HOPSCOTCH HOUR OF CODE

Teacher notes for student-led tutorial

TIME

45-60 minutes (+15 minutes of optional, free code time)

BIG IDEA

Computers can only do what you SAY because they are not smart enough to figure out what you MEAN. Be specific!

SKILL FOCUS

– Debugging
– Make sense of problems and persevere in solving (CCSS.MATH.PRACTICE.MP1)
– Look for and make use of structure (CCSS.MATH.PRACTICE.MP7)
– Designing solutions (NGSS Practice 6)

KEY VOCABULARY

Sequence: The order in which instructions are given to the computer
Event: When something happens
Rule: Instructions that tell your computer what to do (the command) and when to do it (the event)
Loop: Code that repeats
Random: a surprise
Range: the highest and lowest number for *random* to choose between

TRANSFER GOALS

1. Students will understand that coding requires giving a computer explicit directions
2. Students will become familiar with creating and editing rules
3. Students will practice testing their programs to find bugs.
4. Students will abstract a problem to design a solution.
5. Students will develop confidence and persistence.

MATERIALS

– 1 iPad or iPhone per student, or 1 device per 2 students, for pair programming
– Video tutorial available in Hopscotch and on YouTube: http://hop.sc/HOC_Video
– Complete project available: http://hop.sc/HOC_project

Hi!

We're *really* excited that, this Hour of Code, you're programming with your students—both for them and for you. Kids have remarkable imaginations, and creating computer programs is an amazing way for them to express themselves. We've seen kids create astonishing things using our simple but powerful tool. We know you'll see the same when using Hopscotch, and hope you share what your students create.

Anyone, regardless of their experience in programming, can teach this Hour of Code lesson. Just as Hopscotch was built on the principle that anyone can become a great programmer, this lesson is designed on the premise that anyone can teach basic programming, including you!

In this lesson, students will build a game in which their character jumps over fast-moving obstacles. It's simple but fun, and very quickly allows them to experience the satisfaction of telling their computer what to do.

You can teach this Hour of Code in several ways:

1. Students independently complete their games, following along with the video tutorial in the app. The tutorial is designed to be used without any outside help (though we encourage kids to pause it as they're coding). The tutorial is available at http://hop.sc/SpeedJumperVideo.
2. Students independently complete their games but you ask them to pause their own work for discussion and group work. We offer discussion ideas, as well as differentiation techniques and reflection questions, in the following pages.
3. You project the video to the class and use it as a supplement to your instruction. You lead discussion and group work, and adjust the directions for the project.

After a discussion of what needs to be built and, if desired, how it might be coded, students can start coding. Depending on how many devices you have, you can have students work independently or in pairs. At Hopscotch, we do a lot of pair programming (two programmers share one computer) because it helps us write smarter, less-buggy code. We recommend trying it! All students should get into the habit of testing their code frequently by running (playing) it. It is much easier to find and solve mistakes when you're constantly testing.

Have fun and we can't wait to see what your students build. Share their projects on social media and tag us either with #madeonhopscotch or @hopscotch on Twitter and @gethopscotch on Instagram :)

Yours,
Jocelyn Leavitt
Co-founder and CEO, Hopscotch

0. Discussion: Debugging

In this lesson, students will create their own version of Geometry Dash. While building the game, they will inevitably make mistakes and create bugs. This lesson is equally as much about the process of finding and fixing bugs as it is about making a fun game. You can ask your students to think about this task and imagine themselves as bug hunters.

As programmers, we frequently tell our computers to do something other than what we intended. We call the resulting mistakes bugs, or errors in a program introduced by the person writing it. The process of finding and fixing your mistakes is called **debugging**. One of the most important lessons in coding is remembering that your bugs are not caused by the computer—they're caused by the programmer. And it's totally expected that all programmers will write bugs at different points in the development process.

When real-world programmers are in the process of writing code, the rule of thumb is that it takes 10% of their time to write the first draft, and the other 90% of their time to debug it. There are engineers whose whole jobs are to debug other people's code!

