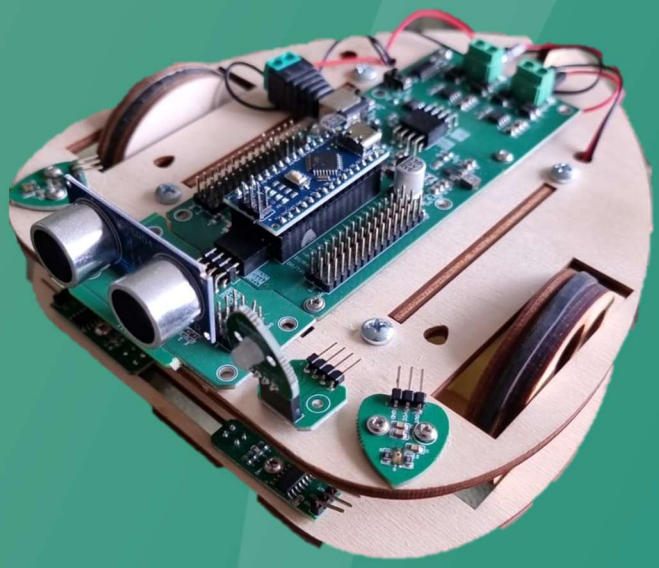
Leaphy Original

Workbook

Leaphy Murphy Shield



LEAPHY

Robotica voor iedere leerling

Leaphy Original - Workbook - Introduction

How does this book work?

This book contains lessons for the educational robot Leaphy Original. The lessons are divided into levels. Each level introduces new skills and knowledge. In this way you will become familiar with robotics step by step.

Do not panic

Leaphy doesn't always do what you want right away. That's why you can learn so much from it.
So:
Just try it. Make mistakes calmly and solve them again. That way you'll get further every time.

Tips and solutions

Are you really stuck at a level?
You can find tips from other Leaphy builders on the Leaphy forum on discord.
The red solution booklet also contains sample programs that will help you get back on track.

Arduino Technique

The Leaphy robot works with an Arduino mini computer. Arduino is used by professional designers and engineers around the world. Use it carefully and you will enjoy it for a long time.
And now: let's get started….enjoy it!
The team of the Leaphy Foundation

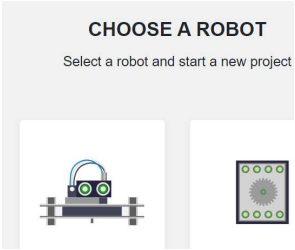
Robot design Leaphy Original: Olivier van Beekum, Vroukje van der Vliet & Hannah Kersbergen
Teaching material - concept and elaboration: Olivier van Beekum & Roeland Smith
First edition – Oktober 2024 © Stichting Leaphy

Level 1 – Building and Programming

Build your Leaphy Original with the instruction video's on the Leaphy Original Building page at www.leaphyfoundation.com
Then program your Leaphy Original using the levels from this workbook.

