

A Play Then Teach Approach to Computer Science in the Classroom

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Playlist

- Getting to know each other
- Unplugged Play
- CS Programming with Scratch
- CS Programming with Python
- CS Programming with Java
- Takeaways



Dr. Abigail Joseph

My Positionality

Immigrant family

Computer Scientist

Educator/Coach/Facilitator

CSTA Equity Fellow

Edstoria (I care about teacher burnout)

storyteller/futurists/experimenter

artists/designer/creator/changemaker



The background of the slide is a dense, overlapping field of small, spherical objects in four primary colors: red, yellow, green, and blue. These objects have a slightly textured, matte surface and are scattered across the entire frame. A faint, light-gray grid pattern is visible over the entire image, including the text.

Who is in the room?



Students choose an option

What is your connection to Computer Science?



Students choose an option







Text Adventure Game




```

if ( game_is_over == 0 )
{
    if ( player_to_move == YOU )
        printf ("Your Move\n");
    }
    else
        printf ("The game is over\n");
}

```

will achieve the desired effect, with the message "The game is over" being displayed if the value of `game_is_over` is not 0.

The `else if` Construct

We have seen how the `else` statement comes into play when we have a test against two possible conditions—either the number is even, else it is odd; either the year is a leap year, else it is not. However, programming decisions that we have to make are not always so black and white. Consider the task of writing a program that displayed -1 if a number typed in by a user were less than zero, 0 if the number typed in were equal to zero, and 1 if the number were greater than zero. (This is actually an implementation of what is commonly called the *sign* function.) Obviously, we must make three tests in this case—to determine if the number that is keyed in is negative, if it is zero, or if it is positive. Our simple `if-else` construct will not work. Of course, in this case, we could always resort to three separate `if` statements, but this solution will not always work in general—especially if the tests that are made are not mutually exclusive.

We can handle the situation just described by adding an `if` statement to our `else` clause. We mentioned that the statement that followed an `else` could be any valid C program statement, so why not another `if`? Thus, in the general case, we could write

```

if ( expression 1 )
    program statement 1
else
    if ( expression 2 )
        program statement 2
    else
        program statement 3

```

which effectively extends the `if` statement from a two-valued logic decision to a three-valued logic decision. We can continue to add `if` statements to the `else` clauses, in the manner just shown, to effectively extend the decision to an *n*-valued logic decision.

The preceding construct is so frequently used that it is generally referred to as an `else if` construct, and is usually formatted differently from that shown previously as

```

if ( expression 1 )
    program statement 1
else if ( expression 2 )
    program statement 2
else
    program statement 3

```

This latter method of formatting improves the readability of the statement and makes it clearer that a three-way decision is being made.

The next program illustrates the use of the `else if` construct by implementing the *sign* function discussed earlier.

Program 6-6

```

/* Program to implement the sign function */

main ()
{
    int number, sign;

    printf ("Please type in a number: ");
    scanf ("%d", &number);

    if ( number < 0 )
        sign = -1;
    else if ( number == 0 )
        sign = 0;
    else /* Must be positive */
        sign = 1;

    printf ("Sign = %d\n", sign);
}

```

Program 6-6 Output

```

Please type in a number: 1121
Sign = 1

```

Program 6-6 Output (Re-run)

```

Please type in a number: -158
Sign = -1

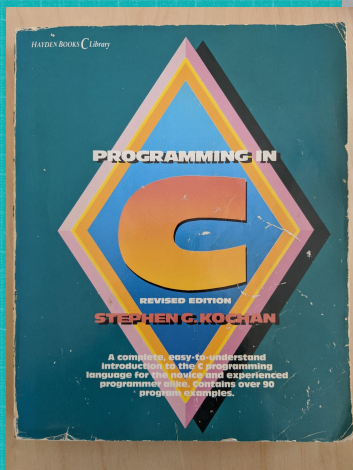
```

Program 6-6 Output (Re-run)

```

Please type in a number: 0
Sign = 0

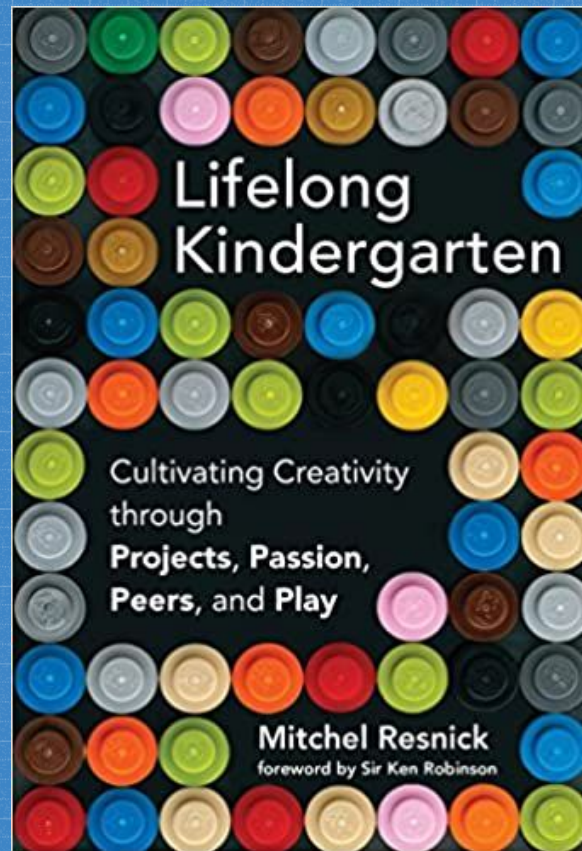
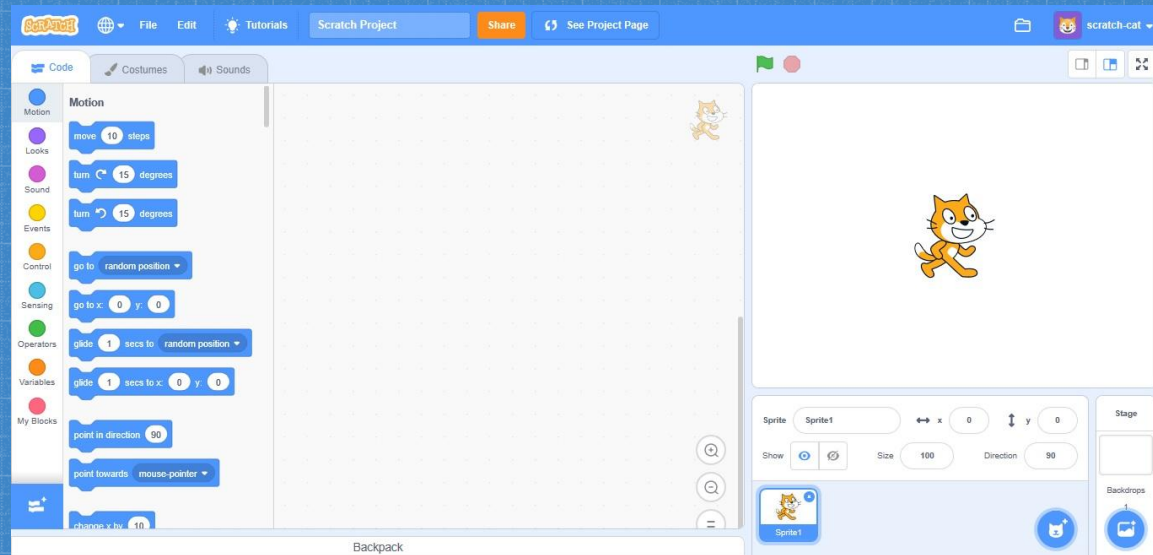
```





