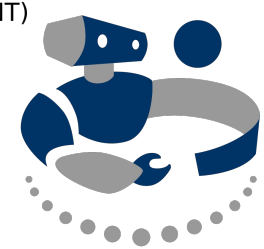
This research is supported by Award #1542465:
RET Site: Cyber Security Initiative for Nevada Teachers (CSINT)



SARG

SOCIALLY ASSISTIVE ROBOTICS GROUP

Core Computing Principles

or, how to code...

Core Computing Concepts To discuss

- Sequencing
- Decisions
- Loops
- Multi-Threading
- Subroutines

scratch

scratch.mit.edu

scratch: howto

ok, scratch is pretty easy...
let’s just talk about how to code

scratch.mit.edu

what do you want to do?

Core Computing Concepts To discuss

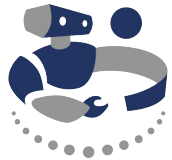
- **Sequencing**
- Decisions
- Loops
- Multi-Threading
- Subroutines

I want to make a cat that meows when the mouse moves over it

pseudocode

pseudo = false

code = a series of letters, numbers, or symbols assigned to something for the purposes of classification or identification



pseudo = false

code = code

I want to make a cat that meows when the mouse moves over it

pseudocode

try to frame program in terms of tools that are available

make a cat

pseudocode

if (mouse is over cat)
then meow

this is called a decision

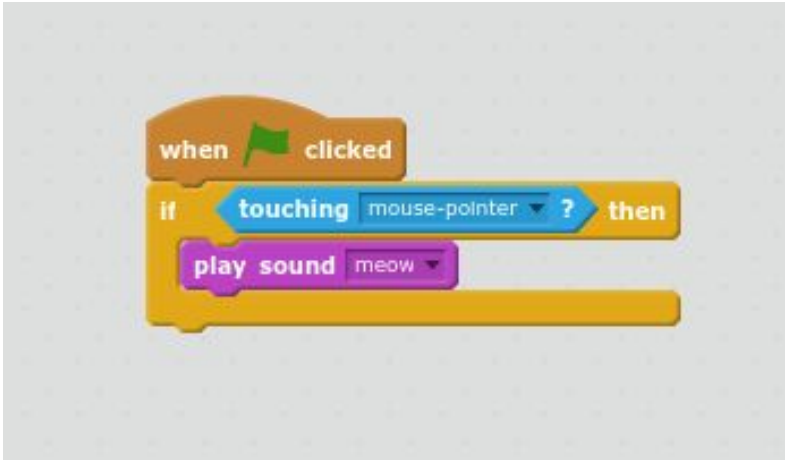
Core Computing Concepts To discuss

- Sequencing
- **Decisions**
- Loops
- Multi-Threading
- Subroutines

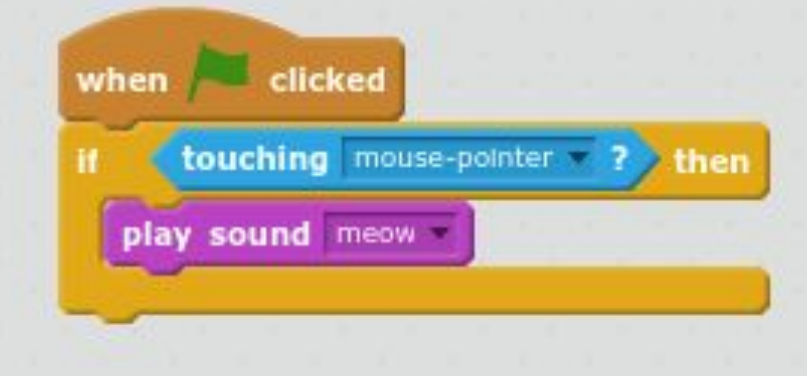
decision

This

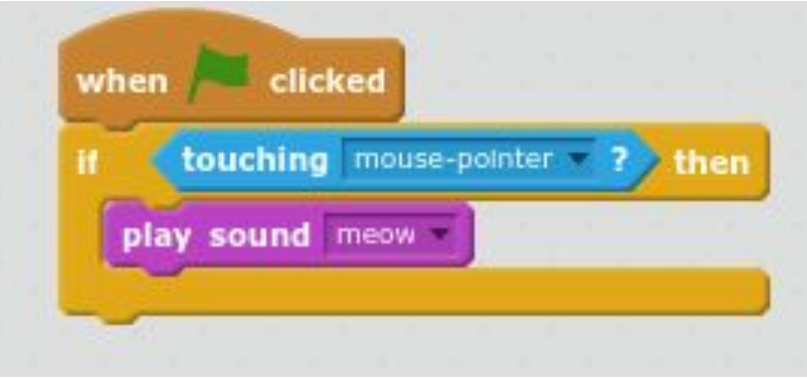
not this


when clicked
if touching mouse-pointer ? then
play sound meow

why didn’t this work?



why didn’t this work?



...this code only runs once

there was a problem with our plan

we need to do the same thing
again and again

Core Computing Concepts To discuss

- Sequencing
- Decisions
- **Loops**
- Multi-Threading
- Subroutines

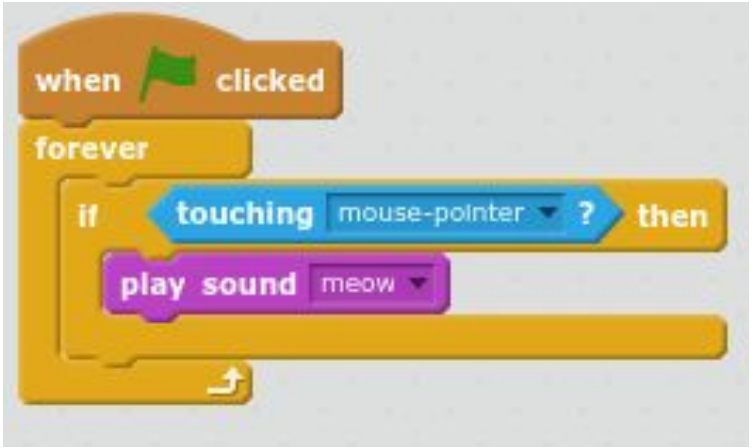
loop

pseudocode

```
repeat forever
    if (mouse is over cat)
        meow
```

pseudocode

```
repeat forever
    if (mouse is over cat)
        meow
```



If your mouse is over cat

meow, meow, meow,

What did you do to the poor cat!?

