Challenge 0: Drive Straight

Setup:

Use Surface B.

Skills to Learn:
In this challenge, you'll practice driving your robot in a straight line, forward and backward, over a set distance. You'll also learn how to adjust motor speeds to get your robot to drive straight.
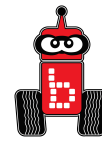
Goal:

Your robot needs to drive the length of mat B, straddling the blue/purple dashed line without either wheel crossing or touching the line.

Guidelines:

- The robot must start straddling the dashed blue/purple line beginning at the end of the B mat on the end with the starting area.
- To complete the challenge:
  - The robot should drive to the far end of the mat and stop without going off the mat and without either wheel touching or crossing the blue/purple dashed line

Extensions:

- The robot should straddle the line out, stop for 1 second, and then back up to the start without crossing the blue/purple line.

Junior Botball Challenges

Challenge 1: Tag, You're It!

Setup:

Use Surface-A. Place an empty 12 oz. can in circle 9.

Skills to Learn:

In this challenge, you'll practice driving your robot forward and backward over a set distance. You'll also learn to drive in a straight line and ensure your robot starts from the same position every time.

Goal:

Your robot must drive to the can in circle 9, touch it (without knocking it down or moving it outside the number nine circle), and return to the starting area (behind the black starting line).
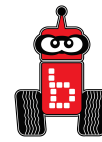
Guidelines:

- The robot must start completely **BEHIND** the inside edge of the starting line.
- The robot may start, finish, and drive off the mat during the run.
- To complete the challenge:
  - The can should not tip over.
  - Part of the can must remain inside the circle.
  - Your robot must touch the can.
  - The robot must return to the starting area.

Extensions:

- Move the can to different locations to promote mastery of the `msleep()` function.
- Students must drive backward to touch the can with the rear of the robot
- Students must drive out, touch the can, then turn around and drive forward back to the starting box
- Students must optimize and complete the task in the shortest amount of time

Extensions with Sensors:

- Complete this task using only motor position counter values and loops to drive set distances and turn precise angles
- Write your own functions using motor position counters to drive set distances and make precise angle turns
- Use the reflectance sensor or motor position counters to find your way back to the start box
- Make your own driving library using your own functions using motor position counters

Challenge 2: Ring Around the Can

Setup:

Use Surface-A. Place a 12 oz. empty soda can in circle 6.

Skill:

Learning to turn. The goal is for the robot to drive out and around the can in circle six and return to the starting area.
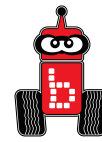
Guidelines:

1. All robot parts must start **<u>BEHIND</u>** the vertical projection of the inside of the start line.
2. Robots may drive off the mat during a run.
3. The entire robot must go around the far side of the can.
4. To achieve completion, the can must not tip over; some part must remain in or touch the circle.

Extensions:

- Drive backward (in reverse) out and around can six and return to the starting area.
- Drive out and circle the can 2 or 3 times before returning to the starting area.
- Drive out and around the can in circle six and return to the starting area, then drive backward (in reverse) out and around can six and return to the start area.
- Go around the can clockwise and counterclockwise.
- Go around the can using a geometric shape (square, rectangle, circle, triangle, polygon)
- Place the can in a different circle.

Extensions with Sensors:

- Complete this task using only motor position counter values and loops to drive and turn.
- Write your own functions using motor position counters to make precise turns.
- Make your own driving library using your own functions using motor position counters.

Challenge 3: Precision Parking

Setup:

Use Surface-A.

Skill:

Making precision turns and movements.

Goal:

The robot will successfully park in at least two of the garages.
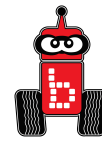
Guidelines:

1. All robot parts must start **<u>BEHIND</u>** the vertical projection of the inside of the start line.
2. Robots may drive off the mat during a run.
3. The team/student must **declare which garage** they intend to park in before starting, and they must **return to the start line** and then continue to the second garage.
4. The robot must stay parked in the garage for at least <u>5 seconds.</u>
5. The robot may **not touch** the solid lines marking the three sides of the garage the team intends to enter. A robot must enter the garage through the dotted lines of the selected garage. All lines from undeclared garages will be ignored.

