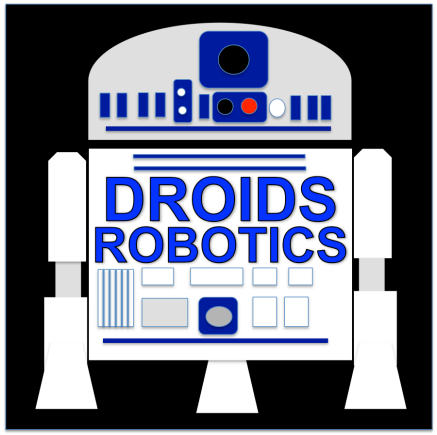
ADVANCED EV3 PROGRAMMING LESSON 1:



MY BLOCKS OVERVIEW (PART 1)

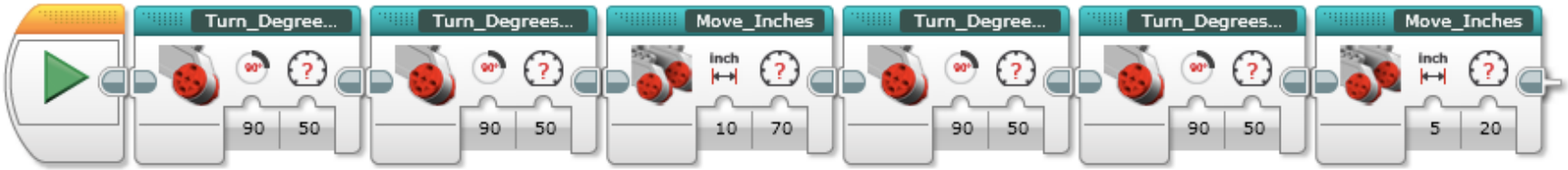
BY DROIDS ROBOTICS

WHAT IS A MY BLOCK?

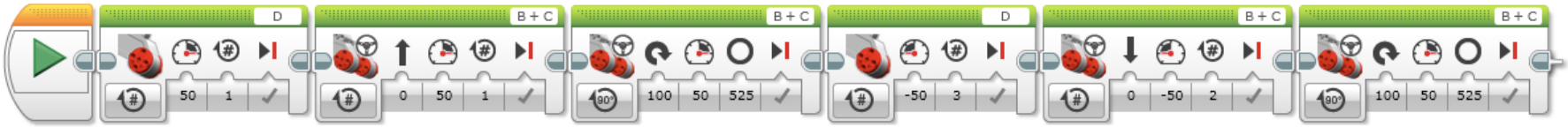
- A My Block is a combination of one or more blocks that you create that can be grouped into a single block
- My Blocks are basically your own custom block in NXT or EV3
- Once a My Block is created, you can use it in multiple programs
- Just like any other block in EV3, My Blocks can have both inputs and outputs

WHY SHOULD YOU BOTHER?

Because of `Move Inches` and `Turn Degrees` My Blocks, your missions will look like this…



Instead of this….

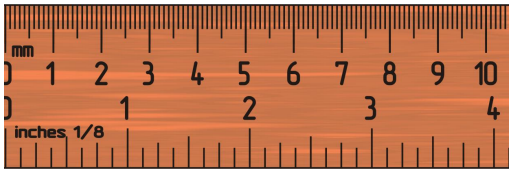


This makes your code easier to read and easier to modify!!!

WHEN DO YOU USE A MY BLOCK

- **Whenever the robot is going to repeat an action inside your program**
- **When code is repeated in a different program**
- **Organize and simplify your code**
  - Example: You have 2 different versions of a robot run in FLL and the first half of both of them are identical, then making the first half of the code into a My Block allows you to “clean up your code” in both programs.

WHY IS A `MOVE INCHES` MY BLOCK A GOOD IDEA



- **Built-in move blocks will not take inputs (values) in centimeters or inches.**
- **Much easier to measure distance with a ruler than degrees or rotations.**
- **If you change your robot design to have bigger or smaller wheels late in the season you don't have to re-measure every movement of your robot**
  - Instead of changing distances in every single program you wrote, just go into your cool `Move Inches` Block and change the value for how many inches/ cm one motor rotation would take.

WHAT MAKES A USEFUL MY BLOCK

Note: Making My Blocks with inputs and outputs can make them far more useful. However, you need to be careful not to make the My Block too complicated.

