SEPjr / CSforAllNYC

How can we teach computer science concepts and practices with robots and robotics?

Name:

Asynchronous Work

Read & Reflect: Teaching CS w/ Robots and Robotics

Please read the following content on how robots and robotics can be used to teach and reinforce student understanding of the CS Practices and Concepts. While reading the materials please reflect on the questions provided below to help prepare for discussion during the January 22nd synchronous session.

Reflection Questions:

1. What makes a robot a robot?
2. How can you connect robots & robotics to the Computer Science Practices?
3. How can you connect robots & robotics to the Computer Science Concepts?
4. What approach would you take when choosing a curriculum that uses robots and/or robotics to teach computer science?
5. What strategies can be used when teaching with robots and robotics?
6. What are possible challenges or obstacles when using robots and robotics to teach computer science?

Teaching CS w/ Robots and Robotics

Robots and robotics provide a meaningful and engaging opportunity for students to explore, learn and demonstrate an understanding of the computer science practices and concepts. It is also a chance for students to strengthen complementary skills such as collaboration, creativity and innovation. Beginning with unplugged lessons and/or app based activities, students learn to apply computational thinking and programming skills in a three dimensional physical space. Activities and tasks can include programming robots to complete mazes, obstacle courses, tell stories and navigate maps. Then through Project Based Learning students can develop a deeper understanding of how robots and robotics can be used to express ideas, solve problems, and while developing a greater comprehension of the design process. In addition, robots provide an opportunity to teach students about computer science concepts such as data, machine learning, artificial intelligence and sensors.

How can you connect robots & robotics to computer science practices?
(analyze, prototype, communicate)

How can you connect robots & robotics to computer science concepts?
(abstraction, algorithm, programming, data, networks)

Curriculum Options for Robots & Robotics

There are a number of curriculum options that use robots and robotics to teach students about computer science, and other subject areas. The lessons and activities help students gain a better understanding of what a robot is and how it functions, teach new computer science concepts, and design thinking. Choosing the right curriculum can depend on what materials are available, the prior experiences of a teacher or students and how much time is available to teach the content.

Getting Started w/ Robots & Robotics

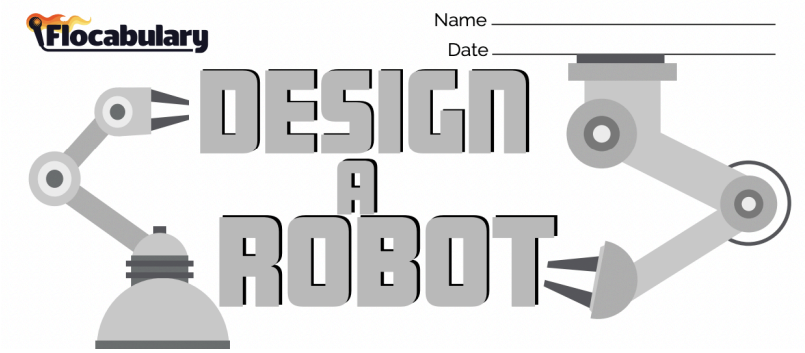
When learning about robots & robotics a good place to start is to have students explore and express their understanding of what a robot is and what they are capable of doing. Students may begin by drawing themself interacting with a robot or creating their own robot design. From the information provided through the drawings or brief descriptions, students will discuss characteristics, different functions, how they think robots work and even discuss what robots might look like in the future.

Example: Flocabulary - Design a Robot

Robots are not science fiction! They're everywhere! In this cross-curricular lesson, students will build their literacy skills while diving into the field of robotics. They'll learn what a robot is and see examples of familiar robots used in daily life. They'll close-read short passages about robots, discuss tasks that robots are well suited for and finish the lesson by designing their own robot to solve a specific problem.

Objectives

1. Describe what a robot is and give examples.
2. Close-read short nonfiction passages about robots and robotics.
3. Design a robot that is well suited to solve a problem or perform a task and explain why.

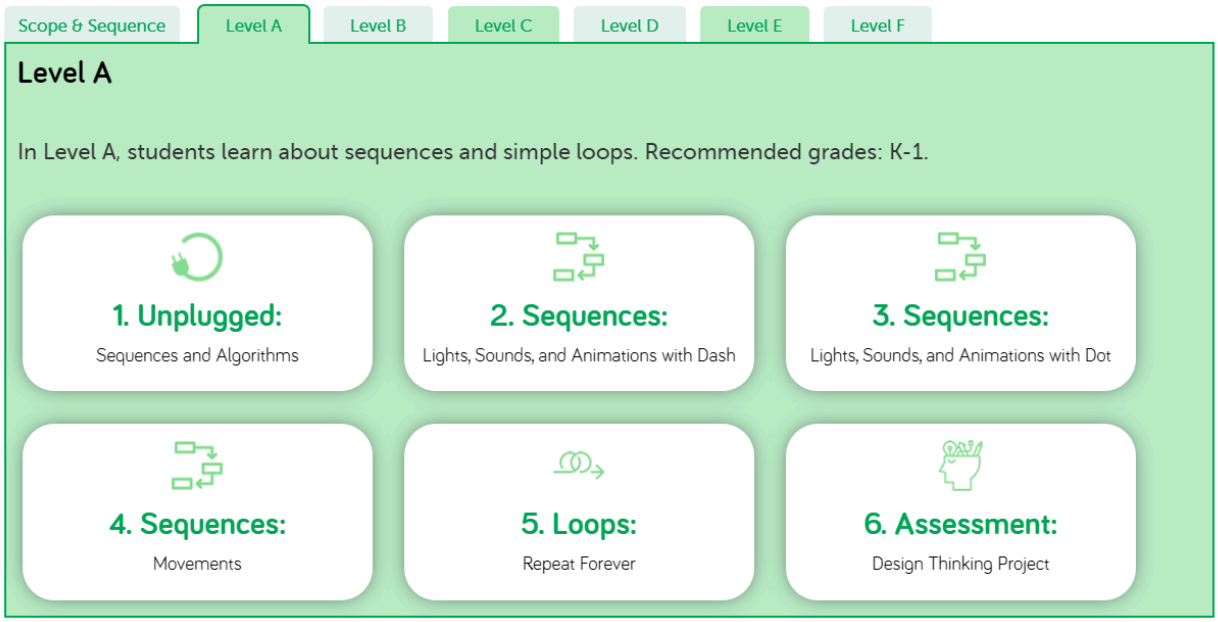


Teaching CS Practices and Concepts

Similar to the online puzzles and tutorials used in other curriculum, such as Code.org or Scratch, content that uses robots and robotics provide scripted lessons to teach students about the computer science practices and concepts. Consisting of unplugged and/or online activities, students follow step-by-step instructions to complete a task that either introduces them to a new concept or helps to reinforce their understanding. The activities often consist of a task where the robot needs to navigate a maze or grid, avoiding specific obstacles and completing additional tasks.

Example: Wonder Workshop - Learn to Code

The Learn to Code Curriculum is organized into six coding levels and covers six fundamental coding concepts: sequencing, loops, events, conditionals, functions, and variables. For students who are new to Dash and Dot, it is recommended beginning with Level A. Each coding level is aligned to a recommended grade as a guide, but it is also suggested that teachers consider the students' coding experience when determining where to start. The curriculum's scope and sequence is aligned with Code.org's Computer Science Fundamentals series.



Project Based Learning

Through project based learning, robots and robotics can also be used to teach students about the design thinking process and an opportunity to integrate computer science to other content areas. The content often starts with presenting students with a problem or challenge connected to another subject area. Students are then challenged to explore

how robots and robotics can be used to create a possible solution. Students may also use robots and robotics to demonstrate an understanding of another subject area through a culminating project.

