Lesson 5: Obstacle Avoidance

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CuteBot Rules:

1. Only run bots on designated mats
2. Limit speed to < 75% (unless otherwise specified)
3. Unplug batteries when not in use
4. Do not drop the CuteBots

If you break any of these rules, you can choose:

A. Do 3 burpees
B. Sing "I'm a Little Teapot" song
C. Do 10 jumping jacks

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What is Obstacle Avoidance?

- Obstacle avoidance is a subsection in the study of robotics
- Deals with **autonomous** navigation and control systems
- Allows a robot to detect and avoid obstacles in its path to reach a predefined destination
- Used in self-driving cars, space exploration, etc.
  - Can you think of any other examples?
- How to detect obstacles? Using sensors!!
  - Can also use path-finding algorithms

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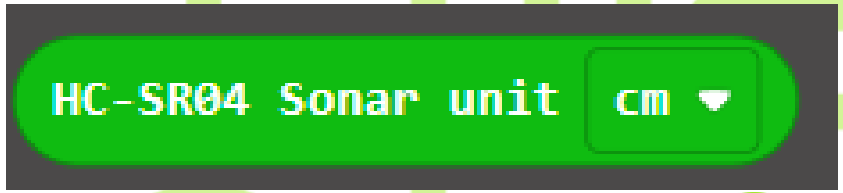
Ultrasonic Sensors

- Ultrasonic is defined as "of or involving sound waves with a frequency above the upper limit of human hearing"
- An ultrasonic sensor is an instrument that **measures the distance to an object** using ultrasonic sound waves
- Look like the "eyes" of the CuteBot
- Check if ultrasensor is in the correct port (**Sonar Port/SR04**)
- In makecode, use this green block -->



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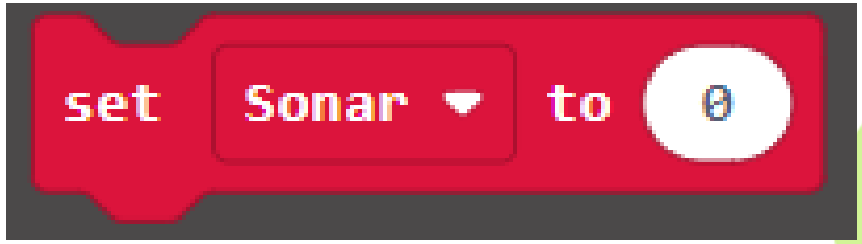
Autonomous Obstacle Avoidance

- Code the CuteBot to avoid the obstacles automatically to move forward
- It should go straight until an obstacle is detected.
- What should go under out On Start block?
- How do we use the ultrasonic sensors in our code?
- We will create a **variable** called Sonar
  - Variables --> Make a variable --> give variable a name (Sonar)
- Use a set variable block to set the value stored in "Sonar"



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Autonomous Obstacle Avoidance

- We need to save the detected Cm value into our Sonar variable

- If an obstacle is near the front of the CuteBot, the CuteBot should begin turning
- How close should the obstacle be for the CuteBot to start turning?
- Pick an appropriate range (Ex: 2cm to 20cm)
- If the value of sonar is within this range, then the robot should course-correct
- Else, the robot should continue moving forward