Question: **Look at the list of three My Blocks below. Which ones do you think are useful for a team to use?**

1) Move2Inches (Moves the robot two inches)

2) MoveInches with an inches and power input

3) MoveInches with inches, power, angle, coast/brake, etc. inputs

Answer:

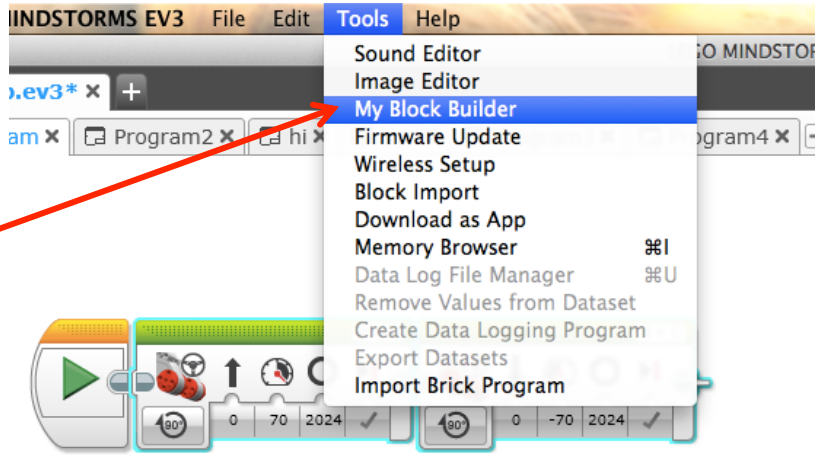
Move2Inches may be used often but you will be forced to make other My Blocks for other distances. This will be hard to update or fix later on.

MoveInches with inches, power, angle, coast/brake, etc. might look more useful but most of the inputs might never be used in any mission.

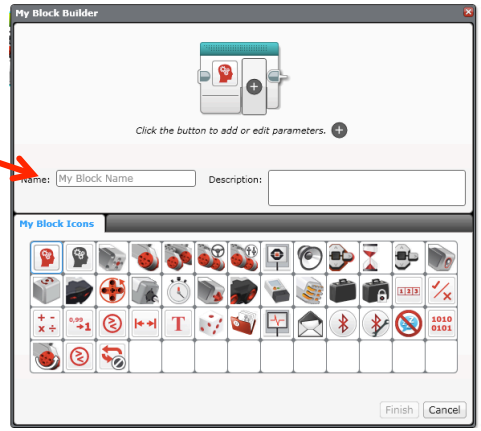
MoveInches with inches and power as inputs is probably the best choice for most teams.

HOW TO MAKE A MY BLOCK

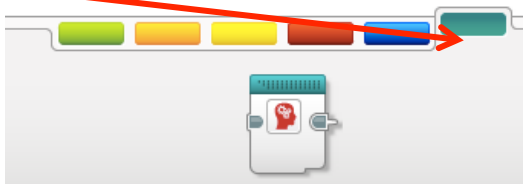
Step 1: Select the blocks you think you will reuse. Go to Tools and Pick My Block Builder



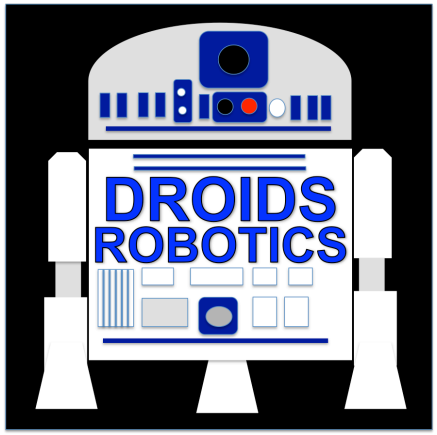
Step 2: Pick a name and icon and set inputs & outputs



Step 3: You can use your block anytime – found in the turquoise tab



ADVANCED EV3 PROGRAMMING LESSON 1:



MOVE INCHES MY BLOCK (PART 2)

