Welcome!

Welcome to the Imaginarium Summer Robotics Camp!

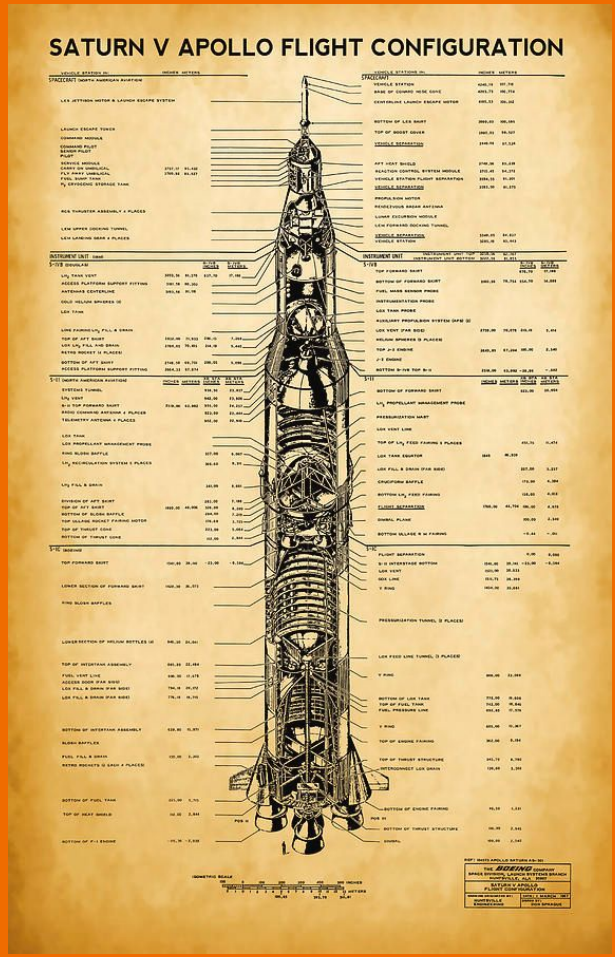
We're going to have fun learning a lot about **STEM** and **Robotics**!

Ice Breaker

When you think of a “robot” what do you picture?

Let's Talk About Engineering Notebooks!

Engineering Notebooks are Used By Engineers
They are used to make rough sketches and plans

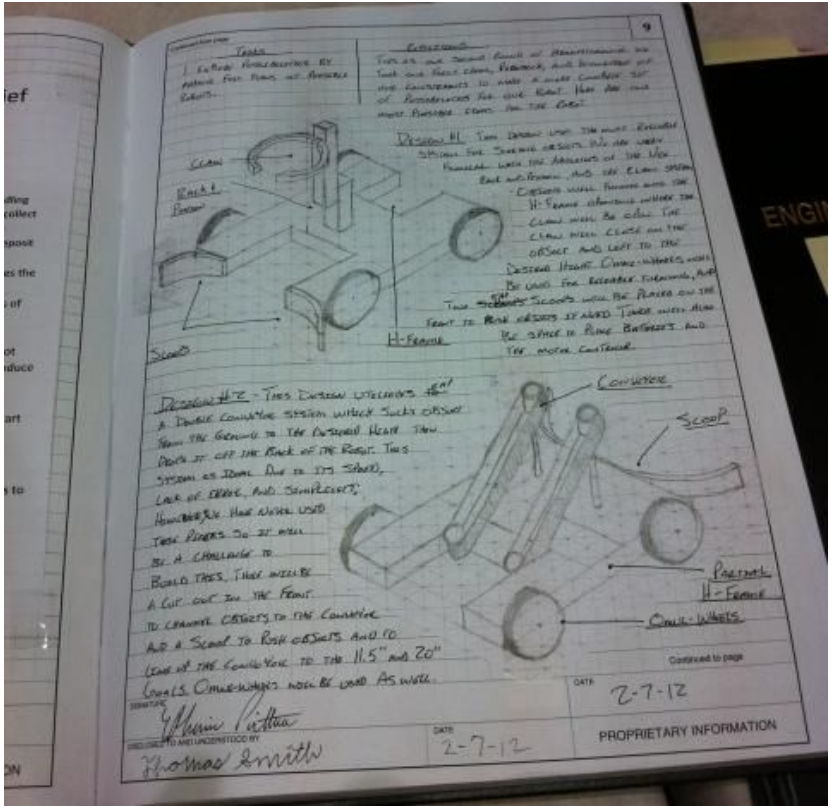


Engineering Notebooks

They are used to track progress and record data on projects.

We will be using engineering notebooks to help build our robots!

How do you all think engineering notebooks will be used in our program?



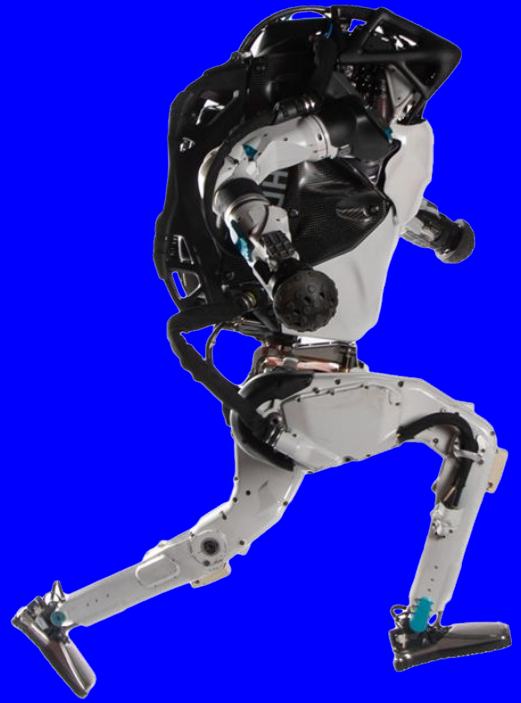
What is Robotics?

Robotics is the study and application of Robots!

- You can...
  - Design Robots
  - Build Robots
  - Research Robots
  - Apply Robots into daily lives

Robotics is the use of robots

Robotics is applying aspects of STEM into building machines.



What is STEM?

Science

$$\nabla \cdot \mathbf{B} = 0$$

Technology

```
>>> from java.util import *
>>> m=TreeMap()
>>> m.put('c', 1)
>>> m.put('a', 2)
>>> m.put('b', 3)
>>> print m
```

Engineering

$$\Delta V = v_e \ln \frac{m_0}{m_1}$$

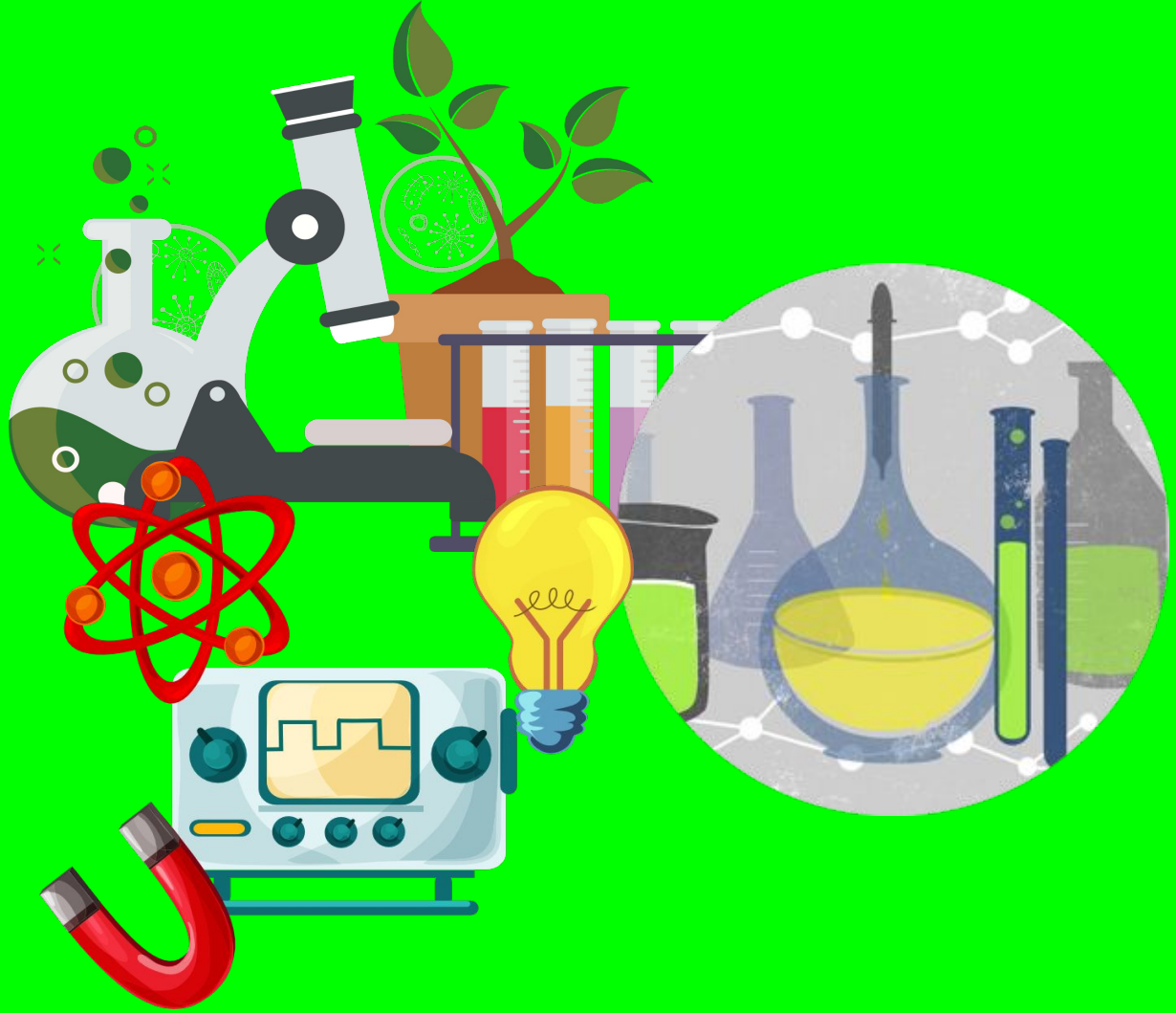
Math

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Science

Science is the branch of STEM that allows us to learn more about the world around us!

- **Science** is used with Math to allow for us to Engineer things!
- **Science** and Technology are becoming more and more interlinked!
- **Science** and Math have always been closely interlinked!

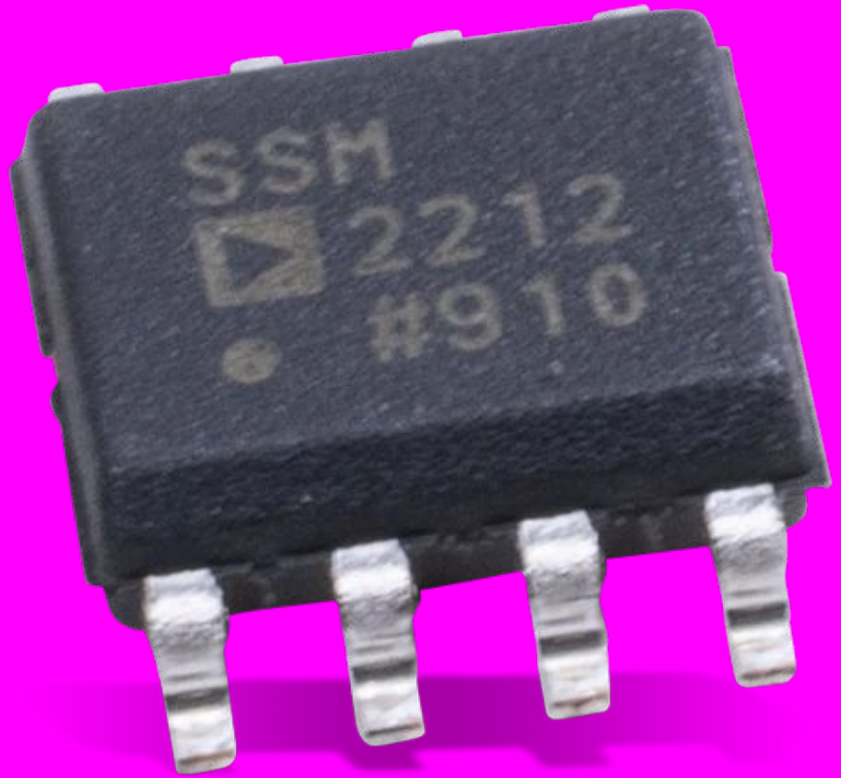


Technology

Technology is the branch of STEM that allows us to use machines to help us learn and use the resources around us!

- Technology is very closely linked with **Science** and **Math**
- **Science** and **Math** made **Technological** advances possible!
- **Technology** and **Engineering** are becoming more and more interlinked

Technology has existed for thousands of years, but is becoming more and more advanced!



Engineering

Engineering is the branch of STEM that allows us to apply our knowledge of **Science, Technology, and Math** into the real world

- We **Engineer** things based on **Scientific** principles
- We **Engineer** things based on the **Mathematical** calculations
- **Technology** helps us **Engineer** things!

Engineering has allowed us to use our knowledge and use it to create and discover amazing things!

There are many branches of Engineering!

https://youtu.be/bipTWWHya8A

Math

Math is the branch of STEM that allows for us to calculate different things so that we can understand more about them

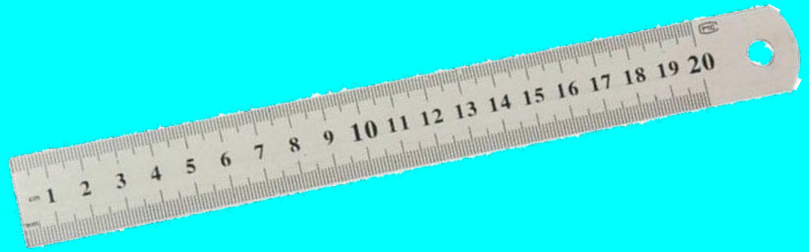
- **Math** and **Science** are very closely interconnected!
- **Math** helped **Technology** get to where it is today!
- **Math** is an integral part of **Engineering**!

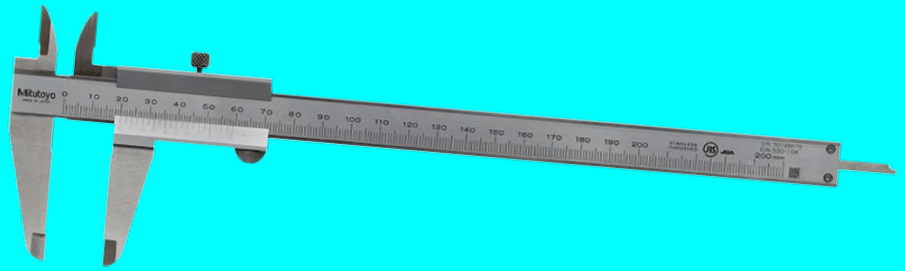
Math is not always a boring subject. It is filled with problem solving and figuring out how to find a solutions to difficult problems. Math is always fun if you have the right mindset!

Engineering Activity: Using Rulers

Rulers are objects that allow us to measure the size of something

- Engineers use a special type of ruler known as an **Engineering Ruler**
  - Engineering Rulers are rulers that are more precise than normal rulers
  - They also have convenient conversions
- Engineers also use a special tool known as a **Caliper**
  - A Caliper is a tool that allows you to easily measure the linear distance of something





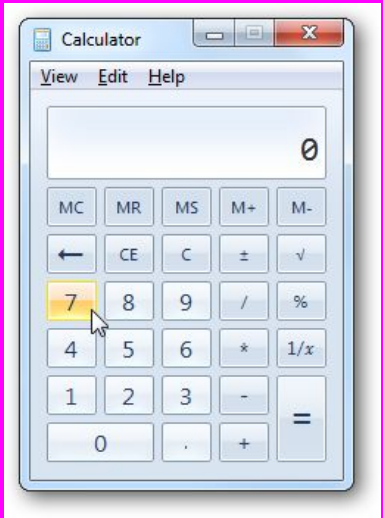
Technology Activity: Using Computers - Finding the Calculators

Using the Basic Calculator

The Basic Calculator is found in almost all computers and can be used to do simple calculations

To Open the Basic Calculator:

- Click on the Windows Button
- Type "Calculator"
- Click on the Calculator Icon
- Calculate Away!



Using Desmos

Desmos is a more advanced calculator than the basic calculator
Desmos is a **Graphing Calculator**
Graphing Calculators are used in more advanced math classes because they are capable of doing more advanced calculations

To Open and Use Desmos:

- Open Chrome
- Go to desmos.com
- Click on "Graphing Calculator"
- Calculate Away!