**I believe that the best way to help
people understand the world is to provide
them with opportunities to actively
explore, experiment, and express
themselves.**

MITCHEL RESNICK, MIT Media Lab





1

Unplugged Play

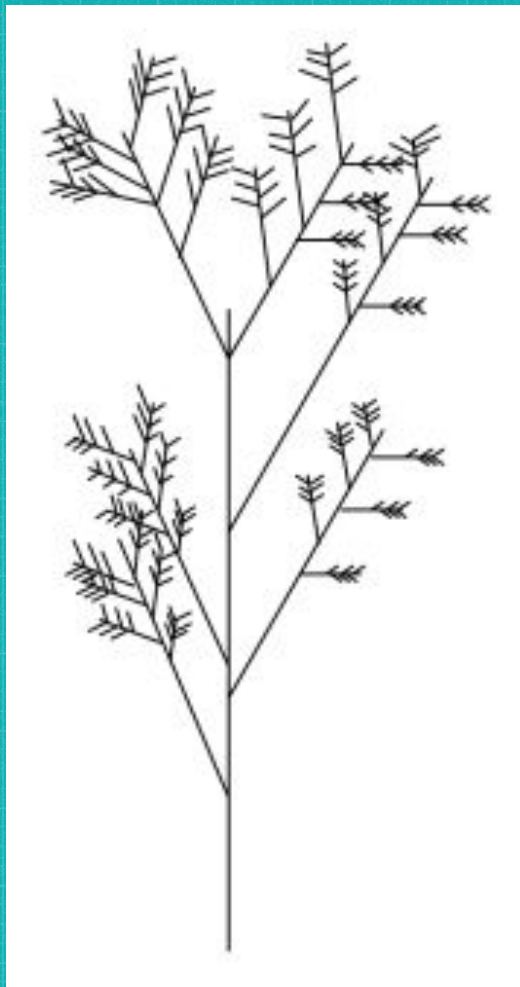
Doodle Draw

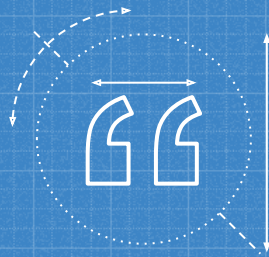
1. Start by drawing a single straight vertical line
2. DoodleDraw from that line as follows.

To DoodleDraw from a given line:

1. Draw 3 shorter lines at an angle in the top two-thirds of the line on its left side.
2. Draw 3 shorter lines at an angle in the top two-thirds of the line on its right side.
3. Choose a new existing line and DoodleDraw from that line

Doodle Draw

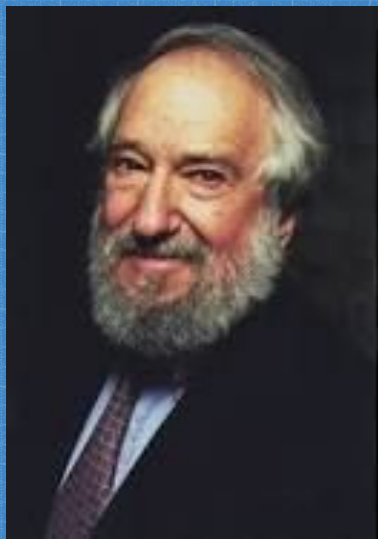




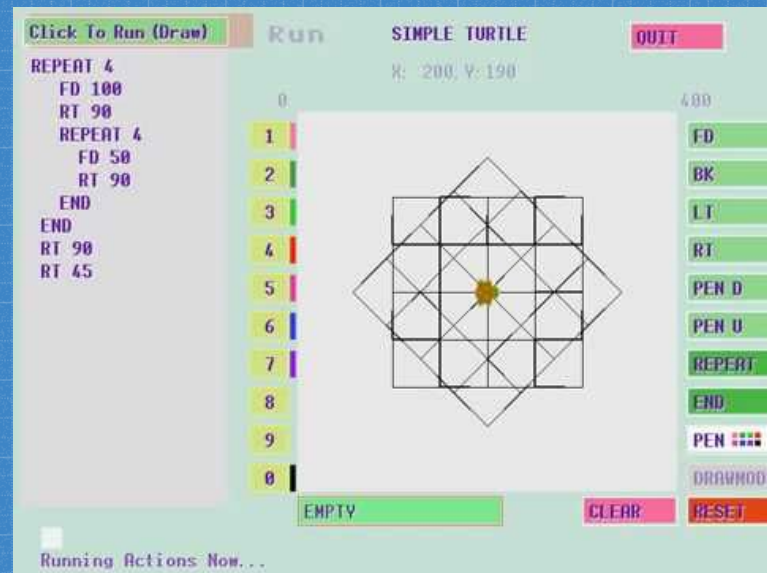
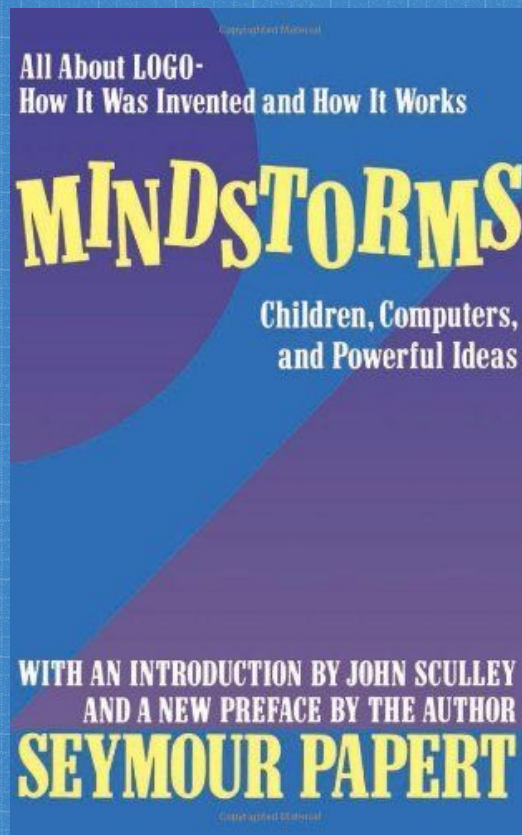
You can't teach people everything they need to know. The best you can do is position them where they can find what they need to know when they need to know it.

