Learning Coding and Math with RoboBlockly
Teaching Resource for Grade 6 Math Activities

Harry H. Cheng
UC Davis Center for Integrated Computing and STEM Education (C-STEM)
http://c-stem.ucdavis.edu
http://roboblockly.ucdavis.edu
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University of California-Davis

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Additional Contributor(s):
Kayce Mastrup
How to Use RoboBlockly Activities in your Classroom

What is the purpose of RoboBlockly?
In RoboBlockly, students program a robot using a user-friendly drag-and-drop method. Students will complete basic problem solving to move a robot or multiple robots.

RoboBlockly is built to allow students to work at their own pace, but in general each problem should take approximately 5 minutes to complete each activity. We encourage you to give students additional time if needed or make it clear that they don’t need to finish the entire set of activities during one class session.

General Computer Usage Requirements
Technology Requirements: Any modern browser on computers, laptops, tables, or smartphones with any type of operating system.

It is important to know that every browser functions differently. We encourage you to test RoboBlockly on the computers you will have students using before implementation. Please test out the following: audio and video streaming quality, default browser specific mechanisms for saving blocks and saving Ch code, etc. all so you are better able to support your students. Make sure that pop ups have been enabled on all computers.

You may wish to provide headphones or ask students to bring headphones to allow students to independently watch tutorial videos.

Prepare yourself
Go through the activities yourself so that you are familiar with what your students will be experiencing. The Teacher Resource Packet contains all the activities and solutions for the pathway. Please note that the activities build on previous activities in each pathways such that students may need to complete some or all activities prior to the activity selected.

1) Determine the purpose for students using RoboBlockly:
   - To support student learning in Math,
   - To support student learning in Computer Programming,
   - To support student learning in Robotics.

2) Based on your purpose, determine what additional resources your students will need for instruction. We do not recommend using RoboBlockly to introduce a mathematical concept but to rather use it for skill building or as a culminating performance task.
   Use as skill building: We recommend that you provide your students with a worksheet that includes important related definitions, work space, leading questions, etc. and encourage your students to refer to their class notes which cover these topics.
   Use as a culminating performance task: Carefully select which activity directly relates to the content you have taught, making note that the previous activities may be necessary to complete to build prior knowledge.

Prepare your students
Help students get excited about RoboBlockly by inspiring students and discussing how computer science impacts every part of our lives. As a class, list things that use code in everyday life, or discuss different ways technology impacts our lives etc.

When using RoboBlockly in class, first demonstrate to students how to navigate and use the RoboBlockly website. There are five Video Tutorials, along with a self-guided interactive non-video tutorial which should be used to help familiarize your students with the different functionalities of RoboBlockly. Helping students understand the functionality of RoboBlockly and which elements can be manipulated in which manners is very important to ensuring your students have full access to the content.
Pre-Requisite Skills

Math
We are currently developing a comprehensive wiring guide to assist you with your planning. Please refer to the Table of Contents Standard Mapping for a complete list of Common Core Grade 6 Math Standards addressed in the RoboBlockly activities.

Computer
- Basic computer skills:
  - Drag and drop using a mouse
  - Key boarding
  - Navigating a web browser
  - Zoom In/Out in a browser
  - Disabling or enabling pop-up windows
  - Adjusting volume for videos

Extension
Using hardwired robots, Linkbot Controller, RoboSim or Robot Controller to execute programs built in RoboBlockly.

All can be downloaded from the UC Davis C-STEM Center’s webpage: http://c-stem.ucdavis.edu/downloads/
# Table of Contents: Activity Description

