

ENJOY AI 2024
INTERSTELLAR JOURNEY

CLOSING CEREMONY OF SPORTS



Line Following

Objectives:

1. Know the basics of line following
2. Know the code blocks for line following
3. Know how to use these code blocks

5+



Review



In the previous course, we program our robot. Do you have any difficulties with it?



Review

Difficulties

1. The robot cannot go precisely into a zone.
2. The robot cannot turn at a precise angle.
3. The program is complicated.

Challenges



Challenges



Can we program the robot more easily?



Challenges



Let's take a look at the competition field. Can the robot move by following the black guiding line?



Challenges

What is line following?



Line following is to let a robot follow a line on the ground. The robot detects the intensity of light reflected from the ground.

If the robot detects a change in the intensity, it moves back onto the line. In this case, the robot may zigzag if it moves fast.

Challenges

To view an example of line following, let's watch a video.



Challenges

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Challenges



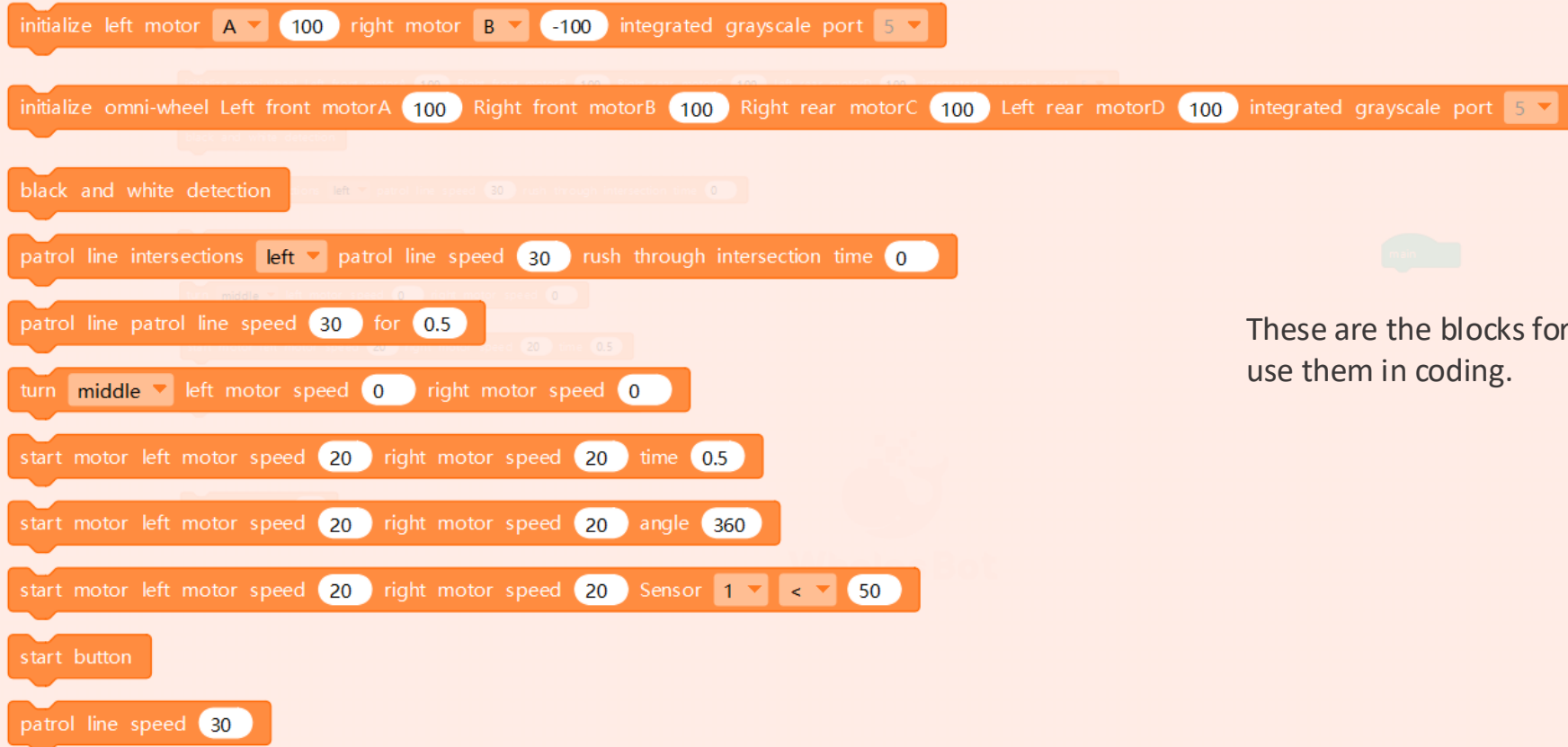
How can the robot follow a line?



Challenges

Line Following Blocks

Patrol line



The image displays a series of code blocks for a line-following robot. The blocks are arranged in a sequence, with some blocks having multiple instances. The blocks are as follows:

- initialize left motor A 100 right motor B -100 integrated grayscale port 5
- initialize omni-wheel Left front motorA 100 Right front motorB 100 Right rear motorC 100 Left rear motorD 100 integrated grayscale port 5
- black and white detection
- patrol line intersections left patrol line speed 30 rush through intersection time 0
- patrol line patrol line speed 30 for 0.5
- turn middle left motor speed 0 right motor speed 0
- start motor left motor speed 20 right motor speed 20 time 0.5
- start motor left motor speed 20 right motor speed 20 angle 360
- start motor left motor speed 20 right motor speed 20 Sensor 1 < 50
- start button
- patrol line speed 30

These are the blocks for line following. We can use them in coding.