Example: Sphero - Bridge Challenge

SPRK STEM challenges are fun, interactive activities that challenge students to use creativity and teamwork to move through simple steps of the design process in order to build Sphero-based creations. In this challenge students will build bridges from finite resources using a $4000 budget and then program Sphero to drive across. Students have the opportunity to research bridges and brainstorm potential concepts, as well as determine design specifications, and effectively communicate their vision for the bridge before building it.

Objectives

1. Identify how Sphero can cross a bridge constructed with inexpensive materials.
2. Illustrate the process of determining which code elements would be best suited to achieve an objective.
3. Drive and create a program that moves Sphero over a bridge of my own design.
4. Analyze the effectiveness of my work with supporting facts; reflect on the learning.

What approach would you take when choosing a curriculum that uses robots and/or robotics to teach computer science?

Teaching Strategies for Robots & Robotics

Unplugged Activities w/ Robots & Robotics

It is important to use both unplugged and online activities when using robots and robotics. Unplugged activities not only provide students an opportunity to get up and move around, but are used to incorporate computer science practices to help students plan and design prototypes. Students may be given a map or maze a robot needs to navigate and asked to plan out the movements before creating a program. Students can take on the role of the robot and practice the steps in the classroom before programming the robot.

Unplugged activities can also help students gain a better understanding of what is considered to be a robot and what it can and can not do. Students look at different examples and come up with may or may not fit the definition of a robot. From the definition students can then discuss characteristics, functionality, and how they think robots work.

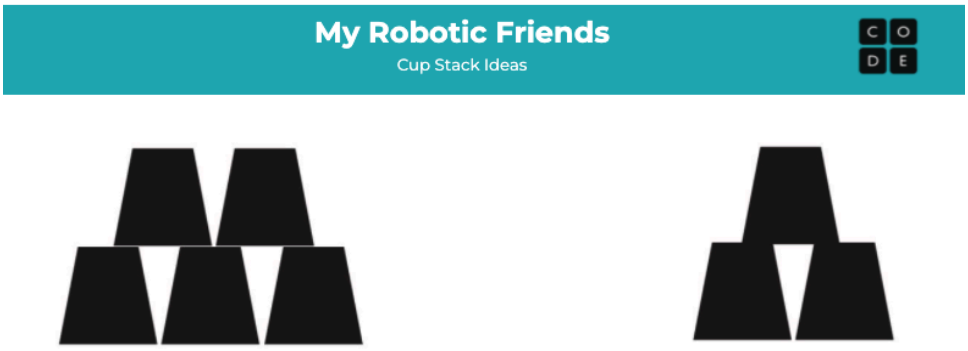
Example: Code.org - My Robotic Friend Jr.

Overview

In the context-setting lessons, students will use a set of symbols to instruct a "robot", a classmate, to stack cups in different patterns. Students will take turns participating as the robot, responding only to the algorithm defined by their peers.

Purpose

This unplugged lesson brings the class together as a team with a simple task to complete: get a "robot" to stack cups in a specific design. This activity lays the groundwork for the programming that students will do throughout the course as they learn the importance of defining a clearly communicated algorithm.



Plugged Activities w/ Robots & Robotics

Programming and prototyping robots can be very exciting and engaging. They can also offer an opportunity for those students who struggle with online platforms alone to demonstrate their understanding of the computer science concepts. With robots and robotics, students are able to build physical representations of their ideas and see the results of their work in a real world space.

Example: Wonder Workshop - Driving School for Dash

Description

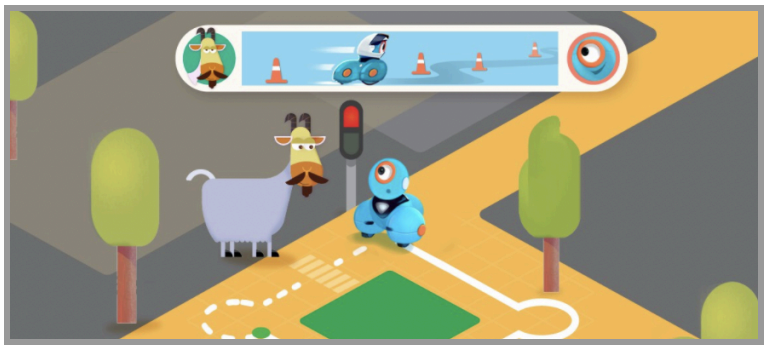
In this first puzzle, your students will learn how to program Dash over a series of 12-driving lesson challenges.

Learning Procedure

By the end of this puzzle, students will understand that a program is an algorithm composed of a series of procedures. Using drag and drop blocks, students will learn how to program Dash to move forward and backward, turn left and right, look left, look right, look forward. The challenges require students to add, connect and delete blocks from a program. Students will be introduced to pre-programmed sounds, i.e., car engine sound and say Hi, colored lights, as well as, editing eye pattern blocks to simulate an expression, i.e., a smile. By the end of this puzzle, your students should feel confident to take Dash out for a spin around the Wonder Workshop neighborhood or, at the very least, the hallways of your school.

Concepts Covered - Drive

- students will learn how to use command blocks in drive that move Dash's two wheels forward and backward.
- students will learn how to program Dash to move forward and backward.
- students will learn how to program left and right turns.



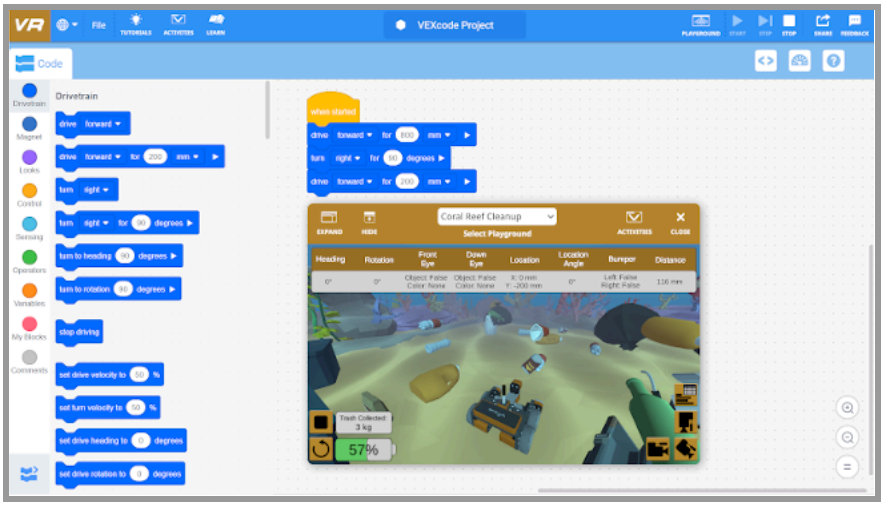
Robot Simulators

There are a number of challenges that teachers may face when trying to use robots. For example teachers may have a limited number of devices or a student may be working remotely during the school year. One option to make sure all students are participating is to use a robot simulator. A simulator, sometimes referred to as an emulator, duplicates a physical robot in a virtual environment and can be programmed to replicate some if not all of the behaviors of the robot. The virtual environment can represent either a two dimensional or three dimensional space. A simulator can provide a similar opportunity for students to learn and apply their understanding of computer science in the context of what a robot can and cannot do, while helping to establish routines or addressing a limited number of robots or devices.

Example: VEXcode VR - Coral Reef Cleanup

Overview of the Activity

In the Coral Reef Cleanup activity, students code the VR Ocean Cleaning Robot in an immersive underwater Playground to collect and remove as much trash as possible from the floor of the Mangrove Reef. Since the VR Robot is equipped with batteries that will only last for a few minutes, students will be challenged to collect as much trash as they can, before the batteries are drained. During the robot's operation, it will keep track of the weight of the trash it collects, and display that on the screen, so students can see their progress in real time. As the VR Robot collects trash, more trash will randomly fall into the Coral Reef. The Coral Reef Cleanup activity will end after the VR Robot's battery is empty or the robot is manually stopped. After the VR Robot's battery is empty or the robot is stopped, the total weight of trash collected will be displayed. Encourage students to try again to improve their project and collect more trash!