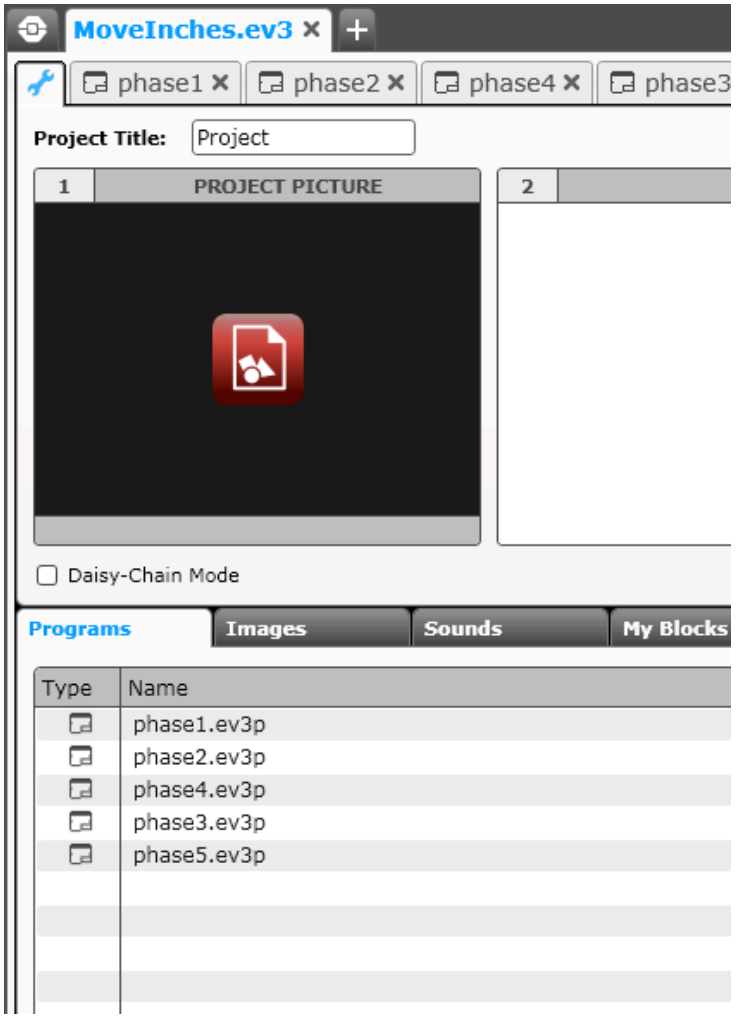
BY DROIDS ROBOTICS

MY BLOCKS WITH INPUTS AND OUTPUTS (MOVE INCHES)

See the corresponding EV3 Files for step-by-step instructions and the actual code for you to learn how to make a `Move Inches` My Block. The code has been made in steps (phases).

Start at the Phase 1 tab and read all the comments in each one. We also give all the code so you can follow along and try it out.

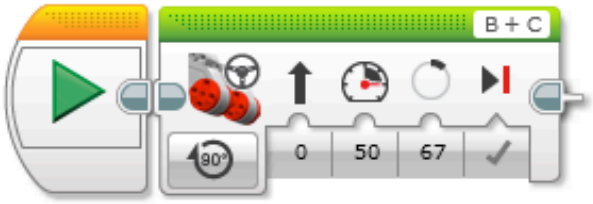
The next few slides are screen captures of the lesson.



PHASE 1: MEASURE WHEELS

This is a program that moves 1 inch. The value 67 degrees is based on the size of the wheels on our robot. You will have to compute or measure how many degrees your wheel turns to move 1 inch. Please read our email for instructions to calulate how many degrees are in 1 inch.

This is a first step in making a Move Inches My Block.



HOW TO MEASURE YOUR WHEEL.

There are 2 ways to figure out how many degrees your robot moves in 1 inch:

1) Put your ruler next to your wheel/robot at 0 inches. On the brick, go to the menu where you can view your sensor and motor readings. (Pick PORT VIEW - under the tab with the 6 circles) Roll your robot forward 10 inches making sure your robot does not slip.

Take the degree reading you see on the screen for the motor sensor and divide by 10. The answer will be the number of degrees your robot's wheels turn in 1 inch.

2) Lego usually prints the diameter of the wheel on the side of the tire in mm. If you can't find it printed, lots of internet sites tell you the size of lego parts. Since circumference is pi X diameter, you can use the mm printed on the wheel to convert to cms or inches and figure out how much the wheel would travel per 360 degree rotation.

e.g.
The standard big motorcyle wheels in the technic sets are 81.6mm = 3.21inches
3.21 x pi = 10.1 inches per rotation
1 rotation = 360 degrees
360 degrees / 10.1 inch = 35.7 degrees per inch

PHASE 2: MAKING AN INCHES TO DEGREES MY BLOCK

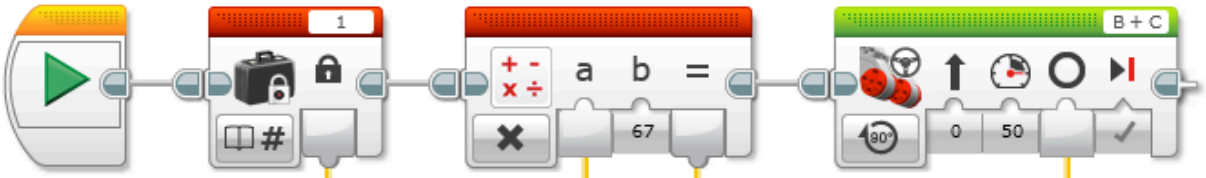
In Phase 1, you could only move your robot 1 inch. This program lets you put in any number of inches you want the robot to move. The number of inches to move is stored in the constant block and connected using a wire to the math block. Remember to change the 67 based on your wheel size.

This block is a constant that can be found in the red tab. The value in the number on the top right corner of the block represents the number inches that the robot will move. This block value can be changed by clicking on In this program the block is used to create an input for our My Block in the next step of making a My Block.

This math block takes the value inputed and multiplies it by 67 to convert the input number (in inches) to degrees. The output wire sends the result into the degrees input of the move block.

