

ADVANCED EV3 PROGRAMMING LESSON



Squaring or Aligning on a Line

By Sanjay and Arvind Seshan



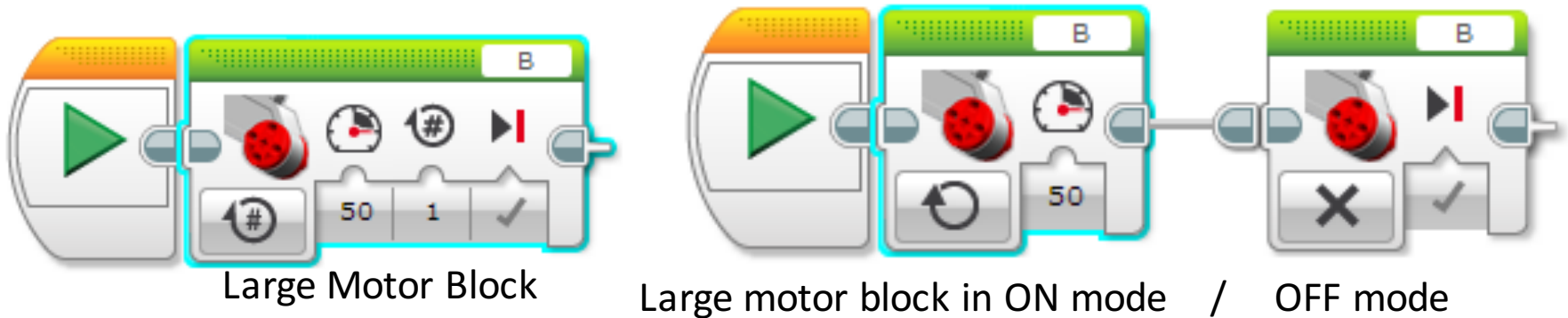
Lesson Objectives

- Learn how to get your robot to square up (straighten out) when it comes to a line
- Learn how squaring (also known as aligning on a line) can help the robot navigate
- Learn how to improve initial code for aligning by repeating a technique
- Practice creating a useful My Block

- Prerequisites: My Blocks with Inputs & Outputs, Data Wires, Parallel Beams, Parallel Beams Synchronization

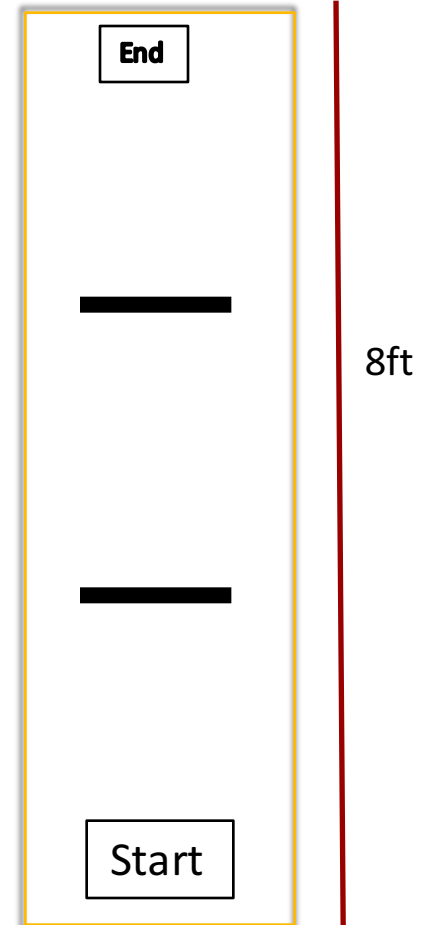
Review: Motor Movements

- Move Steering lets you control both motors at the same time
- What if you want to move or stop one motor at a time?
 - Use the Large Motor Block



Why Align on a Line?

- Aligning on a line helps the robot navigate
 - Robots get angled as they travel farther or turn (the error accumulates)
 - Aligning on a line can straighten out a robot.
 - Aligning can tell a robot where it is when it has to travel far
- Example Goal: Your robot must deliver an object only inside a small END area. The distance between start and end is 8 feet
 - Do you think your robot can travel 8 feet and continue to be straight?