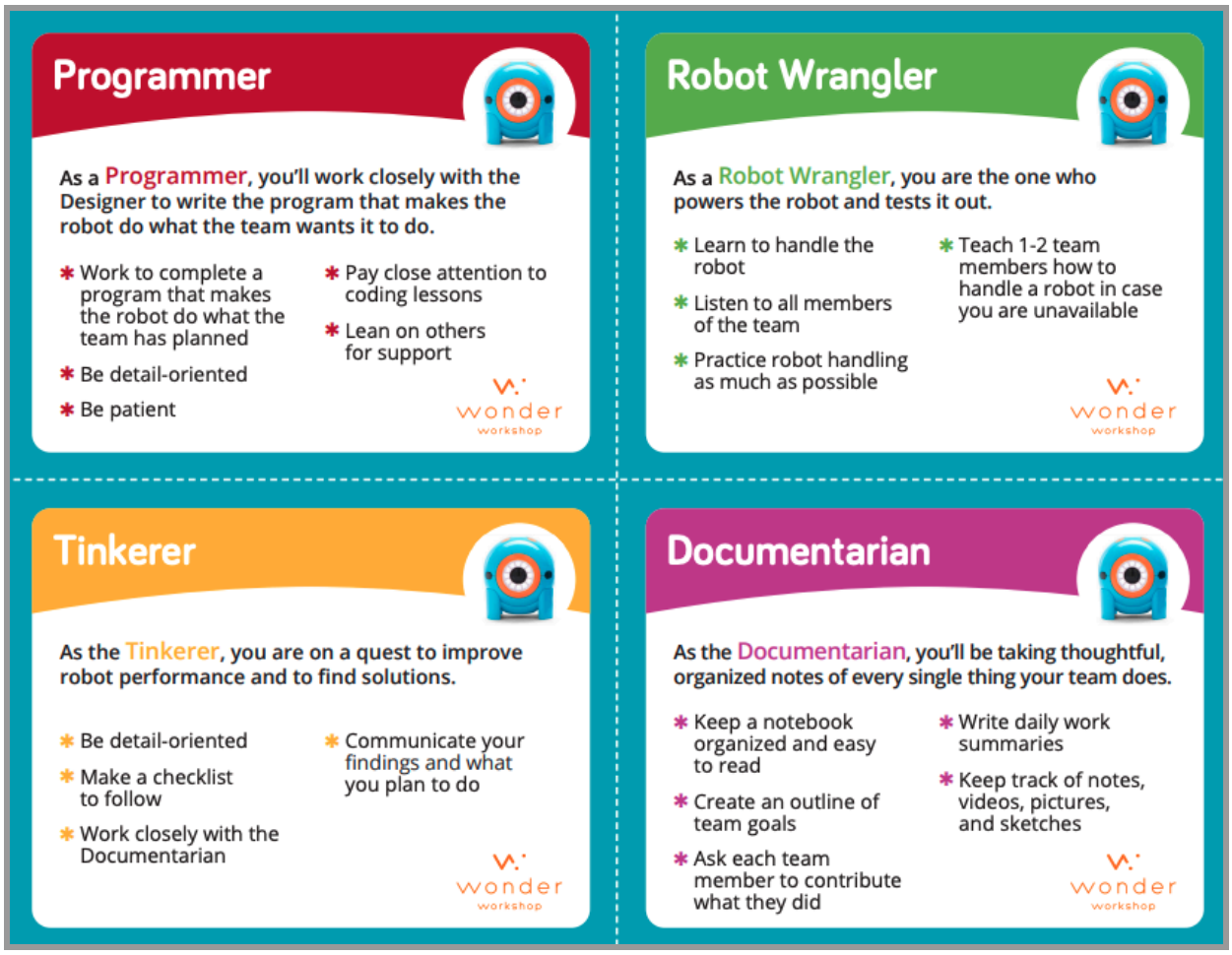
Classroom Procedures & Routines

It is important to remember that with physical devices it can be very overwhelming managing the different robots and robotics materials. Teachers and students should establish procedures and routines before starting any lessons or projects.

Example: Wonder Workshop - Robotics Team Roles

Whether you are a Wonder League Coach or have multiple students use a robot at once, the Robotics Team Role Cards are a great way to ensure that everyone gets a turn at trying out new roles during group work and collaboration.

It's important to provide scaffolding for students learning to work on teams. These roles provide that structure. Swapping and sharing roles throughout a project is encouraged as teams decide what steps are necessary. Hand out these role cards as student guides.



Classroom Centers & Stations

Finally, teachers may choose to use robots and robotics as a classroom center where students are asked to complete specific activities. Teachers may choose to provide students with task or challenge cards highlighting different computer science concepts or practices.

Example: SunsetSpark - Coding w/ Feeling

Coding with Feeling



Directions: Create a program for the Sphero or Dash that represents an emotion.



Step 1: Pick an emotion or feeling to model. Need help picking one? Here are a few examples: *joy, optimism, sadness, trust, distracted, love, annoyance, boredom, excited, anxious, scared.*



Step 2: Think about how emotions can be shown through movement and behavior. What kind of movements do you make when you're feeling that emotion?



Step 3: Use code to create movements and colors that match your selected emotion. Program the robot with your code.



Step 4: Can your classmates guess what emotion your robot is displaying? If not, challenge your classmates to create their own code for how they feel when they experience the emotion.

What strategies would you use when using robots and/or robotics teaching computer science?

What are possible challenges or obstacles when using robots or robotics to teach computer science?

How can you start preparing to use robots or robotics in the classroom?

Teacher Artifact: Plan a Robot Simulator Activity

In this activity you will plan an activity for students to complete using a robot simulator. In planning the activity you will have to identify the platform the students will use, the task students will complete, and how the students will share their work.

To get started make a copy of the Teacher Artifact: Robot Simulator Activity slide deck. Watch the video on slide 2 and review slides 3 to 8. Then follow the directions starting on slide 9 to create your own robot simulator activity. Refer to slides 15 to 22 for an example.

Submit a copy of the Teacher Artifact by Friday, January 13th, using the following Google Form.

Synchronous Session - Jan 22, 2022

(slide deck & session recording)

Welcome & Overview of Teaching CS w/ Robots & Robotics

10:00am to 10:45am

Session 1: Curriculum Choices for Robots & Robotics

10:45am to 11:45am

Session 2: CS Teaching Strategies w/ Robots & Robotics

12:00pm to 12:45pm

Wrap Up & Feedback

12:45pm to 1:00pm

Asynchronous Work Support

1:00pm to 2:00pm

Getting Started w/ Robots

The lesson is an opportunity for students to explore and express their understanding of a robot. Students will look at different examples of robots and come up with their own definition of a robot. From the definiton students will discuss characteristics, different functions, how they think robots work and what robots might look like in the future. Students will draw themselves with a robot and provide a brief description of the robot and how it fits the description.

Is This A Robot?

Which of the following do you think is an example of a robot? Why?








What makes a robot a robot?

Hello Ruby - Make Your Own Robot

In this activity you will learn about robots, how computers learn… and how they might learn the wrong things. When computers learn to solve problems based on examples, it's called machine learning. And the examples we use to teach them are called training data. Design your own robot and draw a picture of it. What does your robot do? A robot may seem human, but its behavior is based on sensors and machine learning.

TASK 25

Design Your Own Robot

Design your own robot and draw an image of it. What is the purpose of your robot?



Name of my robot

Length

Features

Weight



What if you were a robot? Play robots with a friend! One is the robot and the other gives instructions. Then switch!