Perhaps a pause between meows?

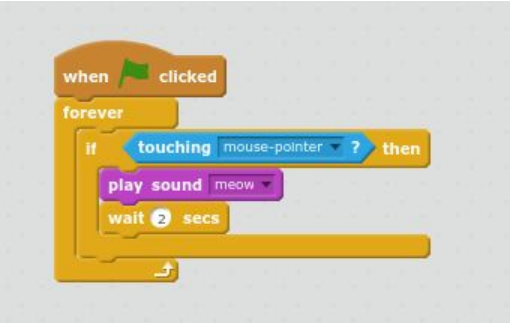
how long a pause?

pseudocode

```
repeat forever
    if (mouse is over cat)
        meow
        wait 2 seconds
```

pseudocode

```
repeat forever
    if (mouse is over cat)
        meow
        wait 2 seconds
```



let’s see what happens

ok... new idea

Core Computing Concepts To discuss

- Sequencing
- Decisions
- Loops
- **Multi-Threading**
- Subroutines

I want to see a woman playing with a dinosaur and do a cartwheel

more specific: anna says something to a dinosaur, then the dinosaur runs away, then anna runs after the dino

there are no cats in this program,
how do we do this?

this program needs two sprites

one for Anna

one for a dinosaur

sprite

is a two-dimensional image or animation that is integrated into a larger scene

for scratch, each character is a sprite

sprites can each do things at the same time

can also interact with each other

how to solve a problem like this?

break the problem into smaller parts

- solve each part individually
- integrate each part together

let’s break up this problem

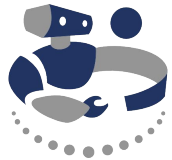
breaking up the problem

1. anna says something to a dinosaur
2. the dinosaur runs away
3. then anna runs after the dino

new pseudocode

ANNA	DINO
anna says: I’m a dinosaur	

new pseudocode



ANNA

anna says: I’m a dinosaur

DINO

dino says: oh no

dino runs away

what went wrong?

what went wrong?

dino didn’t wait for Anna

better pseudocode

ANNA

anna says: I’m a dinosaur

DINO

dino waits for anna to speak

dino says: oh no

dino runs away

what have we done?

1. anna says something to a dinosaur
2. the dinosaur runs away
3. then anna runs after the dino

what have we done?

1. *anna says something to a dinosaur*
2. *the dinosaur runs away*
3. then anna runs after the dino

better pseudocode

ANNA

anna says: I’m a dinosaur

anna waits for dino to run away

anna does cartwheel toward dino

DINO

dino waits for anna to speak

dino says: oh no

dino runs away

do a cartwheel

moves in one direction

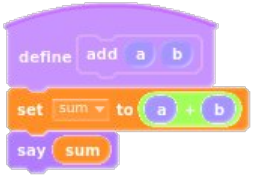
at same time rotates

Core Computing Concepts To discuss

- Sequencing
- Decisions
- Loops
- Multi-Threading
- **Subroutines**

this is a complex idea

use a subroutine



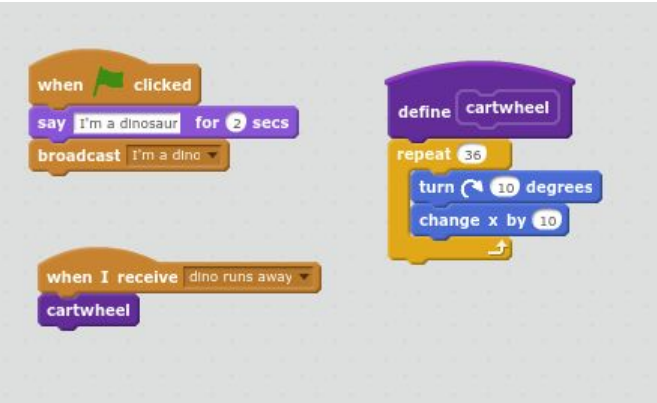
do a cartwheel

repeat a few times

- moves a little to the right
- rotates a bit clockwise

Final Code

Anna



Dino

why use a subroutine?

easier to read code later

might want to do same thing again and again

repeated actions

ANNA

anna says: I’m a dinosaur

anna waits for dino to run away

anna does cartwheel

anna does cartwheel

anna does cartwheel

DINO

dino waits for anna to speak

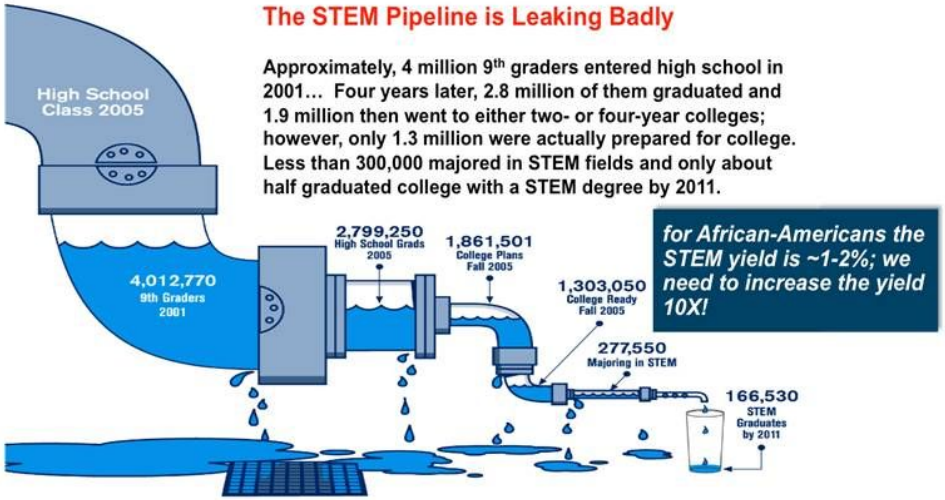
dino says: oh no

dino runs away

Why put programming in K-12 classrooms?