Seymour Papert

Professor and Researcher @ MIT



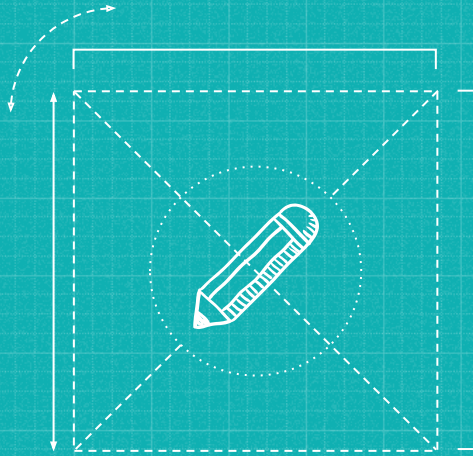
1928 - 2016





1

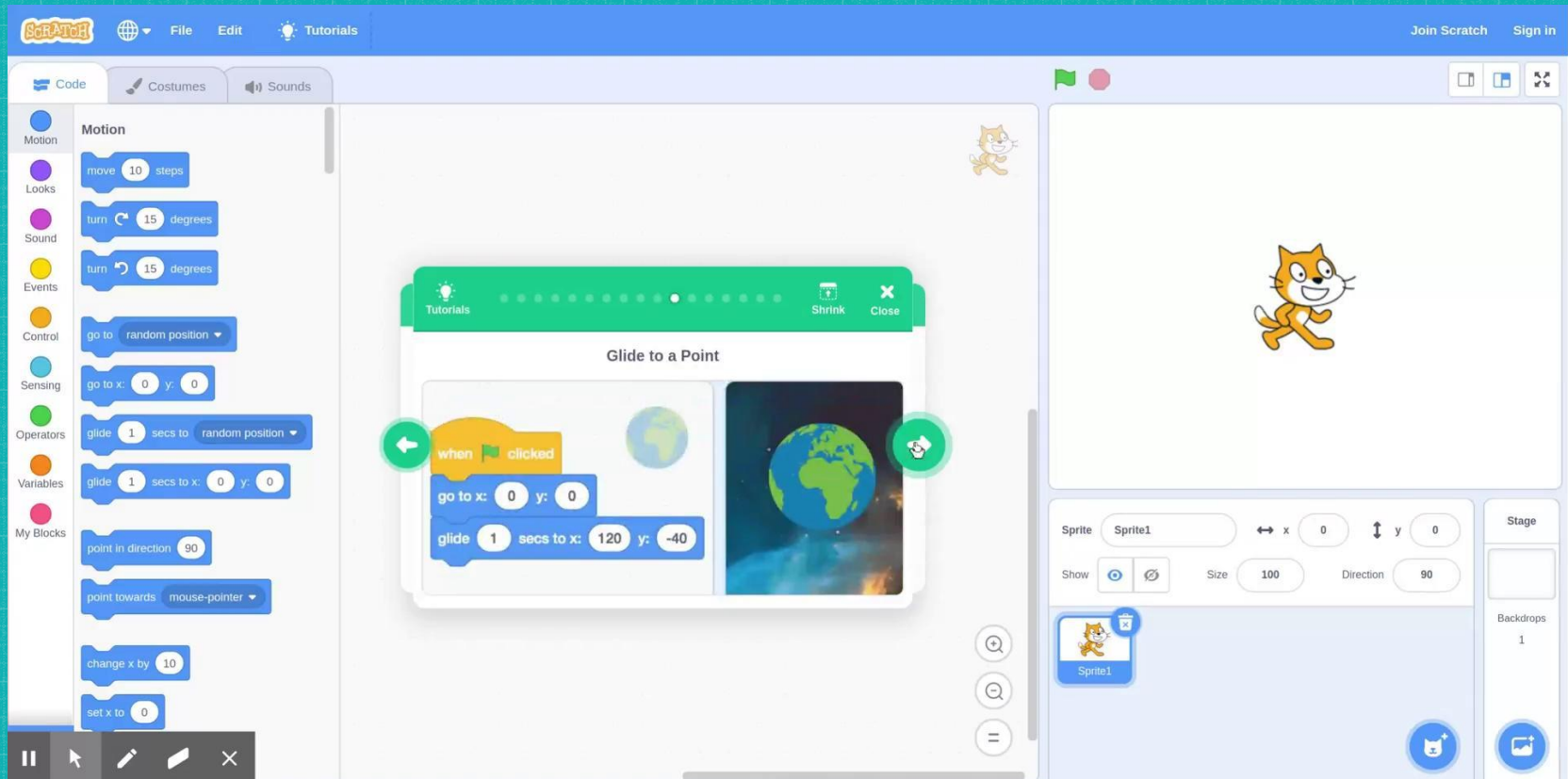
CS Programming with Scratch



Concepts First

Using lessons, tutorials, projects

Hour of Code Scratch Tutorial



Scratch Adventures

<https://sites.google.com/site/scratchadventures/>

Scratch Lessons >

Loops Lesson

Lesson

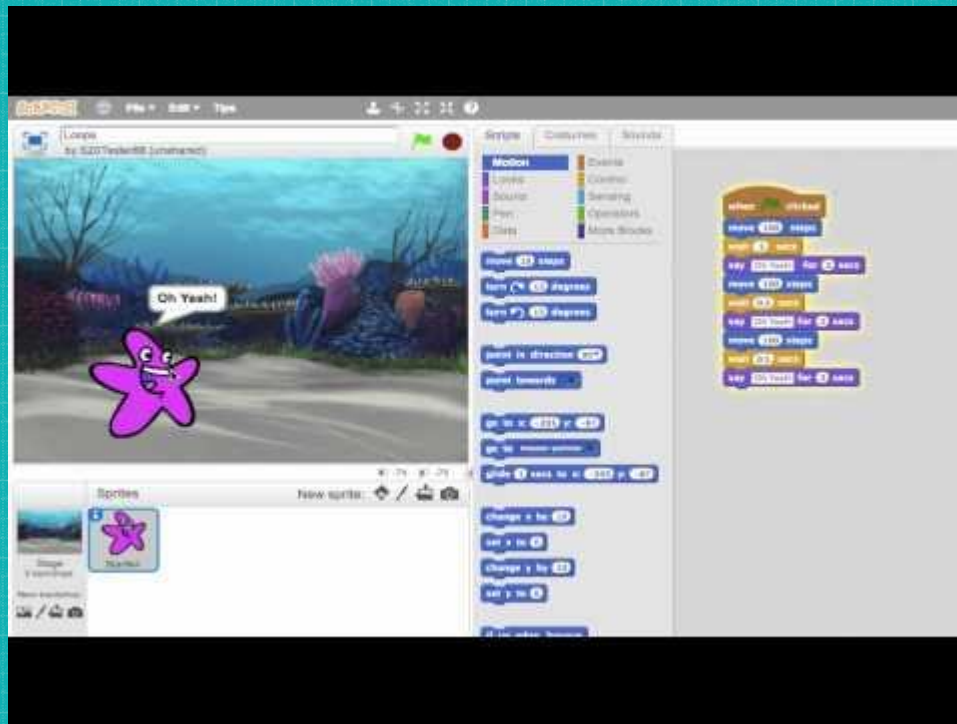
1. Watch [Loops](#) (2:17 minutes) and [Events](#) (2:08 minutes) videos.
2. Remix [Loops](#) project and try out the exercises shown in the video.
3. Reflect in your design notebook:

How would you describe a loop to someone else?

Tips

1. Start and stop the video while you try out the exercise in the project.

Blocks Used





Scratch Cards

