

Lab 1 - Introduction to NXT, Loops, and Switches

1 Objectives

- Become familiar with the NXT programming language
- Learn how to perform basic tasks with the robot
- Understand and implement the concepts of loops and switches

2 Materials

- Robot
- Map 1

3 Lab Overview

The goal of this lab is to familiarize students with how the robot works and how to use the NXT programming language. This lab includes two main tasks, finding a line and following a line.

3.1 Find a Line

In the “Find the Line” portion of this lab, the goal will be to begin with the robot to the right of the black line on Map 1 and to have the robot turn left until it finds the black line and then stop. The most important new idea introduced in this task is the loop concept. Before beginning this portion of the lab, students should be given the “Loop Block” documentation and should watch the “Loop” video.

Students need to translate the phrase “Turn right until black” into NXT code.

The first part to think about is the “turn right” aspect of the task.

Questions to consider:

1. What needs to be done in order to turn right?
2. Which motors need to be used to accomplish this task, and what do they need to do?
3. How can this be translated into NXT code?

At this point, students should write code to make the robot turn in circles to the right with no stop condition. Students can refer back to the documentation to remember which motors correspond to which ports and how to activate the motors using the NXT language.

After students have successfully programmed the robot to turn in circles to right, they will need to think about the second aspect of the task, the “until black” condition.

Questions to consider:

1. When does the robot need to keep moving? When does the robot need to stop moving?
2. How can we tell the robot to stop when it sees the black line using the NXT code?

3.2 Following the Line

In the “Follow a Line” portion of this lab, the goal will be for the robot to follow a black line on the left by switching between the white and black regions on Map 1. This part of the lab elaborates on the “Find the Line” task by requiring the robot to perform a different action based on whether it sees black or does not see black. The most important new idea introduced in this task is the switch concept. Before beginning this portion of the lab, students should be given the “Switch Block” documentation and should watch the “Switch” video.

Since “Following the Line” is not an action that can be directly translated into NXT code, the task needs to be broken down into commands that can be translated into NXT code easily. Following the line is comprised of turning right if the robot sees white and turning left if the robot sees black. So this time students need to translate:

“If black, turn left. If not black, turn right.”

However, if we simply tell the robot to check one time, it will stop after it has checked once and moved once. We need to make sure that the robot checks over and over again and moves accordingly for the amount of time we choose. In this case, we’ll choose forever. The statement the students need to translate is modified to:

“Do the following forever: If black, turn left. If not black, turn right.”

Questions to consider:

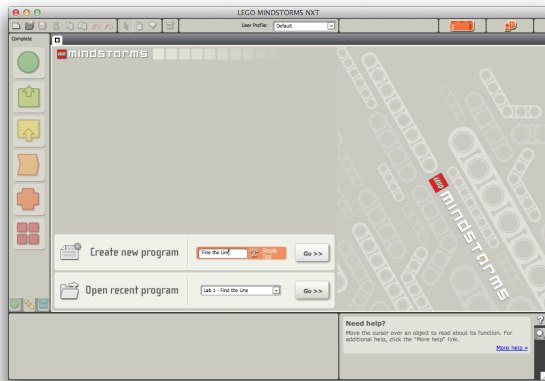
1. What actions are involved in following a line?
2. What are the conditions required to follow a line related to the color?
3. How many times do we need to check the color the robot is sensing and move accordingly if we want to follow the line forever?