It may be worthwhile at this point to discuss debugging with your class. What are some useful strategies to consider while debugging? The following are just some examples:

- Say what you think your program is supposed to do, see what it actually does, and then describe the difference in your own words.
- Look at your code for ambiguities, or places where your blocks don't say exactly what you want to happen, when you want it to happen.
- Make a checklist of common mistakes: Did you repeat forever? Are the numbers you plugged in correct? Did you use the correct blocks for what you intended? Move Forward vs Change X By? Set Speed vs Set Angle, etc. Does your rule belong to the right object?
- Try to map out the logic of your project. Then see if you've written the right code to create that logic.
- Take a break when you get overwhelmed. We often need distance to see what we've done in its entirety.

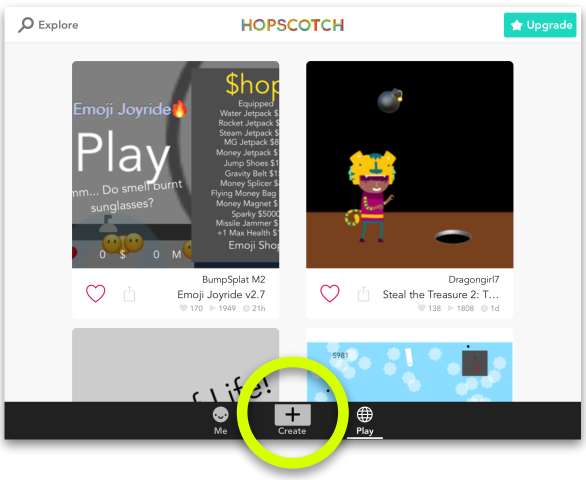
What should bug hunters look for? Why is this an important job? When else in our lives have we had to hunt for and solve problems?

LESSON

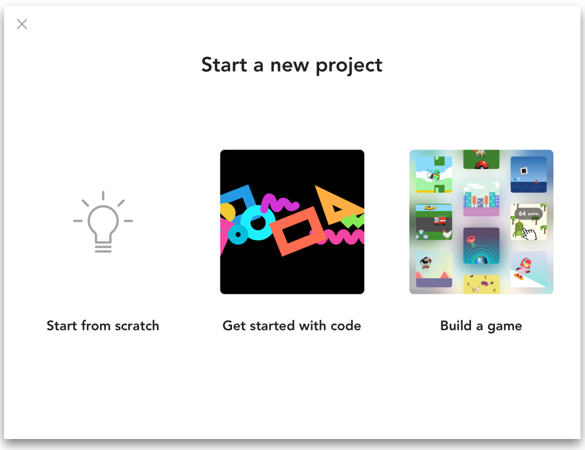
1. Using Hopscotch (5 minutes)

First, get your students acquainted with Hopscotch.

1.1 Finding the Hopscotch app on your iPad
1.2 Signing into your account (students may need to create accounts)
1.3 Making a new project: Tap on the highlighted + on the bottom of the screen



1.4 Choose Blank Project



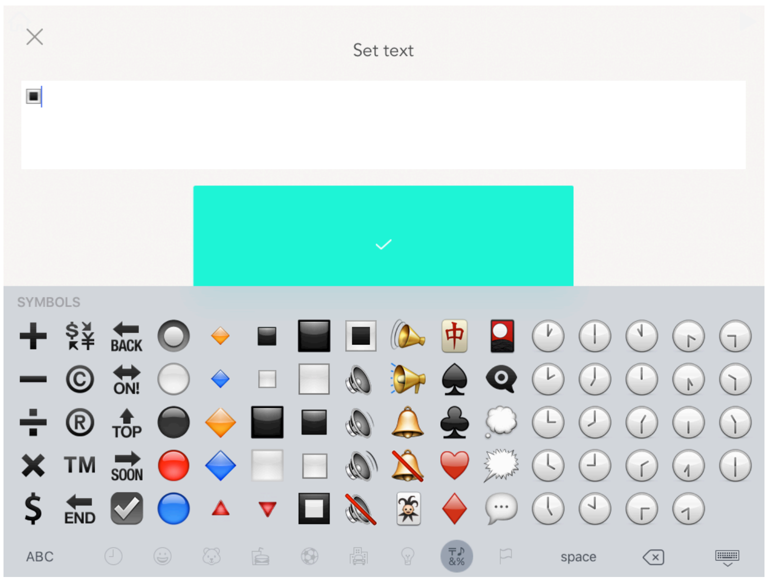
2. Control the hero (ES) (10 minutes)