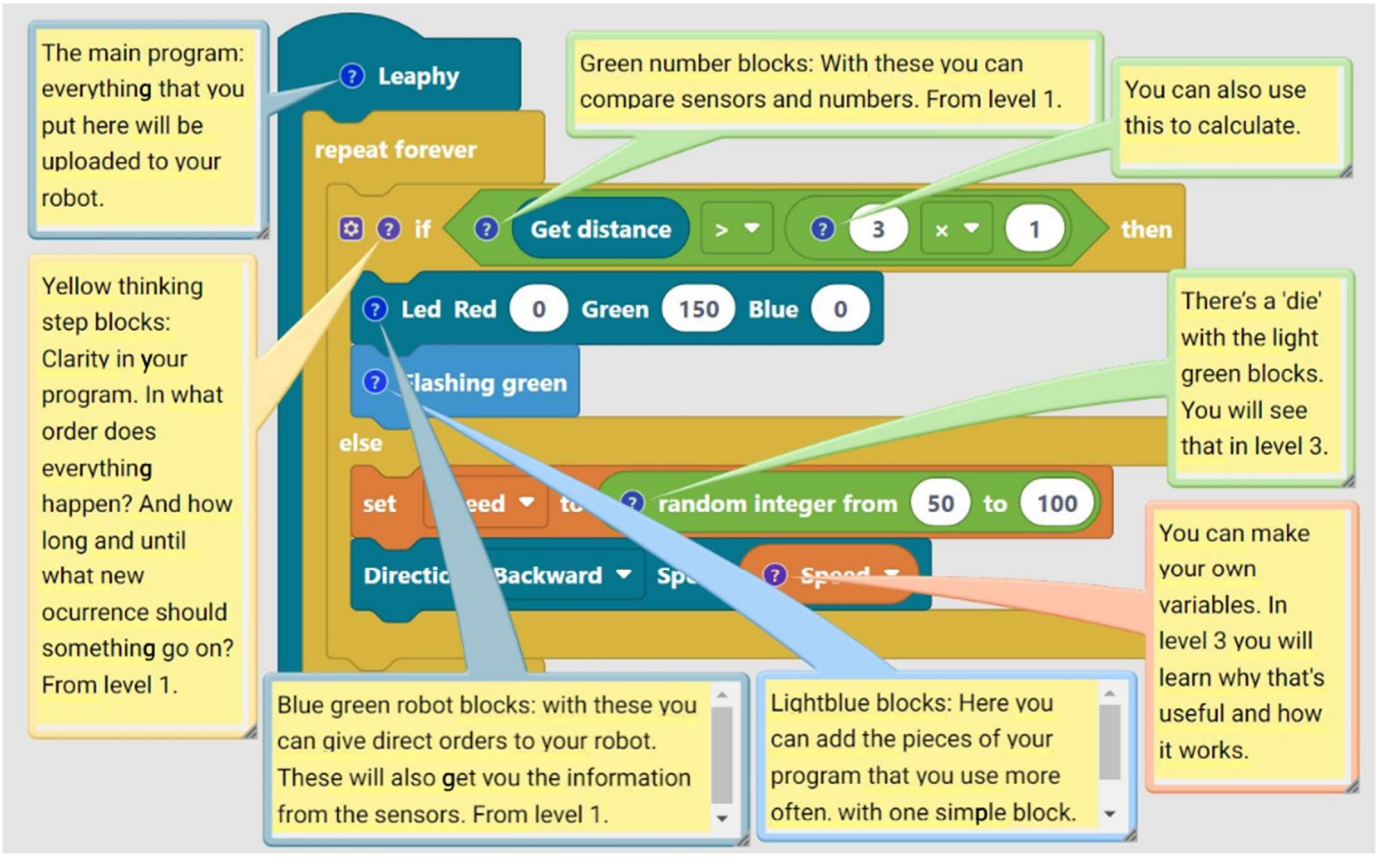
Level 1. 0 – Software Setup

• Go to leaphyeasybloqs.com and you can start right away.
For Windows computers you might have to install the drivers you can find under 'more' in the top menu.
Rather have a desktop version? Install Leaphy Easybloqs (www.leaphyfoundation.com)
• Start Easybloqs and choose 'Leaphy Original' nano.



Level 1.1 – Five types of programming blocks

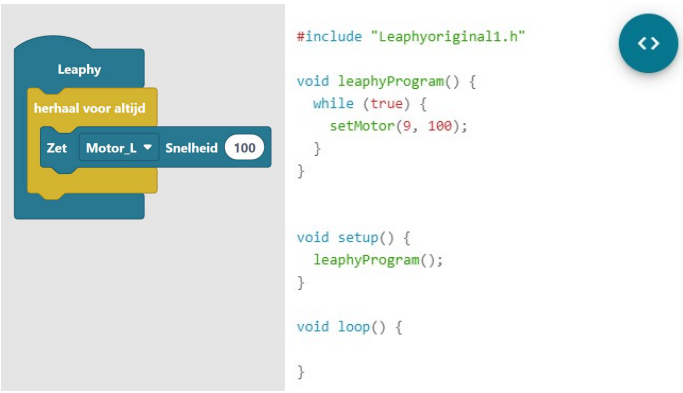
You will find them all in this workbook. Would you like to know in advance what will come? Here they all are together with a short explanation.



Level 1 – Building and Programming

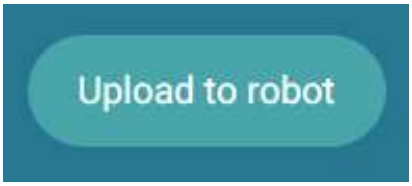
Level 1.2 – Watching Code

By pressing the round button at the top right with the two arrows, you will see the code that will soon be placed on your robot.



Level 1.3 – Upload Code

Connect your Leaphy with the USB cable. Press the 'upload to robot' button.
Easybloqs will now check which USB port your robot is connected to and upload the code.
Some Windows versions may require a driver to be installed. In principle, Apple already has the correct drivers. It doesn't work? Check leaphyfoundation.com for tips.
Is the upload really not working? Check (possibly with a system administrator) whether the USB ports are open (sometimes these are closed for security reasons). Leaphy is not dangerous…Otherwise contact our helpdesk.



Level 1.4 – Clearing and keeping Blocks

Blocks are quickly thrown away with 'delete'.
You can also drag them all the way to the left, until the hand becomes a red cross or trow them in the bin on the bottom left.

You cannot throw the main Leaphy block away.
The backpack at the bottom left is a kind of treasure chest: what you keep in it, you can retrieve later.

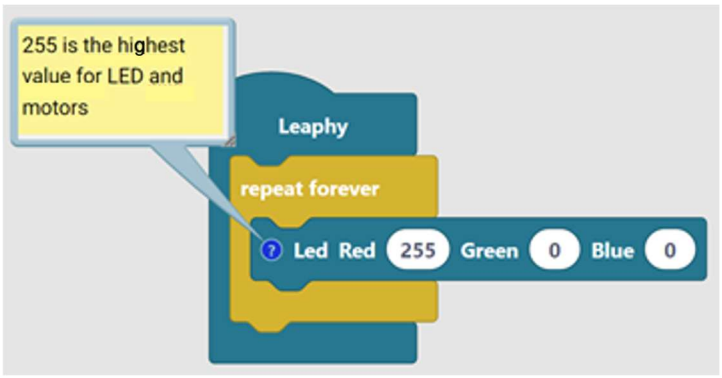
Level 2 – Shine & Drive

The Leaphy has as RGB LED: a light with red, green and blue. You can mix all colors with it. Leaphy can also drive and dodge objects with its motors and the ultrasonic distance sensor.
In this level you will learn how to work with this.

Level 2.1 – Color Testing

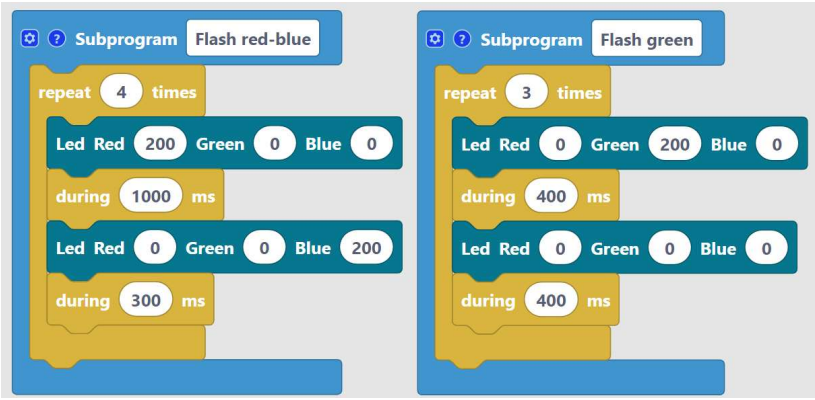
Create and upload this program. Here's how to test the red light. Is it not right?
Reconnect:

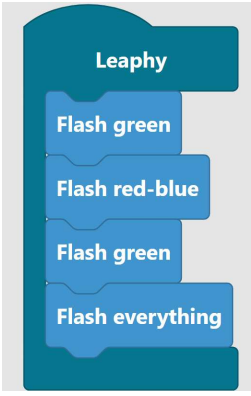
Shield	RGB-Led
8	- (min)
9	B (Blue)
10	G (Green)
11	R (Red)



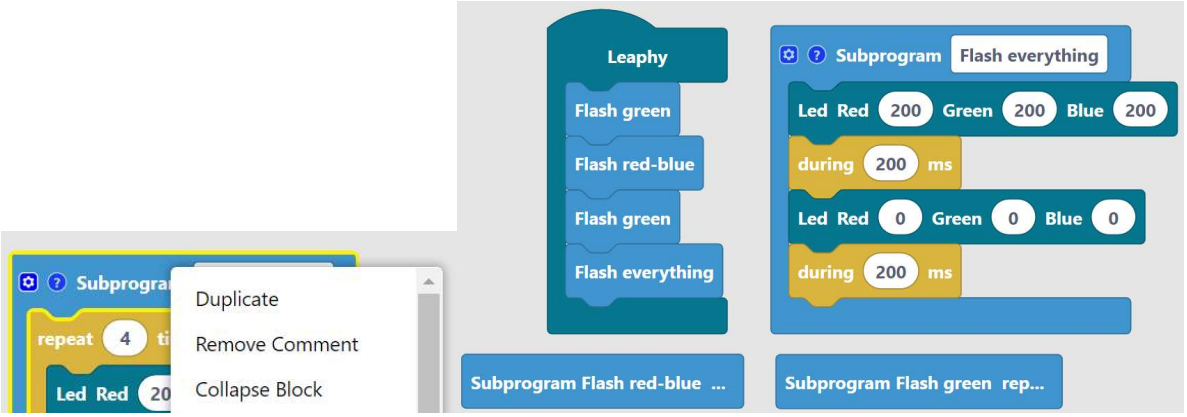
Level 2.2 – Light show

Make flashing blocks with the Own Blocks and make a light show with them. Think of more for yourself. Can you also create pink?





With the right mouse button you can 'duplicate' = copy blocks. You can also 'collapse' blocks.



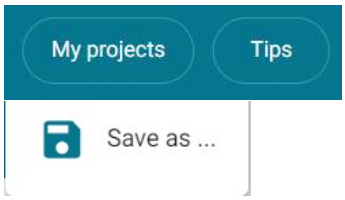
Level 2 – Shine & Drive

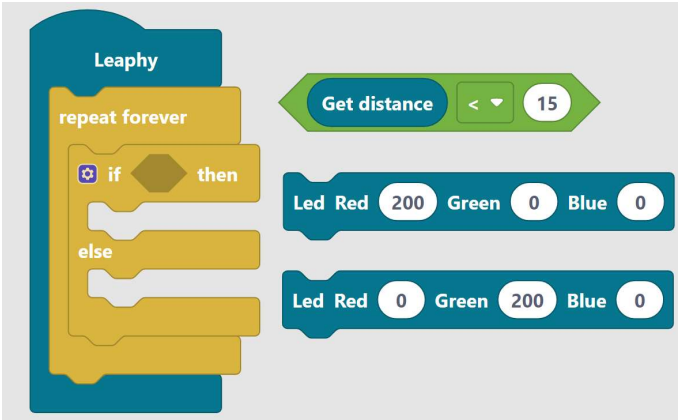
Level 2.3 - Distance Sensor

This program allows you to see the measurements from the distance sensor at the bottom right of your screen. Press the Show on Screen button if you don't see them.
Please note, the USB cable must be inserted to be able to read a sensor.

Level 2.4 – Alert!

Make a program where the light changes color when you place your hand in front of it.
Handy for later: save your program!

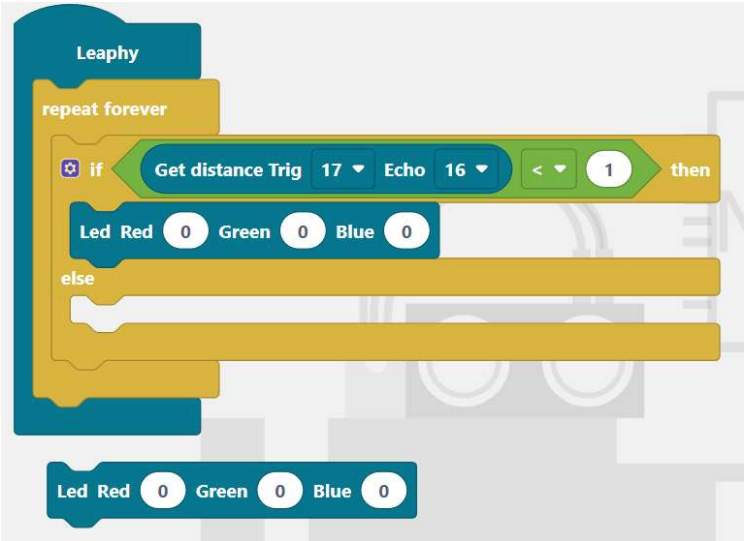




Level 2.5 – Two-step alarm

Use the blocks on the right to create a program that does the following:
Is there nothing in front of the sensor? Endorsement!

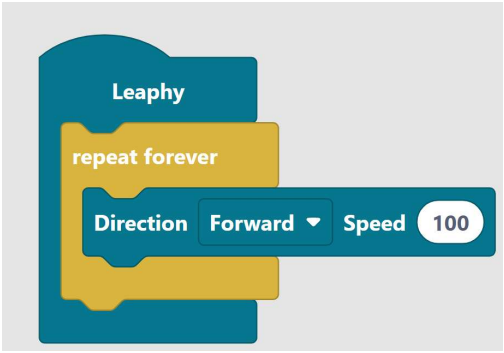
Does something come within 30 centimeters? Blue light!



Level 2 – Shine & Drive

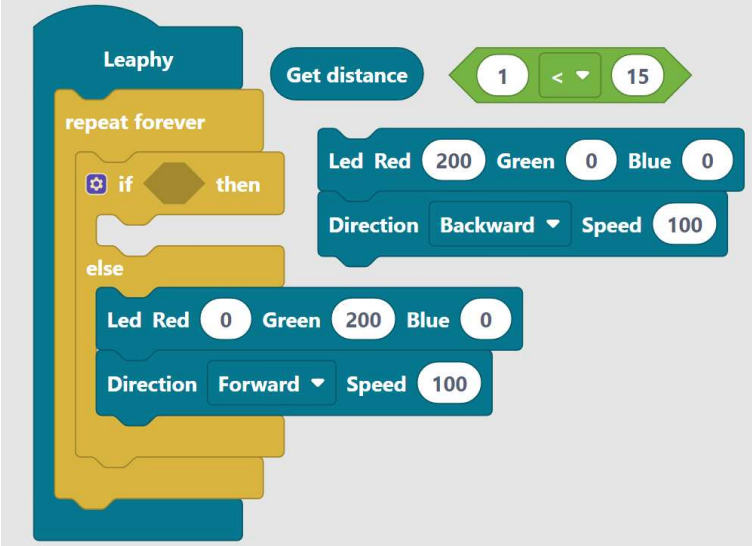
Level 2.6 - Engine Control

Put this program on your Leaphy. Then turn the switch 'ON'. Does the Leaphy drive with his sonar eyes forward? In that case the wires are right.
Is a motor turning the wrong way? Then switch the black and red wire of the motor on the shield.



Level 2.7 - Reverse at Danger

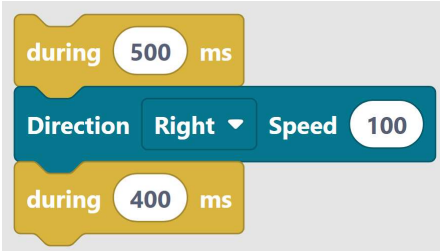
Create a program:
Drive forward when there is no danger.
Back in danger.
Enter by yourself at how many centimeters Leaphy should 'scare'.
Use the program from level 2.4.
Now add engine blocks. You can just leave the LED blocks.



Level 2.8 – Driving and Dodging

Driving backwards only helps against crashing a little bit. Leaphy also has to make a turn after reversing in able to get away. For this, give the blocks on the right a good place in the program from level 2.7.

Think by yourself where they should be.
You can adjust the length of the time blocks to get different effects.

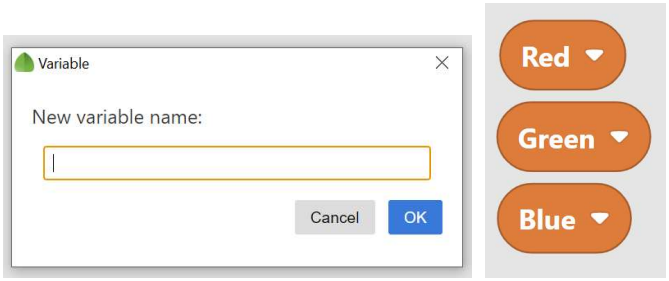


Level 3 – Robot with Character

Animals are surprising and unpredictable, so they are fun to watch.
In this level you will also give character to your Leaphy by making it unpredictable.

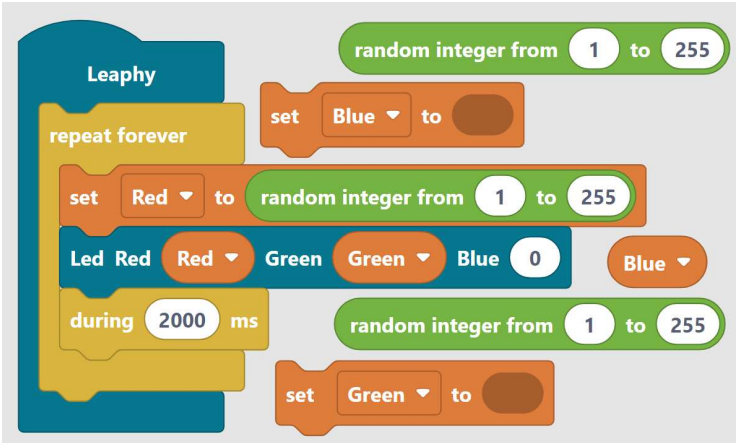
Level 3.1 - Random colors 1

Create the variable 'Red' by yourself under 'Variables'.
Also create 'Green' and 'Blue'.