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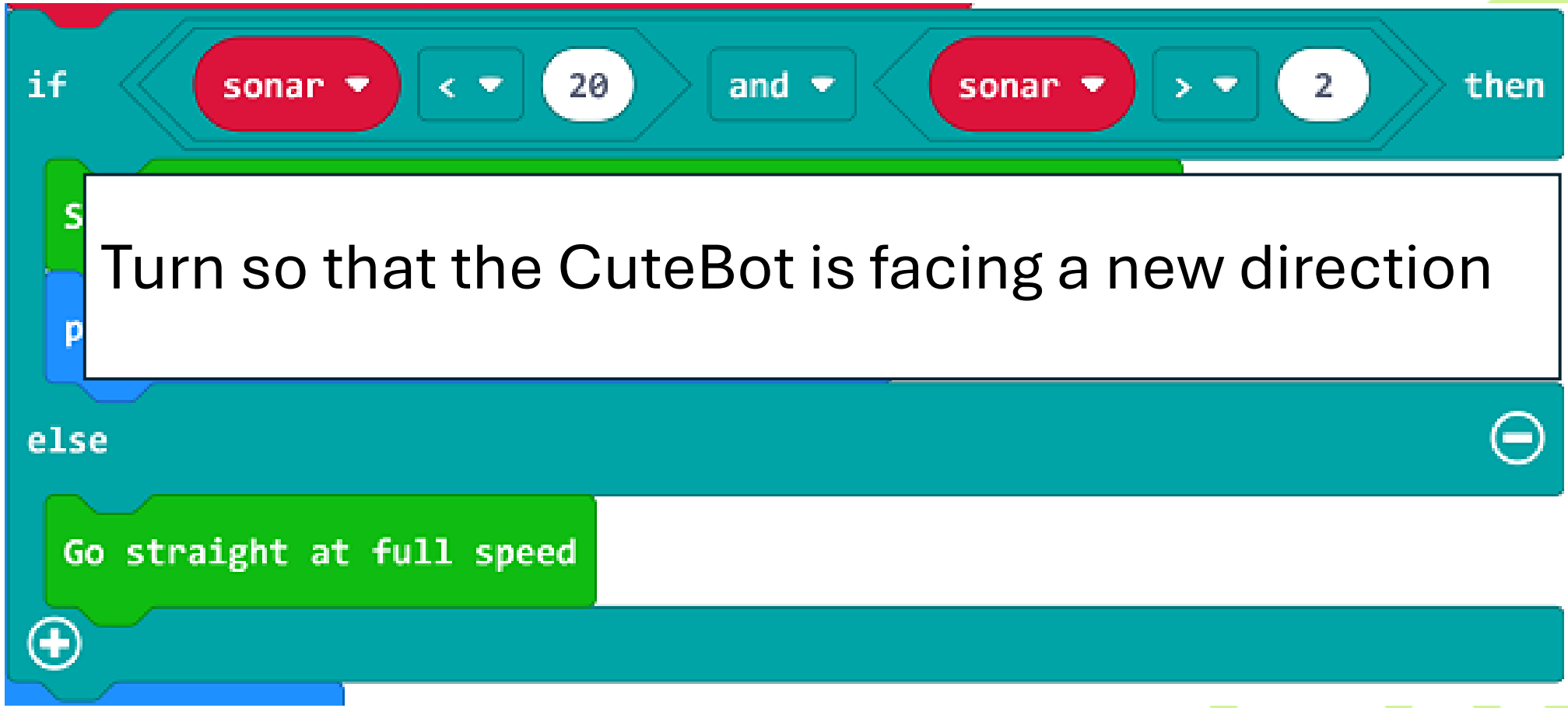
Autonomous Obstacle Avoidance



- How often should we update our "sonar" variable and check this if-else statement?