Regular move block that has an input wire. The robot should move 1 inch with the correct wheels

You will need to highlight and pick the math block. Select Tools --> My Block Builder from the menu to create the My Block that you will see in Phase 3.



output value=1

input value=1

output value=67

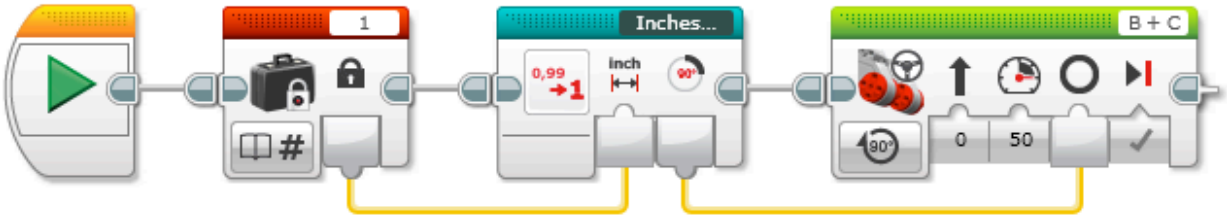
input value=67

These yellow lines are data wires. You use them to send inputs and outputs from one block to another.

PHASE 3: USING THE INCHES TO DEGREES MY BLOCK

This program is the same as phase2 but instead of having a math block to convert inches to degrees, we have a My Block with the math block inside it. As you can see, this My Block has an input and an output. Even though it is only long, we still made this a My Block because we reuse this code over and over again. For instance, we use it in a Wall Follow Inches My Block and in our Line Follower for Inches programs. If we change the wheels on the robot, we would only have to change this 1 My Block and everything would update.

The math block from phase 2 has been made into a My block.



output value=1

input value=1

output value=67

input value=67

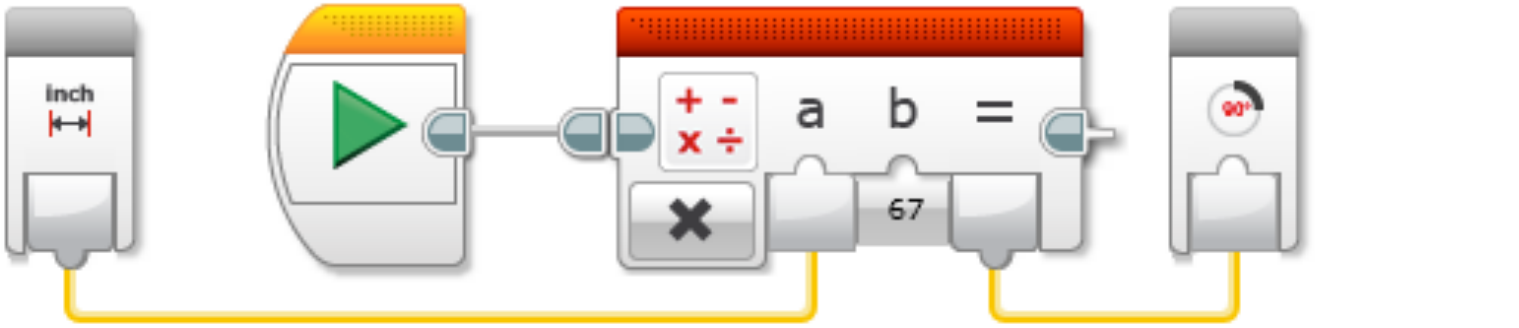
These yellow lines are data wires. You use them to send inputs and outputs from one block to another.

The My Block in this program was made by highlighting the math block and then clicking on Tools ---> My Block Builder.

All My Blocks you make will appear n the green tab at the bottom of the screen for you to reuse.

A LOOK INSIDE INCHES TO DEGREES

This is what Inches to Degrees looks like inside if you double click on the My Block. The input on the left is the amount of inches inputted and the output on the right is the amount of degrees. The program changed the wires to look like the 2 blocks you see below.



Input = Inches

Output = Degrees

PHASE 4: ADDING INPUTS

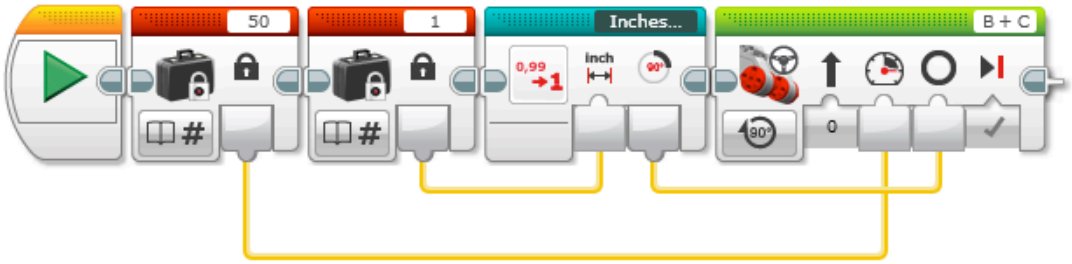
This program adds a power constant to allow you to alter the power. This is the first step in making a My Block with multiple inputs - in this case, we are using POWER and INCHES.