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<th>CCSSM</th>
<th>Blocks Used</th>
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<td>6NS.6C</td>
<td>driveDistance</td>
</tr>
<tr>
<td></td>
<td>6.EE.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.EE.7</td>
<td></td>
</tr>
<tr>
<td>2. Modeling Multiplication &amp; Division on a Number Line</td>
<td>6NS.6C</td>
<td>driveDistance</td>
</tr>
<tr>
<td></td>
<td>6.EE.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.EE.7</td>
<td></td>
</tr>
<tr>
<td>3. Modeling Fractions &amp; Decimals on a Horizontal Number Line</td>
<td>6.NS.2</td>
<td>driveDistance</td>
</tr>
<tr>
<td></td>
<td>6.NS.6C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.EE.2</td>
<td></td>
</tr>
<tr>
<td>4. Graphing Distance vs. Time in the Coordinate Plane</td>
<td>6.EE.2c</td>
<td>setSpeed</td>
</tr>
<tr>
<td></td>
<td>6.EE.7</td>
<td>turn</td>
</tr>
<tr>
<td></td>
<td></td>
<td>driveDistance</td>
</tr>
<tr>
<td>5. Modeling Inequalities on a Vertical Number Line</td>
<td>6.NS.7a</td>
<td>trace</td>
</tr>
<tr>
<td></td>
<td></td>
<td>driveDistance</td>
</tr>
<tr>
<td>6. Modeling Inequalities on Horizontal Number line</td>
<td>6.NS.7a</td>
<td>trace</td>
</tr>
<tr>
<td></td>
<td></td>
<td>driveDistance</td>
</tr>
<tr>
<td>7. Geometry: Perimeter &amp; Area of Basic Shapes in Coordinate Plane</td>
<td>6.G.3</td>
<td>driveDistance</td>
</tr>
<tr>
<td></td>
<td>6.NS.8</td>
<td>turn</td>
</tr>
<tr>
<td></td>
<td></td>
<td>perimeter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>area</td>
</tr>
<tr>
<td>8. Geometry: Perimeter &amp; Area of Basic Shapes in Coordinate Plane</td>
<td>6.G.3</td>
<td>driveDistance</td>
</tr>
<tr>
<td></td>
<td>6.NS.8</td>
<td>turn</td>
</tr>
<tr>
<td></td>
<td></td>
<td>perimeter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>area</td>
</tr>
<tr>
<td></td>
<td>6.G.3</td>
<td>drivexyTo</td>
</tr>
<tr>
<td></td>
<td>6.NS.8</td>
<td>area</td>
</tr>
<tr>
<td>10. Geometry: Polygons in the Coordinate Plane</td>
<td>6.G.1</td>
<td>trace</td>
</tr>
<tr>
<td></td>
<td>6.G.3</td>
<td>drivexyTo</td>
</tr>
<tr>
<td></td>
<td>6.NS.8</td>
<td>perimeter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>area</td>
</tr>
</tbody>
</table>
## Standard Mapping

### Common Core State Standards for Mathematics – Grade 6

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>6.NS.2</strong></td>
<td>Fluently add, subtract, multiply and divide multi-digit decimals using the standard algorithm for each operation</td>
<td>3</td>
</tr>
<tr>
<td><strong>6.NS.6c</strong></td>
<td>Find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane.</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td><strong>6.NS.7a</strong></td>
<td>Interpret statements of inequality as statements about the relative position of two numbers on a number line diagram. For example, interpret -3 &gt; -7 as a statement that -3 is located to the right of -7 on a number line oriented from left to right.</td>
<td>5, 6</td>
</tr>
<tr>
<td><strong>6.NS.8</strong></td>
<td>Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.</td>
<td>7, 8, 9, 10</td>
</tr>
<tr>
<td><strong>6.EE.2</strong></td>
<td>Write, read and evaluate expressions in which letters stand for numbers.</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td><strong>6.EE.2c</strong></td>
<td>Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole-number exponents, in the conventional order where there are no parentheses to specify a particular order (Order of Operations).</td>
<td>4</td>
</tr>
<tr>
<td><strong>6.EE.7</strong></td>
<td>Solve real-world and mathematical problems by writing and solving equations for the form x + p = q and px = q for cases in which p, q, and x are all nonnegative rational numbers.</td>
<td>1, 2, 4</td>
</tr>
<tr>
<td><strong>6.G.1</strong></td>
<td>Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.</td>
<td>9, 10</td>
</tr>
<tr>
<td><strong>6.G.3</strong></td>
<td>Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems.</td>
<td>7, 8, 9, 10</td>
</tr>
</tbody>
</table>
# Table of Contents: Textbook to Activity Alignment

<table>
<thead>
<tr>
<th>Learning Robot Programming with Linkbot for the Absolute Beginner 5th Edition</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section 5.4 Move a Distance for a Two-Wheel Robot</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>Section 5.6 Turn Left and Turn Right</td>
<td>X X X X X X X X X</td>
</tr>
<tr>
<td>Section 10.1 Move a Linkbot-I in a Coordinate System</td>
<td>X X X</td>
</tr>
<tr>
<td>Section 10.3 Trace the Positions of a Linkbot-I</td>
<td>X X X X</td>
</tr>
</tbody>
</table>

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Table content extracted from the image.
### Activity #1 Modeling Addition & Subtraction on a Horizontal Number Line

**Common Core State Standards - Mathematics:**

- **6.NS.6c**: Find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane.

- **6.EE.2**: Write, read and evaluate expressions in which letters stand for numbers.

- **6.EE.7**: Solve real-world and mathematical problems by writing and solving equations for the form \(x + p = q\) and \(px = q\) for cases in which \(p, q,\) and \(x\) are all nonnegative rational numbers.

**Objective**: Students will be able to use RoboBlockly to apply their understanding of addition/subtraction with rational numbers to the coordinate plane in a visual representation.

