ADVANCED EV3
PROGRAMMING LESSON

Proportional Line Follower

By Sanjay and Arvind Seshan

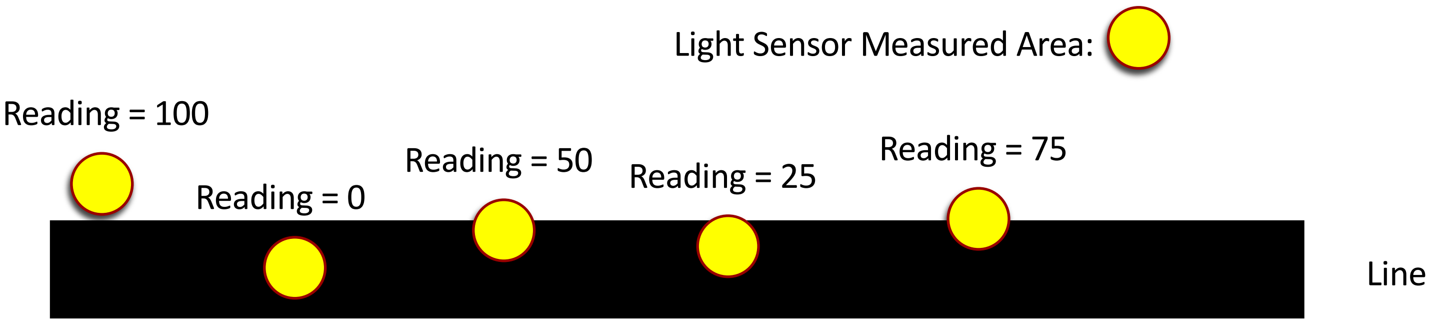
Lesson Objectives

- Learn to create a proportional line follower

- Prerequisites: Basic Line Follower, Color Line Follower, Color Sensor Calibration, Proportional Control, Math Blocks, Data Wires

How Far Is the Robot From The Line?

- Reflected light sensor readings show how "dark" the measured area is on average
- Calibrated readings should range from 100 (on just white) to 0 (on just black)



Line Following

- **Computing an error** → how far is the robot from a target
  - Robots follow the edge of line → target should be a sensor reading of 50
  - Error should indicate how far the sensor's value is from a reading of 50
- **Making a correction** → make the robot take an action that is proportional to the error. You must multiply the error by a scaling factor to determine the correction.
  - To follow a line a robot must turn towards the edge of the line
  - The robot must turn more sharply if it is far from a line
  - How do you do this: You must adjust steering input on move block

How do you make a Proportional Line Follower?

Pseudocode:

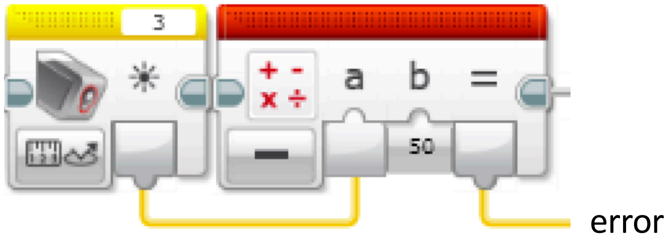
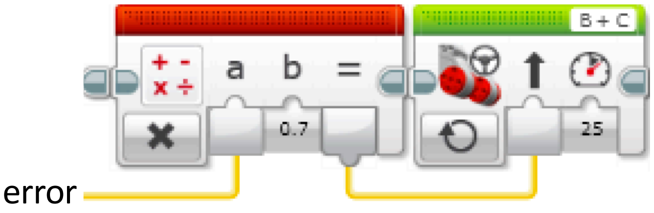
1. Reset the Rotation sensor (Only required for line following for a total distance)

2. Compute the error = Distance from line = (Light sensor reading - Target Reading)

3. Scale the error to determine a correction amount. Adjust your scaling factor to make you robot follow the line more smoothly.

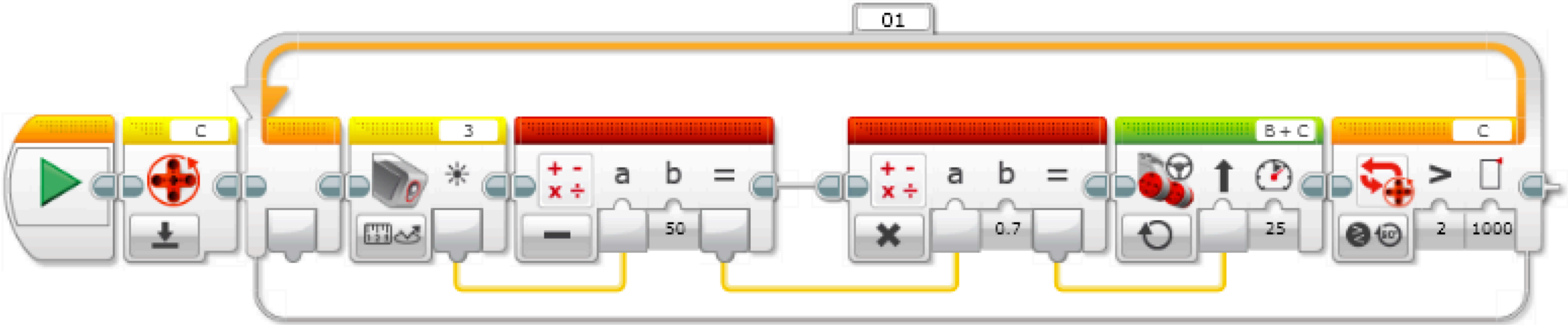
4. Use the Correction value (computed in Step 3) to adjust the robot’s turn towards the line.

