BE MAKER

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ELETTRONICA, ROBOTICA E CODING PER RAGAZZI... E NON SOLO !

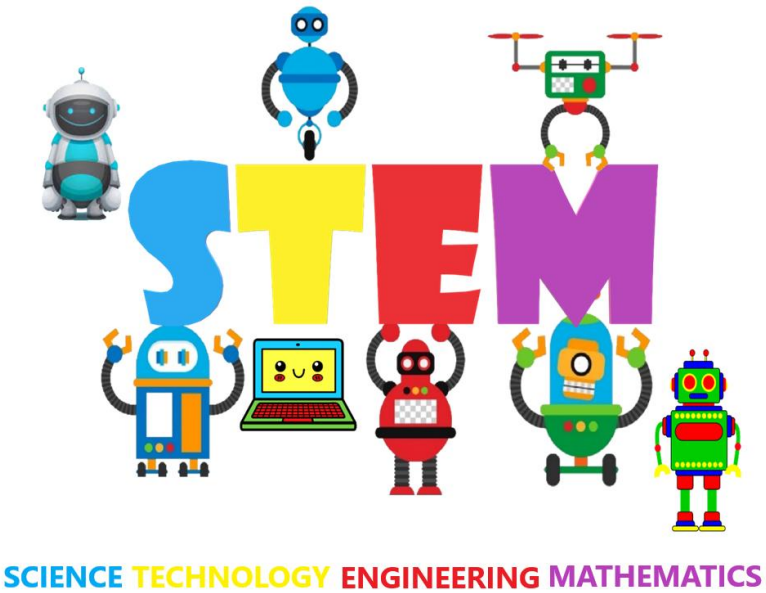
COURSE OF ELECTRONICS, ROBOTICS AND CODING FOR CHILDREN... and not only!

PREPARATION FOR THE BASIC COURSE

Index

STEM disciplines and the Be Maker Basic Course Plan

*The **Be Maker** Course that I wanted to realize, fits perfectly into that new area of teaching that lately, especially internationally, is spreading and in Italy we are at the beginning. More and more resources are being invested in this that has now become even a course of study that starts from elementary schools up to bring students to graduation. This new area that encompasses multiple disciplines, is called STEM and is also the origin of the Logo that I wanted to give to the New Course.*



*STEM is an acronym and stands for Science, Technology, Engineering and Mathematics. This acronym, of course, should be read in the mostimportant*sense of*its meaning, in fact, although the basic subjectsare* of a *scientific type, in this multidisciplinary area art also finds space so much so that, always at an international level, the new acronym STEAM has spread. Consequently, with the introduction of Art, all those associated humanities are also involved (History, Literature, Philosophy, etc...).*

*The **Be Maker** Course represents, trying to do my best,the perfect synthesis of the new study model, where all STEM disciplines are involved and recalled in a homogeneous and coordinated way. Obviously this is a first piece ...*

The Course has been divided into Modules, the first Module that is what we are about to start, is the Basic Course. With this Course the foundations *are created to face the subsequent Courses that will have more specialized characteristics.*

The Study Plan of the *Base Course* is rich and varied and *is* based on four main science *topics: the'ELECTRICITY',theLIGHT,theSOUND* and *theMAGNANDTISMO.*

All theprojects, which are also born for recreational purposes (in fact, if there is no fun there is not even interest), are nothing more than didactic applications of the *theoretical parts treated. The suggested minimum age is **12 years,**but it depends a lot on the student's desire to learn new things. As for the maximum age, there is no limit... in fact, the course creates the knowledge bases of the use of the development platform.... what will then limit the realization of the projects, will only be the imagination and the desire to engage in learning new things ... so there is no* upper *age limit for the students* of the *Course.*

Warnings

With regard to the safety aspects, since the projects are based on a very low voltage power supply supplied by the USB port of the PC or by support batteries or power supplies with a maximum of 9V output,there are no particular risks of an electrical nature. It is however necessary to specify that any short circuits caused during the exercise phase could produce damage to the PC, to the furnishings and in extreme cases even to burns, for this reason every time a circuit is assembled, or changes are made on it, it will be necessary to do so in the absence of power and at the end of the exercise it will be necessary to provide for the disconnection of the circuit by removing both the USB cable connecting to the PC and any batteries from the appropriate compartments or external power connectors. In addition, always for safety reasons, it is strongly recommended to carry out projects on insulating and heat-resistant carpets that can be purchased in any electronics store or even on specialized websites.

At the end of the exercises it is advisable to wash your hands, as the electronic components could have processing residues that could cause damage if ingested or if in contact with eyes, mouth, skin, etc. Although the individual projects have been tested and safe, those who decide to follow what is reported in this document, assume full responsibility for what could happen in the execution of the exercises provided for in the same. For younger children and / or the first experiences in the field of Electronics, it is advisable to perform the exercises with the help and in the presence of an adult.

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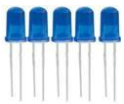
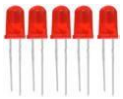
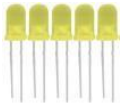
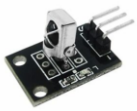
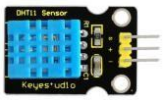
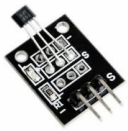
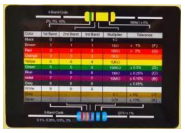
Roberto Francavilla

Preparation of our Electronics and Robotics Laboratory

As the first activity of the Course it is necessary to prepare our Laboratory and to do this we must take out of the packaging all the material of our Starter Kit.
We check that all the material that will be used in the various projects is *present:*

					
Uno R3*1	LED 5mm - Blu*5	LED 5mm- Red*5	LED 5mm - Yellow*5	LED 5mm - Green*5	LED 5mm - RGB*2
					
Resistor 220 Ω*10	Resistor 10 KΩ*10	Resistor 1 KΩ*10	Potentiometer 10 KΩ *1	Active Buzzer *1	Passive Buzzer *1
					
Push Button switch 12 mm with cap*4	Tilt sensor SW520D *1	Photoresistor LDR GL5528 *2	1602 LCD I2C *1	LM35 Temp Sensor	Microphone sound sensor KY037 or KY038 *1
					
Remote Controller IR*1	1 Digit 7 segments display *1	4 Digit 7 segments display *1	LED 8x8 Matrix * 1	Servo SG90 *1	IR Receiver KY022 *1
					
HC-SR04 Ultrasonic *1	DHT 11 Temp & Humidity Sensor *1	Linear sensor module Hall effect - KY021 *1	Hall effect sensor module - KY003 *1	Hall effect sensor module- KY035 *1	IR Sensor Module KY032 *1
					
