

Presenter's Packet

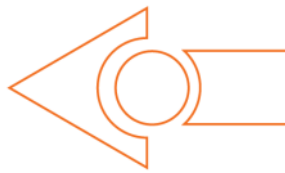
Lesson 1 Worksheet 1.2 - Barcode programming

Reading the barcode

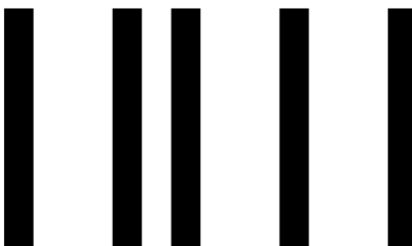
1. Place Edison facing the barcode on the right side
2. Press the record (round) button 3 times
3. Edison will drive forward and scan the barcode



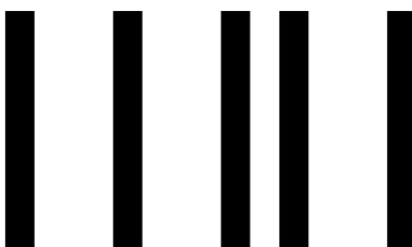
Barcode - Clap controlled driving



Barcode – Avoid obstacles



Barcode – Line tracking



Barcode – Follow torch



Describe the actions that the robot takes and why for each barcode

[illegible]

Presenter's Packet

Background

1. Introductions and Goals

- Self
- Amity Introduction on Student Competition Event(s)
- Getting students interested in programming using robots

2. Edison Demo

- Demo what the Edison can do with barcodes
 - i. **Follow Line**
 - ii. **Bounce in Borders**
 - iii. **Clap Controlled driving**
- Show students what the Edison can do to get them interested. Programming is boring if you don't know why you are doing it or what you can do with it.
- Barcodes let the Edison scan a specific program and run it.
- The barcodes are cool for demonstrating what the robot can do, but aren't really programming. The students will learn how to recreate some of the tasks the barcodes do, but students will be using EdWare programming instead. More on that later.

3. First, what does the Edison Look Like? What can it do?

- See pictures and schematics
- **Take input (Use sensors to sense something):**
 - i. Detect obstacles on front, left, or right.
 - ii. Pause programming until an event happens or until a set amount of time passes. Use this to tell Edison how long to drive forward, or turn, etc.
 - iii. Detect Clap
 - iv. Determine when the robot is on reflective (white) or a non-reflective (black) surface. This allows the Edison to follow a line
- **Send an Output (Do something in response to anything):**
 - i. Control Two Independent Motors to Drive forward/backward/turn with different speeds
 - ii. Play Sounds/Songs (a single note or several notes in succession). Songs are limited to about 16 notes at a time
 - iii. Flash LED (lights)
 - iv. Change variables in its memory, do basic math and number comparisons

4. **How you can combine Edison capabilities to do many things:**

Edison can use a combination of its sensors and its internal clock to accomplish many things. For example, you can program the robot to bounce in between the borders of a black line square by using an “if” statement to turn around by some number of degrees (determined by the speed and time the motors will rotate) if it sees the non-reflective (black) line and to drive forward if it doesn’t see the line.

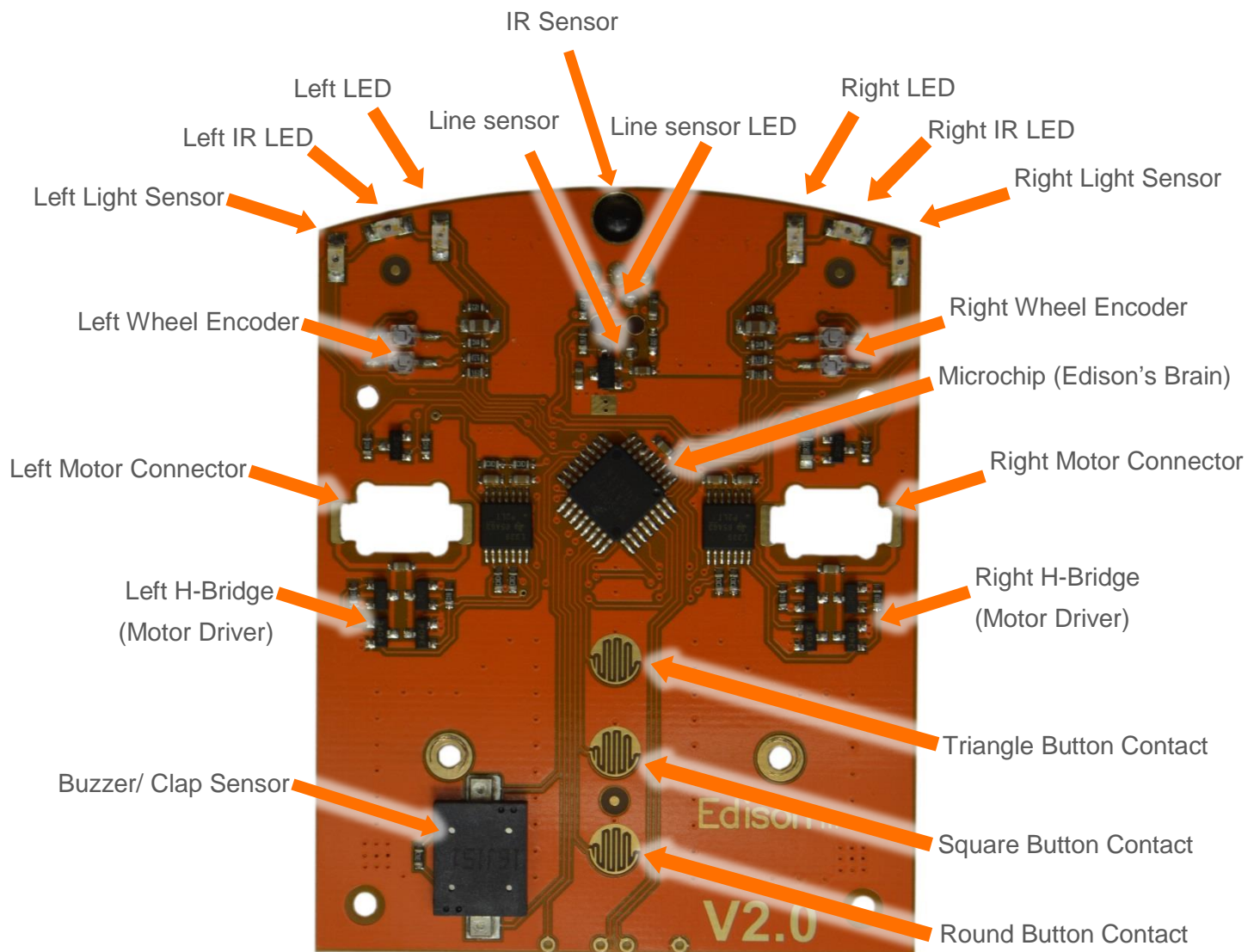
A few examples:

- Bounce in between borders of dark lines
- Play a song when it passes an obstacle or hears a clap
- Follow a line until it sees an obstacle, then turn around and follow the line the other way
- Speed up when it passes an obstacle or when you clap
- Go around a track a certain number of times
- Follow a line and change directions when you clap.

5. **Getting Started with Edison**

- EdWare Lesson Plans has excellent introductory information. We will be going over some of their lessons. The full collection is available at the following website
 - i. <https://meetedison.com/wp-content/uploads/2015/04/Your-EdVenture-into-Robotics-10-Lesson-Plans.pdf>
- I will be interactively working through some of these activities with you, giving you the chance to try out the programs with the Edison robot.
- It's important to know that programming is an interactive processes, requiring frequent troubleshooting. It takes time to develop the logic.
- I'll be asking a few conceptual concepts as we go throughout the session. Feel free to discuss ideas with the people around you
- Lets start by taking a look at the edison robot.

