CFAES

The Ohio State University Extension, Pickaway County

Quadrilaterals: Sphero Coding Challenge

Code is everywhere: agriculture, sports, education, art/design, pharmaceutics, robotics, health, entertainment, travel, law, politics, engineering, transportation, meteorology, tourism - you get the point. No youth or 21st century workforce development program should be absent of code.

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THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

Summer Camp: Sphero Coding Challenge

Introduction

Sphero robots are fun, durable, and programmable teaching toys. This coding challenge is designed for youth grades two and up to explore computer science career pathways. You will need a Sphero robot, the Sphero Edu app on a compatible device, and a hunger to learn. If you're learning to program for the first time, the best place to start is a structured activity. *(approx. 30 mins. activity)*

Terms

COMPUTER PROGRAM: a collection of instructions that performs a specific task when executed by a computer.

BLOCK CODE: a lexical structure of source code which is grouped together. Blocks consist of one or more declarations and statements - actions to be carried out, including functions, variables, and constants. Blocks nested within other blocks to build a computer program.

ALGORITHM: the well-defined instruction, that allows a computer to solve a recurring problem.

LOOP: a sequence of instruction that is continually repeated until a certain condition is reached.

TAILLIGHT: Sphero's small blue light indicating the back of the robot, use for assisting with program directions. To ensure accuracy, check the aim, the taillight, before running program.

Tips

HOW TO MOVE A BLOCK CODE? Drag block by tapping, holding, dragging, and releasing block into position.

HOW TO THROW AWAY A BLOCK CODE? Drag/drop on top of screen until the ribbon with trashcan icon turns red, release block code by lifting your finger.

HOW HERO UNDERSTANDS DIRECTIONS? Assuming you aim the robot with the blue taillight facing you, then **0° heading is forward, 90° is right, 270° is left**, and **180° is backward**.
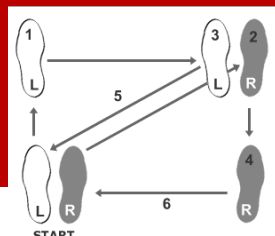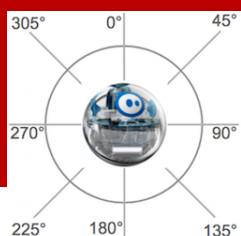
HEADING: think of Sphero always facing the same direction, forward at 0°, and moving right, left, back, or at an angel while keeping its head straight like the dance steps to the left.

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Challenge 1: Coding a Quadrilateral

A computer program is a collection of instructions like a recipe to bake brownies. Each step, instruction, or command is called an algorithm. A computer program is a series of well-defined algorithms that allow a computer to solve a recurring problem. **The Sphero coding challenge is to write a computer program so Sphero moves in an outline of a quadrilateral.**

Q: What is a Quadrilateral?

The study of shapes is a branch of math called *geometry*. Geometry is fun and focuses on points, lines, surfaces, and angles. **Quadrilaterals** include many shapes. In geometry we call a quadrilateral, a **polygon,** because it has <u>four edges</u> and <u>four vertices</u>. A **vertex** is a corner point of a polygon that's formed by the intersection of edges, faces or facets of the object.

Area: ½ x sum of bases x sum of perpendicular heights
Perimeter: sum of sides of the quadrilateral
Number of vertices: 4
Number of edges: 4
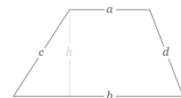**Internal angle:** vary, (90° for a square and rectangle)
Sum of interior angles: 360°

Trapezoid
Solve for <u>area</u> ▾

$A = 68$

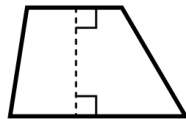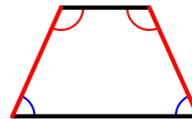|		
a Base	5	
b Base	12	
h Height	8	

Solution

$$A = \frac{a+b}{2} h = \frac{5+12}{2} \cdot 8 = 68$$
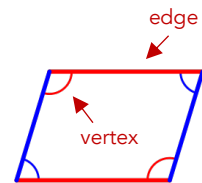
edge

vertex

Irregular Quadrilateral
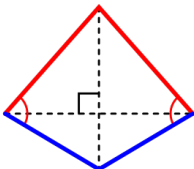*(Brit. Eng.)*
Trapezium
(Amer. Eng.)

