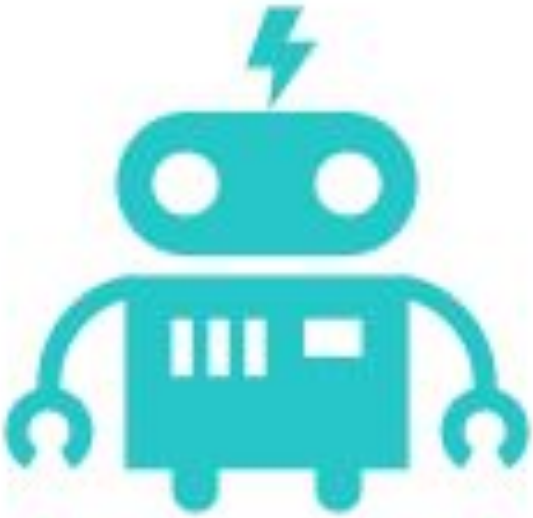
R.I.S.E. Summer Camp

Raptors Inspiring Science and Engineering

Welcome!

This summer camp is meant to be a lot of fun!

We will go over the very basics of robotics, and by the end of this camp, we hope you will have developed a sturdy foundation in robotics.



Before We Start...

Be sure to write everything that sounds interesting to you in your ***ENGINEERING NOTEBOOK***

WHAT IS A ROBOT?

What Robots Will We Be Using?

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.

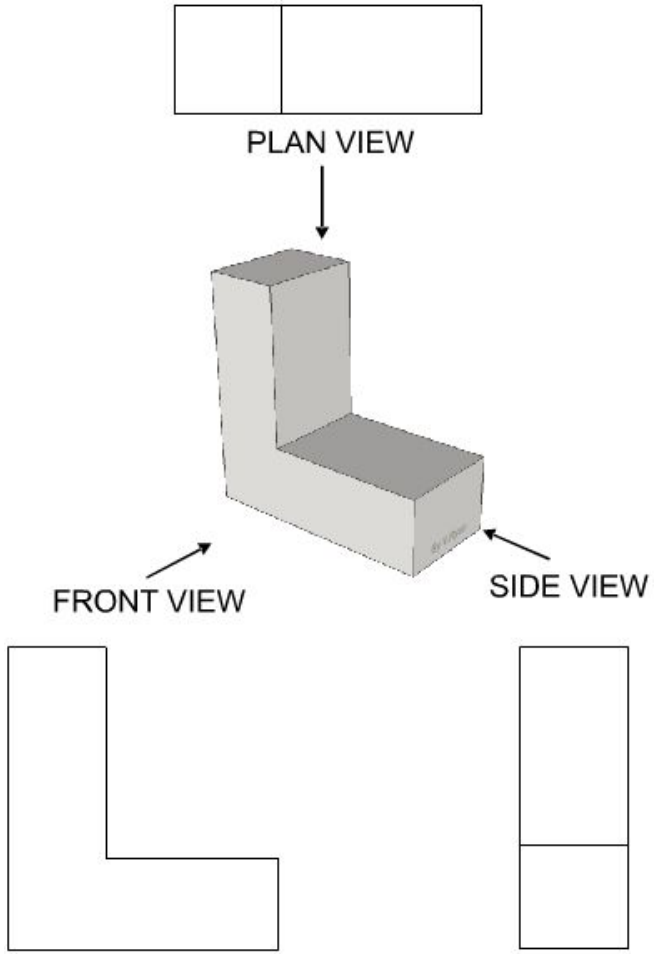
What do you think about the EV3 Robot? What was your first reaction to the robot?

Let’s Do Some Orthographic Projections!

Orthographic Projections

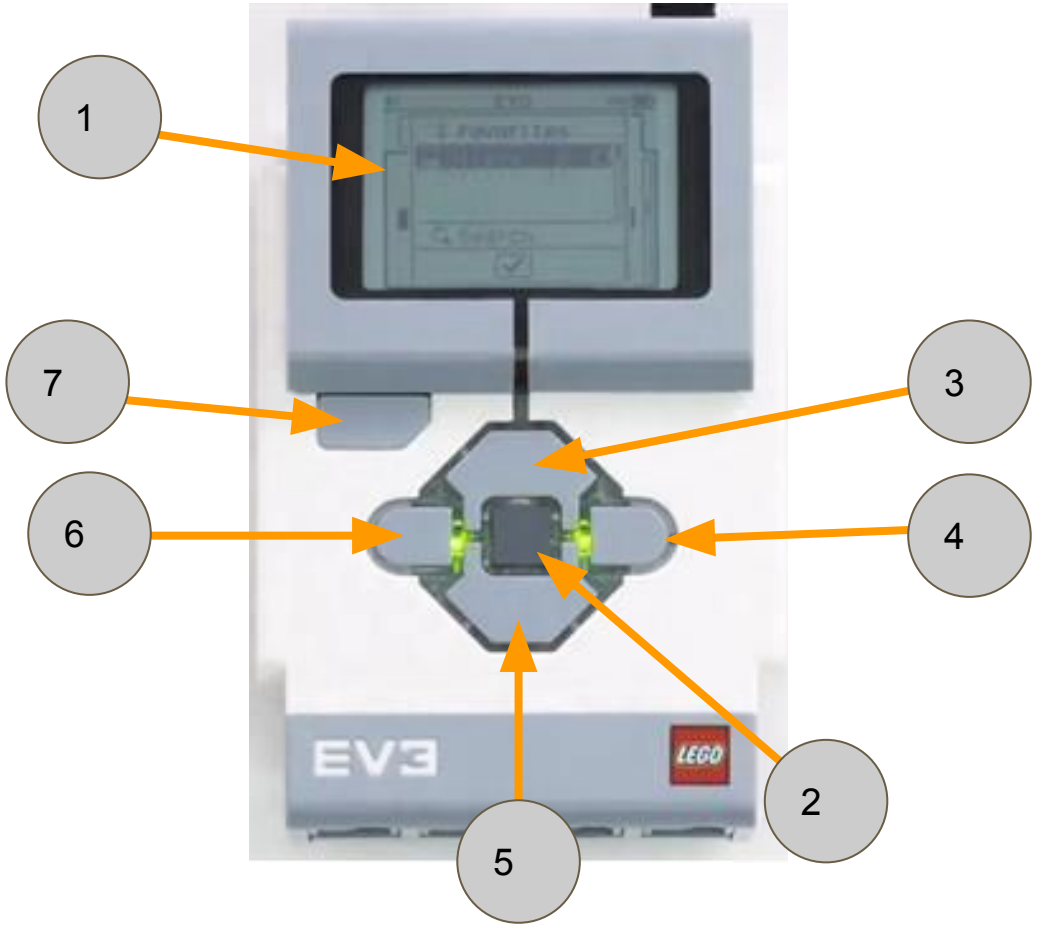
An **Orthographic Projection** is an Engineering Drawing that shows one side of an object.

