BEN SHAPIRO Presents
THE FUTURE OF CS EDUCATION
Starring MICRO:BIT

ATLAS Institute
University of Colorado Boulder
1985

10 year anniversary
$140M in sales
DOS 3.2 & Windows 1.0 released

C++
NSFNET and DNS launched
80386 released
1985

C. A. R. Hoare
Communicating Sequential Processes
1985
Seymour Papert  Daniel Bobrow  Cynthia Solomon  Wally Feurzig

LOGO Language Creators
TO SQUARE
    REPEAT 4 [ FORWARD 100 RIGHT 90 ]
END
TO SQUARE :LENGTH
    REPEAT 4 [ FORWARD :LENGTH RIGHT 90 ]
END
1985

K12 CS Education Content

Loops, Conditionals, IO (Graphics, Keyboard, Sound), & Procedural Abstraction
2016 Computing Is...

- Highly (inter-)networked
- Dependent upon concurrent and distributed systems
- Architecturally heterogeneous
- Social
2016

Computer Science Education
CS Education growing in popularity
Computer Science For All

JANUARY 30, 2016 AT 6:05 AM ET BY MEGAN SMITH

Summary: Learn about President Obama’s bold new initiative to empower a generation of American students with the computer science skills they need to thrive in a digital economy.

In the coming years, we should build on that progress, by ... offering every student the hands-on computer science and math classes that make them job-ready on day one.

- President Obama in his 2016 State of the Union Address
Computer Science For All

JANUARY 30, 2016 AT 6:05 AM ET BY MEGAN SMITH

Summary: Learn about President Obama’s bold new initiative to empower a generation of American students with the computer science skills they need to thrive in a digital economy.

In the coming years, we should build on that progress, by... offering every student the hands-on computer science and math classes that make them job-ready on day one.

- President Obama in his 2016 State of the Union Address
a growing field

LOTS of kids learning CS
Building a Galaxy With Code

JavaScript
Use drag-drop blocks and JavaScript.
English only | Modern browsers | Ages 11+

Blocks
Use drag-drop blocks.
Many languages | Modern browsers, smartphones, tablets | Ages 6-106

Before you get started, watch one of these inspirational videos
New code.org Log-Ins

\[ R^2 = 0.6124 \]
U.S. Schools offering AP CS

<table>
<thead>
<tr>
<th>Year</th>
<th>Schools offering AP CS A</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>19,390</td>
</tr>
<tr>
<td>2011</td>
<td>21,139</td>
</tr>
<tr>
<td>2012</td>
<td>24,782</td>
</tr>
<tr>
<td>2013</td>
<td>29,555</td>
</tr>
<tr>
<td>2014</td>
<td>37,327</td>
</tr>
<tr>
<td>2015</td>
<td>46,344</td>
</tr>
</tbody>
</table>

Ericson (2015)
A Framework for K-12 Computer Science Education
still HUGE inequities

gender
race
economic status

a growing field
Data students in my class collected & analyzed last semester

http://huriphoonado.github.io/colorado-schools-cs-classes/
What Happened To Women In Computer Science?

% Of Women Majors, By Field

- Medical School
- Law School
- Physical Sciences
- Computer science

Source: National Science Foundation, American Bar Association, American Association of Medical Colleges
Credit: Quoctrung Bui/NPR
How are kids learning CS in 2016?
Loops, Conditionals, IO (Graphics, Keyboard, Sound), & Procedural Abstraction

TO SQUARE
   REPEAT 4 [ FORWARD 10 RIGHT 90 ]
END
2016

Loops,
Conditionals,
IO (Graphics, Keyboard, Sound), &
Procedural Abstraction
1985

TO SQUARE
    REPEAT 4 [ FORWARD 10 RIGHT 90 ]
END

2016
Meet the new code...

1985
Loops,
Conditionals,
IO (Graphics, Keyboard, Sound), &
Procedural Abstraction

2016
Loops,
Conditionals,
IO (Graphics, Keyboard, Sound), &
Procedural Abstraction

...same as the old code.
Retro-Computing Education
1985

10 year anniversary
$140M in sales
DOS 3.2 & Windows 1.0 released

C++
NSFNET and DNS launched
80386 released
2016 CS Education
should look like
2016 CS
2016 Computing Is…

• Networked
• Built upon concurrent and distributed systems
• Architecturally heterogeneous (from wearables to clouds)
• Social
• Statistical (machine learning)
2016 Computing Is...