Motherboard layout

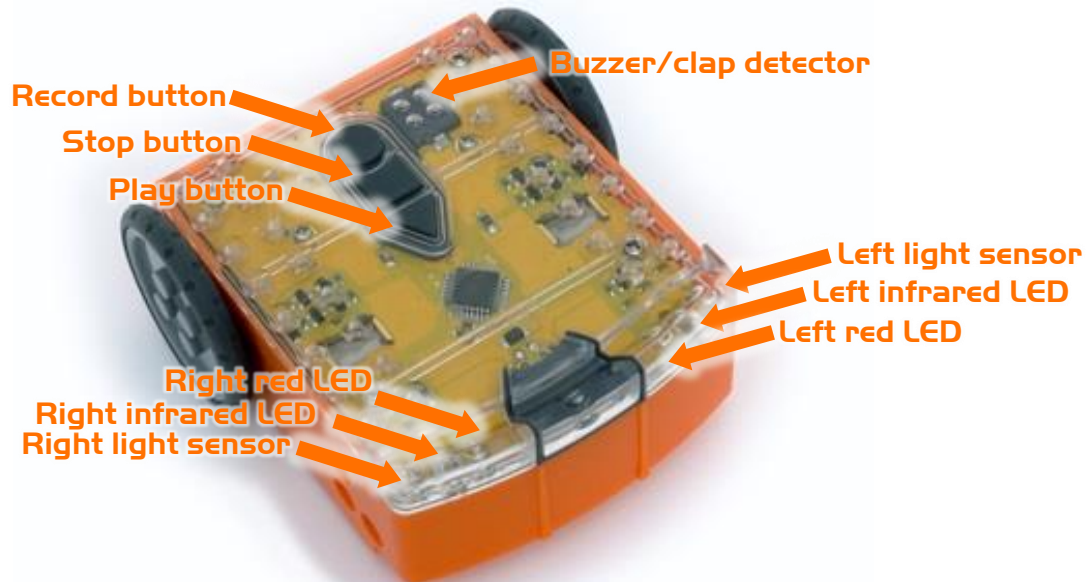


Name: _____

Lesson 1 Worksheet 1.1 – Meet Edison

Edison is a small programmable robot that is compatible with LEGO products.

Edison uses sensors and motors to interact with the world. In the images below you can see Edison's sensors, buttons and switches.



Get to know Edison's sensors and buttons

Play button – Start program

Stop button – Press to stop a program

Record button – 1 press = download program, 3 presses = read barcode



Edison's power switch and line tracking sensor

Edison's line tracking sensor is made up of two parts a red LED light and a light sensor.

The line tracking sensor also reads special barcodes that activate pre-installed programs.

The EdComm cable is used to download your programs to Edison. It connects into the headphone socket on your computer or tablet.



EdComm programming cable

LESSON 1: GET FAMILIAR AND SET UP

Technology skills – Students familiarise themselves with the programming environment and how to download a program to the robot.

Before we can use Edison we need to get a few things ready.

Get Edison ready



Ensure the batteries are the right way

Open the battery compartment and remove the programming cable. Now insert 4 'AAA' batteries. Refer to the image to ensure that the batteries are the correct way around and clip the battery cover on.

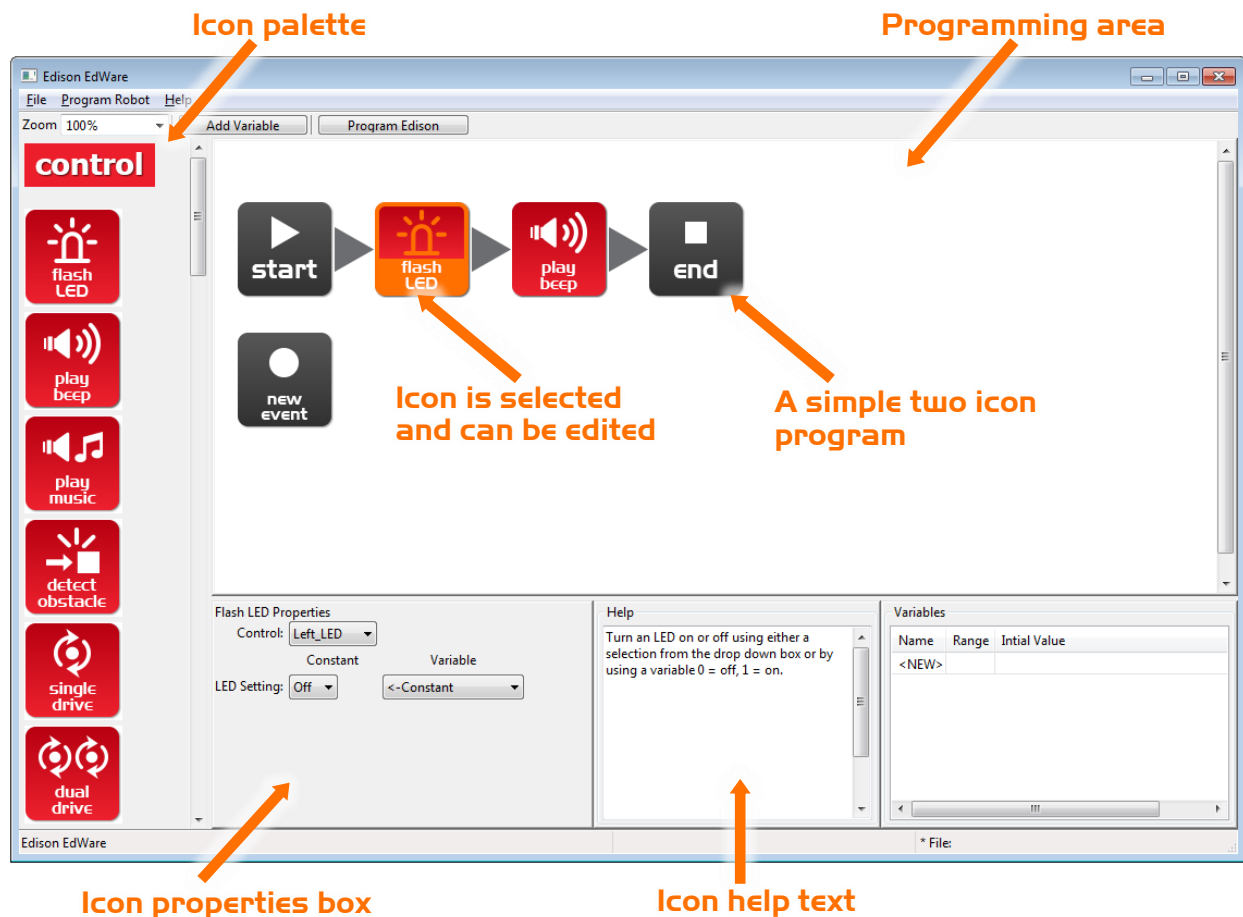
Turn Edison on by sliding the power switch to the on position. Edison's red LED lights will now start flashing. Edison is ready to go!



Push the switch towards the on symbol

EdWare Introduction

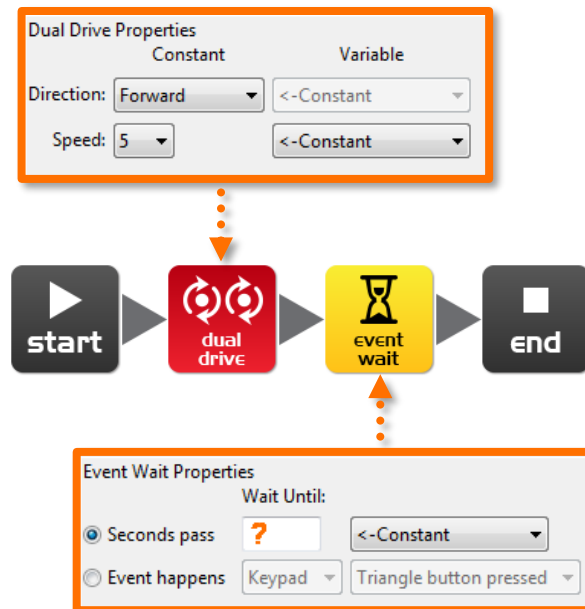
- Click and drag blocks from control into the programming area
- Drag out of line to delete
- New Event block won't be super useful for right now
- Click on blocks to see options and a description
- Save programs on the menu



Name: _____

Lesson 2 Worksheet 2.1 – Drive the robot forward

Write the following program to drive the Edison robot forward.



This is what a program looks like. Edison looks at each icon one at a time and does what the icon says. The arrows show the direction that Edison reads the icons.