In Geometry Dash, the player controls a little square that flips and jumps over obstacles.

Because the jumping and flipping animations happen at the same time, we say they are **concurrent**. The way to program concurrence in Hopscotch is to make two rules with the same event. That way, they are triggered at the same time.

Get students to deconstruct the two steps of jumping (move up, then move down). Does this up and down movement occur along the X or Y axis? Then, ask your students to add their hero object (the square emoji) and tell it to turn and jump when they tap their iPad.

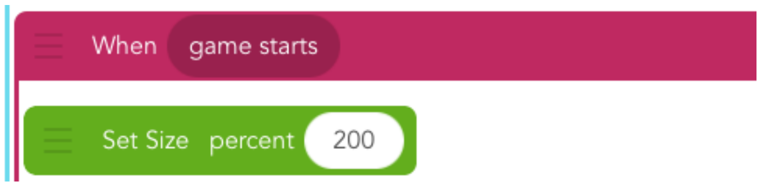
2.1 Add hero object (square emoji) and place it near the bottom left corner of screen



Make sure the emoji keyboard is enabled, which you can do in your iPad's settings.

By default, Hopscotch names text objects "Text", "Text 2", etc. Clearly named objects make it easier for you and others to read your code, however, and students should rename each text object according to the role it will serve in the project. Here, rename the square emoji "Hero".

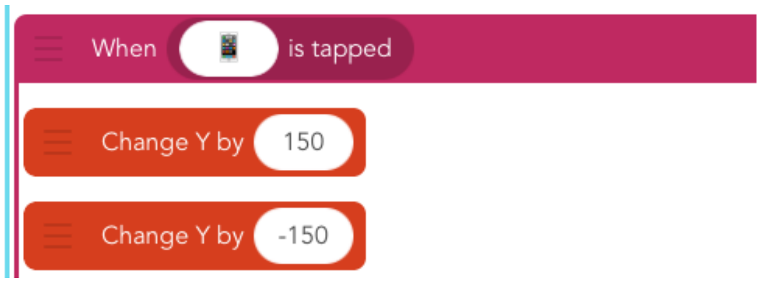
2.2 Add code to hero to make it bigger



```
When game starts
    Set Size percent 200
```

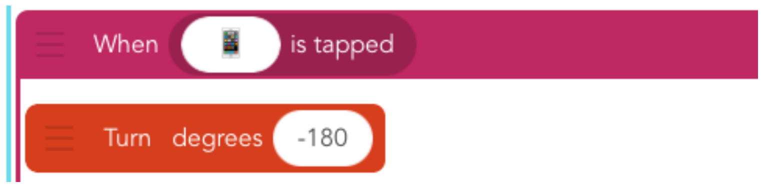
If you choose a number other than 200, all of the other numbers we give will also have to change. This is an opportunity for debugging.

2.3 Add code to hero to jump



```
When [iPad] is tapped
    Change Y by 150
    Change Y by -150
```

2.4 Add new code to hero to turn while jumping



What would happen if you picked a non-symmetrical hero? How much would you have to turn it so it landed on its feet? What happens when you choose +180 instead?

3. Background (S) [10 minutes]

Drawing the background is a skill that you can apply to any game. Because drawing is just like any other code, you have to choose an object to be in charge of drawing. It is customary to make this object invisible, so you don't see the thing itself, only the picture it draws. For this reason, it doesn't really matter which object you choose.

