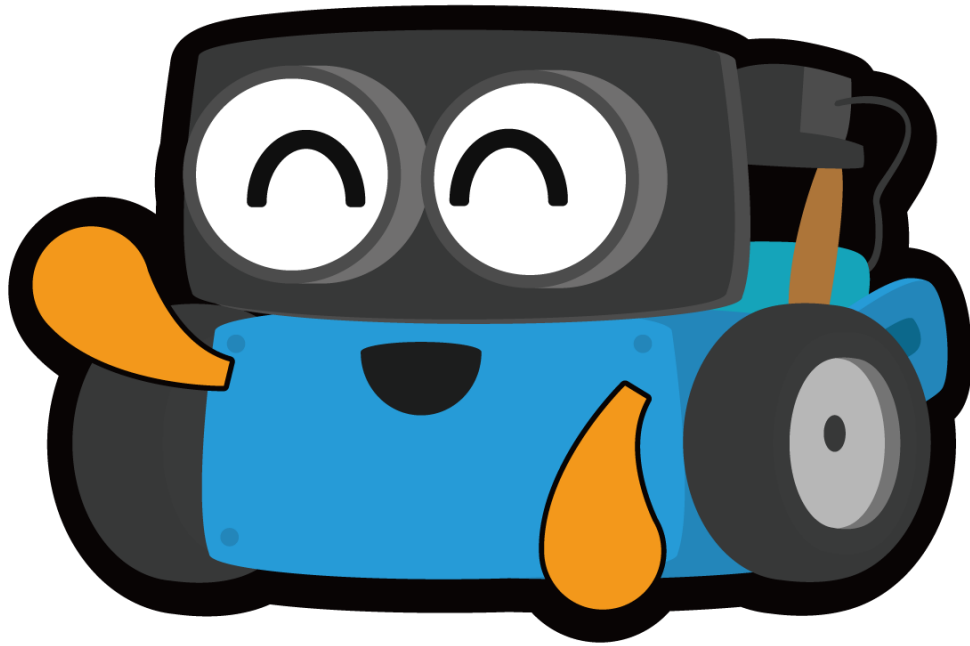


ST LOUIS SCHOOL

COMPUTER LITERACY



mBot programming

Workbook

Name: _____

Class: _____

Number: _____

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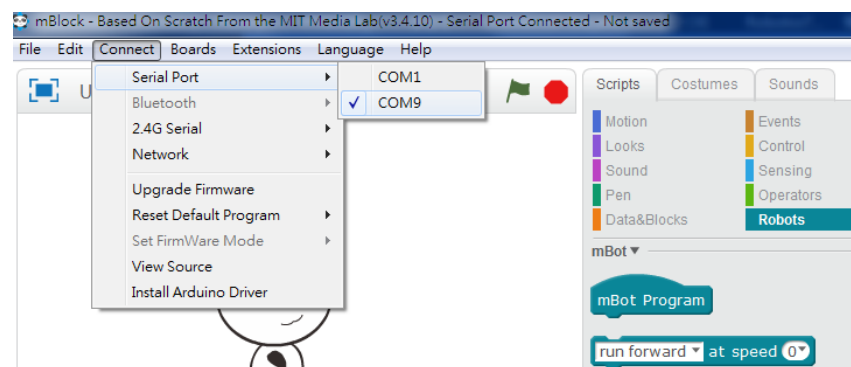
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LESSON 1

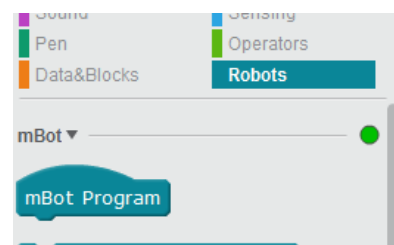


Connect your mBot

Before doing the following test, make sure you choose the right COM port in the mBlock program (different computer may show different COM port for the mBot) after connecting with a USB cable.



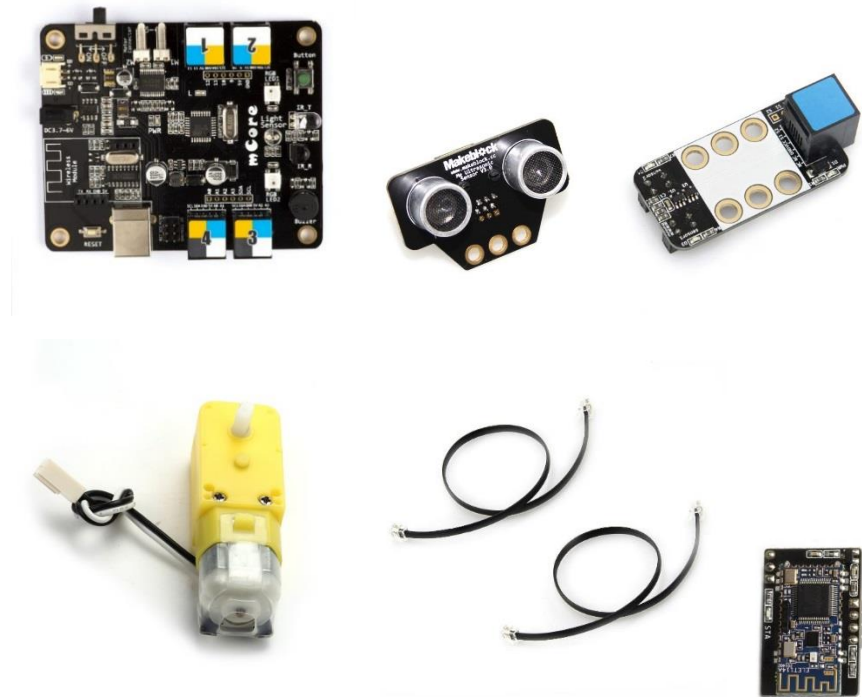
If there is no problem, you should see the status indicator turns green.