The STEM Pipeline is Leaking Badly

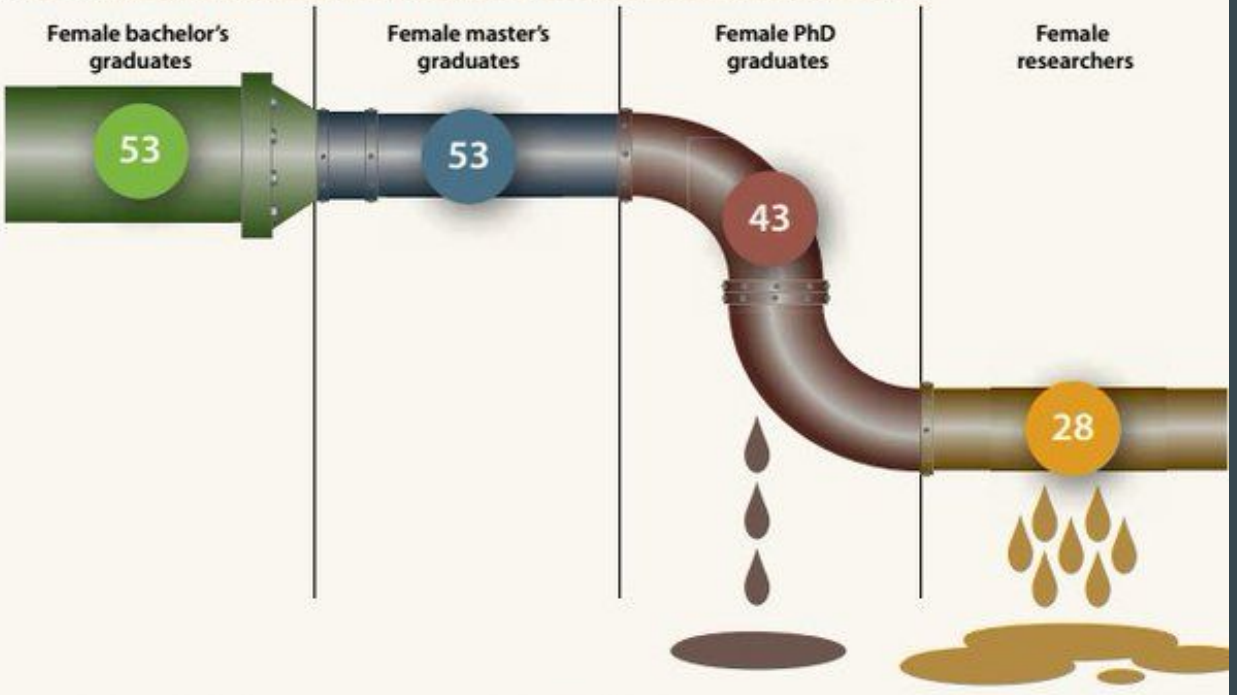
Approximately, 4 million 9th graders entered high school in 2001… Four years later, 2.8 million of them graduated and 1.9 million then went to either two- or four-year colleges; however, only 1.3 million were actually prepared for college. Less than 300,000 majored in STEM fields and only about half graduated college with a STEM degree by 2011.



for African-Americans the STEM yield is ~1-2%; we need to increase the yield 10X!

Source: NCES Digest of Education Statistics; Science & Engineering Indicators 2008

Figure 3.1: **The leaky pipeline: share of women in higher education and research, 2013 (%)**



Source: UNESCO Institute for Statistics estimates based on data from its database, July 2015