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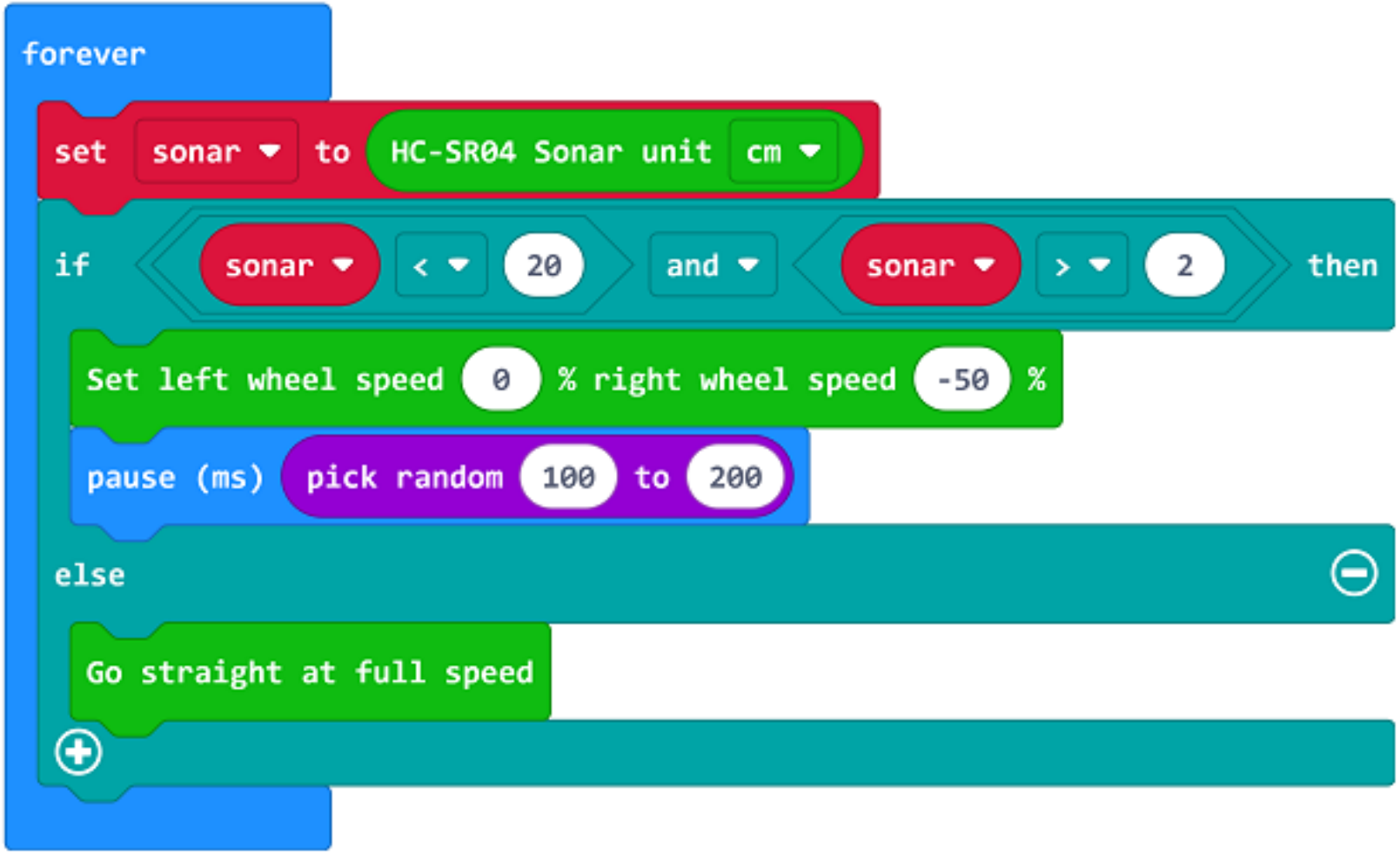
Autonomous Obstacle Avoidance – Solution