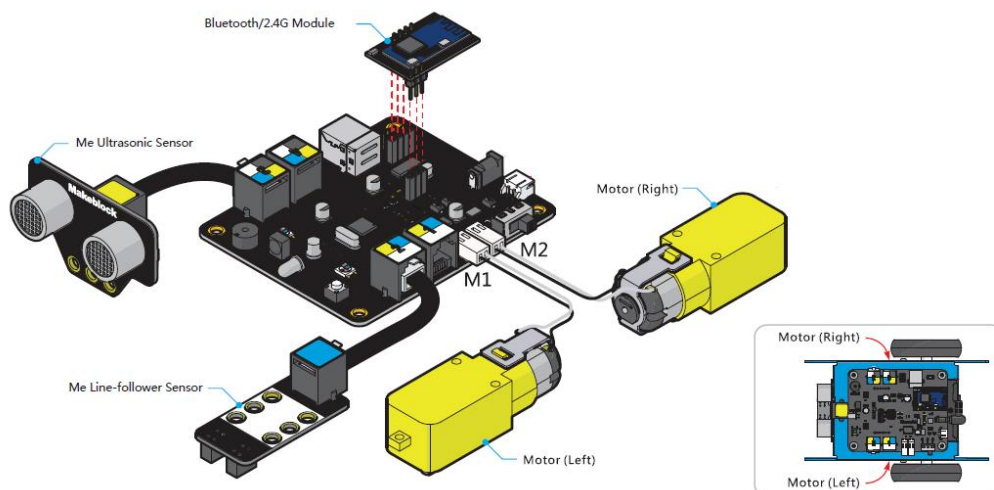
Wiring

You are suggested to remove the cover case at this moment.

Take out the following components:



Do the following wiring



Testing

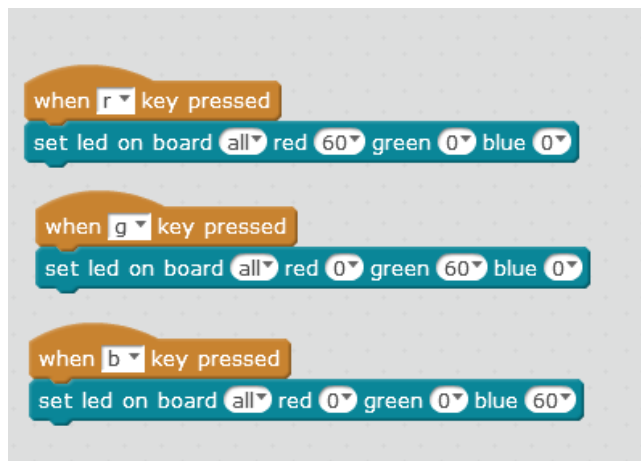
Make sure you have connected the mBot by USB cable and have switched on the mBot.

Test 1 (Line follower module)

How to turn off the blue light on the module when the infra-red sensors facing downwards?

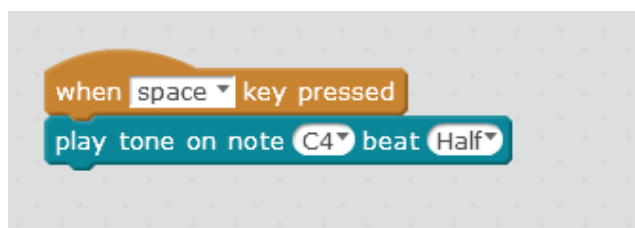
1. Reflecting on a white paper? YES/NO
2. Covered by your fingers? YES/NO
3. Reflecting on a dark surface? YES/NO

Test 2 (RGB LED Light)



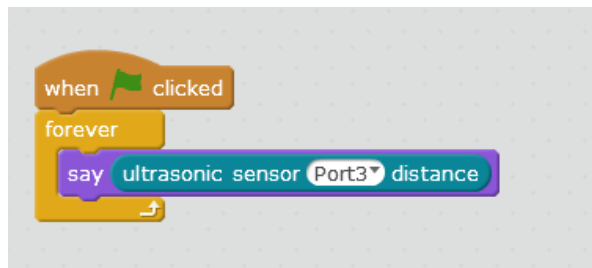
Can you see the LED lights change colour when you press different key? YES/NO

Test 3 (Buzzer)



Can you hear sound when you press the SPACE bar? YES/NO

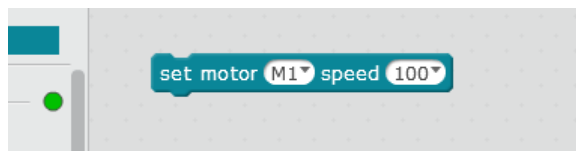
Test 4 (Ultrasonic sensor)



Can you see the reading change when you move your hand in front of the ultrasonic sensor?

YES/NO

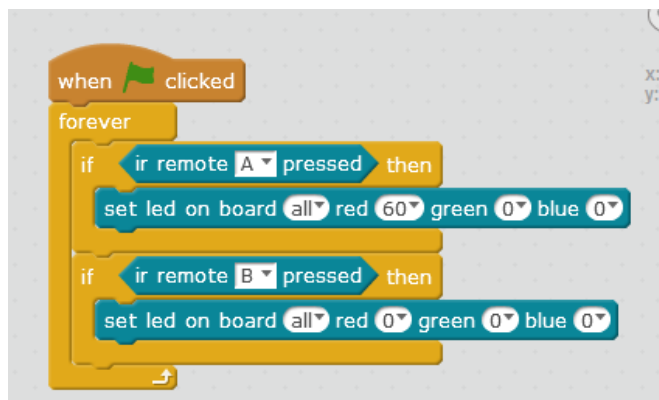
Test 5 (Motors)



Can you see the rotation of the motor?