Constant
Power = 50

Constant
Inches = 1

Inches to Degrees My Block you made earlier

Move Block



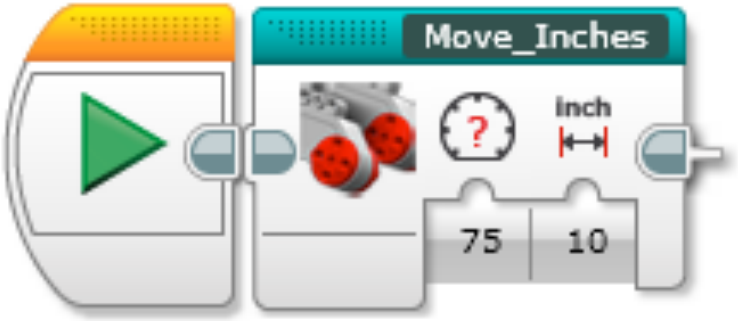
Inputs and Outputs using data wires

In this step, you will need to highlight and select both the Inches to Degrees My Block and the Move Block. Don't select the 2 constants. You will be making this into another My Block by selecting TOOLS --> My Blocks Builder from the menu.

That is what you will see in phase 5.

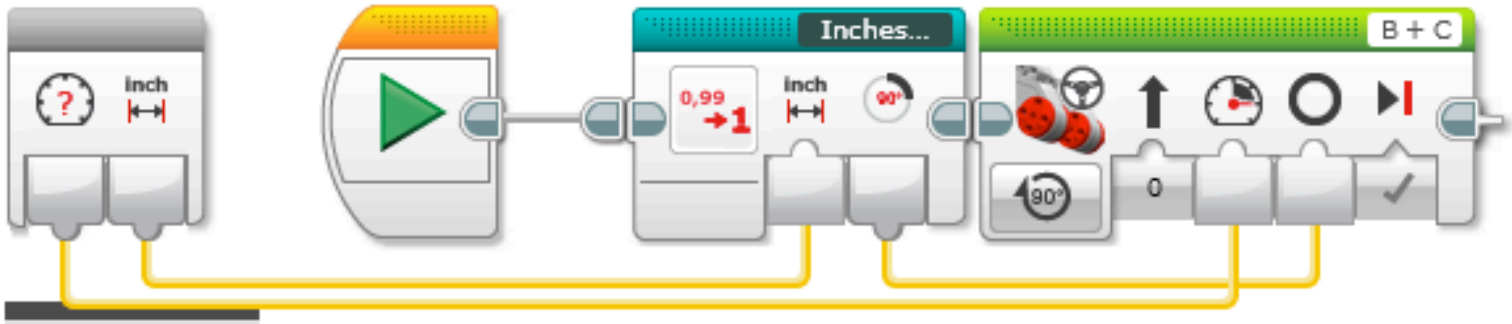
PHASE 5: COMPLETED MOVE INCHES MY BLOCK

This is phase4 convertd into a My Block. We call it Move Inches. It has 2 inputs now = POWER and INCHES. You can double click on any My Block to see what is inside it or make certain changes to it. Move Inches is a My Block that you can use frequently in FLL. When you program, just use a ruler and measure how far you want your robot to move to get to a certain mission model.



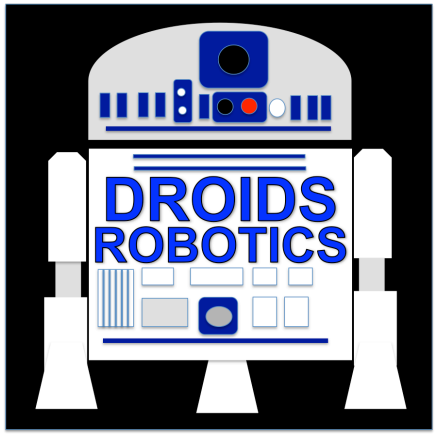
A LOOK INSIDE MOVE INCHES

This is what the Move Inches My Block looks like inside if you double click on it. This program looks a little different from phase4. You remember that when we made the My Block, we did not select the constant to be part of the My Block. The program automatically converted the two wires that go into the My Block (Power and Inches) into the special block on the left.



Power and Inches input converted from wires.

ADVANCED EV3 PROGRAMMING LESSON 1:



TURN DEGREES MY BLOCK (PART 3)