**RoboBlockly Student Activity:**

<table>
<thead>
<tr>
<th>Initial Student Prompt</th>
<th>Addition, Subtraction, on a Horizontal Number Line: In this lesson, you will use a horizontal number line to model addition and subtraction of integers. You can uncheck “Show Robot” to view the distance on the number line.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Placed Blocks</td>
<td>![driveDistance(distance)](5 in)</td>
</tr>
<tr>
<td>Problem Statement</td>
<td>Drive the robot to (x = 5). Then, move the robot to (x = 11), have the robot end on (x = 3) on the number line.</td>
</tr>
<tr>
<td>Wrong Prompt</td>
<td>You did not get the robot to those two places. Please try again.</td>
</tr>
<tr>
<td>Hint</td>
<td>This problem is equal to (5 + _ = 11) and (11 - _ = 3). You can uncheck “Show Robot” to view the distance on the number line.</td>
</tr>
</tbody>
</table>
| Possible Solution in C | `#include <linkbot.h>`  
`CLinkbot1 robot;`  
`double radius = 1.75;`  

  `robot.driveDistance(5, radius);`  
  `robot.driveDistance(6, radius);`  
  `robot.driveDistance(-8, radius);` |
Activity #1 Modeling Addition & Subtraction on a Horizontal Number Line

Picture of solution in RoboBlockly

Location of solution for “Load Blocks” tab in RoboBlockly
   C-STEM Studio -> Teaching Resources -> TeachMath6 -> RoboBlocklySolution -> m1.xml

Student Mathematical Calculations
   Initial move to 5

   Then move to 11. Students need to subtract to find distance to travel 11 – 5 = 6

   Final move end on -3. Students need to subtract to find distance to travel 11 – 3 = 8 but since they are moving to the left they need to make it a negative 8.

C-STEM text alignment: Robot Programming with Linkbot for the Absolute Beginner, 5th edition
   a) Section 5.4 Move a Distance for a Two-Wheel Robot. (driveDistance block)
   b) Section 5.5 Number Line for Distance. (driveDistance block)
   c) Section 2.2 Connect Linkbots from a Computer – have students move a hardwired robot by generating the Ch code using “Save Ch” on RoboBlockly.
Activity #2 Modeling Multiplication & Division on a Number Line

Common Core State Standards - Mathematics:
6.NS.6c Find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane.

6.EE.2 Write, read and evaluate expressions in which letters stand for numbers.

6.EE.7 Solve real-world and mathematical problems by writing and solving equations for the form x + p = q and px = q for cases in which p, q, and x are all nonnegative rational numbers.

Objective: Students will be able to use RoboBlockly to apply their understanding of multiplication & division with rational numbers to the coordinate plane in a visual representation.

RoboBlockly Activity:

<table>
<thead>
<tr>
<th>Initial Student Prompt</th>
<th>Modeling Multiplication and Division on a Number Line: In this lesson, you will model multiplication and division of integers.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Placed Blocks</td>
<td><img src="driveDistance" alt="driveDistance(distance 3 in);" /></td>
</tr>
<tr>
<td>Problem Statement</td>
<td>Drive the robot to x = 3 on the number line. Then drive the robot forward 4 times that amount. Lastly, drive the robot backwards a third of the total distance travelled.</td>
</tr>
<tr>
<td>Wrong Prompt</td>
<td>You did not get the robot where it wanted to go. Please try again.</td>
</tr>
</tbody>
</table>
| Hint                   | Part 1 of the problem is 4*3 = ___  
                          | Part 2 of the problem is (4*3)÷ 3 = ___ |
| Possible Solution in Ch| `#include <linkbot.h>`  
                          `CLinkbot robot;`  
                          `double radius = 1.75;`  
                          `robot.driveDistance(3, radius);`  
                          `robot.driveDistance(12, radius);`  
                          `robot.driveDistance(-5, radius);` |
Activity #2 Modeling Multiplication & Division on a Number Line

Picture of solution in RoboBlockly

Location of Solution for “Load Blocks”
C-STEM Studio -> Teaching Resources -> TeachMath6-> RoboBlocklySolution-> m2.xml

Student Mathematical Calculations
Initial move to 3.

Then move 4 times that so students will need to multiply 4*3 = 12

Final move backwards 1/3 of total distance, students will need to calculate the total distance traveled, and divide by 3. To move backwards they will need to enter a negative number.