YES/NO

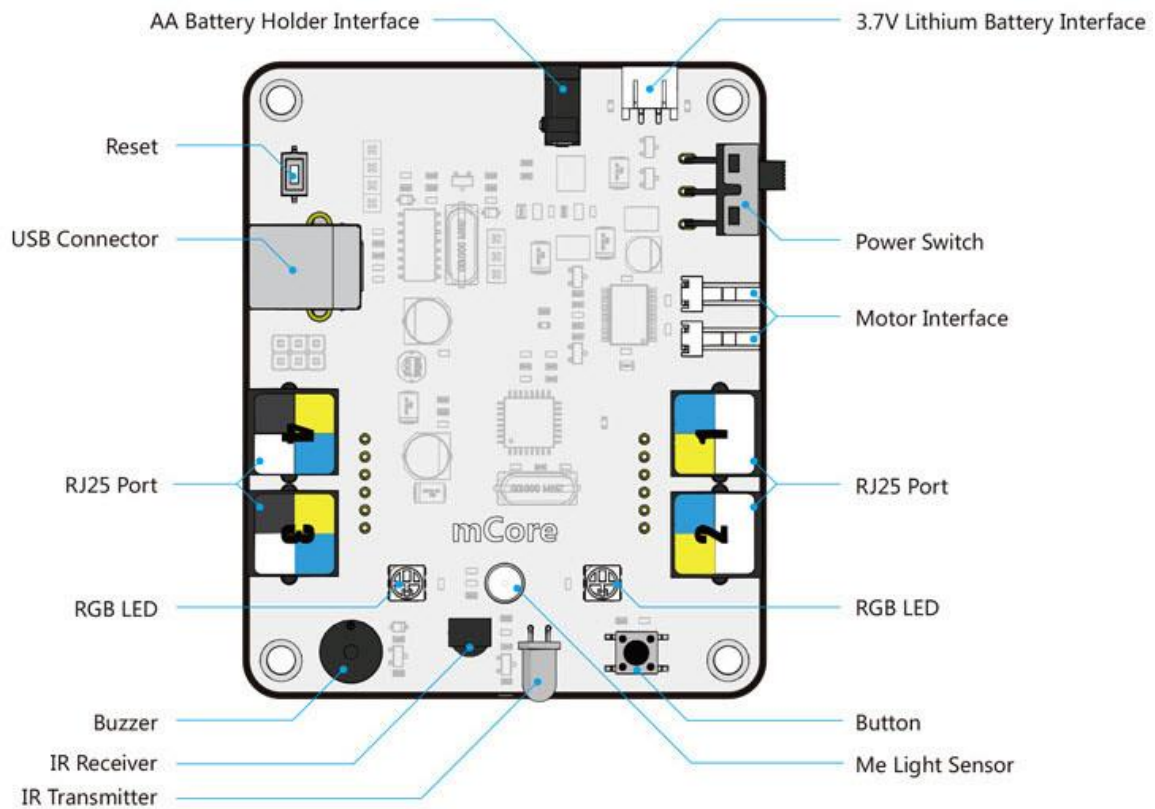
Test 6 (Onboard Infrared)



Can the remote controller turn on and off the LED on board?

YES/NO

LESSON 2



The mBot motherboard is equipped with two LEDs. Each LED consists of a red light, a green light and a blue light.

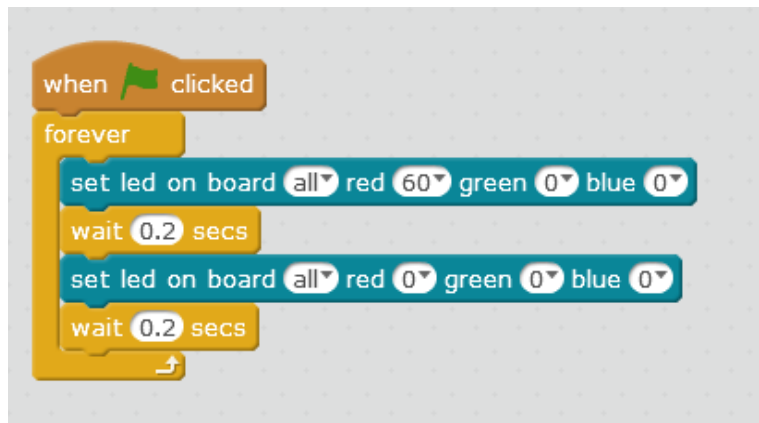
Try



What do you observe?

The intensity of each colour light is represented by a number which ranges from 0 to 255. Different colours can be generated by adjusting the intensity of each colour light.

Task 1



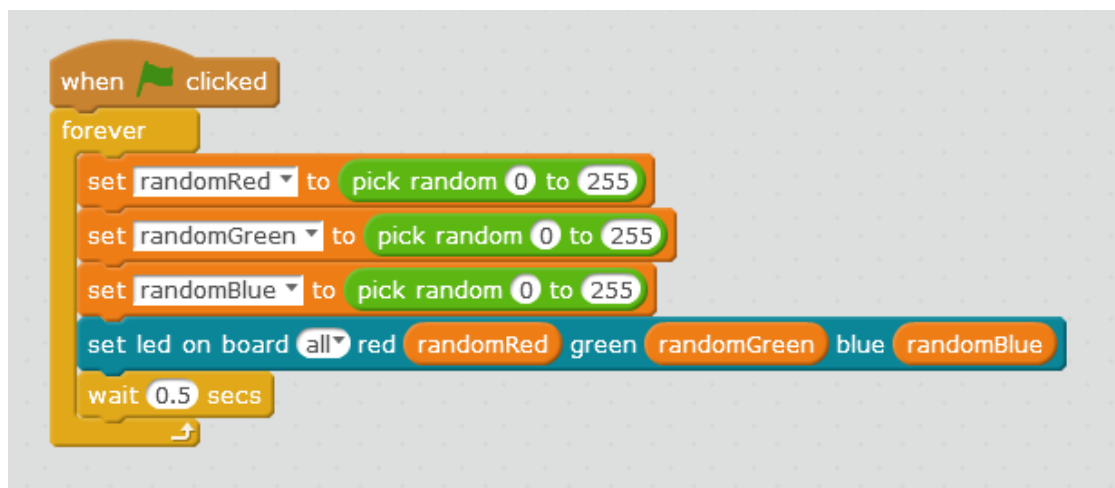
You should see the red light is flashing.

Questions:

- How to make the light flash slowly?
- How to flash red light first, then green and finally blue?
- How to flash left LED light only?
- How to flash left and right LED light interchangeably?

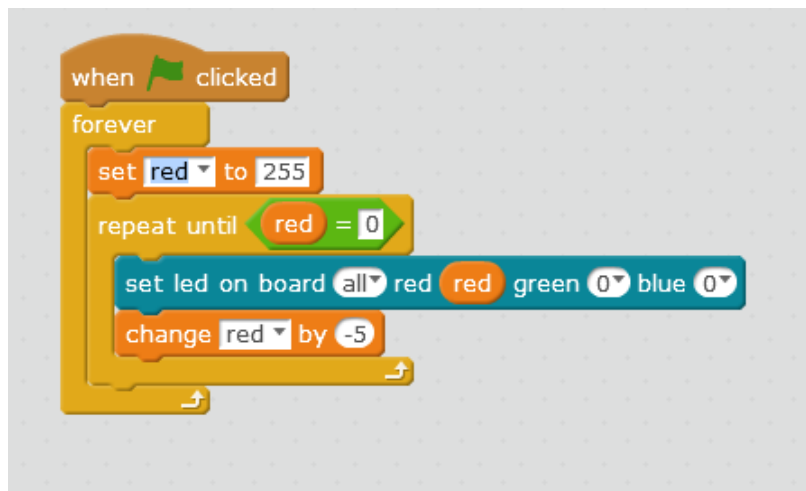
Task 2

Create three variables randomRed, randomGreen and randomBlue.



Task 3

Start a new file, create a variable named red.



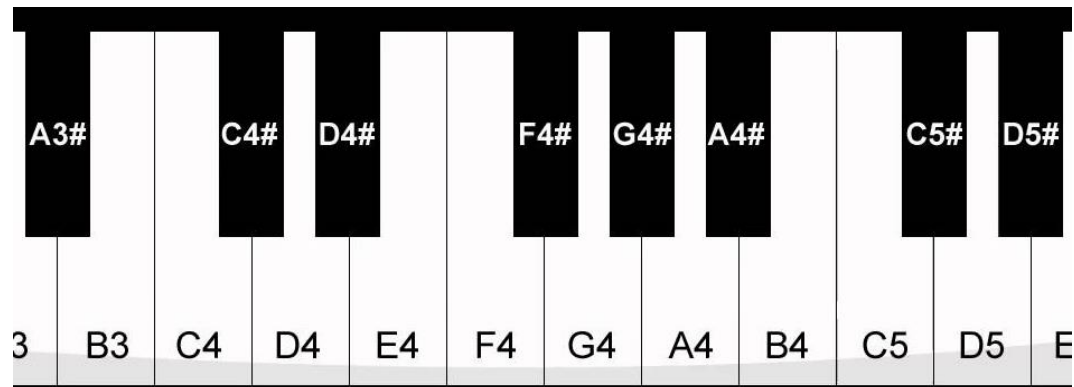
You will see the light will turn red on and off gradually.

Questions

- How to make a faster change?
- What is the problem when changing the number from -5 to -2? How to correct the problem?

LESSON 3

We can let the mBot to make sound by using play tone block which is under robot category. Please don't mix up with the play note block under sound category.

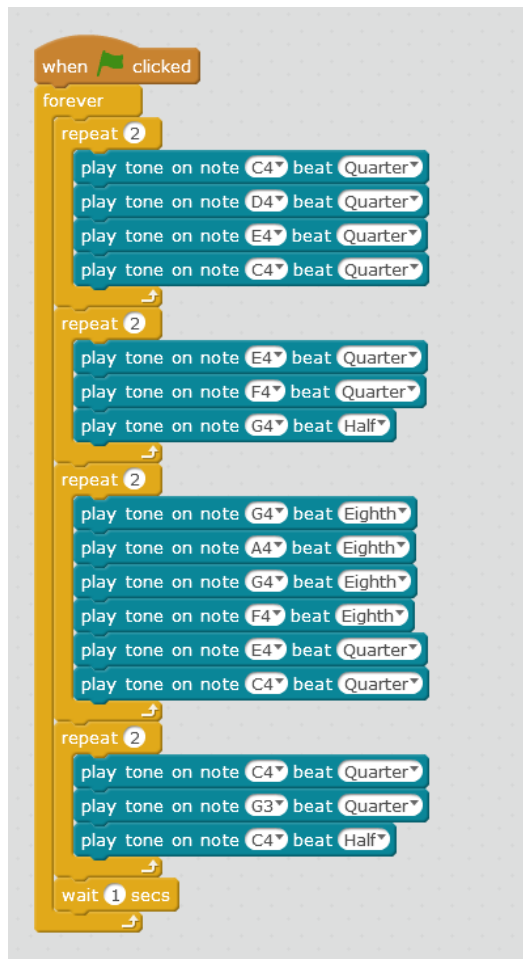


The play tone command can control the tone and the beat played by the mBot.



Whole Note			Two Half Notes	
Half Note			Two Quarter Notes	
Quarter Note			Two Eighth Notes	
Eighth Note			Two Sixteenth Notes	
Sixteenth Note			Two Thirty-second Notes	

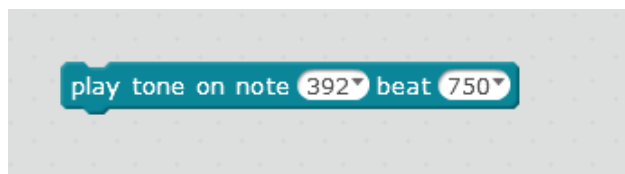
Task 1



Notice that we can't choose C#4 tone from the play tone command. We have to input the corresponding frequency number. Similarly, we can input the duration (in milliseconds) inside the beat part.

Piano key	Tone	Frequency
ti	B3	246.9
do	C4	261.6
do#	C#4	277.2
re	D4	293.7
re#	D#4	311.2
mi	E4	329.2
fa	F4	349.2
fa#	F#4	370
so	G4	392
so#	G#4	415.4
la	A4	440
la#	A#4	466.2
ti	B4	493.9
do	C5	523.3
do#	C#5	554.4
la	D5	587.4
la#	D#5	622.3
mi	E5	659.3

For example, if we want the mBot emit the F#4 tone with duration 0.75s, we add the following:



However, the above notation is hard to read, we may use variables.