Extensions:

●   The robot will parallel park on the side of the garage
●   The robot will park in two garages in separate runs without driving over the walls of any garage they are not parking in
●   The robot will successfully park by driving out to the garage, turning 180 degrees, and backing into the garage.

Extensions with Sensors:

●   Complete this task using only motor position counter values and loops to drive set distances and turn precise angles
●   Write your own functions using motor position counters to drive set distances and make precise angle turns
●   Make your own driving library using your own functions using motor position counters

Challenge 4: Serpentine

Setup:

Use Surface-A.

Skill:

Make precision turns <90° and >90°.

Goal:

The robot will drive on the surface, touching each of the numbered red circles with at least one of the robot's wheels in sequential order (1, 2, 3, etc.) through 8.
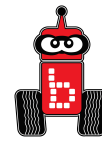
Guidelines:

1. All robot parts must start **BEHIND** the vertical projection of the inside of the start line.
2. Robots may drive off the mat during a run.
3. The robot must touch each circle with at least one drive wheel in the correct order through 8 to complete the task.

Extensions:

- Must complete the challenge through circle numbers 9, 10, 11, or 12
- The robot must return to the starting area after completing the last circle
- Robots must alternate between the left wheel and the right wheel touching the circle
- Robots must touch the circle with the caster instead of either wheel
- Students must drive around and start at 12 or the desired number and work back to 1, and then into the starting area

Extensions with Sensors:

- Complete this task using only motor position counter values and loops to drive set distances and turn precise angles
- Write your own functions using motor position counters to drive set distances and make precise angle turns
- Make your own driving library using your own functions using motor position counters

Challenge 5: Odd Numbers

Setup:

Use Surface-A.

Skill:

Precision robot driving.

Goal:

The goal is for the robot to drive over or touch all the odd-numbered circles without touching or driving over any even circles.
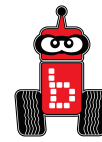
Guidelines:

1. All robot parts must start **BEHIND** the vertical projection of the inside of the start line.
2. Robots may drive off the mat during a run.
3. To complete the task, the robot must touch or drive over each circle in the correct sequential order: 1, 3, 5, 7, 9, and 11 without touching or driving over any even-numbered circles.

Extensions:

● Robots must touch the even-numbered circles
● Robots must alternate between an odd and then an even circle
● Drive over the even/odd numbers to add/subtract up to 35 (or any desired number)

Extensions with Sensors:

● Complete this task using only motor position counter values and loops to drive set distances and turn precise angles
● Write your own functions using motor position counters to drive set distances and make precise angle turns
● Make your own driving library using your own functions using motor position counters

Challenge 6: Figure Eight

Setup:

Use Surface-A. Place two empty 12 oz. cans in circles 4 and 9.

Skill:

Precision robot driving, recognizing repeated actions.

Goal:

The robot will weave in and out of the cans in the pattern of a figure 8 going out and returning. It must end with all parts of the robot back **BEHIND** the starting line.
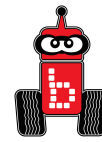
Guidelines:

1. All robot parts must start **BEHIND** the vertical projection of the inside of the start line.
2. Robots may drive off the mat during a run.
3. The robot must weave around the cans in a figure 8 pattern, going out **AND** coming back. The robot must end with all parts back **BEHIND** the starting line. The cans are placed in circles 4 and 9.
4. The cans must not tip over, and some part of each can must remain in the circle.

Extensions:

- Add 3rd turn by putting cans on circles 8,9 and 5 (barrel racing)
- You must use 90-degree turns to complete the challenge
- Make a figure 8 and then complete it in reverse

Extensions with Sensors:

- Complete this task using only motor position counter values and loops to drive set distances and turn precise angles
- Write your own functions using motor position counters to drive set distances and make precise angle turns
- Make your own driving library using your own functions using motor position counters

Challenge 7: Load 'Em Up

Setup:

Use Surface-A. Place three empty 12 oz. cans in circles 2, 9, and 10.

Skill:

Precision robot driving and engineering an effector to push cans.