-\[\frac{12 + 3}{3} = -5\]

C-STEM text alignment: *Robot Programming with Linkbot for the Absolute Beginner, 5th edition*

a. Section 5.4 Move a Distance for a Two-Wheel Robot. (driveDistance block)
b. Section 5.5 Number Line for Distance. (driveDistance block)
c. Section 2.2 Connect Linkbots from a Computer – have students move a hardwired robot by generating the Ch code using “Save Ch” on RoboBlockly.
Activity #3 Modeling Fractions & Decimals on a Horizontal Number Line

Common Core State Standards - Mathematics:
6.NS.2 Fluently add, subtract, multiply and divide multi-digit decimals using the standard algorithm for each operation.

6.NS.6c Find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane.

6.EE.2 Write, read and evaluate expressions in which letters stand for numbers.

Objective: Students will be able to use RoboBlockly to apply their understanding of rational numbers – specifically fractions to the coordinate plane in a visual representation.

RoboBlockly Activity:

<table>
<thead>
<tr>
<th>Initial Student Prompt</th>
<th>Modeling Fractions and Decimals on a Horizontal Number Line. Use the driveDistance block to move the robot the indicated distance.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Placed Blocks</td>
<td>[driveDistance(distance 3.5 in);]</td>
</tr>
<tr>
<td>Problem Statement</td>
<td>Move the robot to $x = \frac{7}{2}$. Then move to $x = \frac{42}{5}$. Have the robot end at $x = 12.5$.</td>
</tr>
<tr>
<td>Wrong Prompt</td>
<td>The robot did not stop at the correct placed. Please try again.</td>
</tr>
<tr>
<td>Hint</td>
<td>This problem is equivalent to $\frac{7}{2} + _ = \frac{42}{5}$ and $\frac{42}{5} + _ = 12.5$.</td>
</tr>
</tbody>
</table>
| Possible Solution in Ch| ```c
#include <linkbot.h>
CLinkbotI robot;
  double radius = 1.75;

  robot.driveDistance(3.5, radius);
  robot.driveDistance(4.9, radius);
  robot.driveDistance(4.1, radius);
```
Activity #3 Modeling Fractions & Decimals on a Horizontal Number Line

Student Mathematical Calculations
Initial move, convert \( \frac{7}{2} \) to decimal \( \frac{7}{2} = 3.5 \)

Then move to \( \frac{42}{5} \), convert to decimal and subtract from initial move to find distance to travel.
\( \frac{42}{5} = 8.4 \) and \( 8.4 - 3.5 = 4.9 \). The robot is now at \( 3.5 + 4.9 = 8.4 \)

Final move. If the robot is to end on 12.5, subtract to find distance needed to travel
\( 12.5 - 8.4 = 4.1 \)

C-STEM text alignment: *Robot Programming with Linkbot for the Absolute Beginner, 5th edition*

a. Section 5.4 Move a Distance for a Two-Wheel Robot. (driveDistance block)
b. Section 5.5 Number Line for Distance. (driveDistance block)
c. Section 2.2 Connect Linkbots from a Computer – have students move a hardwired robot by generating the Ch code using “Save Ch” on RoboBlockly.
   OR if your students are ready
d. Chapter 4: Robot Simulation with RoboSim, all section. If you have already introduced hardwired robots, introduce RoboSim and have students generate the Ch code using “Save Ch” on RoboBlockly and run in RoboSim.
Activity #4 Graphing Distance vs. Time in the Coordinate Plane

Common Core State Standards - Mathematics:
6.EE.2c Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole-number exponents, in the conventional order where there are no parentheses to specify a particular order (Order of Operations).

6.EE.7 Solve real-world and mathematical problems by writing and solving equations of the form $x + p = q$ and $px = q$ for cases in which $p$, $q$, and $x$ are all nonnegative rational numbers.

Objective: Students will learn how to make the robot turn and apply their understanding of evaluating expressions at specific values to model 1) distance in the coordinate plane and 2) graphing an ordered pair in relation to driving the robot up/down and right/left.

RoboBlockly Activity:

<table>
<thead>
<tr>
<th>Initial Student Prompt</th>
<th>Turning Left/Right and the Coordinate Plane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use the turn block to move the robot both horizontally and vertically.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pre-Placed Blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>setSpeed(speed 1.5 in/sec);</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Problem Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>The robot travels at 1.5 units per second. Drive the robot right for 5 seconds and up for 4 seconds.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wrong Prompt</th>
</tr>
</thead>
<tbody>
<tr>
<td>I did not get to my destination. Please try again.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance = Speed * Time. To calculate the distance to drive the robot use $D = 5 * 1.5$ for the first movement. Then to calculate the second distance use $D = 4 * 1.5$.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Possible Solution in C#</th>
</tr>
</thead>
<tbody>
<tr>
<td>#include &lt;linkbot.h&gt;</td>
</tr>
<tr>
<td>CLinkbot! robot;</td>
</tr>
<tr>
<td>double radius = 1.75;</td>
</tr>
<tr>
<td>double trackwidth = 3.69;</td>
</tr>
</tbody>
</table>