REMIX: Tinker with the numbers and observe the affect

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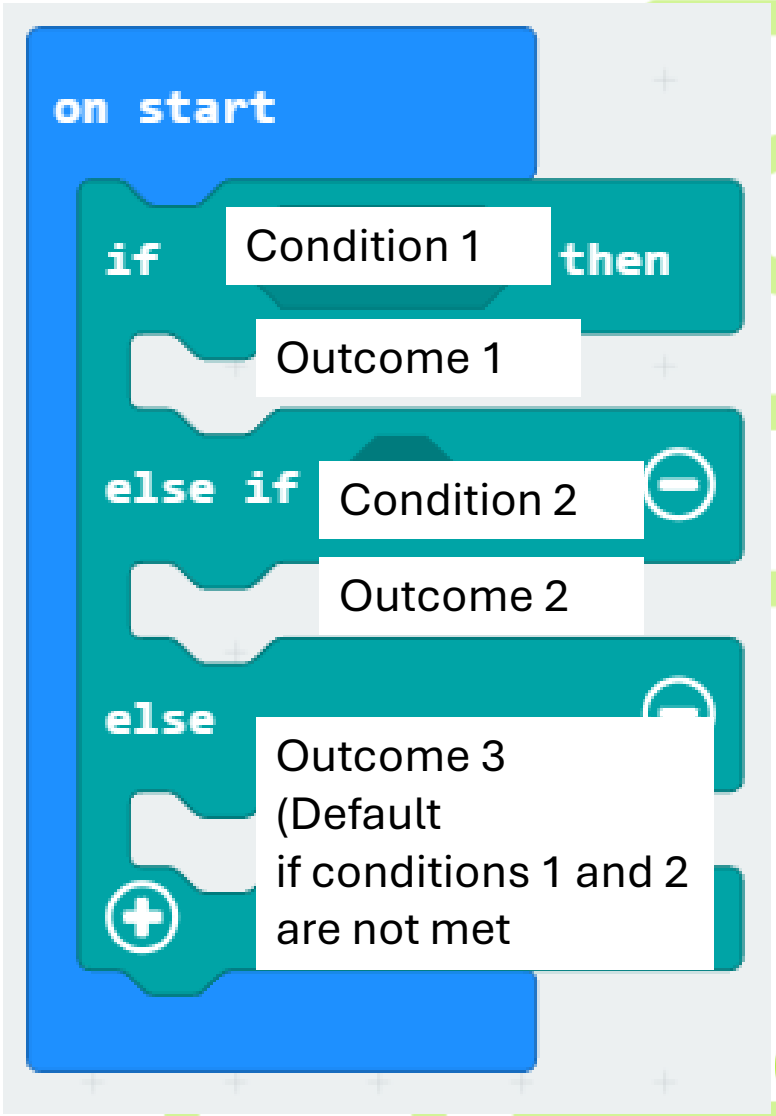
Car Following with a Fixed Distance

- Program the CuteBot to move with a **fixed distance between the car and your hands**
- Set the Sonar variable in the forever block as in the previous exercise
- If the detected value is between 5 and 10 , the car **stops moving**
- If the detected value is below 5, the car **reverses** because of the short distance with the hands
- If not any, the car **moves forward to catch up** with the hands because of the far distance with the hands and then stay still
- Tip: use lower wheel speeds to make testing easier

Car Following with a Fixed Distance

- Using an if - else if - else block
- Click the "+" on the if block to add additional "else if" conditions and outcomes
- Click the "-" on the if block to remove a condition and outcome