Goal:

The robot will manipulate the can in front of each garage and move it into the garage. Put the can from circle two into the green garage, can nine into the blue garage, and can ten into the yellow garage. You will attempt all cans in a single run.

Guidelines:

1. All robot parts must start **BEHIND** the vertical projection of the inside of the start line.
2. Robots may drive off the mat during a run.
3. Robots cannot cross over solid lines of garages.
4. The cans must not tip over, and some part of each can must be on the inside edge of the solid and dotted lines.
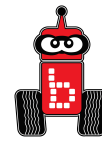5. The robot may be touching cans at the end of the round.

Extensions:

- Robots must push 2 or 3 cans into each garage.

Extensions with Sensors:

- Complete this task using only motor position counter values and loops to drive set distances and turn precise angles
- Write your own functions using motor position counters to drive set distances and make precise angle turns
- Make your own driving library using your own functions using motor position

  counters

Challenge 8: Bulldozer Mania

Setup:

Use Surface-A. Place one empty 12 oz. can in each numbered circle (12 cans total).

Skill:

Precision robot driving, engineering effectors (blades, claws, etc.).

Goal:

The robot will manipulate at least five upright cans behind the starting line in one run.
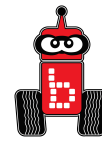
Guidelines:

1. All robot parts must start **BEHIND** the vertical projection of the inside of the start line.
2. Robots may drive off the mat during a run.
3. The cans must not tip over; part of each can must touch the surface and be behind the start line (actual or virtual within the 8' enclosure).
4. The robot may be touching cans at the end of the round.

Extensions:

- Only three cans across the start/finish line (any number)

Extensions with Sensors:

- Complete this task using only motor position counter values and loops to drive set distances and turn precise angles
- Write your own functions using motor position counters to drive set distances and make precise angle turns
- Make your own driving library using your own functions using motor position counters

Challenge 9: Cover Your Bases

Setup:

Use Surface-A. Place seven empty 12 oz. cans anywhere on the black starting line.

Skill:

Precision robot driving, engineering effectors (blades, claws, etc.).

Goal:

The robot will manipulate at least five upright cans back into the circles 1-7.
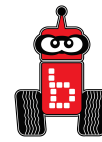
Guidelines:

1. All robot parts must start **<u>BEHIND</u>** the vertical projection of the inside of the start line.
2. Robots may drive off the mat during a run.
3. The cans are to be placed by students anywhere on the black line of the starting box.
4. The robot cannot touch a can before starting.
5. The robot's drive wheels must completely leave the starting box (crossing over and no longer touching the black line marking the starting box).
6. The cans must not tip over, and part of each can must touch the circle.
7. Only one can per circle.
8. The robot may be touching a can at the end of the round.

Extensions:

- Change the number of cans that the robot is required to manipulate.

Extensions with Sensors:

- Complete this task using only motor position counter values and loops to drive set distances and turn precise angles
- Write your own functions using motor position counters to drive set distances and make precise angle turns
- Write a loop that moves the servo slowly and then make it into a function
- Make your own driving library using your own functions using motor position counters and slow servo commands

Challenge 10: Chopped

Setup:

Use Surface-A. Place a can on circle 7

Skill:

Learning to use one servo and planning servo placement for a challenge

Goal:

The robot will drive out and stop in front of circle 7. Before chopping (touching the can with the arm or claw), the robot must pause for 3 seconds. Next, the robot will chop/touch the can with the arm or claw.
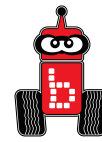
Guidelines:

1. All robot parts must start **BEHIND** the vertical projection of the inside of the start line.
2. Robots may drive off the mat during a run.
3. The robot must stop in front of circle seven and chop the can.

Extension:

● Place multiple cans on the mat the robot must drive to and chop/touch with the arm and/or the claw.

Extensions with Sensors:

● Complete this task using only motor position counter values and loops to drive set distances and turn precise angles
● Write your own functions using motor position counters to drive set distances and make precise angle turns
● Write your own functions to move your servo
● Make your own driving library using your own functions using motor position counters

Challenge 11: Making Waves

Setup:

Use Surface-A.

