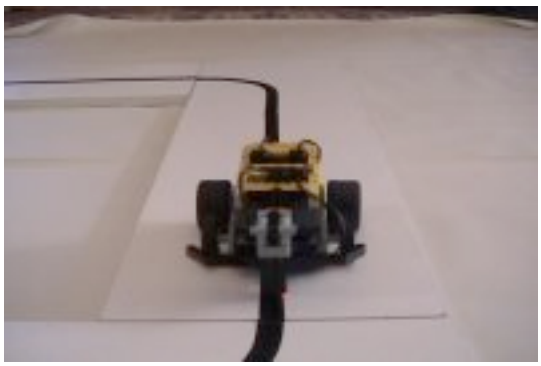
Lego Robot Tutorials
Follow a Line

Following a line is part of many robot games and competitions. In this activity you will learn to make your robot follow a line with one light sensor, and compete in a robot race! You can see a movie of a robot race on the Web site.



Before doing this activity, you should Build a Robot and do the tutorial Light Sensors.

Requirements

The first step in writing a computer program is to understand the requirements. In this case, the requirements are:

1. Make a robot follow a line

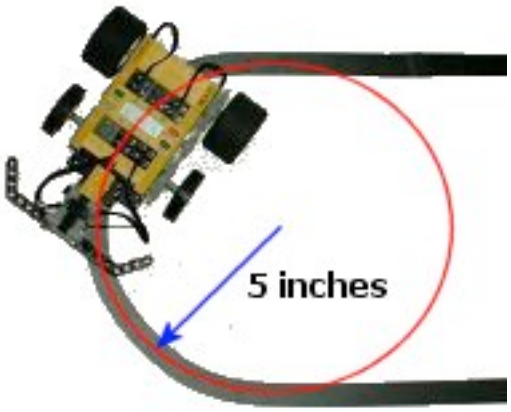
1. The line is 3/4" wide black electrical tape on a white surface

1. The line can be straight or bend left or right

1. Bends in the line will have a radius of 5 inches or more (be part of a circle 10 inches or more across)

Turning Radius

Requirement 4 means your robot must have a turning radius of 5 inches or less. In other words, it can turn fast enough to make a circle 10 inches across or less. See the activity Turning Radius to learn more about this.



Algorithms

An algorithm is a list of steps for solving a problem, something like a recipe. For example, here is an algorithm for a robot bumper car. It goes forward until it bumps into something, then backs up and heads off in a new direction:

Bumper Car Algorithm

1. Go forward until you bump into something
1. Back up about 12 inches
1. Turn about 1/3 of the way around
1. Go to step 1

Brainstorming a Line Following Algorithm

Creating your own algorithms builds brain muscles, and is great fun! Can you create your own line following algorithm? View the Robo Race video again. Watch the position of the light sensor over the line carefully, and how the wheels move. Can you figure out how the robot stays on the line?

Put your robot down on the track. Make your robot move like the one in the video. The light sensor can only tell if it sees a light or dark spot, it can't see the line in two dimensions like you can. Brainstorm with your teammates to create a simple line following algorithm as a list of steps: 1, 2, 3... After you come up with your own idea, go to this page on the Web site and click "possible answer" for one possible solution.

Light Sensor Forks

Use a light sensor fork to take a different action depending on whether the light sensor is seeing light or dark. The drawing at the bottom of the page means:

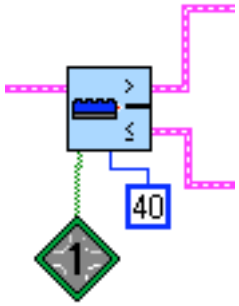
Read the light sensor connected to input port 

Compare the number read (1 - 100) to the cutoff brightness of 

If the brightness is greater than 

, take the upper path (notice the greater than sign > next to the upper wire).

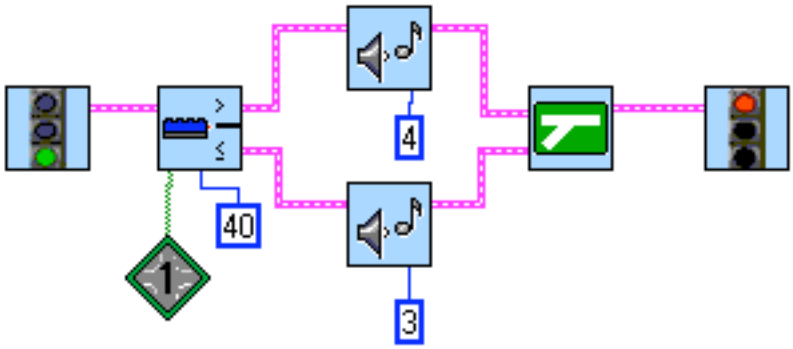
If the brightness is less than or equal to 40, take the lower path (≤ sign).



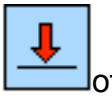
Light Sensor Forks

Here is a simple program that uses a light sensor fork. It plays a rising sweep (sound 4) if the light sensor is over a light surface (brightness > 40). It plays a falling sweep (sound 3) if over a dark surface (brightness <=40).

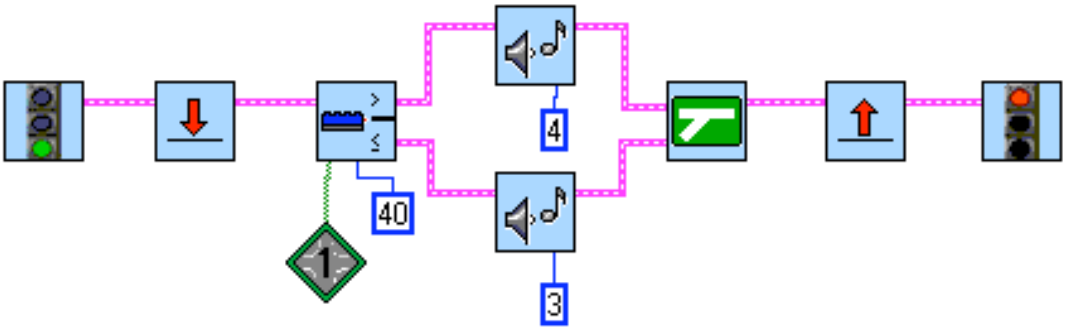
The light sensor is connected to port 1. The merge function  brings the two program paths back together after the fork. Enter the program into RoboLab and try it!



Loops with Light Sensors

Use loops to make your program do the same thing more than once. The jump  function makes the program go to the land function  of the same color. If the land is before the jump, you get an endless loop.

Look at the program below. Try to read it by pointing to each icon in order and telling what it does. How is this program different from the one on the Light Sensor Forks page? Enter it into RoboLab and try it!



Write Your Program

Now you are ready to write your own line-following program in RoboLab®! Try this approach for writing and testing programs:

1. Put your robot on the line and make it do what you want by hand

1. Create or modify your algorithm, or steps 1, 2, 3 for the robot to follow

1. Write a program in RoboLab® that does your algorithm

1. Download it to the robot and test it

1. Did it do what you wanted? If not:

    a. "Run" the program in your mind by pointing to each function and saying what it should do. Did the robot do what you told it to? Do you have an idea of what to change?

    a. Go to step 1, 2, or 3

See the Web site for a hint.

Challenge: Robo NASCAR

With your line-following program, you can race your robot car around the oval test pad included with the Lego Robotic Invention System®! Here are some simple rules for this game. For complete competition rules, click here.

1. On the GO signal, the driver will press the green "run" button and the clock will start.

2. The robot must circle the track 2 times.

3. If the driver must touch the robot between the start and end of the race, there is 10-second time penalty each time.

4. The fastest time wins!