Now teach your robot to recognise a greeting. Can you think of as many possible ways to greet someone?

This is my training data.

Ask a friend to add one more example to your training data.



How should we approach robots? Is a robot a machine, a toy, a pet or a friend? Can you speak rudely to a robot or slap it?

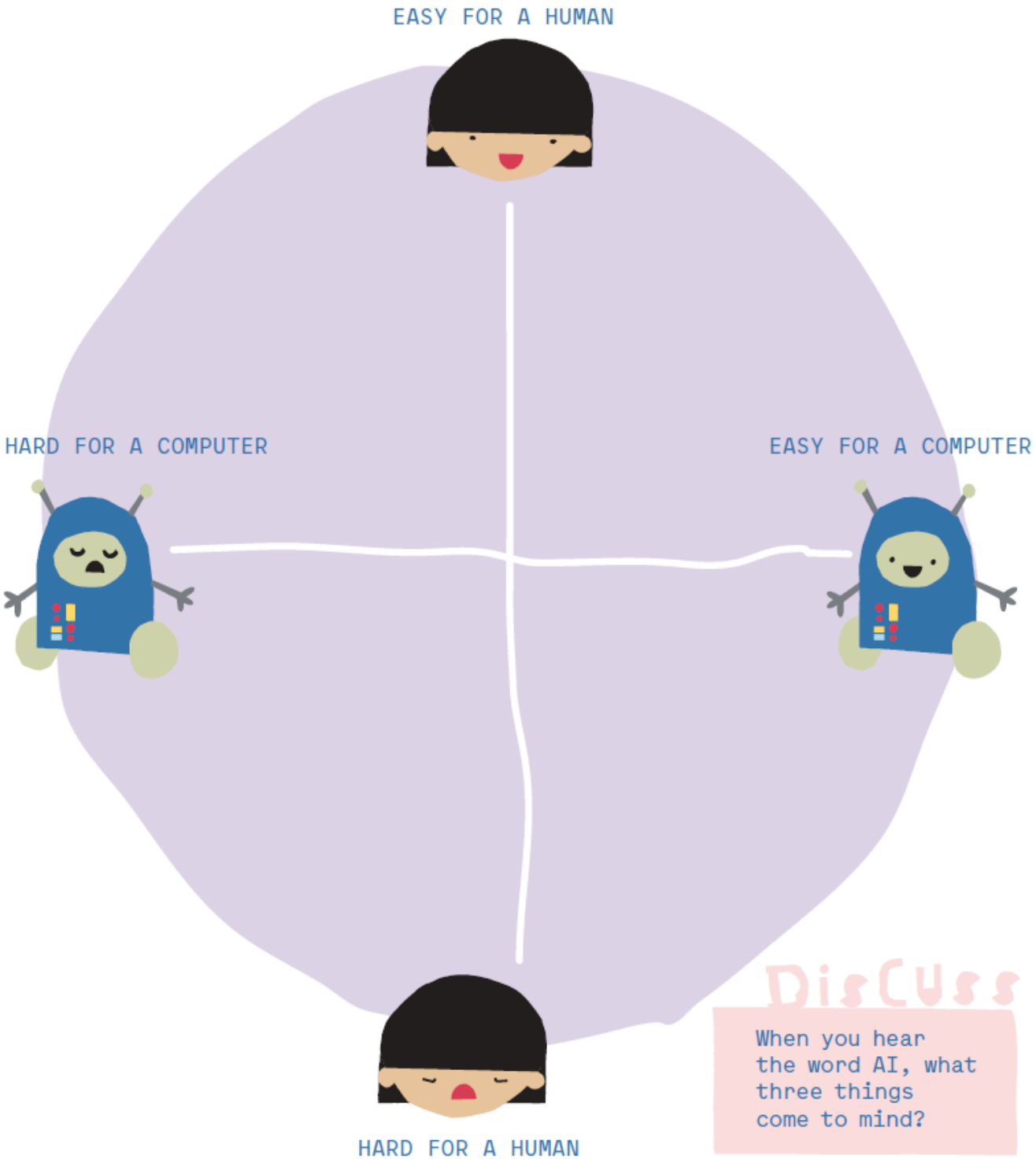


Machine Learning. Machine Learning is the ability of a computer to learn how to solve tasks based on examples.



Training Data and Bias. Data used to teach machine learning algorithms. Training data may contain texts, images, sounds or videos. If the examples in the training data are incorrect or unbalanced, the result is biased and incorrect.

Fill in how you and the robot are going to work together



Discuss

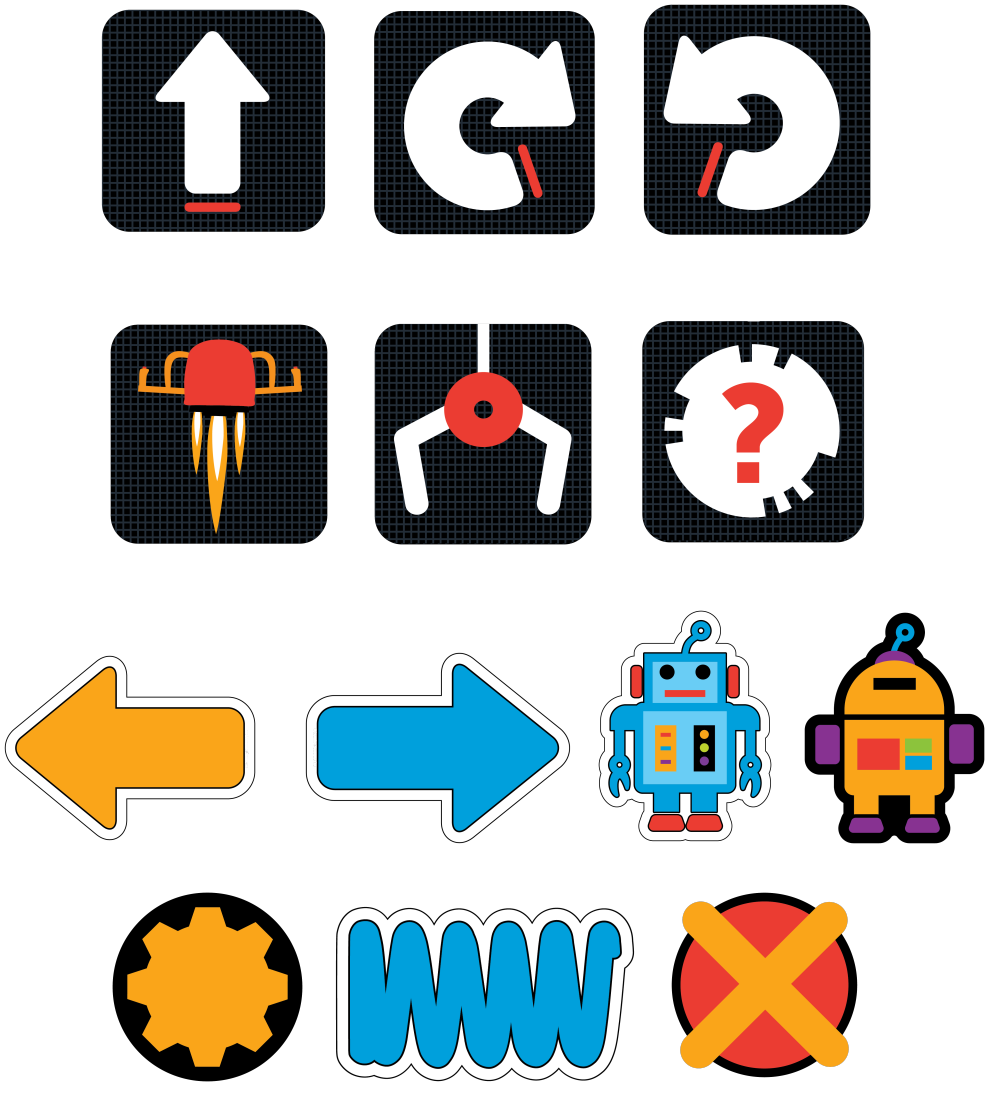
When you hear the word AI, what three things come to mind?