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



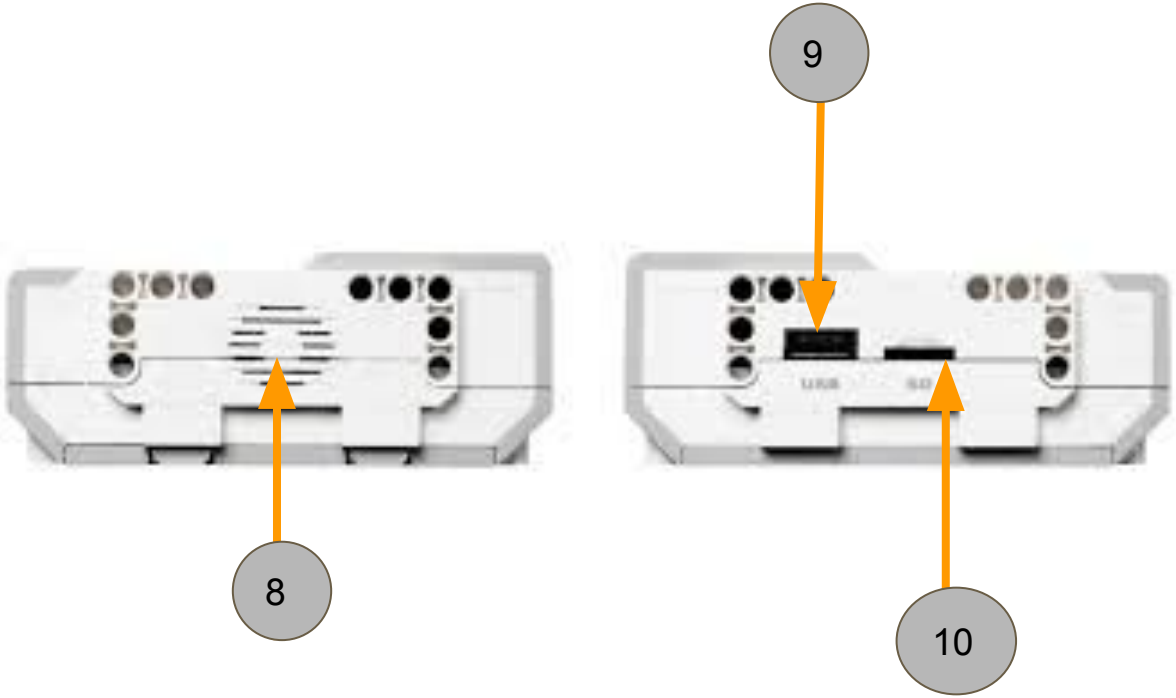
Top View

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



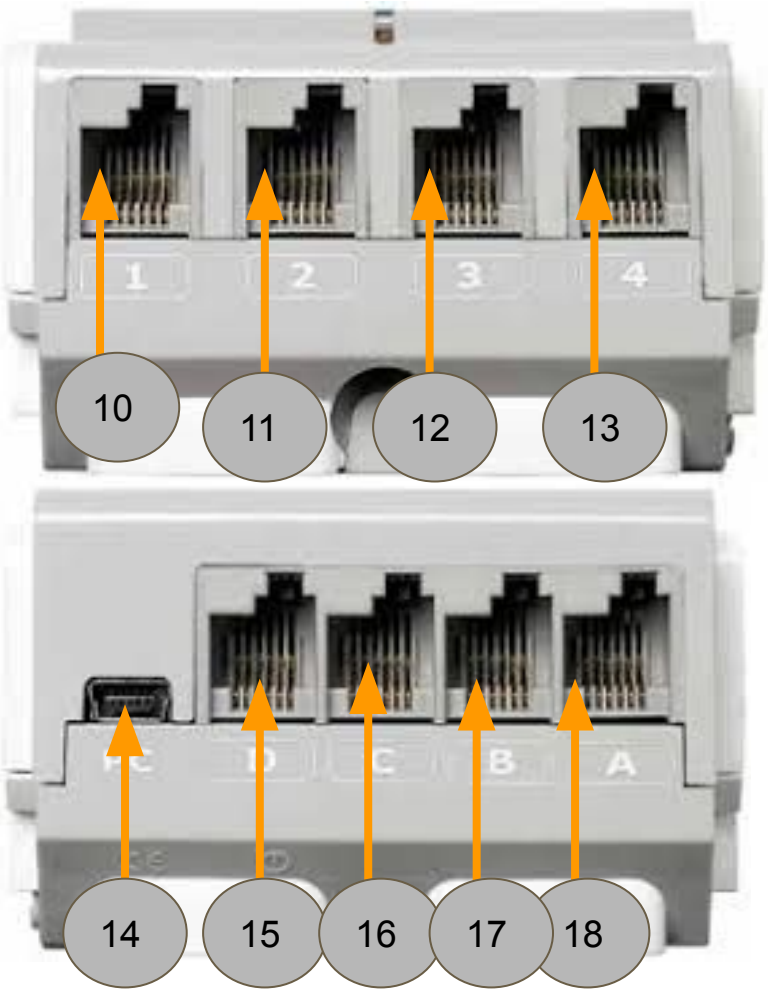
Side Views

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