Level 3.2 - Random Colors 2

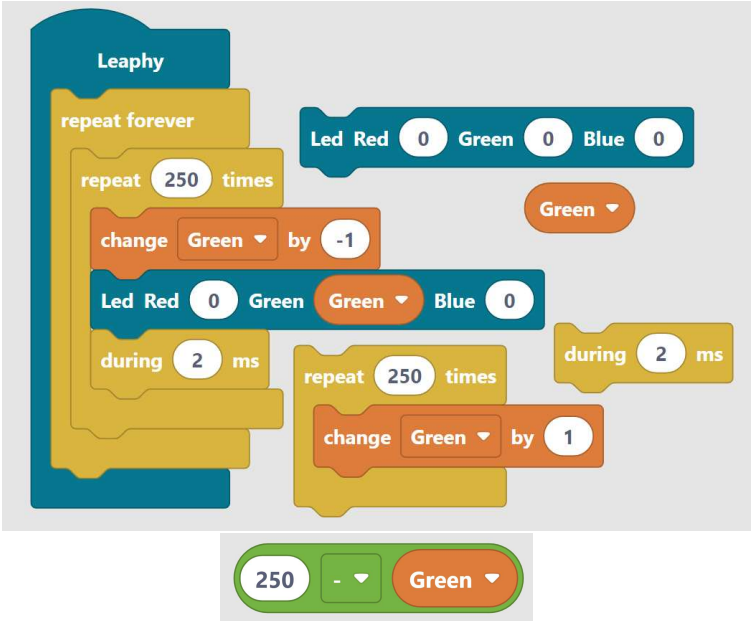
Now create a program that makes a new color every two seconds.
What colors do you see coming by?



Level 3.3 - Color Wave

Variables also allow you to create colors that light up gently.
You can see that right here.
Now make sure with the other blocks that it also goes out softly. And on again. And out again.
Experiment with the waiting time for good results.

If you now paste the calculation block on the right in one of the other colors, you will see that that color switches on and off exactly the other way around.



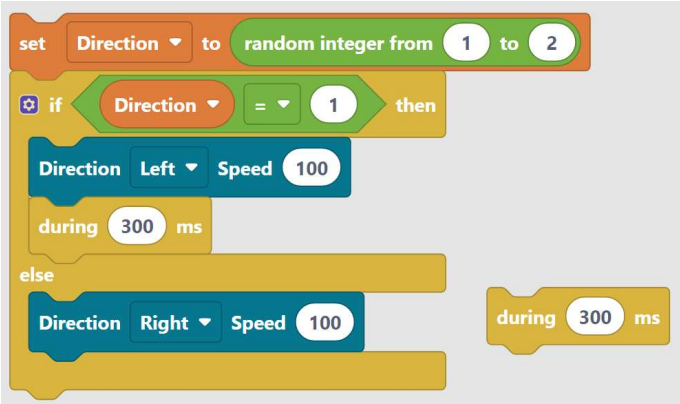
Level 3 – Robot with Character

Level 3.4 – Random Driving Speed

Use the program from level 2.7 and also the blocks on the right.
Have Leaphy back up at random speeds each time.
After each dodge action, have Leaphy move forward again at any speed.
Also make the rotation speed random.

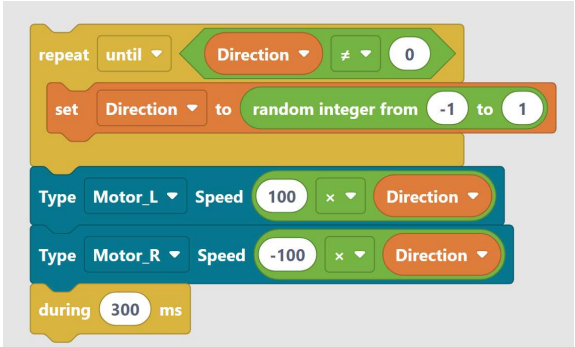
Level 3.5 - Random left or right 1

Let Leaphy randomly pick a side to turn to: left or right.
To do this, add the blocks on the right in the right place to the avoidance program from level 2.7.



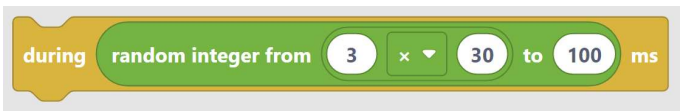
Level 3.6 - Random left or right 2

There is also another way to make your Leaphy randomly turn in one direction. To do this, you can use a trick from mathematics.
Try placing the blocks on the right in your avoidance program.
Don't forget to add a waiting time as well.



Level 3.7 - Random Wait

You'll notice: the waiting time is important for the behavior of your robot. You can also make the waiting time arbitrary.
With a calculation trick you can ensure that it builds up nicely in steps of 100 milliseconds, so that it really stands out.

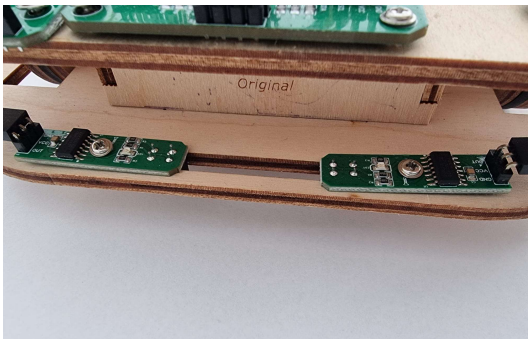


Level 4 – Line Followers

Leaphy can use different sensors. In this level you will learn how to work with active infrared sensors: they emit light and measure how much light is reflected. In this way Leaphy can follow a line.

Level 4.1 – Confirm sensors

On www.leaphy.nl you will find an instructional video for attaching the line followers.
Try without a video? That's fine! Click, screw in. Ready. The connection diagram of the cables can be found at level 4.2.
Tip: If you have a thin line, you can attach the sensors closer together. That way it drives even smoother!



Level 4.2 – Connecting Sensors

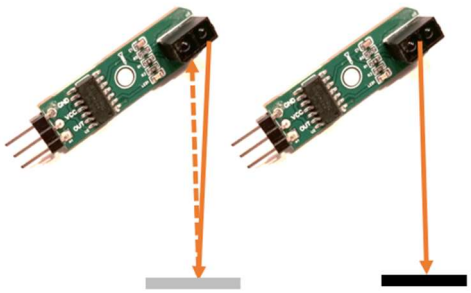
Use a 3-pin jumper wire female-female per sensor. To be on the safe side, the schedule is shown on the right. Always read carefully what is written with the pins. You connect the left sensor to D14 and the right sensor to pin D15.

Shield	Sensor left	Sensor right
Gnd	Gnd	Gnd
3.3 v	Vcc	Vcc
Out	D14	D15

Level 4.3 – Testing the Line Follow Sensor

The line follower works as soon as it receives power. Even without a program. The light blue LED on this sensor emits infrared light. If it hits a light-colored surface some of the infrared light bounces back to the black receiver. Then the sensor sends a 1 to the signal pin on the Leaphy. Does the sensor see black or nothing? Then a 0 goes to the Leaphy.

You can see it on the sensor itself: a very small green LED lights up. Test it with your hand or a sheet of white paper.

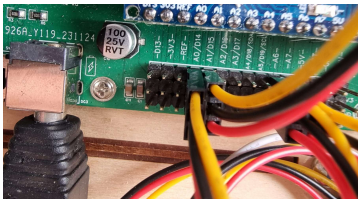


1 = True = YES The light does reflect back
0 = **False = No** The light does not reflect

Level 4 – Line Followers

Level 4.5 – Reading the line followers

Drag two digital reading blocks to the programming field. One for each sensor.
Now enter the correct pin numbers.
Digital pin 14 for the left sensor and the right sensor is next to it on digital pin 15.



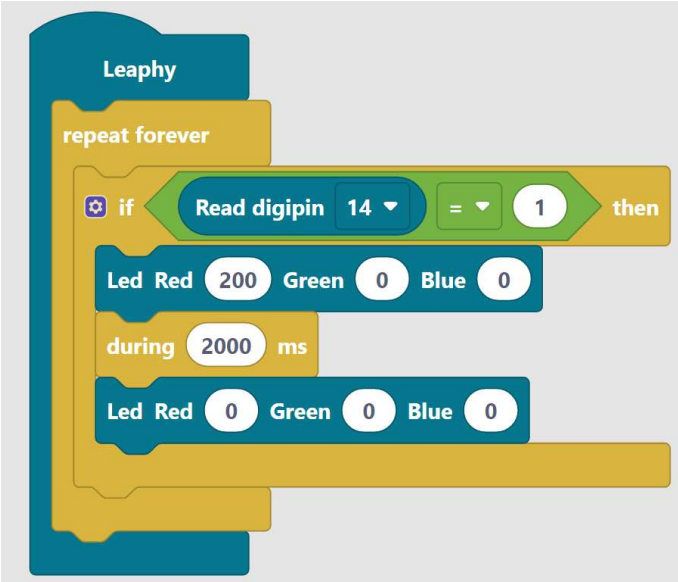
Level 4.6 – Let's read!

The line-following sensors are 'digital'. That means they can only give two types of signals.
Does the green sensor LED turn on? Then it sends a 1 to the signal pin on the Leaphy robot.
Does the sensor see black or nothing? Then a 0 goes to the Leaphy.
1 = True = YES The light does reflect back, so the sensor sees a light-colored surface.
0 = **False = No** The light does not reflect, so the sensor sees a black surface or air.

Level 4.7 – Leaphy LED responds to sensors

Use the program on the right to test whether the sensor on digital pin 14 works well with your Leaphy.

Test the sensor on digipin 15 with this program. The value of the sensor, together with the X sign, immediately turns the LED on and off, without the If-Then block. Mathematics makes your code shorter!



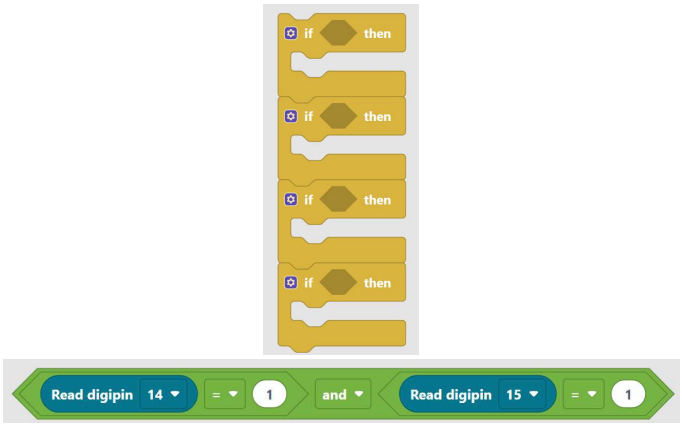
Level 4 – Line Followers

Level 4.8 - Important Blocks

You have two sensors that can both indicate 1 or 0. That gives four situations:

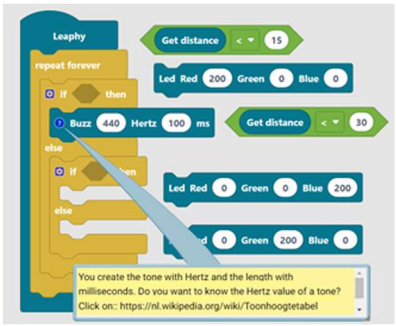
1) Left 0 & right 0
2) Left 0 & right 1
3) Left 1 & right 1
4) Left 1 & right 0

Therefore, use four IF-THEN blocks.
Your Leaphy must always respond to two signals at the same time. Use the AND block for this.