Learning Resources - Let's Go Code

It is very important for students to understand that all programming languages have a set of commands or reserved words and grammar rules that must be followed. The following lesson introduces students to the syntax of the Let's Go Code! Activity Set.

Using the Coding Cards & Robot Controller Slide Deck, review the different materials the students will use when creating the mazes and programming the robot. The Control Panel can be used to help communicate each step.

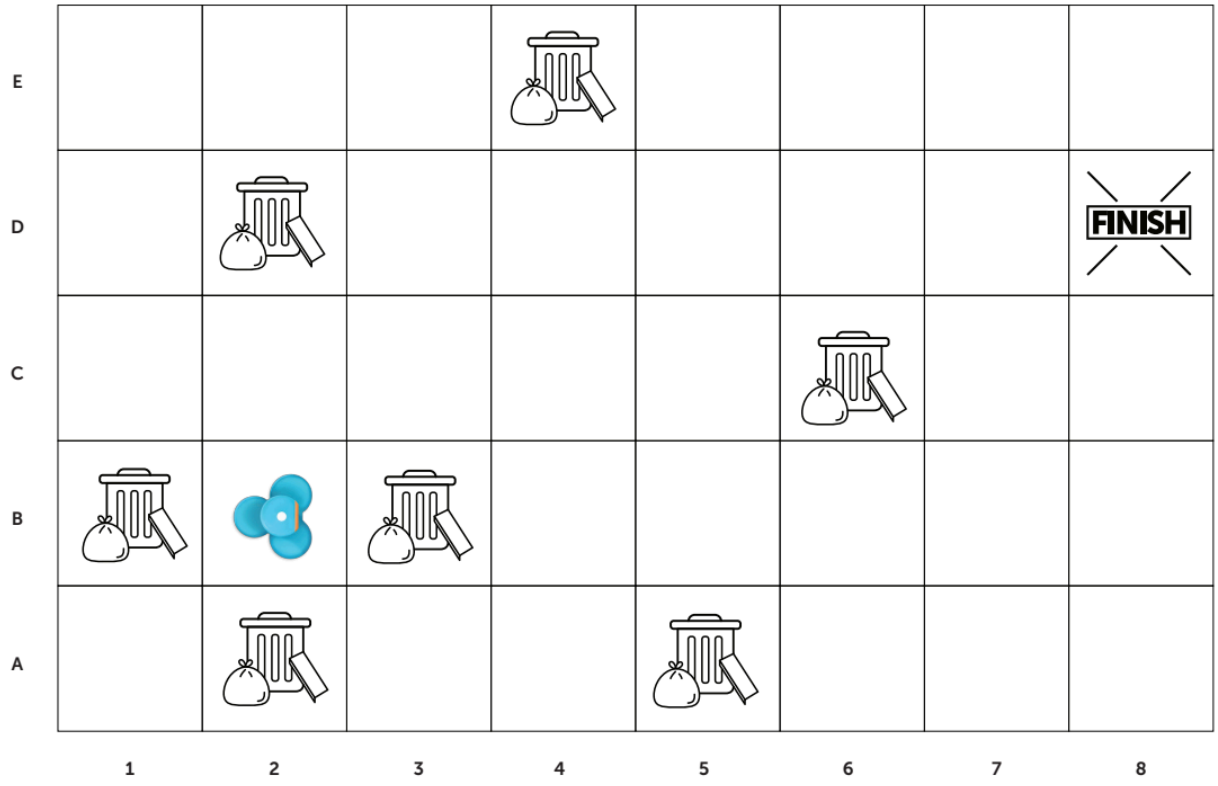
Can you describe or label each of the objects below?



Wonder Workshop - Robot Rescue

The Junk Lord wants to give J.P. a reward for driving their team to victory in the Creek Cart Race last week. So he is letting JP choose one item from the Junk Pile to keep. That's when Craig, Kelsey, and JP discover a little blue robot that clearly does not belong in the Junk Pile. The robot is wearing a very tall hat. What would it be like to have a robot buddy? And JP really wants that hat! Your mission is to help Dash get out of the junk pile safely.

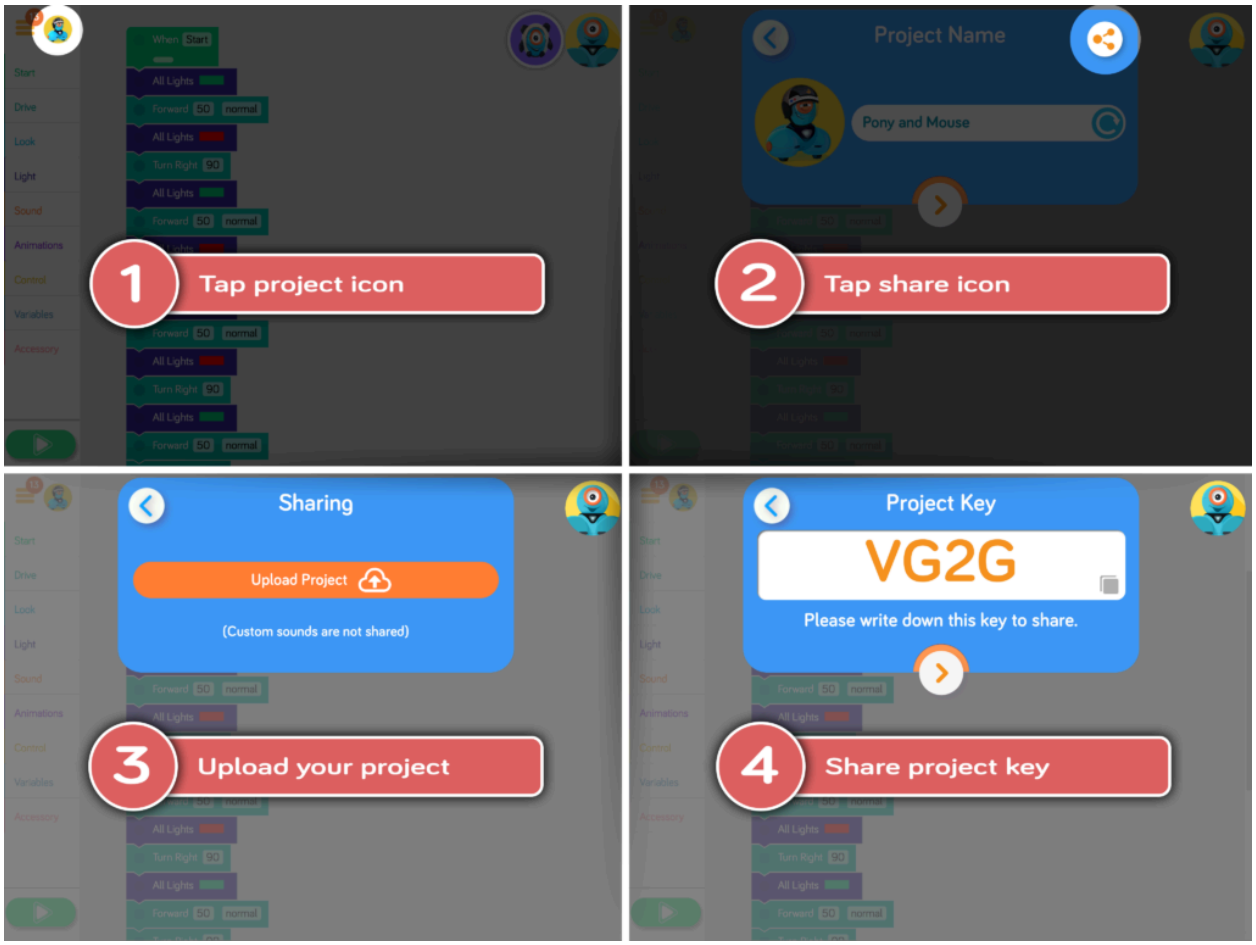
Using the map below, write or draw a program to help Dash get to the finish line.