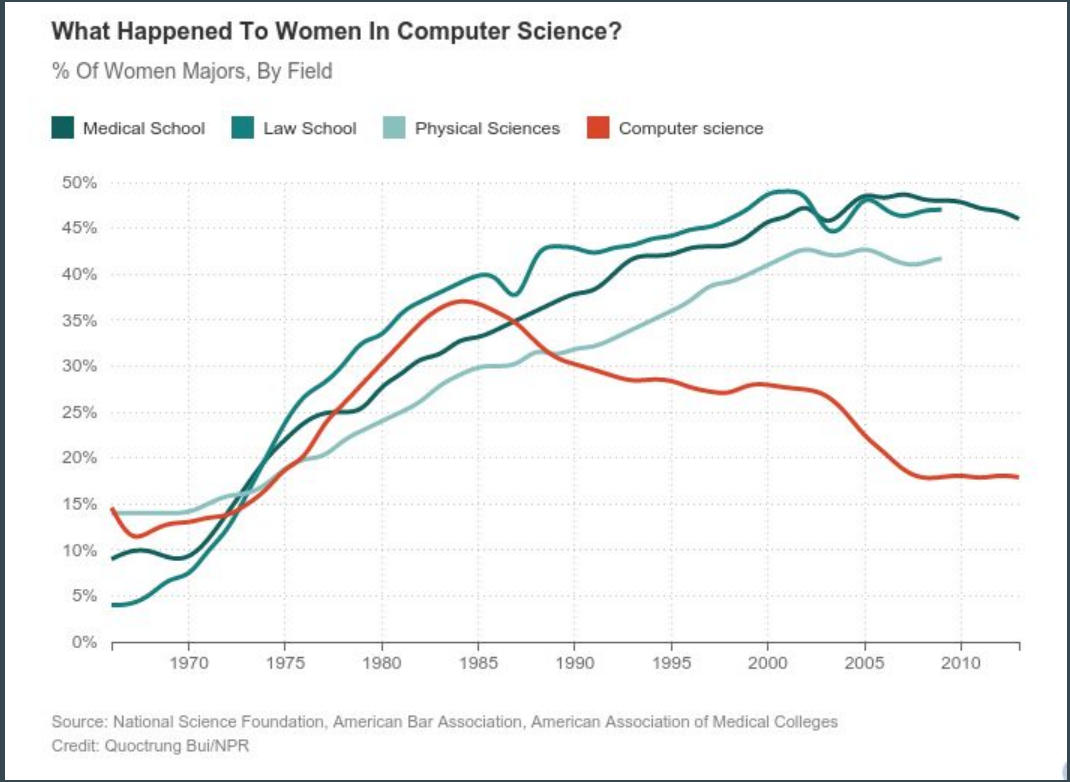
CS Taulbee Survey

Share of degrees in CS/CSE awarded to women

Graduate with BS: 15%

Graduate with MS: 18%

Graduate with PhD: 20%

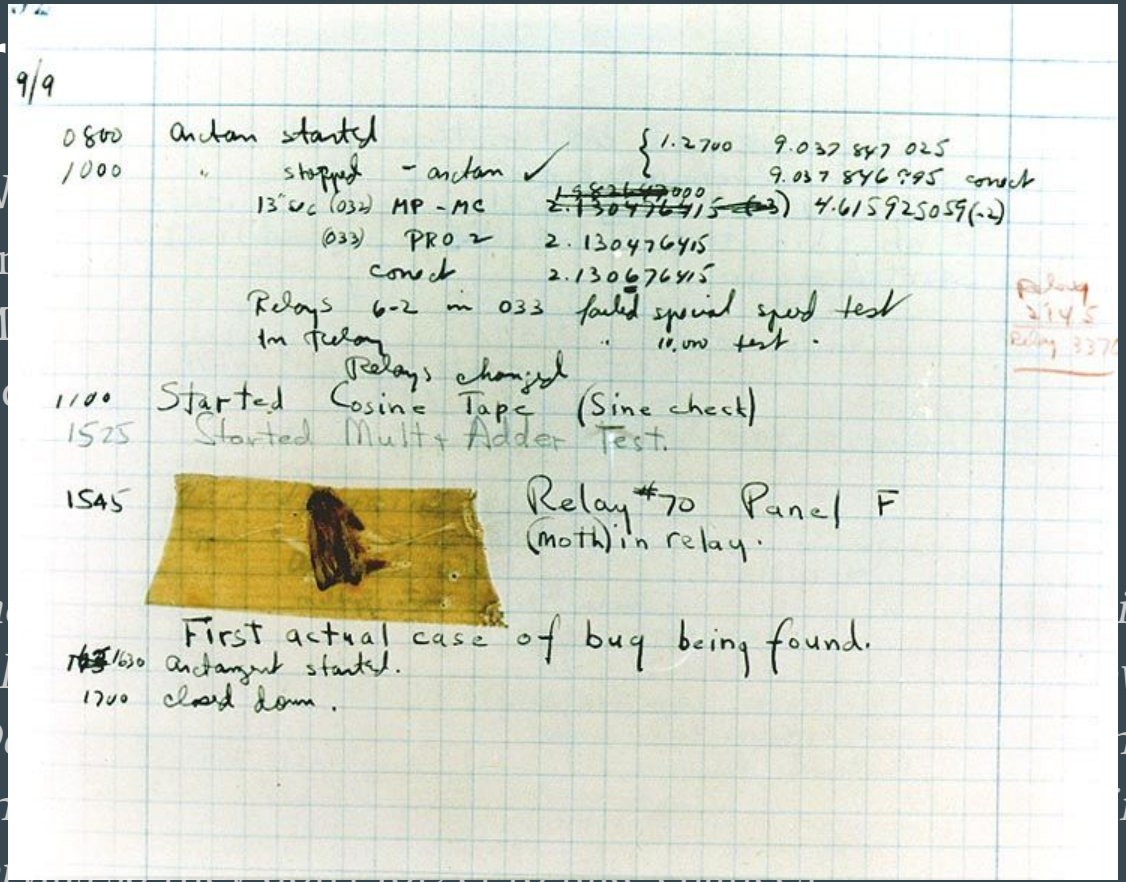

What Happened To Women In Computer Science?
% Of Women Majors, By Field
Medical School
Law School
Physical Sciences
Computer science
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
1970
1975
1980
1985
1990
1995
2000
2005
2010
Source: National Science Foundation, American Bar Association, American Association of Medical Colleges
Credit: Quoctrung Bui/NPR

First Programmer?

Ada Lovelace (1815-1862)