What are 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!

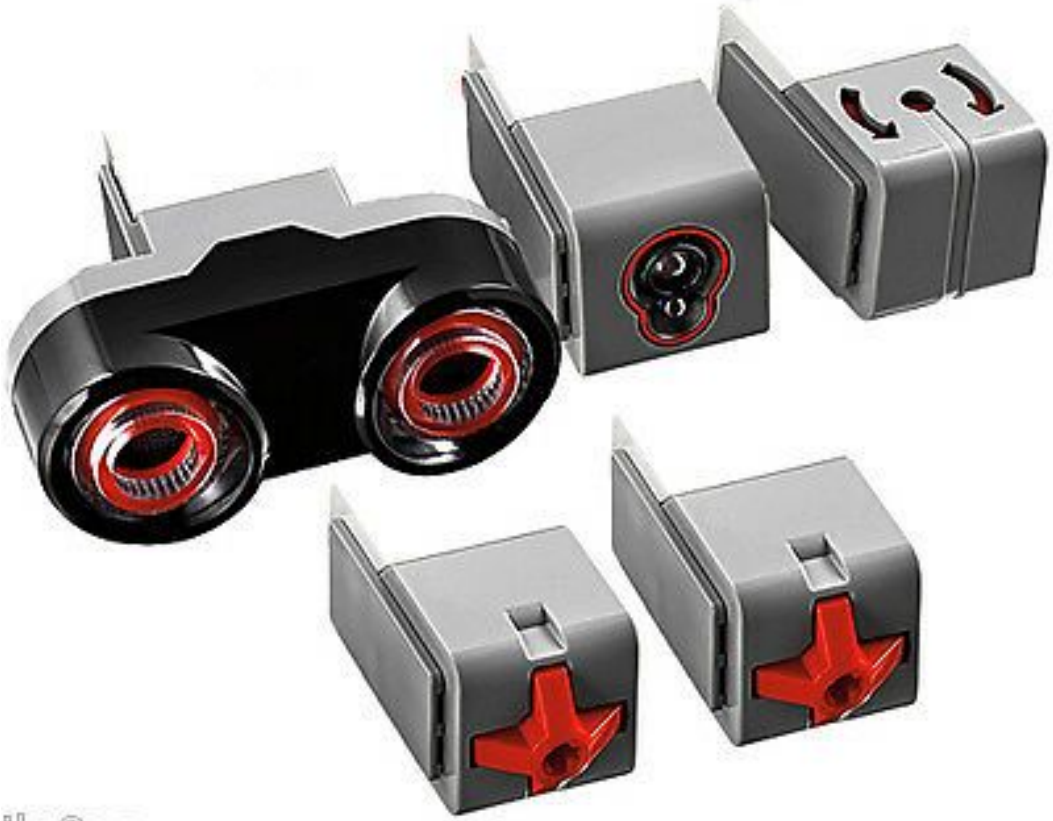
Every Sensor must have certain information present:

- **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.