Level 4.9 – Four situations with four LED colors

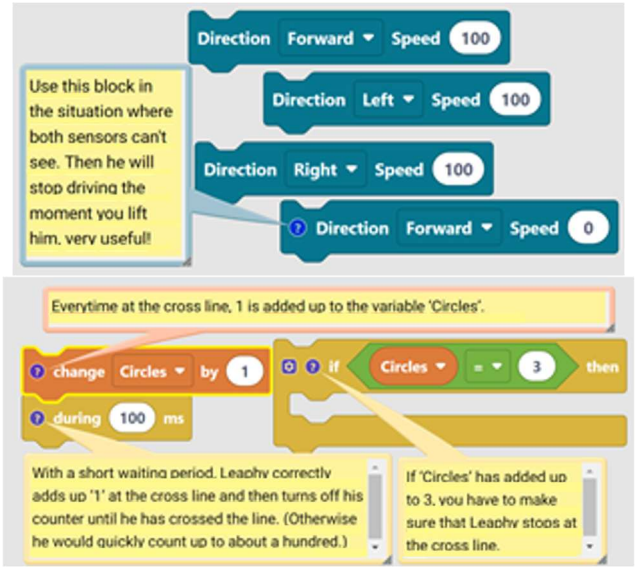
Use four IF-THEN blocks and the AND blocks to create a program that gives the LED a different color in each of the four situations (see level 4.8).



Level 4.10 – Follow the Line

1. Have Leaphy trace a black line of tape over a white surface. Use level 4.9.
2. Now make a thick cross line on the line. Make Leaphy stop here.
3. Have Leaphy do three laps and then stop at the stop line. Create a variable for that.

Tip: save your programs for later!



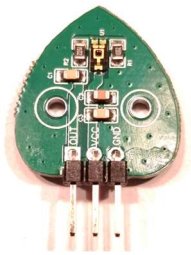
Help! The sensors do not see the line!
Are the sensors not responding to the line? Sometimes this is due to infrared light from the sun or bright lamps.
You can shield the sensors a bit with tape on the bumper of your Leaphy.
Also, the distance to the line may be a little too small. You can turn the tail key (short piece below) or take it out.
So have fun thinking! (See also forum.leaphy.nl!)

Level 5 – Light Sensors

In this level you will learn how to work with light sensors; those are light-sensitive resistors. The more light hits them, the greater the current they let through. You can make Leaphy ride towards the light.

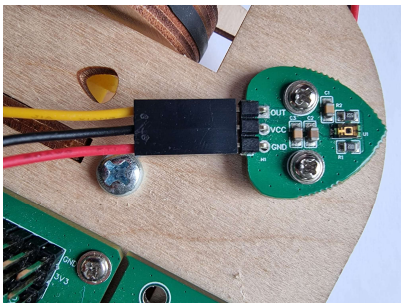
Level 5.1 – Light sensor

The light sensor is an analog sensor, which means that this sensor measures the amount of light and gives it a value between 0 and 1023. This is different from a digital sensor that only returns a value of 0 or 1 to the Leaphy computer.



Level 5.2 – Attaching Sensors

Using an awl or a small drill, make holes in the top and screw the light sensors onto the front corners to the left and right of your Leaphy. Have them both look slightly to the side at an angle.



Level 5.3 – Connecting Sensors

Slide a set of three wires per sensor onto the row of pins of the Shield. Then slide the ends onto the sensor pins. The left sensor on A6 and the right sensor on A7

Shield	Sensor left	Sensor right
Gnd	Gnd	Gnd
3.3 v	Vcc	Vcc
Out	A6	A7

Level 5.4 – Reading sensors

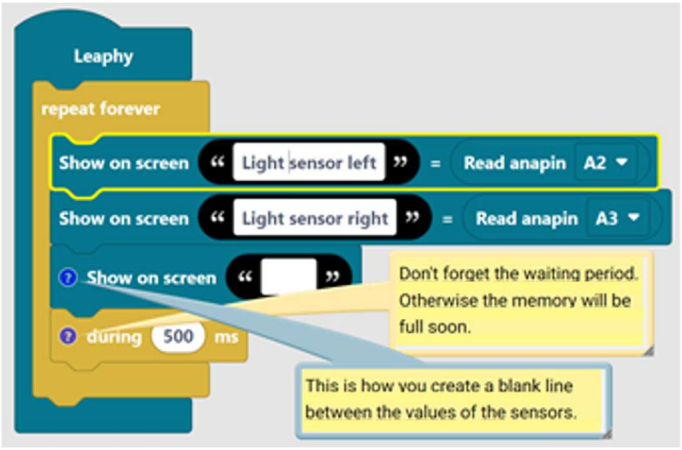
The light sensor measures the light intensity. In other words, the light sensor measures how much light is in the environment.
The sensor gives this amount of light a number between 0 and 1023 and returns it to the nano computer. On the right you can see what those values roughly mean.

Complete Dark	50
Daytime living room	500
Outside cloudy	800
Outside sunny	900
Flashlight shines in the sensor	1000

Level 5 – Light Sensors

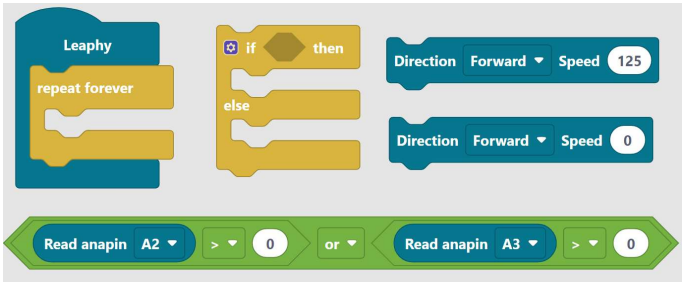
Level 5.5 – What are we measuring?