Three Easy Steps to Align

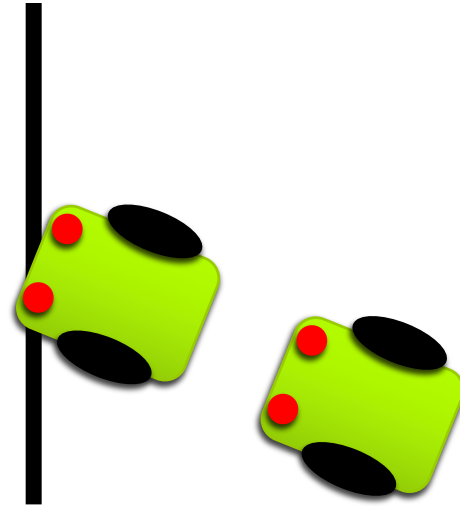
Challenge: Make the robot straighten out (align/square up)

STEP 1: Start both motors

STEP 2: Stop one motor when the sensor on the corresponding side sees the line

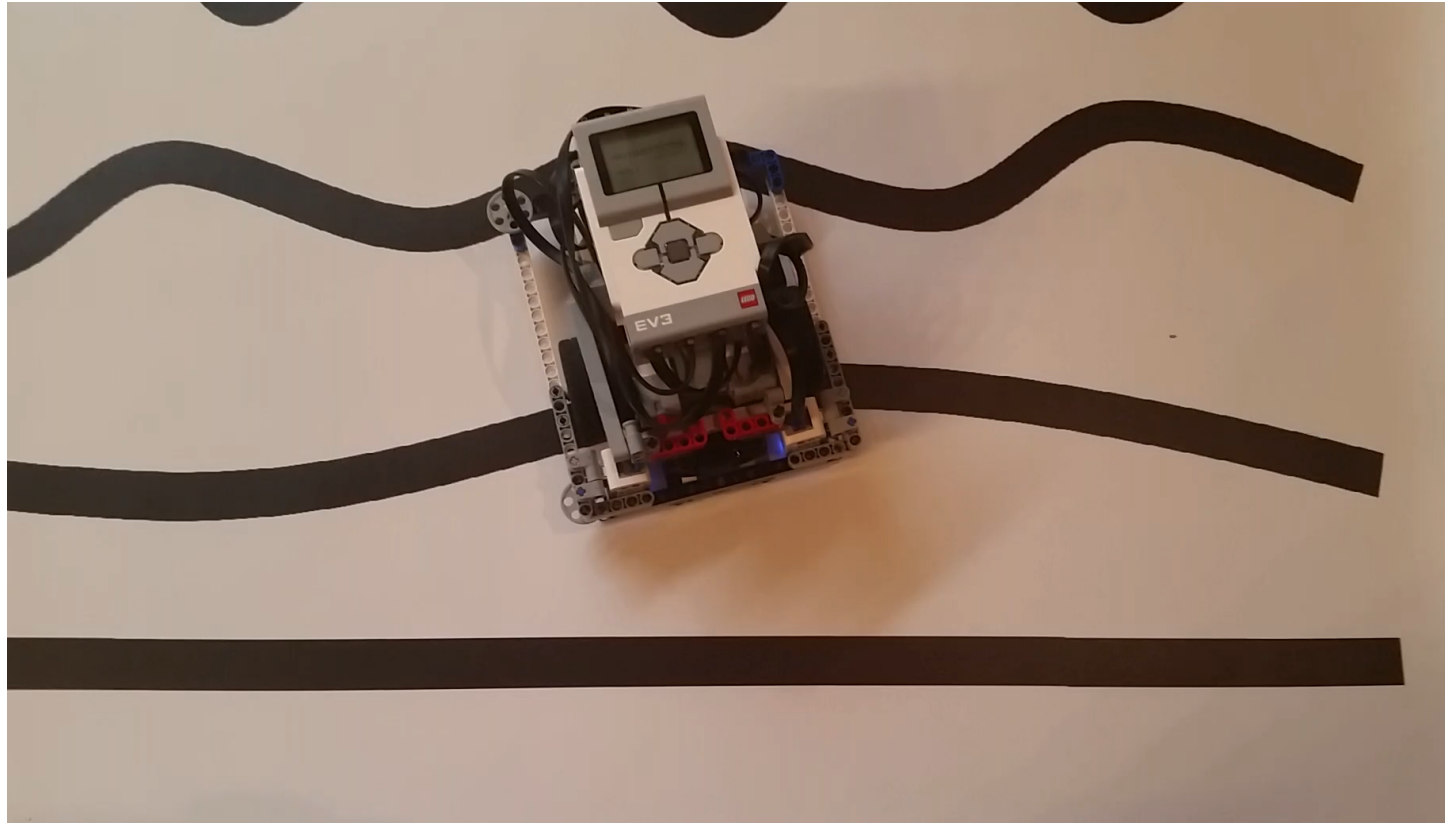
STEP 3: Stop moving the second motor when the sensor on that side sees the line