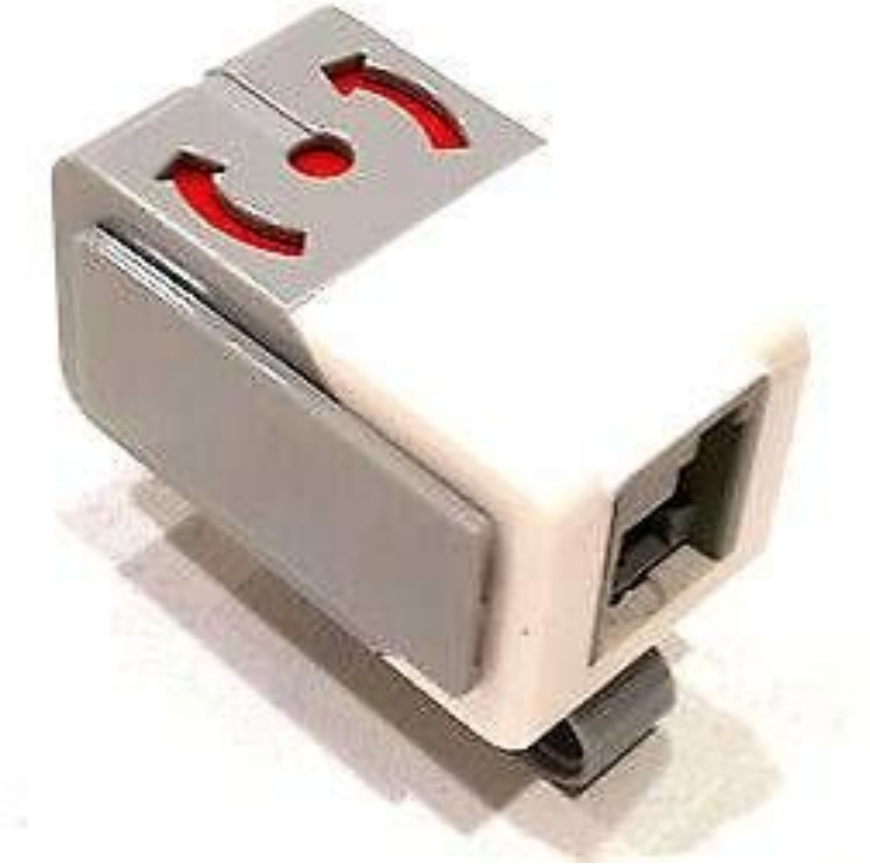
Color measures and detects what color (out of the 6 preset colors) the sensor is pointing at

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.

Motors

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

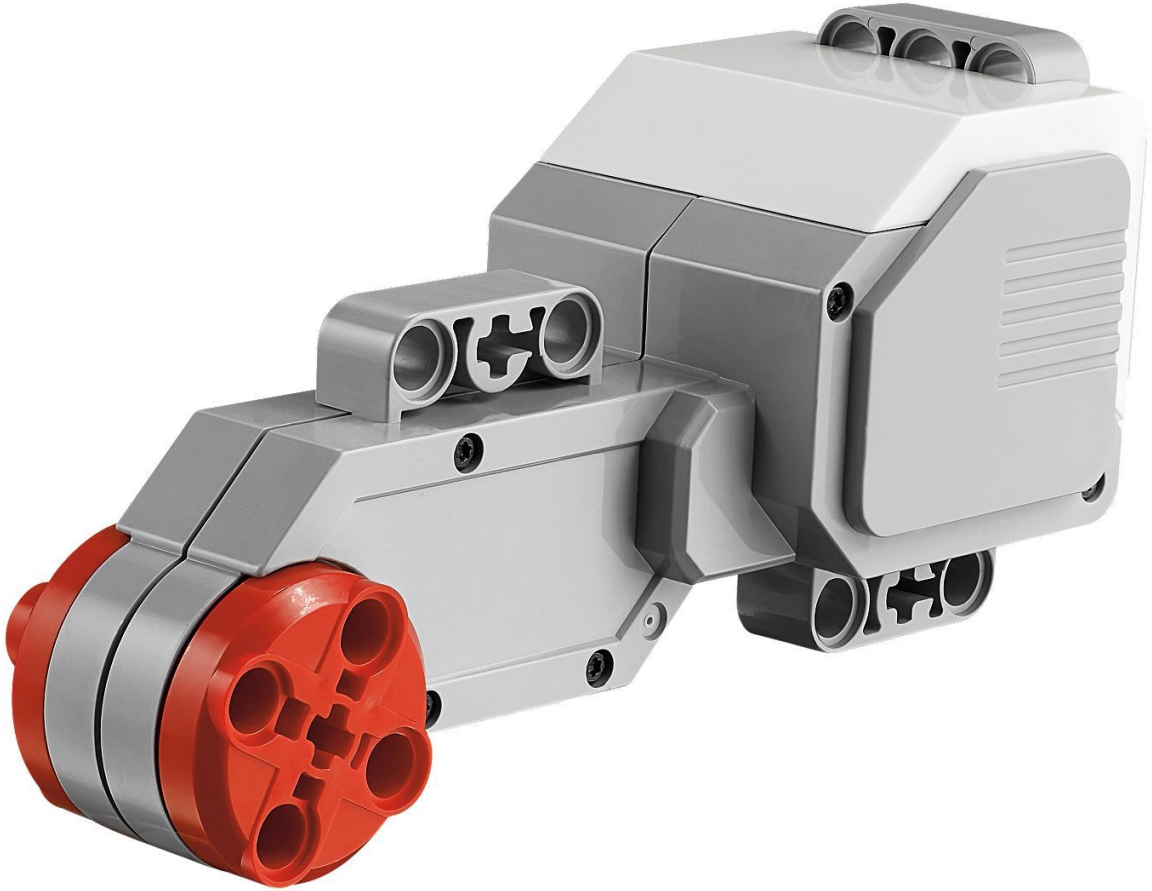
Motors allow robots to move around! The robot supplies power to the motor, which turns it on. When the motor is on, the robot is able to move!

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 (Servo)

This is the Medium Motor! This part is also Called the **Servo**!

