

Workshop 4: Advanced EV3 Programming

1 Getting Started

Make sure you have everything you need to complete this lab. To get started you will need the following:

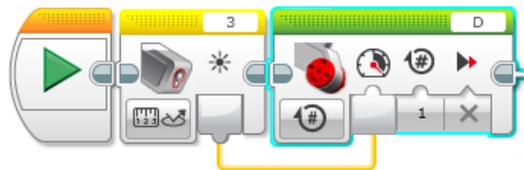
- a LEGO Mindstorms EV3 robot
- a computer with LEGO Mindstorms EV3 software application installed
- a USB cable that connects the robot to your computer

2 EV3 programming concepts

- **Data Hub**

Data Hub in LEGO Mindstorms EV3 Application is a way to connect blocks together. Pass, assign or read a value from blocks. It's really important to know how this works, when we want to display a number on the EV3 brain or connect a Sensor to a Motor (last week).

1. To do this, drag a **Color Sensor** and a **Large Motor block** into your project. It should look like this:

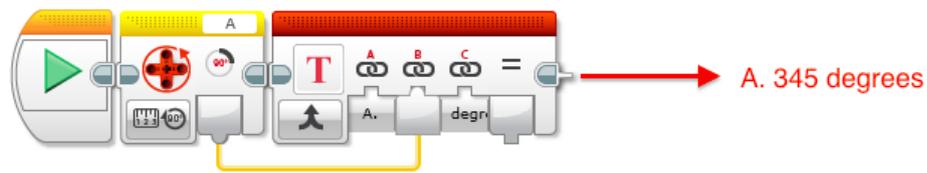


As you can see, there are more than one value associated with a single block. To know what they are, just rollover your cursor above the icons.

2. For example, if we want to move our robot according to the **Color Sensor's Reflected Light Intensity**, we need to connect the Sensor's **Light value** to the Large Motor block's **Power value**. To do this, start dragging a line from the **Light** value to the **Power** value. You will get something like the image above.
3. Now you have connected two independent blocks together. This means, if the the light getting brighter in the room, your robot will move faster, otherwise it will slow down.
4. **Try it out!**

- **Text Block**

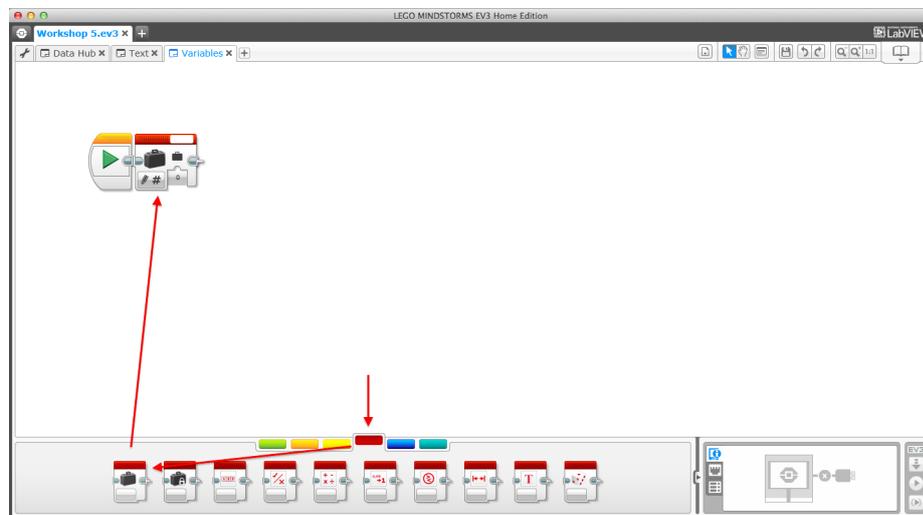
The Text block is a great tool for combining strings together. It's located in the **Data Operations** group. The block is able to combine three different strings, which can be assigned manually or by other blocks. The image below shows a user friendly representation of the time, set up on the **Text Block**. Textfield **B** get its value from the **Rotation Sensor Block (A)**.



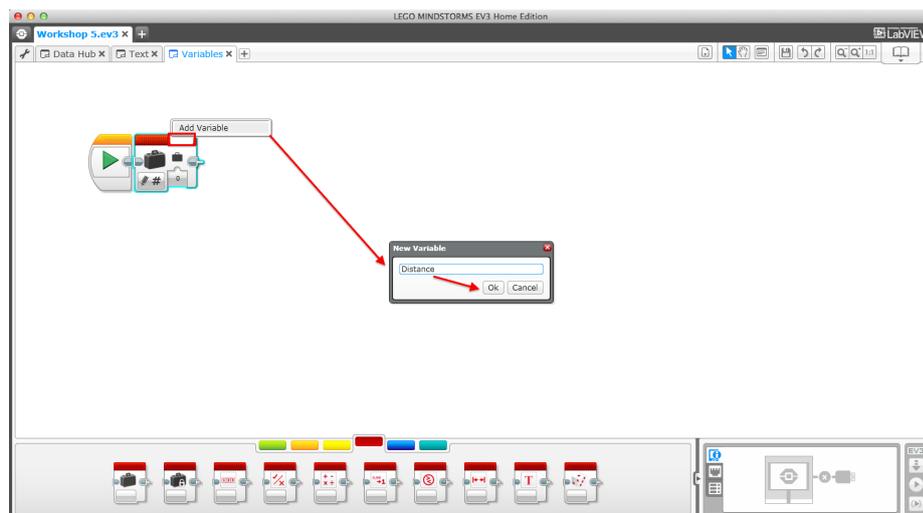
- **Variables**

Variables is an indispensable part of programming, as you will see later on. In LEGO Mindstorms EV3 we can create 5 different types of variable, **Text**, **Numeric**, **Logic (boolean)**, **Numeric Array**, **Logic Array**.