Skill:

Learning to use the servo motor

Goal:

Drive to Circle 12, stop, and wave (move servo up and down); drive to Circle 3, stop, and wave. Drive to Circle 6, stop, and wave. Drive to circle 9, stop and wave.
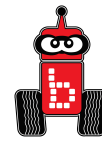
Guidelines:

1. All robot parts must start **BEHIND** the vertical projection of the inside of the start line.
2. Robots may drive off the mat during a run.
3. The robot must stop and wave (move the servo up and down) at circles 12, 3, 6, and 9.

Extension:

- Place multiple cans on the mat.

Extensions with Sensors:

- Complete this task using only motor position counter values and loops to drive set distances and turn precise angles
- Write your own functions using motor position counters to drive set distances and make precise angle turns
- Write your own functions to move your servo
- Make your own driving library using your own functions using motor position counters

Challenge 12: Add it Up

Setup:

Use Surface-A.

Skill:

Learning to use one servo and planning servo placement for a challenge

Goal:

Drive the robot to the chosen numbered circles on the mat (it doesn't have to be sequential), and then use a servo to touch the circles.
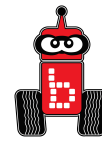
Guidelines:

1. All parts of the robot must start **BEHIND** the vertical projection of the inside of the start line.
2. Robots may drive off the mat during a run.
3. Robots must use a servo to lower an effector to touch the circle (it cannot be something that is always dragging or always touching the surface) and accrue 20 or more points.
4. To count as touching a circle, part of the robot must be lowered by a servo and touch inside or on any part of the red circle line.
5. You can only touch one circle at a time. Any robot that touches two or more circles simultaneously will not get points for the touch.

Extension:

- Change the value the touched circle needs to add up to (12, 15, 24, etc.)
- Change the equation to subtraction to equal a value as opposed to addition
- Print the answer to the equation on the screen of the robot at the end of the program

Extensions with Sensors:

- Complete this task using only motor position counter values and loops to drive set distances and turn precise angles
- Write your own functions using motor position counters to drive set distances and make precise angle turns
- Write your own functions to move your servo
- Make your own driving library using your own functions using motor position counters

Challenge 13: Be Happy

Set up:

Use a 2' x 4' sheet of butcher/craft paper or similar. Attach a marker to the robot arm and/or claw.

Skill:

Driving and operating a servo.

Goal:

The robot will drive on the butcher paper while manipulating the marker to draw a smiley face ☺
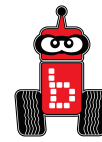
Guidelines:

1. All parts of the robot must start **BEHIND** the vertical projection of the inside of the start line.
2. Robots may drive off the mat during a run.
3. The robot must make at least three marks that could be construed as a smiley face – two eyes and a mouth.

Extension:

● Draw any shape or symbol.

Extensions with Sensors:

● Complete this task using only motor position counter values and loops to drive set distances and turn precise angles
● Write your own functions using motor position counters to drive set distances and make precise angle turns
● Write your own functions to move your servo
● Make your own driving library using your own functions using motor position counters

Challenge 14: Dance Party

Setup:

Use Surface-A.

Skill:

Motor and servo control and movement.

Goal:

The robot must "dance" along with the music or rhythm clap.
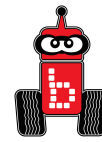
Guidelines:

1. All parts of the robot must start **<u>BEHIND</u>** the vertical projection of the inside of the start line.
2. *Robots may drive off the mat during a run.*
3. If the students want music, they must provide a music clip that plays loud enough for the judges to hear. Music clips can be played from a cell phone, or the students can provide live music (singing).
4. The robot must leave the starting box before completing the dance moves and complete all the following moves:
    a. Must complete at least one 360-degree clockwise turn
    b. Must complete at least one 360-degree counterclockwise turn
    c. Must move forward
    d. Must move backward
    e. Must wave the servo (up and down at least once)

Extension:

- Students make up the rules
- Line dance, student dance with the robot

Extensions with Sensors:

- Complete this task using only motor position counter values and loops to drive set distances and turn precise angles
- Write your own functions using motor position counters to drive set distances and make precise angle turns
- Write your own functions to move your servo
- Make your own library using your own functions using motor position counters

Challenge 15: Go Fetch

Setup:

Use Surface-A. Place an empty can in circle 11

Skill:

Precision robot driving, engineering an effector to <u>pick up</u> a can.