IR KY033 Line Tracking *1	Male to Female Dupont wire 10 cm *10	Female to Female Dupont wire 10 cm *10	Male to Male Dupont wire 10 cm *10	Cable USB 50 cm *1	Connettore batteria 9v *1
					
support HCSR04 with nuts	Resistors table	Breadboard a 400 holes *1	Male to Female Dupont wire 20 cm *10	Female to Female Dupont wire 20 cm *10	Male to Male Dupont wire 20 cm *10

We also need a PC (desktop or notebook is indifferent, but I suggest with Windows 10 installation):

It is also necessary to have a set of screwdrivers with a magnetic cross and flat head *(preferably of different sizes):*

and for the most daring a digital Tester:

Installing software on your PC

All the Basic Course is based on the use of the Arduino UNO R3 development board, Arduino is actually a real open source platform, but it is also possible to use the *numerous* compatible versions of development *boards* made by the *various manufacturers* that use the same *platform.*

*Now let's move on tothe installations of*the software on*our PC.*

There are two software to be installed:

- *The chipset driver of the USB communication* port of the *development board*
- *The "sketch" development environment called IDE*

As for the driver, if not installed you will notice it immediately as the first loading of the sketch (the program that serves to make Arduino work), it will give you an error. Normally the most popular development boards even the compatible ones, make the drivers available on the internet, so just do a search and download the driver and then launch the executable.

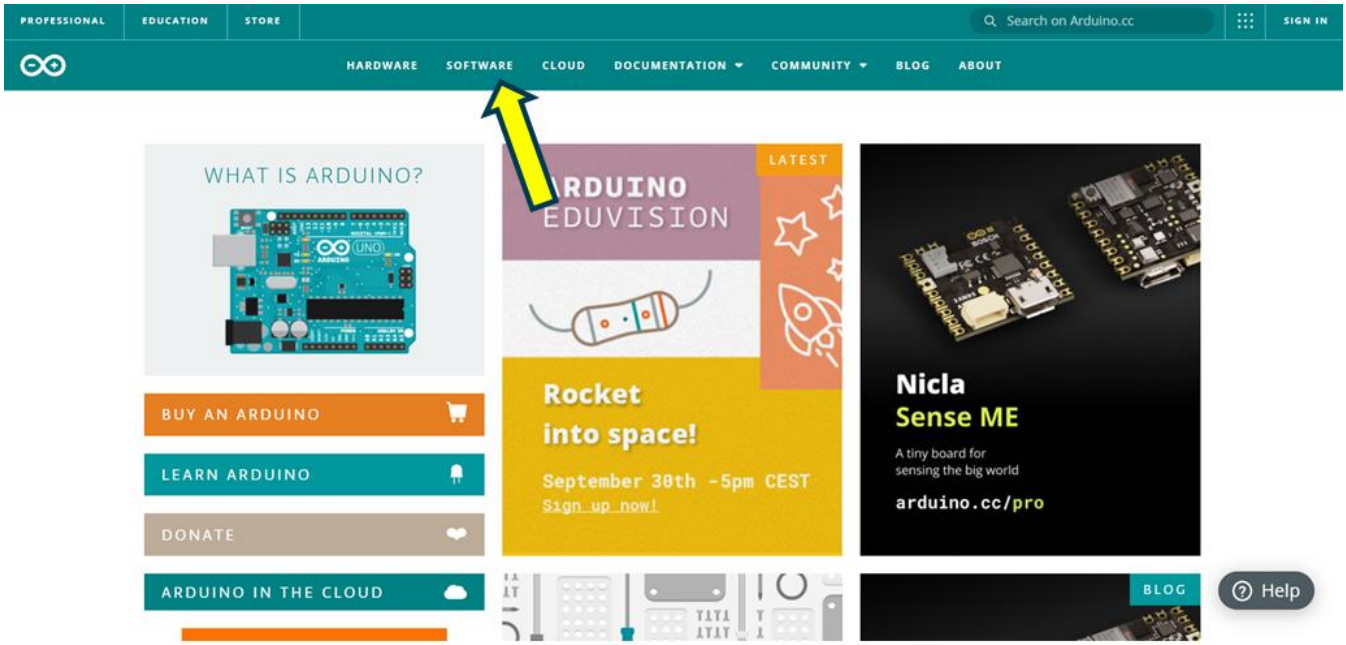
Since I can not predict which cards you will buy, I tell you that for the original card the driver is already included in the development environment, so no particular configuration is needed, while for compatible cards, the most widespread (also because it is very cheap) is the one that has the chipset in SMD format and normally in this case the driver to be installed is called ***CH341SER.zip***

It can be downloaded from the internet, unpacked and then launching the executable, the driver will be installed.

We have said that our development board is based on the open source Arduino platform, and therefore we can use all the tools that the platform makes available to us.

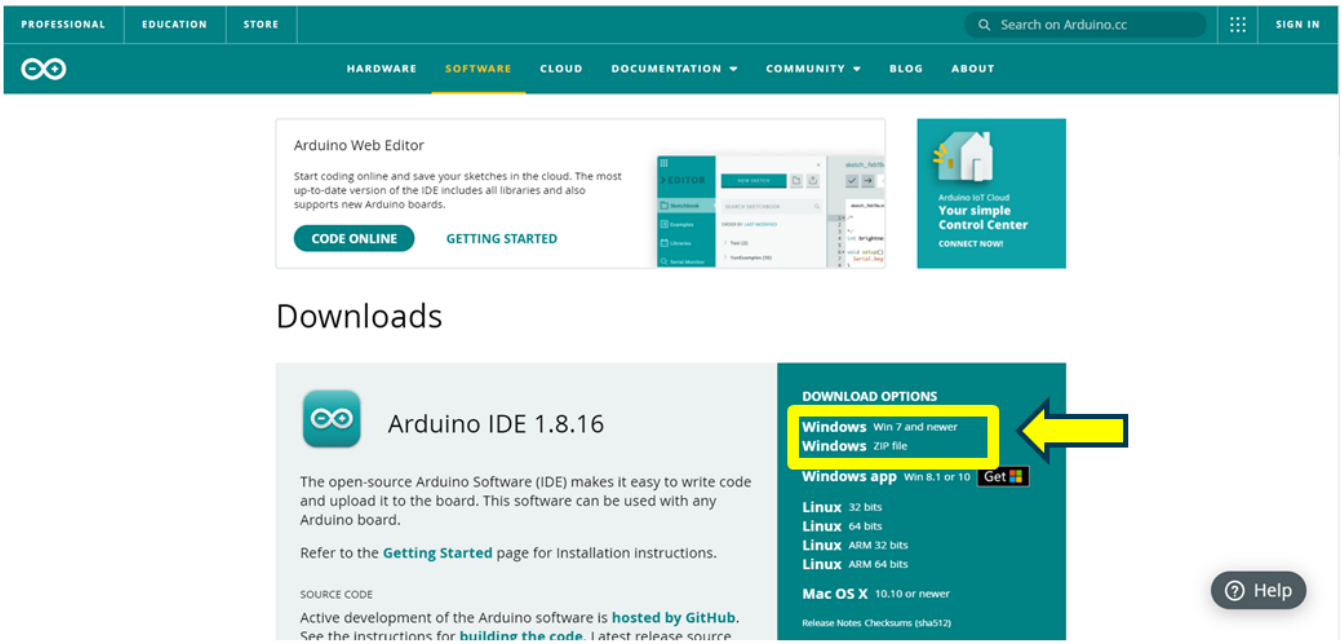
We go to the Arduino website by writing on our browser the following address or by clicking on the following link: https://www.arduino.cc