<https://resources.scratch.mit.edu/www/cards/en/scratch-cards-all.pdf>

Grow and Shrink

Make a sprite change size when you click it.





Imagine a World 7 

Grow and Shrink


scratch.mit.edu

GET READY

Choose a backdrop.  Theater 2

Choose a sprite.  Drums Table

ADD THIS CODE

 Drums Table

when this sprite clicked


repeat 2

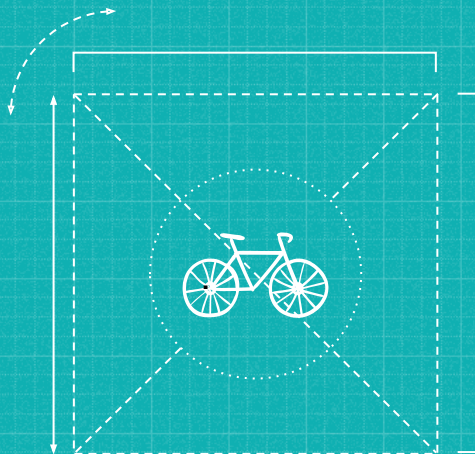
set size to 125 % — Type a larger number to make it bigger.

play sound Hi Na Tabla until done

set size to 100 % — Type 100 to return to original size.

TRY IT

 Click your sprite.



Play First

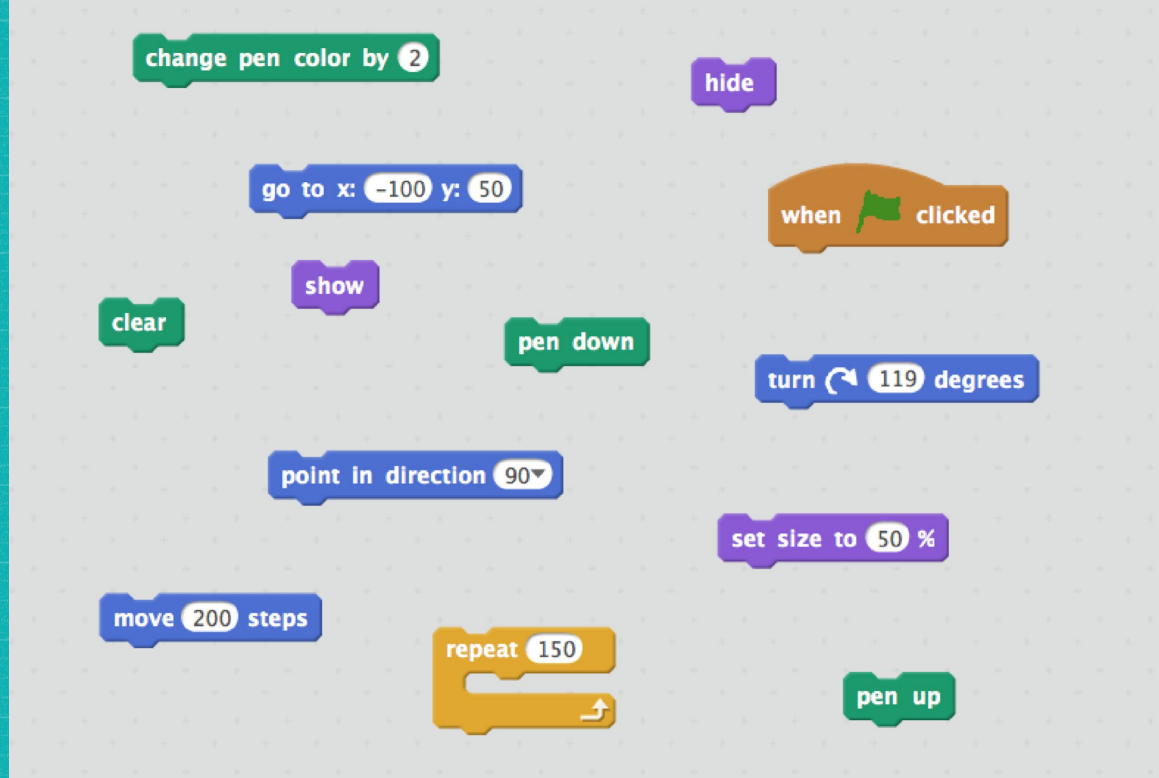
Create a sandbox for exploration

Create a Pattern - Part 1

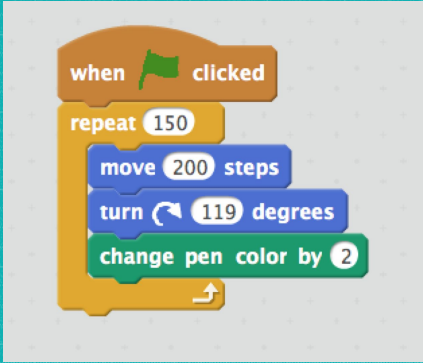
Use the blocks below to create your geometric pattern.