Goal:

The robot will pick up the can in circle 11 and return it to the starting box.

Guidelines:

1. All robot parts must start **<u>BEHIND</u>** the vertical projection of the inside of the start line.
2. Robots may drive off the mat during a run.
3. The can must not tip over.
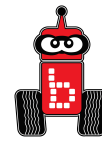4. The robot may be touching cans at the end of the round.

Extensions:

- Place the can to be Fetched in any other circle
- When returning the can to the starting box, the can must be set down standing up without the robot touching it
- The robot must fetch multiple cans

Extensions with Sensors:

- Complete this task using only motor position counter values and loops to drive set distances and turn precise angles
- Write your own functions using motor position counters to drive set distances and make precise angle turns
- Write your own functions to move your servo
- Use the reflectance sensor or motor position counters to find your way back to the start box
- Make your own driving library using your own functions using motor position counters

Challenge 16: Pick 'Em Up

Setup:

Use Surface-A. Place three empty 12 oz. cans in circles 2, 9, and 10.

Skill:

Precision robot driving, engineering an effector to pick up cans.

Goal:

The robot will pick up the can in front of each garage and then place them into the garage. Pick up the can from Circle 2, put it into the green garage, the can from Circle Nine into the blue garage, and the can from Circle 10 into the yellow garage. You will attempt all cans in a single run. The cans must be upright (vertical) after placement.

Guidelines:

1. All robot parts must start **BEHIND** the vertical projection of the inside of the start line.
2. Robots may drive off the mat during a run.
3. The cans must not tip over, and some part of each can must remain on the inside edge of the solid and dotted lines denoting the garage touching the surface, or that can not count towards completion.
4. The robot may be touching cans at the end of the round.
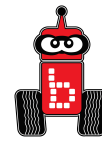
Extensions:

- Empty the Garages- Goal: The robot will pick up the can in each garage and place it on the circle in front of it. The cans must be upright (vertical) after placement. At least two cans need to be placed in front of the garages.
- Place five empty 12 oz soda cans in circles 2, 5, 8, 10, and 11. You must pick them up and put them in one garage.

Extension:

- Change the number of cans from 5 up to 8
- Increase the number of garages they have to put cans in (4 each in 2 or 3 garages etc)

Extensions with Sensors:

- Complete this task using only motor position counter values and loops to drive set distances and turn precise angles
- Write your own functions using motor position counters to drive set distances and make precise angle turns
- Write your own functions to move your servo
- Write a loop that moves the servo slowly and then make it into a function
- Make your own driving library using your own functions using motor position counters

Challenge 17: Mountain Rescue

Setup:

Use Surface-A. Place a whole ream (500 sheets) of standard 8.5" x 11" copy paper inside the blue garage so that it touches the solid side and back lines of the garage and extends over the dashed line. Place five empty 12 oz. soda cans on top of the ream of paper, one on each corner and one in the center of the ream.

Skill:

Precision robot driving, engineering effectors utilizing two servos.

Goal:

The robot will get cans off the platform and bring them to the starting box.
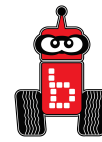
Guidelines:

1. All parts of the robot must start **BEHIND** the vertical projection of the inside of the start line.
2. Robots may drive off the mat during a run.
3. The five empty cans will be placed upright on top of the ream of paper before the start of their run.
   a. One can on each corner and one in the center of the ream of paper
4. Cans are rescued and counted as placed in the starting box when they touch the surface of the starting box and are upright.
5. Once a can is rescued, students can remove it, set it aside, and reset their robot in the starting box to go after additional cans.