Hints: Use a Large Motor Block, Use Parallel Beams, Use the Large Motor Block



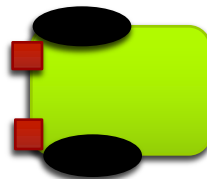
(This slide is animated)

What Aligning Should Look Like



Notes About Our Solution:

- Our solution uses 2 Color Sensors (connected in Ports 1 and 4).
- Our solution assumes that the color sensor on port 1 is next to the wheel on motor port B and color sensor on port 4 is next to the wheel on motor port C.
- You should adjust the ports as needed
- Your color sensors should NOT be placed right next to each other (See red boxes below in robot image. These are the color sensors.)



Basic Solution: Moving Until Line

We use a parallel beam here so that we can do 2 simultaneous actions.
In the top beam, Motor B on our robot keeps moving until the Color Sensor on Port 1 sees Black. Then it stops.
In the bottom beam, Motor C on our robot keeps moving until the Color Sensor on Port 4 sees Black. Then it stops.



Step 1 Goal: Create a SIMPLE way to square up on the line

Note 1: You will need 2 EV3 Color Sensors (connected in Ports 1 and 4 in this program)

Note 2: This program squares onto a Black Line (you can change this to whatever color the EV3 accepts).

Note 3: This program uses the color sensor in COLOR MODE. You can write a program that uses LIGHT MODE, but you will have to calibrate your sensors. We will show you that in another lesson.

Note 4: Your robot design will make a difference - whether you have your color sensors in the rear or front of your robot, and how far apart the sensors are (the further apart, the better).

Note 5: You should adjust the ports as needed - e.g. this assumes that a color sensor on port 1 is next to the wheel on motor port B and color sensor on port 4 is next to the wheel on motor port C.

Note 6: While the robot will be on the black line, this will not create a perfect alignment. See instruction in Step 3 for a simple fix.

Note: Synchronization & Parallel Beams

- When you have two or more beams you do not know when each beam will finish.
- If you wanted to move after the align finishes you might try to add a move block at the end of one of the beams.
 - Note: This will not work because EV3 code will play your move block without waiting for the other beam to finish.
 - Solution: You need to synchronize your beams. To learn more about synchronization and solutions go to the [Advanced EV3Lessons.com](http://AdvancedEV3Lessons.com) Lesson on Sync Beams
- The problem of synchronization can also be solved by making a My Block out of the align code (refer to My Block lesson in Intermediate)
 - My Blocks always wait for both beams to finish before exiting

Improving Your Align Code

- What do you notice about the solution we just presented?
 - The robot isn't quite straight (aligned) at the end of it.
 - Both color sensors are on the line, but the robot stops at an angle.
- **Challenge Continued: Think about how you can improve this code so that the robot ends straighter**

Tips for Success

- You will get better results
 -if your color sensors are about 4mm-12mm from the ground (see Color Sensor Placement Lesson in Robot Design Lessons)
 -if you don't come at the line at steep angles
 -if you keep your color sensors spread apart

Credits

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



This work is licensed under a [Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License](https://creativecommons.org/licenses/by-nc-sa/4.0/).