

# *mBot* Coding Cards



makeblock

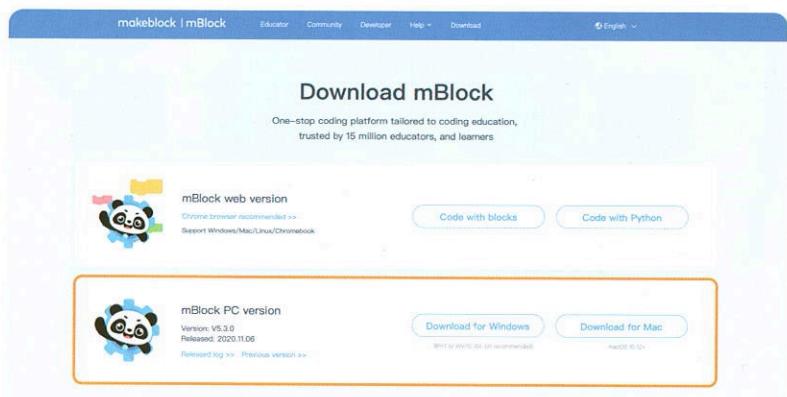
## How to download mBlock PC version?

1. Enter this website [www.mblock.cc](http://www.mblock.cc)

Then click "Download" to enter the download interface.



2. Download mBlock PC version



D1.1.1\_KW010263000

# How to connect mBot to mBlock?

The screenshot shows the mBlock software interface with the title bar "moleblock | mBlock" and tabs "Scratch" and "Untitled". The workspace contains a yellow cat sprite and a green background. A help menu is open, showing options like "Save", "Print", "Help", and "Exit". Below the workspace is a palette with categories: Looks, Sounds, Motion, Events, Sensing, Control, Variables, Operators, and Sprites. A specific block, "LED panel port1 show image [red] for 1 sec.", is selected and highlighted in blue. A callout box points to this block with the text "5 Right-click a block to find out how to use it." To the left, a "My Blocks" section shows a single block: "LED panel port1 show image [red] for 1 sec.". A large yellow callout box on the left side of the screen provides step-by-step instructions:

- 1 Click "add" to add mBot.
- 2 You can click the "x" button in the upper right corner to delete the unwanted devices.
- 3 Turn on mBot, connect it to your computer with a USB cable/Bluetooth dongle. Click "Connect" to connect mBot to mBlock. And you can start programming!

## Example

# How to start programming?

**1** Drag the blocks to the blank area on the right and join them together according to a certain logic. And then a program is done!

**2** Click the green flag to see how mBot reacts.

**3** You can name the program you write and save it to your computer.

**4** You can also click on this gray icon to apply for an mBlock account and save the program to your account.

# Let mBot move!

Meet your new friend mBot and teach it to move forward and turn.



Level 1-1

makeblock

## Program

After compiling the program, remember to upload the program to mBot for testing!

Switch to Upload mode in the device area to use this event block.

when mBot(mcore) starts up

The power takes a range of -100 to 100. Add a "-" in front of the number to see which way mBot goes.

move forward at power 50 % for 1 secs

LED left shows color orange for 1 secs

turn left at power 50 % for 0.7 secs

move forward at power 50 % for 1 secs

Click here to change the color.

Modify this number to ----- see how mBot turns.

## Concepts

### Upload & Live modes

**Upload:** To make mBot run programs without mBlock, you first need to enable Upload mode, and upload your program to mBot.

Upload      Live

Upload

**Live:** mBot stays in constant communication with mBlock so you can test the program online.

Unplug the USB cable so that mBot can move around.

#### Note:

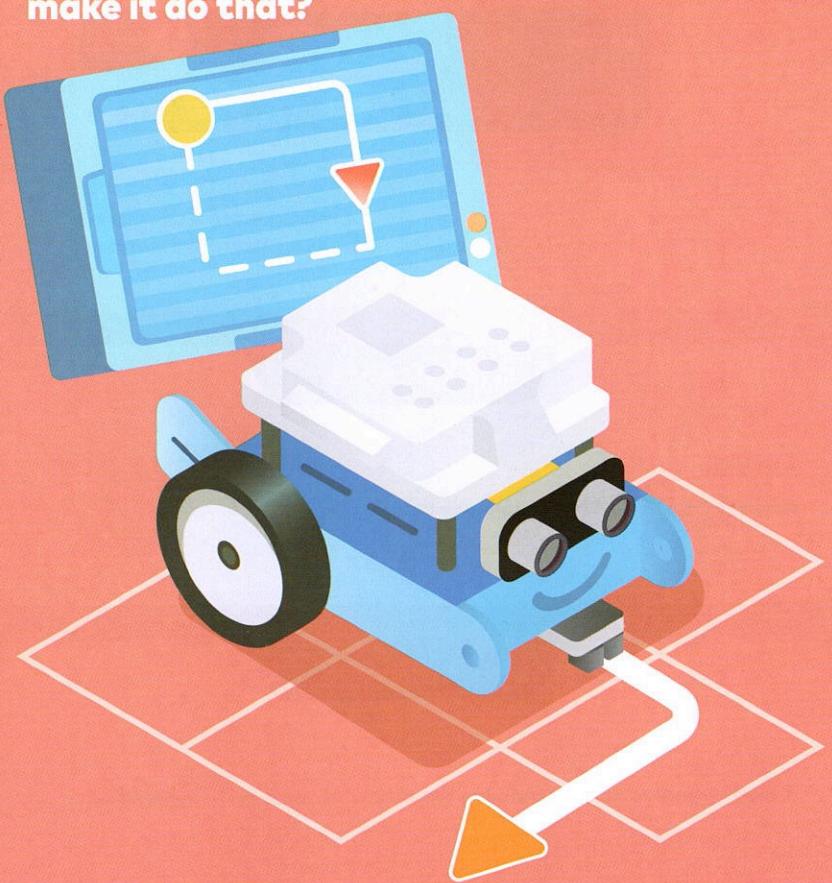
The event blocks available in these two modes are different. If a block is gray, that means it's not available. Before uploading a program, check whether it works.