Task 2

The musical score is written for a single voice part in G major (one sharp) and common time (C). It consists of eight staves of music, each with a corresponding line of lyrics. The lyrics are: "All Hail! All Hail! Sa-le-sian School to thee! By time en-deared the more, our hearts shall e-ver e-ver loy-al be to thee and friends of yore, and me-mo-ries that shall ne-ver ne-ver fade wher-e-ver we may roam, shall ri-vet fast the friend-ship made in youth at boy-hood's home. Long live our Al-ma Ma-ter! On thee may bles-sings rain, and may thy sons here-af-ter bring ho-nour to thy name. Saint Lou-is School, guide of our youth, we're loy-al to you in faith and truth. Saint Lou-is School, guide of our youth, we're loy-al to you in faith and truth. All Hail!"

All Hail! All Hail! Sa - le - sian School to thee! By time en - deared the
 more, our hearts shall e - ver e - ver loy - al be to thee and friends of
 yore, and me - mo - ries that shall ne - ver ne - ver fade wher - e - ver we may
 roam, shall ri - vet fast the friend - ship made in youth at boy - hood's
 home. Long live our Al - ma Ma - ter! On thee may bles - sings
 rain, and may thy sons here - af - ter bring ho - nour to thy
 name. Saint Lou - is School, guide of our youth, we're
 loy - al to you in faith and truth. Saint Lou - is School, guide
 of our youth, we're loy - al to you in faith and truth. All Hail!

when clicked
set do to 261.6
set do# to 277.2
set re to 293.7
set re# to 311.2
set mi to 329.7
set fa to 349.2
set fa# to 370
set so to 392
set so# to 415.4
set la to 440
set la# to 466.2
set ti to 493.9
set doU to 523.3
set do#U to 554.4
set reU to 587.4

when clicked
play tone on note do beat Quarter
play tone on note fa beat Quarter
play tone on note la beat Quarter
play tone on note doU beat 375
play tone on note la beat Eighth
play tone on note so beat 187.5
play tone on note fa beat 62.5
play tone on note mi beat Eighth
play tone on note so beat Eighth
play tone on note fa beat Quarter
play tone on note fa beat Quarter
play tone on note re beat Quarter
play tone on note fa beat Quarter
play tone on note la# beat Quarter
play tone on note reU beat Quarter
play tone on note doU beat Half

OR

when clicked
set ASharp4 to 466.2

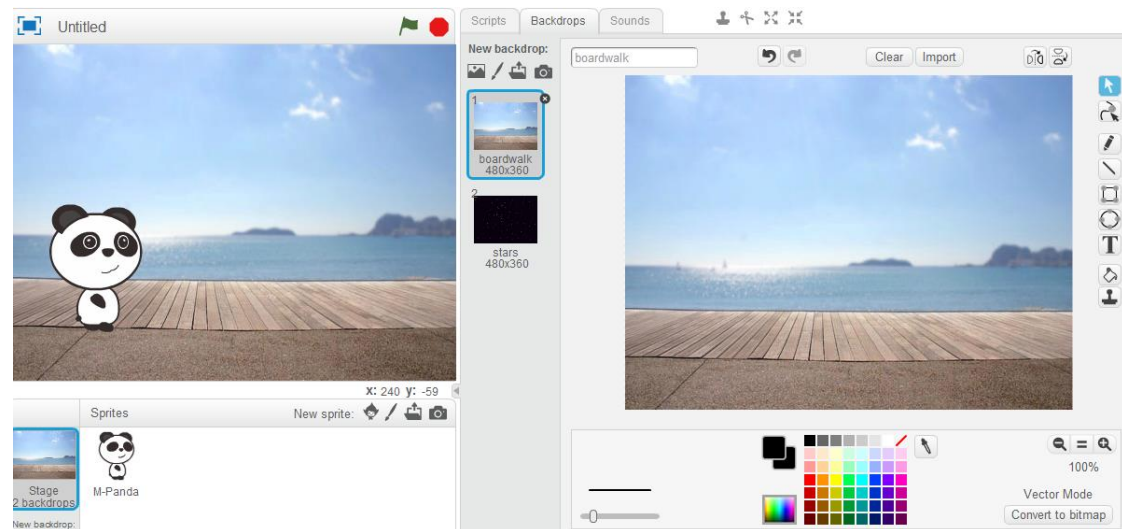
when clicked
play tone on note C4 beat Quarter
play tone on note F4 beat Quarter
play tone on note A4 beat Quarter
play tone on note C5 beat 375
play tone on note A4 beat Eighth
play tone on note G4 beat 187.5
play tone on note F4 beat 62.5
play tone on note E4 beat Eighth
play tone on note G4 beat Eighth
play tone on note F4 beat Quarter
play tone on note F4 beat Quarter
play tone on note D4 beat Quarter
play tone on note F4 beat Quarter
play tone on note ASharp4 beat Quarter
play tone on note D5 beat Quarter
play tone on note C5 beat Half

Please complete the school song.

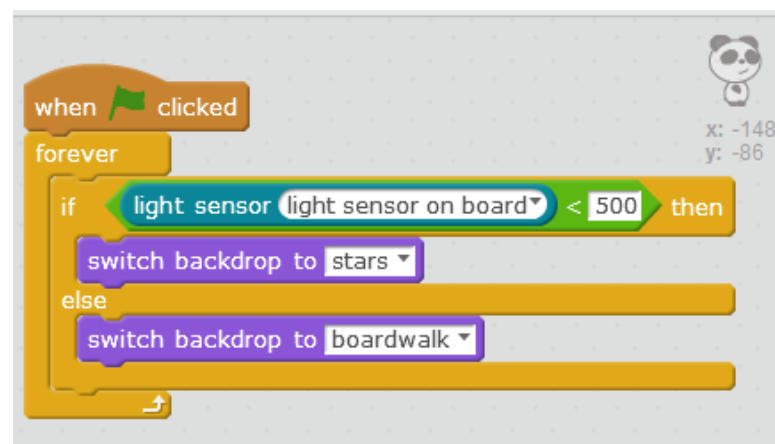
LESSON 4

Task 1

Step 1: Start a new file and create two backdrops (one backdrop indicates afternoon while the other indicates the night).