Trapezium
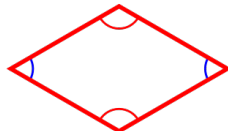*(Brit. Eng.)*
Trapezoid
(Amer. Eng.)

Isosceles Trapezium
(Brit. Eng.)
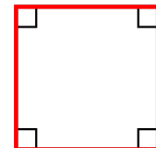*Isosceles Trapezoid*
(Amer. Eng.)

Parallelogram

Kite

Rhombus

Rectangle

Square

Let's the Coding a Square Challenge!

1. AIM: aim your Sphero by clicking on the AIM button on the top right of the ribbon. Aim the blue taillight so it faces you, the programmer. <u>Opposite the taillight, is forward to the Sphero at 0°.</u>

2. GO TO MOVEMENT TAB: to make our square we're going to add a **roll block** (drag and drop in programming canvas.) The roll block has three values we can edit, **0°, 0, 0s**:
   - **0°**: heading, Sphero uses degrees, assuming you angled the aim light correctly, zero degrees would be straight ahead.
   - **0**: speed, how fast Sphero moves on a scale from 0-255, you can use the slider or click directly on the speed number to input an exact speed.
   - **0s**: duration or delay, measured in seconds, the longer the duration the bigger our square will be.
   - Suggested range of to start **Roll: 0°, 50, 2s.**

3. ADD THREE MORE ROLL BLOCKS FOR THE OTHER THREE SIDES OF THE QUADRILATERAL: Because all the sides of a square are equal, each side will have the same duration, speed, but have different headings, so that Sphero turns at each corner:
   - The second roll block will have **vertex°**, moving Sphero to the right.
   - The third roll block will have **vertex°**, moving Sphero to the right.
   - The fourth roll block will have **vertex°**, moving Sphero to the right. Screen shot to the right.
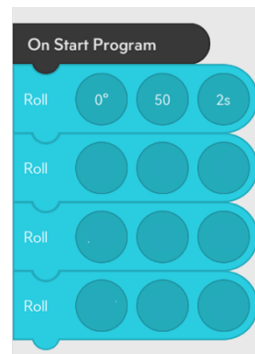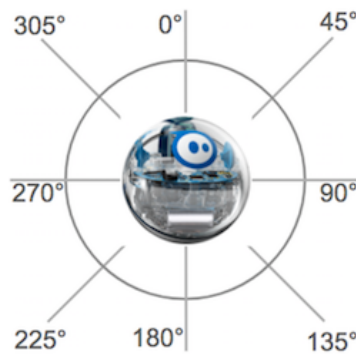
4. EXIT PROGRAM: drag Exit Program block after the last roll block and then **PUSH START**.

Q: What do you notice about the quadrilateral?

It looks like the polygon has four sides, but the turns were not tight angles°. That's because you turned your corners too fast without stopping or **delaying** before turning or **rolling**. Driving a car follows the same principle. If the driver slows down, the car can make a tighter turn. Let's add some delays to our computer program.
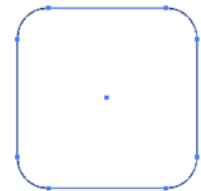
5. GO TO THE CONTROLS TAB: drag **Delay block** after each roll block. SET DELAY: set each Delay block to '**1s**', <u>check your **AIM & PUSH START**</u>.
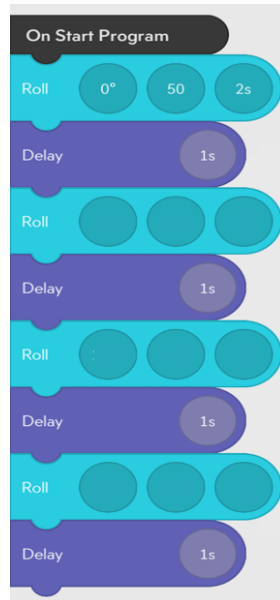
Q: What changed as your Sphero ran through its program and did how adding new code impact the square's shape?

By adding delay before turning at each corners, the corners of the Sphero got closer to making a tighter angle or vertex.

Let's Review

You're learning to code using block code, because it's easier to visual how to write a program and create a series of algorithms that allows a computer to solve a recurring problem.

Programmers use script or programming language to write computer programs rather than block code, because the coding is more complex and easier to program by typing script. If you keep practicing, you will become more comfortable coding Sphero using JavaScript which is the computer language that Sphero understands.