Connect the EdComm cable to the headphone socket on the computer or tablet and **turn up the volume to full**. Plug the other end of the EdComm cable into Edison as shown.



To download the test program follow these steps:

1. Press Edison's record (round) button once
2. In EdWare press the 'Program Edison' button and then 'Start Download'
3. Remove the cable from the Edison and put the Edison upright
4. Press Edison's play (triangle) button to start the program

The robot reads each icon one by one and in the sequence shown by the arrows. Each icon tells the robot what to do.

The program goes from the computer/tablet through the cable to the Edison robot. The cable converts the sounds from the headphone jack into light, which the robot receives and stores the program in its memory.

Try out the program.

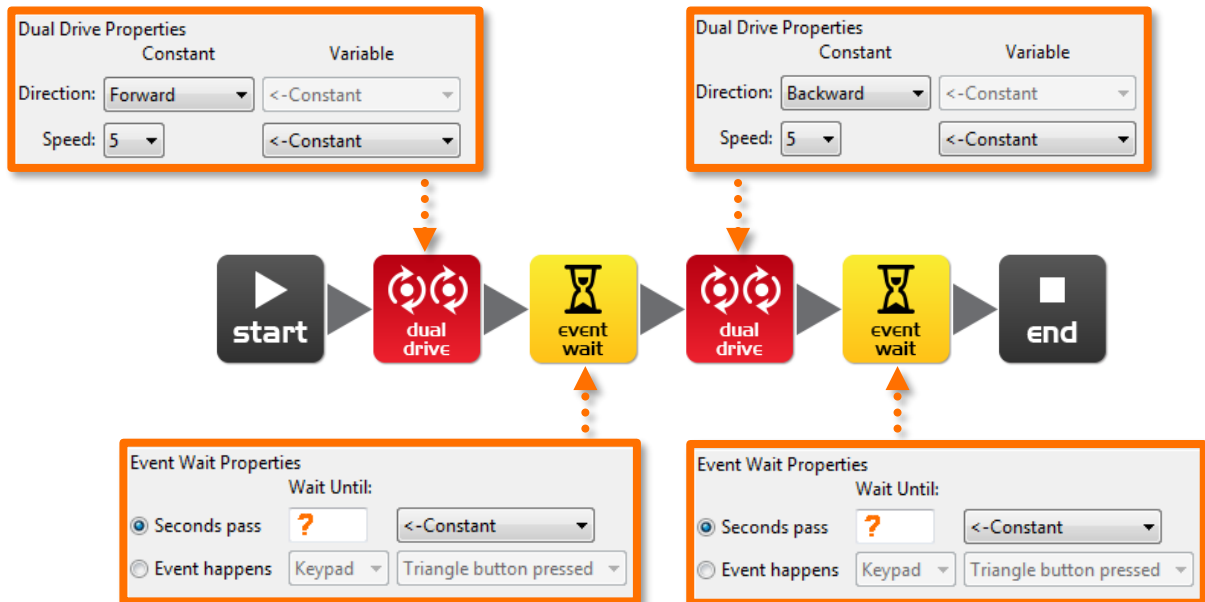
Leading Questions:

- **What would happen without the event wait block? Why? Try it.**

Name: _____

Lesson 2 Worksheet 2.3 – Forward and then backward

Write the following program to drive the Edison robot forward and then backward.



Set the 'Seconds pass' (replace?) to an amount of **time** in seconds to have the robot drive forward and then backward.

Minimum amount of time is 0.01 seconds.

Maximum amount of time is 327.67 seconds.

Name: _____

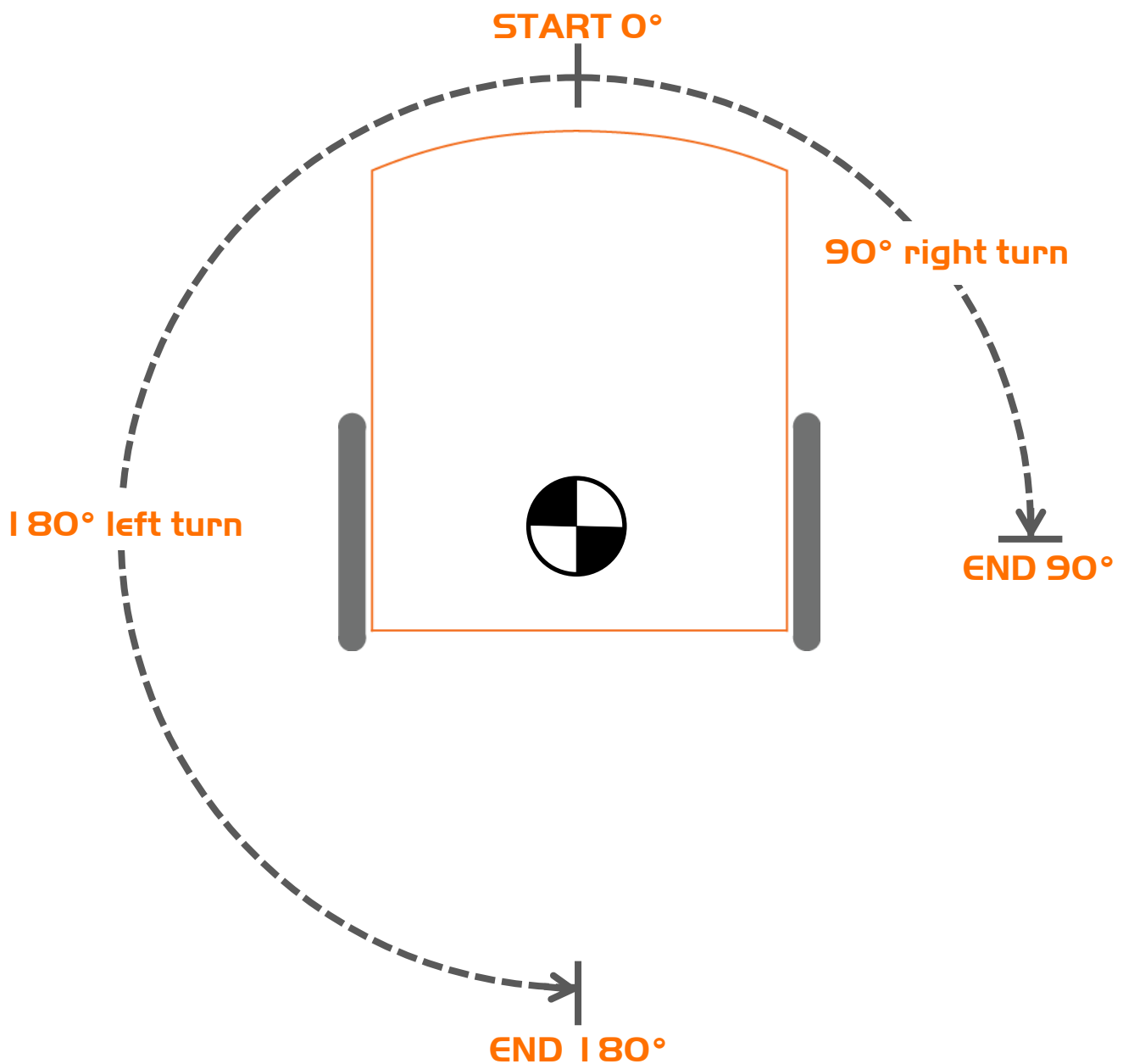
Lesson 3 Activity sheet 3.1 – Turning

Place the robot down as per the outline then play your turning program. Your robot should:

Program 1 – Turn right from start 0° to end 90°

Program 2 – Turn left from start 0° to end 180°

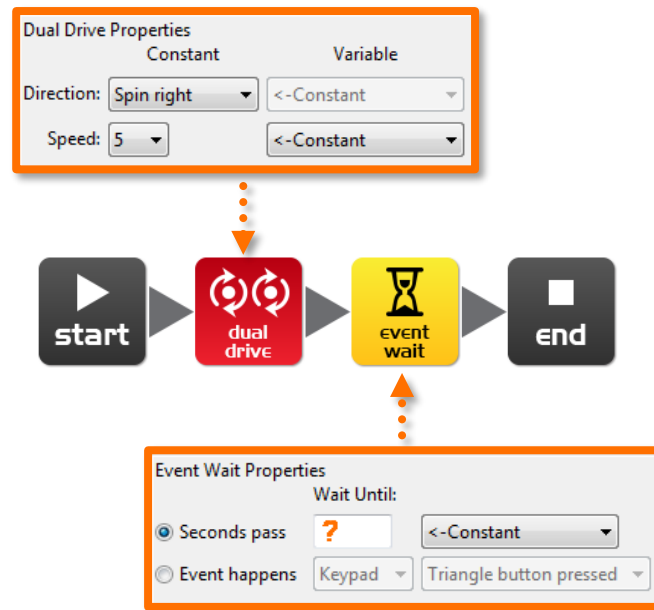
Program 3 – Turn right from start 0° to end 90° , then turn left 270° to end 180°



Name: _____

Lesson 3 Worksheet 3.1 – Right turn 90 degrees

Write the following program to turn the Edison robot right 90 degrees (90°). Use Activity sheet 3.1 or marked lines on a desk as start and stop markers.