```csharp
robot.setSpeed(1.5, radius);
robot.turnRight(90, radius, trackwidth);
robot.driveDistance(7.5, radius);
robot.turnLeft(90, radius, trackwidth);
robot.driveDistance(6, radius);
```
Activity #4 Graphing Distance vs. Time in the Coordinate Plane

Picture of solution in RoboBlockly

Location of Solution for “Load Blocks”
C-STEM Studio -> Teaching Resources -> TeachMath6 -> RoboBlocklySolution -> m4.xml

Student Mathematical Calculations
Students will need to use the formula Distance = Speed * Time

For the first move Speed = 1.5 and Time = 5  Distance = 1.5 * 5 = 7.5
For the second move Speed = 1.5 and Time = 4  Distance = 1.5 * 4 = 6

C-STEM text alignment: Robot Programming with Linkbot for the Absolute Beginner, 5th edition
a. Section 5.4 Move a Distance for a Two-Wheel Robot. (driveDistance block)
b. Section 5.6 Turn Left and Turn Right (turn block)
c. Section 9.1 Move a Two-Wheel Robot with the Specified Distance 9.1.1. (setSpeed block)

Extension: Have students use a hardwired robot or RoboSim to practice running their “Save Ch” blocks.
Activity #5 Modeling Inequalities on a Vertical Number Line

Common Core State Standards - Mathematics:
6.NS.7a Interpret statements of inequality as statements about the relative position of two numbers on a number line diagram. For example, interpret $-3 > -7$ as a statement that $-3$ is located to the right of $-7$ on a number line oriented from left to right.

Objective: Students will use RoboBlockly to model the solution set of the inequality $y > 3$. It is important to note that RoboBlockly cannot account for the appropriate “dot” used to indicate that 3 is not a solution to $y > 3$.

RoboBlockly Activity:

| Initial Student Prompt | Modeling Inequalities on a Number Line
An inequality is a relation between two values that are different. |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Placed Blocks</td>
<td><code>trace (Off !);</code></td>
</tr>
<tr>
<td>Problem Statement</td>
<td>Drive the robot to trace the solution set of $y &gt; 3$</td>
</tr>
<tr>
<td>Wrong Prompt</td>
<td>There isn’t a wrong prompt, rather students will be asked to “Check your answer with the image below.”</td>
</tr>
<tr>
<td></td>
<td>Check Your Answer</td>
</tr>
<tr>
<td></td>
<td>Check your solution with the answer below.</td>
</tr>
<tr>
<td></td>
<td>![Image of number line diagram]</td>
</tr>
<tr>
<td>Hint</td>
<td>The solution set to $y &gt; 3$ is all numbers on the $y$-axis that are greater than positive 3.</td>
</tr>
</tbody>
</table>
| Possible Solution in C | `#include <linkbot.h>`
`CLinkbot1 robot;`
`double radius = 1.75;` |
robot.traceOff();
robot.driveDistance(3, radius);
robot.traceOn();
robot.driveDistance(21, radius);
Activity #5 Modeling Inequalities on a Vertical Number Line

Picture of solution in RoboBlockly

Problem Statement:
Drive the robot to trace the solution set of \( y > 3 \).

Location of Solution for “Load Blocks”
C-STEM Studio -> Teaching Resources -> TeachMath6-> RoboBlocklySolution->m5.xml

Student Mathematical Calculations
Students will need to show the entire solution set for the graph provided. They will need to start their robot at 3 and drive it forward to 24 so they need to subtract \( 24 - 3 = 21 \) and drive a total distance of 21 units.

C-STEM text alignment: Robot Programming with Linkbot for the Absolute Beginner, 5th edition
a. Section 5.4 Move a Distance for a Two-Wheel Robot. (driveDistance block)
b. Section 10.3 Trace the Positions of a Linkbot-I. (traceOn and traceOff blocks)

Extension: Have students use a hardwired robot or RoboSim to practice running their “Save Ch” blocks.
Activity #6 Modeling Inequalities on a Horizontal Number Line

Common Core State Standards - Mathematics:
6.NS.7a Interpret statements of inequality as statements about the relative position of two numbers on a number line diagram. For example, interpret \(-3 > -7\) as a statement that \(-3\) is located to the right of \(-7\) on a number line oriented from left to right.

Objective: Students will use RoboBlockly to model the solution set of the inequality \(x < 7\). It is important to note that RoboBlockly cannot account for the appropriate “dot” used to indicate that \(7\) is not a solution to \(x < 7\).

RoboBlockly Activity:

<table>
<thead>
<tr>
<th>Initial Student Prompt</th>
<th>Modeling Inequalities on a Number Line</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>An inequalities is a relation between two values that are different.</td>
</tr>
</tbody>
</table>

| Pre-Placed Blocks       | trace (Off) (); |

| Problem Statement       | Drive the robot to trace the solution set of \(x < 7\) |

| Wrong Prompt            | No wrong prompt, students will be asked to “Check your answer with the image below.” |
| Check Your Answer        | |
|                         | |
|                         | Check your solution with the answer below. |

| Hint                    | The solution set for \(x < 7\) is all positive and negative numbers less than 7 on the x-axis. |

| Possible Solution in Ch in Ch | #include <linkbot.h> |
|                               | CLinkbotI robot;    |
|                               | double radius = 1.75; |
|                               | double trackwidth = 3.69; |
robot.traceOff();
robot.turnRight(90, radius, trackwidth);
robot.driveDistance(7, radius);
robot.traceOn();
robot.driveDistance(-19, radius);
Activity #6 Modeling Inequalities on a Horizontal Number Line

Picture of solution in RoboBlockly

![Picture of solution](image)

Problem Statement:
Drive the robot to trace the solution set of $x < 7$.