Challenge

Compute Error Distance from line = (Light sensor reading - Target Reading)	
Compute/Apply Correction Scale the error to determine a correction amount. Use this to adjust steering input on move block	

Proportional Line Follower

Note: This program uses the color sensor in reflected light mode. You will need to calibrate your color sensor. If you do not know how to calibrate, please refer to our Calibration lesson.



Reset the rotation sensor

Part 1: Compute the Error
Our goal is to stay at the edge of the line (light sensor = 50)

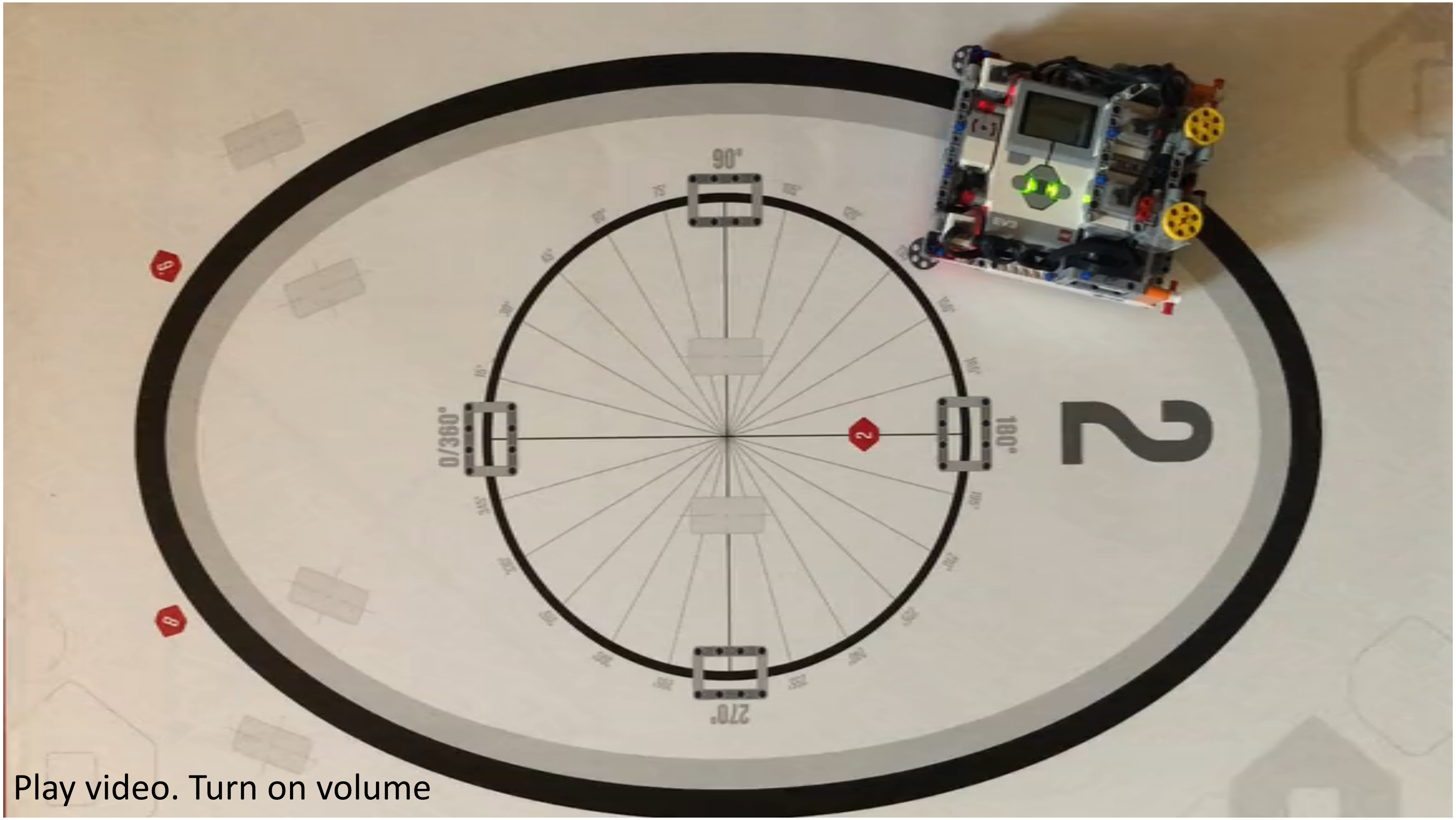
Part 2: Apply the correction
The error in part 1 is multiplied by a Constant of Proportionality (0.7). This will be different for each robot/application. See slides 9-11 to learn how to tune this number.