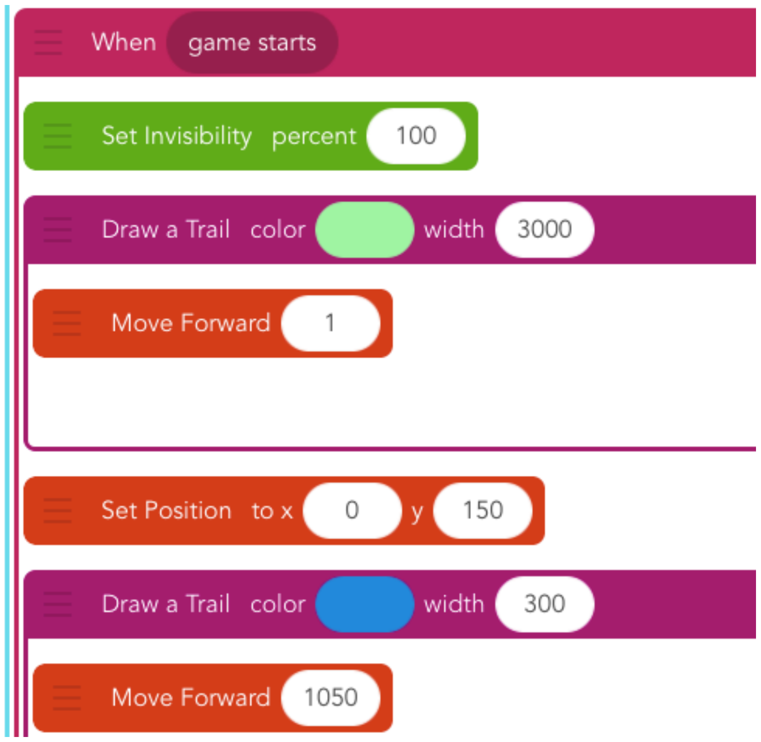
In Hopscotch, we draw with a block called "Draw a Trail" that sets the color and width of the line, then executes the code inside – typically "Move Forward" – as if the object were dragging a marker behind it. It will make a dot if it just moves by 1. To color in the whole screen, make a huge dot (width 3000). To make a thick line, you have to set the position to where you want it to start, and then move along the desired path.

This is another opportunity for debugging. Have the students make a prediction about the following questions and then test out changing their code. What happens… if you don't put anything inside the drawing block? …if you forget to set the width? …if you set the color to white? …if you don't set the position before you start?

Then, have students attempt drawing their backgrounds on their own. They can change the artist's speed to draw the background faster.

3.1 Add drawing object (choose anything)

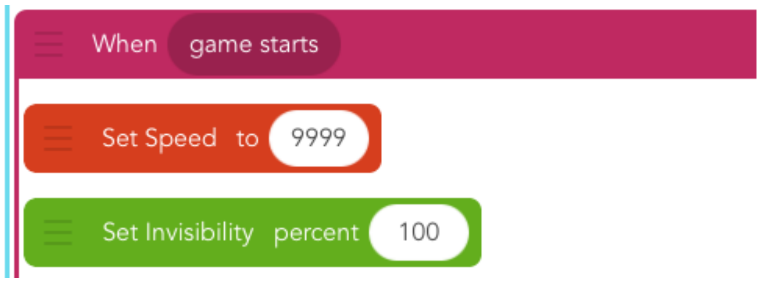
3.2 Add code to drawing object



```
When game starts
  Set Invisibility percent 100
  Draw a Trail color 🟩 width 3000
    Move Forward 1
  Set Position to x 0 y 150
  Draw a Trail color 🟦 width 300
    Move Forward 1050
```

Set the invisibility to 100 so you can't see the painter.

3.3 Edit drawing object's code to draw faster



```
When game starts
  Set Speed to 9999
  Set Invisibility percent 100
```

Change the order of an object's rules by dragging a rule up or down in the editor.