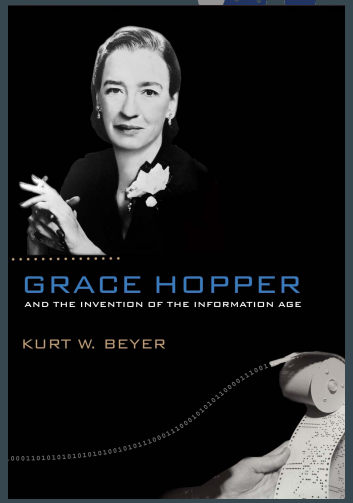
Rear

- W
  Er
- M
- C



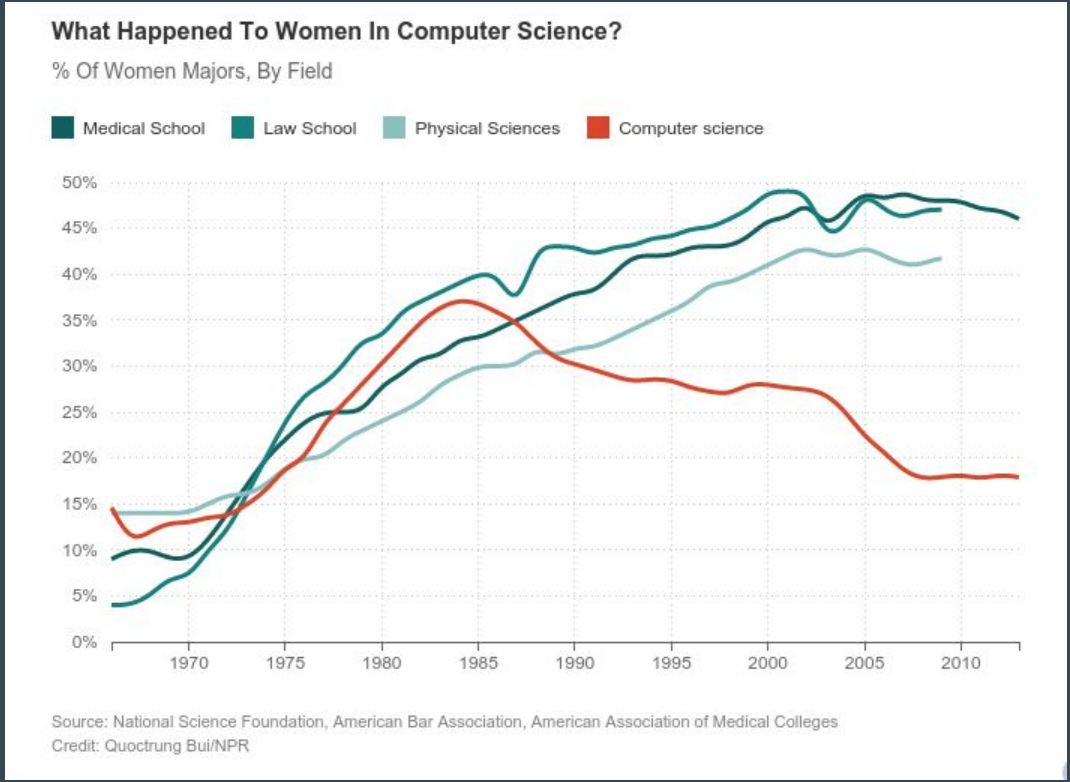
9/9

0800 Arctan started
1000 " stopped - arctan ✓
13"vc (032) MP - MC
(033) PRO 2
correct
Relays 6-2 in 033 failed special speed test
In relay
Relays changed
1100 Started Cosine Tape (Sine check)
1525 Started Mult + Adder Test.
1545 Relay #70 Panel F
(moth) in relay.
First actual case of bug being found.
1700 closed down.



The m ing the
compil w, and
say, 'D m up.
They n r 'em up
at inter

So What Happened?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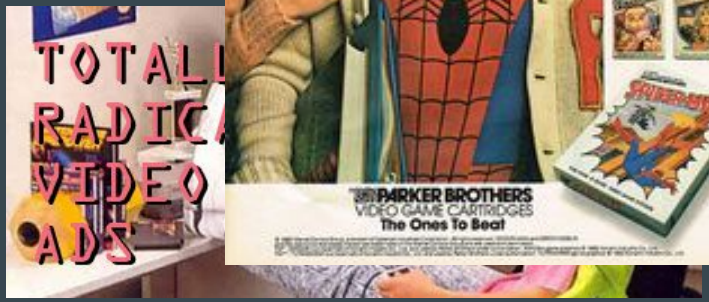
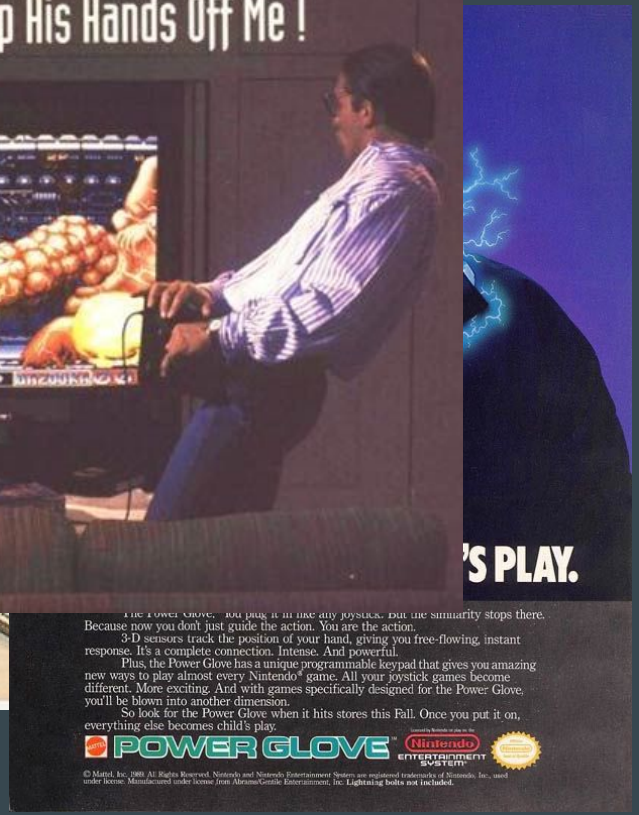
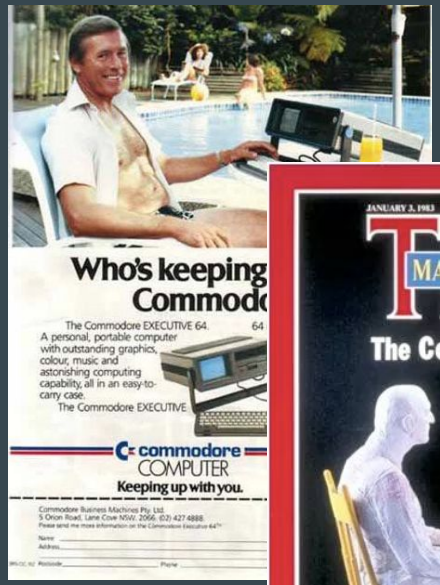
15%
10%
5%
0%
1970
1975
1980
1985
1990
1995
2000
2005
2010
Source: National Science Foundation, American Bar Association, American Association of Medical Colleges
Credit: Quoctrung Bui/NPR

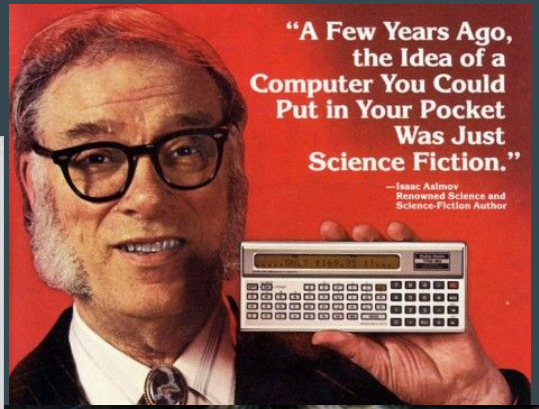
advertising





Computer advertising





Computers in movies

All Fixed Today, Right?

