TUTORIAL 2: BRAINS AND ORDERS

Description: A modern definition of a robot is "A machine capable of carrying out a complex series of actions automatically". This is carried out by the interaction of many things. Of course you need some mechanical parts, and as we humans do, you need a brain to decide what to do and you need some way to execute the instructions.

An easy way of seeing a robot as a system is that there is a brain that executes orders. Some of them might be dull, but some might be really interesting. Watch the movie *2001: Space Odyssey* if you don't believe it.

Now that we know that we need a brain for building a robot, we also need to know how to tell the robot what to do. Engineers like to call this to "program instructions", but we will try to keep things easy for the time being. Let's give some orders to the brain of our robot.

In this tutorial you will see all the process of "programming" a robot. An example of generating tones and music will be used.

Materials needed:
- USB Cable
- Duinobot v1.1 or higher (or any board, while it has a buzzer integrated to it)
- Computer with miniBloq (v0.81 or higher)
- 2 x Cable (red) Multiplo compatible

STEP 1: Connect the board with the USB cable to your computer. You can save yourself from some trouble by reading the Installation manual of the board. If using a DuinoBot 2.x or higher, there is no need to install drivers and you can download the latest version of miniBloq to start working with it.
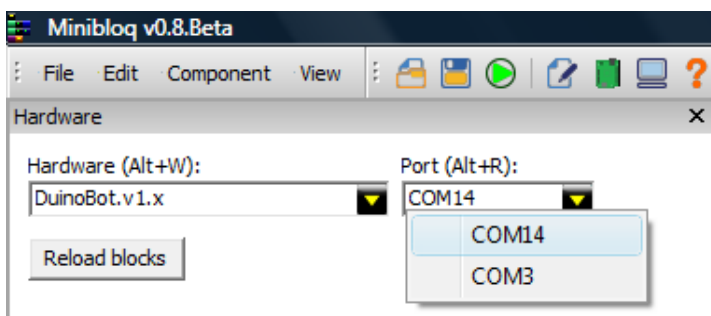
After connecting the board with the USB cable, switch it ON. You should select the port with which it communicates and the type of board in the "hardware" miniBloq section (top left side of the screen).

You can see the board model engraved on its cover. In the example of the picture, it is a DuinoBot 1.2.

Be also sure that the Hardware has your correct model of board. If you have other 3rd party board, this is the step to select it.

STEP 2: With the board connected and miniBloq properly configured, create a new project, selecting from the "File" menu, the option "Create".

On your empty and new sketch, select the gears icon, which symbolizes giving the order to reproduce a tone.
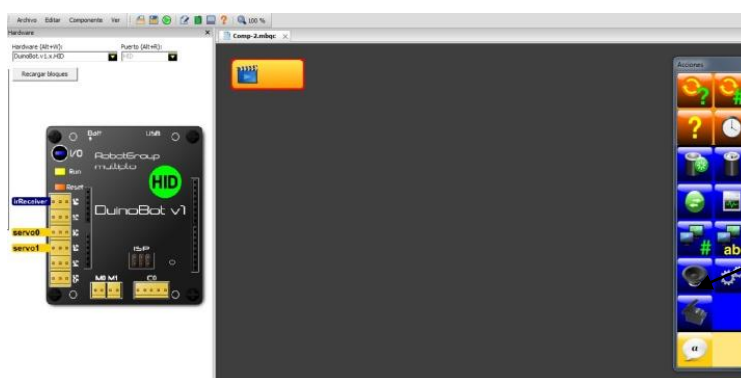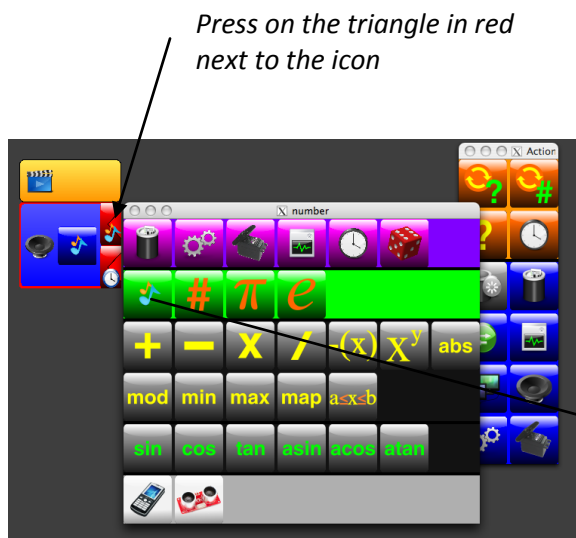

Select this icon
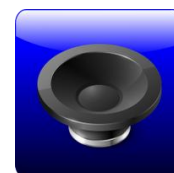
Once you have selected the "Sound Generating" block, you will need to select its inputs. They are two: frequency and duration. This means that you will set how which kind of sound will be reproduced. What we are going to do in this step is to set up a very first sound. When you finish, it should look like this:

Select the pitch to the tone will have

(note or frequency)

Set how long it will play

(duration, in minutes)

STEP 3: Setting the right parameters for reproducing a tone is not difficult; you just need to know which icon to press. Whenever you press on inputs (the red triangles next to each icon) a menu will appear with the different options you have. This way, you don't need to worry too much about what to choose.