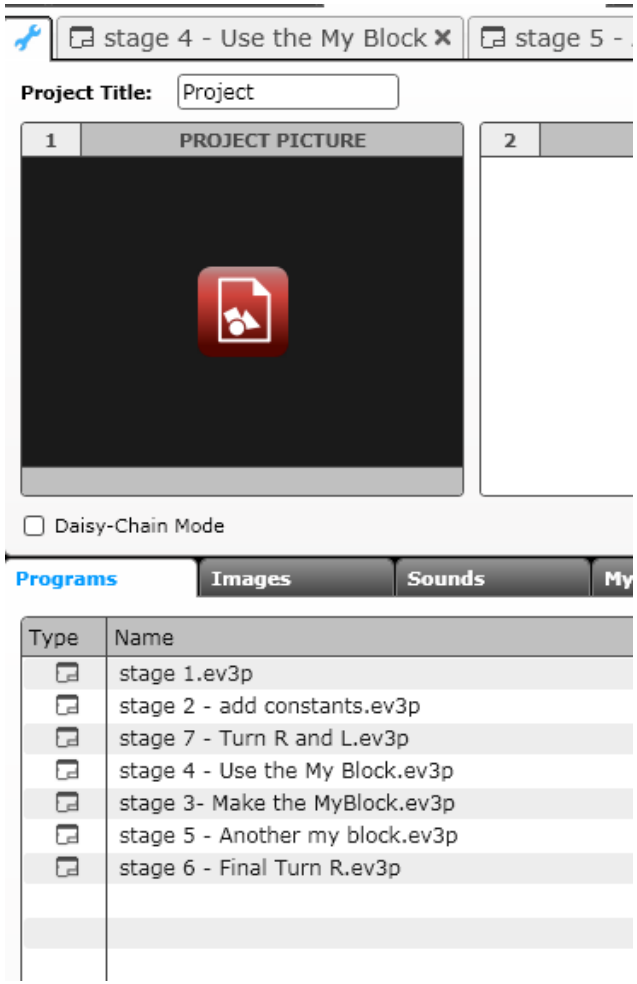
BY DROIDS ROBOTICS

MY BLOCKS WITH INPUTS AND OUTPUTS (TURN DEGREES)

See the attached EV3 Files for step-by-step instructions and the actual code for you to learn how to make a useful My Block to turn.

Start at the Stage 1 tab and read all the comments in each one. We also show you the final programs.

The project file has instructions for a `Turn Degrees` My Block. Some supplemental information is on the next few slides.



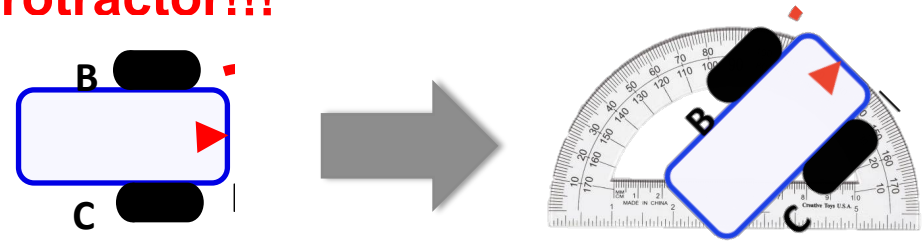
MAKING A TURN MY BLOCK

Just like Move Inches, you can also create a My Block for turns. In Move Inches, we had to figure out how much the robot wheels rotate for one inch on a ruler.

To make a `Turn Degrees` My Block, you have to figure out how much your rotation sensor on the motor turns for one degree on a protractor

A Turn My Block will be extremely useful to any FLL team because now you can measure your turns using a protractor!!!

You can use the EV3 to measure how much your wheel turns. **We call this rotation degrees.**



45 degree turn by the robot in the real world can be measured with a protractor. **We call this protractor degrees.**

MEASURING THE ROTATION SENSOR

The EV3 has a Port View Function which lets it display values measured by sensors

In this section, we will show you how to use the port view to measure turns.

Step 1: Go to Port View on your brick. On the EV3, it is on the third menu to the right. Look for the value for one of your drive motors (motors attached to your wheels)

Step 2: Turn the robot 90 degrees (Pivot Turn) yourself – using your hands to turn one wheel. Make sure the wheels don't slip when you do this.

Step 3: Look at the rotation degrees value and write down the number of degrees (n)

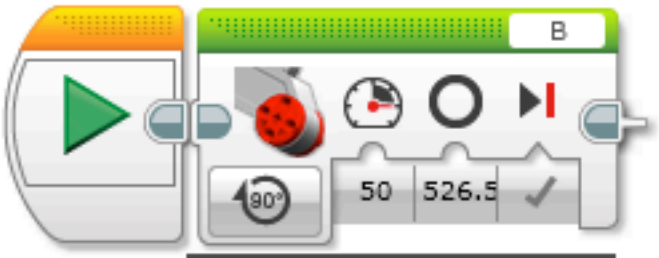
Step 4: Divide the number from step 3 (n) by 90 (n/90)

This is the number of how many motor rotation degrees are in 1 protractor degree.

You can now use this information to make a Pivot Turn My Block called `Turn Degrees`. Please see my attached EV3 file. There are Phases marked for you to follow. Once you understand the code, you can modify this code to make a Spin Turn My Block as well.

STAGE 1: MEASURE TURNS

The goal of this program is to turn the robot 90 degrees.



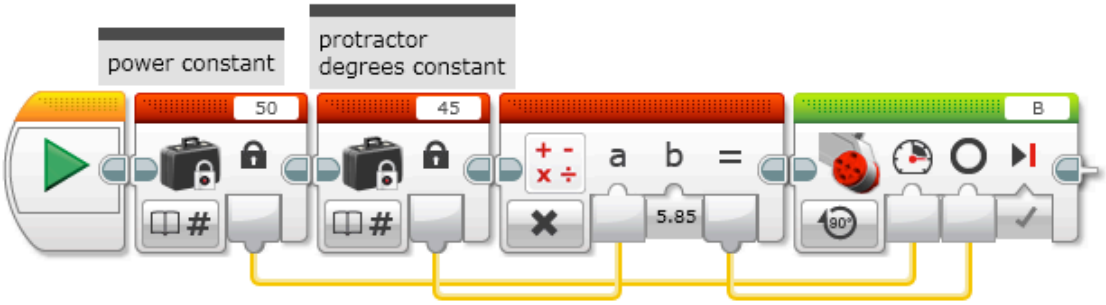
This starts motor B (the left motor if you were facing the same way as the robot)

You need to use the sensor readings on your brick to figure out how many degrees in the rotation sensor it takes if you manually turn your robot 90 degrees right. For our robot, this value is 526.5. See the PDF file for more information on how to do this.