Remember - Students will likely be required to do this same process during any sort of competition.

Try different amounts of time until your robot turns right from the start point to the end point.

What is the correct amount of time to get your robot to turn 90°?

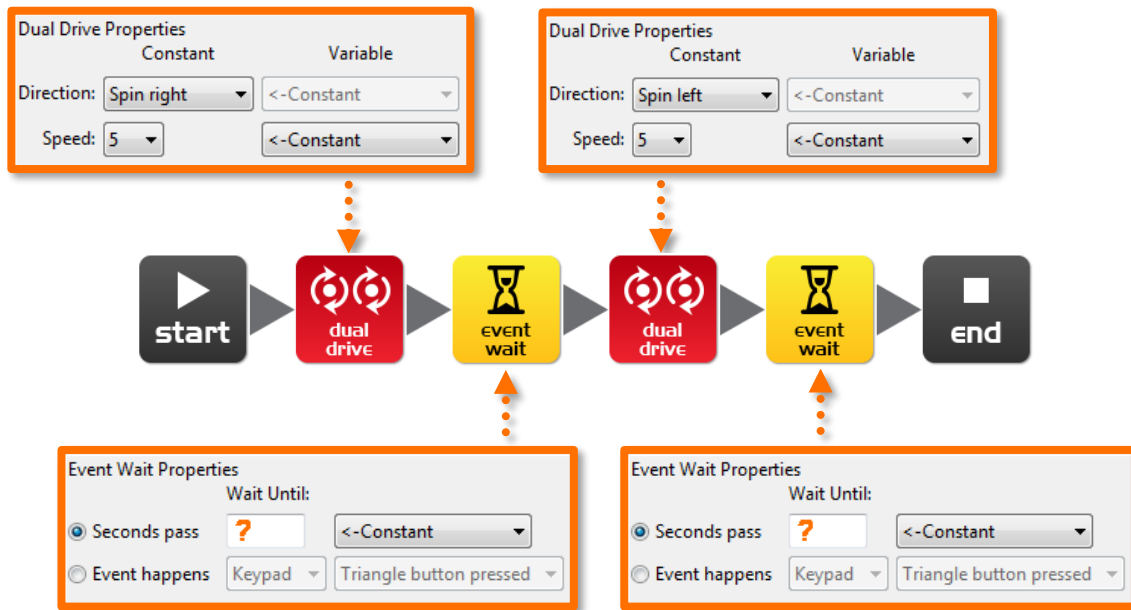
Leading Questions:

- How would the surface the robot is driving on affect the time needed to turn 90 degrees?

Name: _____

Lesson 3 Worksheet 3.3 – Right turn, then left turn

Write the following program to turn the Edison robot right 90 degrees (90°) and then left 180 degrees (180°). Use Activity sheet 3.1 or marked lines on a desk as start and stop markers.



Set the 'Seconds pass' (replace **?**) to an amount of time in seconds to have the robot turn right exactly 90° and then left 270° (90° + 180°) degrees.

Try different amounts of time until your robot turns 90° right from the start point to the end point and then left 270° to the bottom end point.

What is the correct amount of time to get your robot to turn 90°, then 270°?

90°: _____, 270°: _____

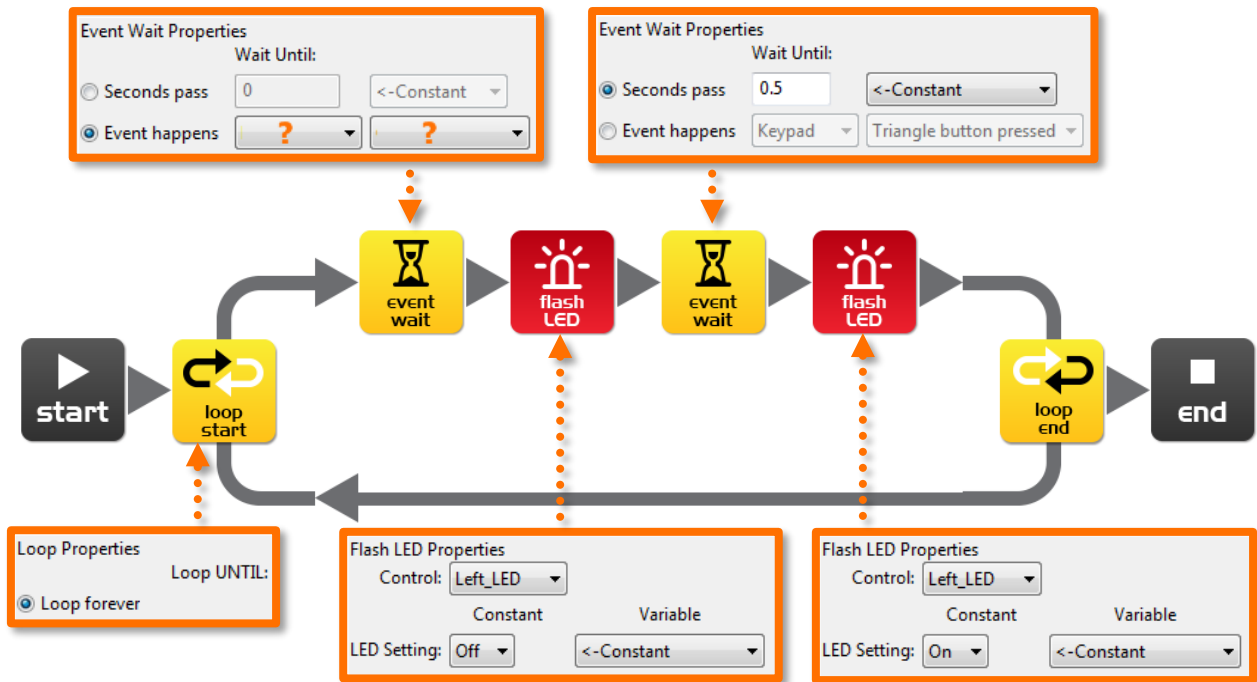
Leading questions:

- Why might it be useful to have the robot spin around so much?
 - Remember, many of the sensors are only on the front of the robot
 - Looking for a line with the line tracker. More on that later.

Name: _____

Lesson 6 Worksheet 6.1 – Flash LED in response to clap

Write the following program to have the Edison robot flash the left LED in response to a loud sound such as a clap.



This time, we wait until an event happens instead of waiting a certain amount of time

Within the first event wait icon's properties box select the 'Event happens' radio button and then select the event type you think is required to respond to a clap.