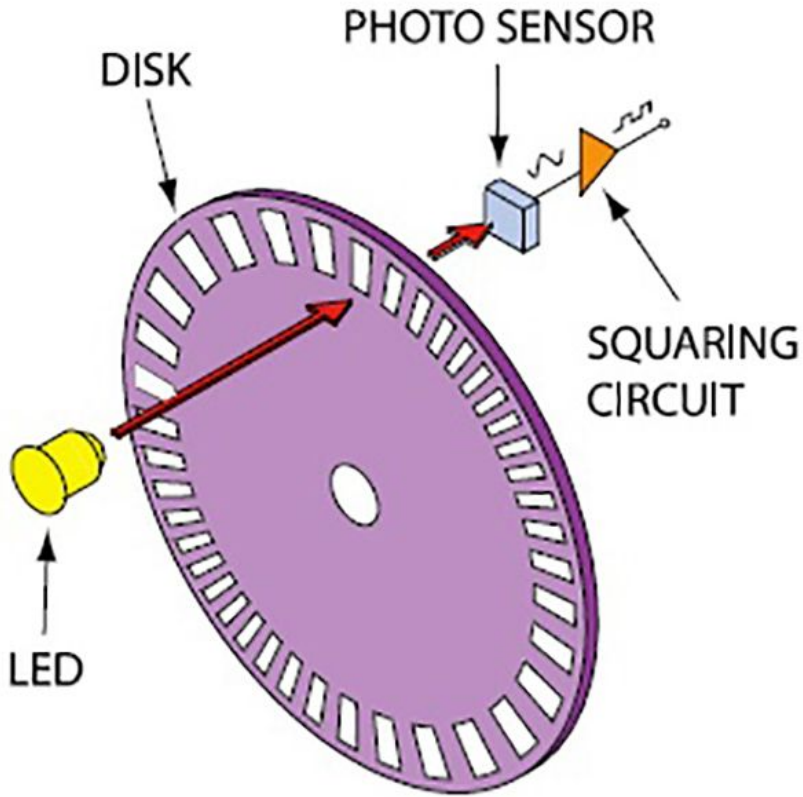
A **Servo** is similar to a motor, but is usually smaller, yet it is more precise. A Servo uses magnets to tell how far it has traveled!

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.

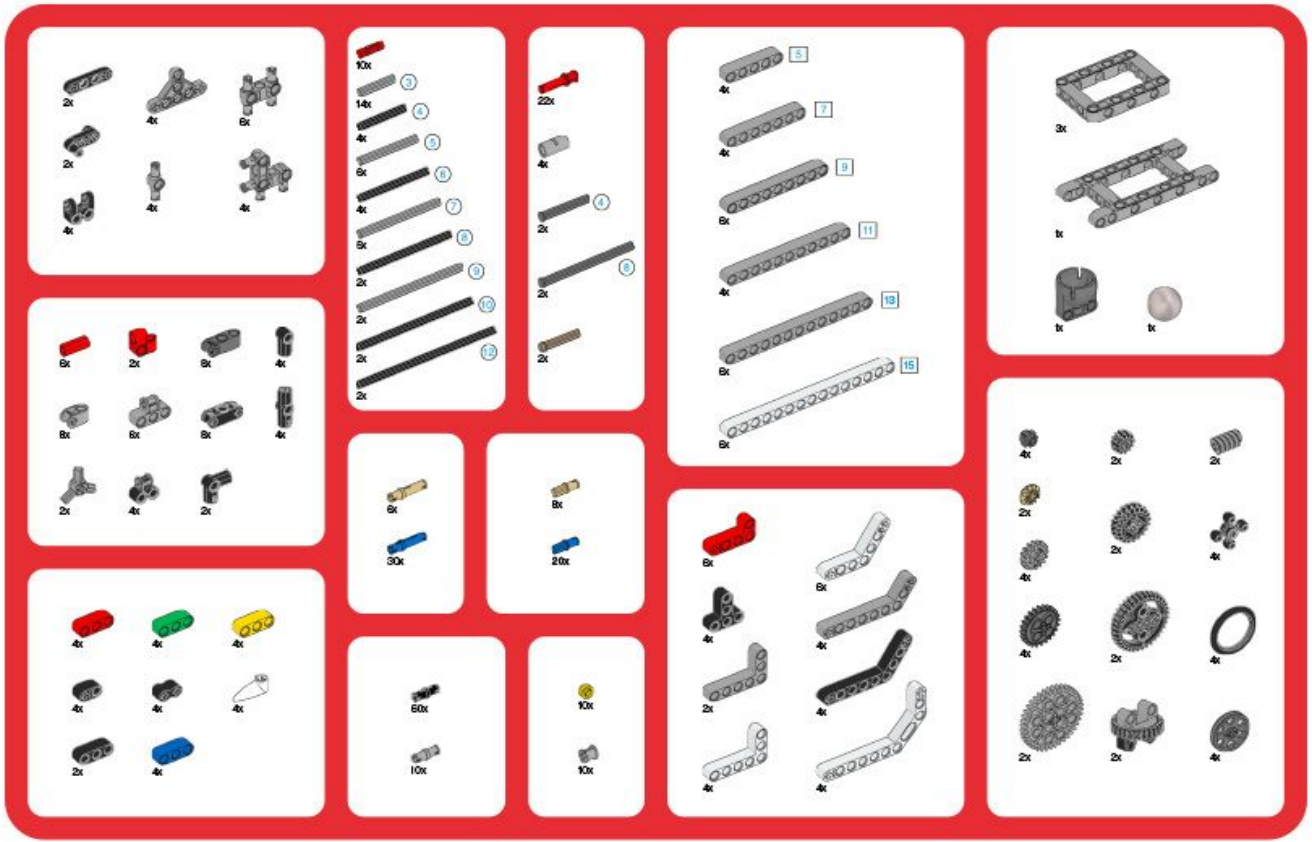
Position

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.



What is used to build the robots?