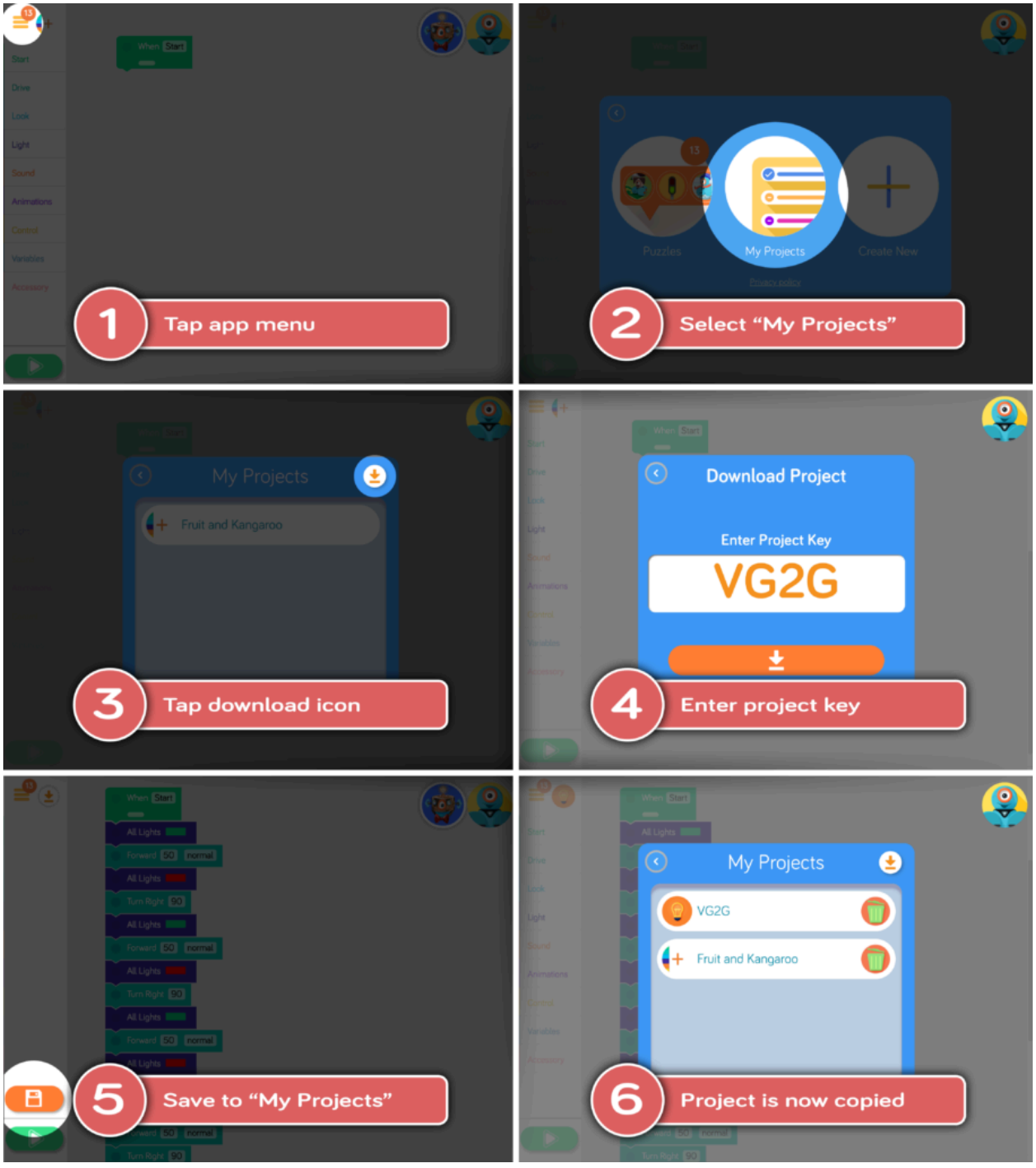
Compare your program with an elbow partner. How were your programs different? How were the programs similar?

Next go to code.makewonder.com, choose Play w/ Dash & Dot and click Create New. Select Blank Project and name your new project. Then click on Create in the lower right corner. Based on your original program, use the blocks on the left to build a new program to help Dash reach the finish line.

Finally, create a project key to share your program.

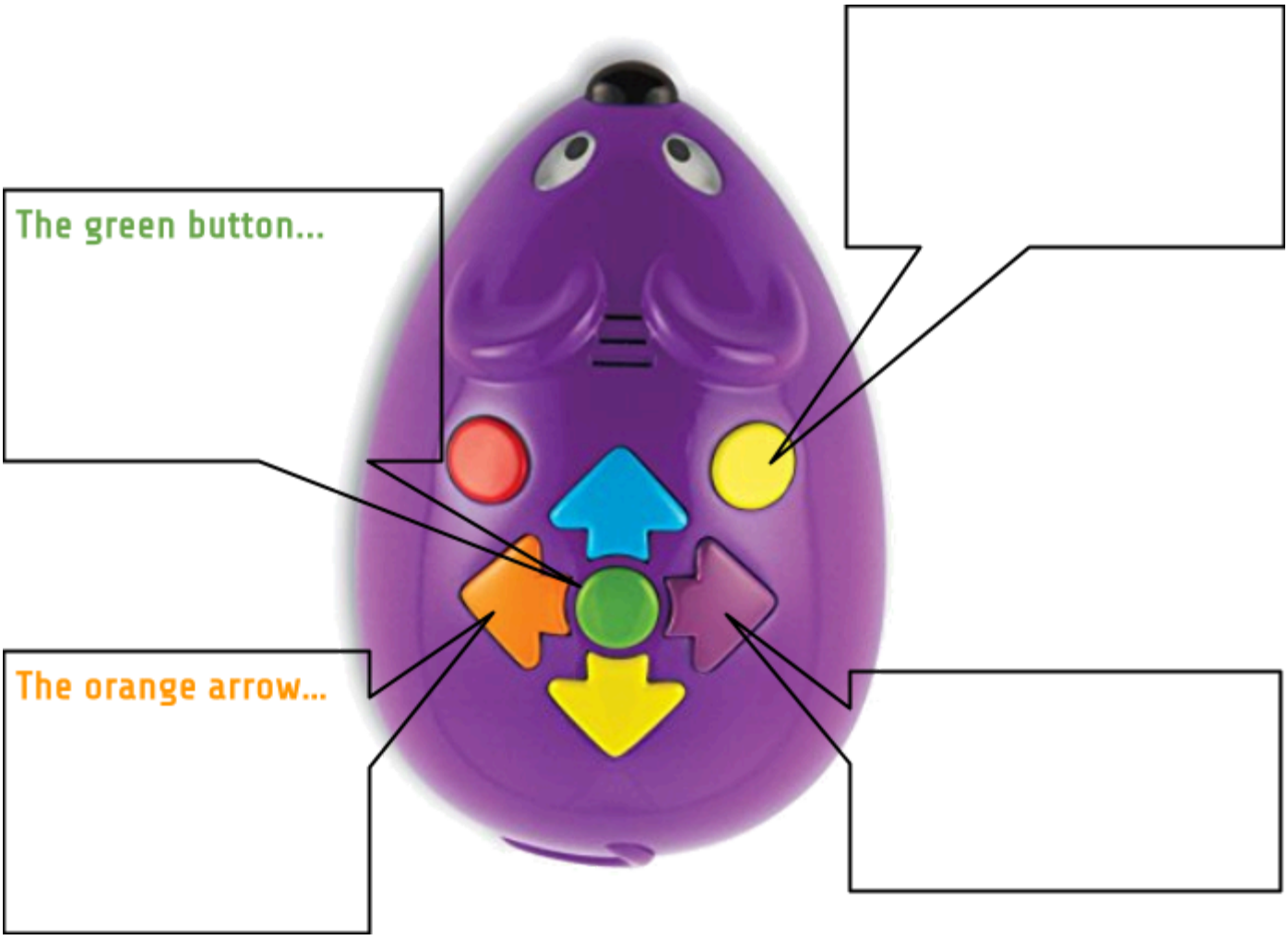


Then share your project key with an elbow partner. How are your programs different? How are the programs similar?