Start slow. Use one or two blocks at a time and then test your program.

Explore different patterns by changing the numbers for different blocks.



Part 1: Hint
If you are
feeling stuck,
here is a hint.

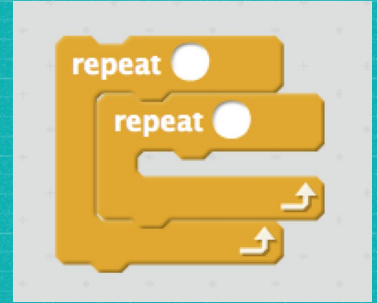


Part 2

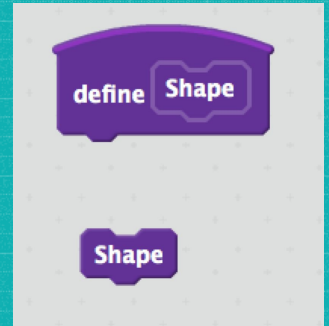
Use the blocks below and any or all blocks from **Part 1** to complete this part of the challenge.

You can change the values of the blocks to any number you would like and add in any blocks you may need, but you must include the blocks below.

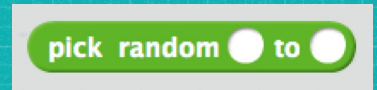
- ❖ A nested repeat block - a repeat block inside of a repeat block



- ❖ A block called Shape (You can define Shape to be whatever shape you like.)



- ❖ A random number



RESOURCE

Creative Computing Lab at the Harvard Graduate School of Education



Creative Computing Curriculum

<http://scratched.gse.harvard.edu/guide/index.html>

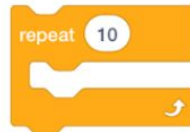
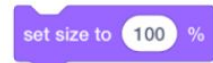
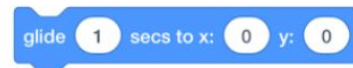
10 BLOCKS

WHAT CAN YOU CREATE WITH ONLY 10 SCRATCH BLOCKS?

Create a project using only these 10 blocks. Use them once, twice, or multiple times, but use each block at least once.

START HERE

- ☐ Test ideas by experimenting with each block.
- ☐ Mix and match blocks in various ways.
- ☐ Repeat!

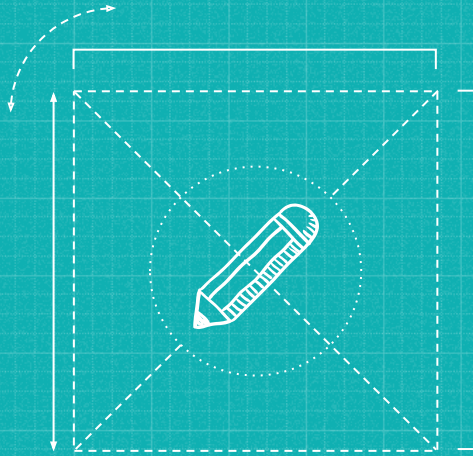


FEELING
STUCK?



1

CS Programming with Python



CONCEPTS FIRST

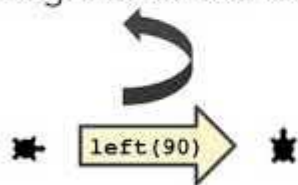
Python lessons and tutorials

Intro to Turtle Graphics with Tracy (CodeHS Hour of Code)

Tracy Command: left and right

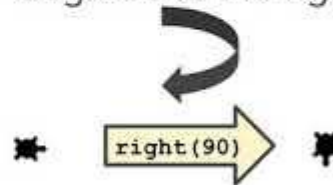
`left(90)`

Turns Tracy 90
degrees to the left



`right(90)`

Turns Tracy 90
degrees to the right



Welcome / Loops

Get started learning Python with [DataCamp's free Intro to Python tutorial](#). Learn Data Science by completing interactive coding challenges and watching videos by expert instructors. [Start Now!](#)

Loops

There are two types of loops in Python, for and while.

The "for" loop

For loops iterate over a given sequence. Here is an example:

```
script.py
1 primes = [2, 3, 5, 7]
2 for prime in primes:
3     print(prime)
```

Run

IPython Shell

In [1]:

Powered by DataCamp

For loops can iterate over a sequence of numbers using the "range" and "xrange" functions. The difference between range and xrange is that the range function returns a new list with numbers of that specified range, whereas xrange returns an iterator, which is more efficient. (Python 3 uses the range function, which acts like xrange). Note that the range function is zero based.

```
script.py
1 # Prints out the numbers 0,1,2,3,4
2 for x in range(5):
3     print(x)
```

IPython Shell

In [1]:

Prints out 3,4,5
for x in range(3, 6):



DataCamp

Learn Python
from the best
instructors.