Rechargeable Battery
Akku
Pile rechargeable
Batería recargable
Pilha Recarregável
Akkumulátor

Interactive Servo Motors
Interaktive Servomotoren
Servomoteurs interactifs
Servomotores interactivos
Servomotores interativos
Interaktiv szervomotorok

Gyro Sensor
Kreisel-sensor
Capteur gyroscopique
Sensor giroscópico
Sensor de giroscópio
Giroszkóp

Touch Sensors
Berührungssensoren
Capteurs tactiles
Sensores de contacto
Sensores de Toque
Érintésérzékelők

Color Sensor
Farbsensor
Capteur de couleur
Sensor de color
Sensor de Cor
Színérzékelő

Ultrasonic Sensor
Ultraschallsensor
Capteur ultrasonique
Sensor ultrasónico
Sensor ultra-sônico
Ultrahangos érzékelő

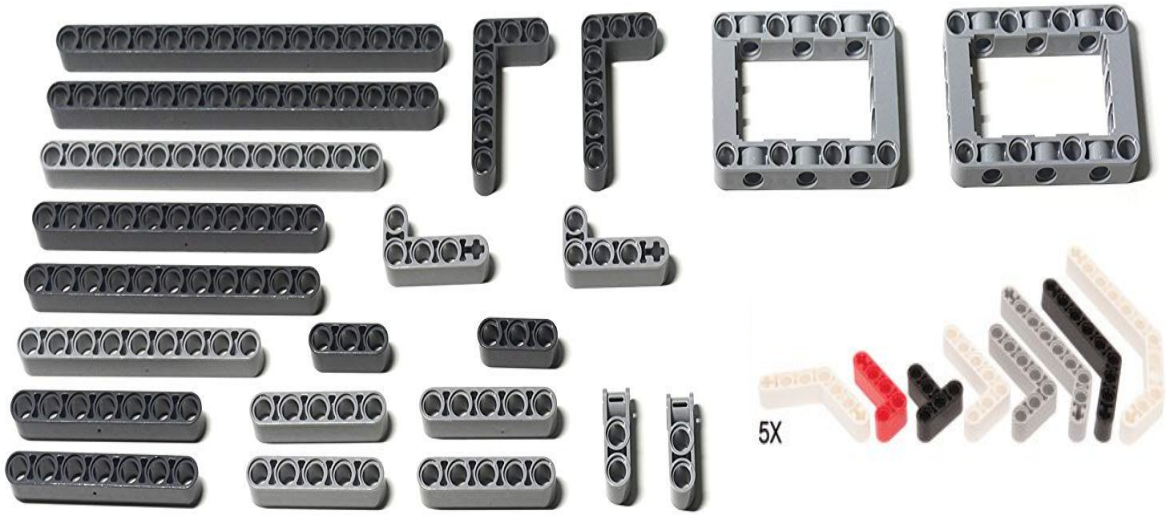
Intelligent EV3 Brick
Intelligenter EV3-Stein
Brique EV3 intelligente
Ladrillo inteligente EV3
Peça EV3 inteligente
Intelligens EV3 építőelem

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.

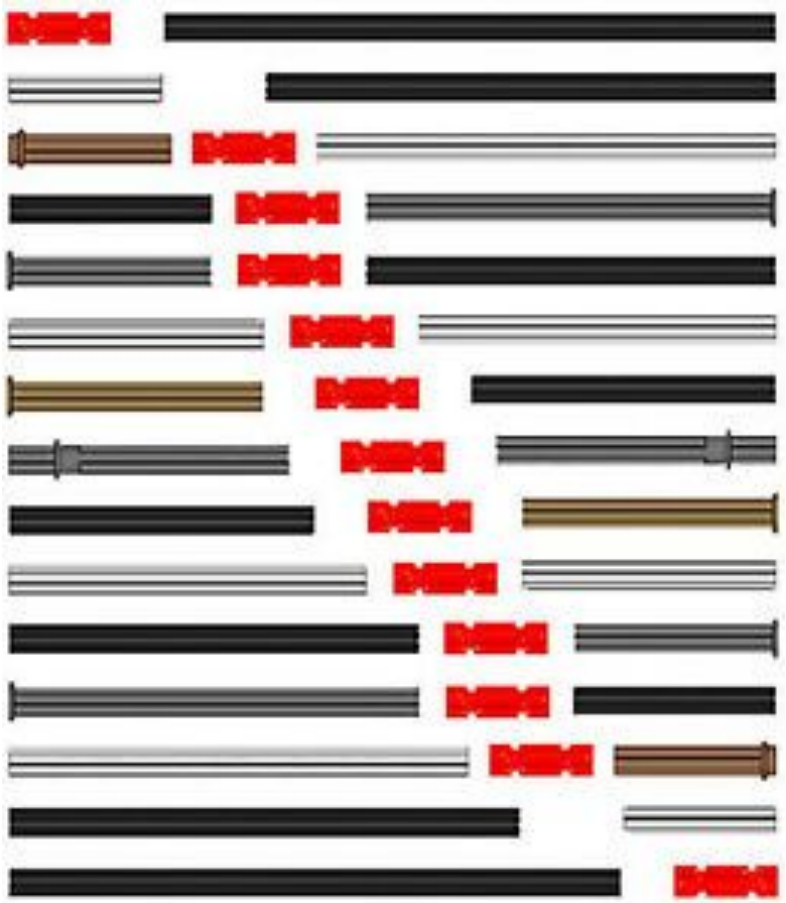


Axles

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.

How do You Program your Robot?

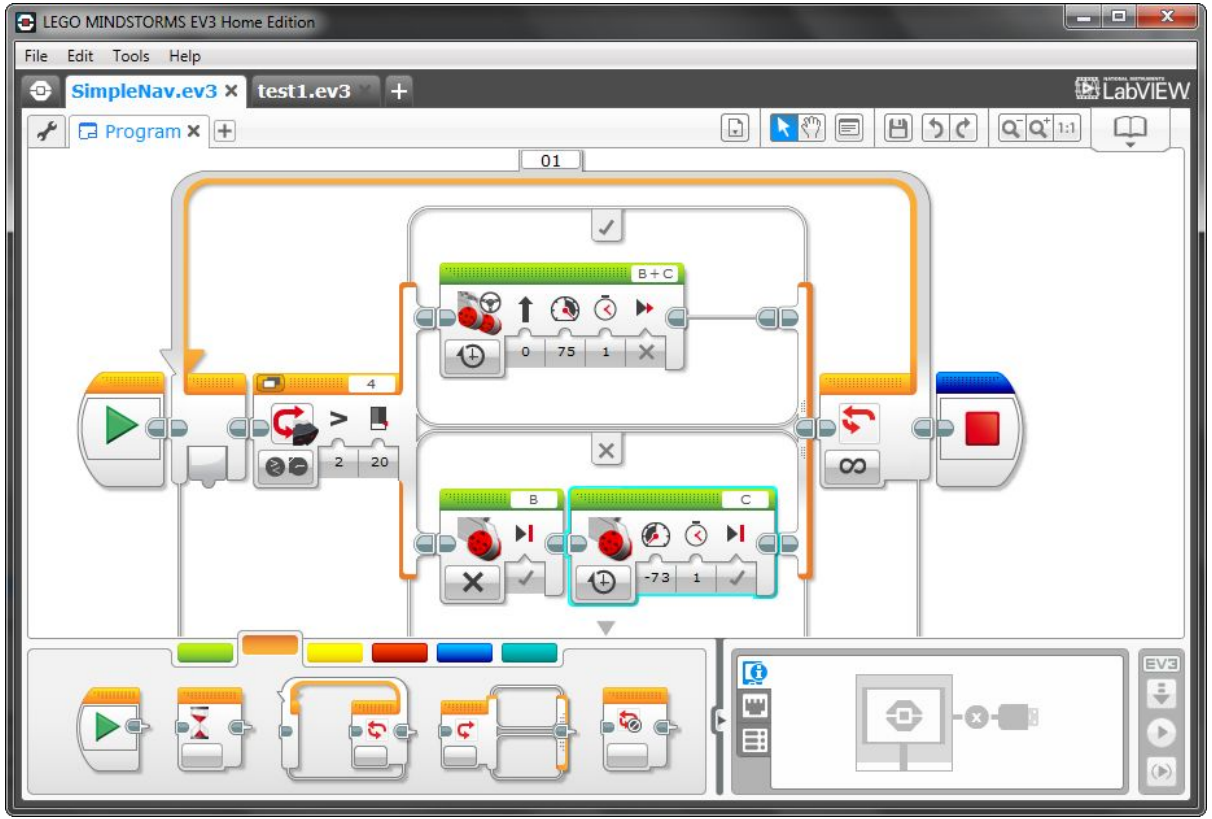
Lego Mindstorms

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!

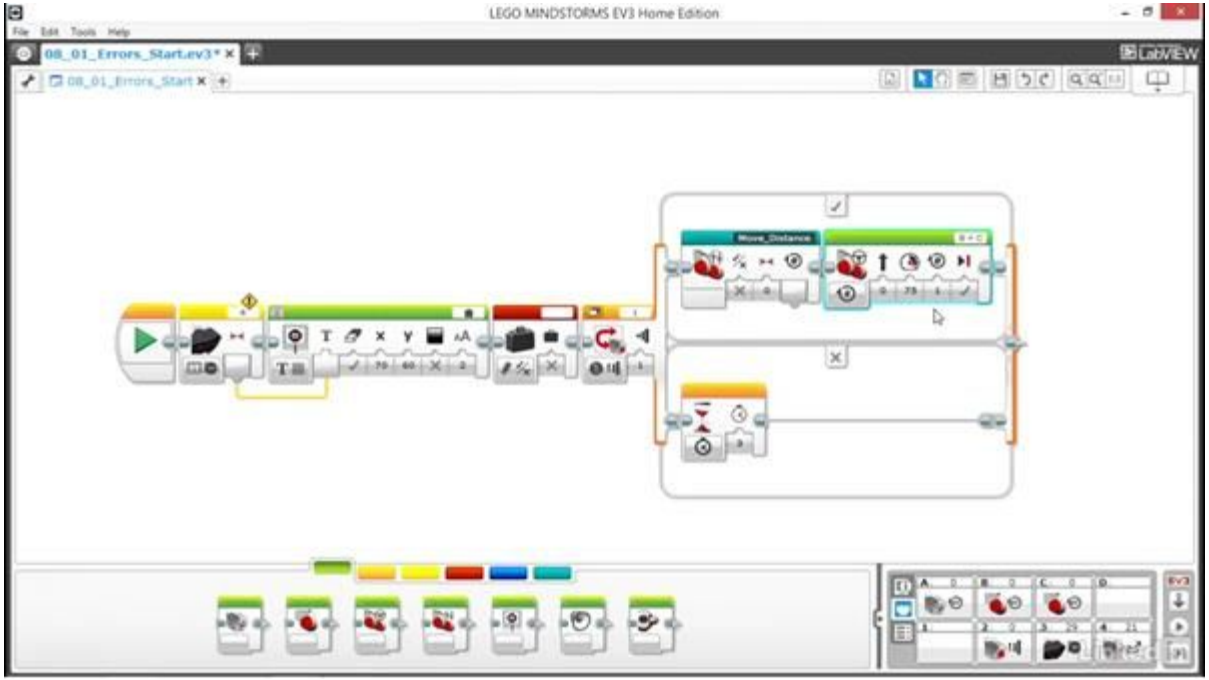


Lego Mindstorms

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!