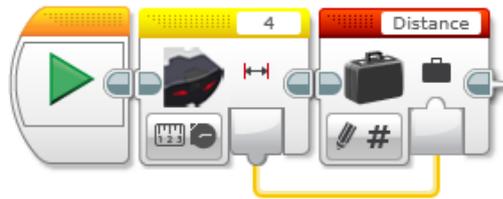
1. To use a variable, drag a **Variable Block** from the **Data Operations** group:



2. **Create a new variable** by clicking on the upper right corner on the block, then **Add Variable** and name it. Finally press **OK**. You should get something like this at the end:



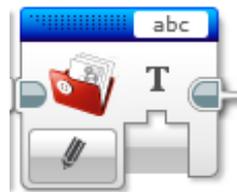
3. Now you're ready to use the variable during the programming. Drag an **Ultrasonic Sensor (or Infrared Sensor) block** and drop it before the **Variable Block**.
4. Choose its functionality to **Measure Proximity**, then connect the data hubs, by dragging a line from the **Sensor Block** to the **Variable Block**.



5. Once you connected the two blocks together, the program will save the **distance**. You can get this value whenever you want during this program by selecting the **Read** functionality on the **Variable Block**.

- **File Access**

Finally, you need to understand how the **File Access Block** works in order to data log with the EV3 Robot. The block is located in the **Advanced** group, it looks like this:



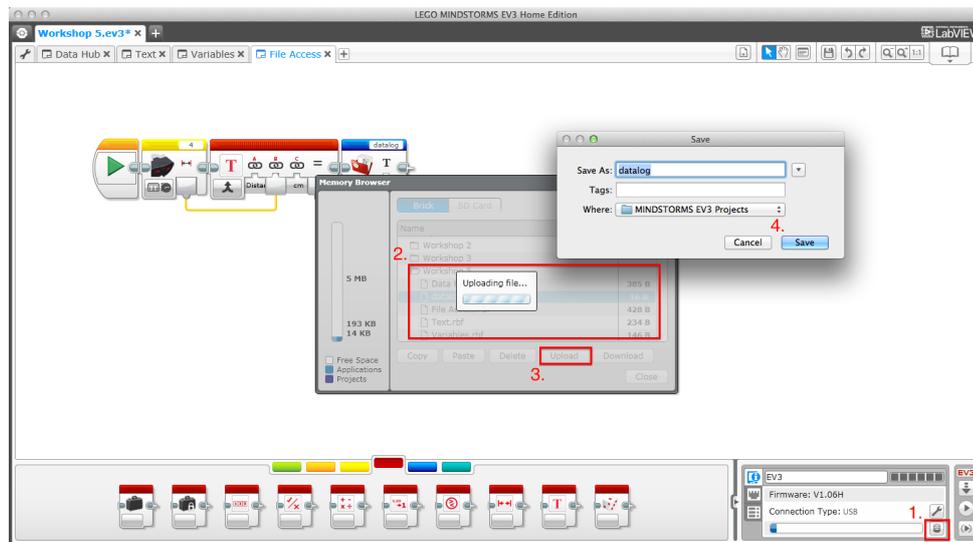
It has an **Input Text** hub, which need to be assigned by another block or by manually entering the text. **If no text has been assigned, a new line will be created in the text file!**

On the **File Access Block**, the following options are setable:



- **Name:** In the upper right corner of the block, you can specify the name of the text file. If you have more than one **File Access** block in your program and you give the same name for all of them, the program **will not create a new file, but expand the existing one**.
- **Functionality:** In the drop down menu you can choose the action for the block. You can either **Read, Write, Delete** or **Close** a file.
- **Text:** The Data hub for the text input, which can be entered manually or assigned by another block.

Once you finished with your program, **run it**. After the program terminates, you will need to get the file that you just created during the run-time. To do that, follow the instructions below:



1. Connect the EV3 brain to the computer and press the **Memory Browser button** marked with **1.** on the image.
2. In the **Memory Browser**, find the name of the project, where you have created the **File Access Block**. In this picture it's **Workshop 5**. Then select the text file, according to the name you gave on the block. In this example, it's called **datalog.rtf**.
3. To download it to your computer, click on the **Upload button (marked with 3.)**
4. Finally you can change the name of the file and specify its path. Once you have done that, press **Save**.

Now you can go to the folder you saved the text file and see what has been printed out.

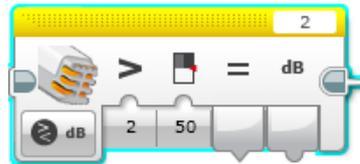
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3 Challenge: Sound Sensor Calibration

As you may already noticed, the LEGO Mindstorms EV3 robot also includes a Sound Sensor. The Sound Sensor record the sounds around you live and tells you the volume in a 1 to 100 scale.

To get set up:

- You will need to use a **Sound Sensor** block, just like you did before with other blocks. It should be in the **Sensor** group. It looks like this:



- Throughout the week, bring the robot with you and try to determine the volume around you. Connect the robot with the real world!
- Try out the sensor in a room, on the street or when you playing on some instruments. What is the volume of these things?
- What is the volume of a normal conversation? a street during the day (or at night)?
- **Be creative** to understand how the Sound Sensor works!
- **Important!** Keep track of your work and the data. **Convert** the sound volume into a text and write out the data with some additional useful text, using a **Text Block**. Use the output data to understand the sound volume changes in the real world.