### Sequential execution

A program consists of a series of instructions, and a building block is an instruction. The program executes the instructions in sequence from top to bottom. This is called sequential execution.

# Move in a square

mBot wants to move in a square. How do we make it do that?



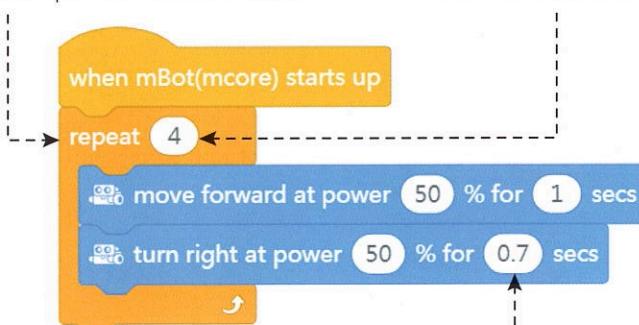
Level 1-2

makeblock

## Program

This block makes the blocks in it repeat a specified number of times.

Modify the number.  
Notice any changes in mBot's movement ?



If your mBot fails to drive in a square, modify this number.

Level1-2

## Concepts

### Loops

Running the same sequence multiple times.

## Challenge

If mBot wants to move in a square twice, how do you modify the program ?

# Ambulance

When mBot was out for a walk, it came across an injured animal. It quickly transformed into an ambulance and took the animal to the hospital.

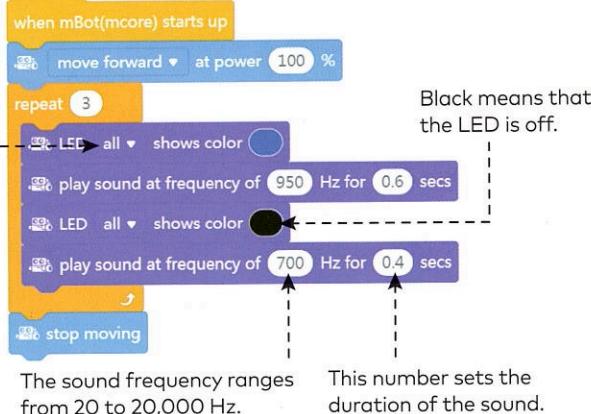


Level 1-3

makeblock

## Program

Click here to choose which light to turn on.

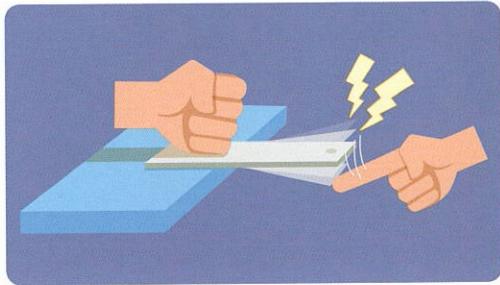


Level1-3

## Concepts

### Sound and frequency

How are sounds made? They are made when objects vibrate. The faster the vibrations are, the higher the pitch of the sound will be. The slower the vibrations are, the lower the pitch of the sound will be. We use Frequency to describe how quickly or slowly an object vibrates, and frequency is measured in Hertz (Hz). Human ears can hear sounds between 20 to 20,000Hz.



Try: Hang a ruler over the desk as shown below, push it down and let it go. Pay attention to the sound changes when the length of the part hanging over the edge of the desk changes.

# Celebrate Christmas

Christmas is coming, so mBot turns on colored lights  
and hums to celebrate.

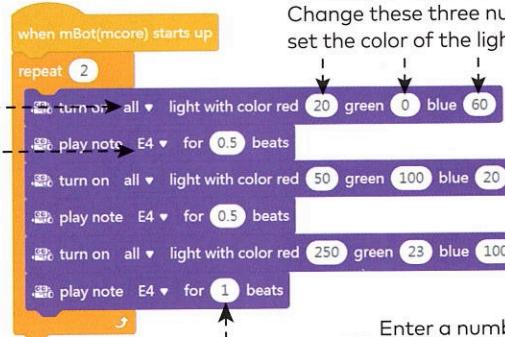
Level 1-4



makeblock

## Program

Click here to choose which light to turn on.



The intensity of red, green, and blue lights ranges from 0 to 255. Change these three numbers to set the color of the light.

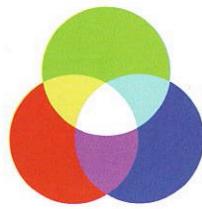
Click here to select and play different notes.

Enter a number here to change the beat.

## Concepts

### RGB

mBot's LEDs can light up different colors, why? In fact, each LED is a combination of three tiny LEDs, and they emit red (R), green (G), and blue (B) light respectively. The intensity of red, green, and blue lights ranges from 0 to 255. Combining the light of red, green, and blue in various amounts can make light of other colors. However, the light of these three colors cannot be obtained by mixing other colors. This is why red, green, and blue are called the primary colors of light.



## Challenge

Music is on and mBot wants to dance! Can you modify the program to add two sways for mBot?

# Solar car

*mBot starts its adventure in the wilderness. There is no gas station in the wilderness, so mBot has to rely on solar energy for power.*



Level 1-5

## Program



Remove the "forever" block and see what happens.

Strong light is necessary in this task, so use a flashlight to shed light on mBot.

mBot moves only when the condition that light intensity is greater than 600 is met.

Adjust this value based on the intensity of the light you shed on mBot.

## Concepts

### Light sensor

A light sensor can measure the intensity of ambient light. The range of the light sensor is 0-1000. If it is exposed to strong light, the value it returns will be over 500. The intensity of night light usually falls between 0 and 100. As for indoor environments, the light intensity may vary between 100 and 500.

