ADVANCED EV3
PROGRAMMING LESSON

EV3 Classroom:
Proportional Control

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EV3 CLASSROOM LESSON
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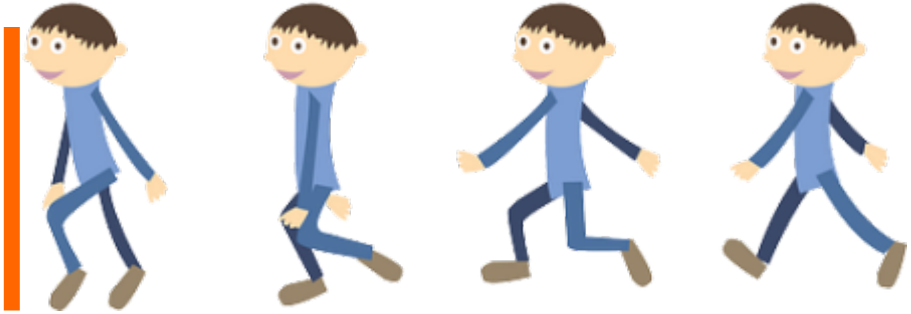
Lesson Objectives

- Learn what proportional control means and why to use it
- Learn to apply proportional control to the ultrasonic sensors
- Prerequisites: Operator Blocks (Math Blocks), Ultrasonic Sensor

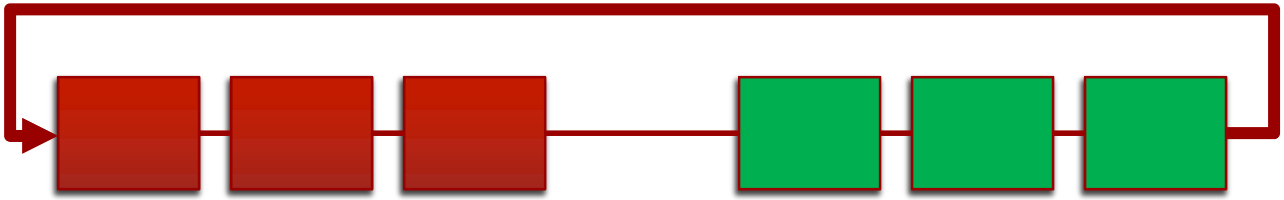
Learn and Discuss Proportional Control

- Let’s start with a game
- Imagine that you blindfold one teammate. He or She has to get across the room as quickly as they can and stop exactly on a line drawn on the ground
- The rest of the team has to give the commands.
- When your teammate is far away, the blindfolded person must move fast and take big steps. But as he gets closer to the line, if he keeps running, he will overshoot. So, you have to tell the blindfolded teammate to go slower and take smaller steps.
- You have to program the robot in the same way!



What Proportional Control Looks Like

- The Pseudocode for every proportional control program consists of two stages:
  - Computing an error → how far is the robot from a target
  - Making a correction → make the robot take an action that is proportional to the error (this is why it is called proportional control). You must multiply the error by a scaling factor to determine the correction.



Compute Error

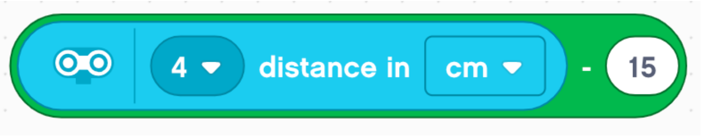
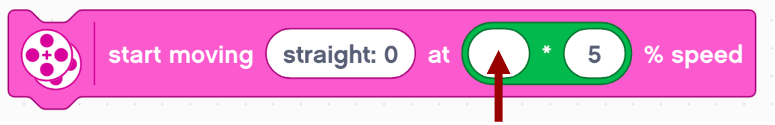
Make Correction

Challenge

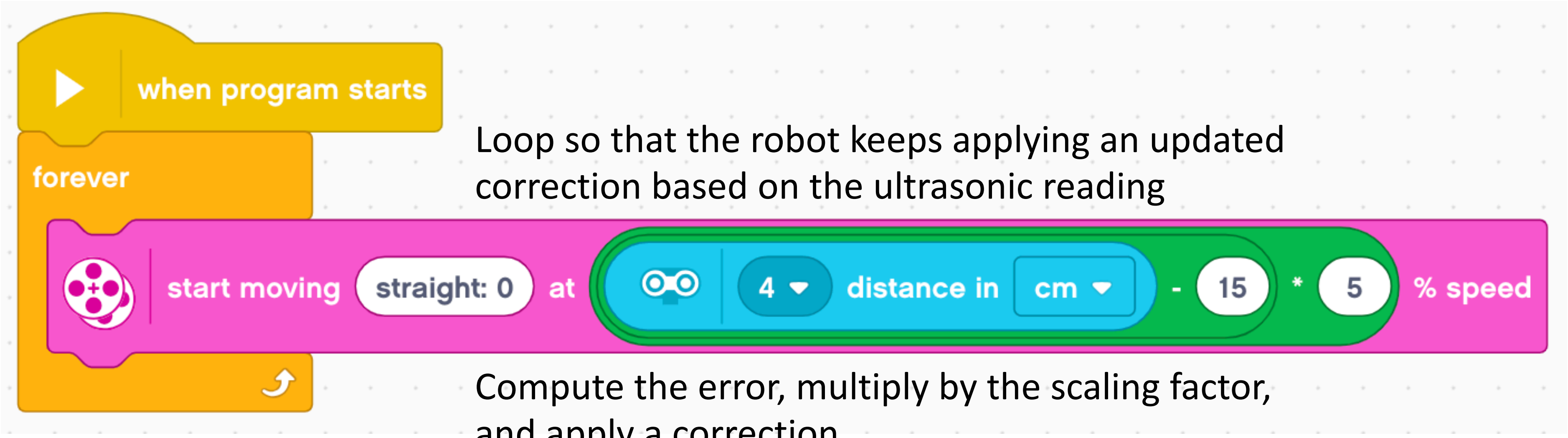
- To learn how to use proportional control, create a Robot Follower program
  - Use proportional control with the ultrasonic sensor to get the robot to stay 15cm away from the human at all times (even when the human moves)

Objective	Error	Correction
Get to a target distance from human	How many cm from target location (current_distance – target_distance)	Move faster based on distance

Challenge

Compute Error	error  4 distance in cm - 15
How many cm from target location (current_distance – target_distance)	
Compute/Apply Correction	 start moving straight: 0 at * 5 % speed error
Multiply by scaling factor and adjust speed based on distance	

Putting It All Together: Ultrasonic Robot Follower



```
when program starts
forever
    start moving straight: 0 at ((4 distance in cm - 15) * 5) % speed
```

Loop so that the robot keeps applying an updated correction based on the ultrasonic reading

Compute the error, multiply by the scaling factor, and apply a correction

Discussion Guide

1. What does proportional control mean?
   Ans. Moving more or less based on how far the robot is from the target distance

2. What do all proportional control code have in common?
   Ans. Computing an error and making a correction

Credits

- This tutorial was created by Sanjay Seshan and Arvind Seshan
- More lessons at www.ev3lessons.com