Math Activity: Using Calculators to Solve Problems

Addition

1+2

5+15

25+45

628+90

256+857

392+1,085

5,887+3,654

Subtraction

5-3

2-10

59-27

380-85

965-650

1,456-125

9,753-6,428

Math Activity: Using Calculators to Solve Problems

Multiplication	Division
1*2	5/3
5*15	2/10
25*45	59/27
628*90	380/85
256*857	965/650
392*1,085	1,456/125
5,887*3,654	9,753/6,428

Math Activity: Using Calculators to Solve Problems

Addition

1+2 = 3

5+15 = 20

25+45 = 70

628+90 = 718

256+857 = 1,113

392+1,085 = 1,477

5,887+3,654 = 9,541

Subtraction

5-3 = 2

2-10 = -8

59-27 =32

380-85 = 295

965-650 = 315

1,456-125 = 1,331

9,753-6,428 = 3,325

Math Activity: Using Calculators to Solve Problems

Order of Operations and Multi Step Problems

“PEMDAS”

$6+10$

$9*5+5$

$(4+4)/(3+3)$

3^3

5^2+25

$(12^2-12*2)/(6*4)$

Math Activity: Using Calculators to Solve Problems

Order of Operations and Multi Step Problems

“PEMDAS”

$6+10 = 16$

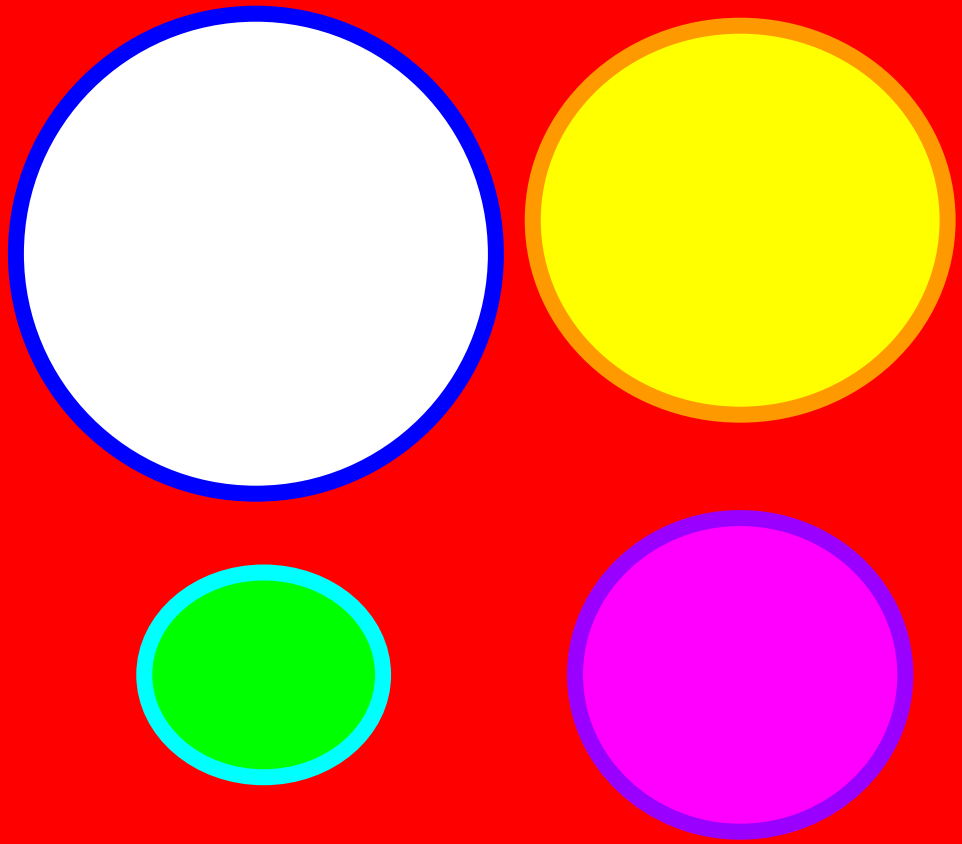
$9*5+5 = 50$

$(4+4)/(3+3) = 1.33$

$3^3 = 27$

$5^2+25 = 50$

$(12^2-12*2)/(6*4) = 5$



Math Activity: Discovering Pi

Math Activity:

Where is π?

Area

Area is the amount of space the shape takes up

Radius

The Radius is the length of a line that starts from the center and goes to an edge of the circle

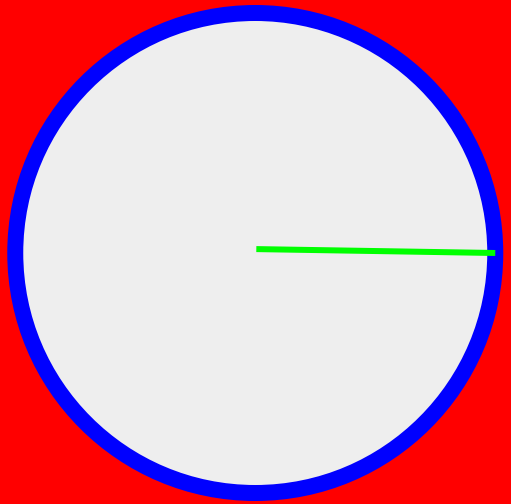
Circumference

Circumference is the length around the circle. It is the “Perimeter” of the circle

Fun Fact: Circles are Polygons with an Infinite amount of Sides! That is why we can’t say the circumference is the perimeter of the circle.

Challenge: Find the Value of π !

π (pi) is a special number. It is a Universal Constant. This means this number shows up in a lot of places in math (and even around the universe!)



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Challenge: Find the Value of π !

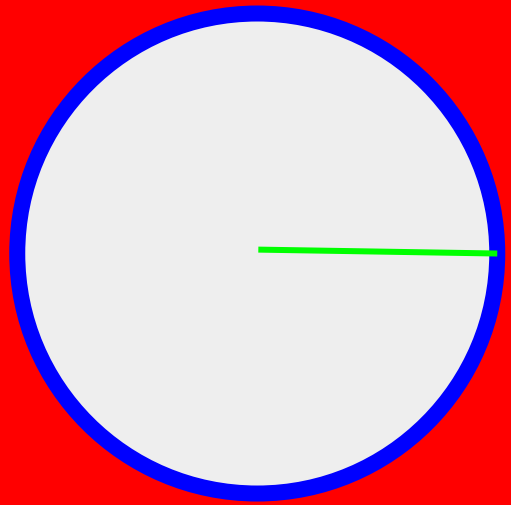
π (pi) is a special number. It is a **Universal Constant**. This means this number shows up in a lot of places in math. You can even find this number throughout the universe! This number is so universal that if aliens do exist, they would know about this number!

Let's see if you can find what pi is by using the following formulas. Find Pi using the Circumference formula and the Area formula

$$C = 2\pi r$$

$$A = \pi r^2,$$

To do this we need to rearrange equations! Lets see how we can rearrange equations to solve for pi!



Math Activity: Using Math and Science Formulas

Lets learn how to input values into formulas!

3 Different Ways of Finding Pi

C = 2πr

$C = 2\pi r$

$\Rightarrow \frac{1}{2}C = 2\pi r \times \frac{1}{2} \quad \frac{2}{2} = 1$

$\Rightarrow \frac{1}{2}C = \pi r$

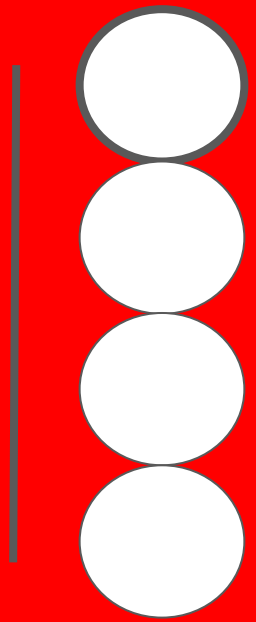
$\Rightarrow \frac{C}{2} = \pi r$

$\Rightarrow \frac{1}{r}\frac{C}{2} = \pi r \frac{1}{r} \quad \frac{1}{r} \cdot r = 1$

$\Rightarrow \pi = \frac{C}{2r}$

$\therefore \pi = \frac{C}{2r}$

Circle Method



A = πr²

$A = \pi r^2$

$\Rightarrow \frac{1}{r^2}A = \pi r^2 \frac{1}{r^2} \quad r^2 \cdot \frac{1}{r^2} = 1$

$\Rightarrow \frac{A}{r^2} = \pi$

$\therefore \pi = \frac{A}{r^2}$

This is π! Pi is a number with an Infinite Amount of Digits!

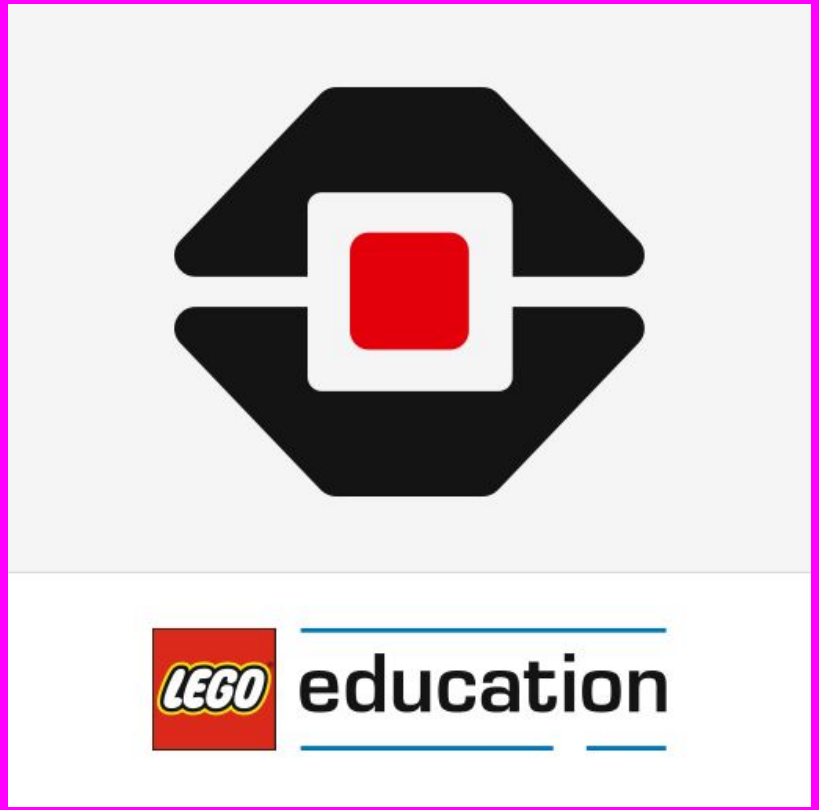
3.1415926535897932384626433832795028841971693993751058209749445923078164062862089986280348253421170679821480865132823066470938446095505822317253594081284811174502841027019385211055596446229489549303819644288109756659334461284756482337867831652712019091456485669234603486104543266482133936072602491412737245870066063155881748815209209628292540917153643678925903600113305305488204665213841469519415116094330572703657595919530921861173819326117931051185480744623799627495673518857527248912279381830119491298336733624406566430860213949463952247371907021798609437027705392171762931767523846748184676694051320005681271452635608277857713427577896091736371787214684409012249534301465495853710507922796892589235420199561121290219608640344181598136297747130996051870721134999999837297804995105973173281609631859502445945534690830264252230825334468503526193118817101000313783875288658753320838142061717766914730359825349042875546873115956286388235378759375195778185778053217122680661300192787661119590921642019893809525720106548586327886593615338182796823030195203530185296899577362259941389124972177528347913151557485724245415069595082953311686172785588907509838175463746493931925506040092770167113900984882401285836160356370766010471018194295559619894676783744944825537977472684710404753464620804668425906949129331367702898915210475216205696602405803815019351125338243003558764024749647326391419927260426992279678235478163600934172164121992458631503028618297455570674983850549458858692699569092721079750930295532116534498720275596023648066549911988183479775356636980742654252786255181841757467289097777279380008164706001614524919217321721477235014144197356854816136115735255213347574184946843852332390739414333454776241686251898356948556209921922218427255025425688767179049460165346680498862723279178608578438382796797668145410095388378636095068006422512520511739298489608412848862694560424196528502221066118630674427862203919494504712371378696095636437191728746776465757396241389086583264599581339047802759009946576407895126946839835259570982582262052248940772671947826848260147699090264013639443745530506820349625245174939965143142980919065925093722169646151570985838741059788595977297549893016175392846813826868386894277415599185592524...

Technology Activity: Using Computers

Let's find the Programming IDE!

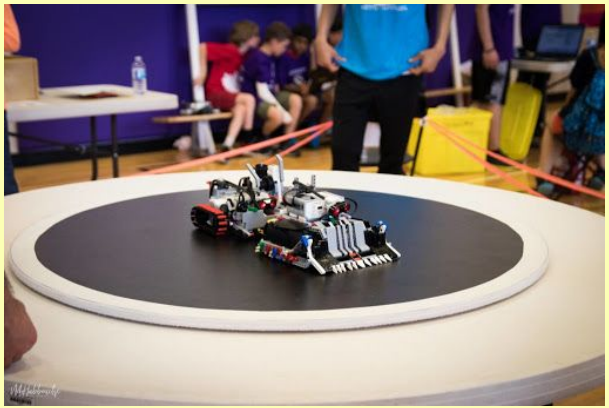
- The Programming IDE is where we will be programming our robots!
- IDE stands for “Integrated Developers Environment”
    - Since you are programming the robot, you are developing the code for the robot

When we are at the computers, look for a symbol like the one you see on the right! That is where we will be programming our robots

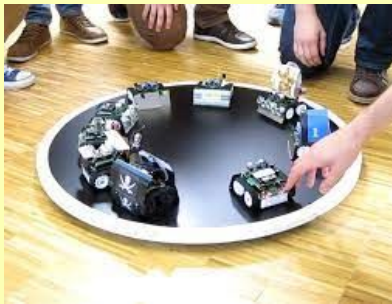


Challenges

Are you ready to build a sumo bot?



Our volunteers are here to help you!



This is the robot you will be learning with!

This robot is called an EV3!

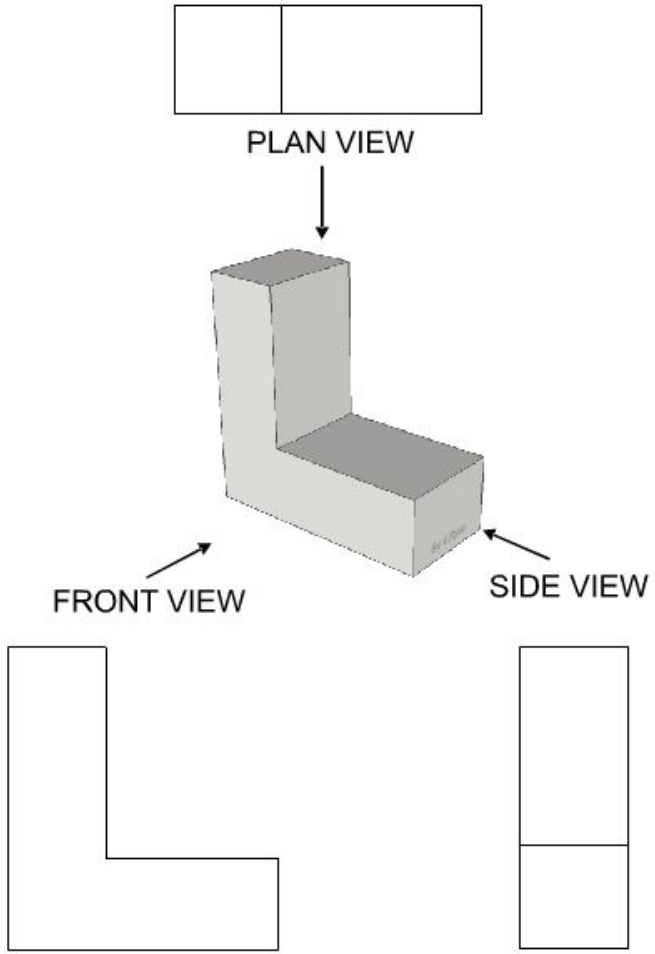
The EV3 is a fully functional robot that many people use to learn the basics of robotics.

What do you think about the EV3 Robot? What was your first reaction to the robot?

Orthographic Projections

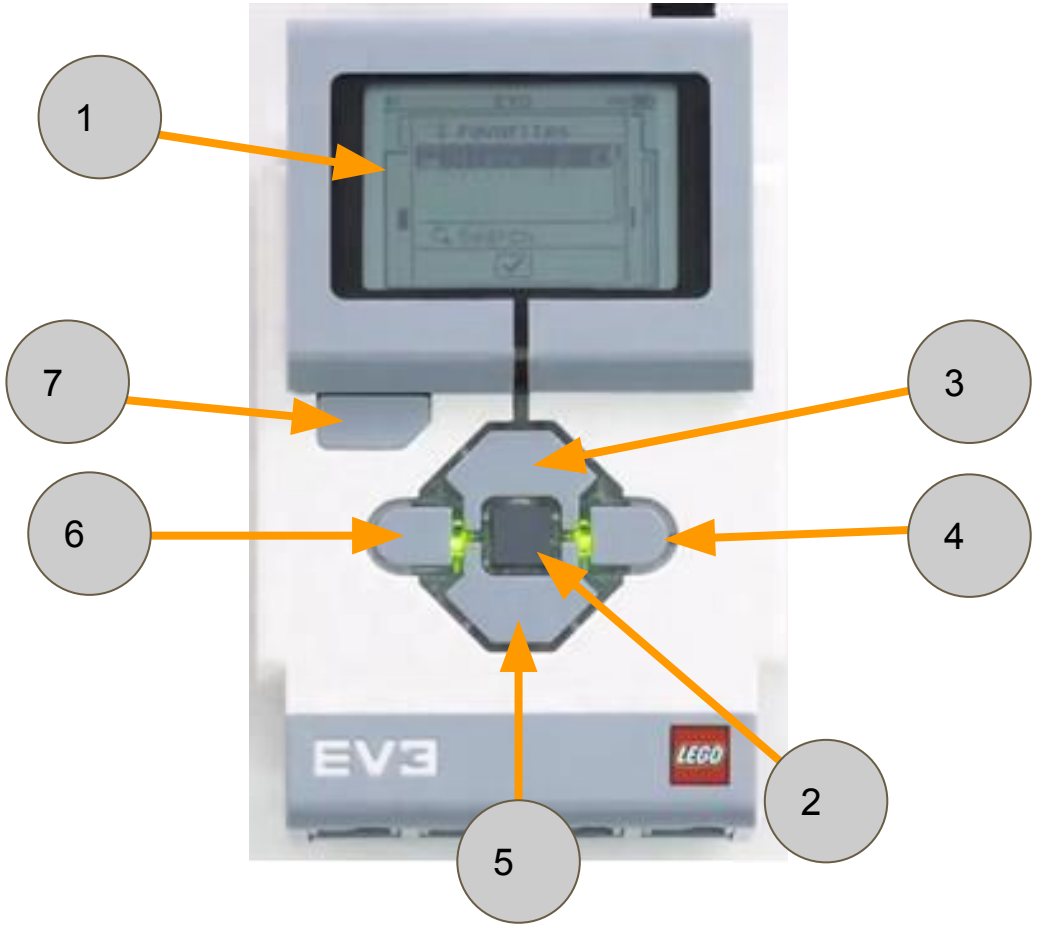
An **Orthographic Projection** is an Engineering Drawing that shows one side of an object.

It is used to show an Engineer how an object looks in all directions!