The initial window appears, click on"SOFTWARE" :



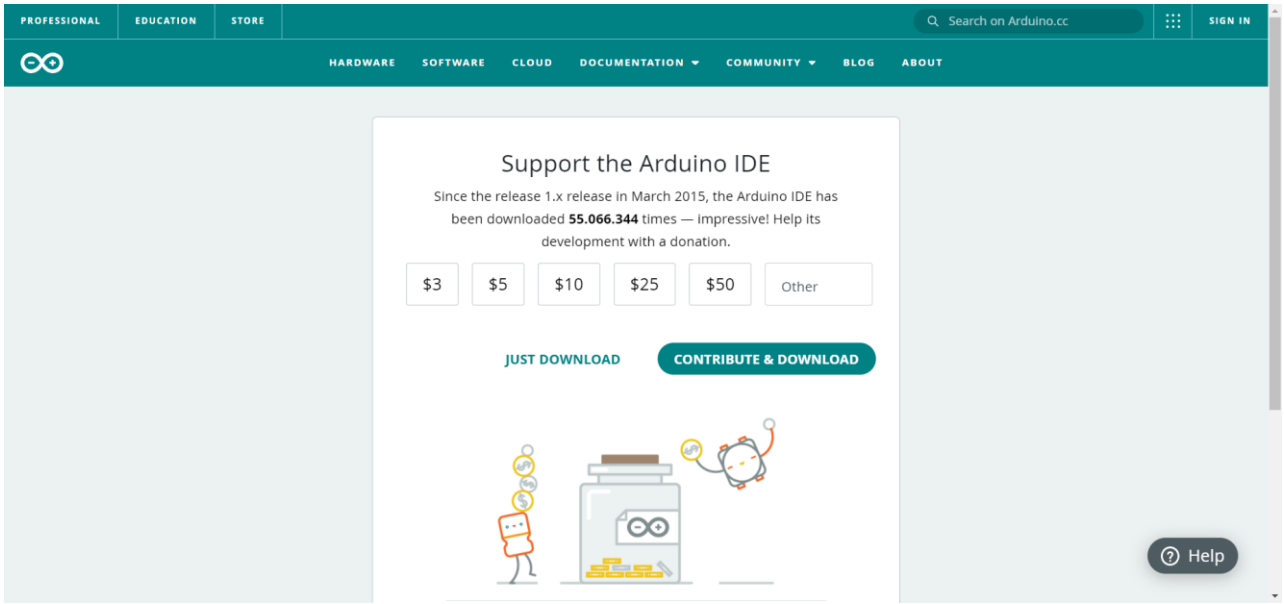
quindi will display a page where you can download *the latest version of the IDE.*
Depending on your operating system used, on the part of your right you need to choose the relevant DOWNLOAD link:

As you can see from the photo of the web page above, there are the different versions of the IDE for: Windows, Mac, Linux,...
The one shown below is the procedure for Windows, for other systems, the procedure is almost identical.



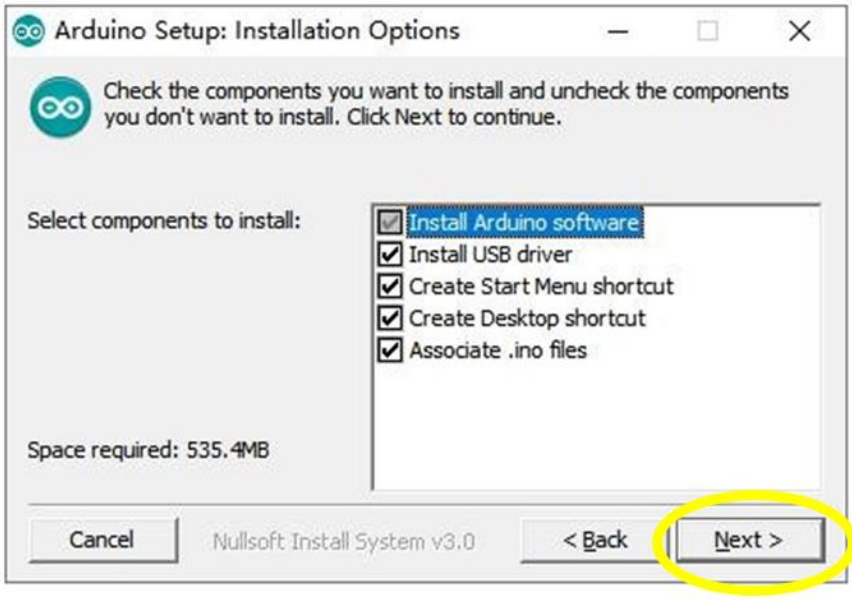
Two ways of installing the IDE are possible, the automatic one, by clicking on "Windows Win 7 and never"and the manual one, where you must first download the ZIP package *and then, once unpacked, you click twice on the executable.*

By clicking on one of the two options,in both cases the donation window appears:

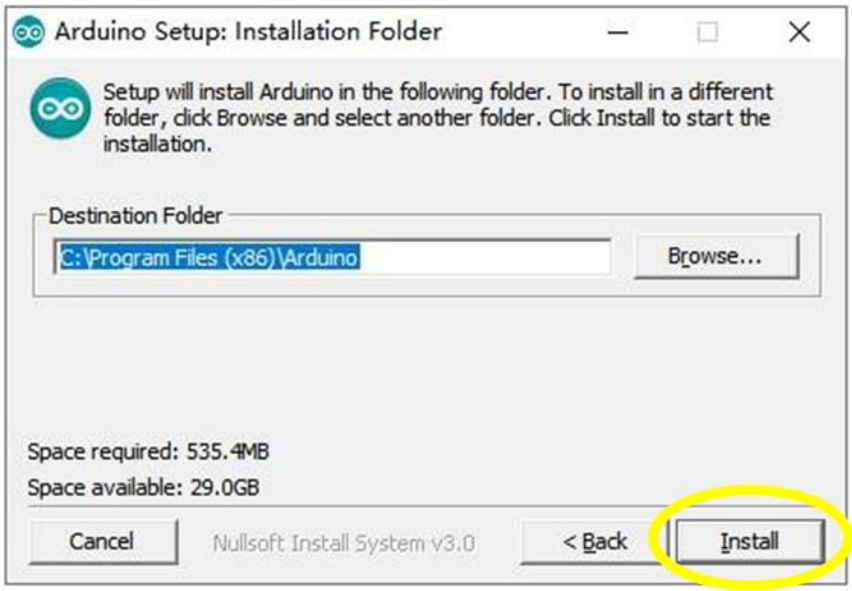


andd in this*regard, I strongly suggest, given the immense work that the guys of Arduinodo, to*carry *it out, even a small sum.*
If you decide not to make the donation, you can proceed with "JUST DOWNLOAD".
Oncethe installer is launched (by double-clicking on the executable file. EXE),following the instructions that are requested on the screen through dialog boxes, we proceed to the complete *installation* of both the *IDE development environment and* the driver *for the Arduino development board. The windows that will appear to you will be:*