```xml
trace (Off - 0);
turn (Right = 1) (angle - 0°);
driveDistance (distance - \(-12\) in);
trace (On = 1);
driveDistance (distance - 7 in);
```

Location of Solution for “Load Blocks”
C-STEM Studio -> Teaching Resources -> TeachMath6-> RoboBlocklySolution -> m6.xml

Student Mathematical Calculations
Students will need to show the entire solution set for the graph provided. They will need to start their robot at 7 and drive it backwards to -12 so they need to subtract $7 - (-12) = 19$ but since they are driving backwards they will drive a distance of -19 units.

C-STEM text alignment: *Robot Programming with Linkbot for the Absolute Beginner, 5th edition*

a. Section 5.4 Move a Distance for a Two-Wheel Robot. (driveDistance block)
b. Section 5.6 Turn Left and Turn Right. (turn block)
c. Section 10.3 Trace the Positions of a Linkbot-I. (trace block)

Extension: Have students use a hardwired robot or RoboSim to practice running their “Save Ch” blocks.
Activity #7 Geometry: Perimeter & Area of Basic Shapes in Coordinate Plane

Common Core State Standards - Mathematics:
6.G.3 Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems.

6.NS. 8 Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.

Objective: Students will be able to use RoboBlockly to draw a square in the coordinate plane based on the definition of a square and given parameters. Students will then have to calculate the lengths of the sides to solve for the Perimeter and Area of the square.

RoboBlockly Activity:

| Initial Student Prompt | Calculating the Perimeter and Area of Squares  
A square is a shape with four equal sides and four equal angles. |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Placed Blocks</td>
<td>![Pre-Placed Blocks Image]</td>
</tr>
<tr>
<td>Problem Statement</td>
<td>Draw the square represented by points (0,0), (8,0), (0,8) and (8,8). Calculate the perimeter and area. Place the results in corresponding variables.</td>
</tr>
</tbody>
</table>
| Wrong Prompt            | You did not follow instructions properly.  
Please try again. |
| Hint                    | Perimeter is the distance around a shape. To calculate find the length of all the sides, then find their sum. (Perimeter formula: 2b + 2h) 
Area is space contained inside a two dimensional shape. To calculate, multiply the length by the height of the shape. (Area formula: b*h) |
| Possible Solution in C# | ```csharp
#include <linkbot.h>
double perimeter;
double area;
CLinkbotI robot;
double radius = 1.75;
double trackwidth = 3.69;

robot.driveDistance(8, radius);
robot.turnRight(90, radius, trackwidth);``` |
robot.driveDistance(8, radius);
robot.turnRight(90, radius, trackwidth);
robot.driveDistance(8, radius);
robot.turnRight(90, radius, trackwidth);
robot.driveDistance(8, radius);
perimeter = 32;
area = 64;
Activity #7  Geometry: Perimeter & Area of Basic Shapes in Coordinate Plane

Picture of solution in RoboBlockly

Location of Solution for “Load Blocks”
C-STEM Studio -> Teaching Resources -> TeachMath6 -> RoboBlocklySolution -> m7.xml

Student Mathematical Calculations

Students are not likely using the driveToxy function so they will need to find the location of the coordinate in the coordinate plane prior to graphing and calculate the distance the robot needs to travel by recognizing the change in either the x or y coordinate.

- (0, 0) to (8, 0)  distance to travel = 8
- (8, 0) to (8, 8)  distance to travel = 8
- (8, 8) to (0, 8)  distance to travel = 8
- (0, 8) to (0, 0)  distance to travel = 8

C-STEM text alignment:  
Robot Programming with Linkbot for the Absolute Beginner, 5th edition

- Section 5.4 Move a Distance for a Two-Wheel Robot. (driveDistance block)
- Section 5.6 Turn Left and Turn Right. (turn block)

Extension: Have students use a hardwired robot or RoboSim to practice running their “Save Ch” blocks.
Activity #8 Geometry: Perimeter & Area of Basic Shapes in Coordinate Plane

Common Core State Standards - Mathematics:
6.G.3 Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems.

6.NS.8 Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.

Objective: Students will be able to use RoboBlockly to draw a rectangle in the coordinate plane based on the definition of a rectangle and given parameters. Students will then have to calculate the lengths of the sides to solve for the Perimeter and Area of the rectangle.