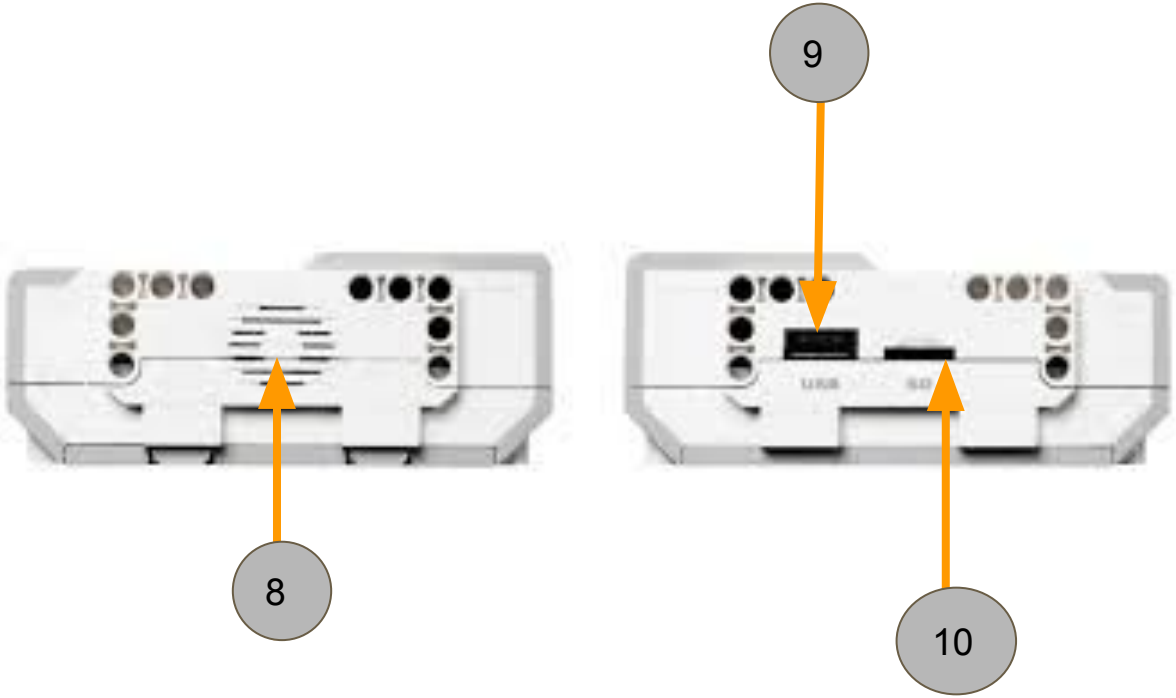
Top View

1. LCD Screen
2. OK Button
3. Up Button
4. Right Button
5. Down Button
6. Left Button
7. Back Button



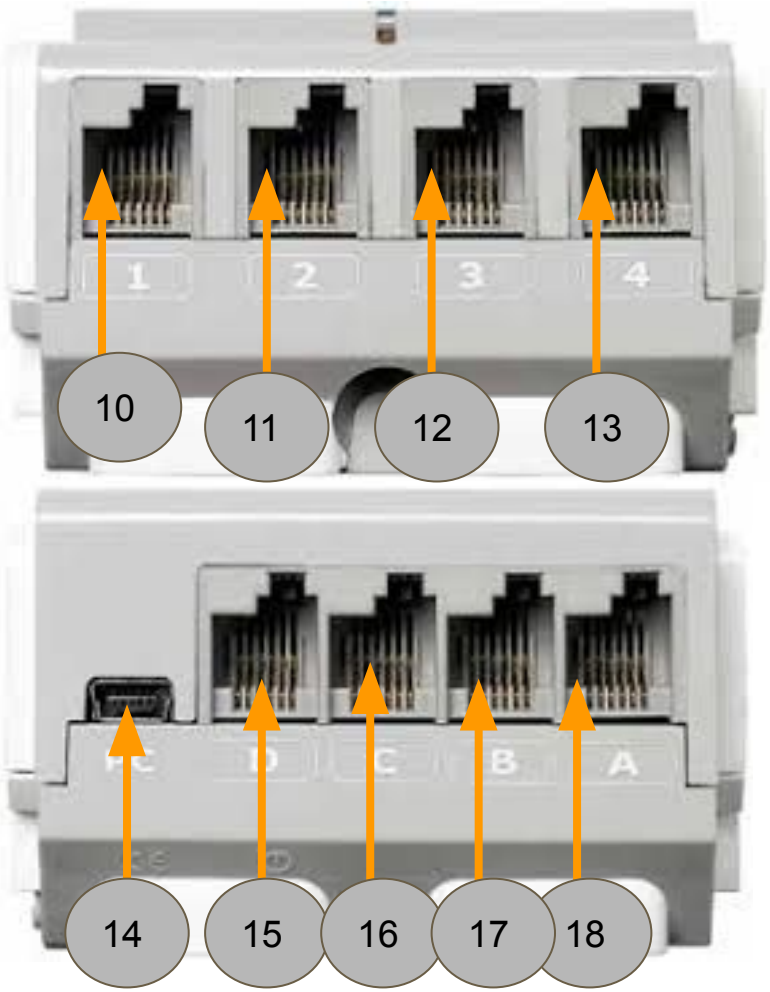
Side Views

8. Speaker
9. USB Port
10. SD Port



Bottom and Top View

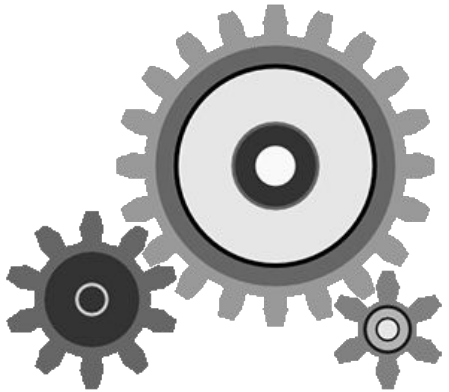
10. Sensor Port 1
11. Sensor Port 2
12. Sensor Port 3
13. Sensor Port 4
14. Computer Port
15. Motor Port D
16. Motor Port C
17. Motor Port B
18. Motor Port A



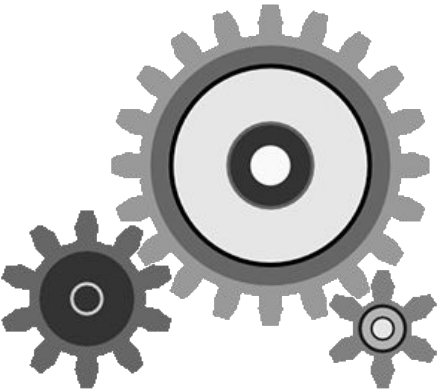
Orthographic Projection Activity

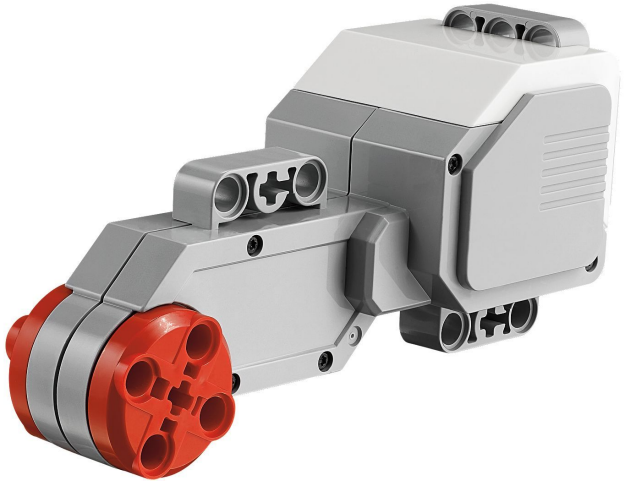
Sketch orthographic projections of the EV3 with descriptions of what the buttons/ports do

Use Rulers to measure the size of the robot



Motors and Sensors





Sensors

A device that is able to sense its surroundings.

The robot uses Sensors in order to gather **Data** about its surroundings!

Every Sensor must have certain information present:

- **Data**
- **Units for the Data**
- **Scientific Backing!**

EV3 Sensors

The EV3 has 4 Important Sensors!

- **Ultra-Sonic**
- **Color**
- **Gyro**
- **Touch**

The Ultrasonic Sensor

This is the Ultrasonic Sensor!

This sensor allows the robot to measure Distance. The Sensor measures distance in Centimeters.

The Sensor works by sending waves to an object, and detecting the waves reflected back by the object.

The Color Sensor

This is the Color Sensor!

The Color Sensor has 3 Modes: Reflected, Ambient, and Color.

Reflected measures a percent value of how much light is reflected off of a surface.

Ambient measures the total light in the room based on a predetermined value.

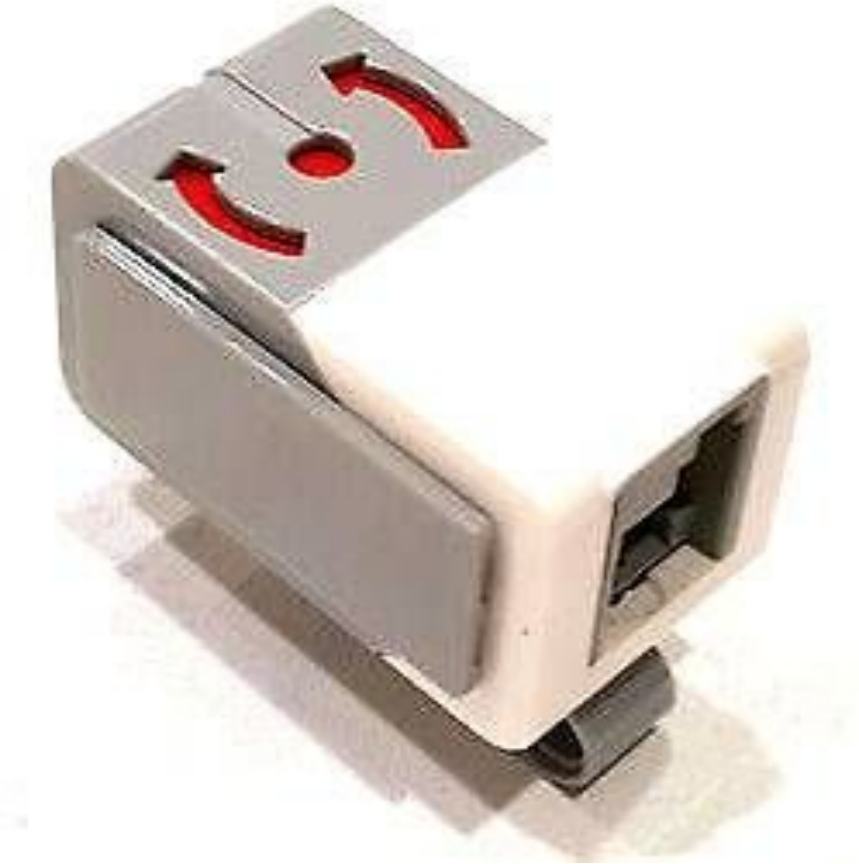
Color measures and detects what color (out of the 6 preset colors) the sensor is pointing at

The Gyro Sensor

This is the Gyro Sensor!

The Gyro sensor is able to detect changes in direction and orientation.

The sensor works by either having a magnet inside of it that is able to detect the earth's natural magnetic field, or by having a fluid inside the sensor which moves with changes in orientation.



The Touch Sensor

This is the Touch Sensor!

It is able to detect when an object presses down upon the sensor.

The Sensor has two modes, Pressed and Not Pressed, which the sensor is able to detect an instantaneous change in orientation.

Sensor Activity: Using the Ultrasonic Sensor

Let's Use the Ultrasonic Sensor!

1. Turn On the EV3
2. Press the Right Button Twice
3. Click on “Port View”
4. Find the Ultrasonic Sensor

Sensor Activity: Using the Ultrasonic Sensor

Let's Use the Ultrasonic Sensor!

What does the Ultrasonic Sensor Measure?

5. In your engineering notebook, create a table like the one on the right
6. Measure the distances of 5 objects your robot reads

Challenge

1. What is the smallest number the ultrasonic sensor can measure? Write this number in your notebook
2. What is the largest number the ultrasonic sensor can measure? Write this number in your notebook

Object	Value
1	
2	
3	
4	
5	
Smallest	
Largest	

Sensor Activity: Using the Color Sensor

Let's Use the Color Sensor!

1. Turn On the EV3
2. Press the Right Button Twice
3. Click on “Port View”
4. Find the Color Sensor

Sensor Activity: Using the Color Sensor

Let's Use the Color Sensor!

5. Be sure you are on “Reflected Mode”
    a. To do this press the center button
    b. Click the option that says “Reflect”
6. In your engineering notebook, create a table like the one on the right
7. Measure the reflected value of 10 different objects
    a. Be sure to what the object is on the object column

Object	Value
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Sensor Activity: Using the Touch Sensor

Let's Use the Touch Sensor!

1. Turn On the EV3
2. Press the Right Button Twice
3. Click on “Port View”
4. Find the Touch Sensor

Sensor Activity: Using the Touch Sensor

Let's Use the Touch Sensor!

5. In your engineering notebook, create a table like the one on the right
6. What value does the sensor return when the button is untouched?
7. What value does the sensor return when the button is touched?

Touched/Untouched?	Value
Untouched	
Touched	

Motors

A Motor is an object that creates rotational movement that can be supplied to an object.

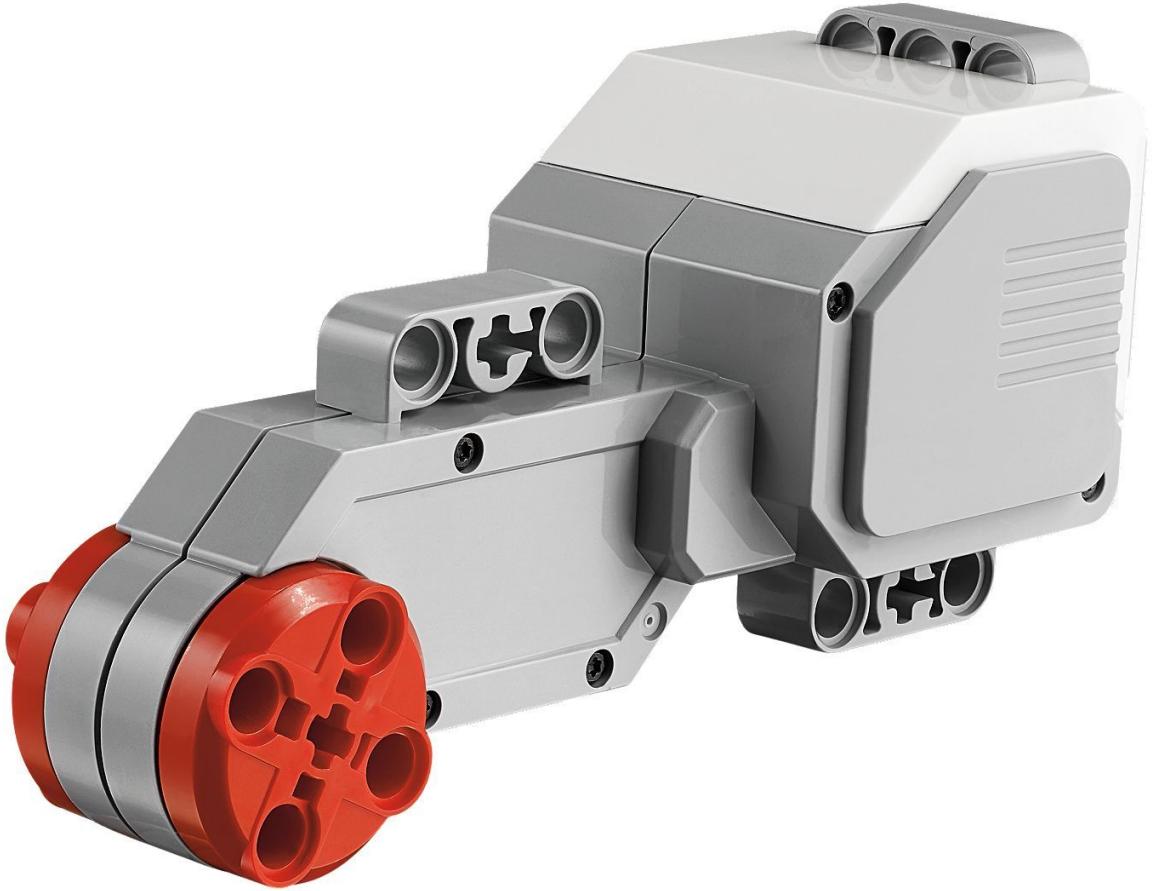
Motors allow robots to move around! The robot supplies power to the motor, which turns it on. When the motor is on, the robot is able to move!

Large Motor

This is the Large Motor!

This motor is normally used for your **Drive Train**.

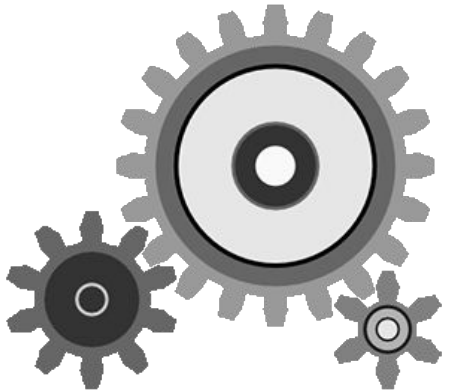
The **Drive Train** is the group of parts that deliver power to the wheels!



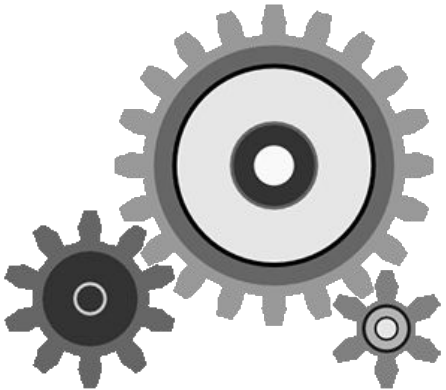
Medium Motor

The medium motor is used for **Effectors** (**Extensions or Arms**). Effectors are mechanisms that are attached to the robot. Effectors allow the robot to do a wider variety of tasks.

The medium motor is used for lighter tasks compared to the large motor.