Cliccare su I Agree



Cliccare su Next



Cliccare su Install

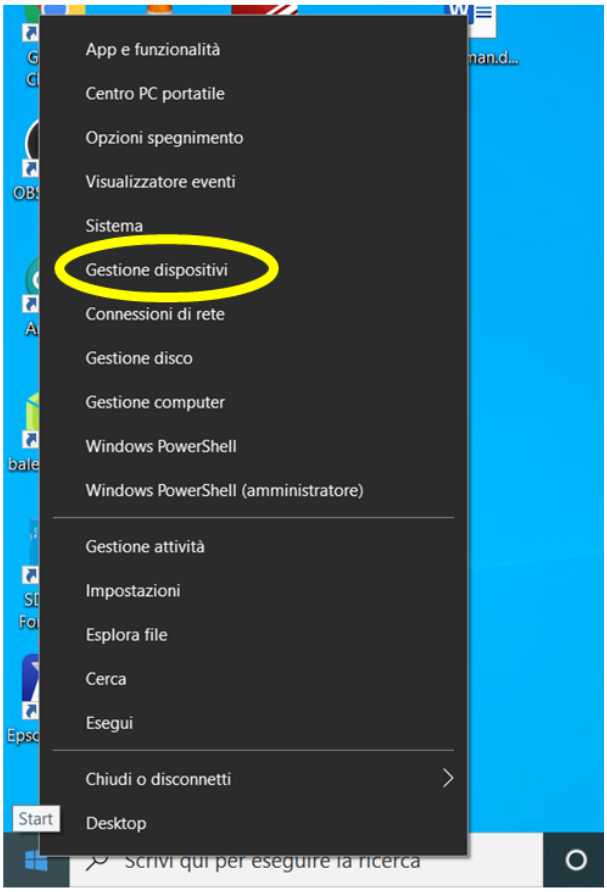
If the following dialogboxappears, you must choose "Install".

At the end of the installation process, an icon will appear on our Desktop:

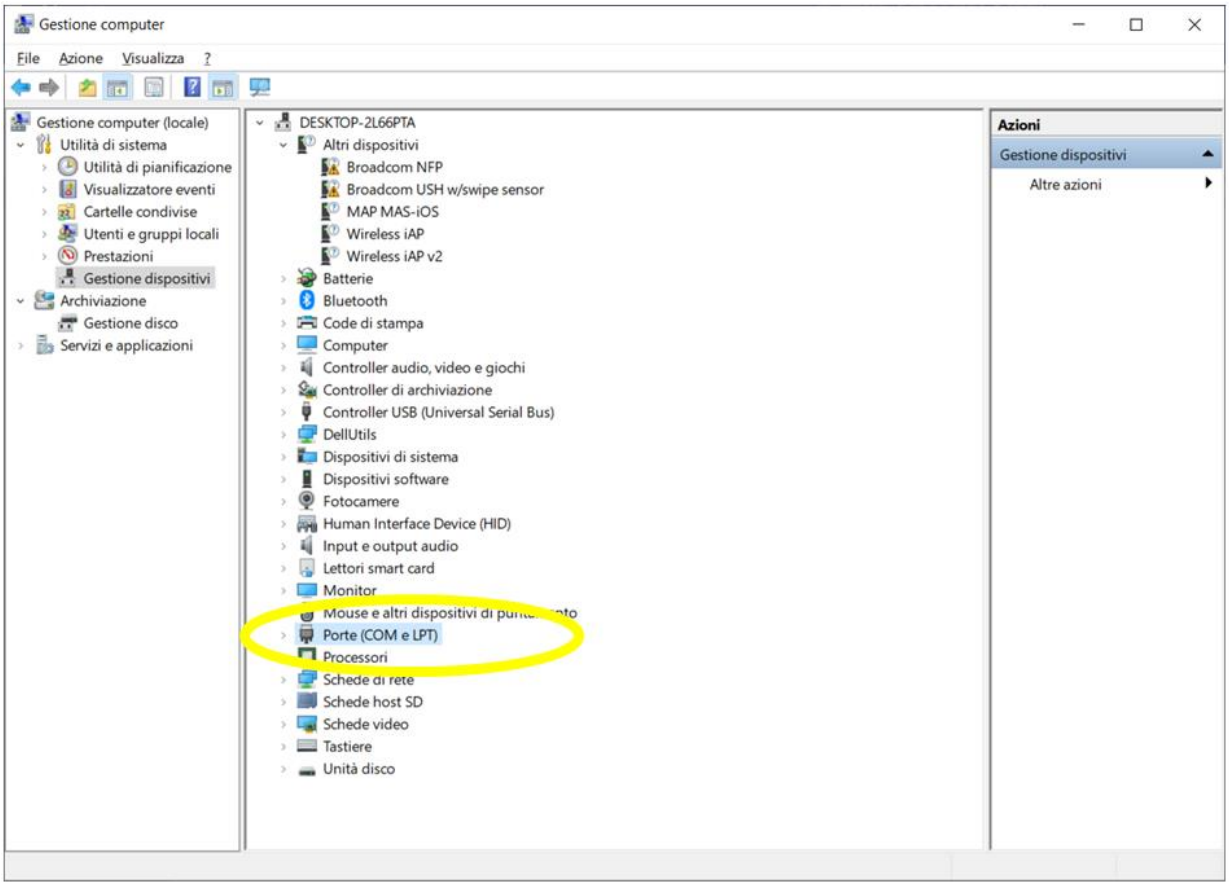
At this point we connect the Development Board to the PC using the *USB cable supplied with the same card. .*

*If everything went well, thePC, after a few seconds (necessary for the installation of the driver), should be able to recognize the new perif*ou*wereconnected.*

It is possible to verify the correctness of the installation process by going to *the START windows window located at the bottom left of the desktop:*