Press on the triangle in red next to the icon

Select this icon
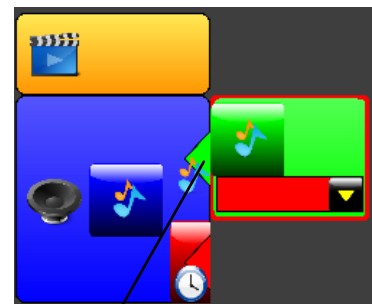
The triangle will turn green, showing that you don't have anything incomplete any longer

About tone frequencies, those more familiar with musical instruments probably don't want an explanation of what we are setting here. For some of us, with very little or none knowledge of music, the general idea is that notes establish how low or high the pitch is.

*The note "middle C" is also called "tenor C"
in vocals. It's a tone of 523.25Hz and it can
be found in pianos and other instruments.*

You can play it in miniBloq by selecting "C5" as the "note" parameter in the dropdown menu.

STEP 4: Setting the duration of the tone requires a very similar procedure, but this time we will select a different parameter. It won't be a tone but it will be a number. The number, the bigger it is, the longer the tone will last playing. You can enter a number like "200" to start with.
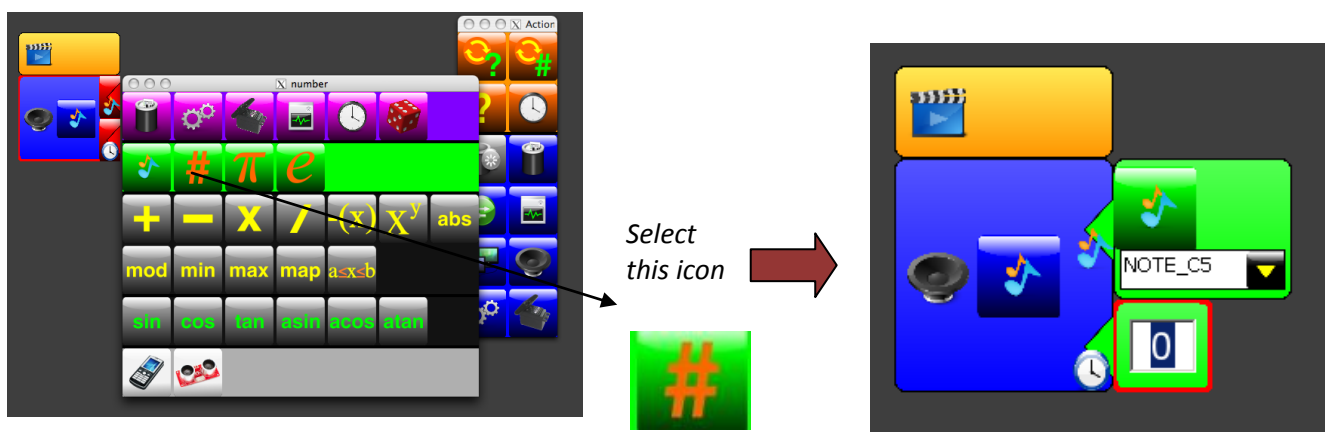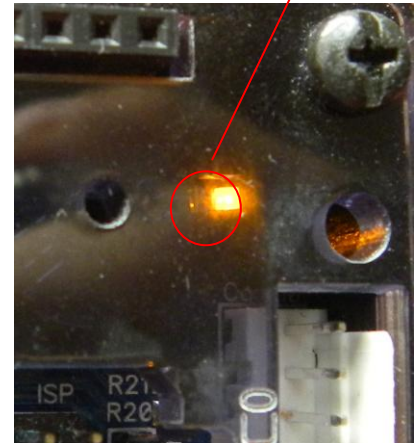
*Select
this icon*

STEP 5: Press the "Run" icon, so that the orders can be downloaded from the computer to the board.

Select this icon

Yellow LED blinking

The program will be downloaded to your board. The yellow LED should be blinking for some seconds, showing that it is programming the board and then… your program will be executed. And you are ready to make your own music!

STEP 6: What we have just done is what we could technically say as "Upload a firmware into the EEPROM, reset the device and run the program by the CPU". WOW! That sounds confusing, right?

Let's step back and see what we did. In simpler words, what happened was:

1. The blocks you selected were the program. You can see the generated code at any time by activating the "View/Generated Code". The code is what geeks use to program Arduino or other devices. Engineers like to call these instructions "C code". You can see in miniBloq how this

   You can take a peep of what the
   generated code looks like, but don't get scared

2. The "Run" icon gives the order of sending the set of instructions to the brain of our robot. The program miniBloq did a process that is called "compiling" and the instructions were translated into machine language.
3. The instructions were stored in the memory of the Brain, we call that process "programming". The information goes from your computer through the USB cable.
4. After programming, the system sent a command of resetting and running the board.
5. The Brain started and knew what to do: to execute the order.

```
toneWithDelay(BuzzerPin, NOTE_C5, 0);
```

6. You heard the result. Enough of theory for now.

STEP 7: Once that you have mastered the skill of reproducing a tone, you are ready to make different melodies. Try to repeat the steps we did for one tone and input the following sequence:

In order to execute one order after the other, just click again in new orders. The Brain will understand that it should execute one after the other and will stop after the last one.

We will see more advanced structures and ways to tell the brain to execute many things in the following tutorials.