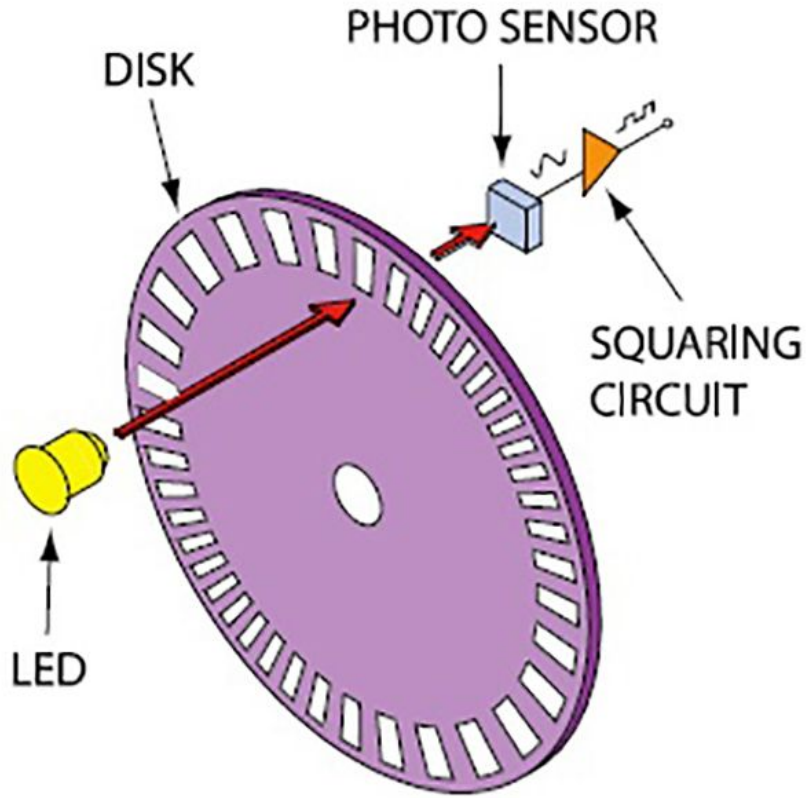
Motor Activity: Reading Motor Values



Position

How does a motor know how far its traveled?

Most motors have **Encoders**, which allow the motor to calculate how much the motor has turned. Encoders allow you to calculate how many **Rotations** the motor has completed. Rotations are used when programming your robot to move a certain distance.



Motor Activity: Using the Large Motor

Let's Use the Large Motor!

1. Turn On the EV3
2. Press the Right Button Twice
3. Click on “Motor Control”
4. Find either Motor B or Motor C

Motor Activity: Using the Large Motor

Let's Use the Large Motor!

What does a Motor do? What is the Large Motor normally used for?

5. In your engineering notebook, create a table like the one on the right
6. Spin your motor forward
    a. What happens?
7. Spin your motor backward
    a. What happens?

Spinning Direction	Direction
Forward	
Backward	

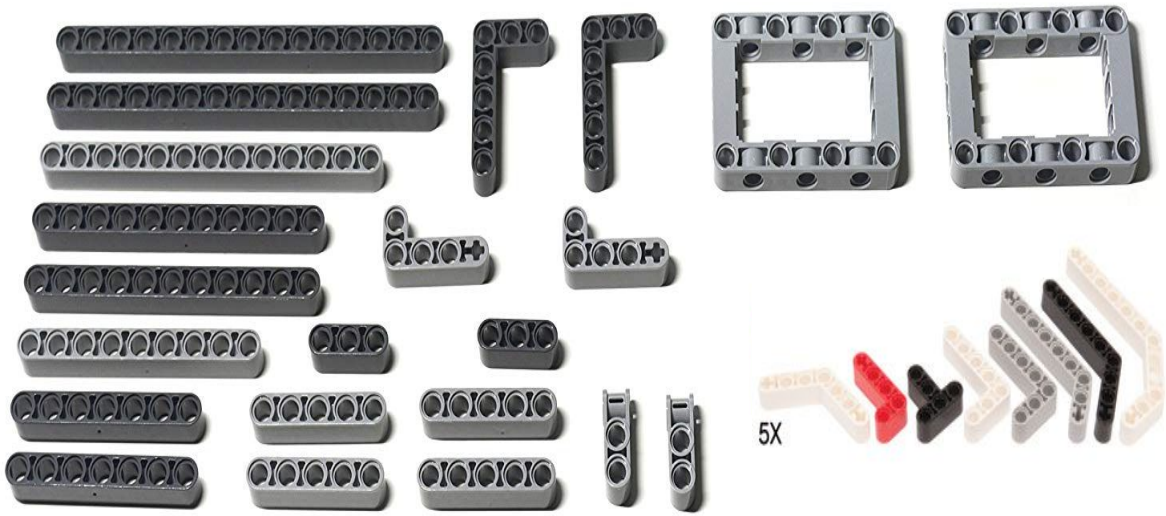
What is used to build the robots ?

Beams

These are the Beams!

Beams are used for your **Chassis**.

The Chassis is the physical build of your robot, but excludes all electrical components.

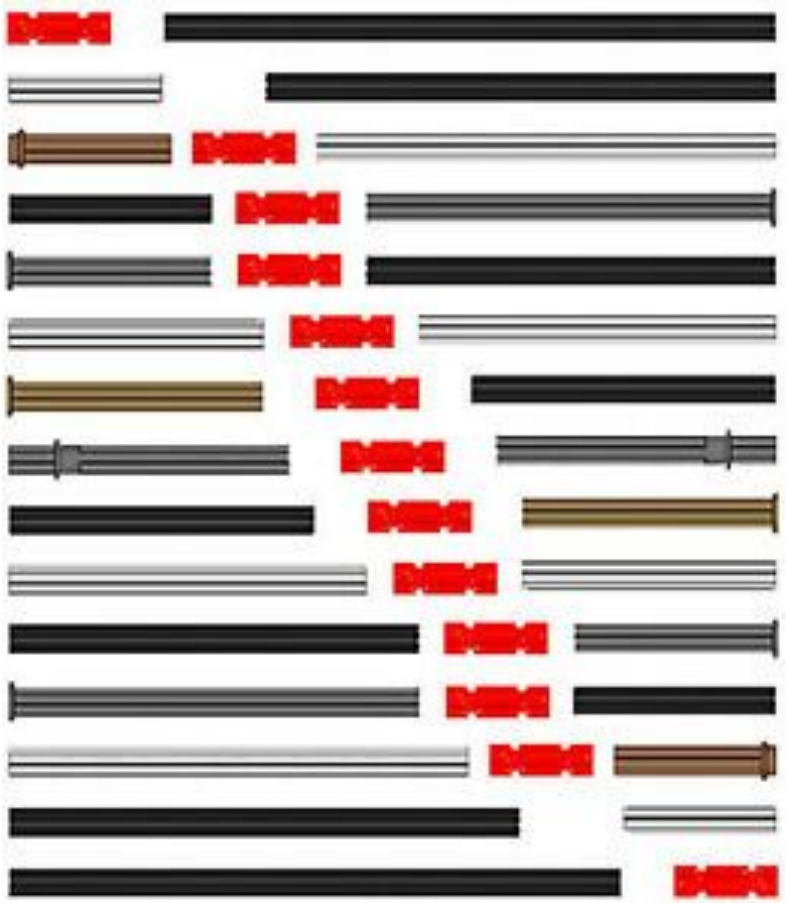


Axles

These are Axles!

Axles can be used for two things. They can be used to transfer motion (like from a motor to a wheel) or to help support structures.

They are used for **Rigid Movements**. These movements are restricted to one type of movement, which is usually rotational



Connector Pieces (Pegs)

Pegs are used to connect pieces!

There are multiple types of pegs, but they fall into two main categories - **Rigid** and **Kinetic**. Kinetic Pieces are able to rotate, while Ridgid Pieces are able to hold pieces safely.

Gears

These are the Gears!

Gears are able to rotate to transfer **Rotational Mechanical Energy**. This energy is what allows the gears to operate.

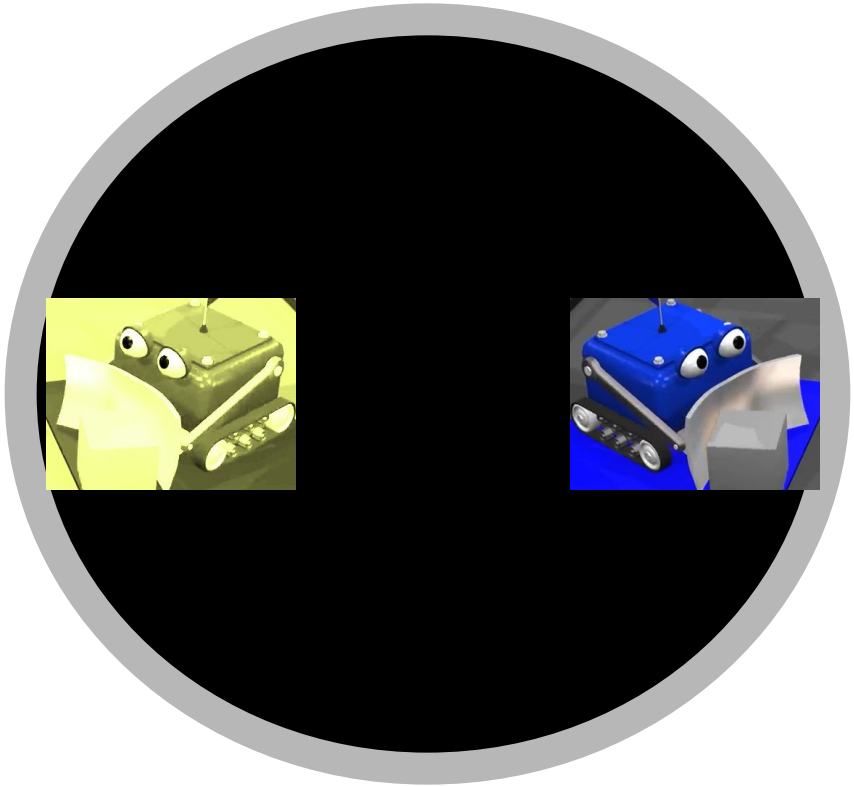
Gears have **Teeth**, which are the little spokes coming out of the gear. The teeth are used to connect with other gears.

Sumo Bots

1. The Sumo Bot challenge is a robot challenge that you all will be doing!
2. Two Robots start in the center of the center of the mat, facing away from each other
3. We start the countdown,
4. **“Three, Two, One, LEGO!”**

Sumo Bots

1. The robots move to the white line
2. Then, using the *color sensor*, they turn around

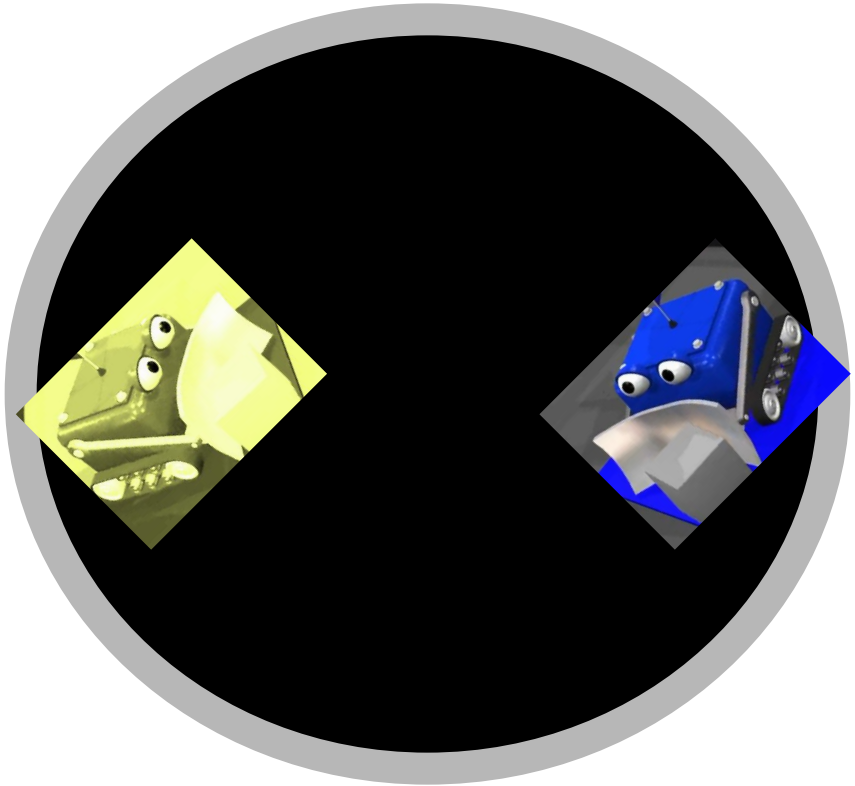


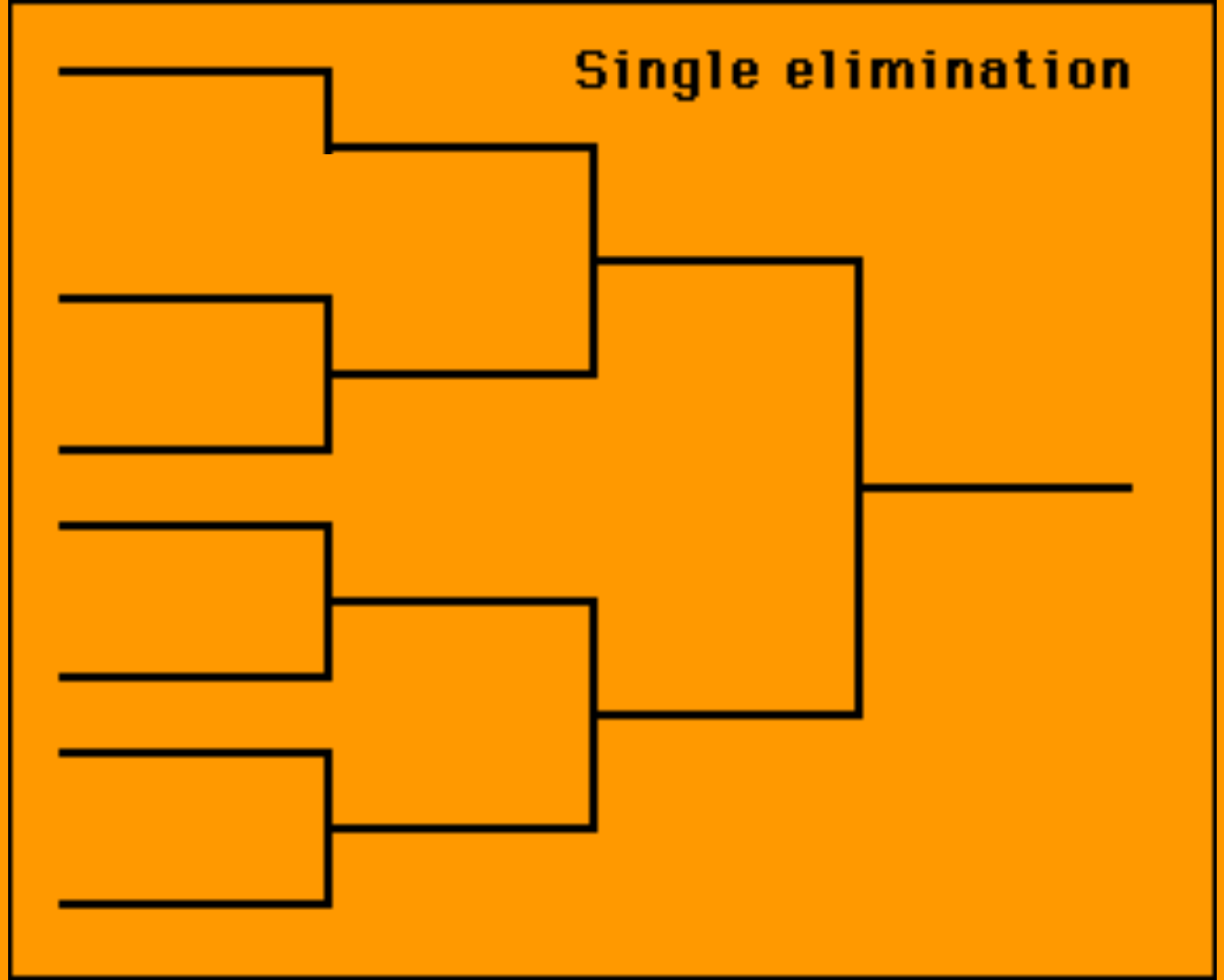
Sumo Bots

1. They then face off!
2. Which ever robot passes the white line first is the loser!

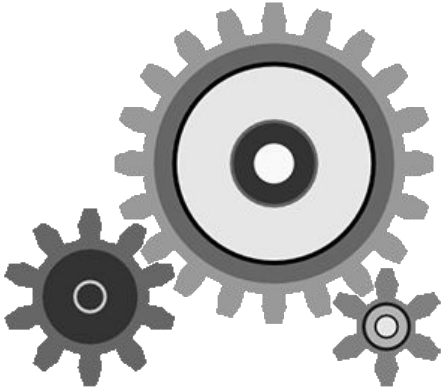
Here's how the competition will work

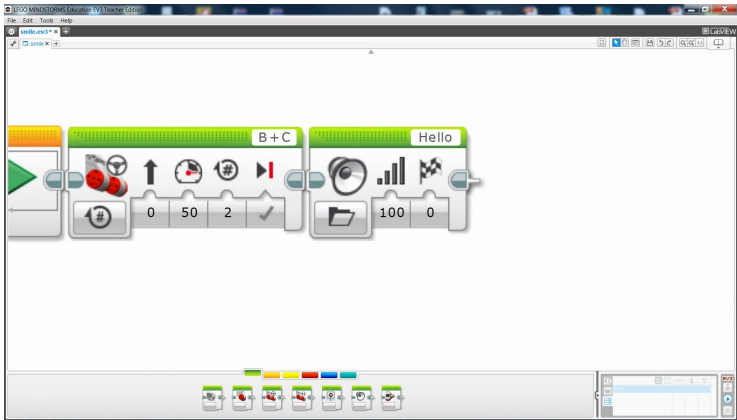
- The competitions have a two minute time limit
- We will do a tournament style competition
  - The team with the best engineering notebooks will automatically advance to the next round
  - Each round is a best out of 3 basis




Single elimination

Robot Programming





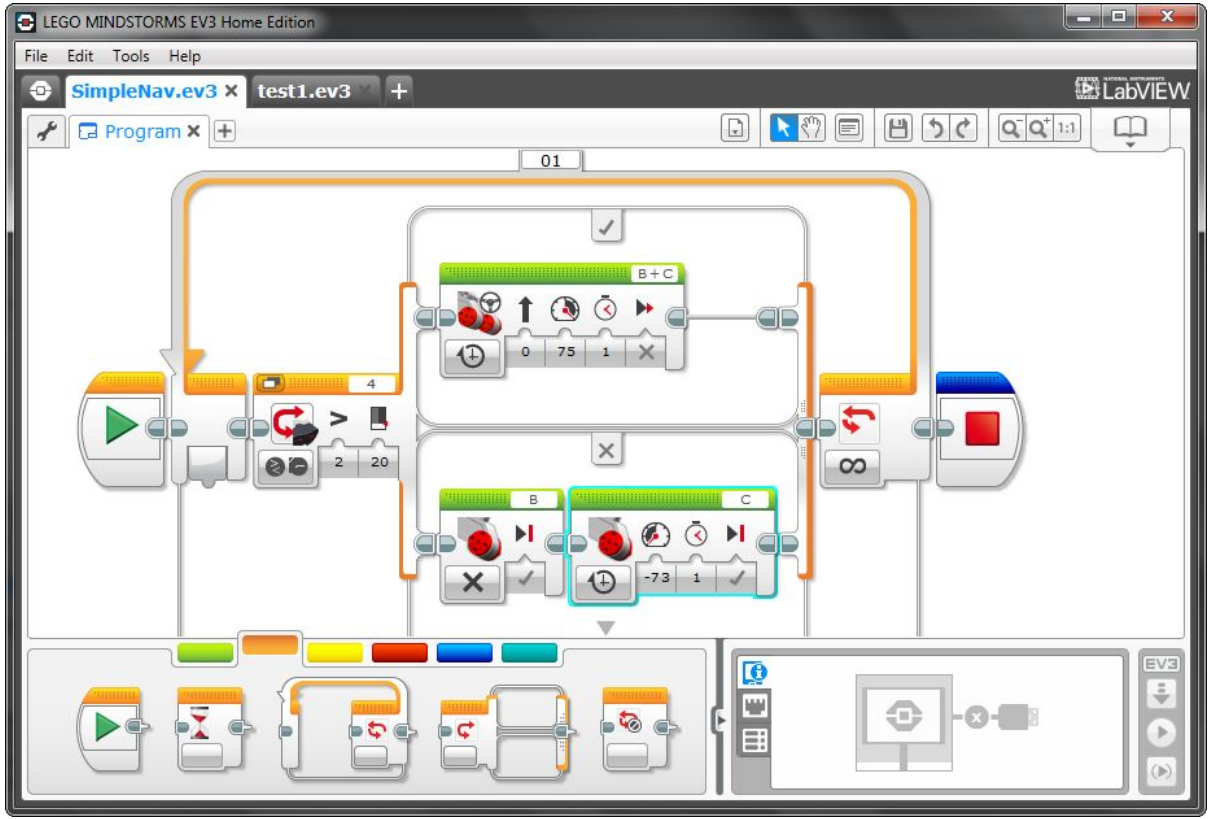
Lego Mindstorms

We program the robots with **Lego Mindstorms**!