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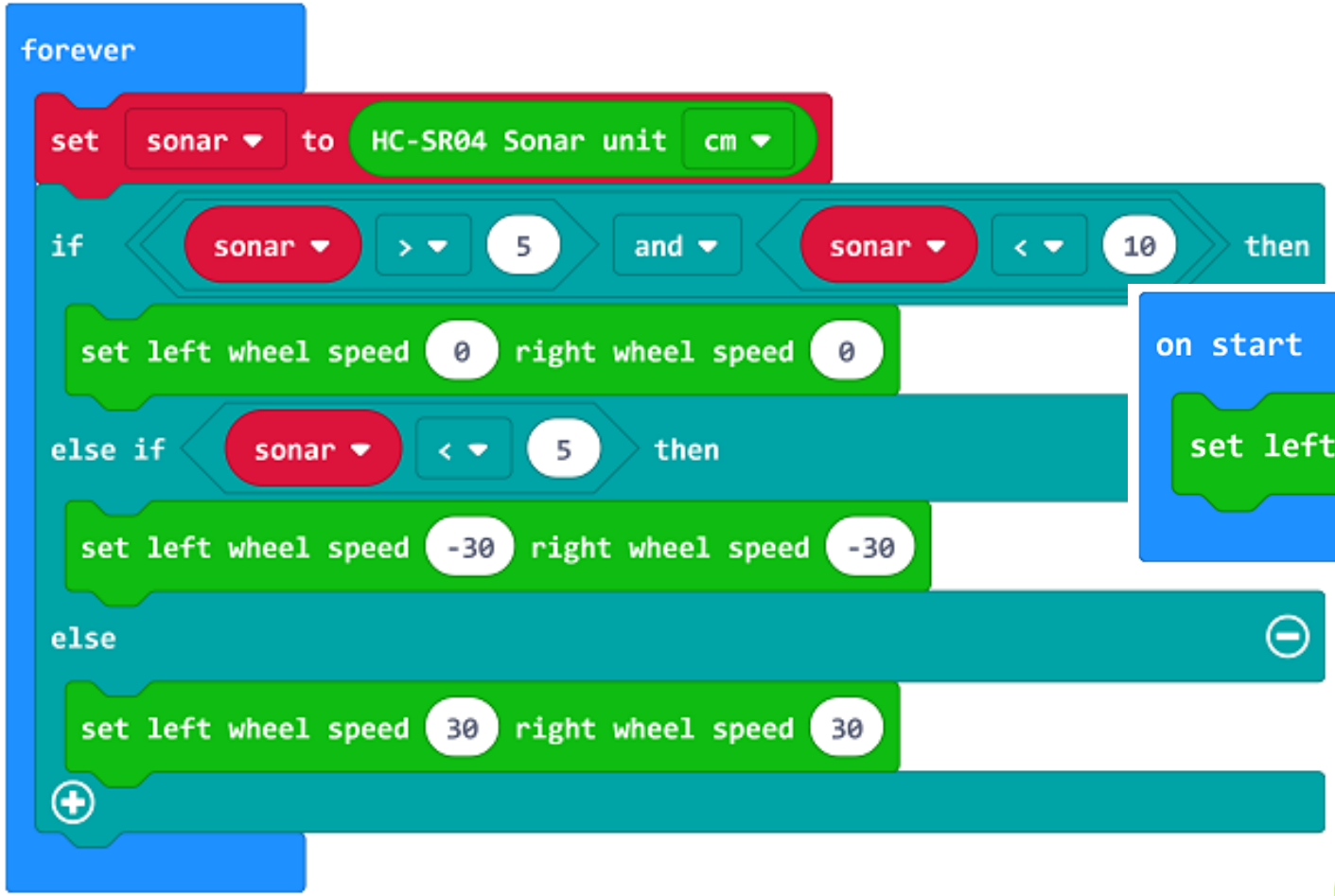
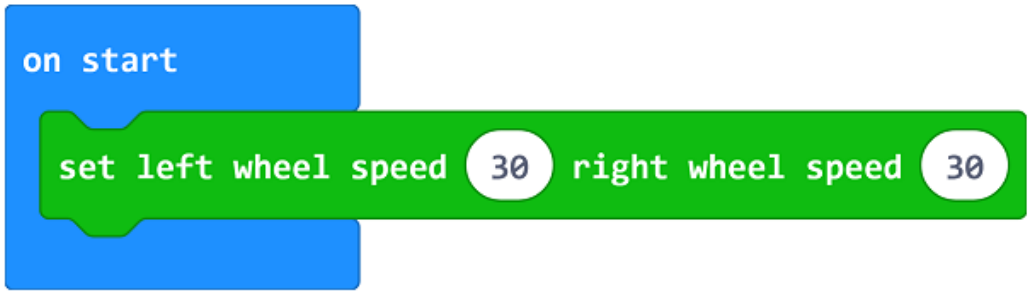
Car Following with a Fixed Distance -- Solution

RESULT: The CuteBot Shuld adjust itself to follow at a fixed distance





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Car Following with a Fixed Distance

- Keep your hand in front of the robot to make it move backwards
- Expand upon this program
- Try adding different behaviours for different ultrasonic sensor reading
- Examples:
  - Green light when going forward and orange light when going backwards
  - Faster wheel speed when hand is far away and slow down as hand gets closer
  - Etc.

Challenge 1: Train of CuteBots

- Create a train of CuteBots following each other
- Work in groups of 3 to 4
- Have a happy face when they join a train (using Micro:Bit display)
- Have a sad face when there is no one to follow
- What should happen if the CuteBot in front of you stops?
- What should happen if the CuteBot in front of you speeds up?
- What should happen if the CuteBot in front of you reverses?
- Have the front of the train randomly speed up, slow down, and stop and program the rest of the robots to respond appropriately