6. Now let's take a look at your **JavaScript**. Click on the **Three Dots** icon in the top right corner. Then click on JavaScript Code. This code is sent over Bluetooth to the Sphero.

```javascript
async function startProgram() {
    setMainLed({ r: 16, g: 255, b: 50 });
    await roll(0, 50, 2);
    await delay(1);
    setMainLed({ r: 255, g: 243, b: 47 });
    await roll(90, 50, 2);
    await delay(1);
    setMainLed({ r: 50, g: 86, b: 255 });
    await roll(180, 50, 2);
    await delay(1);
    setMainLed({ r: 255, g: 15, b: 0 });
    await roll(270, 50, 2);
    await delay(1);
    exitProgram();
}
```
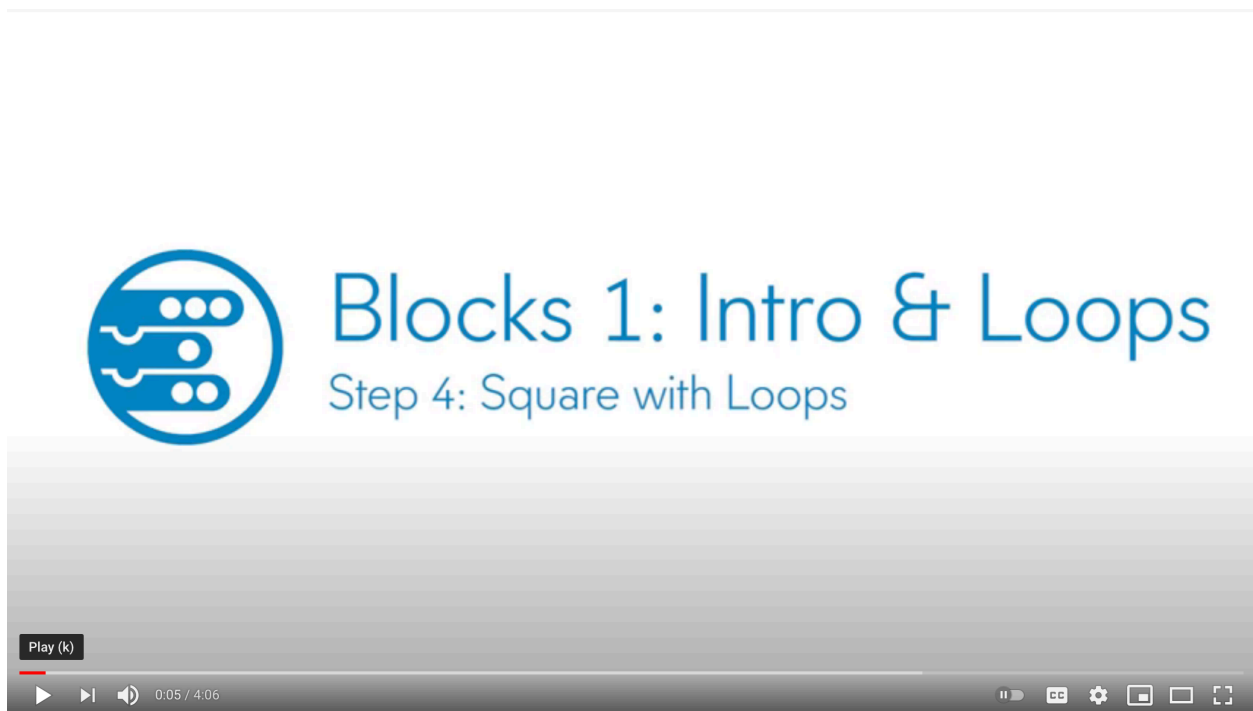
Q: IS THERE A SHORT WAY TO WRITE THIS PROGRAM?

There is a lot of creativity that happens in coding. A coder with higher levels of creativity will adapt, see patterns, understand the big picture, create short cuts, and learn to solve recurring problems faster and more efficiently than others. Computer programs are as different as the programmers that create them. Creative programs tent to get to the point faster and more direct than others. For example, let's look at the computer program above.

Is there a way we could program a square faster and more directly with less repetitive algorithms?

7. Let's consider all we learned from the geometry of a square. A square must have <u>four equal angles and four equal sides</u>. Therefore, there is a recurring command that could be looped! A loop is a sequence of instruction that is continually repeated until a certain condition is reached. Watch this video and try to rewrite your computer program by using a loop.

https://www.youtube.com/watch?v=mzRlitytV94&t=59s