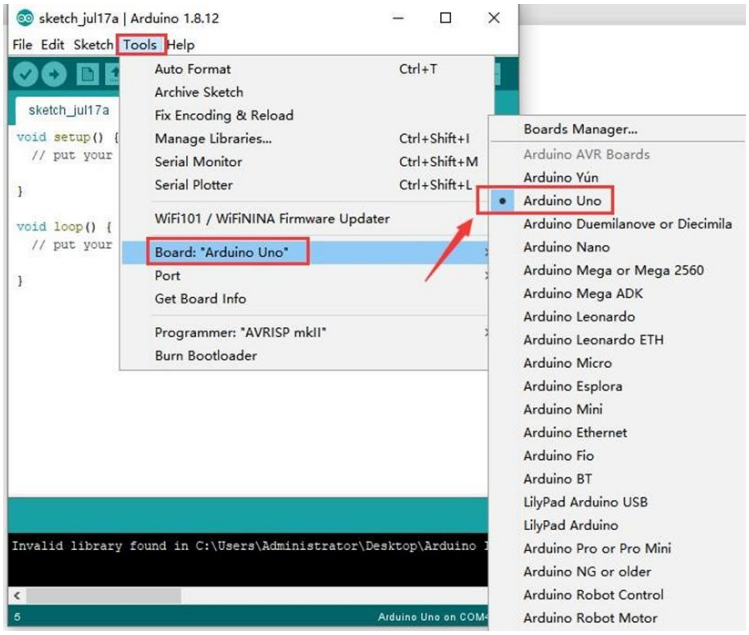
Click Device Manager:



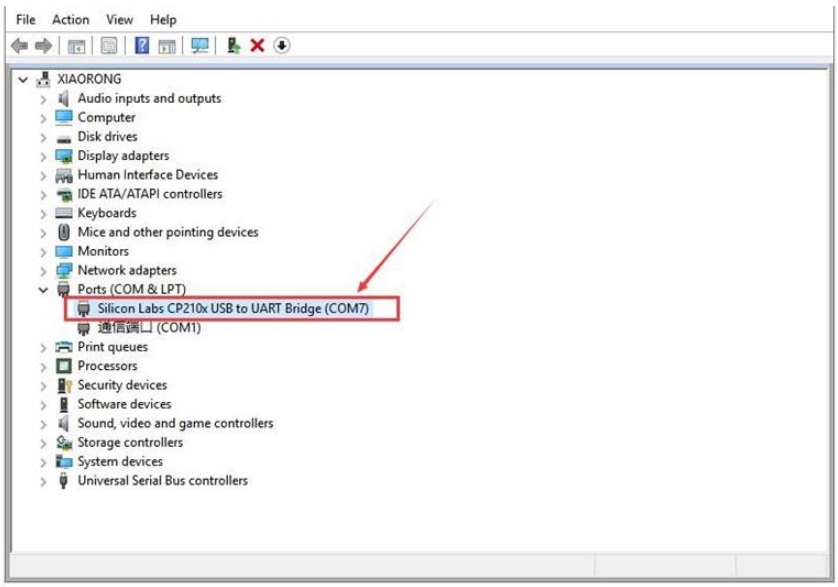
Look under Ports (COM and LPT) orother devicesi.
A yellow exclamation mark indicates that the driver installation failed. In this case it is necessary to proceed with the manual installation of the driver.

Configure the Arduino IDE

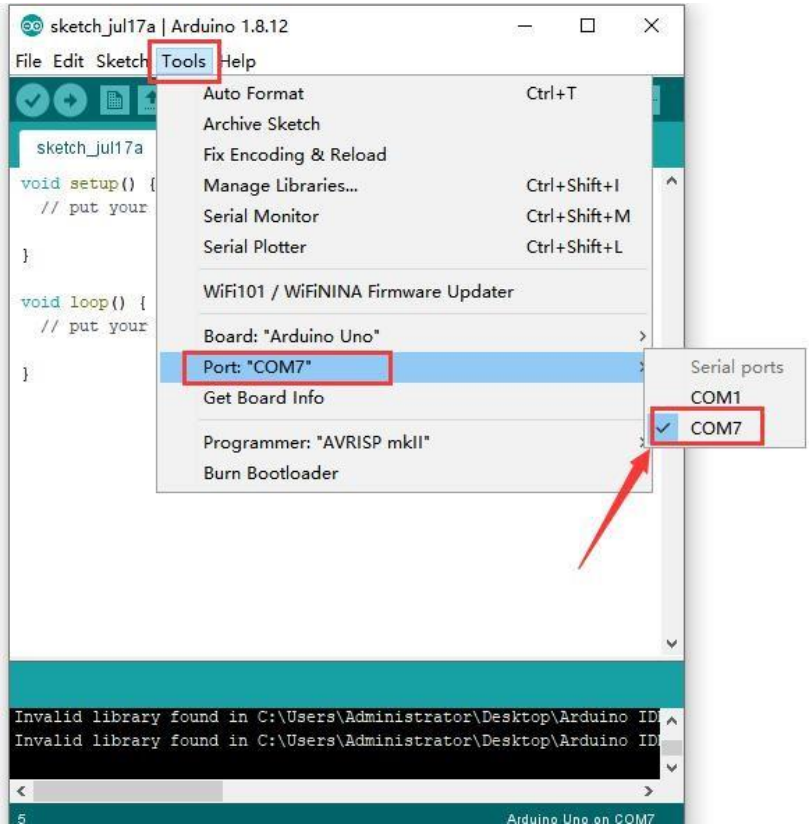
After installing the driver correctly, it is time to configure the IDE, this is*because the IDE can be used for different devices, we instead want to use it for our Arduino or compatible Development Board.*
For the Development board both original Arduino andcompatible, go to Tools ---><---- board >and select Arduino Uno (as shown below).



Then we move on to select the correct COM *port.*
Once the Development Tabisconnected, go to Windows START and click on it with the right mouse button, then with the left button on the Device Manager



Clicking on Ports (COM & LPT) shows which COM port the device is connected to.
At this point we return to the Arduino IDE, go to Tools --→ COM Ports and select the port to which our device is connected.



So we finished the most boring part, do not worry from now on there will be to learn many new things and have *fun.*

Those who start well are halfway through the work

Our ambitious goal is to become a Maker!

That is, the creators of our electronic and robotic projects, and I am sure we will succeed.

The following lessons, based on practical projects, are set up in such a way that theoretical topics are explained several times, even on different practical projects. In this way, even if a topic may turn out to be unclear or particularly difficult to understand at first, do not worry.... GO AHEAD!!

In fact, surely the same topic you will find in another application, perhaps easier to learn .... And so you will find yourself saying.... ahhh!.. then it works like this... that thing I had not understood at the project n. .....

I also want to remind you that through the email you will have the opportunity to get in touch with me, indeed I would be happy, so do not delay when you need clarification, or even give me suggestions (which will always be welcome) and also to deepen some topic that needs clearer explanations ....