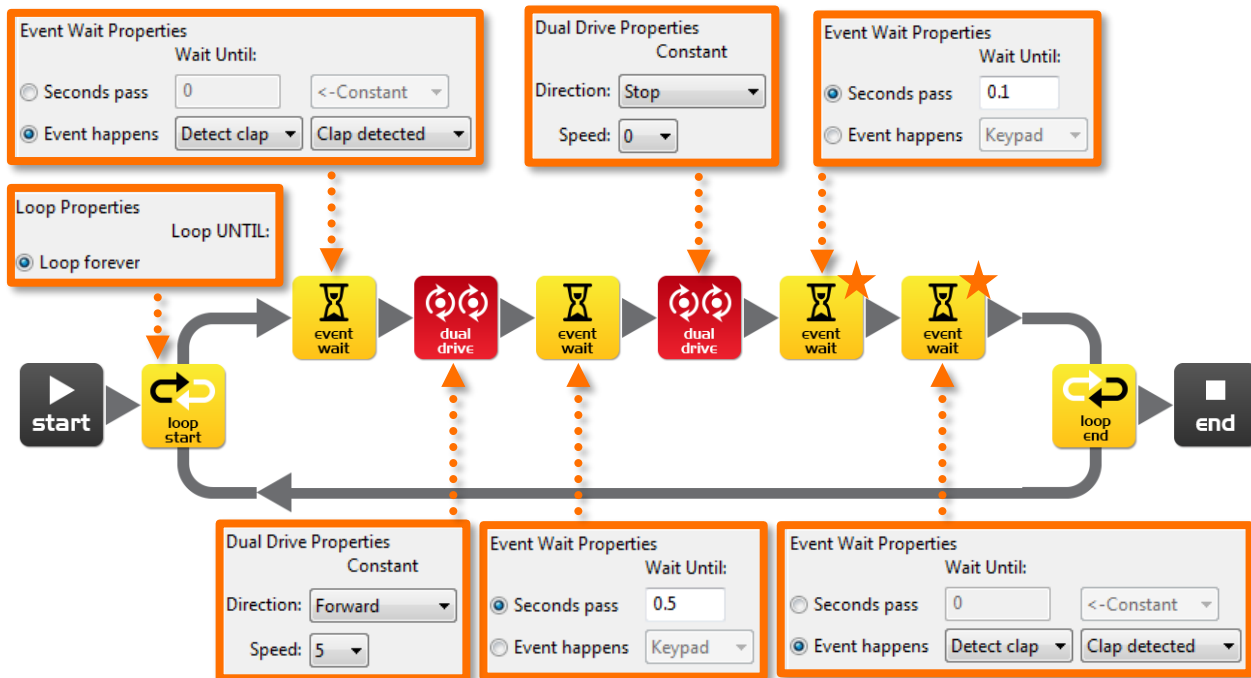
Leading Questions:

- What is the purpose of the loop icons in this program?
- What would happen if the loop wasn't there?

Name: _____

Lesson 6 Worksheet 6.2 – Drive in response to a clap

Write the following program to have the Edison robot drive forward in response to a clap.



The Edison robot's sound sensor is not just sensitive to claps, but can also respond to any loud sound. This includes the robot's motors, gears and wheels, which also make sound as they turn. To prevent the sound of the robot driving from triggering the sound sensor there are two additional icons used in this program and are marked above with orange stars. The first event wait icon is set to 0.1 seconds and gives the robot's motors time to stop. The second event wait icon is set to wait for a clap and will allow the program to continue, because it will have detected the sound of the motors.

You will need to use these two icons after stopping the motors if you are using the clap sensor.

Leading Questions:

- Do you think the robot should try to detect a clap when driving?

Name: _____

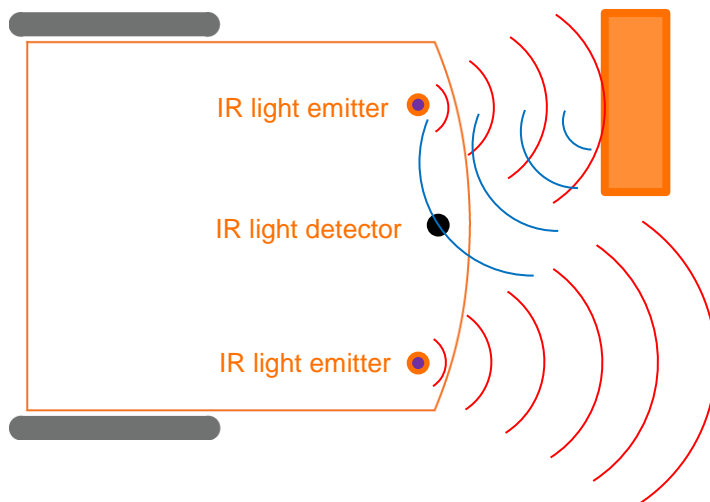
Lesson 7 Worksheet 7.1 – Infrared obstacle detection

The Edison robot is equipped with infrared (IR) 'vision'. IR light is not visible to the human eye, so you can't see this light, but it allows Edison to 'see' in the dark.

For Edison to detect obstacles IR light is emitted forward from the left and right side of the robot. If the IR light is reflected off an obstacle such as a wall, then the reflected light is detected by Edison's single IR detector. The IR detector is in the front centre of the robot.

In the illustration below there is an obstacle to Edison's left, so only IR light from the left emitter is reflected. From the received signal Edison can determine that there is an obstacle to the left, but no obstacle to the right.

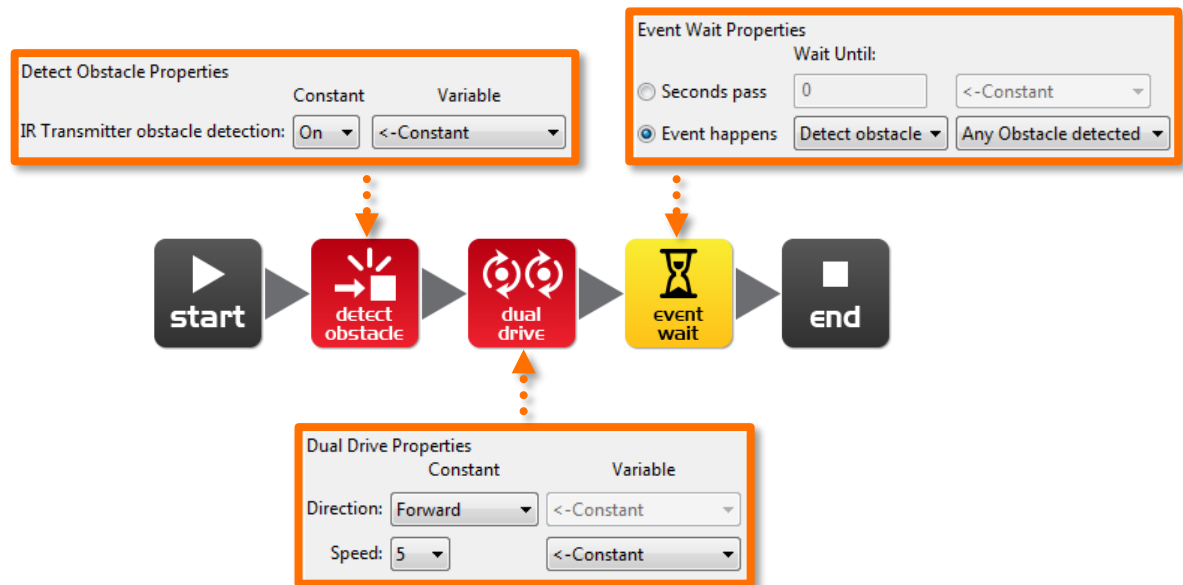
Emitted IR light is shown in red and reflected IR light is shown in blue.



Name: _____

Lesson 7 Worksheet 7.2 – Detect obstacle and stop

Write the following program to have the Edison robot drive until it encounters an obstacle.



The red (control group) detect obstacle icon is required to turn the obstacle detection system on and starts the IR light emitters.

The dual drive speed is set to 5 to allow the robot to detect an obstacle before colliding with it. If the speed is too fast then the robot will crash into obstacles.