The default speed is 400. 9999 is as high as you ever need to go; that speed is indistinguishable from 999999999...

4. Obstacles (LS) [10 minutes]
In games like Flappy Bird and Geometry Dash, it feels like the hero is moving forward through a stationary world but actually, the hero is stationary and the world is moving backward. Have you ever sat in a stationary car and another car next to you backs up – doesn't it feel, for just a moment, like you're moving forward? In this game, the hero is the car you're in, and the obstacles are the things moving backwards.

Take some time to talk about the movement of the obstacles from one edge of the screen across to the other edge. See if you can come up with the sequence of obstacles' movement rules as a class.

After students agree on the correct code, ask them to try implementing it. Then, bring the class together again and decide as a class at what point the obstacle should be visible and invisible. Discuss why this feels so much more natural (It's because our brains are good at imagining that an object that moves out of our field of view is probably still in motion even though we can't see it).

What if we want to make it look like there are many obstacles but only use one object? This is another great design trick. See if your students can identify the technique to make this possible – putting the code inside a loop.

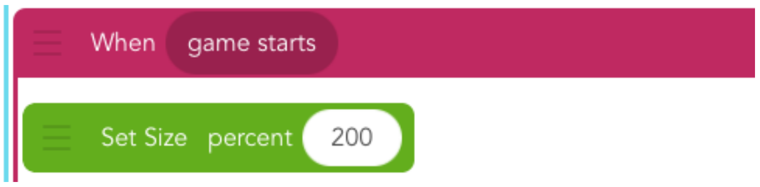
Give the students a few minutes to play their game, and then bring the class together again. Ask for suggestions to make the game more fun and challenging. Like with Crossy Road in Lesson 1, it is boring (and easy!) because it's the same every time! Games are challenging (and fun!) when there is an element of unpredictability. If you make the obstacle wait for a **random** amount of time in between passes, the game becomes more fun.

Debugging opportunity: What is the appropriate range for the random wait time? Try out some different combinations until you settle on one you like.

4.1 Add emoji object for obstacle (triangle)

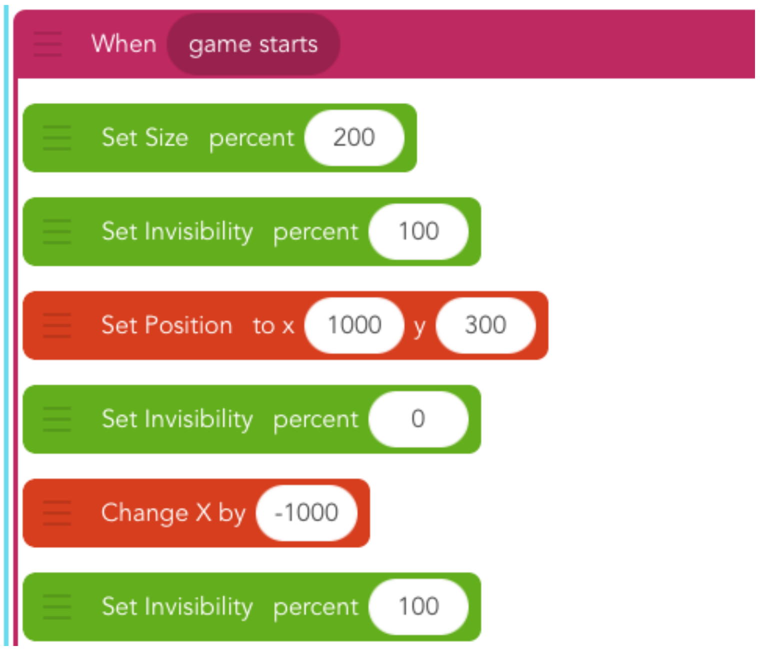
Rename the triangle emoji "Obstacle".

4.2 Add code to obstacle to make it bigger



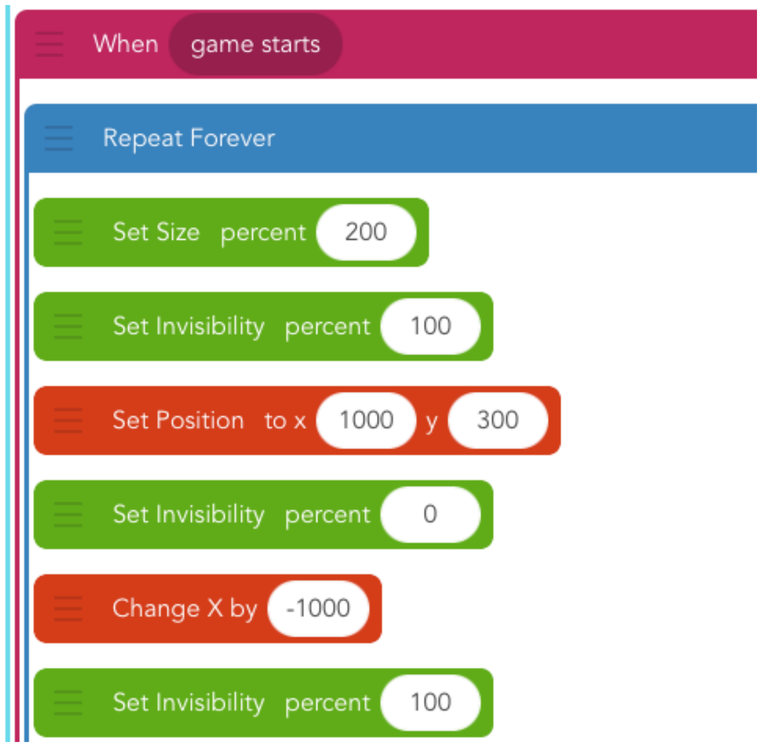
```
When game starts
    Set Size percent 200
```

4.3 Edit obstacle's code to move it across the screen



```
When game starts
    Set Size percent 200
    Set Invisibility percent 100
    Set Position to x 1000 y 300
    Set Invisibility percent 0
    Change X by -1000
    Set Invisibility percent 100
```

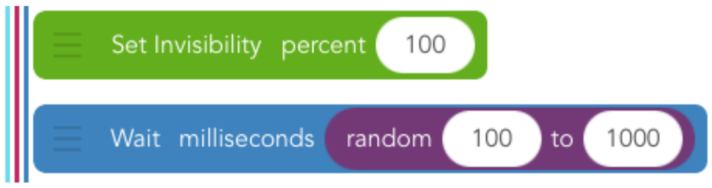
4.4 Edit obstacle's code to make sequence repeat forever



```
When game starts
  Repeat Forever
    Set Size percent 200
    Set Invisibility percent 100
    Set Position to x 1000 y 300
    Set Invisibility percent 0
    Change X by -1000
    Set Invisibility percent 100
```

When moving code into the repeat block, make sure not to change the order. Students will probably make a mistake here—a good opportunity for debugging!

4.5 Edit obstacle's code to wait random (100,1000)



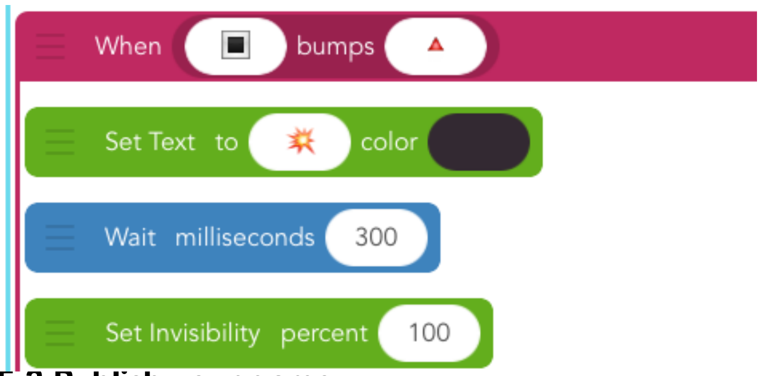
```
Set Invisibility percent 100
Wait milliseconds random 100 to 1000
```

5. Collisions (ES) [10 minutes]

As we learned in Lesson 1, when two objects bump into one another, it is called a **collision**. A collision is a type of **event**, so we can decide what actions should happen when that event occurs. In Geometry Dash, when the hero collides with an obstacle, the game is over.