### How to check the real-time light intensity detected by mBot?

1. Switch to Live mode.
2. Click the yellow "Update" button to update the firmware.
3. Reconnect mBot after the firmware update is complete.
4. Go to the "Sensing" category and check the box in front of the "light sensor on-board light intensity" block.
5. The light intensity will be displayed on the stage, and it will keep changing.

mBot: light sensor on-board light intensity 975

# Super power

The power of mBot varies on the light intensity.

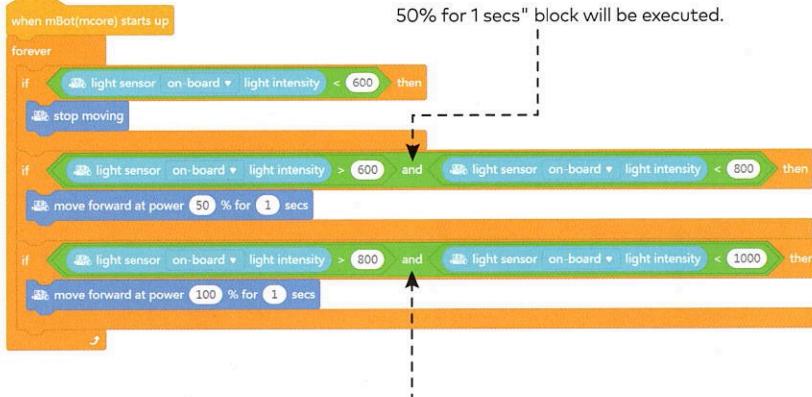
Level 1-6



makeblock

## Program

After uploading the program, shed light on mBot with a flashlight, first at close range, then from a farther distance. Do you notice any changes in mBot's motion?



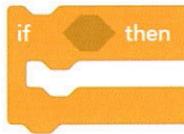
The "and" operator returns true when both conditions held inside are true. In other words, if the light intensity is greater than 600 and less than 800, the "move forward at power 50% for 1 secs" block will be executed.

Try to figure out the range of light intensity which can make mBot move forward at 100% power.

## Concepts

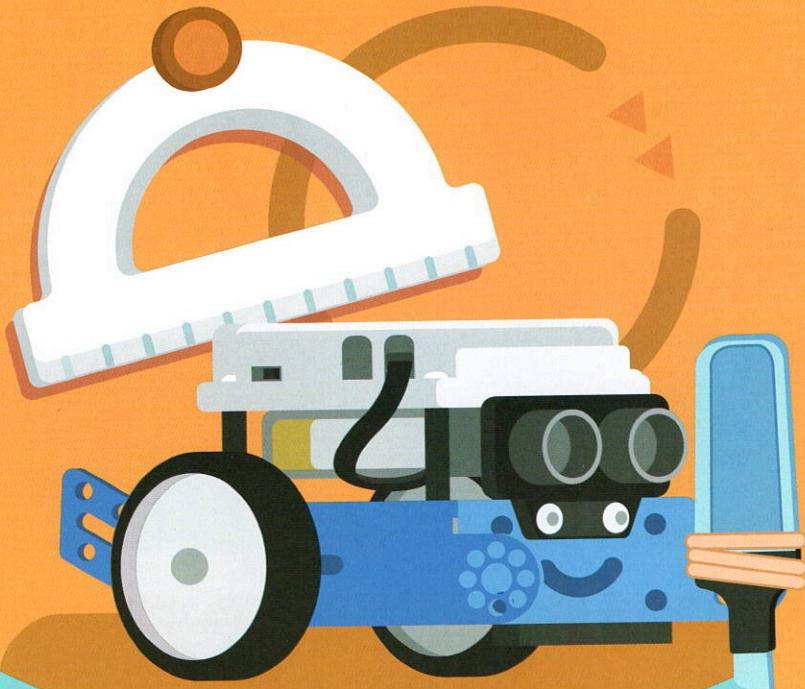
### Conditional statements

Use conditional statements if you want a program to execute instructions based on different conditions. In the program above, mBot will not move forward unless the condition in the "if () then" block is met. Conditional statements enable your program to react differently to different situations.



# Artist

*Fix a pen on mBot and draw circles of different sizes  
by programming mBot to rotate.*



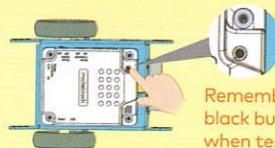
Level 1-7

makeblock

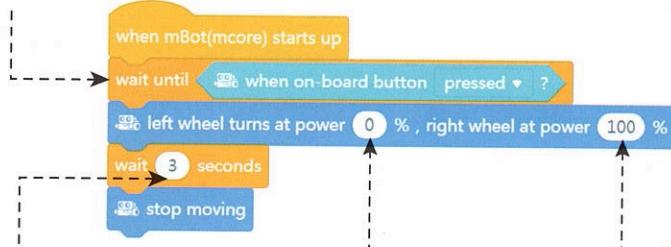
## Program

In this task, you need a pen and a sheet of white paper. Attach the pen to mBot and make mBot draw on the paper.

The "wait until () " block pauses the script until the specified condition in it is met.



Remember to press the black button on mBot when testing.



Modify the waiting time and see if mBot draws out a different shape.

Change the power of the left wheel to 100 and the power of the right wheel to 0. Will mBot draw a different circle, and how different?

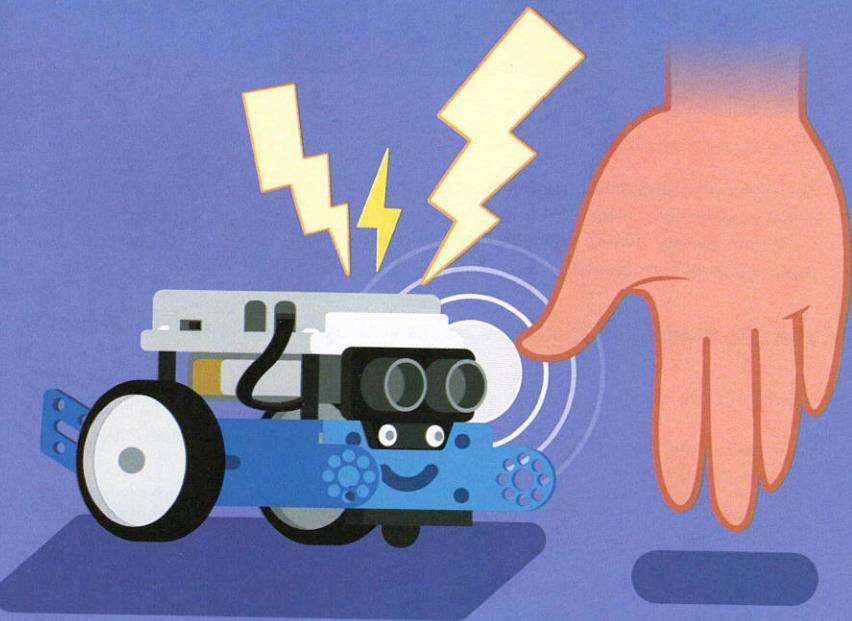


## Challenge

By combining different-sized circles and arcs, what interesting graphics can you control mBot to draw? Try it out!

# Detecting obstacles

*When there is an obstacle in front of mBot, mBot will make a warning sound.*



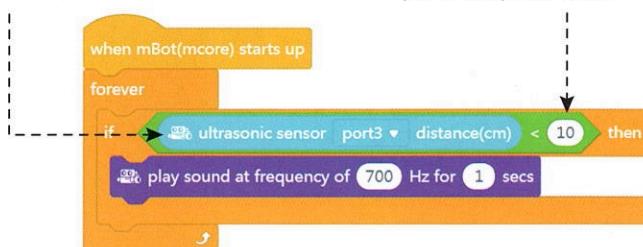
Level 2-1

makeblock

## Program

This block contains the distance detected by the ultrasonic sensor.

If you want to detect an obstacle from a farther distance, how will you modify this value?



## Concepts

### Ultrasonic sensor

The ultrasonic sensor can measure distances. Its detection range is 3-400 cm and its accuracy is 1 cm. The ultrasonic sensor allows mBot to "see" and learns its distance to other objects.



### How to check the distance detected by the ultrasonic sensor?

1. Switch to Live mode.
2. Click the yellow "Update" button to update the firmware.

Update

3. Reconnect mBot after completing the firmware update.

4. Go to the "Sensing" category and check the box in front of the "ultrasonic sensor (port3) distance(cm)" block.



5. You can see the distance detected by the ultrasonic sensor on the stage. If you put your hand in front of the sensor, the distance value will change.

# Obstacle-avoiding car

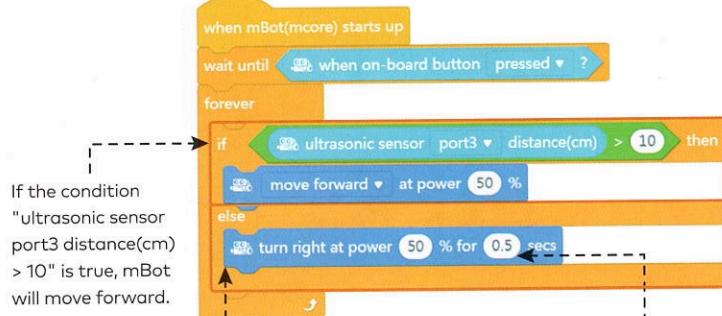
If mBot comes across an obstacle when moving forward, it will turn right at a certain degree to avoid the obstacle.



Level 2-2

makeblock

## Program



If the condition "ultrasonic sensor port3 distance(cm) > 10" is true, mBot will move forward.

As for the "else" part, if the condition is false, mBot will turn right for 0.5 seconds.

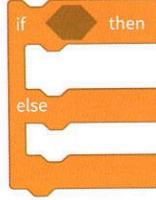
If you want mBot to make a smaller turn, how will you modify this number?

## Concepts

### "if () then" VS "if () then, else"



The "if () then" block only tells the script what to do when the condition is true.



The "if () then, else" block tells the script what to do when the condition is true and also when it is false.

# Follower

*mBot becomes a follower. It follows people who are in front of it.*

Level 2-3

makeblock

## Program

After mBot starts up, the script will be executed only when the button is pressed.

If you want mBot to follow the person even when they are far away from each other, how will you change this number?



## Challenge

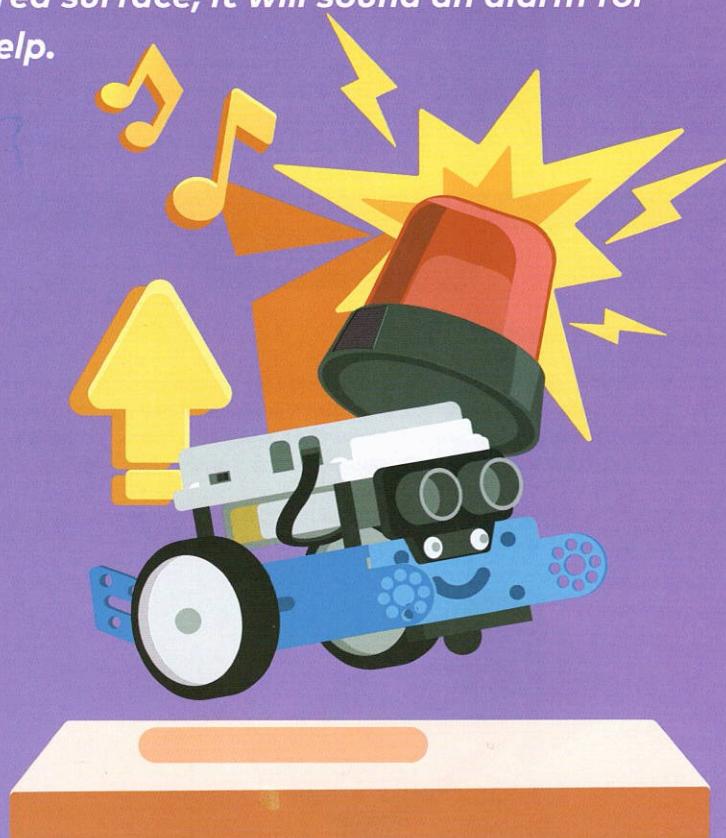
As mBot is following the person, if the person stops suddenly, mBot will hit the person. Can you modify the program to have mBot stop following the person when the distance is less than 20cm?