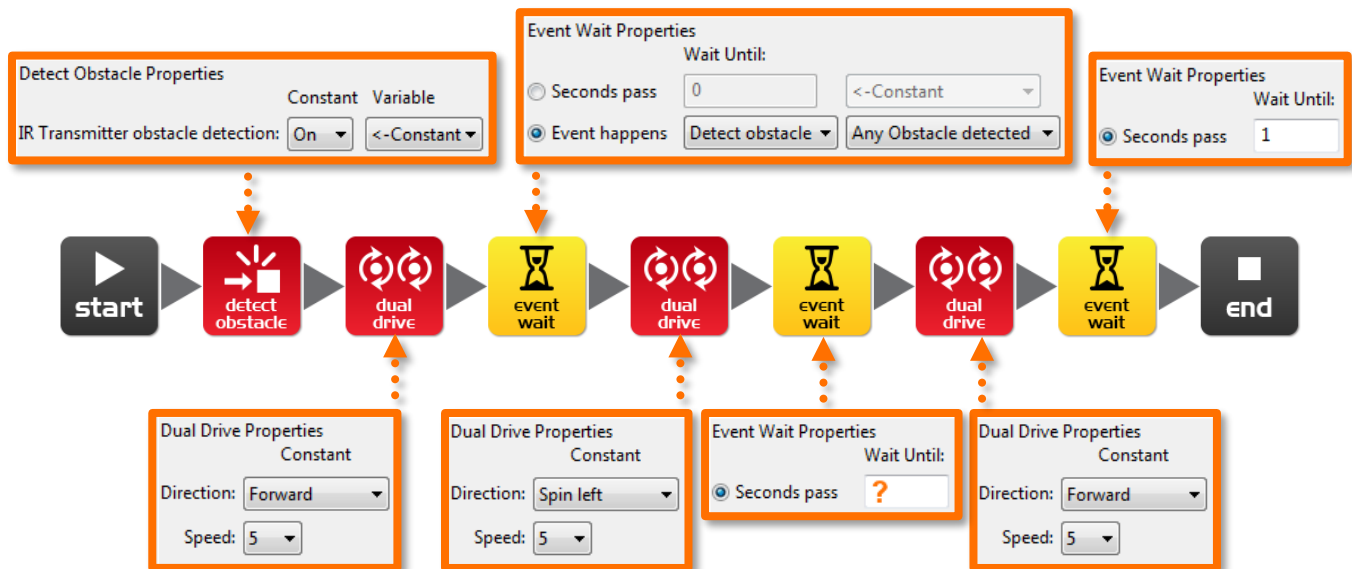
Leading Questions:

- What happens if the "detect obstacle" block is removed from the beginning of the program?

Name: _____

Lesson 7 Worksheet 7.3 – Detect obstacle and avoid

Write the following program to have the Edison robot drive until it encounters an obstacle, then turn 180° and drive for 1 second away from the obstacle.



In lesson 3 (Worksheet 3.2), you found the right amount of time to have the robot to turn 180°. Use this time again where indicated above by the orange question mark (?).

Leading Questions:

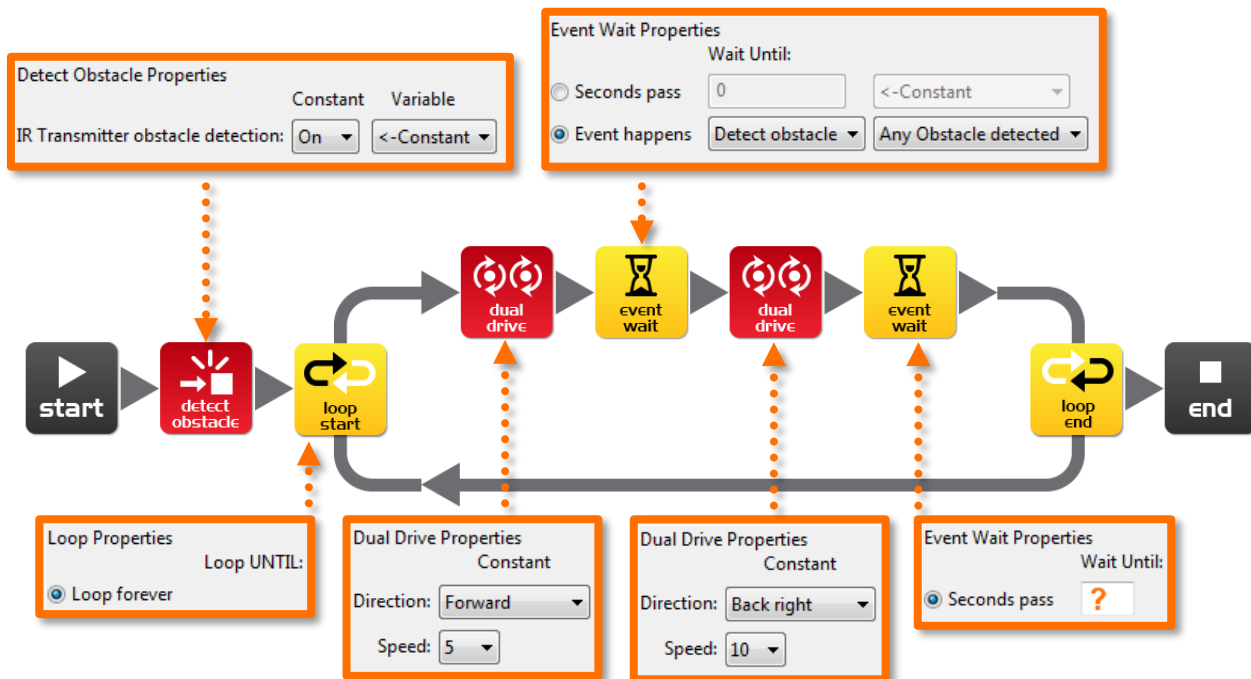
- What if we wanted to have the robot continuously drive around and avoid obstacles?

○

Name: _____

Lesson 7 Worksheet 7.4 – Obstacle avoidance

Write the following program to have the Edison robot continuously drive avoiding obstacles.



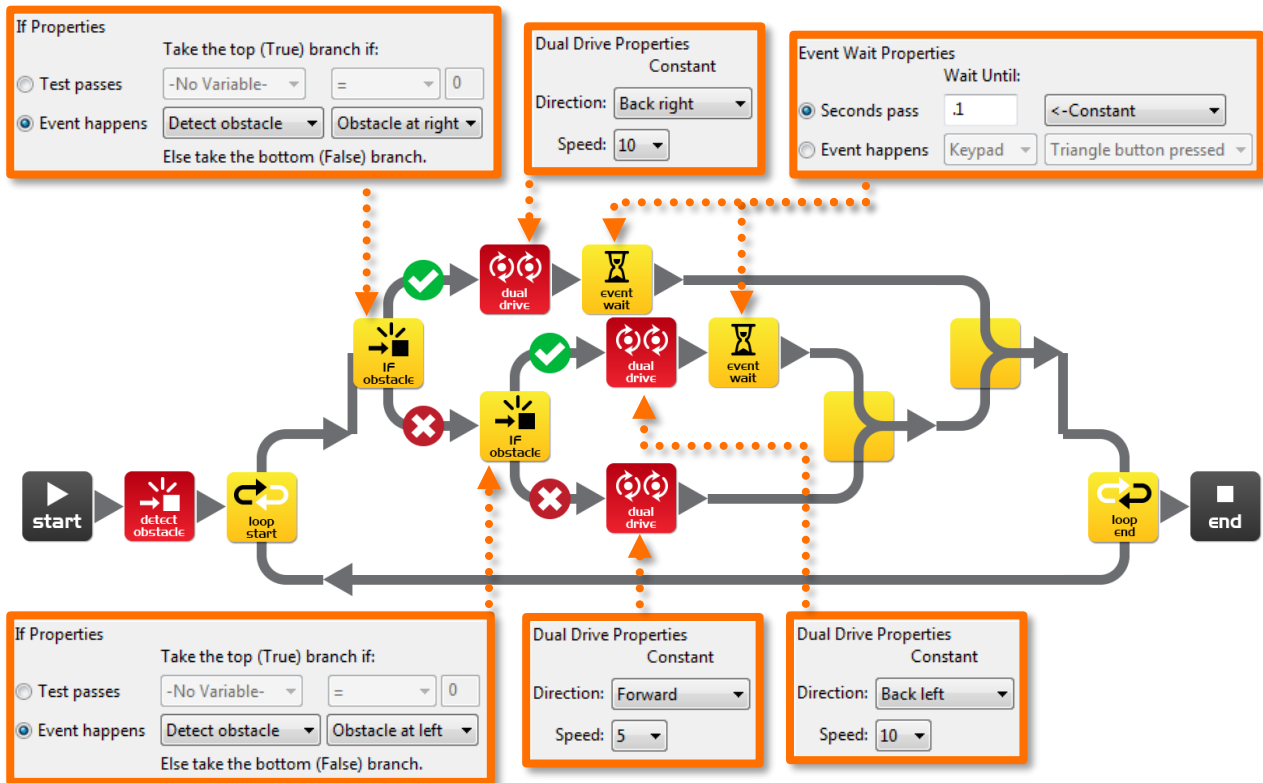
Try experimenting with different amounts of time in the second event wait icon. This time setting determines how long the robot turns for and is indicated above by the orange question mark (?).