Lego Mindstorms is a **Programming Language**.

Programming Languages, allow you to program a variety of things, from Apps to Robots!

Lego Mindstorms is a special **IDE**.IDE stands for Integrated Developers Environment. It is a special interface that allows you to program the robots!

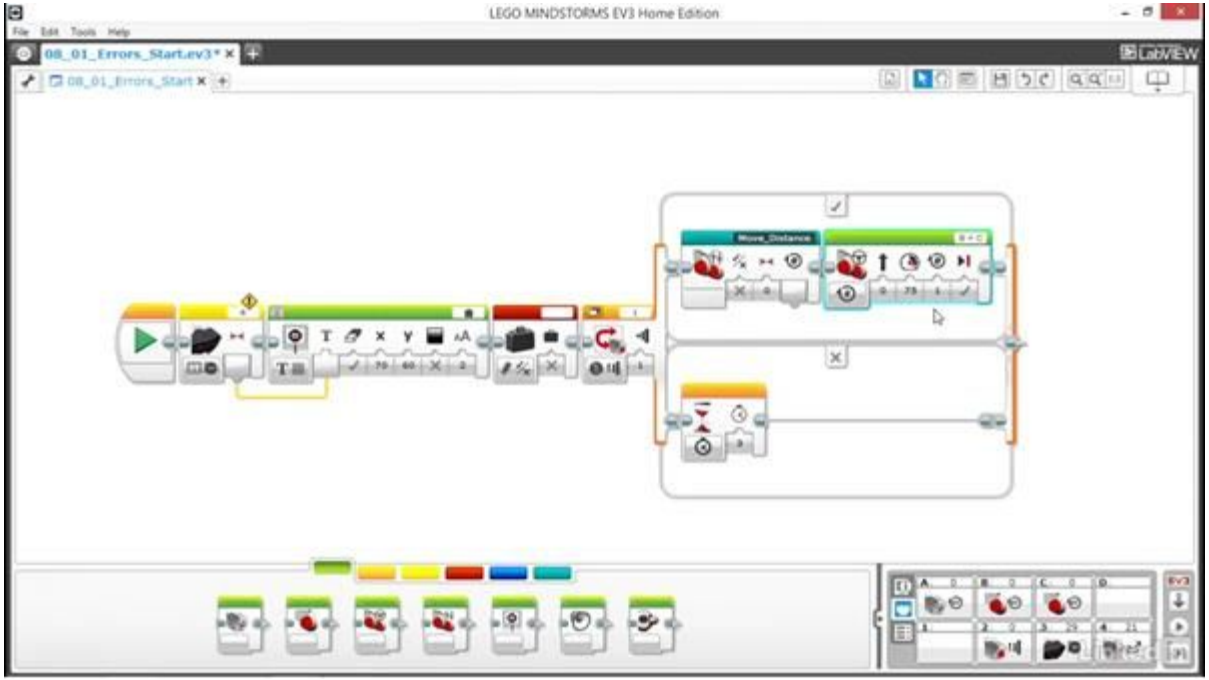


Lego Mindstorms

This IDE also has a very special **API**. API stands for Application Programming Interface. API's are used to program the robot.

With Lego Mindstorms, the API uses **Block Programming**. Block programming works by having "Blocks" being dragged and dropped into the program.

Lets Learn How to Program!

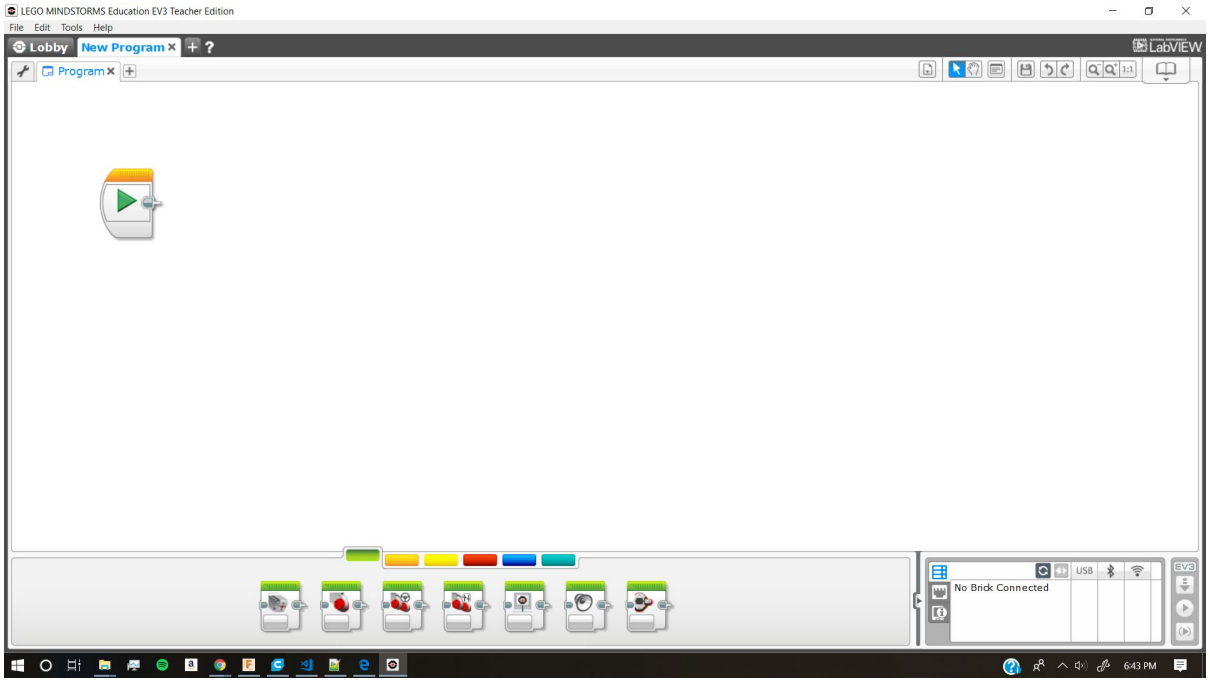


The Basics

This is how you begin in Mindstorms. You connect your blocks to the **Start Block** to program.

The **Start Block** is the block with the Green Arrow. It signifies the **Chronological Order** of the program.

The Program runs **Chronologically**, so it runs in order of precedence.

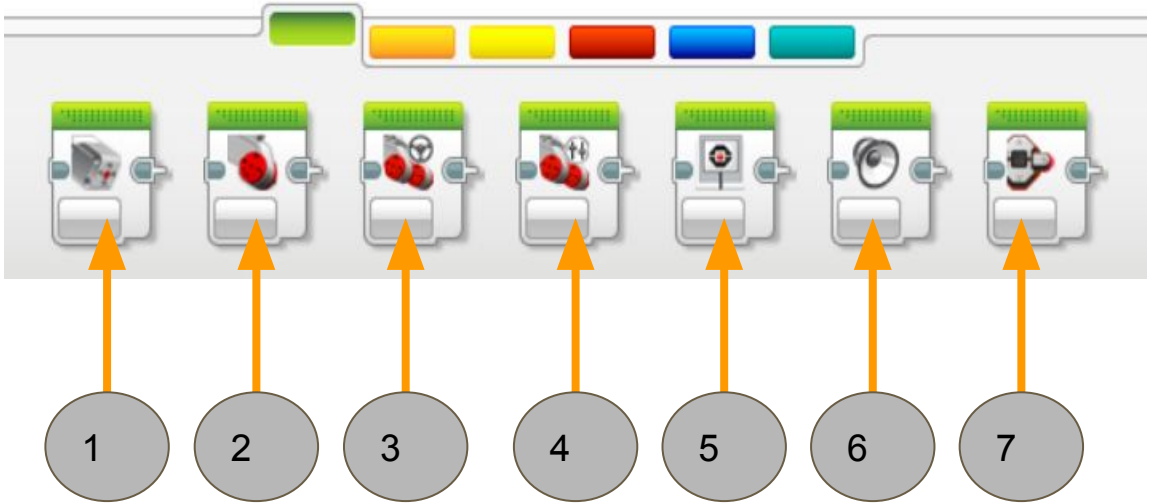


Actions

These are the Action Blocks!

These Action Buttons are known as **Commands**. Commands tell the robot what to do.

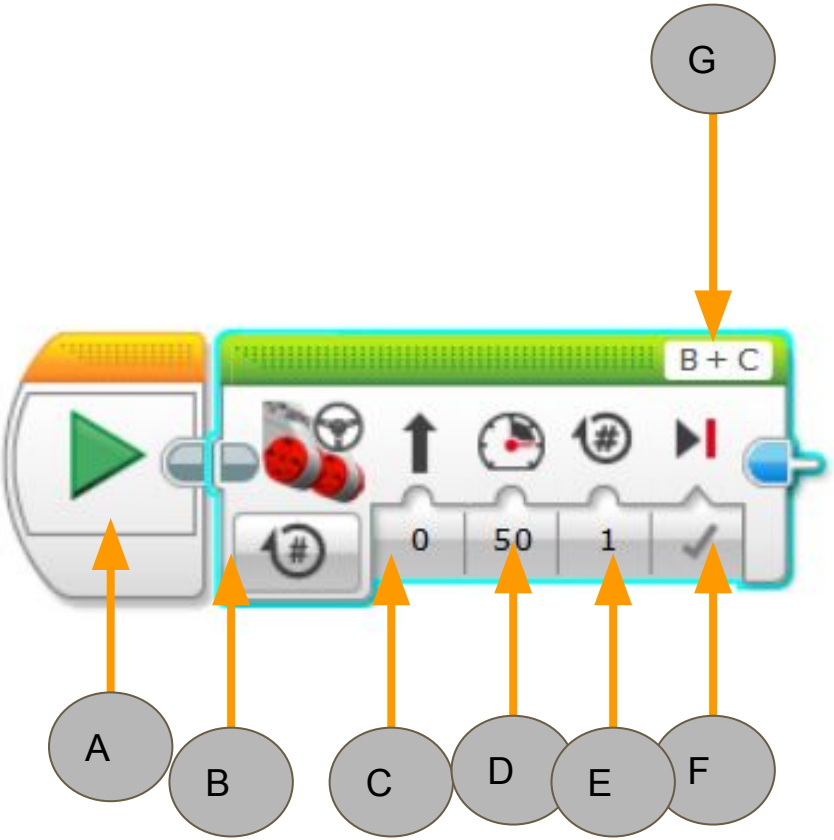
1. Medium Motor Control
2. Large Motor Control (Individual)
3. Steering Control
4. Tank Control
5. Display Control
6. Sound Control
7. Brick Status Light



Blocks

Let's take a closer look at the command blocks!

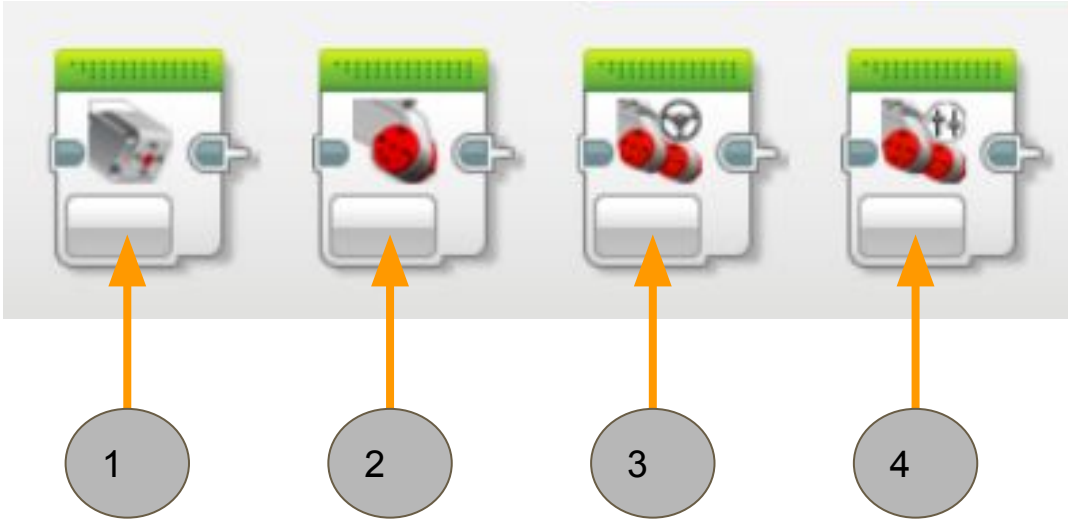
A. Start Block
B. *On For* Statements
C. Steering
D. Power
E. *On For* Condition
F. Brake at End Statement
G. Port Selection



Motor Programming

Let's look at the Motor Commands!

1. Allows you to control the medium motor
2. Allows you to control a single, specific motor
3. Allows you to control the Drive Train, with **driving**
4. Allows you to control the Drive Train, with **Two Motor Control**



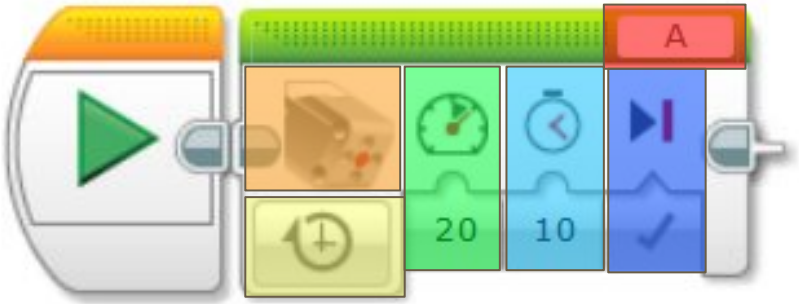
Driving allows for rotation, and is much easier to program. However, it is much harder to control the robot.

Two Motor Control allows you to control two motors, but is much harder to program. It allows for greater control.

Human Code Example 1A

Lets go over some **Human Code** based upon the following code. Pseudo Code is a human readable version of your program.

- **ON PORT A**
- **ON MEDIUM MOTOR**
- **RUN MOTOR BASED ON TIME**
- **RUN MOTOR AT 20% POWER**
- **RUN MOTOR FOR 10 SECONDS**
- **STOP MOTOR AT THE END**



Human Code Example 2A

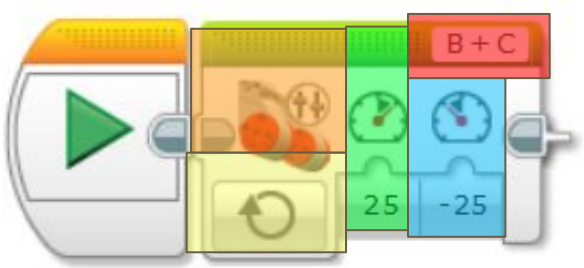
- ON PORT D
- ON LARGE MOTOR
- RUN MOTOR BASED ON ROTATIONS
- RUN MOTOR AT 50% POWER
- RUN FOR ONE ROTATION
- STOP MOTOR AT THE END

Human Code Example 3A

- ON PORT B AND PORT C
- ON THE LARGE MOTORS
- RUN LARGE MOTORS FOR STEERING
- RUN LARGE MOTORS BASED ON DEGREES
- RUN ROBOT FORWARD
- RUN ROBOT AT 50% POWER
- RUN ROBOT FOR 360°
- STOP AT THE END

Human Code Example 4A

- ON PORT B AND PORT C
- ON THE LARGE MOTORS
- RUN LARGE MOTORS FOR DRIVE TRAIN
- RUN CONTINUOUSLY
    - ROBOT WILL NOT STOP
- RUN LEFT MOTOR AT 25% POWER
- RUN RIGHT MOTOR AT -25% POWER



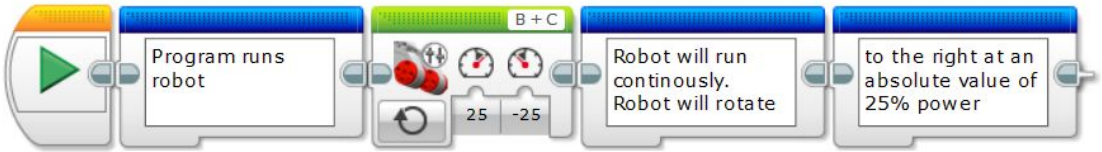
Comments

These are Comments (Notes)!