### Tips:

1. Keep this in mind yourself: if the distance is less than 20, mBot will stop moving; if the distance is 20~50, mBot will move forward; if the distance is greater than 50, mBot will stop moving.
2. Use multiple "if () then" blocks. See Card "Level 1-6" for reference.

# Let me down

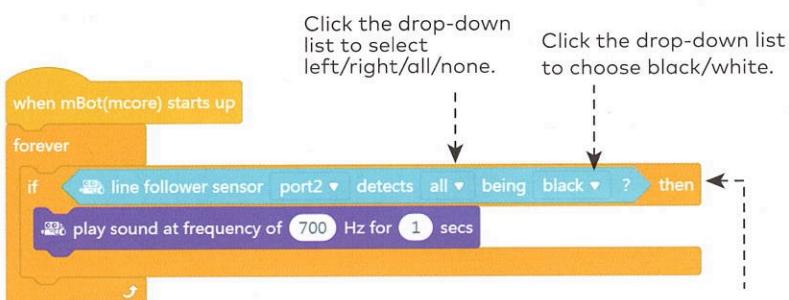
*When mBot is picked up from a light-colored surface, it will sound an alarm for help.*



Level 2-4

makeblock

## Program



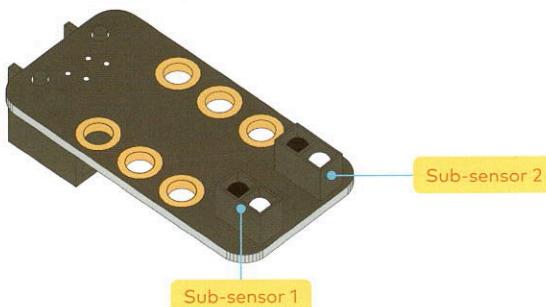
If the line follower sensor detects that all is black, it means that mBot is on a black surface or mBot is beyond the detection range for it's picked up from the surface.

## Concepts

### Line follower sensor

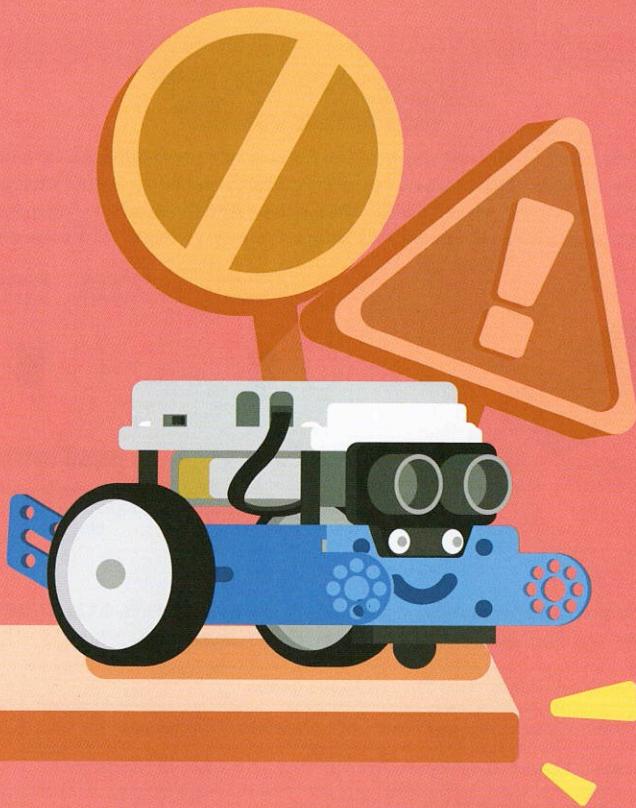
The line follower sensor contains one sub-sensor on the left side and the other on the right side. When it's on a black surface or beyond the detection range (1-2cm), the sub-sensor will show that it detects black. When it's on a white or light-colored surface, the sub-sensor will show that it detects white.

It is called "line follower sensor" because it allows the robot to move along the black line on a white background.



# Cliff Detection

*When mBot is on the edge of a cliff or a surface, it will automatically stop moving forward.*



Level 2-5

makeblock

## Program

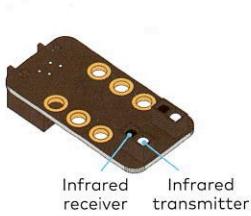
```
when mBot(mcore) starts up
forever
  if [line follower sensor port2 value = 3] then
    [move forward at power 50 %]
  else
    [stop moving]
```

"Value=3" means that both the left and right sub-sensors have received the reflected infrared signal, indicating that mBot is on a white or light-colored surface right now.

When mBot detects black or is beyond the detection range (on the edge), mBot will stop moving forward.

## Concepts

Both the left and right sub-sensors of the line follower sensor are composed of an infrared transmitter and an infrared receiver. If the sensor fails to receive a reflected infrared signal, it could be that the sensor meets a black surface or is beyond the detection range. If the sensor receives a reflected infrared signal, it may be that it meets a white or light-colored surface.