RoboBlockly Activity:

<table>
<thead>
<tr>
<th>Initial Student Prompt</th>
<th>Calculating the Perimeter and Area of Rectangles. A rectangle is a shape with four equal angles. It has two pairs of congruent, opposite sides.</th>
</tr>
</thead>
</table>
| Pre-Placed Blocks      | set perimeter to 0  
                        set area to 0 |
| Problem Statement      | Draw the rectangle represented by points (0,0), (5,0), (0,11) and (5,11). Calculate the perimeter and area; place the results in corresponding variables. |
| Wrong Prompt           | You did not follow instructions properly. Please try again. |
| Hint                   | Perimeter is the distance around a shape. To calculate find the length of all the sides, then find their sum. (Perimeter formula: 2b + 2h)  
                        Area is space contained inside a two dimensional shape. To calculate, multiply the length by the height of the shape. (Area formula: b*h) |
| Possible Solution in C | #include <linkbot.h>  
                        double perimeter;  
                        double area;  
                        CLinkbotI robot;  
                        double radius = 1.75;  
                        double trackwidth = 3.69;  
                        robot.driveDistance(11, radius); |
robot.turnRight(90, radius, trackwidth);
robot.driveDistance(5, radius);
robot.turnRight(90, radius, trackwidth);
robot.driveDistance(11, radius);
robot.turnRight(90, radius, trackwidth);
robot.driveDistance(5, radius);
perimeter = 32;
area = 55;
Activity #8  Geometry: Perimeter & Area of Basic Shapes in Coordinate Plane

Picture of solution in RoboBlockly

Problem Statement:
Draw the rectangle represented by points (0,0), (5,0), (0,11) and (5,11). Calculate the perimeter and area; place the results in corresponding variables.

Location of Solution for “Load Blocks”
C-STEM Studio -> Teaching Resources -> TeachMath6 -> RoboBlocklySolution -> m8.xml

Student Mathematical Calculations
Students are not likely using the driveToxy function so they will need to find the location of the coordinate in the coordinate plane prior to graphing and calculate the distance the robot needs to travel by recognizing the change in either the x or y coordinate.

\[
\begin{align*}
(0,0) & \text{ to } (5,0) \quad \text{distance to travel} = 5 \\
(5,0) & \text{ to } (5,11) \quad \text{distance to travel} = 11 \\
(5,11) & \text{ to } (0,11) \quad \text{distance to travel} = 5 \\
(0,11) & \text{ to } (0,0) \quad \text{distance to travel} = 11
\end{align*}
\]

C-STEM text alignment: *Robot Programming with Linkbot for the Absolute Beginner, 5th edition*

a. Section 5.4 Move a Distance for a Two-Wheel Robot. (driveDistance block)

b. Section 5.6 Turn Left and Turn Right. (turn block)

Extension: Have students use a hardwired robot or RoboSim to practice running their “Save Ch” blocks.
Activity #9  Geometry: Perimeter & Area of Basic Shapes in Coordinate Plane

Common Core State Standards - Mathematics:
6.G.1 Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.

6.G.3 Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems.

6.NS.8 Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.

Objective: Students will be able to use RoboBlockly to draw a triangle in the coordinate plane based on the definition of a triangle and given parameters. Students will then have to calculate the lengths of the base and height to solve for the Area of the triangle.

RoboBlockly Activity:

<table>
<thead>
<tr>
<th>Initial Student Prompt</th>
<th>Calculating the Area of Triangles. A triangle is a shape with three sides.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Placed Blocks</td>
<td>![Set area to 0]</td>
</tr>
<tr>
<td>Problem Statement</td>
<td>Draw the triangle represented by points (3,0), (9,0), and (4,5). Calculate the area.</td>
</tr>
<tr>
<td>Wrong Prompt</td>
<td>You did not follow instructions properly. Please try again.</td>
</tr>
<tr>
<td>Hint</td>
<td>You can use rectangles to help you determine the area of a triangle or use the area formula ( A = \frac{1}{2} (b*h) )</td>
</tr>
</tbody>
</table>