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Challenge 2: Rainbow Lights

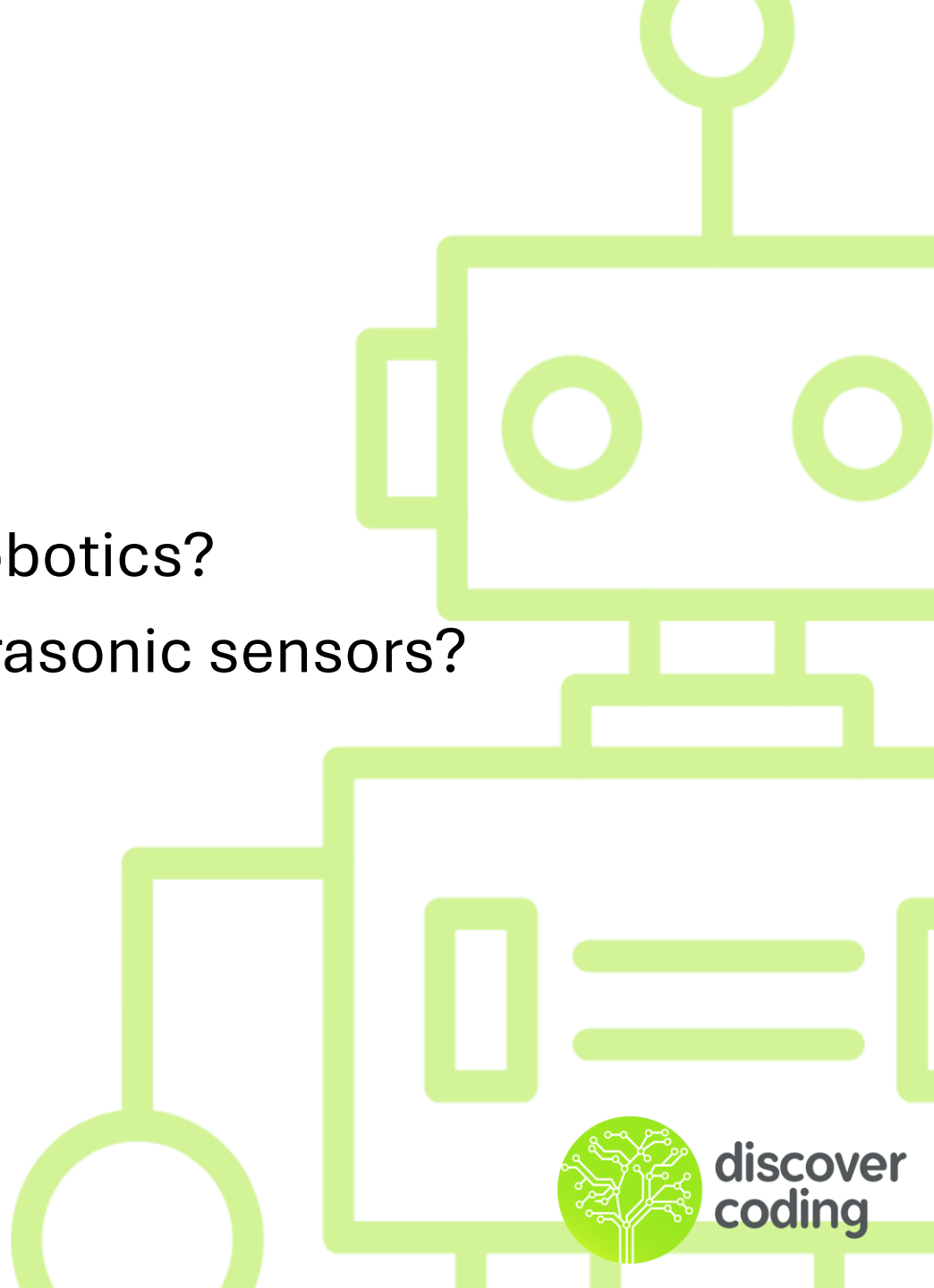
- Have the CuteBot change the colors of its LED lights as it gets closer to an obstacle (or as you move your hand closer to the robot)
- Must use at least 6 different colors
- Quickly alternate colors to create a fun affect
- Use different colors for different sonar ranges, so that you are able to show all the colors

SHOWCASE!!

- Show off your projects to the rest of class!
- You may share your group's Train of Cutebots OR your Rainbow Lights

Q&A

- What are ultrasonic sensors?
- How can we use them with our CuteBots?
- How can they be used more generally in robotics?
- What are some real world examples of ultrasonic sensors?



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