Infrared transmitter      Infrared receiver

Infrared transmitter      Infrared receiver

It can reflect plenty of infrared light when it meets a white or light-colored surface

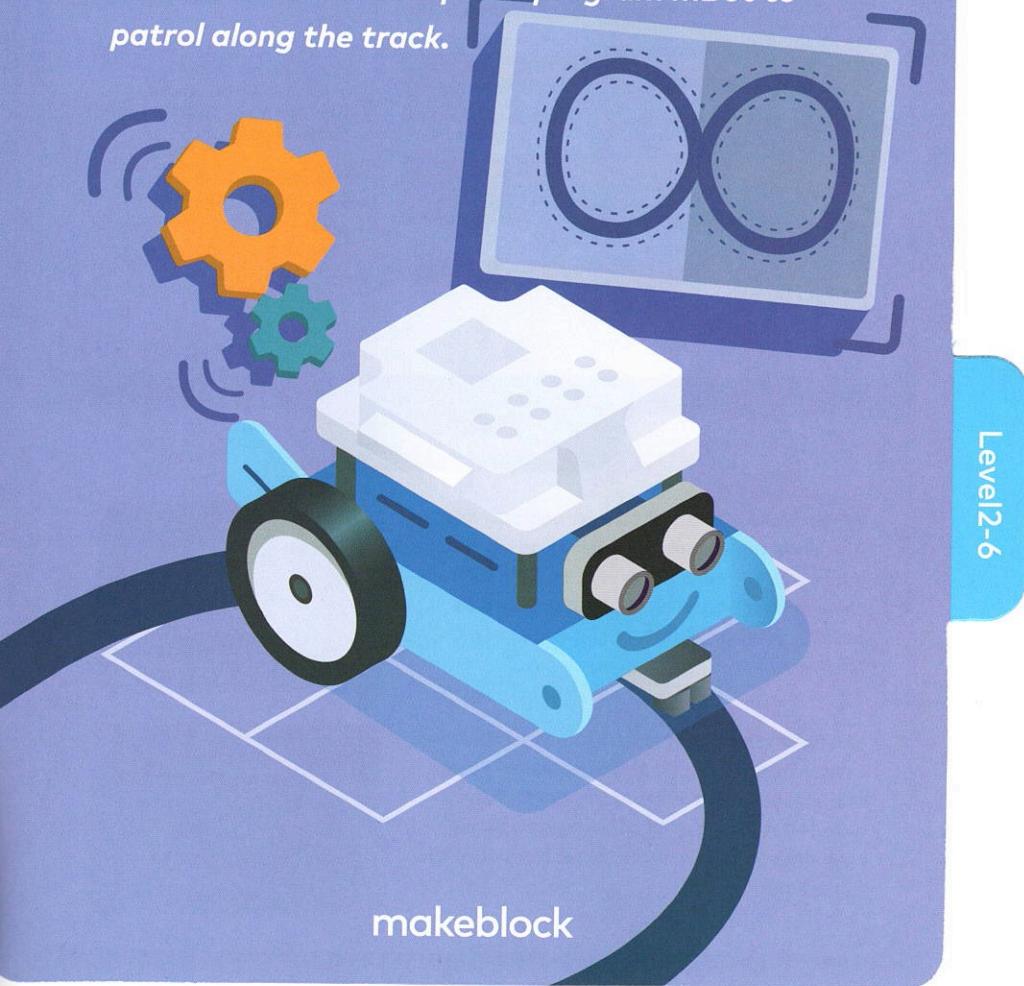
It reflects few infrared light when it meets a black surface.

The line follower sensor may output one of the following four values, 0,1,2 or 3, depending on whether the infrared receiver receives reflected infrared signals.

0: Neither of sub-sensor 1 and 2 has received signals.
1: Sub-sensor 1 has not received signals, but sub-sensor 2 has received signals.
2: Sub-sensor 1 has received signals, but sub-sensor 2 has not received signals.
3: Both sub-sensors 1 and 2 have received signals.

# Track Patrol

Take out the track map and program mBot to patrol along the track.



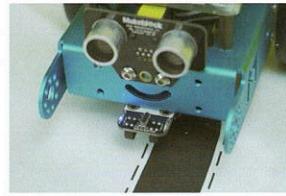
makeblock

## Program

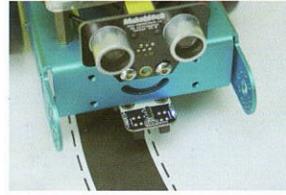
```
when mBot(mcore) starts up
forever
  if [line follower sensor port2 value = 0] then -> When both sub-sensors detect black, mBot can move forward.
    move forward ▾ at power 50 %
  if [line follower sensor port2 value = 1] then -> When the right sensor does not detect black, mBot needs to turn left to get back onto the black line.
    turn left ▾ at power 50 %
  if [line follower sensor port2 value = 2] then -> When the left sensor does not detect black, mBot needs to turn right to get back onto the black line.
    turn right ▾ at power 50 %
  if [line follower sensor port2 value = 3] then -> When neither sensor detects black, mBot needs to move backward to get back onto the black line.
    move backward ▾ at power 50 %
```

## Concepts

When "value=1", it means that only sub-sensor 2 receives the infrared signal, indicating that the sensor on the right side of the line follower sensor is not on the black line right now, so mBot needs to turn left to get back onto the black line.

