button D down
character change x by 1

Use right-click “duplicate”
Full Program: 07-BluetoothControl.hex
Phone Phun: Program

Devices Palette

Game Palette (Under Advanced)

Use right-click "duplicate"

Full Program: 07-BluetoothControl.hex
Use right-click “duplicate"
Full Program: 07-BluetoothControl.hex
Pro tip: Create one of these, then right-click and “duplicate” 3x, then modify.

Use right-click “duplicate”
Full Program: 07-BluetoothControl.hex
Micro:bit Shutter Release
Program

on button A pressed

tell camera to take photo

Full program: 08-Selfie.hex
App Config
SIGCSE Selfie!
Extra Hardware: Extensions

• Extensions...extend
• Additional hardware support (today)
• Additional simulator features
Wiring Sensor

- + (to 3V)
- - (to GND)

out (to 0)
Collecting Data

Full Program: 09-TempHumidity.hex
Collecting Data

```
for ever

serial write value "Temp" = A11 A0 = temperature Celsius
serial write value "Humidity" = A11 A0 = humidity
```

Full Program: 09-TempHumidity.hex
Collecting Data

Minode Palette

Minode's "...more" Palette

Full Program: 09-TempHumidity.hex
Collecting Data

Minode Palette
Minode’s "...more" Palette
Advanced Serial Palette

Full Program: 09-TempHumidity.hex
Graphing
Bluetooth Streaming: Program

```plaintext
on start
bluetooth uart service

forever
bluetooth uart write value "x" = acceleration (mg) x
bluetooth uart write value "y" = acceleration (mg) y
bluetooth uart write value "z" = acceleration (mg) z
bluetooth uart write value "str" = acceleration (mg) strength
```

Full Program: 12-WirelessAccel.hex
Pairing Process
(Settings> No Pairing Required; but need to connect to micro:bit)
Pairing Process
(Settings> No Pairing Required; but need to connect to micro:bit)
IoT Example Overview
Hardware Ecosystem
U.S. Resellers
Available via DonorsChoose.org

- AKJ Education is an approved DonorsChoose.org vendor and micro:bit reseller
- Teachers enter projects and request classroom materials
- Individuals and companies can donate money towards the purchase of those materials
• Address Safety!
  • Low voltage / low current vs. Mains power
Bill's SIGCSE Blog Post
https://tinyurl.com/SIGCSE19uBit
Questions / Discussion
Remove Add Bluetooth
(& remove Radio)
Remove Add Bluetooth
(& remove Radio)