What do you think is the best time setting for the robot to turn?

Name: _____

Lesson 7 Worksheet 7.5 – Right and left detection

Write the following program to have the Edison robot continuously drive avoiding obstacles to the left and right.



In the above program we are using 'IF' icons. These are very important icons, because they give the robot the ability to make decisions without human guidance. When this occurs in a robot it is now called an **autonomous robot**, as it has artificial intelligence.

An 'If' icon asks whether a condition is true or false. If the result is true the program takes the path with a tick. If the result is false the program takes the path with the cross.

The above program has three different paths that it can take based on where an obstacle is. **Explain in your own words what these three paths cause the robot to do.**

No obstacle detected: Drive forward

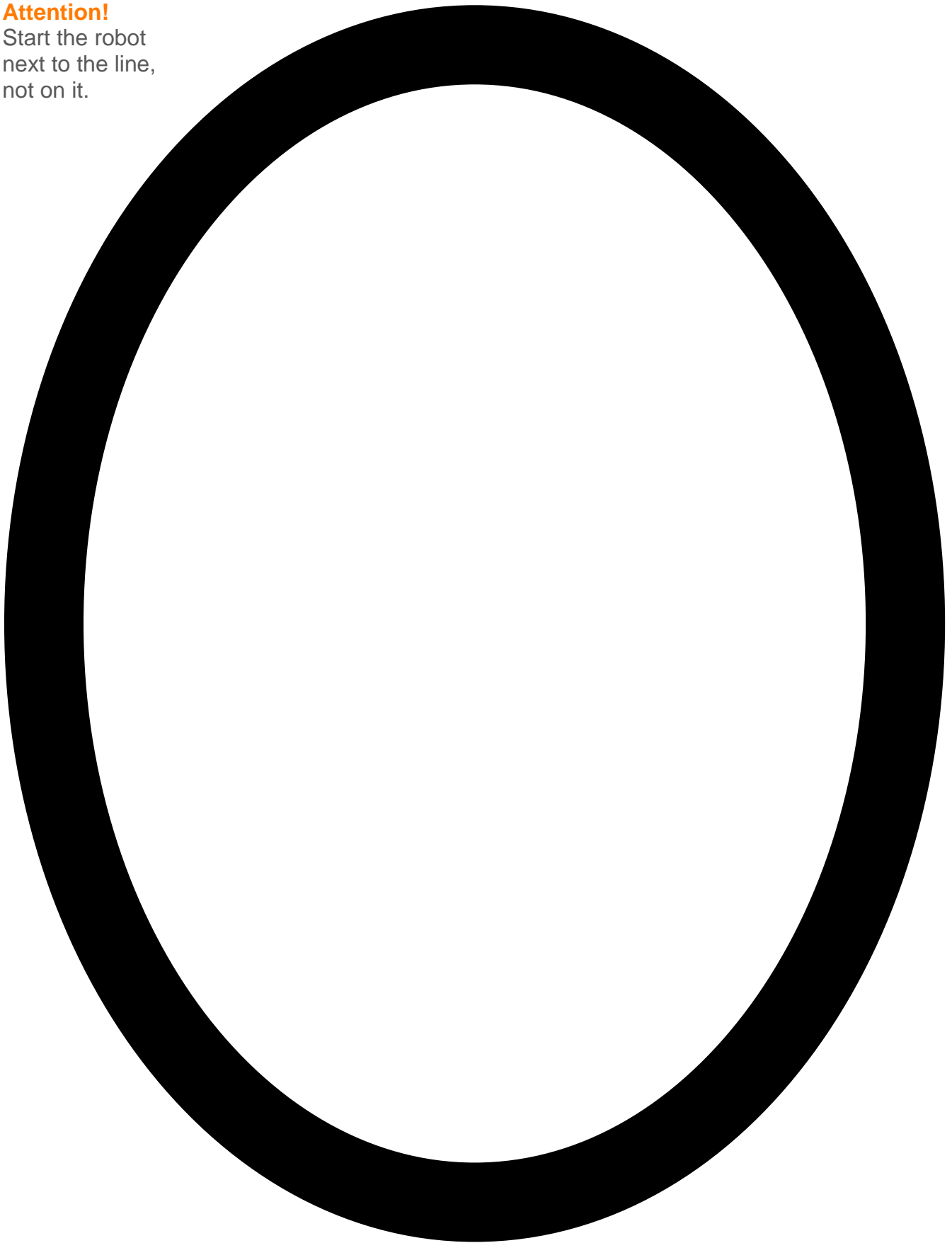
Obstacle detected on right: Back up and turn to the right

Obstacle detected on left: Back up and turn to the left

Get out the following track:

Attention!

Start the robot
next to the line,
not on it.

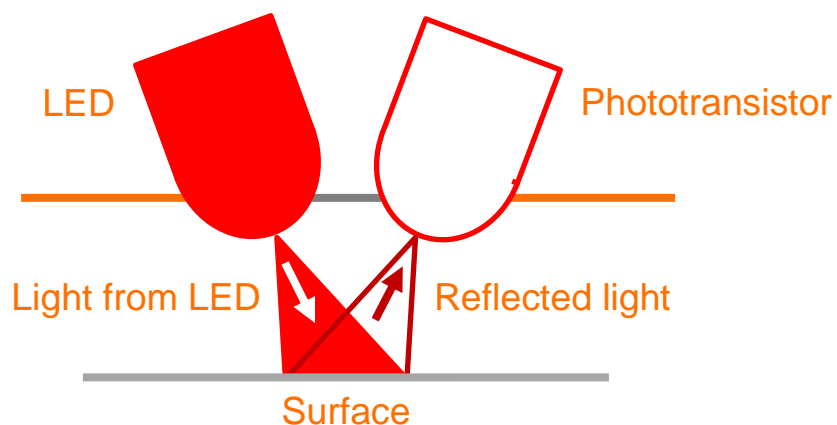


Lesson 8 Worksheet 8.1 – Line tracking sensor

Goal: Use line sensor feature of the Edison.

1. Red Light Emitting Diode (LED)
2. Phototransistor (light sensor)

The Edison robot is equipped with a line tracking sensor. The sensor is made up of two main electronic components:

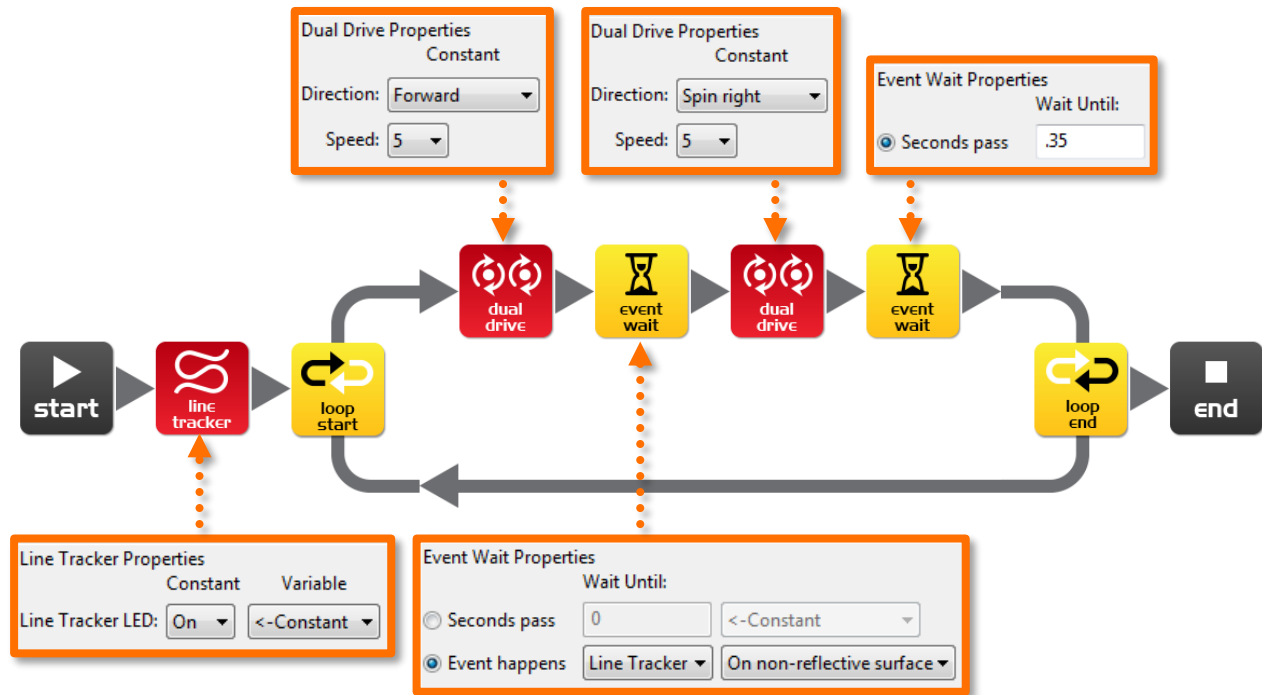


There is more light reflected from a white surface than from a black surface. Therefore the phototransistor gives a higher light reading when on a white surface than on a black surface. This allows the robot to be programmed to behave and respond to the surface that it is driving on. A black surface is considered to be 'non-reflective' and a white surface is considered to be 'reflective'.

