Move Steering – Part 1

– How the Steering Setting Determines Wheel Rotations –

Considerations for Robotics Task

Learning Goal

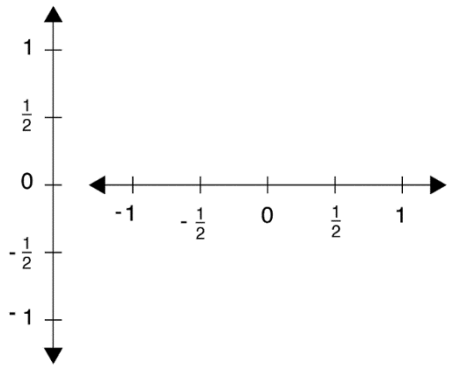
The learning goal of Part 1 is to describe and model how the steering setting of the <Move> Programming Block determines the rotations of the left and right robot wheel. The directionality of the wheel rotations helps students gain a spatial sense of positive and negative numbers.

Mathematical Engagement

Student engage in **observation** and **data collection**, **interpretation of data**, as well as the use of **negative numbers** and **fractions**. Integers are not yet introduced in Grade 4, but we believe that Canada's cold weather provides prior experiences of negative numbers (e.g., -10^{o} Celsius means cold). Note that the wheels' motions can be represented intuitively using a **number line**, where increasing positive numbers mean forward movement, and negative numbers symbolize backward movement.

Using a positive number of wheel rotations in the <Move> Programming Block corresponds to forward motion and vice versa for negative numbers. A brief explanation of these motions and positive and negative numbers using a number line can be grasped quickly. To reinforce and scaffold **spatial understandings of numbers**, it can be useful to provide **a vertical and horizontal number line representation** of the fractions to help students visualize number as position or location (see Figure below).

Vertical and Horizontal Number Line to Scaffold and Reinforce Spatial Understandings of Number



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Teaching Suggestions

We noticed that it might be helpful to show students how to save their files before getting started, so no programs get lost.

More detailed instructions for this part of the task can be found on the recording (see below). The students observe and record the direction and amount of wheel rotations according to different steering setting in the <Move> Programming Block, i.e., -100, -75, -50, -25, 0, 25, 50, 75, and 100.

To observe and record the wheel rotations, we suggest holding **the robot above the ground** and line up the arrow-like wheel holder each time.

Materials Needed

- Lego Mindstorms EV3 **robot**
- Lego Mindstorms Education EV3 classroom **software**
- **Recording Sheet** for Part 1, available at http://stem-education.ca/files/SteeringRecordingsheet_2020Part1.pdf (a version with the older EV3 Education program is available here: http://stem-education.ca/files/SteeringRecordingsheet-oldEV3_2020.pdf)

Instructions, Steps and Programming for Part 1

Please find a printable version of the Recording Sheet for Part 1 at http://stem-education.ca/files/SteeringRecordingsheet_2020Part1.pdf

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Assessment of Student Understanding

Indicators of Student Understanding

In this part, students measure the rotation of the wheels, record the direction along with positive and negative numbers (spatial understanding of number), order fractions and whole numbers (extend understanding of fraction equivalence and ordering), represent data, and find patterns and structures for interpretation. Students may start to recognize the **pattern** quite quickly. It is symmetrical around 0: The robot turns clockwise with positive steering and counterclockwise with negative steering. Also, the amount of rotations for the left and right wheel is reversed. You may want to encourage students to predict the pattern before they test their ideas using the robot.

Assessment of Student Understanding

Students demonstrate understanding of Part 1 when they can **articulate/explain the relationship between negative and positive steering setting and** subsequent positive and negative **left and right wheel rotations**. For example, a steering setting of 25 moves the right wheel ½ rotation forward and the left wheel 1 rotation forward.
Please also see the second column of our summary table for an overview of steering settings and associated amount and direction of wheel rotations.

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