GO TO STAGE 2 after this step. CLICK ON the wrench icon on the top left to pick the next stage. Follow this step at the end of each Stage.

STAGE 2: ADD CONSTANTS

This program is the same as stage 1 except it has two constants to input the degrees and power. We also added a Math block to convert from protractor degrees to motor rotation degrees. We are adding these constants so that it is easy to make the My Blocks.



These are constants. A constant is like a variable, but it is set one time and you can change the value somewhere else.

This is a Math Block. It is currently set to convert the protractor degrees to motor degrees. 5.85 is how many degrees on the protractors. See the comment on the far right.

We move the motor for the amount of degrees that was calculated in the previous block using the data wires (yellow lines).

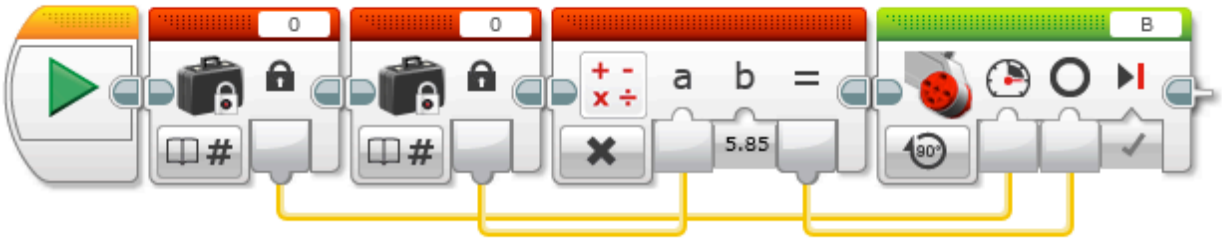
From Stage 1: (you can use the value calculated in stage 1) You need to use the sensor readings on your brick to figure out how many degrees in the rotation sensor it takes if you manually turn your robot 90 degrees right. For our robot, this value is 526.5.

In this stage you have to divide the above value of motor degrees in 90 protractor degrees by 90 degrees to calculate to get how many motor degrees are in one protractor degrees. For our robot, this is 5.85.

You should read our PDF document if you need more explanation for what we just did in this step.

MOVE TO STAGE 3

STAGE 3: MAKE MY BLOCK



This is the Math Block you need to make into a My Block BEFORE you move to stage 4.

This program is the same as stage 2 except you will make a My Block. Click on the Math Block on the right and click on the Tools Menu. Choose My Block Builder. Customize the My Block and choose finish. We found that the My Block builder does not let you pick a long name. To make a long name, I saved the My Block and renamed it named "turndegrees_to_mtr_degrees". You can rename a my block or program by opening the program and then double clicking on the program tab at the top of the screen. For example, you can double click on "stage 3" at the top of the screen to rename this program.

In general, you should name your My Block something useful so that you can easily remember what it does.

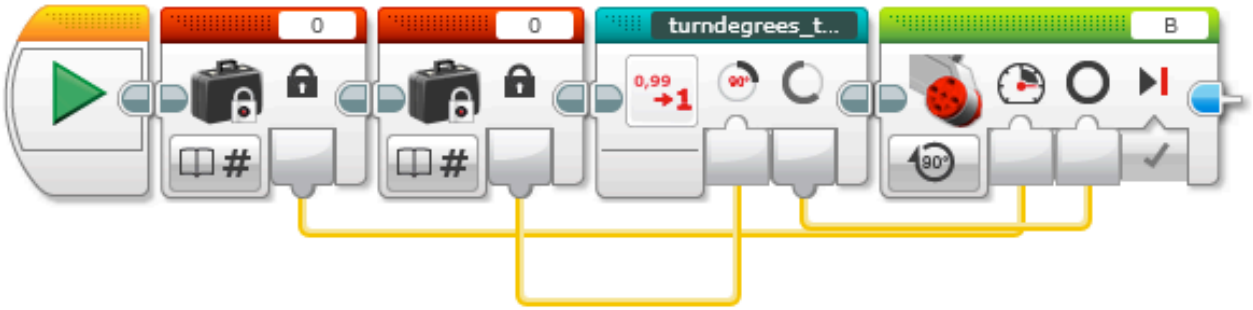
Once you make My Blocks, they show up in the darker green tab at the end. It will show you the name of the My Block if you hover over it. Now you can use the new My Block over and over again.