Name: _____

Lesson 8 Worksheet 8.3 – Drive inside a border

Write the following program to have the Edison robot drive within a border.



Use the oval track as a border

You can also use black electrical tape on a white desk to create a large border.

If you create a large border try adding lots of robots to see what happens.

Also, experiment with different speeds.

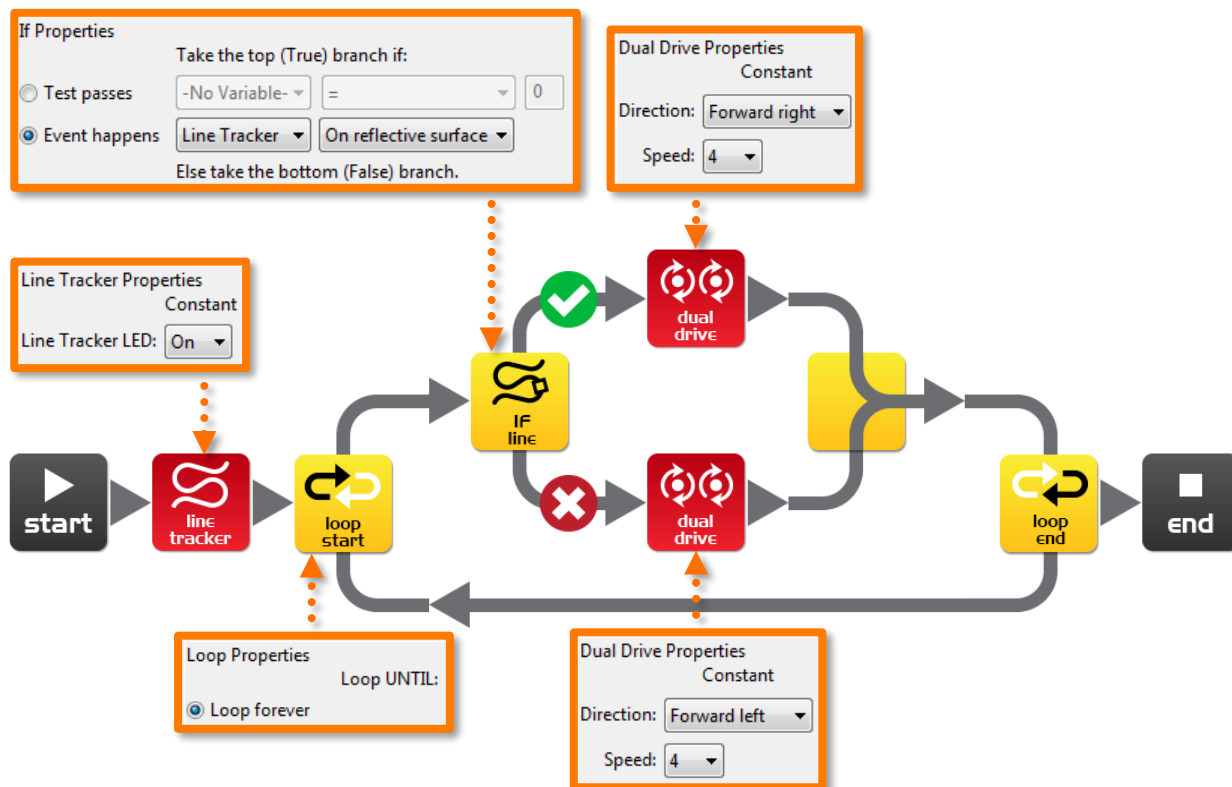
Leading Questions:

- What happens when the robot drives too fast?

Name: _____

Lesson 8 Worksheet 8.4 – Follow a line

Write the following program to have the Edison robot follow a black line.



This program uses the 'IF' icon to allow the robot to decide what to do. If the line tracking sensor is on a reflective surface (white), then drive **forward right** at speed 4. If the line tracking sensor is not on a reflective surface, then drive **forward left** at speed 4. When the robot is on white it drives off white, when the robot is on black it drives off black. As it does this it moves forward and tracks the edge of the line.

Place the robot inside the track on Worksheet 8.2 and watch the robot track the line.

Which way does it travel (clockwise or anti-clockwise)? _____

Place the robot outside the track on Work sheet 2 and watch the robot track the line.

Which way does it travel (clockwise or anti-clockwise)? _____

Why do you think the robot doesn't go in the same direction around the track?

Challenge Problem

Come up with a program to have the Edison follow the circle track, but turn around and drive the other direction if an obstacle is encountered. The robot should beep and light up both LED's temporarily when the obstacle is detected.

Extra Information

Collection of EdWare resources (from EdWare website):

<https://meetedison.com/robot-programming-software/edware/>

What Edison can't do that students will likely have to figure out:

- Figure out the right speed and time for the motors to turn to make a 90 degree spin. It doesn't have a specific angle control. This also depends on how much friction there is on the surface the robot is driving on. Make sure the students/teachers find the right time and speed to turn the robot 90 degrees while the robot is on the same material as the track they will be testing it on.
- Move a specified distance. Students will have to figure out the actual speed (maybe inches/second) for each speed setting (0-10) and use the distance to calculate the time to drive forward if they want to move an exact distance.

Edison Performance Tips, Tricks, and Notes (Gained from Personal Experience) :

- Permanent marker on white paper works well for making a line-following track, if you use the line tracker block on nonreflective surface
- Edison can't follow really tight curves very well, and driving faster makes it worse. Recommendations for line thickness is a black line about 0.6 inches thick.
- Edison reads a light value on the sensor as soon as a line-following program starts and uses it as a comparison for a white surface, so make sure it's on a white surface to start before following the line. The Edison should start off of the black line (next to it) and turn to the line when the program starts. See the following page for more information:
 - <https://meetedison.com/forum/edware-graphical-programming/line-tracking-problem/>
- Noticed some funny behavior in the Edison that didn't make any sense with the program that was running. Changing the batteries helped, so perhaps failure of the Edison to run programs as commanded may be due to low-battery power
- The Edison robot turns and drives faster on smoother surfaces, even with the same time and speed settings. Make sure students anticipate the environment the robot will be in before programming motor movements too carefully
- You can set how close an object has to be to the Edison for it to register as an obstacle by setting the sensitivity on the obstacle detector (see page 44 of EdWare Lesson Plans).

- Switching directions when following a line is a little bit more complicated than one might imagine. When you want to turn around and follow the line the other way, make sure the robot turns a few degrees (maybe 60 degrees of a turn) in the direction that the robot will turn when it is not over the line. This small turn is just enough to put the line sensor past the line it was previously scanning. The robot will now rotate as part of the “line-following” loop until it is facing 180 degrees backwards. Make sure not to pass the line with the turnaround command, otherwise it will continue turning around and face the same direction it originally came from.

Additional Thoughts:

- EdPy is an excellent (and free) way to get older or more experienced students interested in programming. It is based on Python programming language. Make sure the interested students know Python is a free programming language that is WIDELY used for many things in many fields (making simple video games, programming robots, control systems, many types engineering, etc.). Knowing this is a good way to motivate interested students to get into programming using a language