Challenges

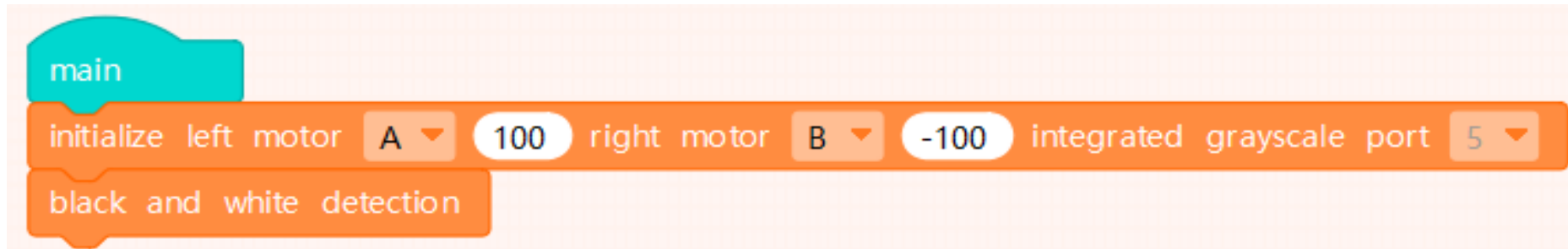
Initialization of Line Following

initialize left motor **A** **100** right motor **B** **-100** integrated grayscale port **5**

1. Connect the left motor to Port A, and the right motor to Port B.
2. The MC 101s controller uses a 5-in-1 grayscale sensor, so select the initialization block with the 5-in-1 grayscale feature. Connect the sensor to Port 5.
3. The actual efficiency of a motor is calculated based on the following formula: $(\text{Efficiency in the initialization block} \times \text{Efficiencies in subsequent blocks})/100$
4. The efficiency value of the right motor is a negative number, which indicates a switch in the direction. Then, the positive numbers in the subsequent settings indicate forward movement.
5. After the initialization, you must enable grayscale detection first.

Challenges

Grayscale Detection



1. Download the program to the controller. Follow the prompts on the controller screen.
2. Press the power on button, and you will hear an audio instruction to place the grayscale sensor on the black line. Then, press the power on button again.
3. Put the grayscale sensor onto the light-colored surface, and then press the power on button.
4. The detection is complete.

Challenges

To view an example of grayscale detection, let's watch a video.

Challenges

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Challenges

Movement at Crossroads

The robot marches at the specified speed until it arrives at the crossroads.



If you do not set the duration to cross the crossroads, the robot stops.

If you set the duration, the robot crosses the crossroads at the specified speed within the specified duration without following the guiding line.

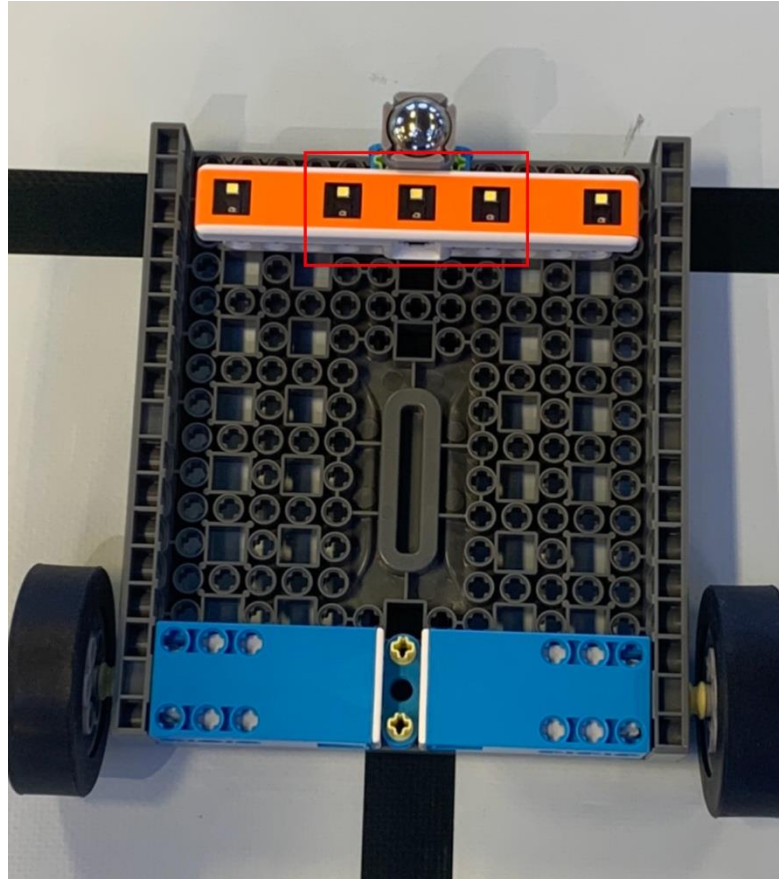
Left: The robot stops when a black line is detected on Road 1, 2, and 3.

Right: The robot stops when a black line is detected on Road 3, 4, and 5.

T/Cross interaction: The robot stops when a black line is detected on Road 2, 3, and 4.