Comments are used to tell people what your code does.

Comments are also used by programmers to tell other programmers and people what their code does.

Try reading the comments and looking at the Command!



Programming Part 2

Let's learn how to program sensors

But Before we can do that, we need to learn how to program **Statements**!

Statements and Logic

Statements are pieces of code that test **Logic**.

Here is a Verbal Example of a Statement!

If it is raining outside, I will bring my umbrella.

If if it is Not Raining outside, I will leave my umbrella behind.

Lets see some examples of this this in Human Code!

```
IF IT IS RAINING
        BRING UMBRELLA
ELSE
        DON'T BRING UMBRELLA
```

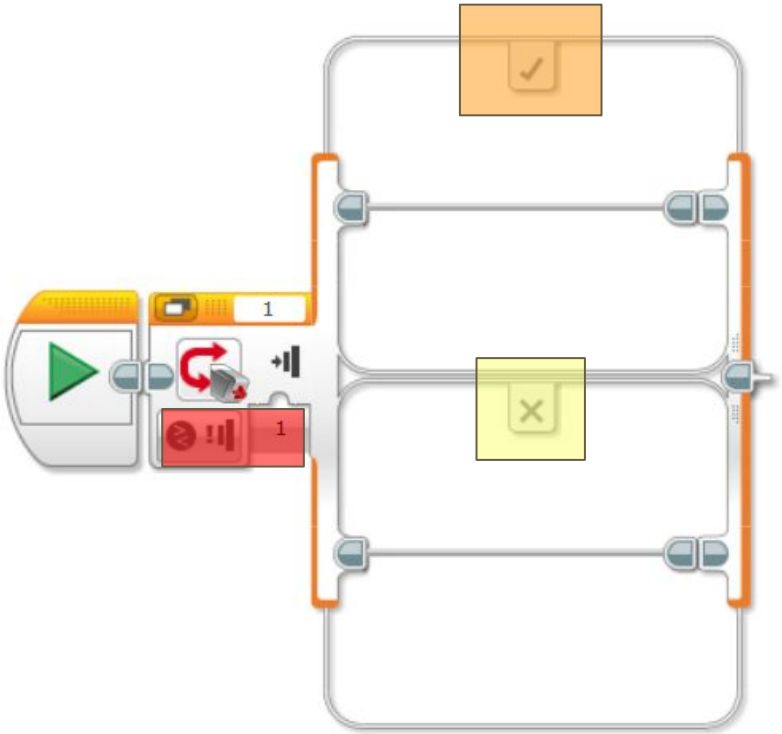
```
IF IT IS COLD OUTSIDE
        WEAR A SWEATER
IF IT IS HOT OUTSIDE
        WEAR A T-SHIRT
ELSE
        WEAR NORMAL CLOTHES
```

Sensor Programming

Lets see some examples of Logic in Mindstorms. We will be putting the **Switch Statement** in our IDE.

Let's look at this Statement more carefully!

- The **Condition**
  - What gets Tested
- **IF Statement**
  - What gets run if the condition is true
- **ELSE Statement**
  - What gets run if the condition is false

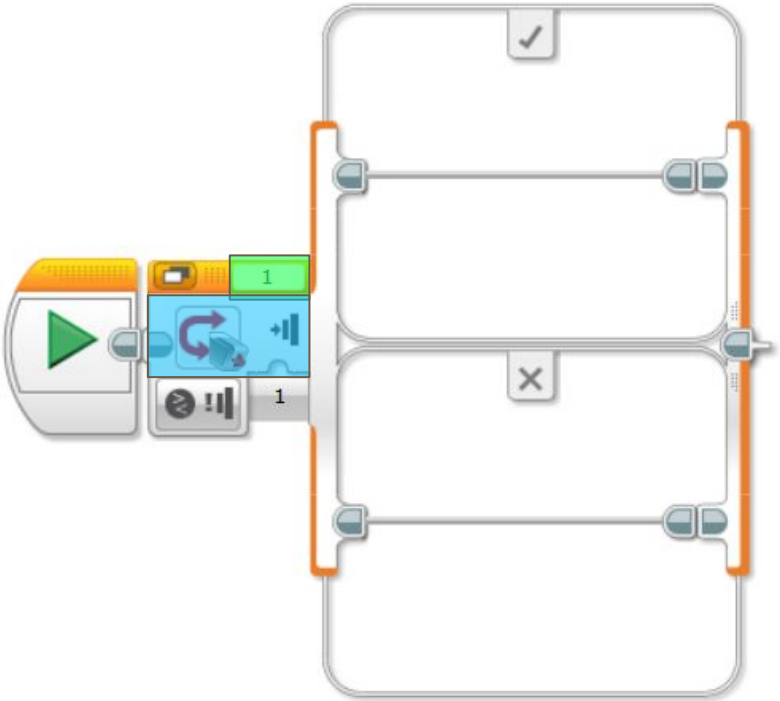


Sensor Programming

Let's look at the statement a little more carefully!

- Tells the IDE what Port the Sensor is in
- Tells the IDE what Sensor to expect

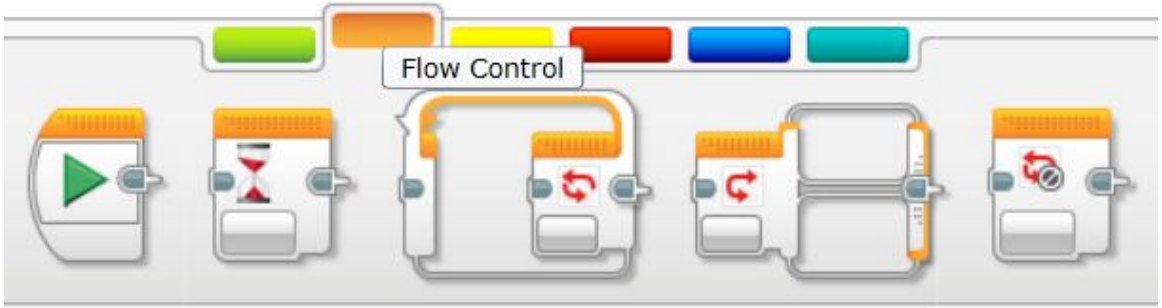
Let’s Practice writing logic with our Switch Statement!



Where to Find Statements

Statements can be found under the Flow Control Tab.

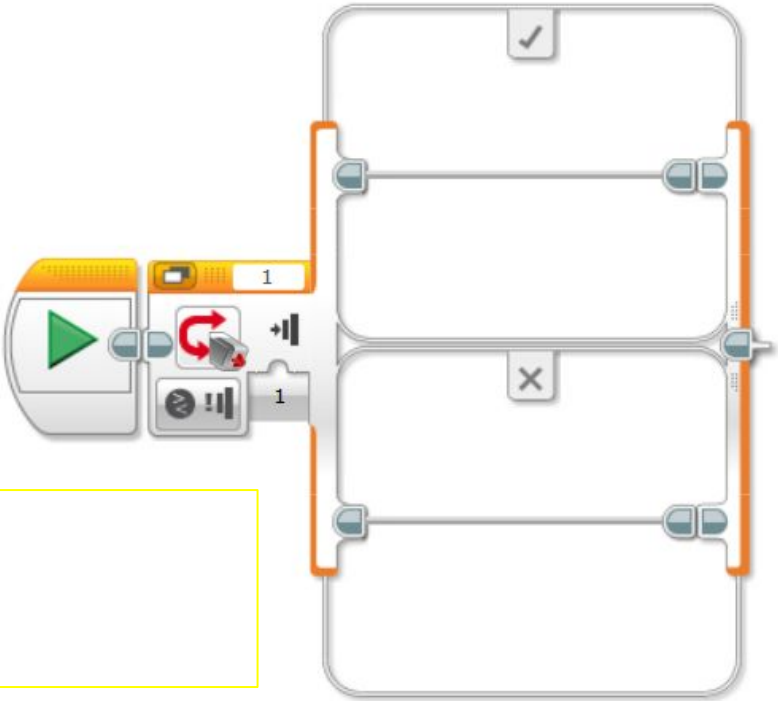
The Statement we are after is called the Switch Statement, and it is the second to last statement.



Sensor Logic

Let's Practice!

If we wanted our robot to run the following Pseudocode, what should we put in the True and False Boxes?

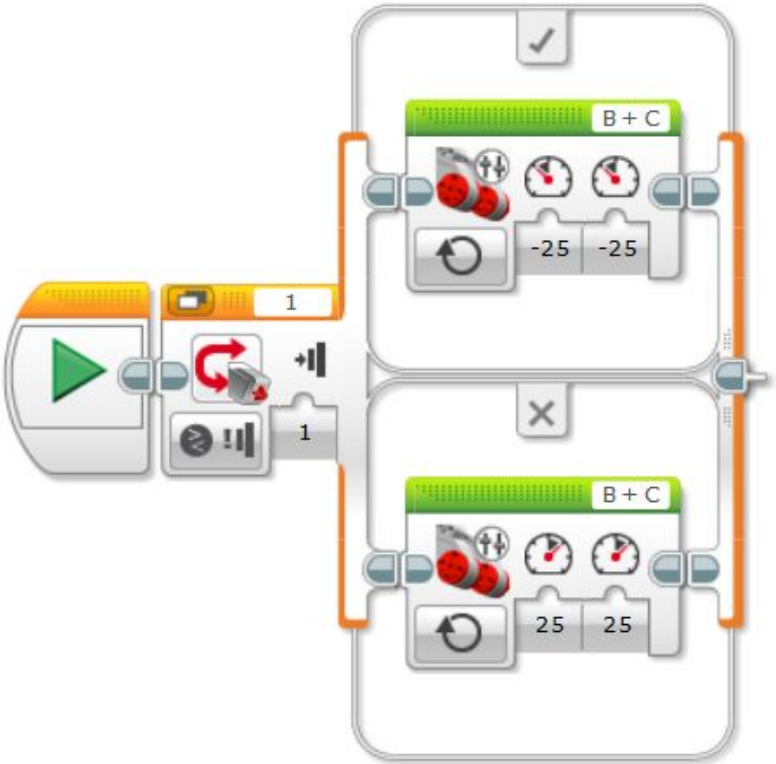


IF TOUCH SENSOR REGISTERS 1
MOVE BACKWARD
ELSE
MOVE FORWARD

Sensor Logic

Here is what we would put if we wanted to run the Human Code from the last slide!

Remember, we want our robot to move backwards if the touch sensor is at 1 (pressed), and move forward otherwise.



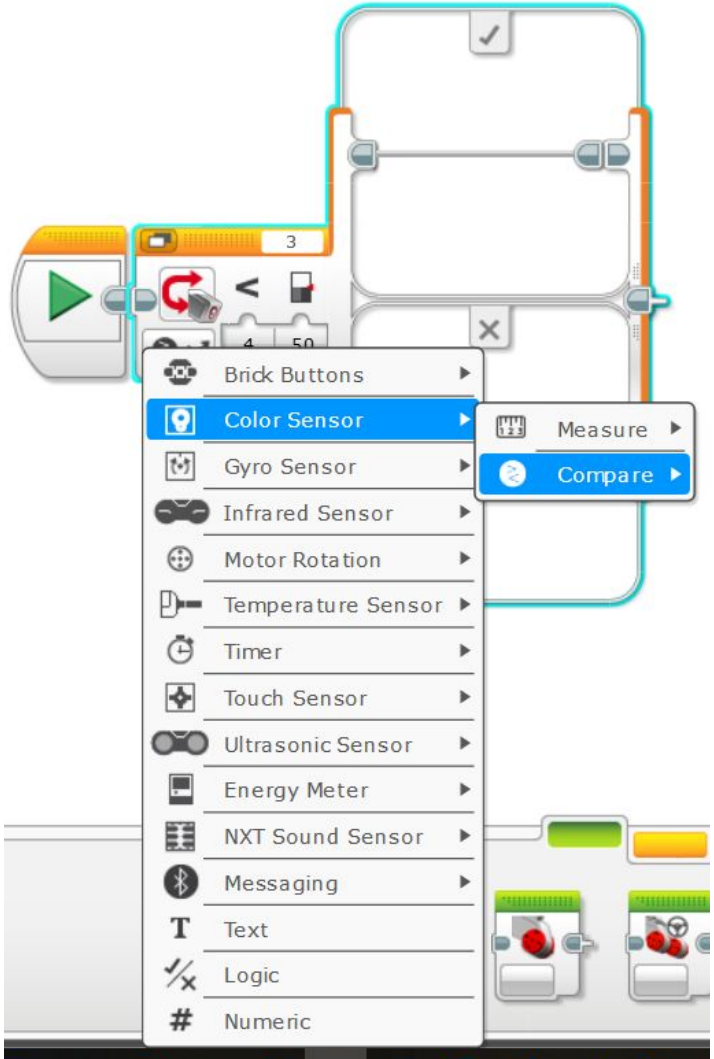
Let's Look at all the things we can test!

We can test a variety of sensors and data sets!

Let's look closely at the Color Sensor settings!

There are two options: **Measure** and **Compare**. For the purpose of testing Logic, we will use **Compare**!

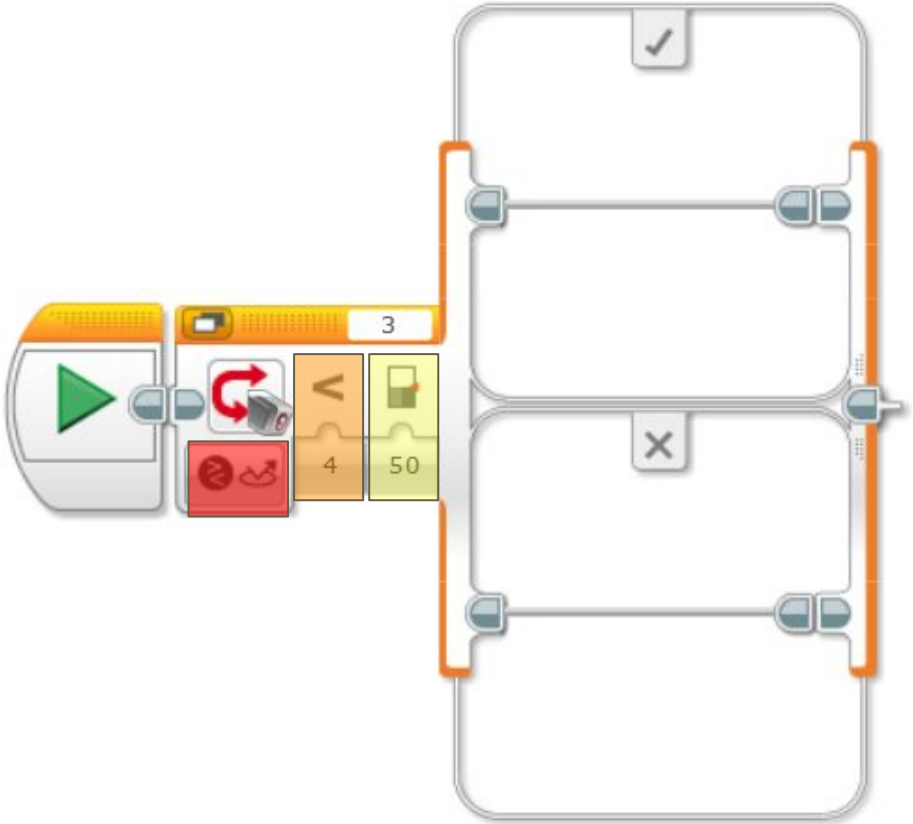
Compare allows for values to be tested against one another!



Comparing Logic

Let's look at how we compare logic in Mindstorms!

- Tells What is being Compared
- **Comparison Operator**
  - Greater Than >
  - Less Than <
  - Greater Than or Equal ≥
  - Less Than or Equal ≤
  - Equal =
  - Not Equal ≠
- **Threshold**
  - The value at which the statement determines if it is true or false

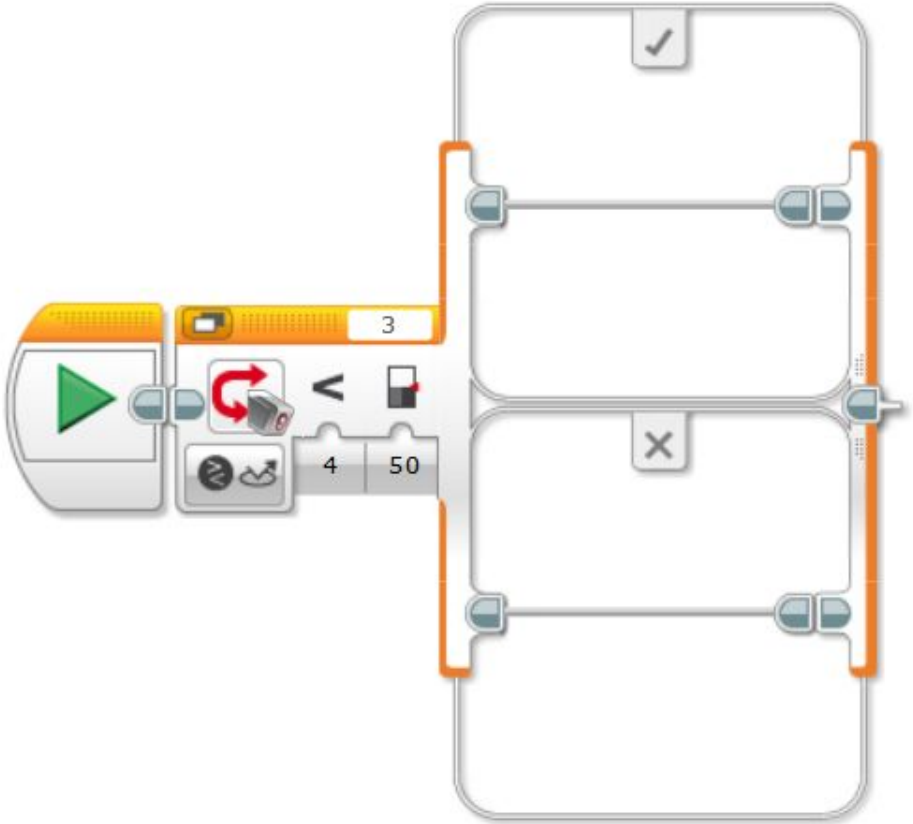


Thresholds

Let's look at the Comparison Operator and Threshold.