MOVE TO STAGE 4

STAGE 4: USE MY BLOCK

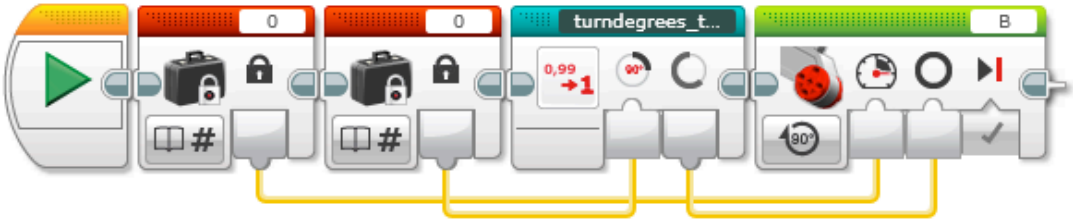
This program is the same as stage 3 except it now uses a My Block called turndegrees_to_motor_degrees which you would have created in Stage 3.

This is a My block we made. It converts protractor degrees to motor degrees.



MOVE TO STAGE 5 once you have inserted your My Block

STAGE 5: ANOTHER MY BLOCK



Select these two blocks (use shift click or select area to select multiple blocks)

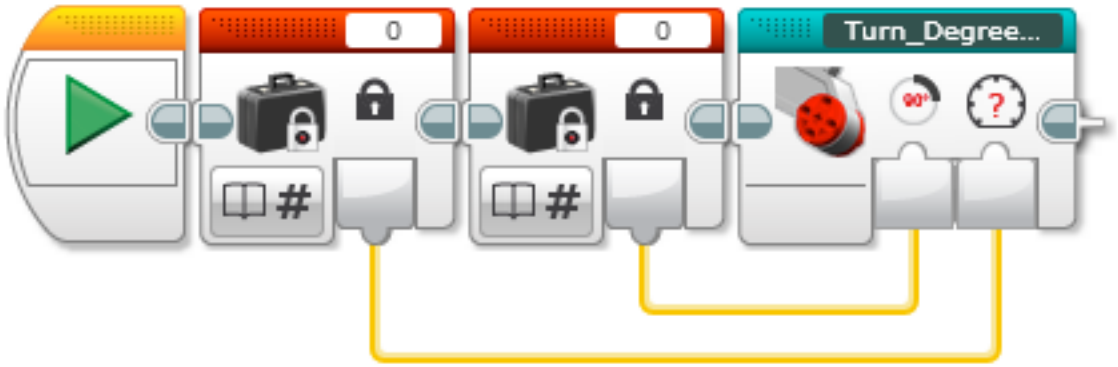
This program is the same as stage 4 except you will make another My Block. Highlight both the turndegrees_to_mtr_degrees and the Move Motor B blocks (use shift click or select area to select multiple blocks) and click on the Tools Menu. Choose My Block Builder. Customize the My Block and choose finish.

The My Block builder did not let me pick a long name. I saved the My Block and renamed it named "turn_degrees_right". Follow the same instructions as before.

MOVE TO STAGE 6

STAGE 6: TURN DEGREES RIGHT

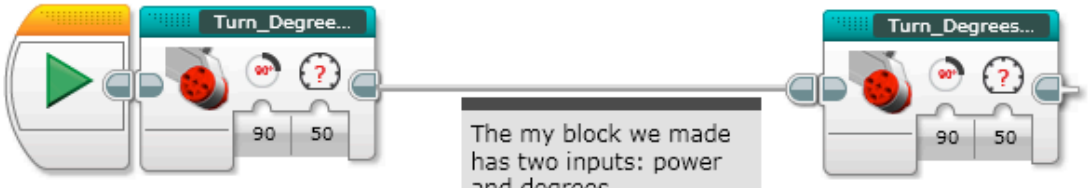
This program is the same as stage 5 except it now uses a My Block called Turn_Degrees_Right. This block will let you turn the robot any number of degrees to the right.



MOVE TO STAGE 7

STAGE 7: FINAL TURN DEGREES

This is the final Turn Degrees Right program. It does Pivot Turns RIGHT



This block turns the robot right.

The my block we made has two inputs: power and degrees.

Using the same technique, I made a Turn Degrees Left. You can look at it here.

This block turns the robot left.

These are the final two my blocks for turning right and turning left. You can double click on any my block to look inside and see the contents. You can try combining this with the move_inches my blocks from the earlier lesson to move around the FLL table easily.

You can add these my blocks to any of your progams from the darker green tab at the bottom of the screen (the far right one in the set of tabs).

CREDITS

- **These slides and the corresponding EV3 project files were made by Sanjay Seshan and Arvind Seshan from FLL Team: Not the Droids You Are Looking For.**
- **They are free to use and distribute. We just ask that you send us an email letting us know if you liked the material, how you used it and if you have any corrections or suggestions for improvement.**
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- **Other useful resources: http://www.droidsrobotics.org/Droids_Robotics/World_Class_Resources.html**