The light sensors are analog. They provide much more information than digital sensors.
On the Leaphy these are values between 0 and 1023. Test with this program whether your sensors work.And in which light you get which values.



Level 5.6 – Leaphy light sensitive

Create a program in which Leaphy will drive when you shine a flashlight on one of the sensors.
Enter a 'threshold value' yourself.

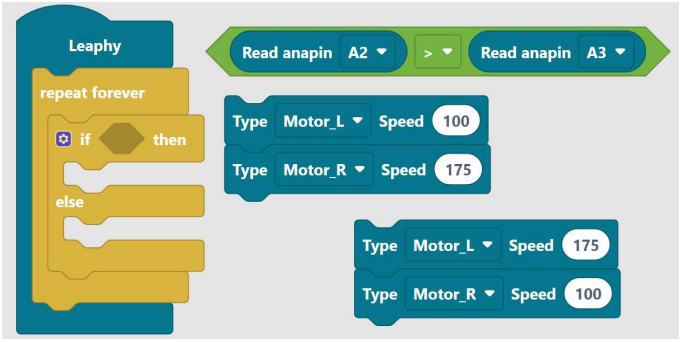


Level 5.7 – Light makes you go faster

Create and link the variable 'Speed' to the value of the light sensor on pin 2. Your Leaphy will go faster when it gets lighter!
Challenge: can you incorporate this idea into the dodge program from level 2.8?

Level 5.8 – Light Follower

You can make Leaphy drive towards the light by comparing the values of the two sensors and giving the left and right motors different speeds.
Does it work? Does he also follow a flashlight?
And: Can you also let him drive into the dark?



Level 6 – Line Train

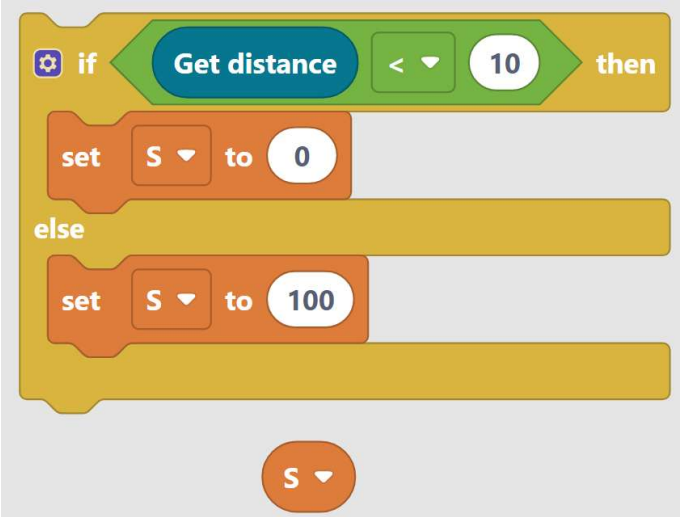
Using the sonar, you can equip a line-following Leaphy with an anti-collision system. However, the danger is that Leaphy loses the line during braking. So a nice challenge!

Level 6.1 – Line Follower – Basic

Create a line follower like in level 4.10

Level 6.2 – Anti-collision System 1

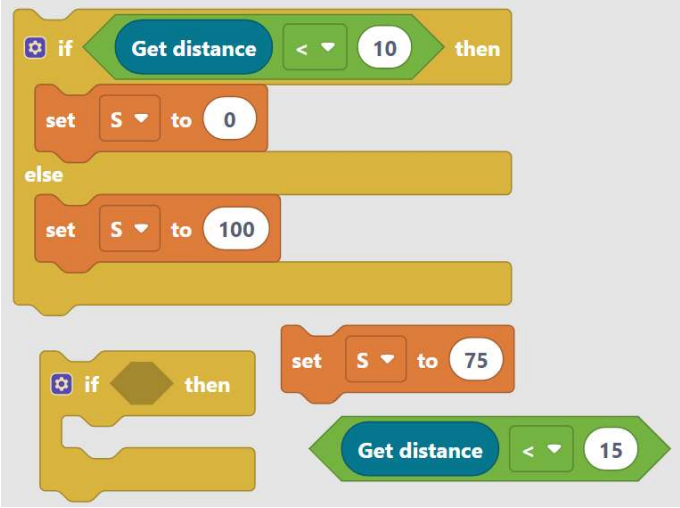
Now when Leaphy approaches a slower Leaphy on the line, you'll want him to stop for a moment. But he must stay on the line.
The steering function must therefore remain on and the forward drive function must be switched off for a while.
This can be done with a variable for the speed. We call it "S".
Place this program part in a logical place in the line follower program from level 4.10.
Now add the variable 'S' in the correct motor command block. Does it work? You may need to point the sonar slightly at the frame of the Leaphy in front.
Or you put a small 'screen' on the Leaphy in front of you to reflect the sound waves



Level 6.3 – Anti-collision System 2

You can see that the Leaphy now stops completely when there is a risk of collision.
Can you just slow him down a bit?

Or: slow down at 15 centimeters and stop at 10 cm?



LEAPHY NEXT LEVEL?

Unfortunately! That was the last level…or was it?

No! Because the Leaphy Foundation regularly publishes new levels for your Leaphy Original online.
You can find them at **www.leaphyfoundation.com**!
You will also find nice expansion sets for a few euros!
Proud of your Leaphy? Post a video on the Leaphy forum on discord!
There you will also find tips and nice ideas from others.
Have lots of fun!

Team Leaphy Foundation

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