Finally, since I do not want to bore you with all these premises, the last message concerns the methodology of explanation of the lessons; it is my intention to avoid using technical terms except those strictly necessary, trying to explain their meaning. Also for the theoretical parts, I will try to avoid going into details of physics and chemistry and I will keep a level of explanation suitable and congruous with school bases for children aged 12 and over.

At this point we begin to know the tools that we will use for our training path as a Maker.

Che cos'è Arduino

*Arduino is a kind of small PC, it has a processor (to be exact a microcontroller), memory (like the RAM and the Hard Disk of a PC), a motherboard and connectors for the inputs and outputs of the signals that go to external peripherals that can be sensors, modules implemented*as electric*motors, etc.. There are different types of cards, depending on certain characteristics,for example there are cards that already have the integrated WiFi module,* those that *have GPS,* etc *.. among the most popular is the Arduino UNO R.3,a basic development board that can be integrated with any type of module. Since the Arduino* project *is open source, many other manufacturers have made their own UNO R.3 board:*

Some manufacturers, given the potential of this board, have also developed it further by adding functionality and making its use even easier.

With this development board for Maker it is possible to realize many projects, the only limit is our imagination.

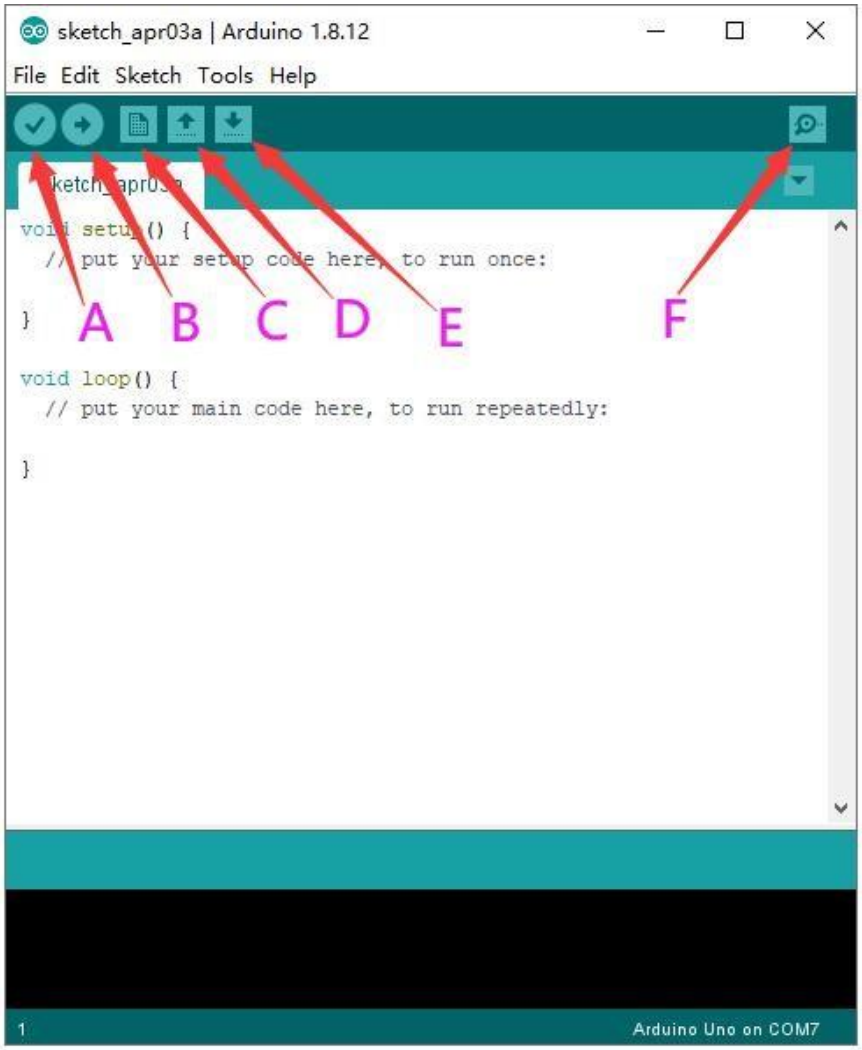
Through the supplied USB cable it is possible to connect the *Development Board* to *the* USB port of the PC *from which the same card* takes the *power necessary for its operation and interfaces with the PC to be programmedto.*

Che cos'è l'IDE di Arduino

First of all, let's start from the name: IDE which is an acronym and stands for ***Integrated Development*** *Environment, that is, a series of applications that aggregates common development tools in a single graphical user interface. The IDE is an environment consisting essentially of:*

- ***Editor****: a text editor that facilitates the writing of software code that is called sketch. The programming language used is based on C++.*
- ***Monitor and Serial Plotter****: where numerical or textual variables can be represented, but also graphically and is also useful for the debugger (search for errors in sketches)*
- ***Libraries****: they are a collection of functions and instructions that simplify the use of certain devices (sensors, modules, etc.)*

Clicking on the Arduino icon opens the window below:



What are the icons indicated?

A- *It is used to verify the written sketches by pre-filling it and identifies any errors.*

B- *Upload the sketch to our Arduino or Board board.*

C- *It is a quick choice to create a new editor window for a new sketch.*

D- *It is used to directly open a sample sketch.*

E- *It is used to save the sketch.*

F- *It is used to send data from the card to the serial monitor.*

IMPORTANT: ALL THE PROJECTS LISTED CAN BE REPRODUCED WITH ANY COMPATIBLE ARDUINO UNO R.3 BOARD, OBVIOUSLY INCLUDING THE ORIGINAL !!!

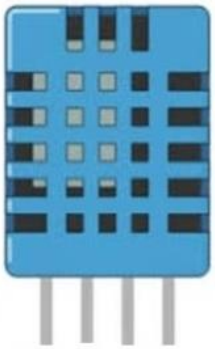
Whatis an Libreria and how to add it to theIDE

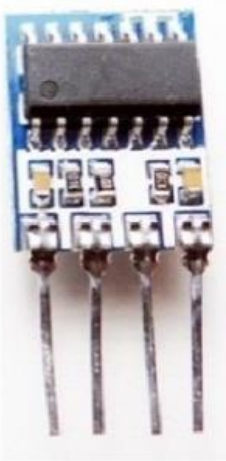
Internet, as you well know.... even better than me!, it's a vast world where you can find everything. Also for the Arduino world.... surely there has been someone in the vast global world who has already solved technical problems and made his knowledge available to humble mortals so that they could improve (or even improve what had been created!) by making complicated things easy to understand and apply. The creators of knowledge in the field of electronics and robotics, are called... ***MAKERS!*** *(pronounced: meikers) and I hope that one day you will become so thanks to my little help!*

Well! The concept of "Library" is basically this.... It is an archive where you can find instructions that simplify and make it easier to use things that would otherwise require complex operations that are difficult to apply.