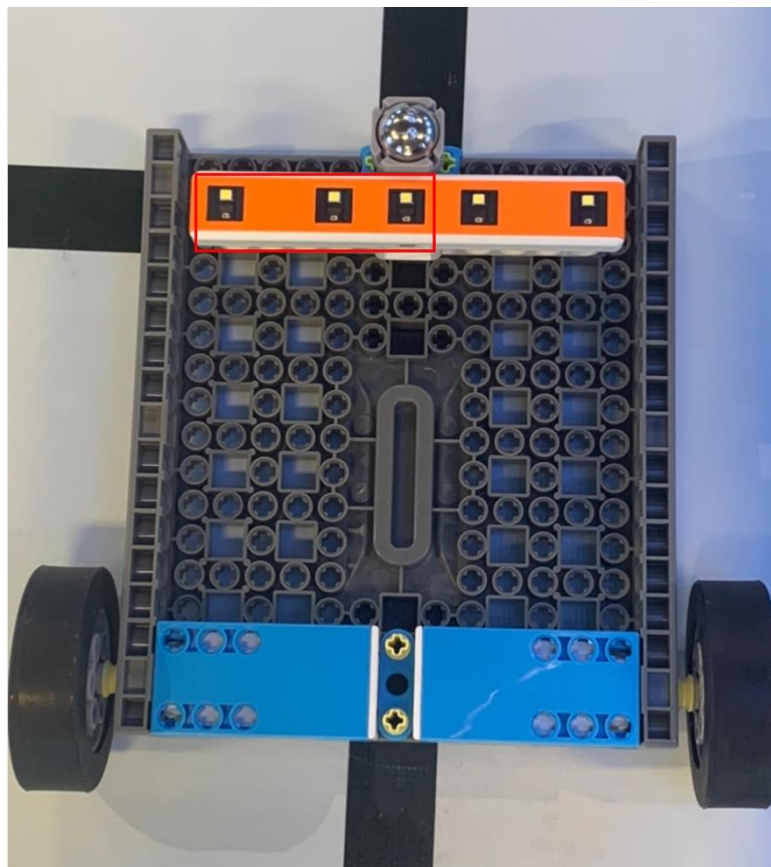
Challenges

Select "T/Cross interaction"



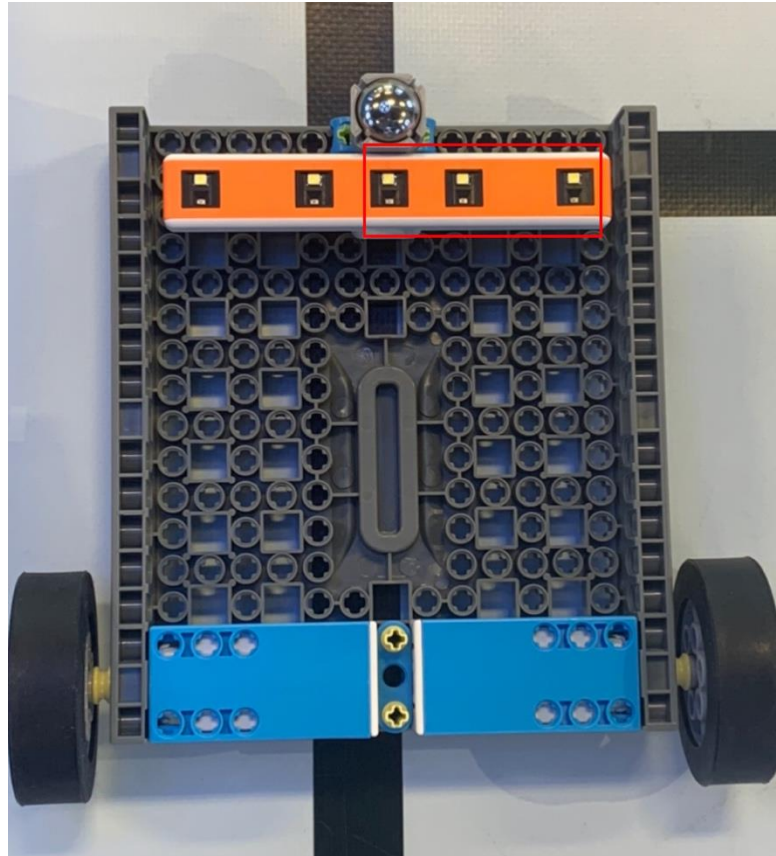
Challenges

Select “left”



Challenges

Select “right”



Challenges

Timing and Turning

Timing: The robot follows the guiding line within the specified seconds.

patrol line patrol line speed 30 for 0.5

Stop on the second road from the left

Stop on the third road from the left

Stop on the fourth road from the left

Turning: The robot turns in the specified manner to the specified road.

turn left left motor speed 0 right motor speed 0

left
middle
right

Left Motor Speed	Right Motor Speed	Manner	Rotation Center
100	-100	Spin clockwise	Midpoint between two wheels
-100	100	Spin counterclockwise	Midpoint between two wheels
100	0	Turn right	Right wheel
0	100	Turn left	Left wheel
100	20	Circle clockwise	N/A
20	100	Circle counterclockwise	N/A

Challenges

Powering On

After you power on the motors, the motors rotate based on the specified settings.