Start Course
for Free

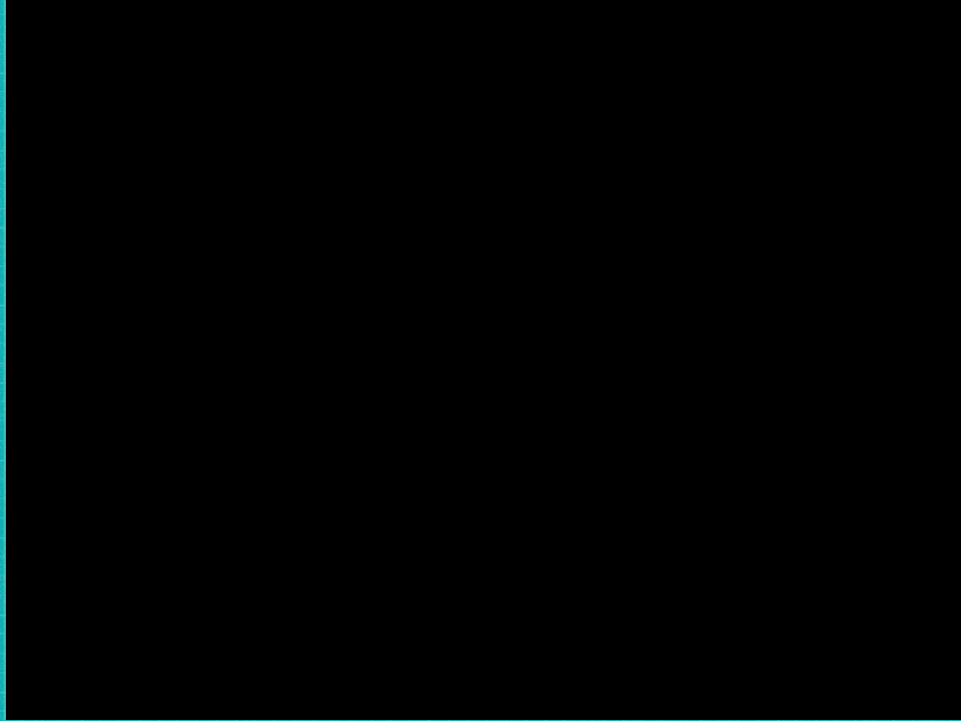


Filip Schouwenaars
DataCamp

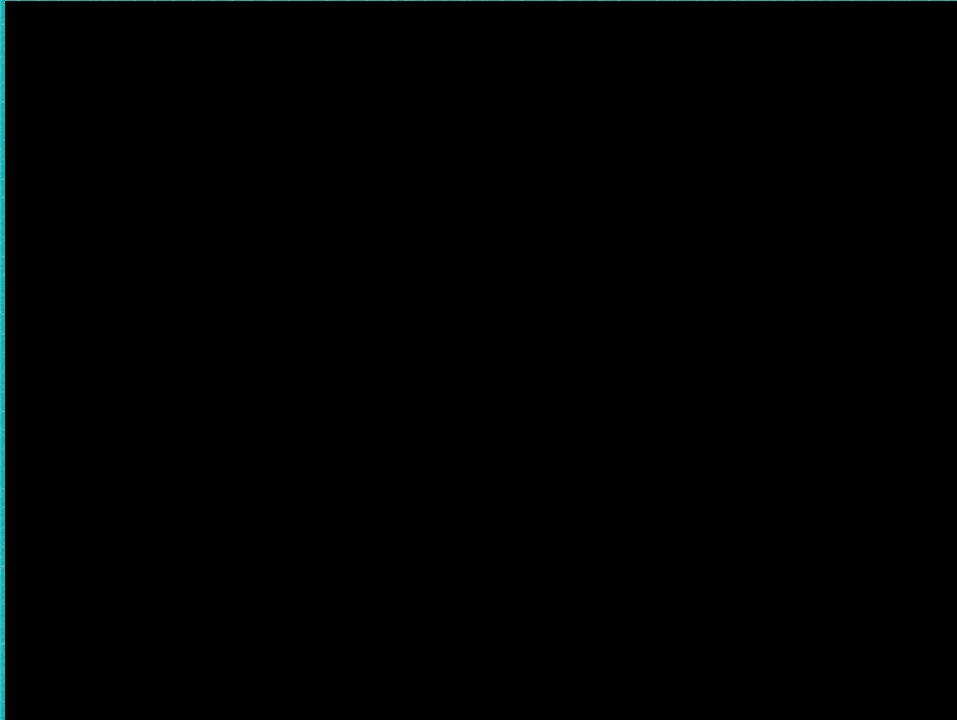
Sponsors

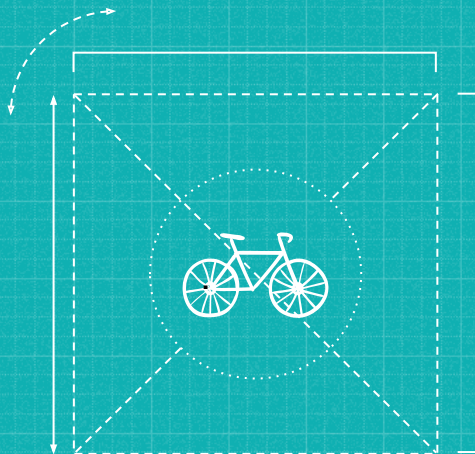


The Beginner's Guide to Python Turtle



Learn How to Code with Karel the Robot (Hour of Code - simplified Python)





PLAY FIRST

Use existing Python examples and references to learn
and construct meaning.

Dr. Emily Thomforde @thegreene

Repl.it - Python Turtle

Google Search: Python Turtle repl.it

 repl.it/languages/python_turtle

Run and example

main.py

```
1 | Not sure what to do? Run some examples (start typing)
```

Hello

```
import turtle

t = turtle.Turtle()

for c in ['red', 'green', 'yellow', 'blue']:
    t.color(c)
    t.forward(75)
    t.left(90)
```


Repl.it - Python Turtle

What does the program do?

main.py

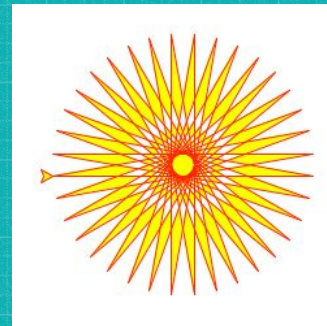
```
1  import turtle
2
3  t = turtle.Turtle()
4
5  for c in ['red', 'green', 'yellow', 'blue']:
6      t.color(c)
7      t.forward(75)
8      t.left(90)
```

Turn it into a triangle

Repl.it - Create A Pattern

Google Search: python turtle
reference

 docs.python.org/3/library/turtle.html



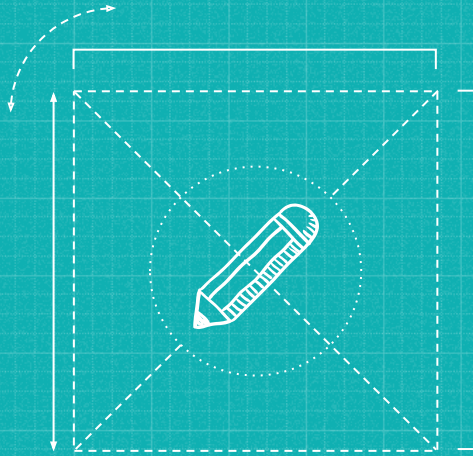
How do you get the turtle to
fill a shape?