Hasbro: *“The Star Wars: Monopoly game was released in September, months before the movie’s release, and Rey was not included to avoid revealing a key plot line that she takes on Kylo Ren and joins the Rebel Alliance”*

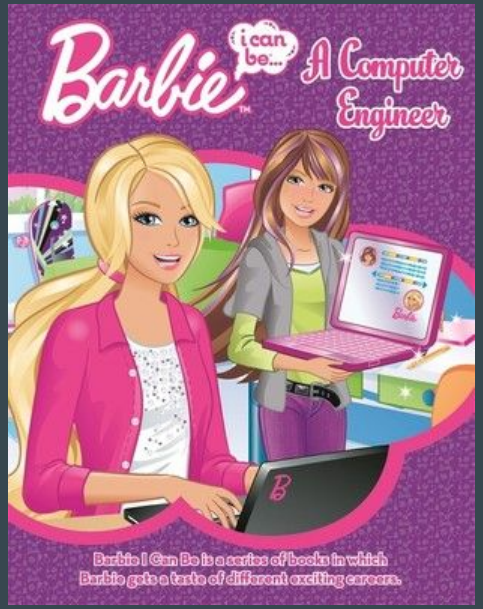
Spoiler Alert

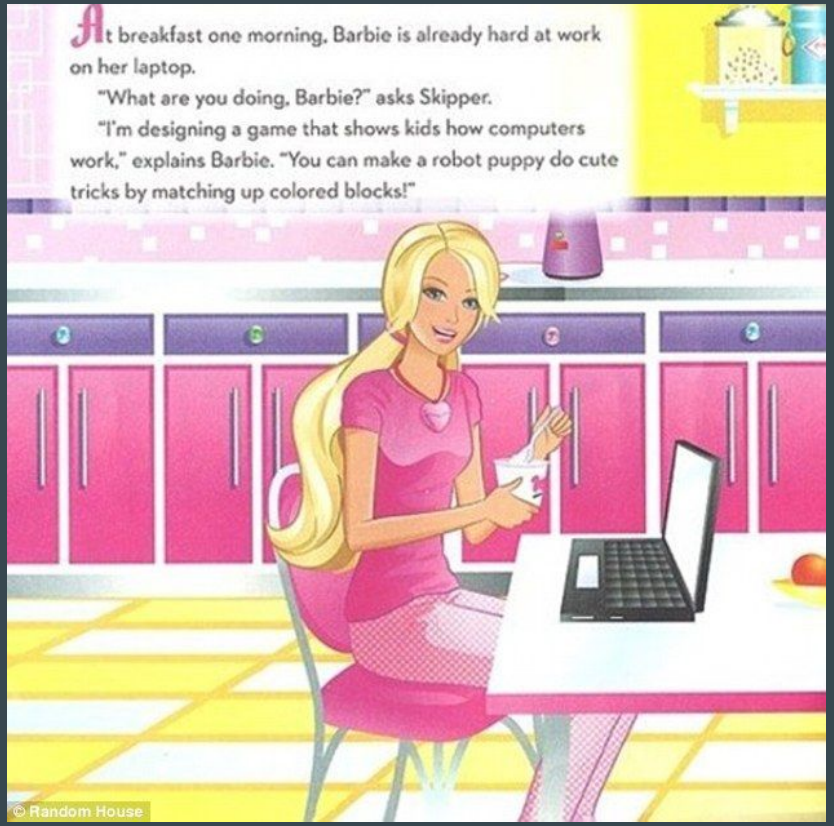
Hasbro: *“The Star Wars: Monopoly game was released in September, months before the movie’s release, and Rey was not included to avoid revealing a key plot line that she takes on Kylo Ren and joins the Rebel Alliance”*

OK, let’s fix it...

... girls like pink, right??

Computer Engineer Barbie: starts off fine





Computer Engineer Barbie: uh-oh

Barbie tries to email her design to Steven, but suddenly her screen starts blinking.

"That's weird!" says Barbie.

Barbie and Skipper try to reboot the computer, but nothing happens.

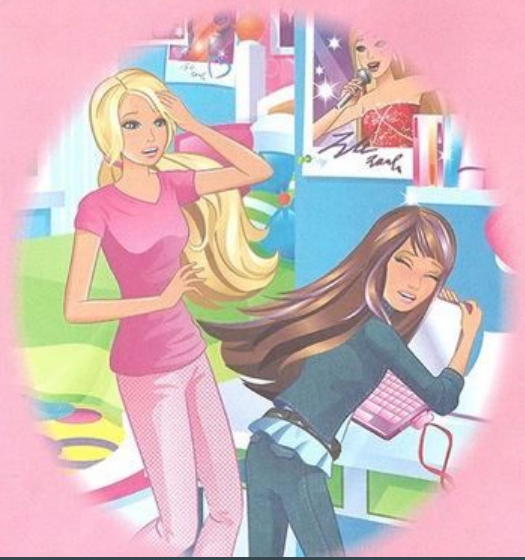
"Looks like you've got a virus, big sister," says Skipper.

"Luckily, I wear my flash drive on a necklace so that I'll always remember to back up my work," replies Barbie.

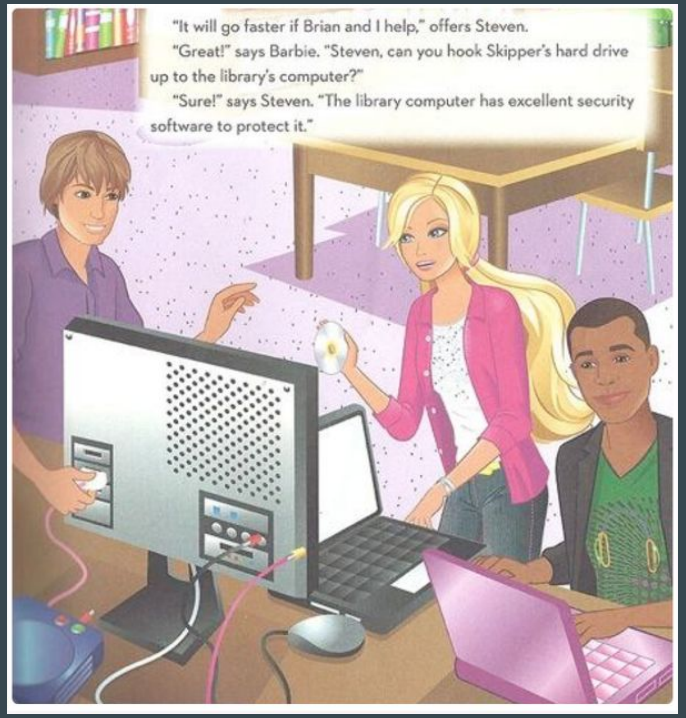
When Barbie puts her flash drive into Skipper's laptop, the screen starts blinking.