Since we have our comparison operator to be *Less Than* the Value must be *Less Than the Threshold Value* in order for the statement to be true.

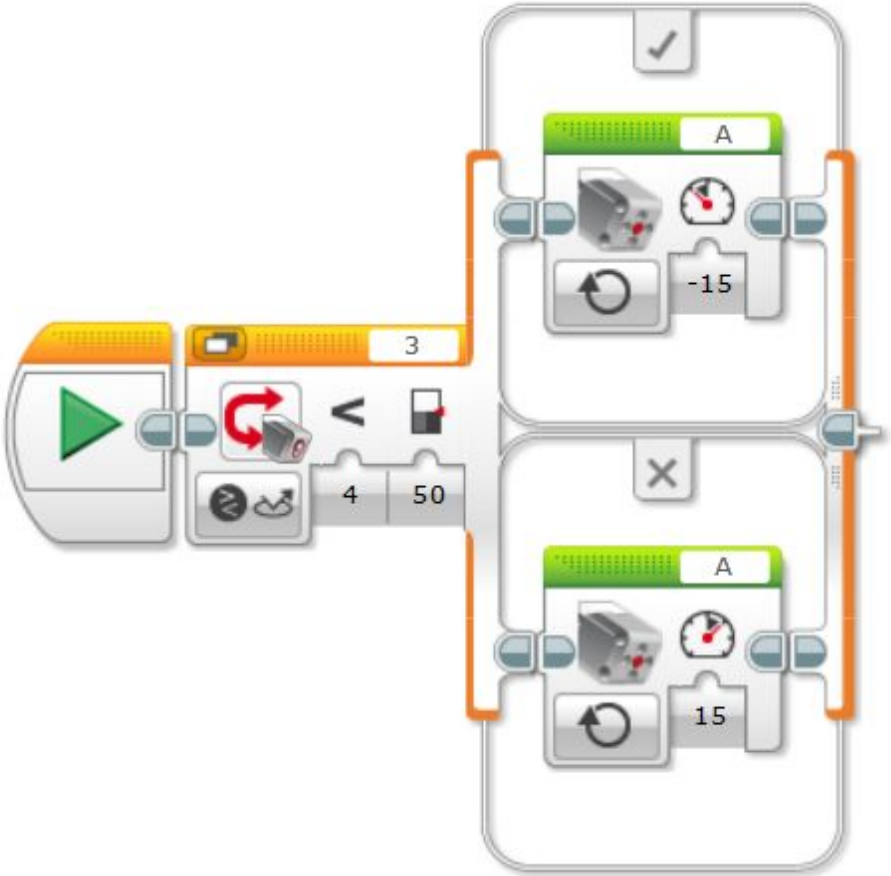
To Calculate threshold, you must add the darkest color value and the lightest color value and divide the sum by 2



Practicing Logic

What would happen if the color sensor registers the following Values?

- 75
- 25
- 50



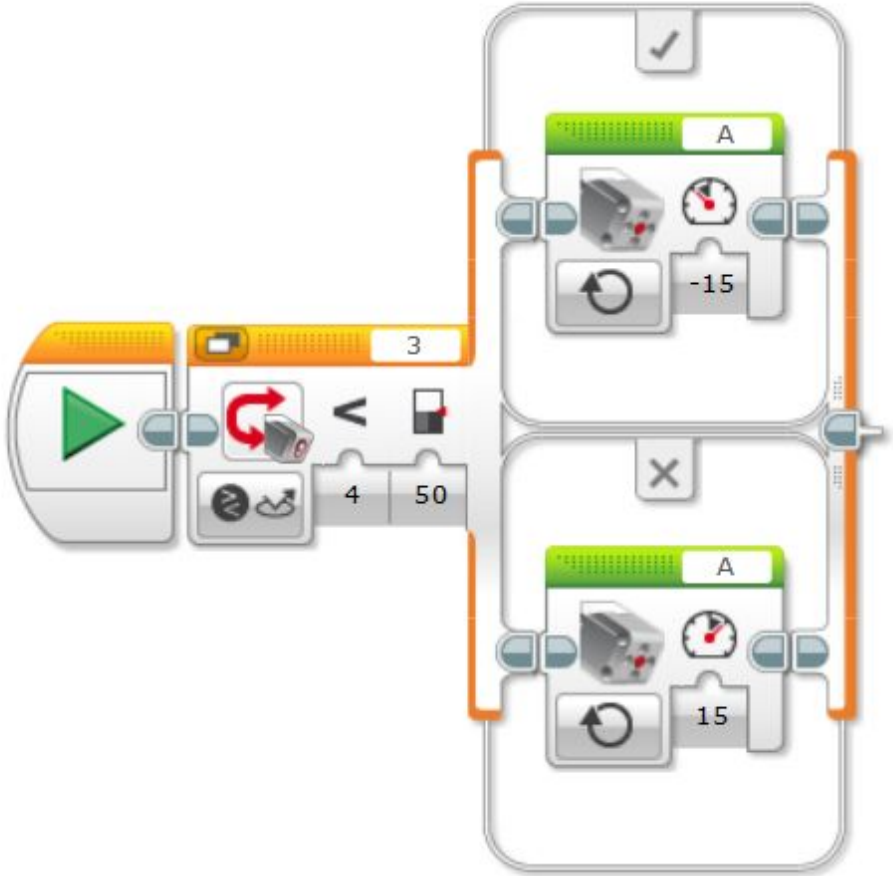
Practicing Logic

Here's what would happen!

At a Sensor Value of 75, the motor would spin Forward, because 75 is greater than 40

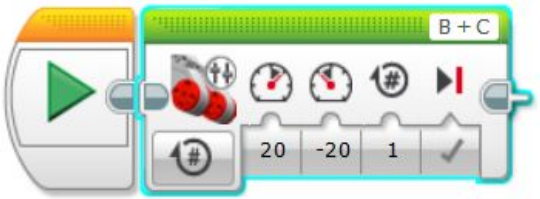
At a Sensor Value of 25, the motor would spin backwards, because 25 is NOT greater than 40

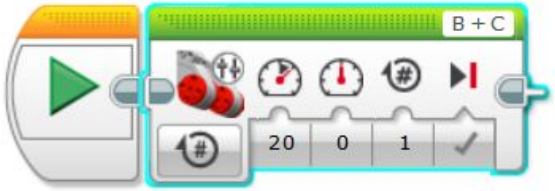
At a sensor Value of 50, the motor would spin Backwards, because 50 is NOT greater than 50



Types of Turns

- **Point Turn**
  - A precise turn that covers little space
  - One Drive Motor is Positive, the Other Drive Motor is Negative
- **Swing Turn**
  - A Wide Turn that covers a lot of space
  - One Drive Motor is Positive, the other is turned off
- **Modified Turn**
  - A Turn that is modified by having one motor at a higher power than the other motor.
  - It is very hard to program, and isn't very accurate

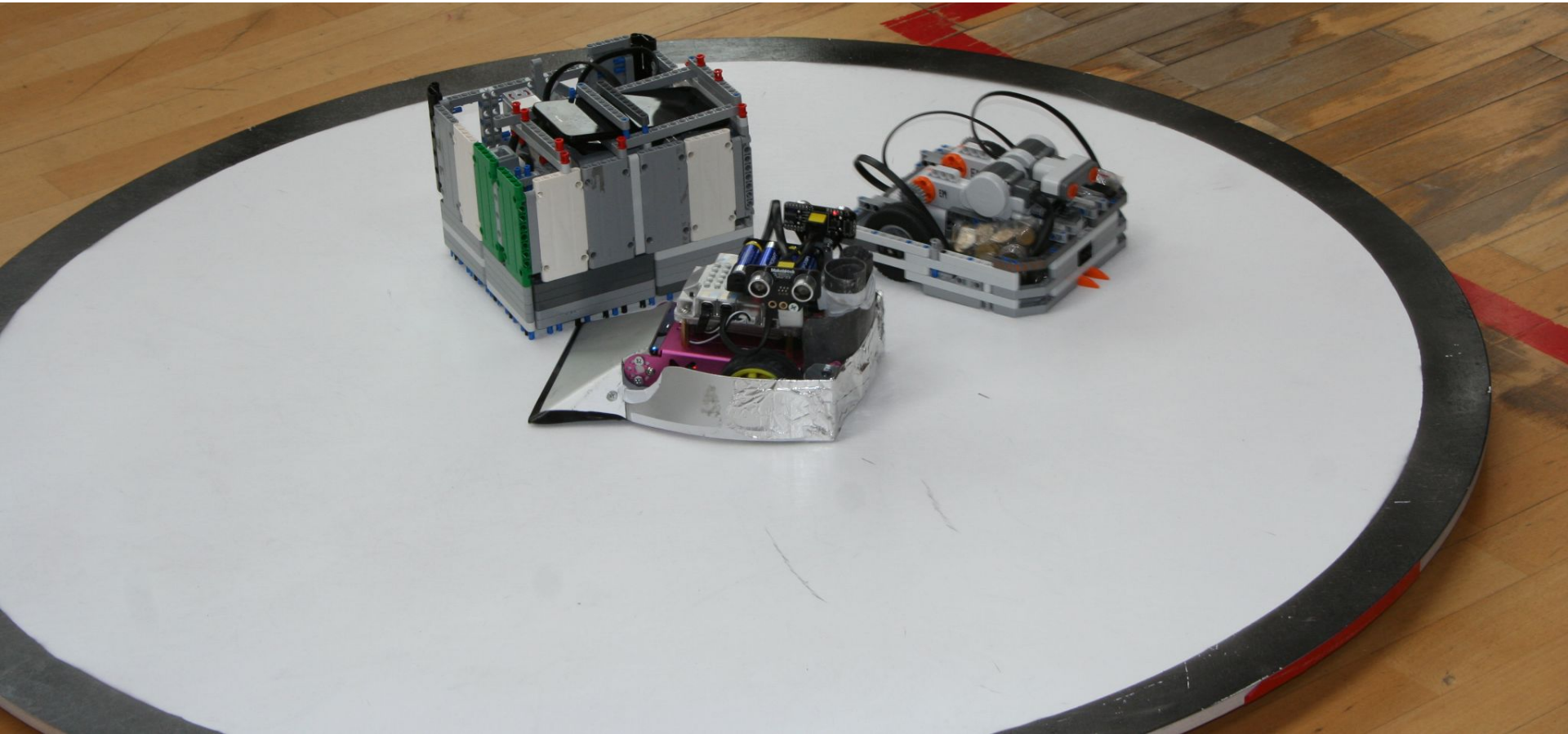




The Engineering Design Process

What is the EDP?

Intro To Sumo Bots



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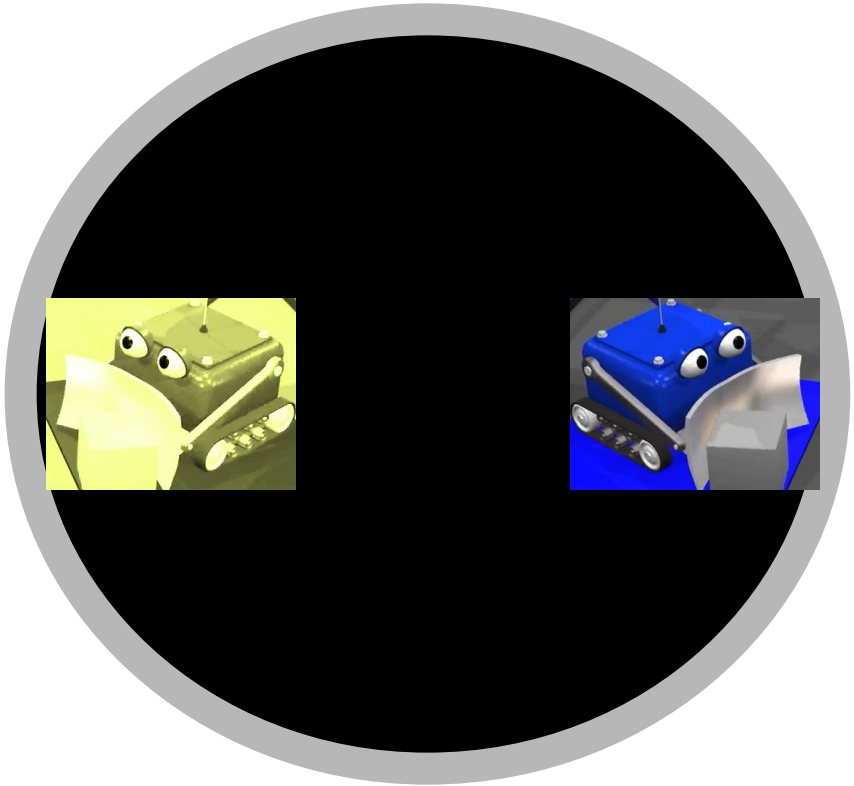

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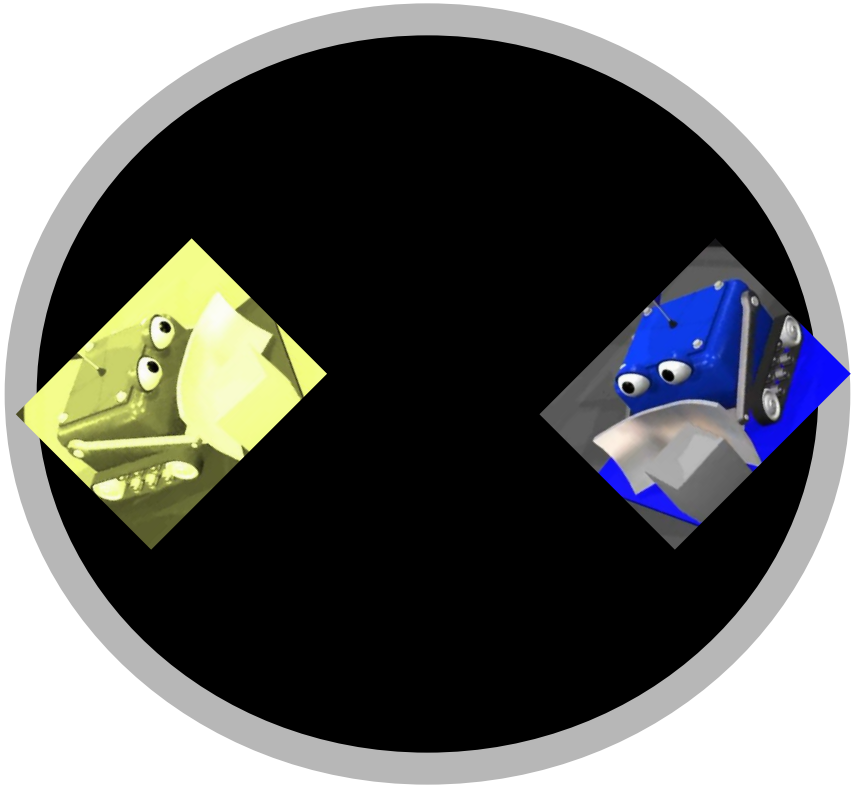
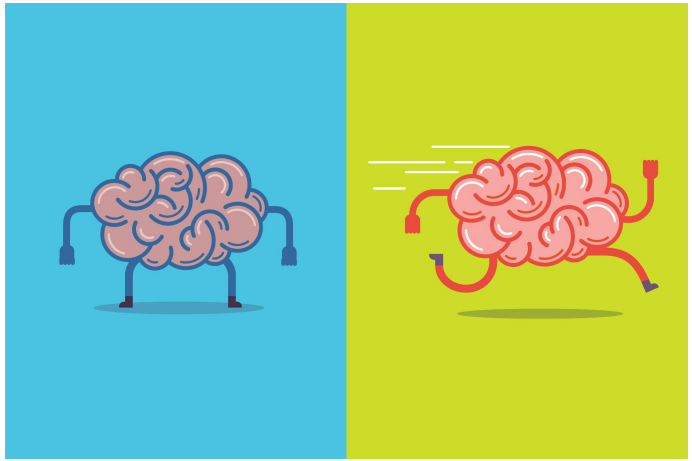


Before we begin….

https://youtu.be/KUWn_TJTrnU
https://youtu.be/hiiEeMN7vbQ
https://youtu.be/wtxuP5M2rjo

Lets learn about growth mindset



The power of yet

This is essentially for engineers and the learning process

Recap and Reflection

Open notebooks

How can we improve our robots? (was it to big?was it easy to tip over?)

What are some things you like to change?

If you lost a round what made you lose it? How can you prevent that from happening?

(Pls right them in your notebook)

Challenge #1

Complete the maze

- Your robot will navigate its way through the maze using your own program!!!
- Constrains:
  - Your Robots wheels cannot move outside the white line
    - The only exception is when you are turning
  - You will have 2 hours to complete the challenge
  - You can only ask the volunteers for hints
- Hints:
  - You will need to use tank drive
  - This is Trial and Error*
  - You will need to find out how to make a perfect 90 degree turn
  - Do not use time to rotate

There's Actually One More Important Part of Engineering That Isn't Part of STEM!

Let's Talk About It!

Business

Business is a type of job where you work with other people to sell, buy, and trade items and objects with each other.

- An important part of STEM is knowing how to conduct business
- Without Business, STEM would not be able to be as commonplace as it is today
- An important part of Business is the ability to communicate and to make presentations

Throughout this camp, we will be making various presentations that will help us better our marketing skills!

Challenge #2

Your First Presentation!