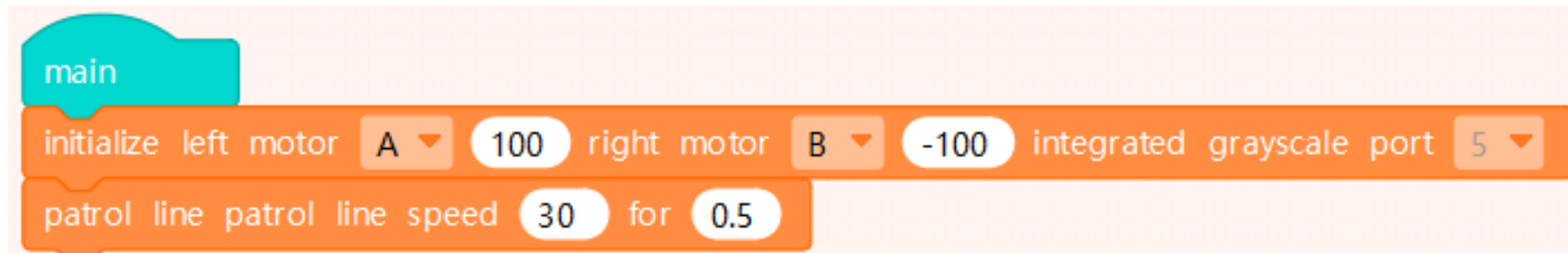
start motor left motor speed 20 right motor speed 20 angle 360

start motor left motor speed 20 right motor speed 20 time 0.5

Challenges

Block Combination (Time-limited Line Following)

This combination is used if you want your robot to stop at the roadside after a specified period. You can set the speed and duration of line following.



Due to the changes in friction and batteries, the robot may stop at different spots when the block combination runs. We recommend that you use the blocks for movement at crossroads instead if there are no crossroads ahead.

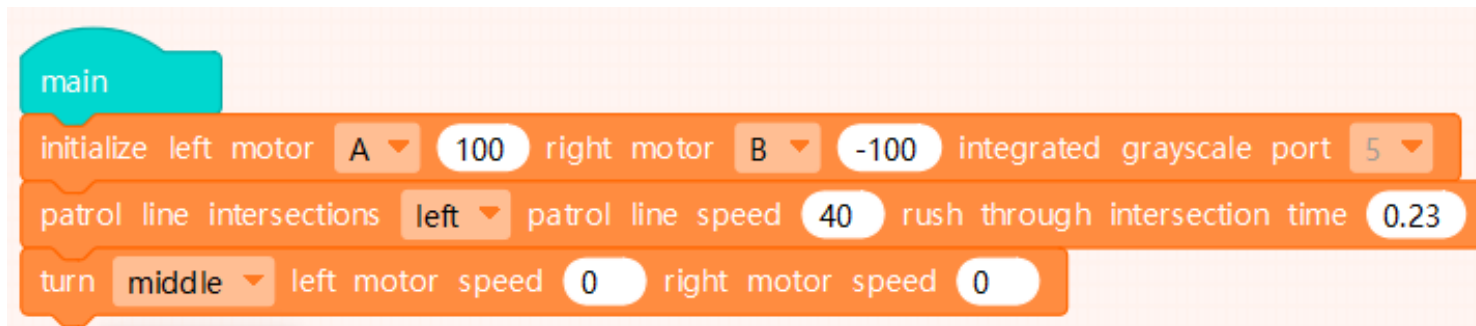
We recommend that you set an appropriate duration of line following to ensure that your robot arrives at the required spot.

Challenges

Block Combination (Turning in Line Following)

The “turn” block is usually used together with the blocks for movement at crossroads.

This combination is used to make the robot turn left or right onto the specified road. You can set the rotation speed of the left and right motors, and the spot where the robot stops.

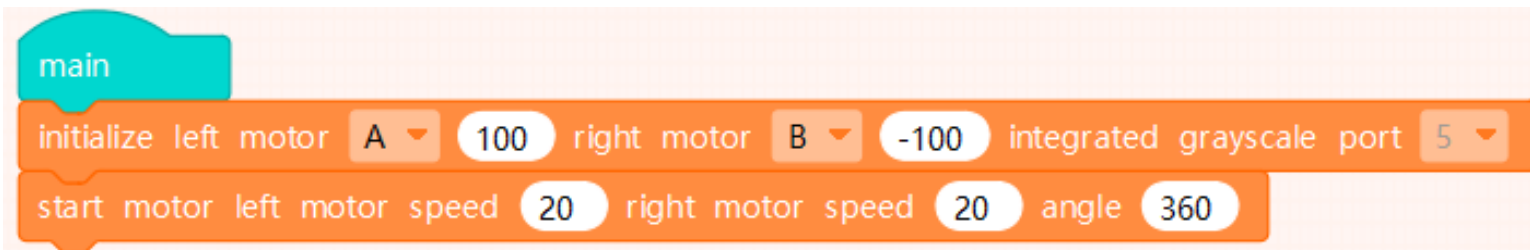
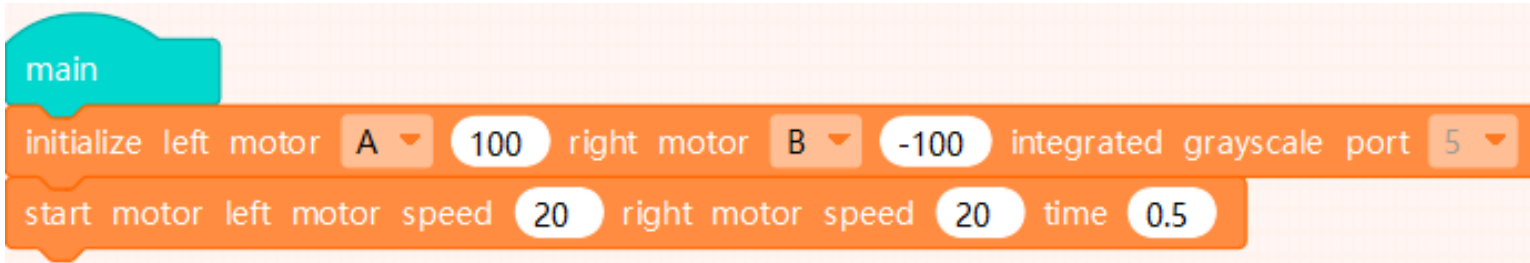