This line follower ends after 1000 degrees. Change this to suit your needs.

Key Step: Tuning the Constant

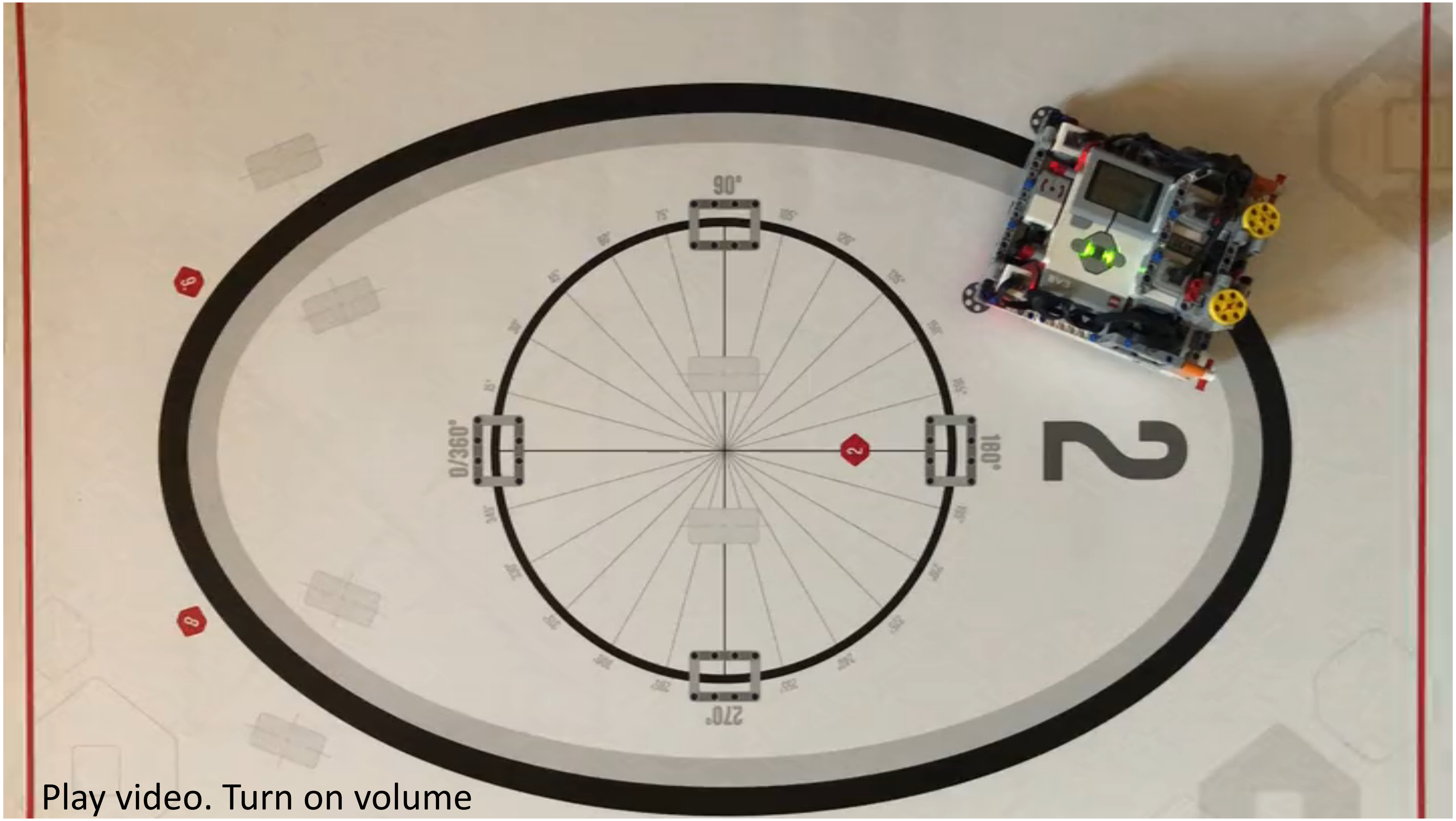
- Note, the 0.7 constant in the previous slide is specific to our robot – you need to tune this value for yourself
- This constant is called the Proportional Constant, or Constant of Proportionality
- The most common way to tune your constant is trial and error.
- This can take time. Here are some tips:
  - Start with your constant as1.0 adjust by ±0.5 initially
  - Adjust to a point where the controller is pretty smooth
  - Adjust ±0.1 for fine tuning

Proportional Control (0.6 Constant)



Play video. Turn on volume

Proportional Control (0.8 Constant)



Play video. Turn on volume

Credits

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