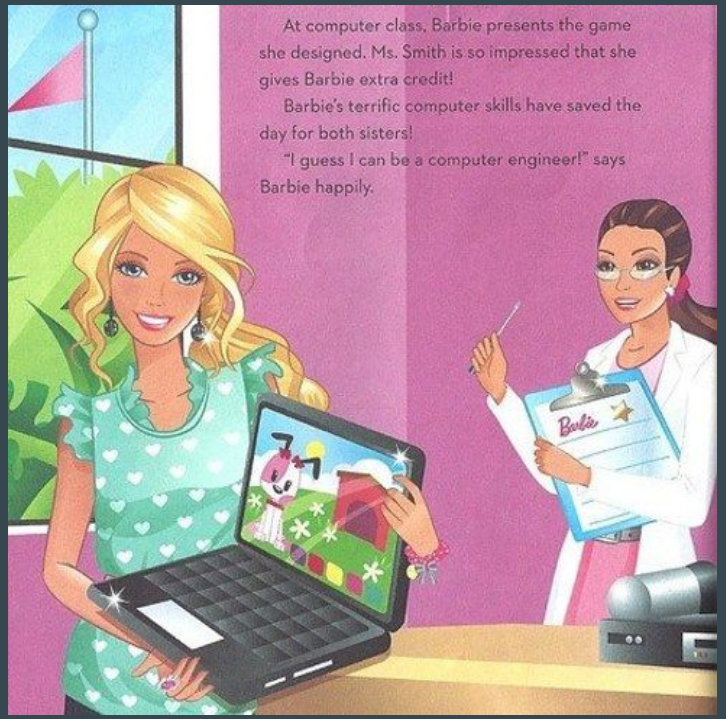
"Oh, no!" says Barbie. "The virus must be on the flash drive!"

"I forgot to back up my homework assignment!" cries Skipper. "And all my music files are lost, too!"



Computer Engineer Barbie: calling in the men





for the record...

... nice, though it took until last year

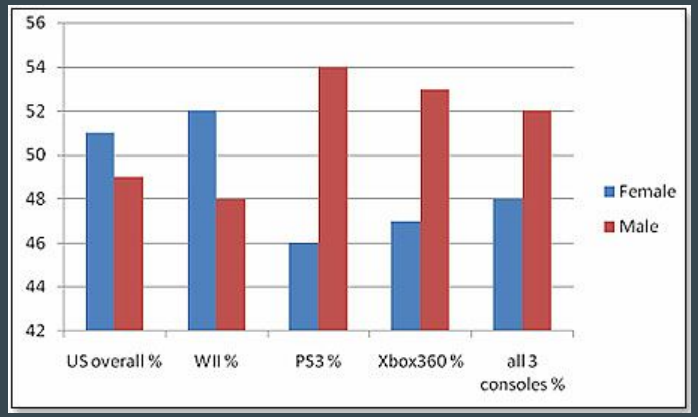
Inclusive Over Pink

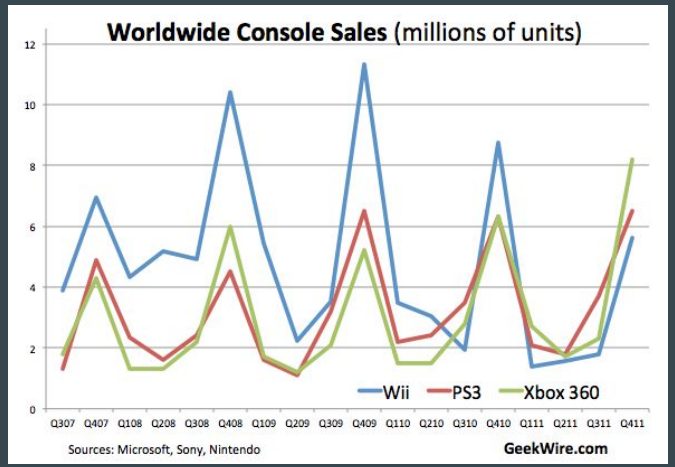
Wii ads

D-pad controls player movement
Hand is used for motion swinging (lobs, backhands, etc)
Both A and B could be used for shot variations, if at all.
Wii

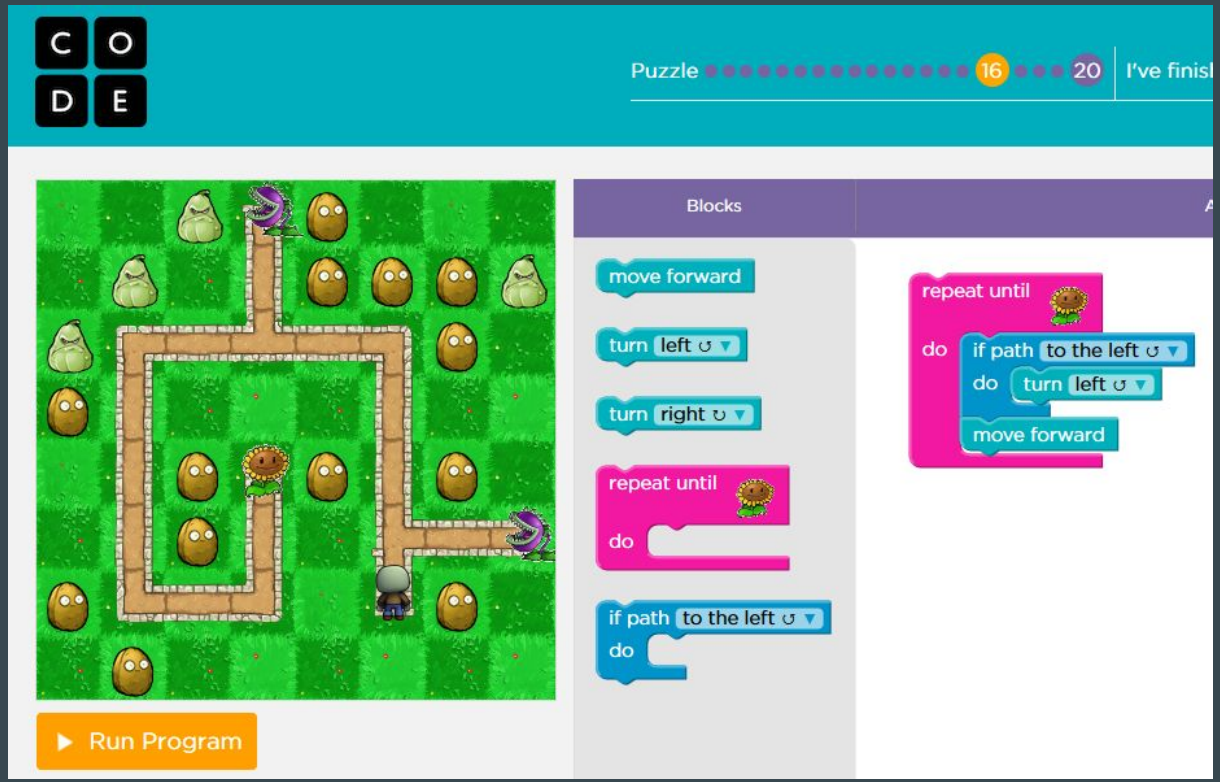
Catch it!