Settings:

Set the left motor to -40 and the right motor to 40. The left wheel goes forward and the right wheel goes backward. The robot turns left and moves until arriving at the specified spot.

Challenges

Block Combination (Motors)



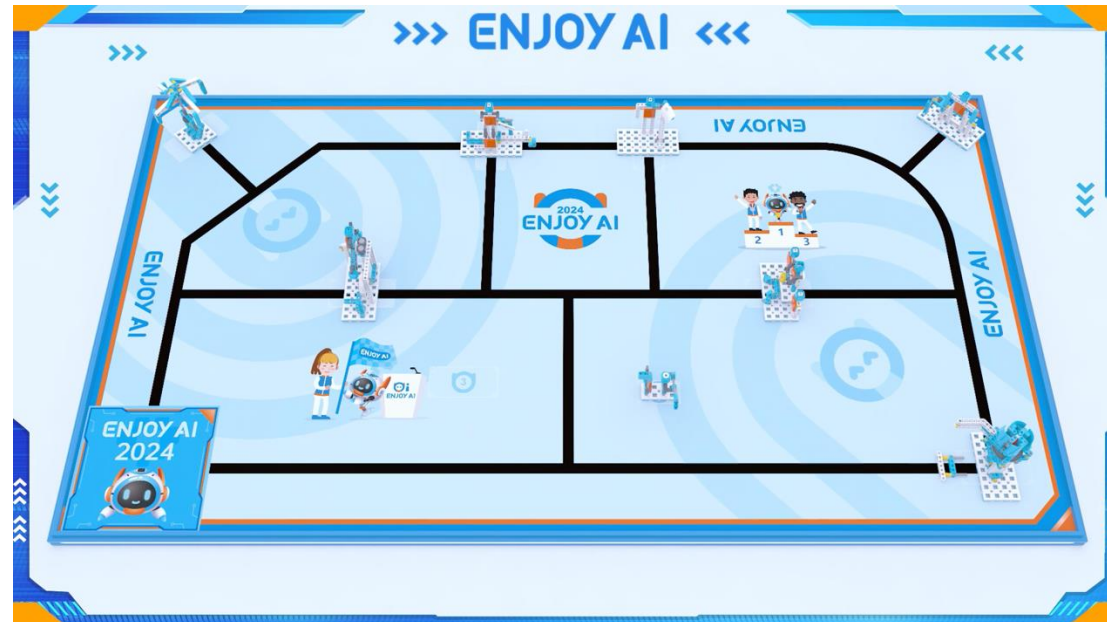
The parameters in the rectangles specify the condition where the motors stop.

1. The robot goes at the speed of 20 for 0.5 seconds.
2. The motor turns a full circle (360°).

Tasks



Tasks



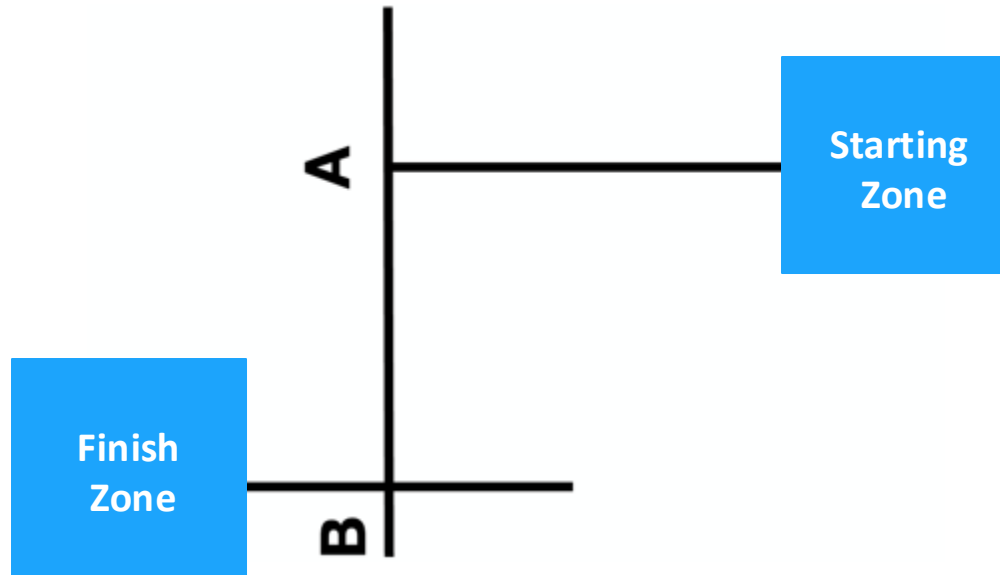
After learning about line following blocks, let's use these blocks to finish tasks!