Extension:

- Students must stand the can upright in the starting box and not have the robot touching it to count.
- Students must get at least two cans in one continuous run
- Students must get at least four cans in one continuous run

Extensions with Sensors:

- Complete this task using only motor position counter values and loops to drive set distances and turn precise angles
- Write your own functions using motor position counters to drive set distances and make precise angle turns
- Write your own functions to move your servo
- Write a loop that moves the servo slowly and then make it into a function
- Use the reflectance sensor or motor position counters to find your way back to the start box
- Make your own driving library using your own functions using motor position counters

Challenge 18: Stackerz

Setup:

Use Surface-A. Place 2 empty 12 oz. cans; one in circle five and the other in circle seven.

Skill:

Precision manipulating.

Goal:

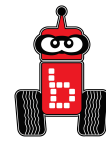The robot will stack one can on top of the other.

Guidelines:

1. All parts of the robot must start BEHIND the vertical projection of the inside of the start line.
2. Robots may drive off the mat during a run.
3. If the team doesn't complete the challenge, they may leave the enclosure area and can return and retry the challenge later.
4. The robot's drive wheels must completely leave the starting box (crossing over and no longer touching the black line marking the starting box).
5. The bottom of the top can must be touching the top of the bottom can.
6. The robot may not touch either can (cans must be free-standing) at the end of the round.

Extension:

- Students must stack the cans inside the starting box and not have the robot touching them to count.

Extensions with Sensors:

- Complete this task using only motor position counter values and loops to drive set distances and turn precise angles
- Write your own functions using motor position counters to drive set distances and make precise angle turns
- Write your own functions to move your servo
- Write a loop that moves the servo slowly and then make it into a function
- Make your own driving library using your own functions using motor position counters
- Utilize motor position counters and/or reflectance sensors to locate the start box

Challenge 19: Bump

Set up:

Use Surface-A. Place the mat so the end of the mat is against a wall or heavy object (wall, ream of paper, etc.) or alternatively place the heavy object somewhere on the mat.

Skill:

Precision robot driving using a digital touch sensor.
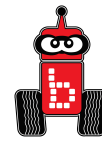
Goal:

The robot leaves the starting area and touches the wall or heavy object.

Guidelines:

1. All parts of the robot must start BEHIND the vertical projection of the inside of the start line.
2. The students must use a touch sensor to detect the wall or heavy object.

Extension:

- The robot leaves the starting box, touches the ream of paper using a touch sensor, visibly pauses, backs up, and then touches the other ream of paper, visibly pauses, drives forward to circle 2, and bumps another ream of paper.
- Set up a maze using reams of paper or similar heavy objects to make a maze with a known direction of turns to solve it (IE. all right turns).

Challenge 20: A'mazing

Setup:

Use Surface-A and Surface -B put together to form a large square
4- reams of paper or similar books or boxes. Place a ream of paper or something similar at each corner area of the square so that the robot can go forward and touch, then make a right turn and touch, etc.

Skill:

Students will use sensors to solve a simple maze with known turns (right turns)

Goal:
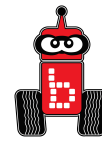
Complete the maze using sensors.

Guidelines:

1. All parts of the robot must start backed up to the ream of paper on the lower left corner of the square pointed towards the ream of paper on the same side.
2. Robots may drive off the mat during a run.
3. Robots must drive and touch each ream, completing the maze clockwise.
    a. Completion is when the robot touches the original ream of paper it started from

Extensions:

● Adjust the distance between the reams to make the distance shorter.

Extensions with Sensors:

● Robots must drive and sense each ream with a rangefinder, completing the maze in a clockwise fashion
● Complete the labyrinth counterclockwise using the touch and then the rangefinder sensor.
● Write your own functions to drive til touching the wall; precise right turns or left turns
● Write your own functions to drive til sensing the wall; precise right turns, or left turns
● Make your own driving library using your own functions that drive til touch and drive til sense

Challenge 21: Proximity

Setup:

Use Surface-A. One ream (500 sheets) of standard copy paper.
Level: Intermediate

Skill:

Students will learn how to use the rangefinder (ET) sensor to sense an object and stop before hitting the object

Goal:

On two separate runs, the robot has to sense the wall (ream of paper) that has been randomly placed on the mat and drive out to it, stopping within approximately 4 1/4" (the width of a piece of copy paper folded in half lengthwise) of the wall (ream of paper) without touching it.