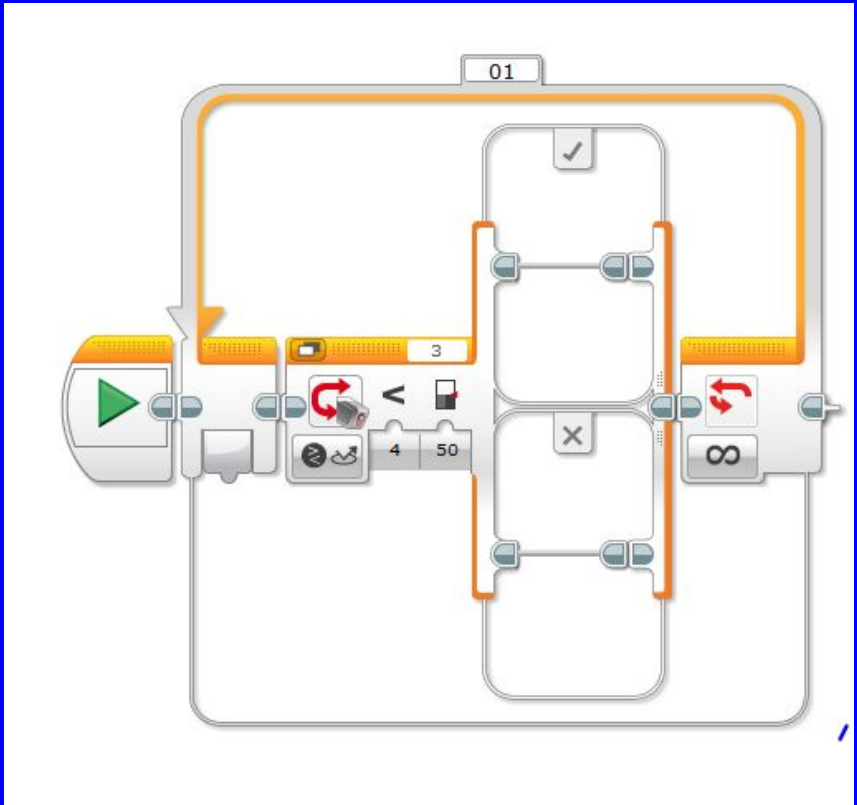
- You will be doing a ~3 Minute presentation
- You will present about your favorite part of the camp so far
- You will have ~15 minutes to prepare
- You will need to:
  - Introduce yourself
  - Say what has been your favorite part
  - Explain why it is your favorite part
  - Be sure to go into detail about why it has been your favorite part

Challenge #3

Follow the Line

- Your robot will follow a line
- The Line will start off straight, but will eventually twist and turn
- Constraints
  - Your Robot cannot pass the line
  - You will have 2 hours to complete the challenge
  - You can only ask the volunteers for hints
- Hints:
  - Your robot will ***not*** move in a straight line
  - Your robot will use the color sensor

Another Big Hint!



TIPS

- Start updating notebook
- Think of how you will explain your strategy to the judges.
- TWO DAYS LEFT!!!

Upgrading SumoBots using torque

Potential SumoBot Upgrades

- Make it bigger or smaller
- Make it harder to tip over
- Make it stronger

What does it mean to make the robot “stronger”

- Make the robot harder to be moved by other robots

- Make it easier for the robot to move other robots

How do we make the robot stronger?

- Increasing the **torque** on the wheels

What is torque?

- A twisting force that causes rotation

How do we increase torque?

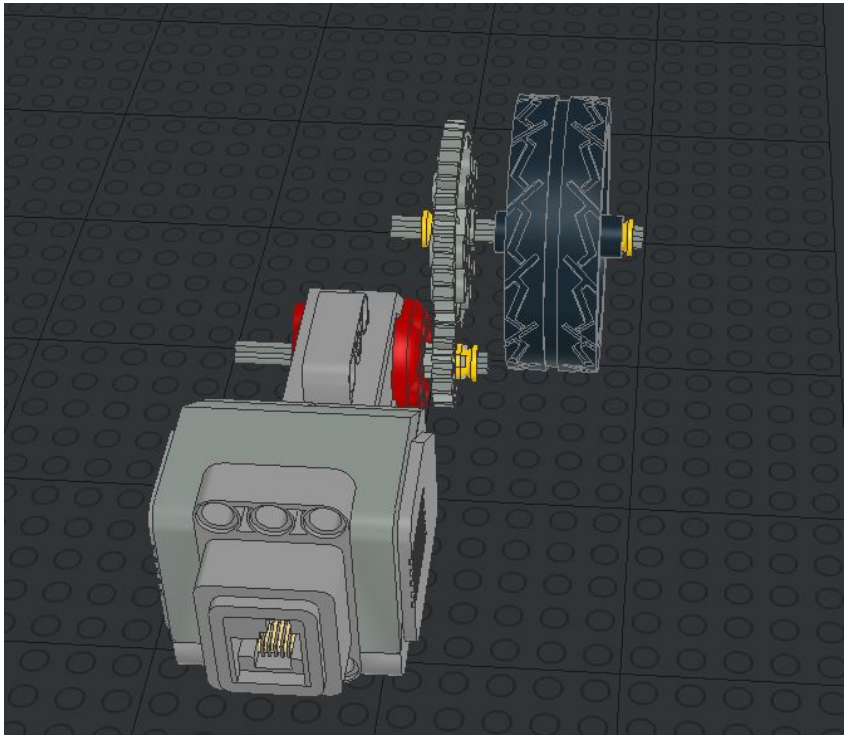
- By having a smaller gear at the **source of rotation** mesh with a larger gear at the **target of rotation**

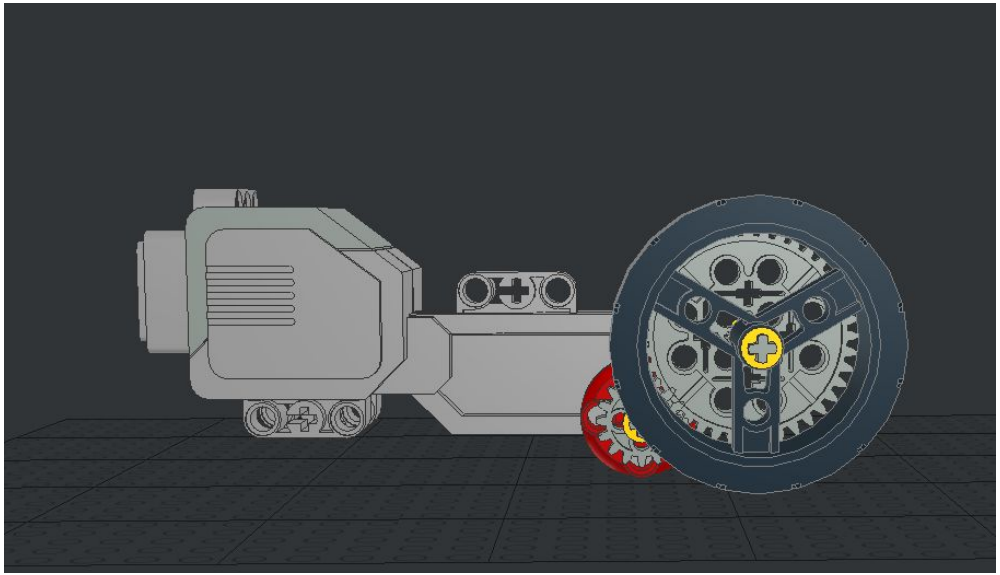
What are these terms?

- Gear - 
- Source of Rotation - The motor
- Target of Rotation - The Wheels

How do we increase torque?

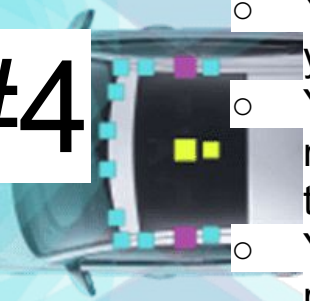
- By having a smaller gear at the **motor** mesh with a larger gear at the **wheels**





CAMERA NAVIGATION LIDAR RADAR

Challenge #4



Stop at 5, 10, and 20!

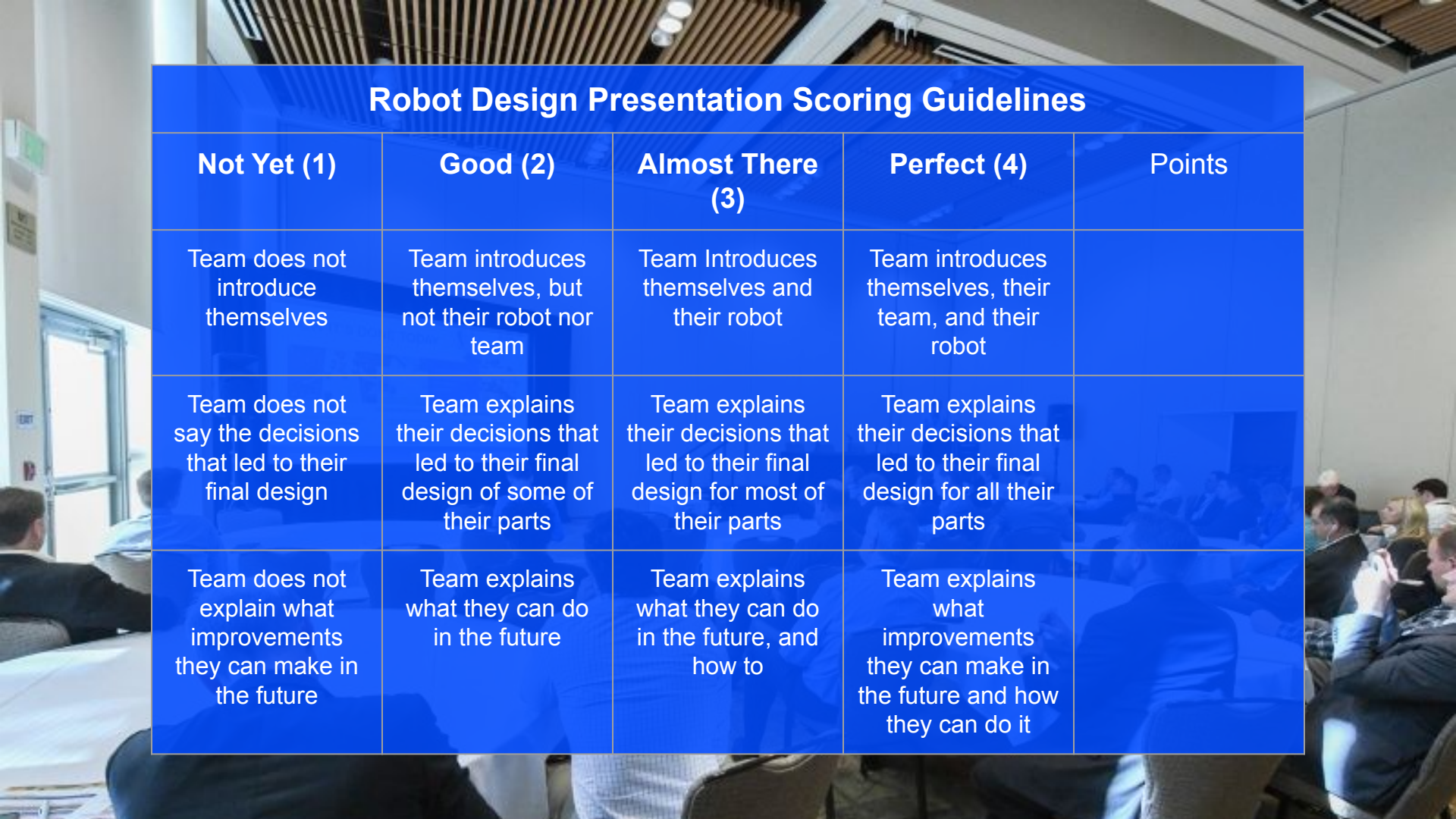
- Your robot will start a random distance from a wall
- You will make 3 programs
  - Your first program should make your robot stop 5cm from the wall
  - Your second program should make your robot stop 10cm from the wall
  - Your third program will make the robot stop 20cm from the wall
- Constraints
  - You will be starting a random distance from the wall
- Hints:
  - You will be using the sensor that measures distance (what sensor is that one?)

Challenge #4

What's Special About Your Robot?

- You will be doing a presentation on what is special about your robot
- **This is called a Robot Design Presentation**
- You will be doing a Robot Design Presentation to the Judges on Friday
- Your Presentation should last 3-5 minutes

Lets See What You will need to present!



Robot Design Presentation Scoring Guidelines

Not Yet (1)	Good (2)	Almost There (3)	Perfect (4)	Points
Team does not introduce themselves	Team introduces themselves, but not their robot nor team	Team Introduces themselves and their robot	Team introduces themselves, their team, and their robot	
Team does not say the decisions that led to their final design	Team explains their decisions that led to their final design of some of their parts	Team explains their decisions that led to their final design for most of their parts	Team explains their decisions that led to their final design for all their parts	
Team does not explain what improvements they can make in the future	Team explains what they can do in the future	Team explains what they can do in the future, and how to	Team explains what improvements they can make in the future and how they can do it	

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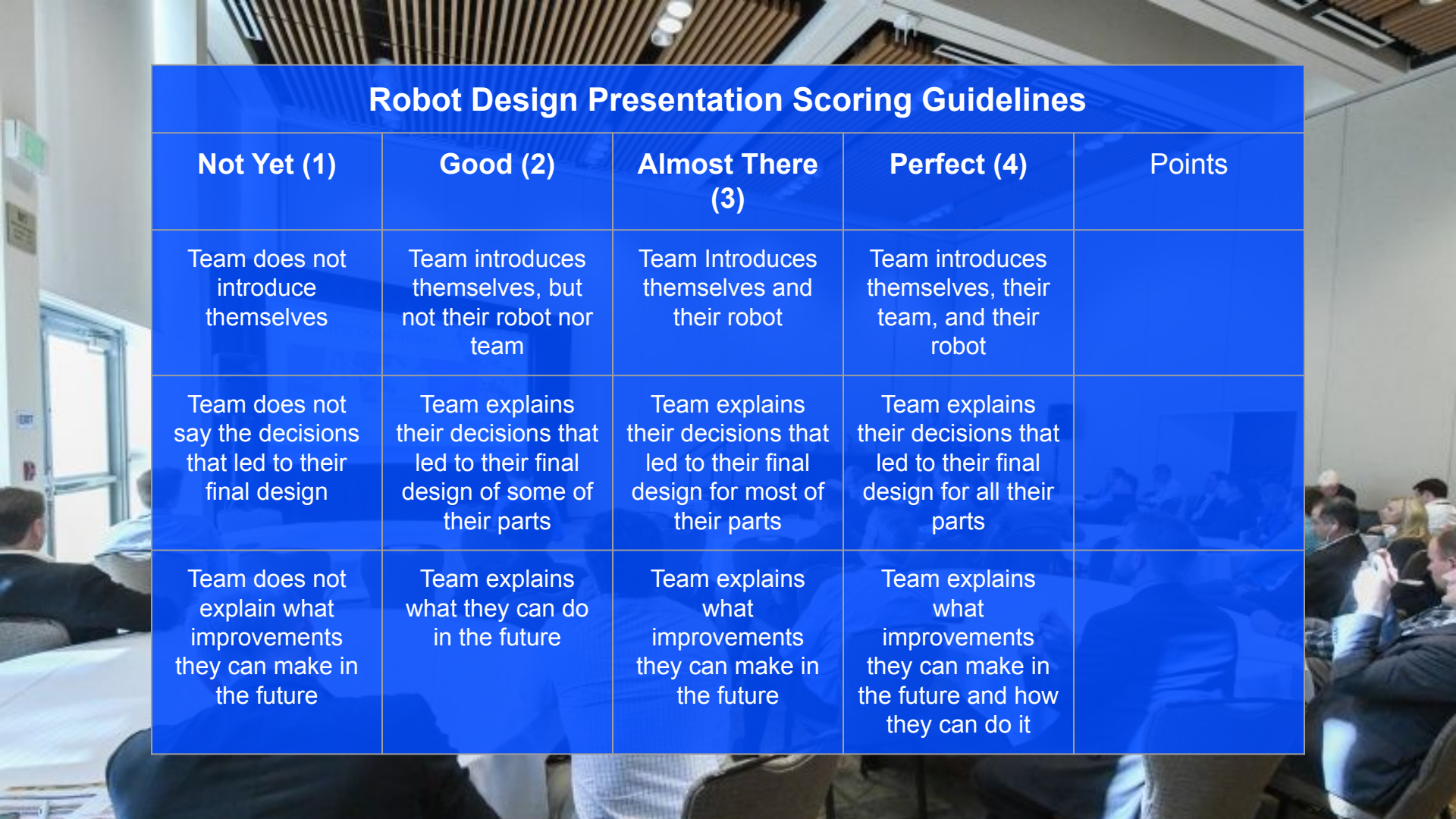

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Engineering Notebook Scoring Guidelines				
Not Yet (1)	**Good (2)**	**Almost There (3)**	**Perfect (4)**	Points
Nb. is not well organized	Notebook has is somewhat organized	Notebook is organized	Notebook is very well organized	
Nb. does not contain notes	Nb. contains some notes	Nb. contains notes	Nb. contains detailed notes	
Nb. does not contain pictures of sensors	Nb. contains some pictures of sensors	Nb. contains all pictures of sensors	Nb. contains all pictures of sensors and notes of what the sensors do	
Nb. does not contain tables	Nb. contains tables	Nb. contains tables	Nb. contains tables with correct information	

SumoBot Competition Rules

- Robots must start on or near the center of the mat
- Robots must turn around once it reaches the white line
- There is a 2 minute time limit
- Both teams or an officiator can call a stalemate.
  - Both teams must agree to the stalemate for the match to end and a rematch to begin
    - If a team disagrees to the stalemate, the match continues
  - A single officiator can call a stalemate to end the match and for a rematch to begin
  - A stalemate occurs after 30 seconds of robots being locked in to each other
- A robot loses when it is knocked out of the mat. A robot is knocked out when more than half its body passes the white line or if a judge determines the robot has passed the line

SumoBot Competition Rules

- A robot can also lose when it becomes incapacitated. Robots become incapacitated if:
  - The robot cannot move
  - The robot gets flipped over
  - The robot gets a stalled motor
  - An officiator determines a robot is incapacitated
- The match continues even if the robot looses parts
- The team must keep their robot in good condition
  - The team will be responsible to keep their robots charged. If a robot loses charge before or during a match they will lose
  - The team can repair or make slight changes to their robot when they are not in a match
  - The team cannot make changes to the program while they are not in a match
- A team may recieve penalties at a Judges discretion if a team breaks a rule

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  - The team cannot make changes to the program while they are not in a match

SumoBot Competition Rules

- Only team members and officiators are allowed near the table
  - Spectators are allowed to watch from a distance
- Team members are not allowed to touch the mat or table. They may also not touch the robot. The only exception to this rule is:
  - When the teams start the program at the beginning of the match
  - When the team gets their robot at the end of the match