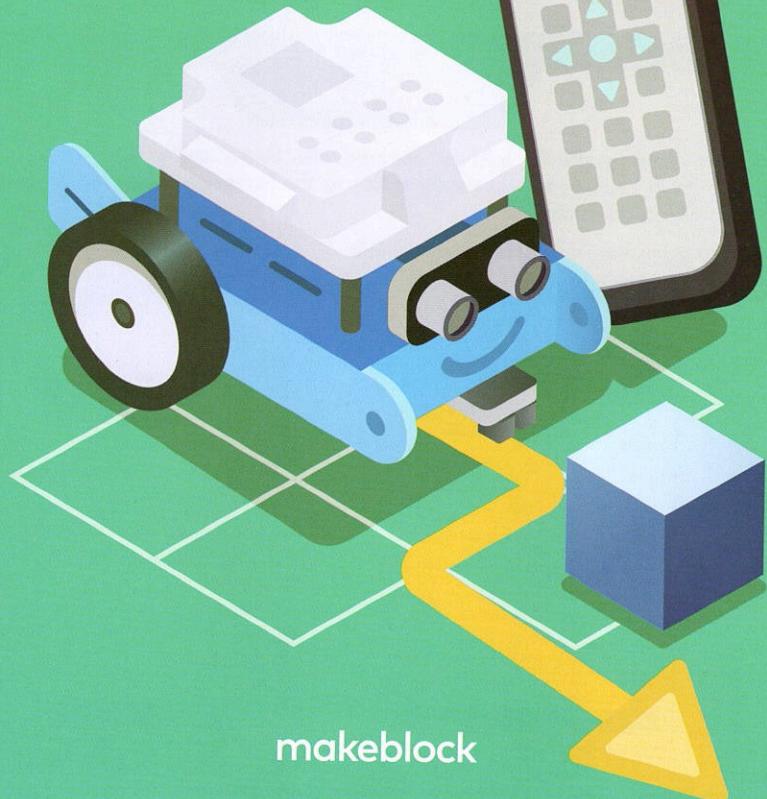


When "value=2", it means that only sub-sensor 1 receives the infrared signal, indicating that the sensor on the left side of the line follower sensor is not on the black line right now, so mBot needs to turn right to get back onto the black line.

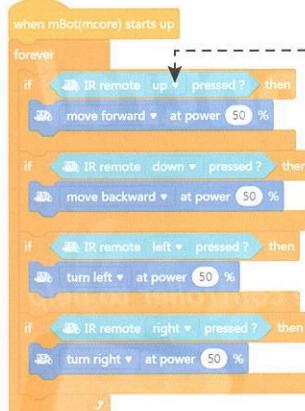


# Remote control mBot

Use your infrared(IR) remote controller to help mBot avoid obstacles.



# Program



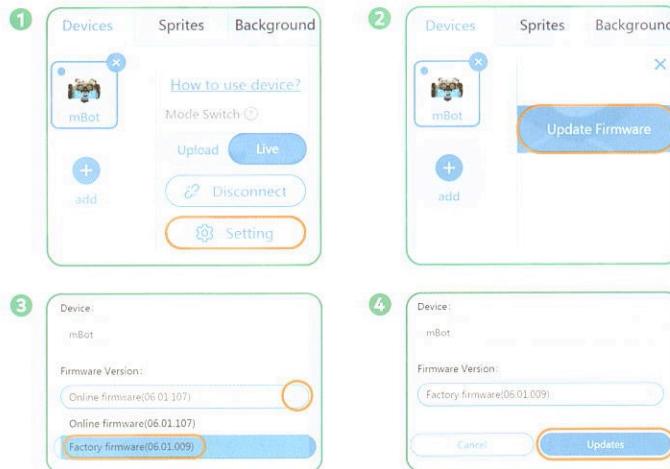
Click the drop-down list to select a button on the remote control.

After uploading the program, point the IR remote controller at the front of mBot and press a button to make mBot move as programmed.

## Concepts

You can program the infrared remote controller to define the function of each button, or you can restore the mBot to the factory settings, so that you can use its initial functions.

How to restore mBot to factory settings:



## Program



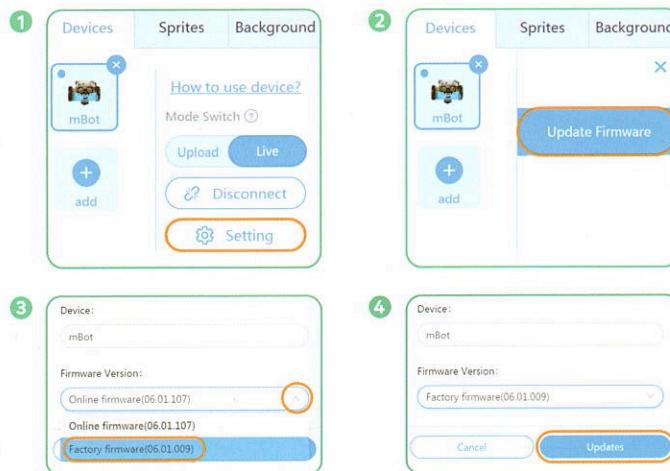
Click the drop-down list to select a button on the remote control.

After uploading the program, point the IR remote controller at the front of mBot and press a button to make mBot move as programmed.

## Concepts

You can program the infrared remote controller to define the function of each button, or you can restore the mBot to the factory settings, so that you can use its initial functions.

How to restore mBot to factory settings:



# **It's dawn, it's dark**

*When the light is sufficient, the backdrop  
is a city during the day; or else the back-  
drop is a city during the night.*



Level 3-2

makeblock

## Program

You need to enter the Devices area, switch to Live mode, and then write your program.



You can use this block only when mBot is in Live mode.

Mode Switch  
Upload Live

when green flag clicked  
forever  
set light v to (light sensor on-board light intensity)

The data returned from the light sensor keeps changing, so you need to use a "forever" block.

Click green flag, then block the light sensor of mBot with your hand to see the effect.



One single "light" variable is shared across Sprites and Devices, which is the light data returned from the light sensor.

When the light data is higher than 500, the backdrop switches to "City6".  
When the light data is less than or equal to 500, the backdrop switches to "City night3".

## Concepts

### Variable

In computer programming, we often create variables to store changing values, like light and distance. Think of creating a variable as asking the computer for a box to store values. The value in the box can change constantly, but the box name must be unique. One single variable can be shared across devices and sprite.

### How to make a variable



# **Tell us the distance**

**Use mBot to measure the distance from an object and let the sprite read the value aloud.**



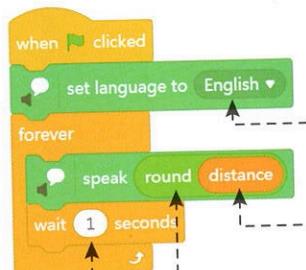
Level 3-3

makeblock

## Program



Create a "distance" variable and store the distance data returned from the ultrasonic sensor in this variable.