| Possible Solution in C | `#include <linkbot.h>`  
  `double area;`  
  `CLinkbot1 robot;`  
  `double radius = 1.75;`  
  `double trackwidth = 3.69;`  
  `robot.traceOff();`  
  `robot.drivexyTo(3, 0, radius, trackwidth);`  
  `robot.traceOn();`  
  `robot.drivexyTo(9, 0, radius, trackwidth);`  
  `robot.drivexyTo(4, 5, radius, trackwidth);`  
  `robot.drivexyTo(3, 0, radius, trackwidth);`  
  `area = 15;` |
Activity #9 Geometry: Perimeter & Area of Basic Shapes in Coordinate Plane

Picture of solution in RoboBlockly

Location of Solution for “Load Blocks”
C-STEM Studio -> Teaching Resources ->TeachMath6->RoboBlocklySolution->m9.xml

Student Mathematical Calculations
To find the area of the triangle students can either: 1) Count out the height and base and use the area formula OR 2) Compose a rectangle around the triangle, find the area of the rectangle and divide it in half.

Method 1: triangle’s height = 5, base = 6 so, \( \frac{5 \times 6}{2} = 15 \) square units
Method 2: rectangle’s height = 5, length 6 so, \( \frac{5 \times 6}{2} = 15 \) square units

C-STEM text alignment: Robot Programming with Linkbot for the Absolute Beginner, 5th edition
a. Section 10.1 Move a Linkbot-I in a Coordinate System (drivexyTo block)
b. Section 10.3 Trace the Positions of a Linkbot-I. (trace block)

Extension: Have students use a hardwired robot or RoboSim to practice running their “Save Ch” blocks.
Activity #10 Geometry: Polygons in the Coordinate Plane

Common Core State Standards - Mathematics:
6.G.1 Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.

6.G.3 Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems.

6.NS.8 Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.

Objective: Students will plot the vertices of a polygon and use the robot to draw the shape. Students will then be able to calculate the length of each side to find the perimeter of the drawn polygon. Students will be able to calculate the area by composing into rectangles.

RoboBlockly Activity:

| Initial Student Prompt | Polygons in the coordinate plane
| A polygon is a plane shape (two-dimensional) with straight sides. Triangles, rectangles and squares are all types of polygons. |
| Pre-Placed Blocks | ![set perimeter to 0](set.png) set perimeter to 0; set area to 0 |
| Problem Statement | Draw the polygon represented by points (5,0), (5,12), (12, 12), (12, 4), (16,4), and (16,0). Calculate the perimeter and area of the polygon. |
| Wrong Prompt | You did not follow instructions properly. Please try again. |
| Hint | Perimeter is the sum of all of the side lengths of the polygon, it is the distance around the shape. To find the area of the polygon try to “divide” the shape into a rectangle and a square. |
| Possible Solution in Ch | ```c
#include <linkbot.h>
double perimeter;
double area;
CLinkbotI robot;
double radius = 1.75;
double trackwidth = 3.69;

robot.traceOff();
robot.drivexyTo(5, 0, radius, trackwidth);
``` |
robot.traceOn();
robot.drivexyTo(5, 12, radius, trackwidth);
robot.drivexyTo(12, 12, radius, trackwidth);
robot.drivexyTo(12, 4, radius, trackwidth);
robot.drivexyTo(16, 4, radius, trackwidth);
robot.drivexyTo(16, 0, radius, trackwidth);
robot.drivexyTo(5, 0, radius, trackwidth);
perimeter = 46;
area = 100;
Activity #10 Geometry: Polygons in the Coordinate Plane

Student Mathematical Calculations

**Perimeter:** Students will need to count to find the lengths of all the sides of the polygon and find their sum: \(12 + 7 + 8 + 4 + 4 + 11 = 46\) units

**Area:** Students will need to compose the polygon into either: a 7 by 12 rectangle and a 4 by 4 square OR a 4 by 12 rectangle and a 7 by 8 rectangle. They will then need to calculate the area of each shape and find their sum.

- **Method 1:** \((7 \times 12) + (4 \times 4) = 84 + 16 = 100\) square units
- **Method 2:** \((4 \times 11) + (7 \times 8) = 44 + 56 = 100\) square units

C-STEM text alignment: *Robot Programming with Linkbot for the Absolute Beginner, 5th edition*

- a. Section 10.1 Move a Linkbot-I in a Coordinate System (drivexyTo block)
- b. Section 10.3 Trace the Positions of a Linkbot-I. (trace block)

**Extension:** Have students use a hardwired robot or RoboSim to practice running their “Save Ch” blocks.