NXT-G Lesson 1: Mastering the Turn
October 14, 2010

Description:
This lesson does not suppose any prior knowledge of the important icons, but does assume a basic understanding of NXT-G.

For the first meeting of the semester, students will participate in an icebreaker activity with mentors. After a round of introductions, groups will start off building the ‘full car model’—a basic mobile robot that can be constructed in 15 minutes. Ambitious groups should add a downward facing light sensor on the front of the robot. Once groups have constructed a robot they will be presented with a hallway containing a 90-degree turn, which groups must navigate. In order to precisely calculate the correct type of turn needed to navigate the course, groups will complete the attached worksheet detailing the difference between and point turn, curve turn, and pivot turn. Once students decide which type of turn is best for the course, they will write a program that displays the number of rotations made during the turn on the NXT screen. Groups will compare the actual amount (as displayed on the screen) to the expected amount (as calculated prior to testing).

Important icons and concepts:

![Displaying Sensor value](image1.png) ![Resetting sensor](image2.png)

Agenda:
4.00 – 4.15: Introductions and icebreaker activity
4.15 – 4.20: Explanation of activity
4.20 – 5.10: Group work: Building a robot, completing turn testing, print to display
5.10 – 5.15: Wrap up—video blogs
5.15 – 5.25: Discussion and Demonstration
5.25 – 5.30: Clean up

Part 1: Introductions and Icebreaker – 15 minutes

Take a minute or two to go around your group and make introductions. I suggest a game of two truths and a lie (each person takes a turn in the hot seat. The person
Part II: Group Work—Building a robot and completing turn testing.

Part II.1 – construction-- 15 minutes

Groups will start off with a LEGO NXT Education kit, as well as an Education Resource Kit. The basic ‘full car model’ requires minimal knowledge of LEGO robotics, and uses very few pieces. As such, it can be constructed in less than 15 minutes. Groups should follow the attached build guide in order to assemble the full car model. The image below shows what the mobile robot will look like once construction is complete.

Part II.2 – working with turns (worksheet part 1) -- 15 minutes

Once groups have constructed robots it’s time to work through two different turns, ultimately leading up to a specific 90-degree turn. Please see the corresponding handout for detailed instructions and explanations of the different types of turns.
Part II.3 – testing calculations (worksheet parts 2 and 3) – 20 minutes

Once students finish part one of the attached worksheet, it is time to test their theories. First, have students explore the display icon, located in the complete palette of NXT-G. With the display icon, programmers can print images, text, and even drawings on the NXT screen. For this lesson, groups will display the number of rotations each motor travels during a turn. This is useful for comparing the actual number of rotations to the expected, as calculated in part one of the worksheet.

Specifically, programmers need to reset the rotation sensor immediately before completing the turn, then convert the sensor value from a number into text (necessary for displaying to the LCD) and display it to the screen. Groups who finish early should display the ‘expected rotation’ value in addition to the ‘actual rotation’ value. This display algorithm becomes useful when students add code to make the robot complete point and pivot turns (section three of the worksheet).

Part III- Video blog wrap up – 5 minutes

Video blogs provide students an opportunity to talk about the day’s events. This is not intended to be a time for students to describe the lesson—rather they should discuss their experience with the lesson. It is important that students touch on the following topics while recording video blogs. This list should not limit the scope of the topics—rather it should be a road map to guide students through their 2-minute (ish) discussion.

   1.  What did and didn’t work with today’s lesson?
   2.  What did our group do well today?
   3.  What do we need to work on as a group?
   4.  What did we learn today that could be used in school?

Part IV—Discussion and Demo—10 minutes

This is an opportunity for all students to reconvene as a large group and discuss the lesson. Groups may choose to demonstrate their programs (some lessons are more conducive to group demonstrations than others, so it is not always mandatory or useful to require demos).
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<thead>
<tr>
<th></th>
<th>B</th>
<th>I</th>
<th>N</th>
<th>G</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Plays piano</td>
<td>Favorite color is duke blue</td>
<td>Has a cat</td>
<td>Can ride a unicycle</td>
<td>Read a new book this summer</td>
</tr>
<tr>
<td>I</td>
<td>Wants to study engineering in college</td>
<td>Has two or more siblings</td>
<td>FREE SPACE</td>
<td>Has a relative who works at UNC</td>
<td>Has used a film camera</td>
</tr>
<tr>
<td>N</td>
<td>Can name all of the Twilight characters</td>
<td>Has a relative who went UNC</td>
<td>Has a video on youtube.com</td>
<td>Was born outside of North Carolina</td>
<td>Is an only child</td>
</tr>
<tr>
<td>G</td>
<td>Rides horses</td>
<td>Can ride a bike with no hands</td>
<td>Was born in another country</td>
<td>Is on Twitter</td>
<td>Plays basketball</td>
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<tr>
<td>O</td>
<td>Has NOT read Harry Potter</td>
<td>Watched the 2010 World Cup and knows the final score of the final game</td>
<td>Can dunk a basketball</td>
<td>Middle and last names start with the same letter</td>
<td>Has never broken a bone</td>
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Model Description:

This is a simple, 2 motor car that can be built in less than 15 minutes using the NXT kit. Additionally, all front end setups (Section III) and sensor types can easily be added to this model. The following model displays the single front wheel front assembly.
These are the parts that you will need:
Step# 1

Attach a double black connector peg and a single black connector peg to both sides of the NXT. Connect the double peg vertically in the top most holes. The single peg should be connected in the middle horizontal hole. Your NXT should look like the below picture before moving on to the next step.
Step 2

Side View     Top View

Attach the motors (one per side) to the NXT using the double black connector pegs and the short black connector pegs attached to the NXT. The red dots in the side view identify which holes on the motor attach to the pegs. Your NXT should look like the below picture before moving on to the next step.

Note: The top connection of the double black connector peg is not connected to anything.
Step# 3

Take an 11-holed rounded beam and attach two short black connector pegs to the outside holes as seen in the red square. Connect the pegs to the back of each motor (as identified by the red dots) to further support the motors to the NXT. Your NXT should look like the below picture before moving on to the next step.
Step# 4

Assemble 2 rear wheel assemblies using a 6 stud axle, a wheel, and a hub. Attach one to each motor as seen below.
Step# 5

Take an L-beam and attach a black connector peg to the first and third hole on the smaller part of the L. Take a small L-beam and attach a black connector peg to the 1st and 3rd hole on the larger part of the L. In the 2nd hole between the 2 connector pegs on each L-beam, attach an extended black connector peg. Also attach a friction axle to the fourth hole on the small L-beam. Now attach 2 small L-beams to the protruding pins below the other L-beams. Attach a black connector peg to the second hole on the small part of the L. Now attach an axle joiner on each of the protruding connector pegs below the small L-beams. Then, align the wheel between 2 half bushings and slide the 5-axle through the axle joiners. Connect the front wheel assembly to the bottom of the NXT at the protruding connector pegs.
Step# 6 (Optional)

Insert a black connector peg into the 1st and 3rd holes of the 5-hole beam and an extended black connector peg into the 4th and 5th holes. Attach an axle joiner to the extended black connector pegs. Insert a friction axle into each hole of the axle joiners and attach the light sensor to the friction axles. Attach the light sensor to the car from Step #5. The 5-hole beam should connect to the top of the L-beam on the front wheel assembly.
Step# 7 (Optional)

Attach the two black connector pegs to the first and third holes of the touch sensor. Attach the touch sensor assembly to the car from Step #5. The sensor should attach to the top of the L-beam on the front wheel assembly.