Make something interesting



1

CS Programming with Java



CONCEPTS FIRST

Java lessons and tutorials

Coding in Java with CodeHS (Hour of Code)

Assigning to a Variable

numApples


0

```
int numApples = 5;
```



```
numApples = 0;
```

This sets the value in the box equal to 0.

Coding in Java with CodeHS (Hour of Code)

 **HOUR OF CODE** with CodeHS

Example

FILES

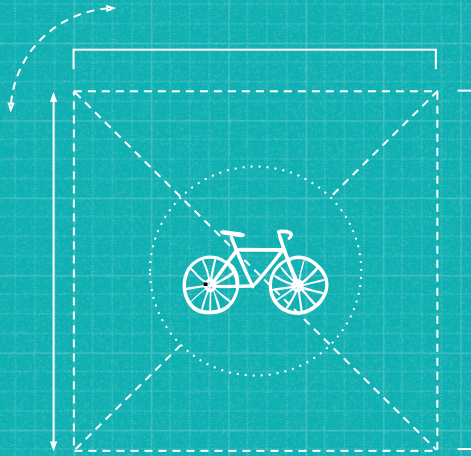
Variables.java

7: Variables

```
1 public class Variables extends ConsoleProgram
2 {
3
4     public void run()
5     {
6         int snapchatSent = 353;
7         System.out.println("Number of snapchats sent: " + snapchatSent);
8
9         double youtubeVideosWatched = 130.5;
10        System.out.println("Number of YouTube videos watched: " + youtubeVideosWatched);
11
12        String favoriteApp = "Instagram";
13        System.out.println("Favorite app: " + favoriteApp);
14
15        youtubeVideosWatched = 240.4;
16
17        System.out.println("Number of YouTube videos watched: " + youtubeVideosWatched);
18
19        char firstLetter = 'A';
20        System.out.println("First letter " + firstLetter);
21    }
22
23 }
```


Learn Java - Codecademy





PLAY FIRST

Inquiry exploration with POGIL

CS-POGIL

Process Oriented Guided
Inquiry Learning in
Computer Science

<https://cspogil.org/Home>



POGIL - Process-Oriented Guided-Inquiry Learning

- POGIL is based on the biology of learning
- developed and validated over the last 15 years, primarily in chemistry education
- teams of learners (typically 3-5) work on scripted inquiry activities and investigations designed to help them construct their own knowledge

POGIL - Process-Oriented Guided-Inquiry Learning

- teams follow processes with specific roles, steps, and reports that encourage individual responsibility and meta-cognition.
- POGIL activities and processes are designed to achieve specific learning objectives.
- The instructor serves as a facilitator, not a lecturer.

POGIL Group Roles

Quality Indicators for POGIL Roles

Facilitator

- The group begins promptly.
- The group stays on task, progressing through the activity in a timely fashion.
- All members of the group are participating.

Spokesperson

- Seeks group input before consulting teacher or other groups.
- All group members feel satisfied that their issues have been addressed.
- Articulates questions and responses well.

Quality Control

- Any individual sample collected should accurately demonstrate the groups' understanding.
- Regularly checks that group members' answers are consistent (not necessarily identical).
- Encourages individuals to make sure answers are thorough (i.e. showing work).

Process Analyst

- Analyst reports to group regarding group performance at least one time during the activity as well as at the end.
- Analyst provides insightful and positive feedback on how the group is working.
- Analyst completes the process questions report form if directed.

Operators - Divide Activity

Content Learning Objectives

After completing this activity, students should be able to:

- Evaluate a Java expression that uses the / operator with integers.
- Explain the difference between integer and floating-point division.

Operators - Divide Activity

Process Learning Objectives

During the activity, students should make progress toward:

- Explaining the responsibilities of the POGIL roles.
- Providing feedback on how well group members are fulfilling their responsibilities.

Operators - Divide Activity

Student Activity

Model 1. (20 min) Introduction to Team Roles	start time:
---	-------------

The goals of this class are to:

1. Learn Computer Science concepts that will help you develop working computer programs.
2. Learn how to think and learn.
3. Learn how to work with others.

For this reason, group work will be a large component of this class. You will work better with people if you know a little about each other. Introduce yourselves to your group, and make sure you will remember everyone's names.

Critical Thinking Questions

1. List the names of the four roles that are on [these cards](#).
2. Assign each person in your group one of the role cards based on where you are sitting. Once this is done, each person needs to read the job description on their role card and write a summary of your job. Be ready to share these with your group.
3. Each person in your group should share your summary of the job description on the role card that you have with your group.¹
4. Since we are using Google Docs to create one copy of this activity for each group, only one person needs to record the group's answers. Which role would be most appropriate to serve as a recorder? Explain your reasoning.²
5. For each role, give an example of how someone observing your group would know that a **person is not doing their job well**.

¹ If not using Google Docs, add the following to the end of question 3:

Write a brief description of the jobs of the other roles.

² If not using Google Doc, this question could be replaced by:

Some groups prefer to have one person read each question to keep the group together. Which role would be most appropriate to serve as a reader?



- Facilitator
- Spokesperson
- Quality Control
- Process Analyst

If there are only three people in your group, have one person serve as both facilitator and spokesperson for the rest of this activity.



Model II. (5 min) The / Operator

start
time:

9 / 4	evaluates to	2
10 / 4	evaluates to	2
11 / 4	evaluates to	2
12 / 4	evaluates to	3
13 / 4	evaluates to	3
14 / 4	evaluates to	3
15 / 4	evaluates to	3
16 / 4	evaluates to	4
17 / 4	evaluates to	4

Critical Thinking Questions

- In the above Model, which number(s) / 4 evaluate to 3 in Java?
- How do the above answers differ from the arithmetically correct answer (what you would get if you entered the same expressions into a calculator)?