- **Networked**
- Built upon concurrent and distributed systems
- Architecturally heterogeneous (from *wearables* to clouds)
- **Social**
- **Statistical** (machine learning)
Wearables
e-textiles

Leah Buechley

Lilypad Arduino
but

Programming = 💩

Guyer, 2015
int lightState = 0;
bool buttonPressed = false;

void setup() {
  pinMode(1, INPUT);
  pinMode(2, OUTPUT);
  digitalWrite(2, LOW);
}

void loop() {
  if (digitalRead(1) == HIGH) {
    if (buttonPressed == false) {
      buttonPressed = true;
      if (lightState == 0) {
        lightState = 1;
        digitalWrite(2, HIGH);
      } else {
        lightState = 0;
        digitalWrite(2, LOW);
      }
    }
  } else { //thus digitalRead(1) == LOW
    if (buttonPressed == true) {
      buttonPressed = false;
    }
  }
}
Welcome back!

Minimal Arduino code to toggle a light.

```cpp
int lightState = 0;
bool buttonPressed = false;

void setup() {
  pinMode(10, INPUT);
}

if (lightState == 0) {
  pinMode(13, OUTPUT);
  digitalWrite(13, HIGH);
  lightState = 1;
} else {
  pinMode(13, OUTPUT);
  digitalWrite(13, LOW);
  lightState = 0;
}

if (buttonPressed == true) {
  buttonPressed = false;
}
```
Micro:bit makes this easy
on button A pressed

set status to false

if status

do show leds

else

do show leds

set status to not status
int lightState = 0;
bool buttonPressed = false;

void setup() {
  pinMode( 1 , INPUT);
  pinMode( 2 , OUTPUT);
  digitalWrite(2, LOW);
}

void loop() {
  if (digitalRead(1) == HIGH){
    if (buttonPressed == false){
      buttonPressed = true;
      if (lightState == 0) {
        lightState = 1;
        digitalWrite(2, HIGH);
      }else{
        lightState = 0;
        digitalWrite(2, LOW);
      }
    }
  }else{ //thus digitalRead(1) == LOW
    if (buttonPressed = true){
      buttonPressed = false;
    }
  }
}
One hitch...

Distance from eyelets to edge leads to shorts with adjacent pins.

Distance too large.
Easy Fix
Easy Fix
Made with Kristin Searle (Utah State)
Summer camps sponsored by NCWIT
Networking
Micro:bit does wireless networking
A Simple Abstraction

Joins a short-range multicast group

- set group 42
- on button A pressed
  - send string "Sarah"
What can kids do with this?
This Fall
Networked Friendship
Jewelry Workshops
together with

BOULDER PUBLIC LIBRARY
Toward heterogeneity
2016 Computing Is...

- **Networked**
- Built upon concurrent and distributed systems
- **Architecturally heterogeneous** (from *wearables* to clouds)
- **Social**
- **Statistical** (machine learning)
2016 Computing Is...

• Networked

• Built upon concurrent and distributed systems

• Architecturally heterogeneous (from wearables to clouds)

• Social

• Statistical (machine learning)
Interactive Machine Learning
Interactive Machine Learning

Choose learning algorithm → Create & edit training examples → Train algorithm to build model → Evaluate model through realtime experimentation, visualization of data & decision boundary, inspection of model function, ...

Rebecca Fiebrink
Interactive Machine Learning

Rebecca Fiebrink, Goldsmiths University of London
Interactive Machine Learning

Rebecca Fiebrink, Goldsmiths University of London
Custom fitness wearables for safe physical training

Leah Petruccelli
Custom fitness wearables for safe physical training

Leah Petruccelli
Micro:bit enables the future of CS education.
Thank you.

ben.shapiro@colorado.edu