Let's take a practical example: the ***DHT11 sensor****.*

The DHT11 sensor is a device that thanks to the amount of water in the air or the ambient temperature, measures the variations in electrical resistance of some elements. In essence, the DHT11 sensor is as if it were in turn a mini Arduino to which are connected elements whose resistance varies according to the more or less presence of water in the environment and its temperature.





This means that the sensor, already in itself, has a mini computer (you can see it in the photo above) that would already require software for its operation that should be written before the real software that we should have developed for its use.

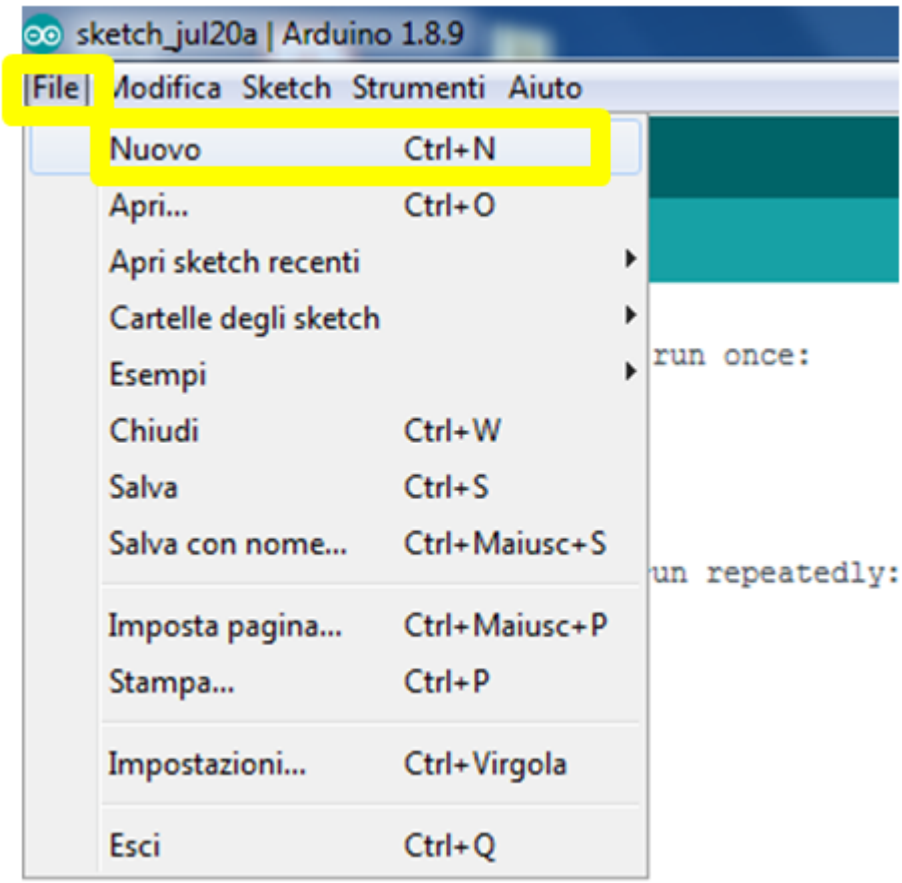
Then the creator of this sensor has given us a ***gift****!, he has already developed all the software necessary for the internal functioning of the sensor and has created a* ***LIBRARY,*** *that is a series of simple instructions made available to us in such a way that the DHT11 sensor is already correctly programmed to return the values we need.*

To insert a library in the Arduino IDE there are several ways, the one we will use is the easiest and fastest, but know that it will not always be possible to use this method ... but don't worry we'll see them all if necessary!

Let's get back to us: insert a new library in the Arduino IDE and then allow the same IDE to load on Arduino the right instructions necessary for the operation of Arduino and the add-ons that connect to it.

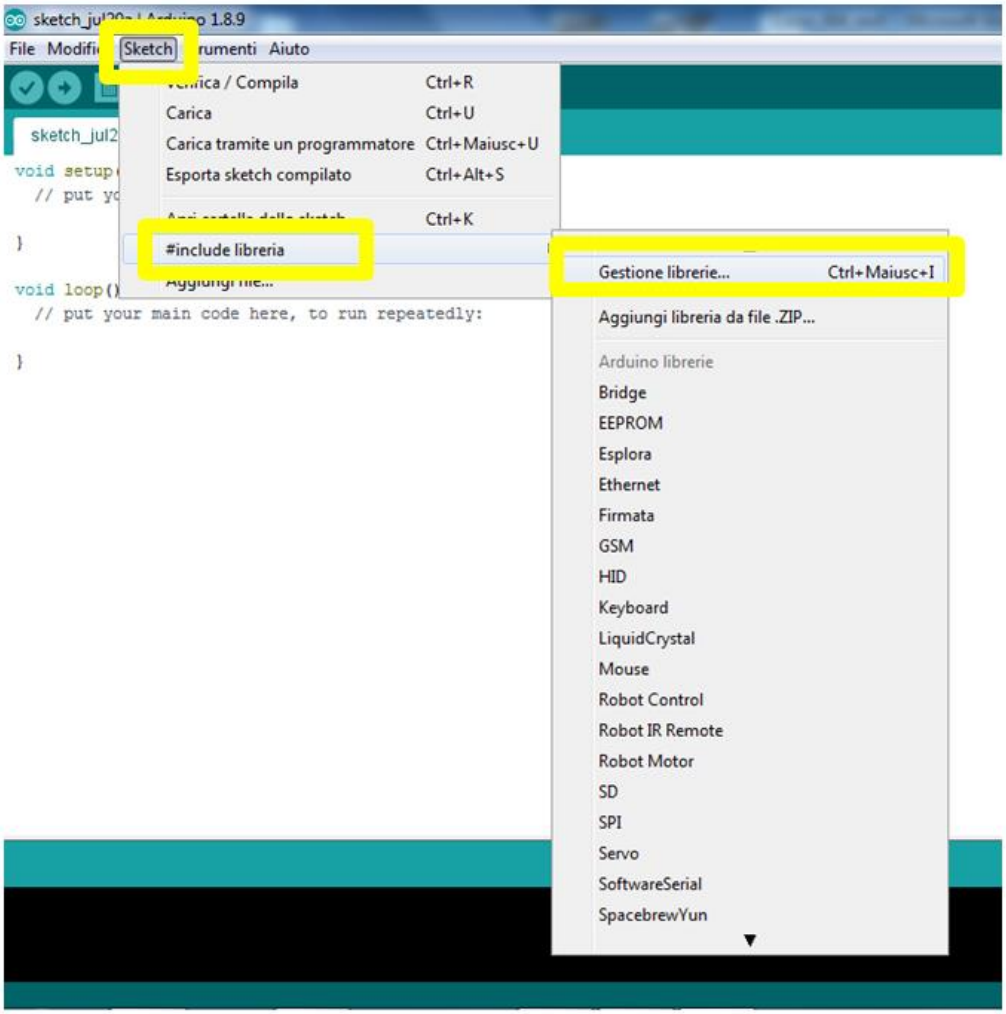
First we open the software, click twice on the Arduino icon on the Desktop and the IDE opens:

Since when you open the IDE it usually loads the last written sketch, we start from a clean sketch so as not to create confusion. To do this, click on "File" and then on "New":

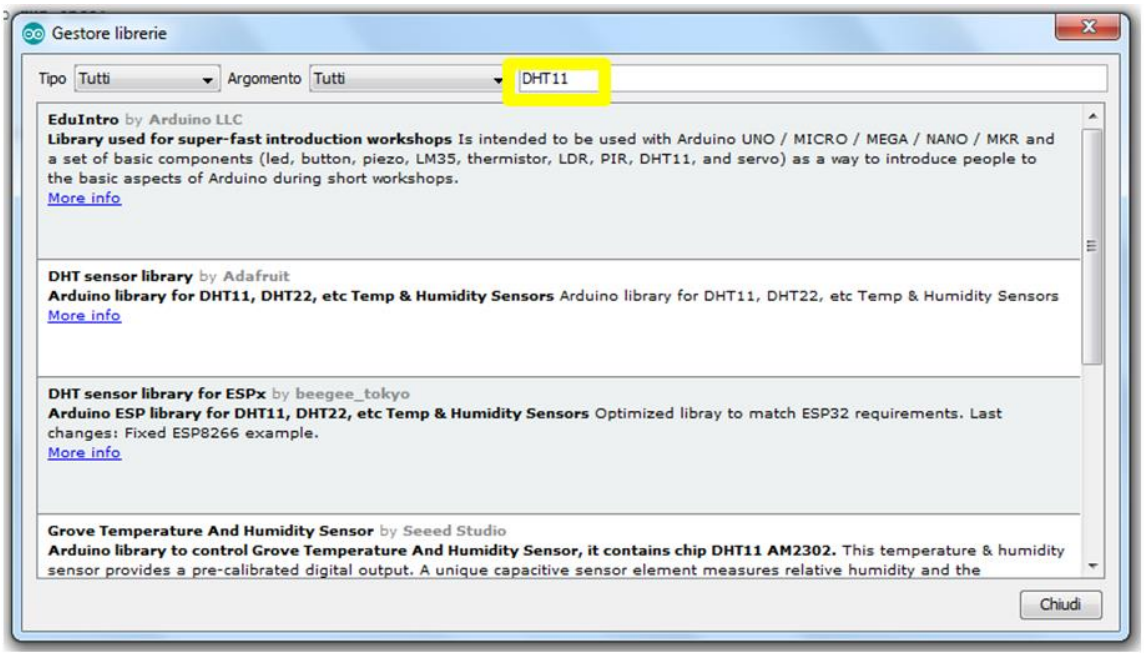


as represented above. At this point we can close the initial window where the previous sketch was.

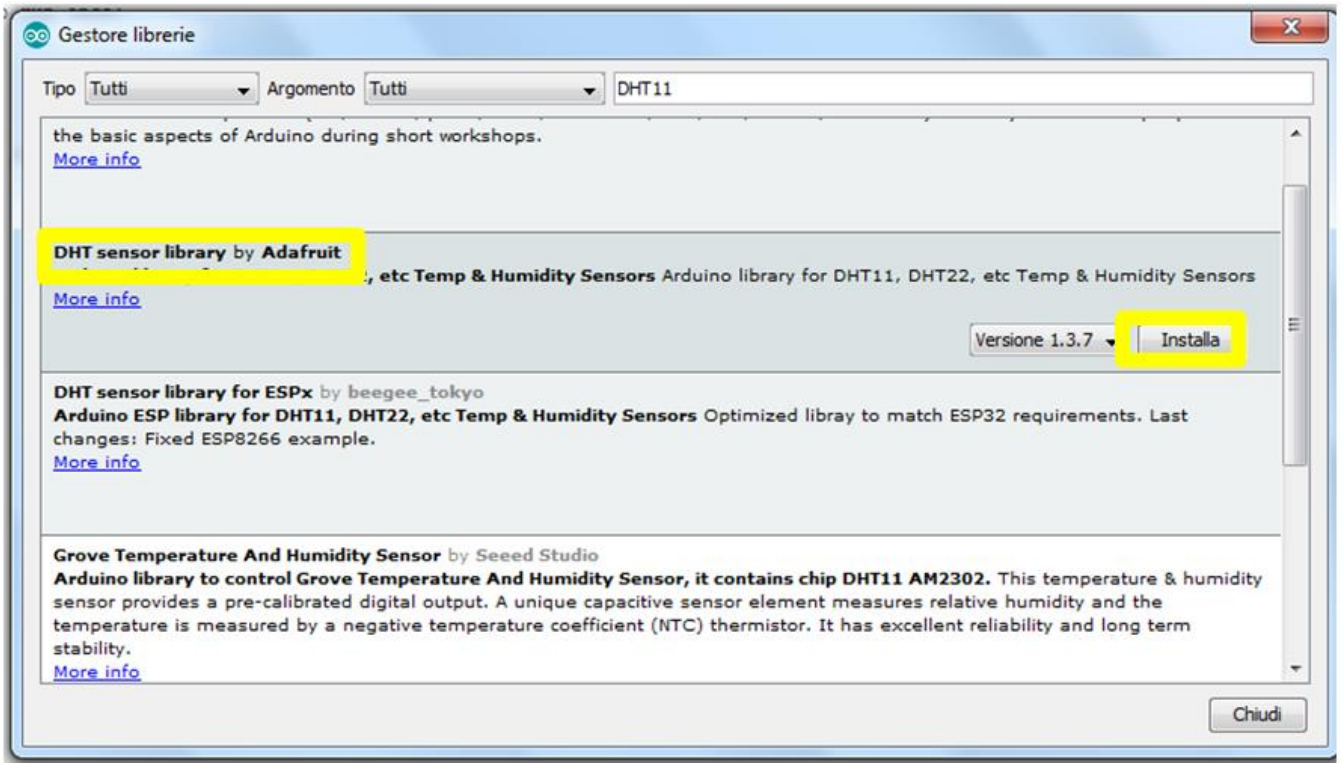
Now click on "sketch" then on "#includi library" and then on "Manage libraries...".



After a few seconds the following window appears and we go to write in the text box "DHT11"



A list of libraries comes out, we select the one produced by Adafruit...



... and click on "Istalla".
After a few seconds the window with the inscription "INSTALLED" appears. The library is now usable and at the time of compilation of the sketch for Arduino will not give error the IDE.

This procedure is valid for any new sensor that requires the installation of a library, just change the name of the sensor.