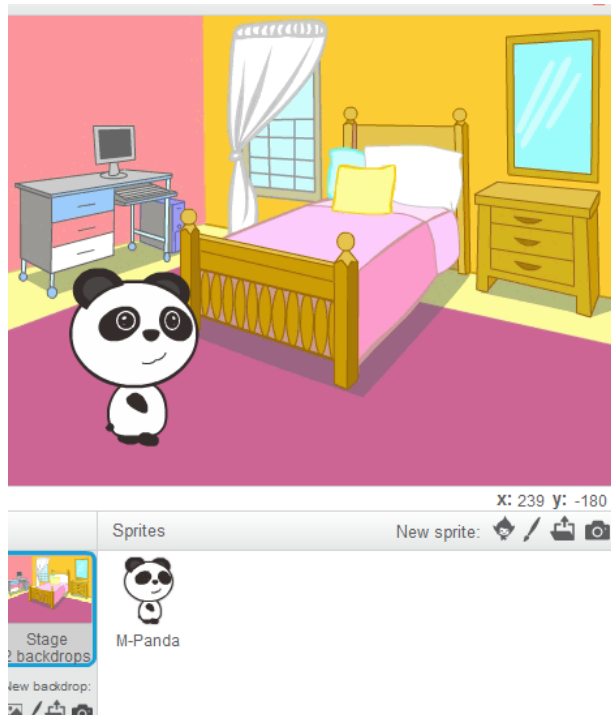
Step 2: Add the following script to the default sprite.



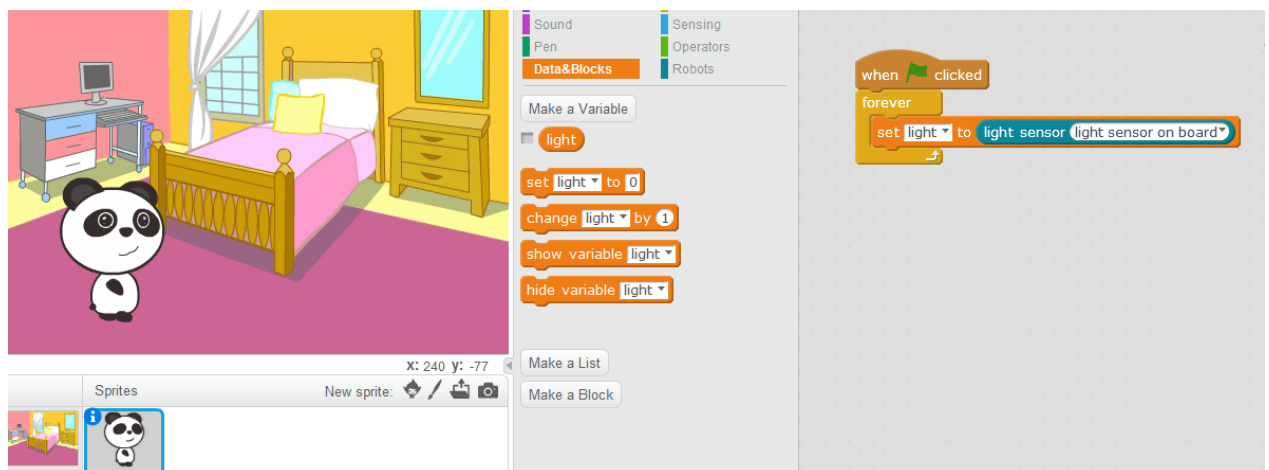
Question: What happens when the light sensor is covered by hand?

Task 2

Step 1: Start a new file and change the backdrop.



Step 2: Add a variable light to store the current reading of the light sensor on board. The script should put inside the default sprite.



Step 3: Add the following script into the script area of the backdrop.



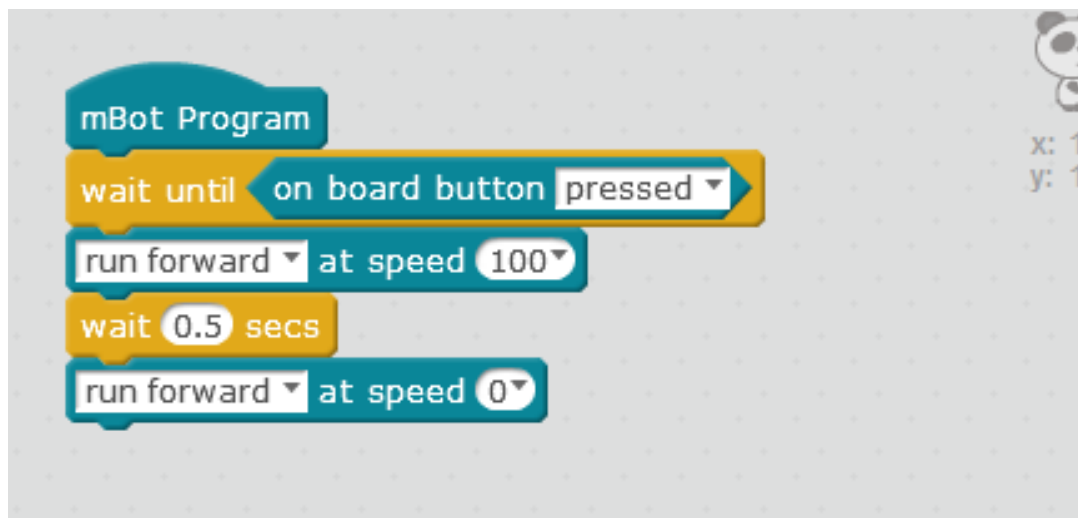
Brightness = [sensor value / 1023 * 100] – 100

	Normal	Dark
Brightness	0	-100
Sensor value (0-1023)	1023	0

Question: What do you observe?

LESSON 5

Task 1: Write a program for mBot such that it starts to move 30cm forward after pressing the button on board.



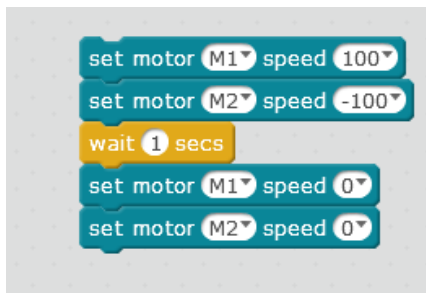
Does your mBot move 30cm forward after pressing the button on board? If no, what need to be modified?