4 Solutions

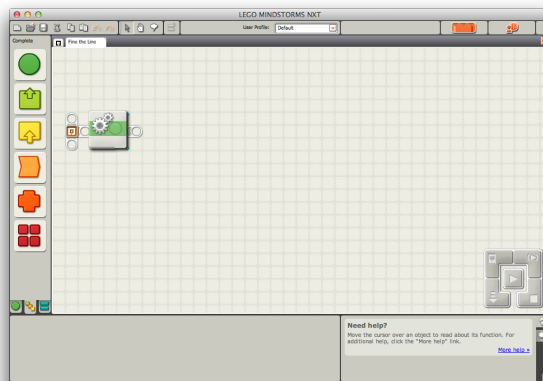
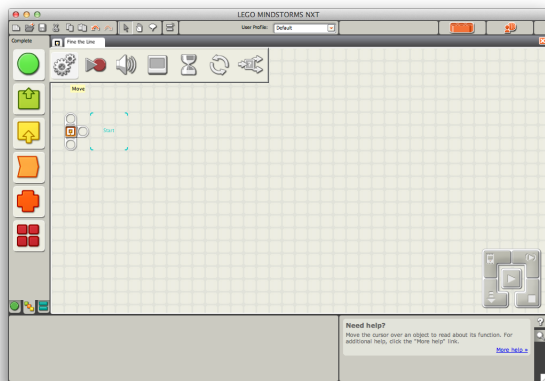
4.1 Find a Line

Students learned about the “Loop Block” at the beginning of this section of the lab, so the goal is for them to recognize that they can use one of the loop blocks to accomplish this task. It will be important to start the robot positioned within the turning radius of the black line when testing the final solution of the code so that it is able to reach the black line when it turns.

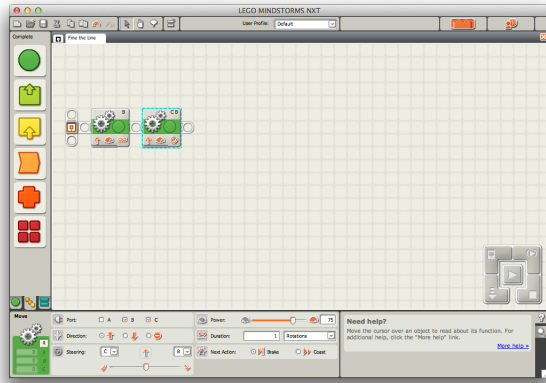
- To begin, students will need to create a new program, which they can do by typing the name of their program into the “Create new program” bar and clicking “Go”. The beginning screen when the Mindstorms program is opened should look like this:



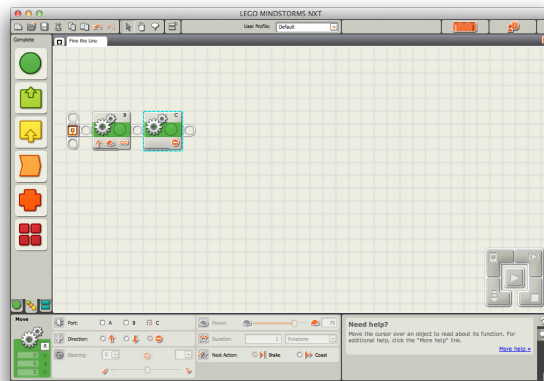
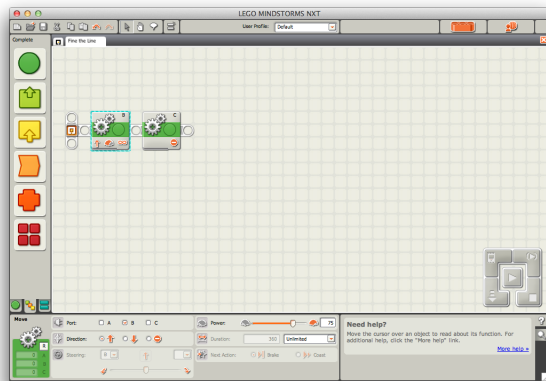
- First the students should think about moving in a circle to the right. In order to do this, they will need to activate the left motor, which is the motor connected to port B, and stop the right motor, which is the motor connected to port C. In order to do this, first students will need to navigate to the “Common” bar, which includes commonly used blocks, select a “Move” block, and drag it onto the Sequence Beam. The steps are shown below:



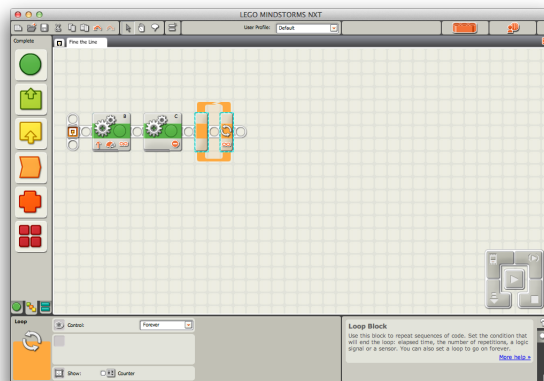
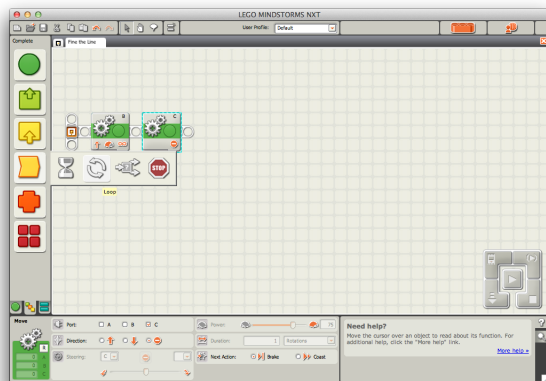
- This step should be done twice so that there are two motor blocks on the Sequence Beam:

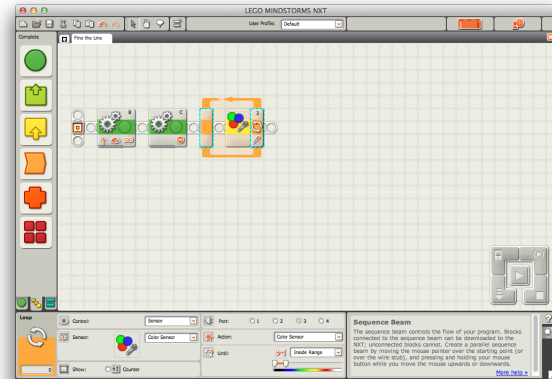
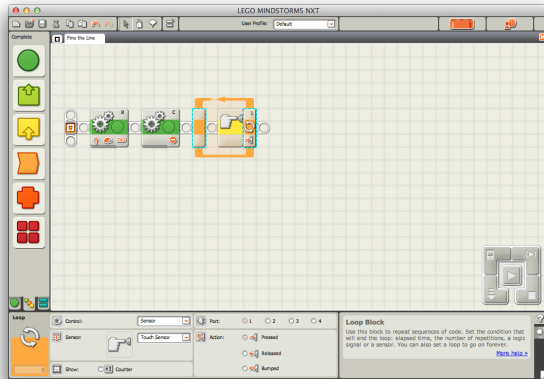


- Now students need to set the correct powers, directions, and durations to the two Motor Blocks. The first Move Block should set Motor B to Power 75 for an unlimited duration. The second Move Block should be set so that Motor C does not move. The properties of the first and second Move Blocks shown at the bottom of the screen should look like this:

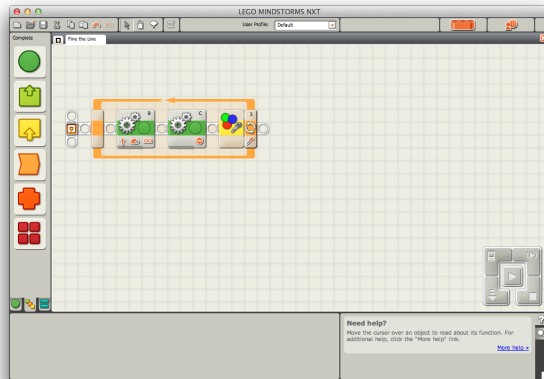


- Finally, students will need to include the Loop Block in order to loop until the robot sees black. In order to do this, they will need to navigate to the “Flow” bar, select a Loop Block, and drag the Loop Block onto the Sequence Beam. Then they will need to change the properties of the Loop Block by selecting “Sensor” from the “Control” drop-down bar and then selecting “Color Sensor” from the “Sensor” drop-down bar. The color range in the “Until” section of the Loop Block properties should be changed to include only black. These steps are shown below:





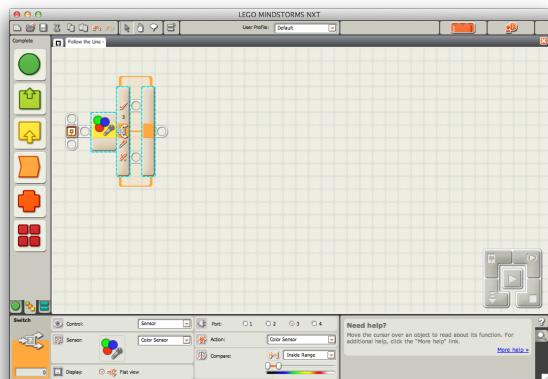
- In the final step, students need to drag both Motor Blocks into the Loop Block. The final code should look like this:



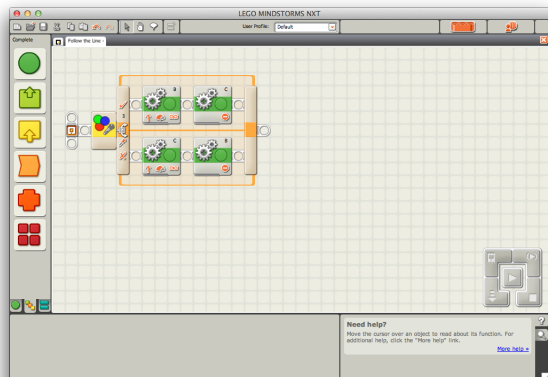
4.2 Following the Line

Students learned about the “Switch Block” at the beginning of this section of the lab, so the goal is for them to recognize that they can use one of the Switch Blocks to accomplish this task. The robot will follow the line on the left, so it will need to be positioned to the left of the black line when testing the code.

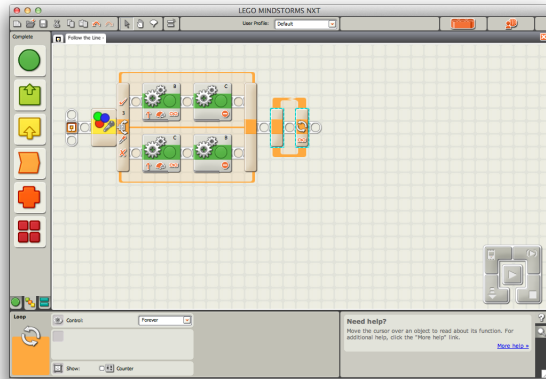
- Once students have made a new program, they will first need to choose a Switch Block from “Flow” bar and drag it onto the Sequence Beam. They need to change the properties of the Switch Block so that the “Compare” section of the properties checks if the robot senses black. At the end of this step, the code should look like this:



- Then they will need to enter Move Blocks into the Switch Block so that the robot moves left if it senses black and right if it senses white. Similar to the code from the “Find a Line” section of the lab, students will need to activate Motor B and stop Motor C to turn right, and they will need to activate Motor C and stop Motor B to turn left. At the end of this step, the code should look like this:



- Finally, the students will need to add in a Loop Block so that the robot checks which color it senses more than just one time. In this case the robot should follow the line without a stopping condition, so the students should leave the “Control” section of the Loop Block properties to be “Forever”. The end of this step will look like this:



- In the final step, students need to drag the entire Switch Block into the Loop Block. The final solution should look like this:

