

# **FIRST® LEGO® League**

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### LESSON 3: FINDING LINES ON THE MAT

SESHAN BROTHERS

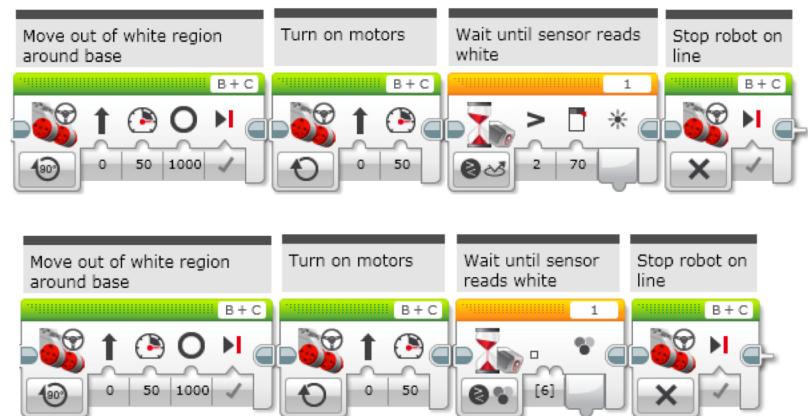
# FIRST STEPS

- In the below path, the first step is moving until the line across the board. Making this simple first step reliable can be tricky!
- Using just distance is prone to error. If you set up your robot at a slight angle or too far forward/backward – your robot will not stop accurately on the line.
- Our goal is to use the light sensor to stop the robot on the white or black part of the line



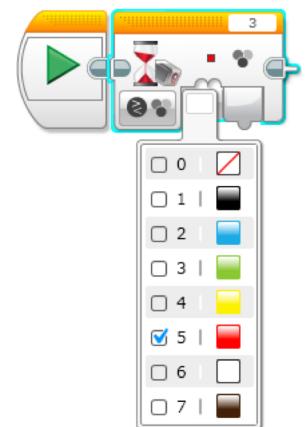
# FIRST SOLUTION

- We will try to stop at the white part. The issues with stopping on black are similar.
- Below are two programs that attempt to perform this step. The top uses reflected light and the bottom uses color sensing.
- Both begin by moving out of base (since base is white) and then turning on the motor until sensor reads white (or bright in the case of reflected light)
- Unfortunately, neither solution is reliable! Why?



# COLOR SENSING

- In color mode, the sensor shines a whitish light on the board and tries to match the reflect light to one of 7 different standard LEGO brick colors.
- Since the mat's printing does not match LEGO brick colors the colors the sensor reports are often unpredictable. What looks green to you may look be closer to LEGO black than LEGO green.
- The color sensor also reads regions of the table at a time. If it sees a bit of yellow and a bit of blue – it may report the color as green.



# REFLECTED LIGHT SENSING

- In reflected light mode, the sensor shines a red light on the board and reports the amount of light reflected back.
- First, you should try to calibrate your sensor if you are using reflected light mode. This will give you more predictable readings.
- Second, the mat looks very different to the robot under the red light than it does to us in normal room lighting. The picture on the right below shows what the Hydro Dynamics mat looks like under red light. Red becomes white, while green and blue become black.



# RELIABLE LINE FINDING

- The main problem is that if you try to find a white region over a large section of the mat, the sensor may report white in some spot before the line
- The solution is to move close to the line before having the robot start searching for white
- This significantly reduces the likelihood that your robot will stop at the wrong spot



## WHAT'S NEXT

- To program this solution, you should read the following lessons from EV3Lessons.com
  - Move Straight
  - Introduction to Color Sensor
  - Move Inches
  - Moving with My Blocks
  - Color Sensor Calibration

# CREDITS

- This tutorial was created by Sanjay Seshan and Arvind Seshan
- More lessons at [www.ev3lessons.com](http://www.ev3lessons.com) and [www.flltutorials.com](http://www.flltutorials.com)



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