Coding Tasks



Task 1



Run the program to drive your robot!



Task 1



In this task, what kinds of code blocks are required?



Task 1

Program your robot to finish Task 1.



Task 1

main

initialize left motor A 100 right motor B -100 integrated grayscale port 5

patrol line patrol line speed 50 for 1.8

turn left left motor speed -30 right motor speed 30

patrol line intersections right patrol line speed 50 rush through intersection time 0.2

turn right left motor speed 30 right motor speed -30

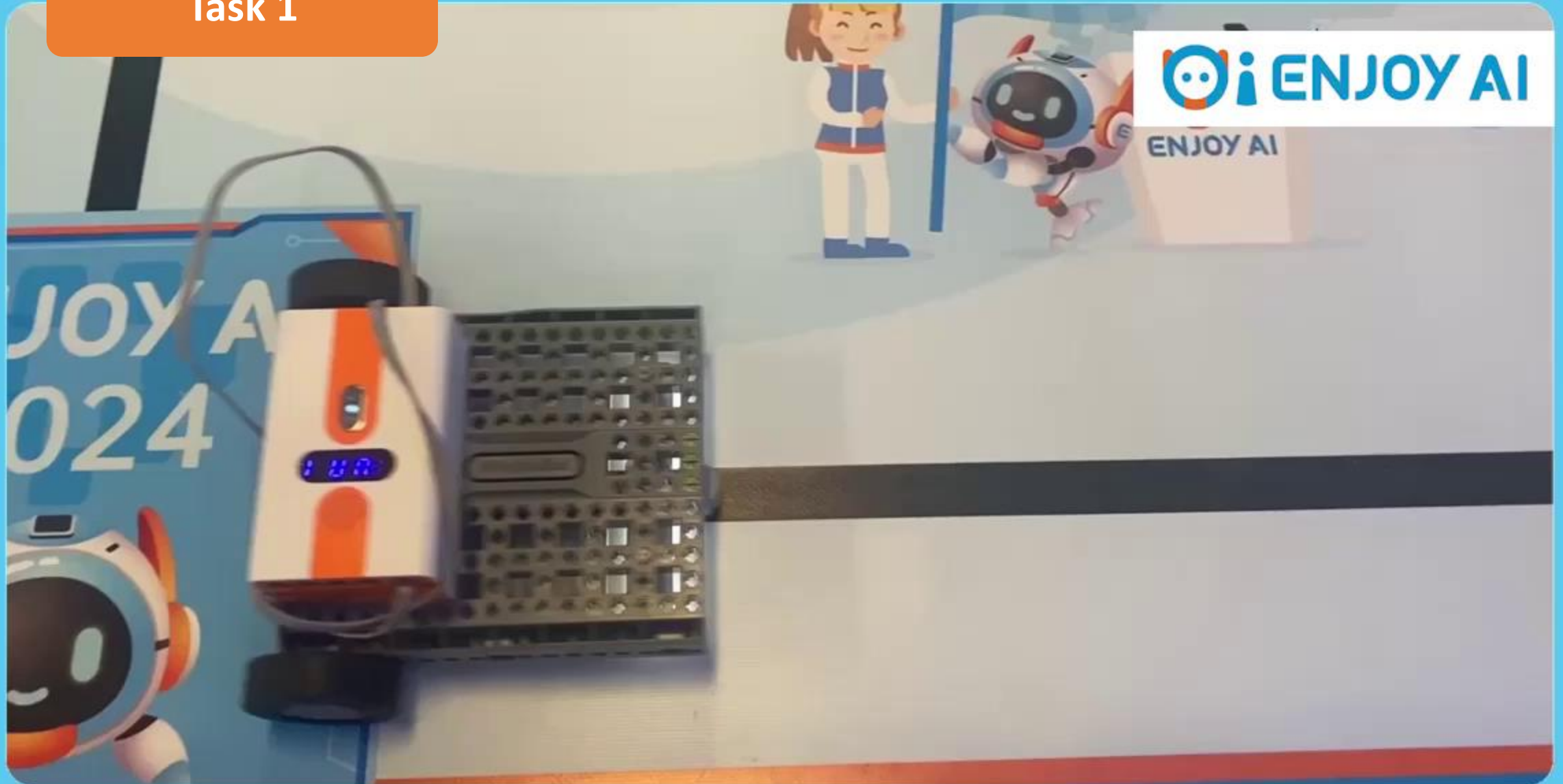
patrol line patrol line speed 50 for 0.4

Task 1

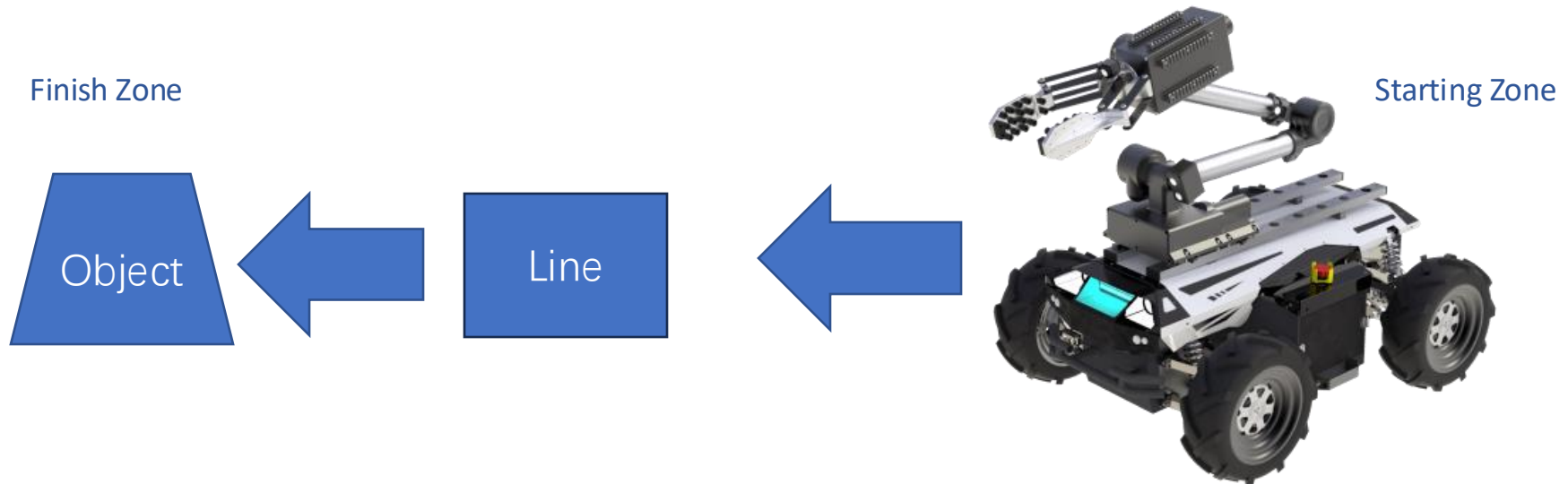
**What happens when we start the program?
Let's watch a video.**



Task 1



Task 2

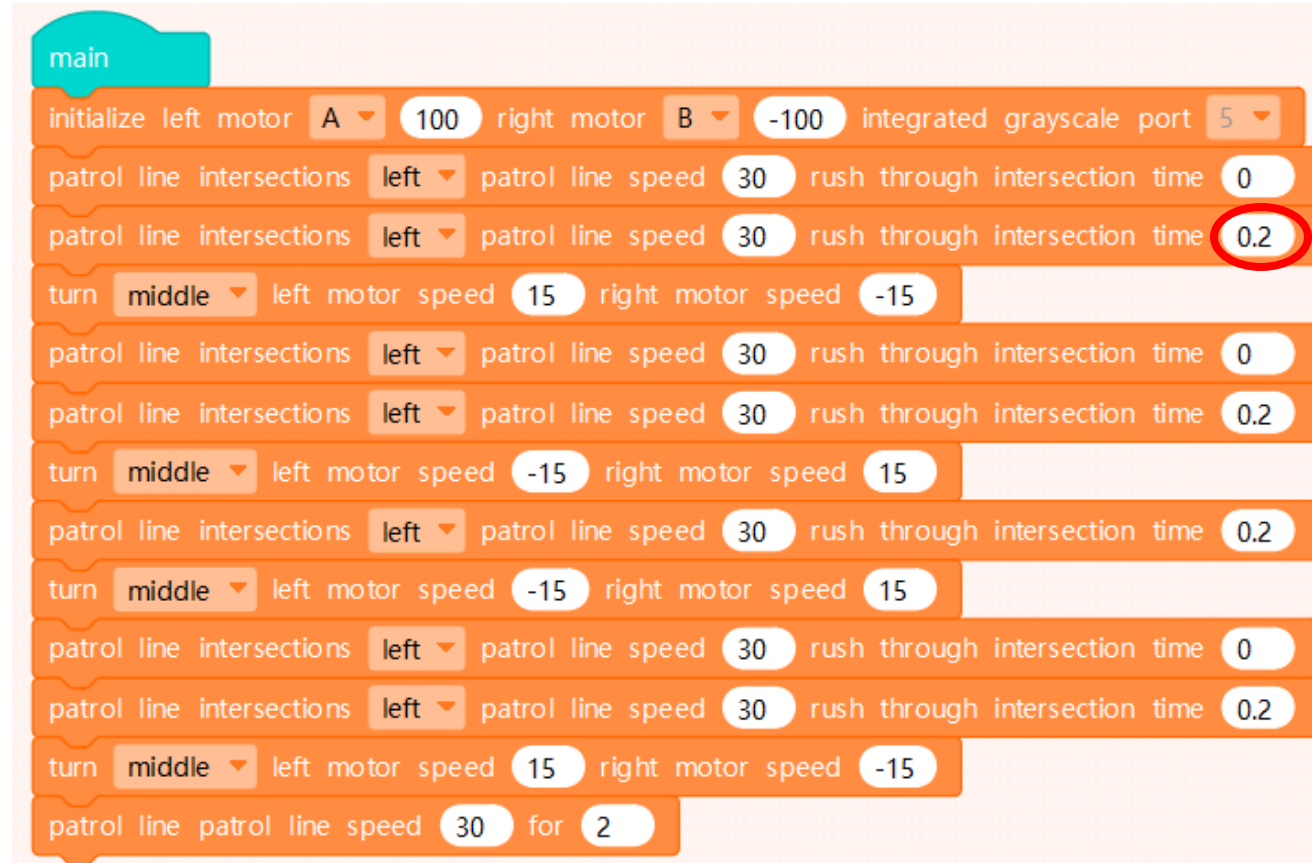


Run the program to let the robot follow the line.