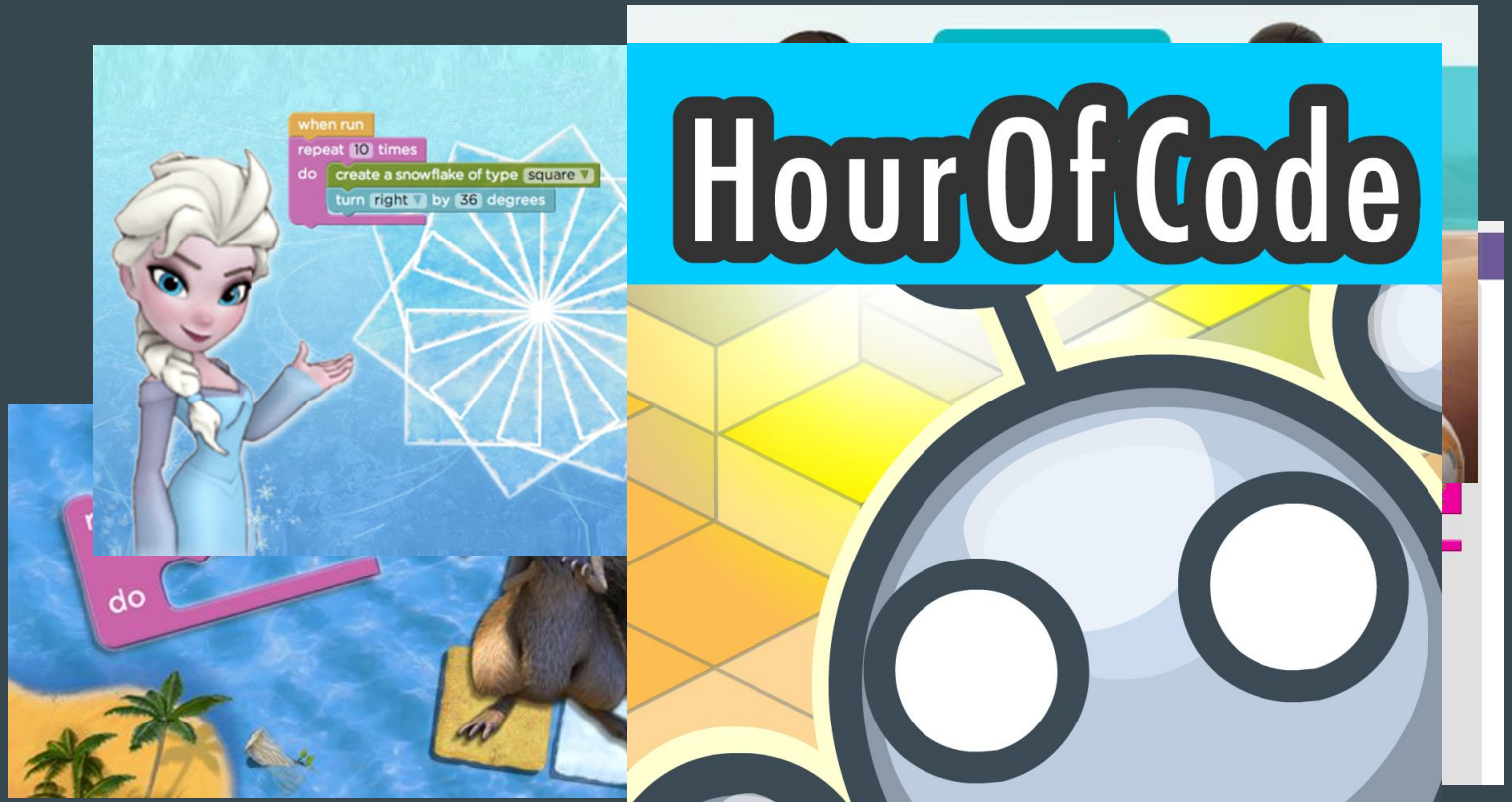
The results? Creating a blue ocean





Hour of Code (HoC)




when run
repeat 10 times
do
create a snowflake of type square
turn right by 36 degrees
do
Hour Of Code

Hour of Code (learn.code.org)

1. Youtube videos of celebrities and prominent programmers talking about computing
2. 1-hour lesson on computing and programming concepts
    a. Variables
    b. Loops
    c. Decisions
    d. Subroutines
3. 20-hour follow-up course that covers much of the fundamentals of programming

... FREE

Takeaways

1. Yes, there are bias/leaky pipeline problems in CS programs nationwide
2. But, there are also ingrained bias problems **before** students get to college
3. Inclusive interventions can help increase interest in STEM
4. Computing presents unique opportunities for pre-University exposure to a STEM discipline