Note: You have to choose the COM port every time after you detach the USB cable.

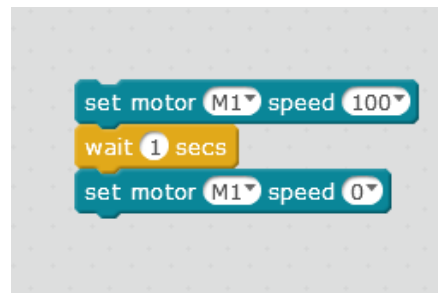
LESSON 6

Task 1: Write a program for mBot such that it moves forwards along a square (side = 30cm) after pressing the button on board. The mBot should stop at the same starting point and facing the same direction.

Task 2: Compare the following.



Program segment 1



Program segment 2

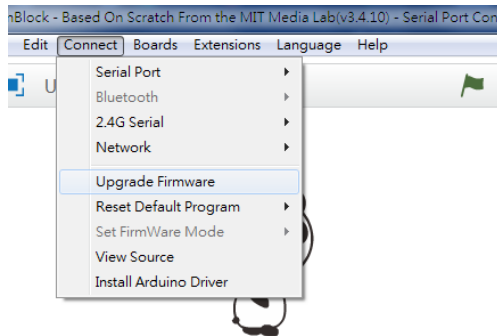
What are the differences? Where is the center of rotation?

Task 3: Write a program for mBot to move forward when the light sensor is covered by your hand.

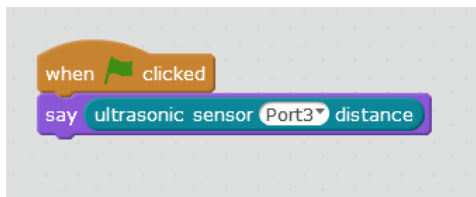


LESSON 7

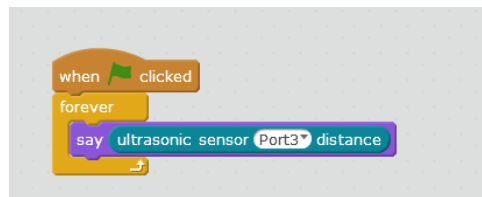
Note: If you experience problem when testing your mBot, you may first clear the installed program by updating the firmware.



To obtain the reading of the ultrasonic sensor, we may use a “say” block. Which of the following program segment will be used? Why?



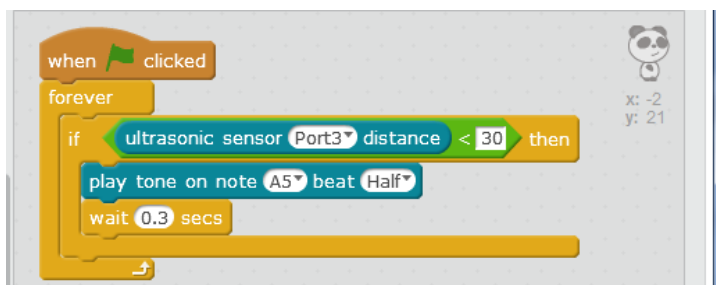
Program segment 1



Program segment 2

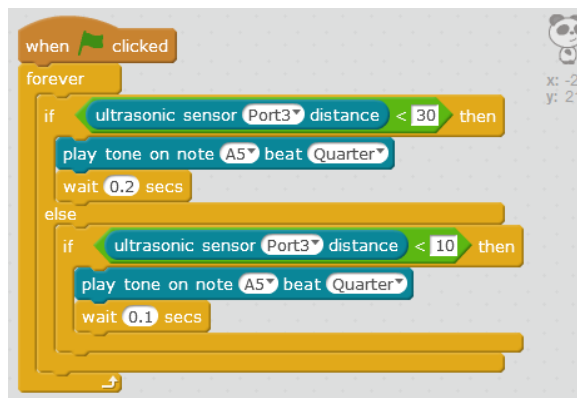
Task 1

Try the following.

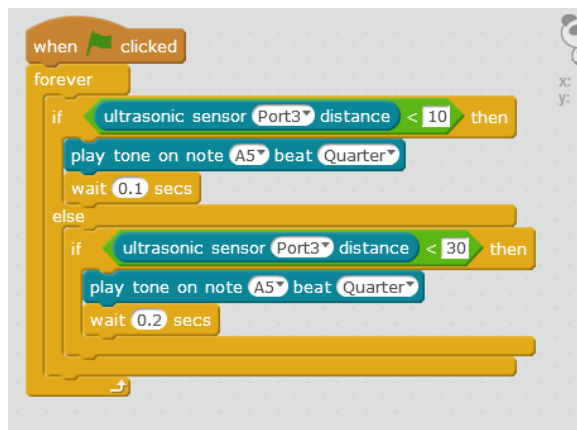


You will hear the beat sound when there is an object in front.

If we want the faster tone indicating that the distance is closer, which of the following program will be used?



Program 1



Program 2

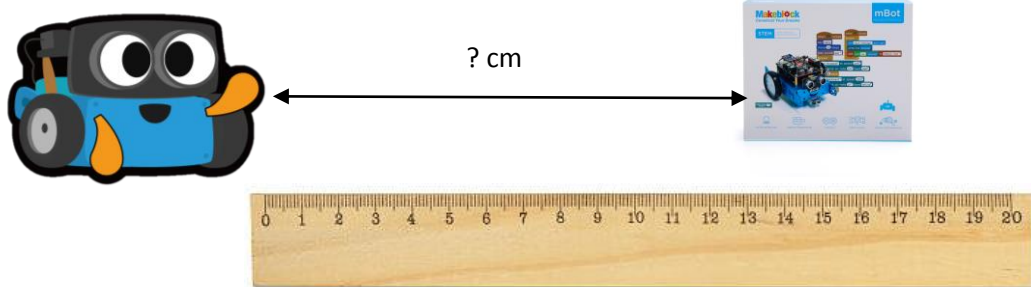
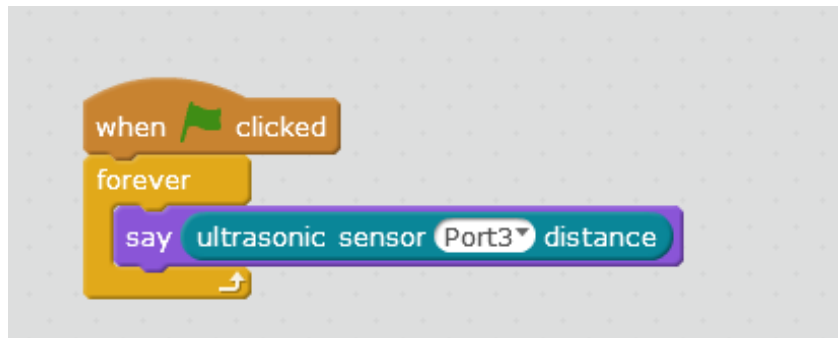
We will use (Program 1 / Program 2).