Completion:

Participants will receive a completion award when the robot goes out, senses the wall, and stops within approximately 4 1/4" of the wall without touching it on two different runs.
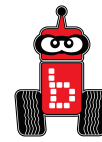
Guidelines:

1. All parts of the robot must start BEHIND the vertical projection of the inside of the start line.
2. Robots may start and/or drive off the mat during a run.
3. Once the robot is in the starting position, a ream of paper is placed on edge (long side down and parallel to the starting line) at either circles 4 to 6 or 9 to 11.
4. Once the ream of paper is set, students can push "run" on their robot.
5. The robot must come to a complete stop within approximately 4 1/4" (the width of a piece of paper folded in half lengthwise) without touching the wall with any part of the robot.

Extensions:

- Give the students the distances they must stop within before hitting the object.
- Have students convert sensor values to distance from an object into cm or in.

Extensions with Sensors:

- Record the distance traveled in tics for each run at different stopping distances
- Graph the value of the rangefinder and distance stopped from the object
- Graph the value of the motor position counter and the distance stopped from the object

Challenge 22: Search and Rescue

Setup:

Use Surface-A. Place an empty can in either circle 2, 4, or 6
The can is placed after the robot is behind the start line and ready to run.

Skill:

Using a sensor to find a can, precision driving, and engineering an effector to pick up a can.
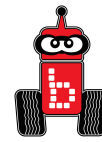
Goal:

The robot will sense the can using the rangefinder, pick it up, and bring it back to the starting box.

Guidelines:

1. All robot parts must start **BEHIND** the vertical projection of the inside of the start line.
2. The can is placed in and positioned after the robot is ready to run.
3. Robots may drive off the mat during a run.
4. The robot must sense the can with a rangefinder
5. The can must not tip over.
6. The rescued can must be touching the surface of the mat somewhere within the starting box.

Extensions:

●   When returning to the start box, use the reflectance or motor position counter sensors to locate it.
●   When returning the can to the starting box, it must be set down standing up without the robot touching iPlace. The can can be Rescued in 1, 5, 7, or 3 in addition to 2, 4, or 6.
●   When returning the can to the starting box, the can must be set down standing up without the robot touching it.
●   The robot must sense and rescue multiple cans during one run
●   Write your servo functions and search functions
●   Place your servo and search functions into a library

Challenge 23: Find the Black Line

Setup:

Use Surface-A. The robot must start in either circle 2, 4, 6, 9, or 11, positioned facing the starting/finish line

Skill:

Learning to use the reflectance sensor to find a black line on the mat

Goal:

The robot will drive out and stop once the sensor senses the black line on the starting box from two different starting positions on the mat.

Guidelines:

1. Robots must start on the designated circle
2. Robots may drive off the mat during a run.
3. The robot must stop when sensing the black line using the reflectance sensor.
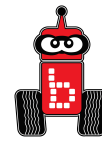
Extension:

- Robots must find the black line and then park the robot inside the starting line without touching any black lines.
- Write your own function, "FindBlack," to find the black line.

Extensions with Sensors:

- Once the black line is found, use the motor position counter sensor to reverse back to your original starting position
- Make your own driving library adding a FindBlack line function

Challenge 24: Walk the Line

Setup:

Use Surface-B. The robot must start with the reflectance sensor on the right side of the wide black line behind the green start line.

Skill:

Learning to use the reflectance sensor and a bang-bang algorithm to follow a black line.

Goal:

The robot will follow the black line using the reflectance sensor to the purple Line B on the mat.

Guidelines:

1. Robots must use a reflectance sensor to sense the black line
2. Robots must start behind the green "Start Line" on the mat

Extension:

- Robots must follow the line to the Yellow "Line C."
- Robots must follow the line to the Magenta "Line D."
- Robots must follow the line to the Finish Line."
- Robots must follow the inside of the line (not the outside)
- Write your own function, "LineFollow" to follow the black line.

Extensions with Sensors:

- Place a ream of paper on the finish line area. Once the black line is followed, use a touch sensor on the front of the robot to bump into the ream of paper and exit the line following.
- Make your own driving library by adding a line follow function.