Learning Resources - Meet Cody, The Robot Mouse

Students need to understand how Cody works. Start by providing a simple, guided introduction to the mouse: identify the color and function of each of the mouse's buttons.



What else can you identify?

Wonder Workshop - Dash Directions

Teaching computer science can present a new set of challenges for teachers when it comes to device management and procedures. It is very important to establish routines for students to follow using and maintaining robots in the classroom. The following is an example from Wonder Workshop to help students learn about handling and using Dash.

DASH DIRECTIONS



1. CARRY AND MOVE DASH WITH BOTH HANDS.



2. BE GENTLE WITH DASH.



3. MAKE SPACE FOR DASH.



4. PUT DASH ON THE FLOOR WHEN YOU PROGRAM.



5. BE CAREFUL WITH TABLETS.



6. SHARE ROBOT AND TABLET TIME.



7. WATCH YOUR STEP!



8. BE RESPECTFUL OF OTHER PEOPLE'S WORKSPACES.



9. KEEP DASH AWAY FROM WATER.



10. TURN OFF DASH WHEN YOU'RE DONE.



11. CLEAN UP YOUR WORKSPACE.

iRobot Education - Robo Shape

Challenge Series

Robo Shapes



iRobot Education

Robots come in all shapes and sizes! Can you code your Root® Coding Robot to draw some shapes? In this coding challenge, explore the drawing functionality to create four shapes in the iRobot® Coding App.

Subject(s):
Coding, Robotics

Experience Level:
Beginner

Time:
30-45 minutes

Group Size:
1-3

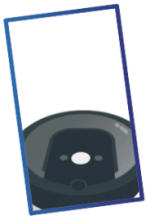
Getting Started

1. Visit **code.irobot.com** or the iRobot® Coding App on an **Android** or **iOS** device.
2. Tap on the + icon to open a new coding project.

With Coders

1. Find the Marker Block. 
2. Model how to code the Root SimBot to draw a square.



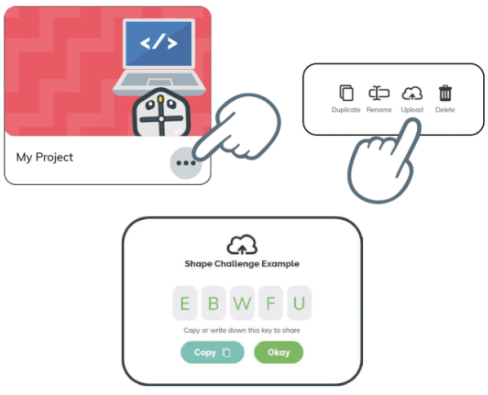




3. Encourage coders to create three other shapes with code. Coders can work together in small groups or individually.
   - **Option 1:** Each participant codes a shape and then shares codes with group
   - **Option 2:** Code four shapes in the the same project (example: **V2L8A**)

Share Your Projects

1. Click the three dots on your coding project
2. Rename your project. Tap the Upload Icon
3. Copy your Project ID
4. Share your Project ID on social media and tag us @RobotEducation! Post a picture as well!
5. Have fun!



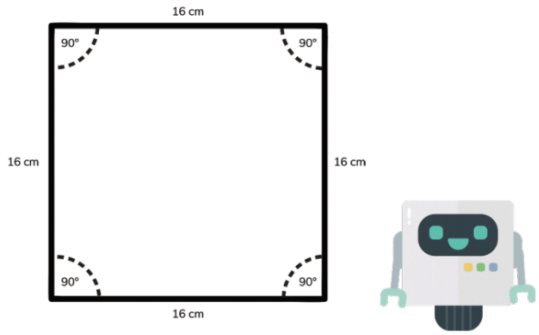
© 2021 iRobot Corporation. All rights reserved. iRobot Education and Root are trademarks of iRobot Corporation.

Shapes Reference Guide (Level 1)

Robots come in all shapes and sizes! Here are some shapes to build with code in Level 1.

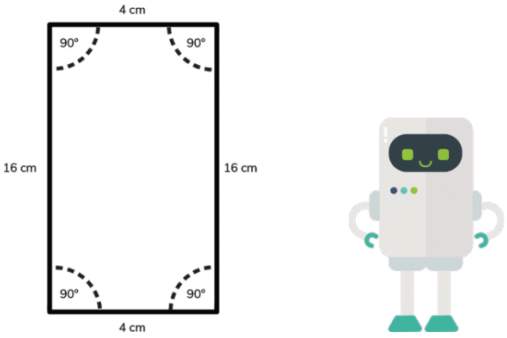
Square





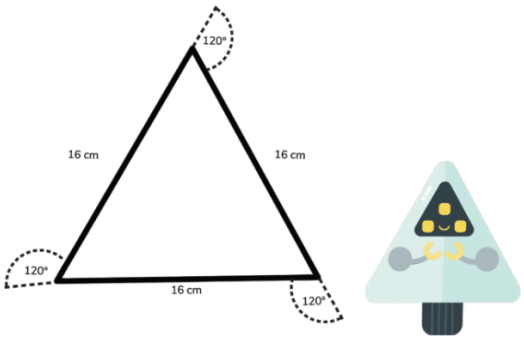
Rectangle





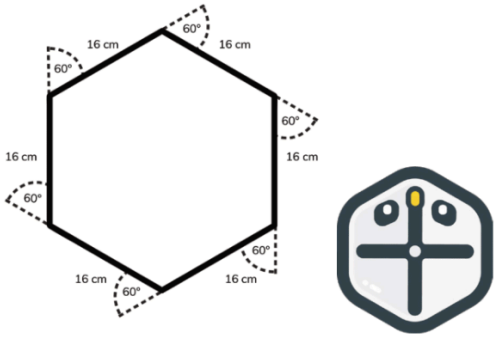
Triangle





Hexagon

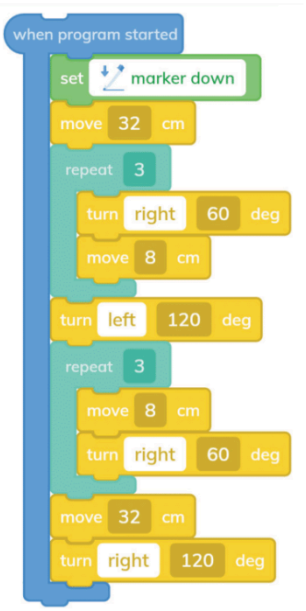


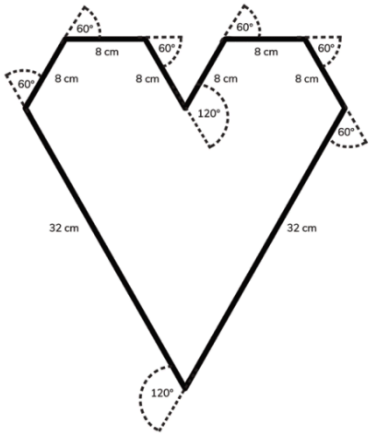


Shapes Reference Guide (Level 2)

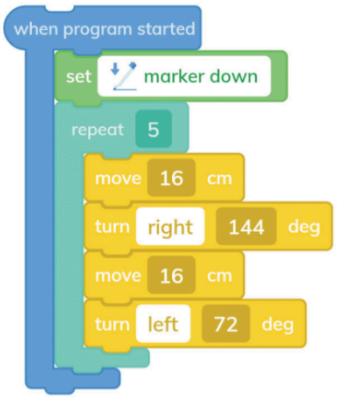
Here are some more complex shapes to build with code in Level 2.