Modify the program such that the effect is more realistic.

By using a ruler, compare the reading output with the actual distance measured, is the reading accurate? If not, how to output an accurate reading?

Task 2

Use a ruler and the program below to record the reading output.



Fill in the following table.

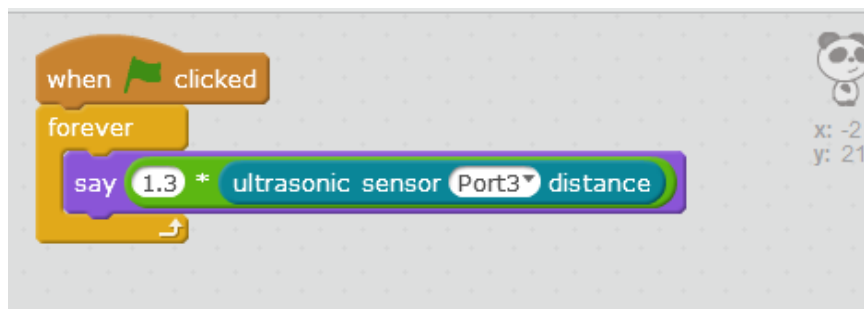
	Actual distance (A)	Reading output (B)	A/B (scale factor)
Try 1	5		
Try 2	10		
Try 3	15		
Try 4	20		
Try 5	25		
Try 6	30		

Example

	Actual distance (A)	Reading output (B)	A/B (scale factor)
Try 1	5	3.7	1.35
Try 2	10	7.5	1.33
Try 3	15	11.5	1.30
Try 4	20	15.8	1.26
Try 5	25	19.5	1.28
Try 6	30	23.5	1.27

Choose a suitable scale factor. For example, you may take the average of the scale factors obtained. In the example, we may choose 1.30 as the scale factor.

Modify the program and compare again the actual distance and the reading.



LESSON 8

Advance line following program (For reference)

The image shows a Scratch script for an mBot line following program. The main script is titled "mBot Program" and includes the following blocks:

- set speed to 255
- wait until on board button pressed
- forever loop:
 - set line to line follower Port2
 - if line = 0 then:
 - run forward at speed speed
 - set normal to 10
 - if line = 1 then:
 - run forward at speed speed
 - if normal > 1 then:
 - change normal by -1
 - if line = 2 then:
 - run forward at speed speed
 - if normal < 20 then:
 - change normal by 1
 - if line = 3 then:
 - if normal = 10 then:
 - run forward at speed speed
 - if normal < 10 then:
 - LeftTurn
 - if normal > 10 then:
 - RightTurn

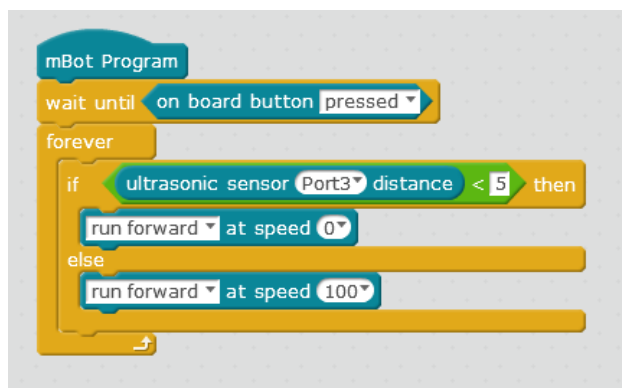
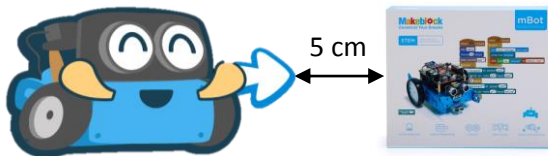
There are two subroutines defined on the right:

- define LeftTurn**
 - set motor M1 speed 0
 - set motor M2 speed speed
- define RightTurn**
 - set motor M1 speed speed
 - set motor M2 speed 0

The interface includes a search icon, an equals sign, and a plus icon at the bottom right. A small panda icon with coordinates "x: -2 y: 21" is visible in the top right corner.

LESSON 9

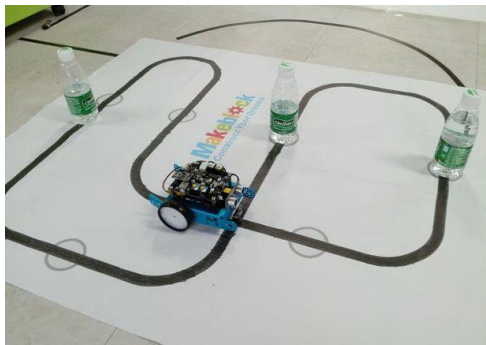
Task 1: Write a program for mBot such that it starts to move forward the box after pressing the button on board and stop exactly at 5cm in front of the box.



Does the program shown above work as expected? YES/NO

If not, why? Try to build your own program. What will happen if you remove the box?

Task 2: Write a program for mBot such that it will run automatically in the lane and detect if there is a roadblock along the way. (p.46-48 in the textbook)



Task 3: Write a program for mBot such that it will run automatically in the lane and reverse if there is a roadblock along the way. (p.49-51 in the textbook)