To designate "game over," upon a collision the hero will explode and then disappear. In Hopscotch, when an object is invisible, it can no longer collide with anything, be tapped, or swiped. Spend some time testing this sequence and getting the timing right, then publish!

5.1 Add new collision rule to hero



```
When ■ bumps ▲
  Set Text to 💥 color ●
  Wait milliseconds 300
  Set Invisibility percent 100
```

You can change the object into an explosion, make it spin around, or drop off the screen like Mario. Turning invisible is necessary, because it stops the game from being playable.

5.2 Publish your game

DIFFERENTIATION

(15 minutes, optional)

- Draw a better background
- Make the background colors random
- Add more obstacles (two or three emojis in a row is a possibility, make movement into an ability)
- Set the obstacle size to random each time; pick a good range!
- Print and laminate index cards with debugging strategies and have students check off strategies as they go

REFLECTION

(5 minutes, optional)

- What are computers good at? What are they bad at?
- How does this compare to what humans are good and bad at?
- Is drawing with a computer easier or harder than drawing with pencil and paper? Why? If it is harder, why do we still do it?

GLOSSARY FOR YOUNGER STUDENTS

Ability: Code that can be reused

Algorithm: A recipe for a program

Coding: Telling computers what to do

Concurrence: Two things happening at the same time

Conditional: Statements of the form “IF (something is true) THEN (do an action)”.

Debugging: Finding mistakes in your code and fixing them

Event: When something happens

Iteration: Having ideas and making mistakes, over and over

Logic: The process of making decisions

Loop: Code that repeats

Operator: A mathematical symbol that makes an equation

Program: A set of instructions a computer can understand

Programmer: A person who writes programs

Programming Language: A set of rules or blocks that can be used to write any program

Random: When there’s no pattern

Range: The highest and lowest number random can choose between

Rule: Instructions that tell your computer what to do (the command) and when to do it (the event)

Sequence: The order in which instructions are given to the computer

Object: A character or text with its own rules

Value/Variable: A holder for a number

GLOSSARY FOR OLDER STUDENTS

Ability/Function/Procedure/Subroutine: A saved set of blocks. What we call abilities in Hopscotch are known as functions or subroutines in other programming languages. Easily replicable routines are a key concept in computer programming, and allow you to scale your code and create complex programs.

Algorithm: Algorithms are at the heart of computer science; they are the recipes that computers follow to solve problems.

Bug: An error that a programmer has made in their code

Coding: Writing the rules of behavior for a computer to follow automatically; programming

Concurrency: Two or more things happening at the same time, or triggered by the same event

Conditional: Statements of the form "IF (something is true) THEN (do an action)"

Debugging: Finding mistakes in your code (bugs) and fixing them

Event: A trigger that the computer recognizes and causes it to do some action. In Hopscotch, events include "When the iPad is tapped" or "When the play button is tapped"

Iteration: the repetition of a process

Logic: the science of the formal processes of thinking and reasoning

Loop: a repeating set of instructions

Operator: a mathematical symbol that produces a value

Program: a set of instructions a computer can understand

Programmer: a person who writes programs

Programming Language: a set of words, rules, blocks or instructions that can be used to write a program.

Random: Any number or item among a set. The lack of a pattern among items in a set.

Range: The highest and lowest number random can choose between

Rule: Rules tell your object what to do and when to do it. When you make an ability and pair it with an event, you create a rule.

Sequence: An ordered list of things (instructions, blocks, numbers, etc) which can be triggered by an event or repeated

Object: A character or text with its own rules on screen

Value: A holder for a number. Also known as a variable