Give it a try. What happens if you remove the "wait (1) seconds" block?

Make sure your computer has a speaker if you want the sprite to read the distance data aloud.

Add the "Text to Speech" extension to use these blocks. Click the drop-down list to select a language.

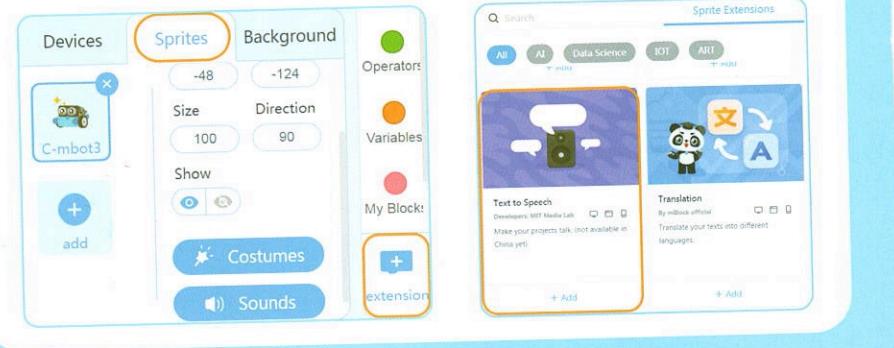
Put the "distance" variable in the "speak ()" block to read aloud the value stored in the variable.

The "round ()" block rounds the value to the nearest integer.

## Concepts

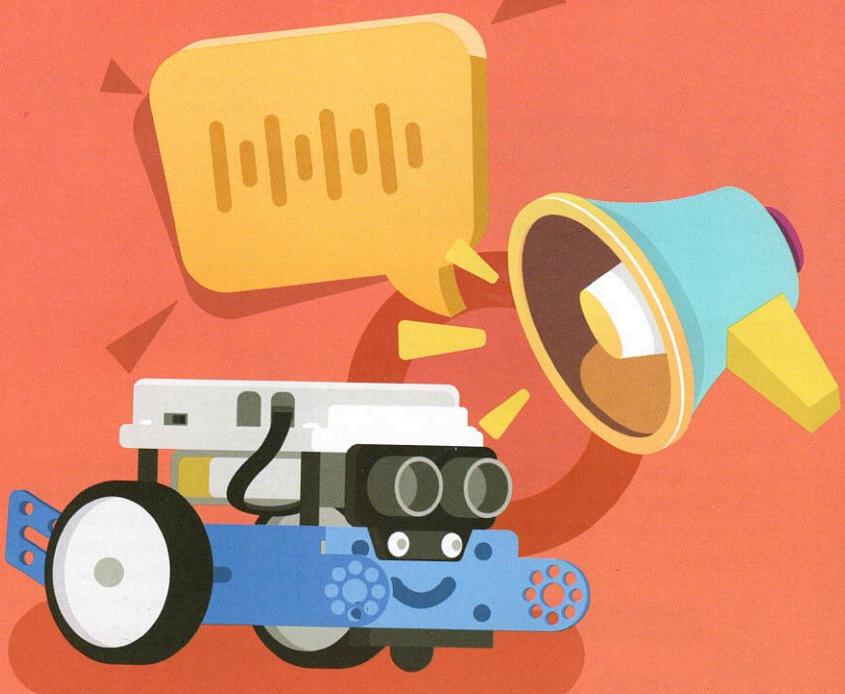
### Text to Speech

"Text to Speech" is an extension which makes your project talk. Click the "extension" button in the Sprites area to enter Sprite Extensions, and click the "Add" button to see the speech related blocks.



# Voice controlled mBot

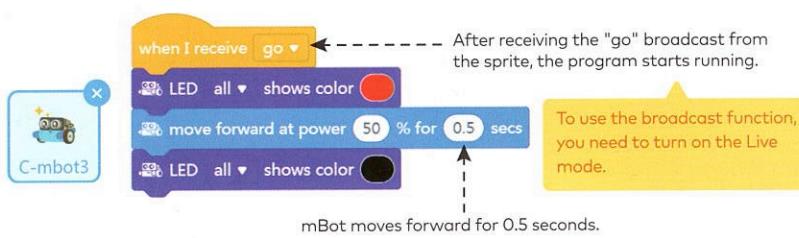
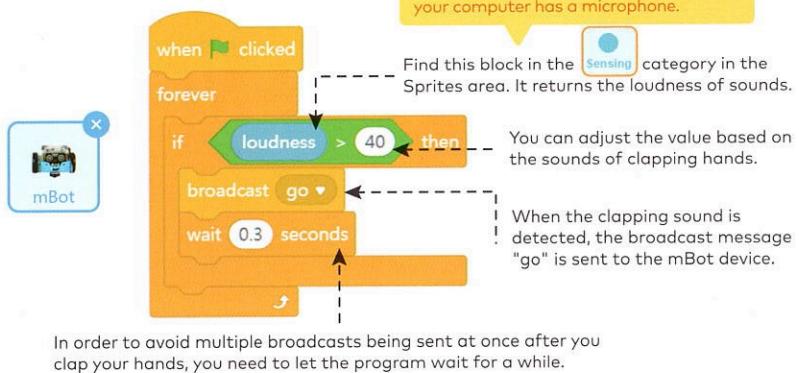
*Make mBot move forward by clapping hands or making a sound.*



Level 3-4

makeblock

## Program



## Concepts

### Loudness

In Live mode, you can check the box in front of the "loudness" block for the sprite so that you can monitor the loudness data on the stage.



### Broadcast

A sprite can send a broadcast to other sprites or devices when it needs to send messages or commands to them. Make sure the name for the broadcast one sends is consistent with the broadcast name in the receiving script.