Model IV. (10 min) The / Operator Revisitedstart
time:

9.0 / 4.0	evaluates to	2.25	rounds to	2
10. / 4.	evaluates to	2.5	rounds to	
11 / 4.0	evaluates to	2.75	rounds to	
12. / 4	evaluates to	3.0	rounds to	
13 / 4.0	evaluates to	3.25	rounds to	

Critical Thinking Questions

- Fill in the right column of the above table, by rounding each number to the nearest integer.
- Compare the values you just filled in to the first five values seen in the previous Model. How do the "rounds to" answers compare to what you saw in the previous Model?
- Now compare the *evaluated* values of 9.0 / 4.0 (from this Model) to 9/4 (from previous Model). How do the "evaluates to" answers differ?
- What do you think the Java expression "14.0 / 4.0" would evaluate to?
- Based on what you see in the rest of the table, what values would you see for the following divisions? Notice 14.0 and 4.0 are being represented slightly differently each time.

14. / 4.	evaluates to	
14. / 4	evaluates to	
14 / 4.	evaluates to	
14 / 4	evaluates to	

- Dividing a number with fractional parts (known as a **floating-point number**) gives you different



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results from dividing two **integers**. In the previous critical thinking question,

- Which of the rows evaluate to an integer?
- Which of the rows evaluate to a floating-point number?

- Assume you are writing a Java program that requires division.

- What must be true about the **operands** (the numbers around the operators) for you to get the arithmetically correct answer?
- Does it need to be true for *both* operands?

- Consider what you know about addition (+). If you add two integers in a Java expression, will the answer be arithmetically correct?

- What about subtraction (-) and multiplication (*)? If you subtract or multiply two integers, will the answer be arithmetically correct?

Group Reflection:

The **Process Analyst** should get an [‘Evidence of Competencies’ paper](#) and provide one piece of positive evidence for each members of the group. Only give each person **one** piece of positive feedback right now. Then, complete the section for the ‘Group’s Area for Improvement’ by recording **one** specific suggestion that will improve your group’s success in the future. Cut out and give each of your group members their ‘Evidence’ section and give the group improvement section to your instructor.

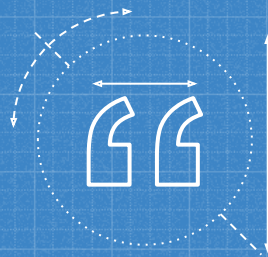
Individual Assignment:

Everyone should turn in their own individual answers to the following three questions. Each answer should be 2-3 sentences long:

- What does the / operator do? Be sure to mention the effect of using integers versus floating-point numbers with the / operator.
- Reflect which role from Model 1 is most comfortable for you personally.
- Reflect which role from Model 1 is most challenging for you personally.



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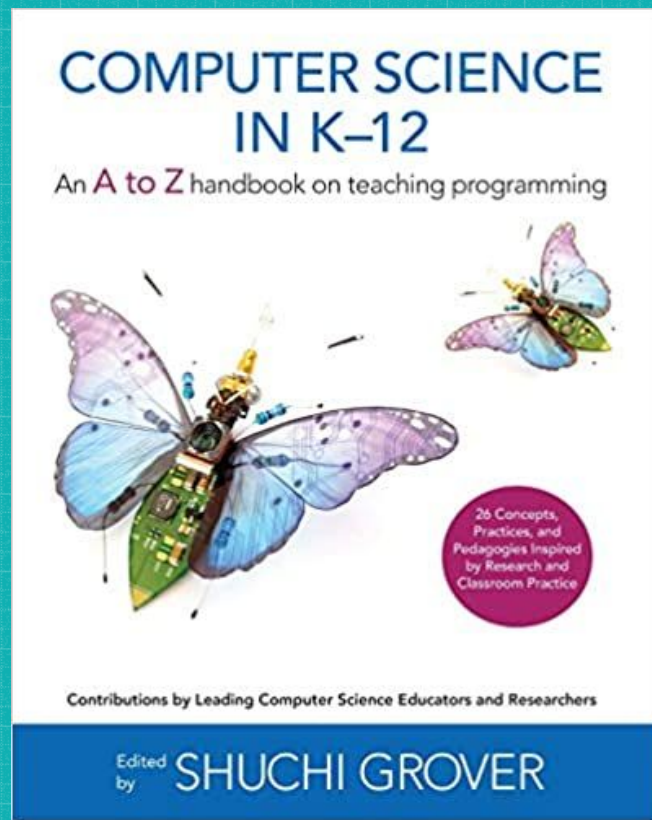


**I am convinced that the best
learning takes place when the
learner takes charge.**

Seymour Papert

Takeaways

- Play allows for students to construct their own meaning, make mistakes, and formulate questions
- Mixed approaches to teaching CS will open doors to more students
-

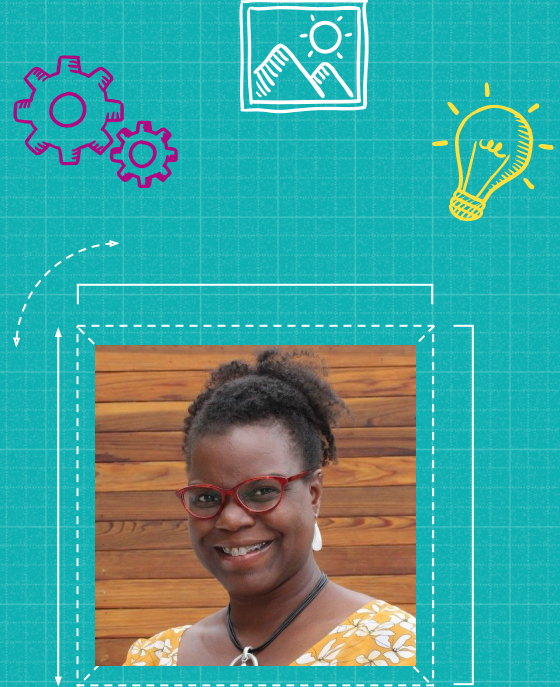


Let's Play!

ANY QUESTIONS?

You can find me at:

@drabigailjoseph @edstoria
dr.abigailjoseph@gmail.com



CREDITS

Special thanks to all the people who made and released these awesome resources for free:

- Presentation template by [SlidesCarnival](#)
- Photographs by [Unsplash](#)



Free templates for all your presentation needs



For PowerPoint and
Google Slides



100% free for personal
or commercial use



Ready to use,
professional and
customizable



Blow your audience
away with attractive
visuals