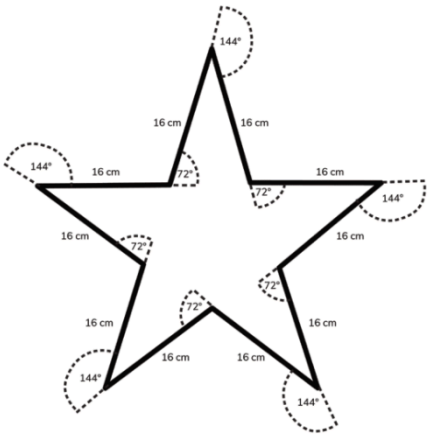
Heart





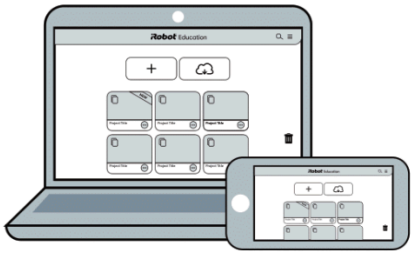
Star





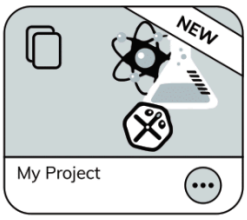
Uploading Projects

Step 1:



Visit **code.irobot.com** or the **iRobot™ Coding App.**

Step 2:



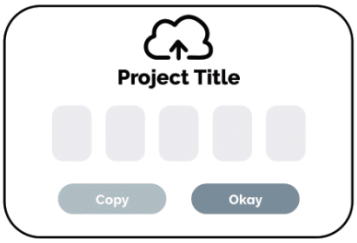
Select the project. Click on the three dots.

Step 3:



Click on the **Upload Icon**.

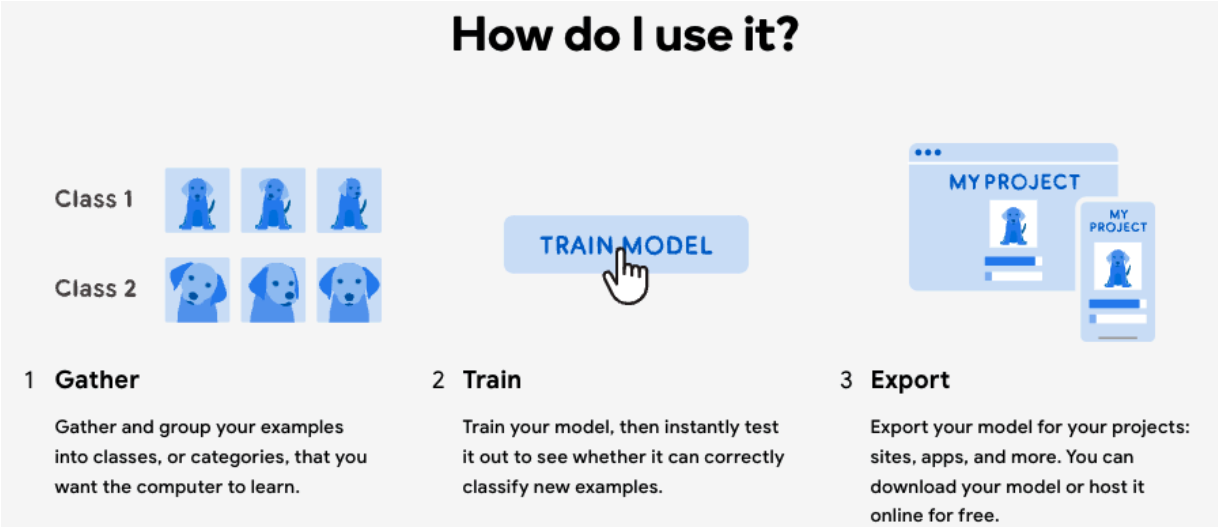
Step 4:

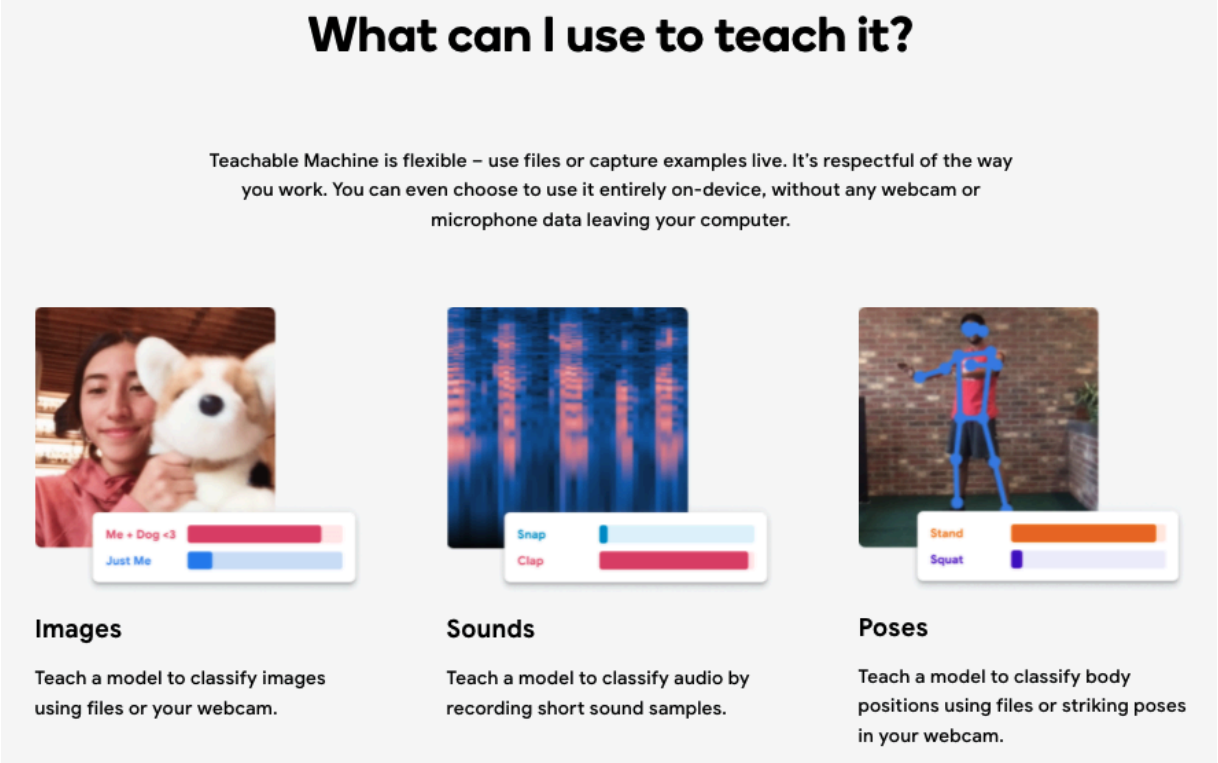


Copy the project code to share with your friends!

Google - Teachable Machine

Teachable Machine is a web-based tool that makes creating machine learning models fast, easy, and accessible to everyone.





Notes:

NYC Department of Education

COMPUTER SCIENCE FOR ALL