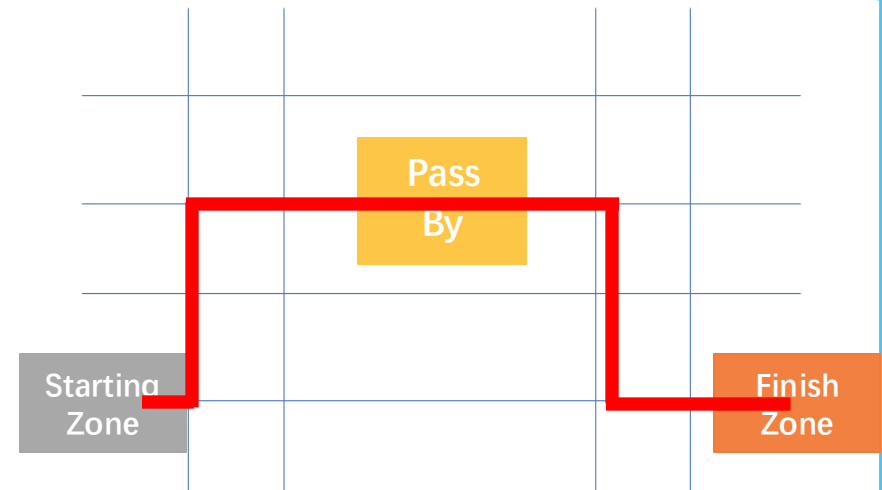
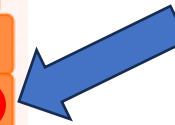


Task 2

Sample Program



The 0.2-second duration is set to prevent your robot from stopping while turning.



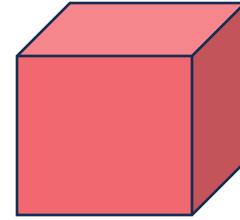
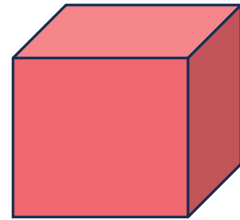
Run the program.



Further Study



Further Study



There are some cubes on the road. Try to use code blocks for line following to take away these obstacles.



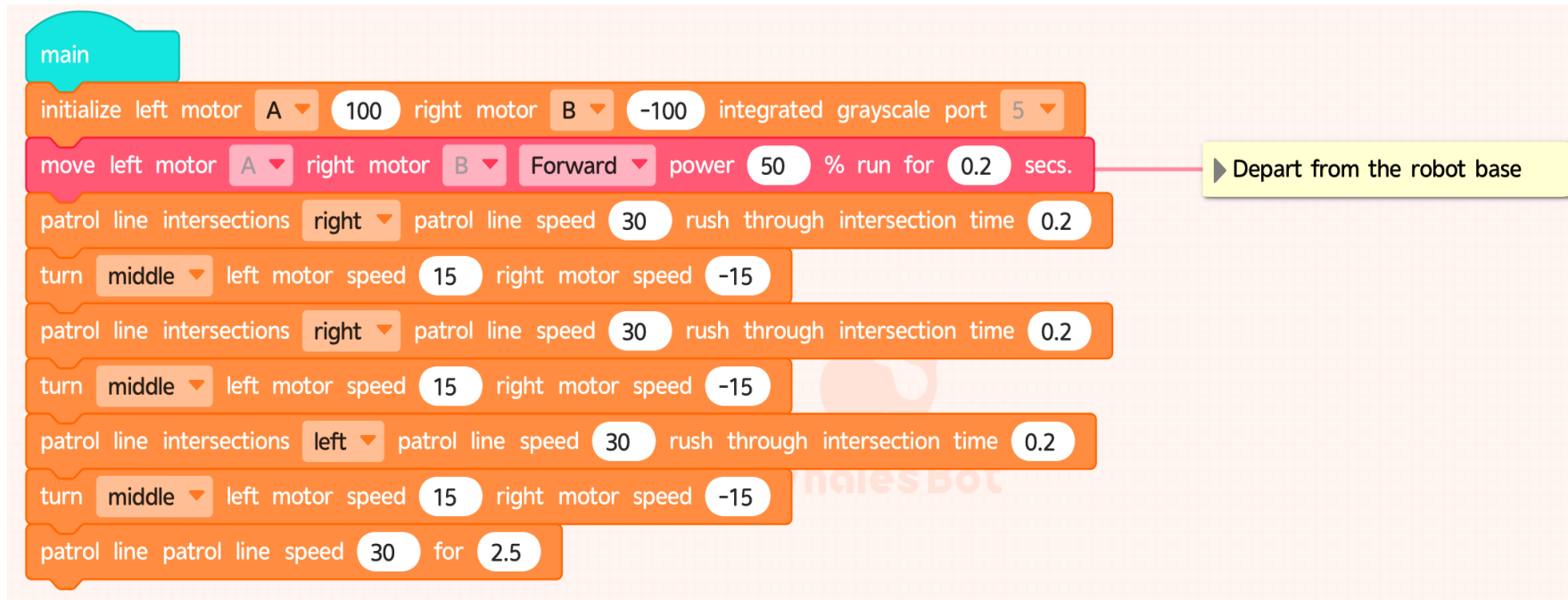
Further Study



The obstacles are placed on the road. Try to move them to the robot base.



Further Study



Further Study

**What happens when we start the program?
Let's watch a video.**



Further Study

 ENJOY AI



See you next time!