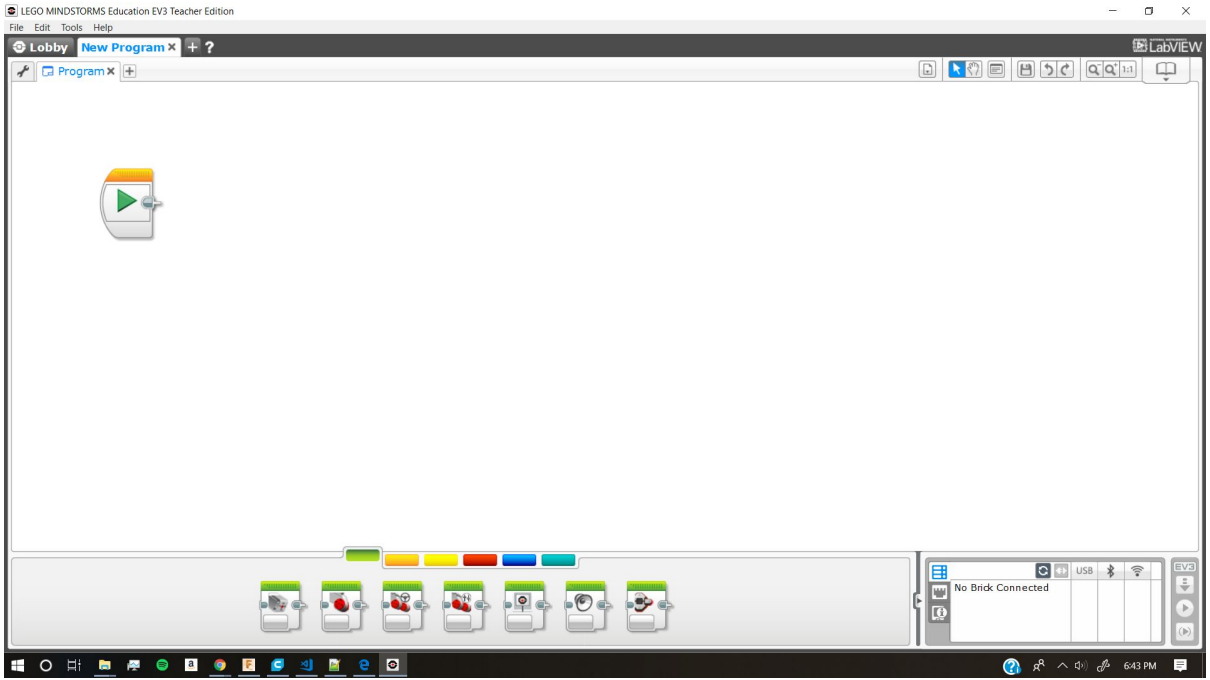


The Basics

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.

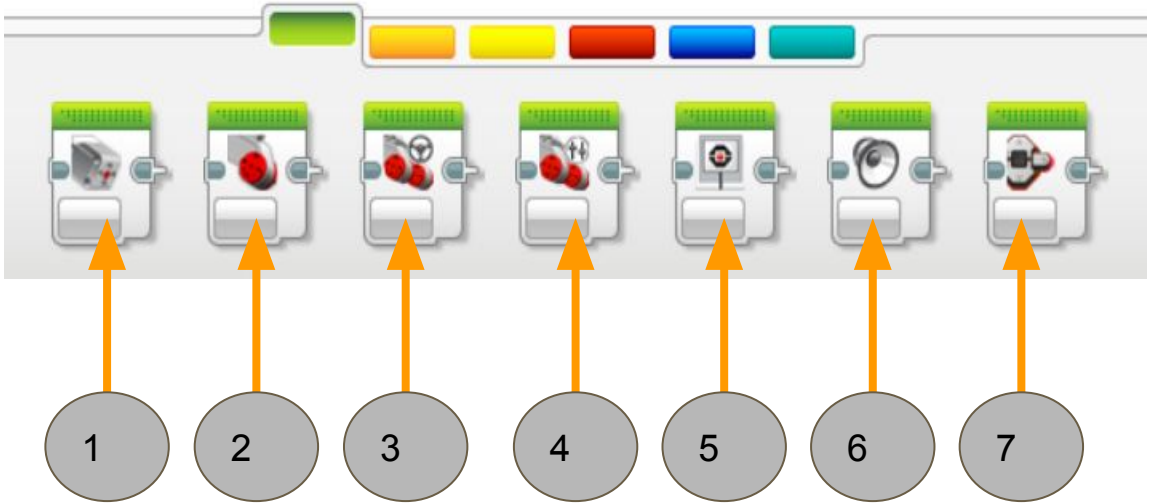


Actions

These are the Action Blocks!

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

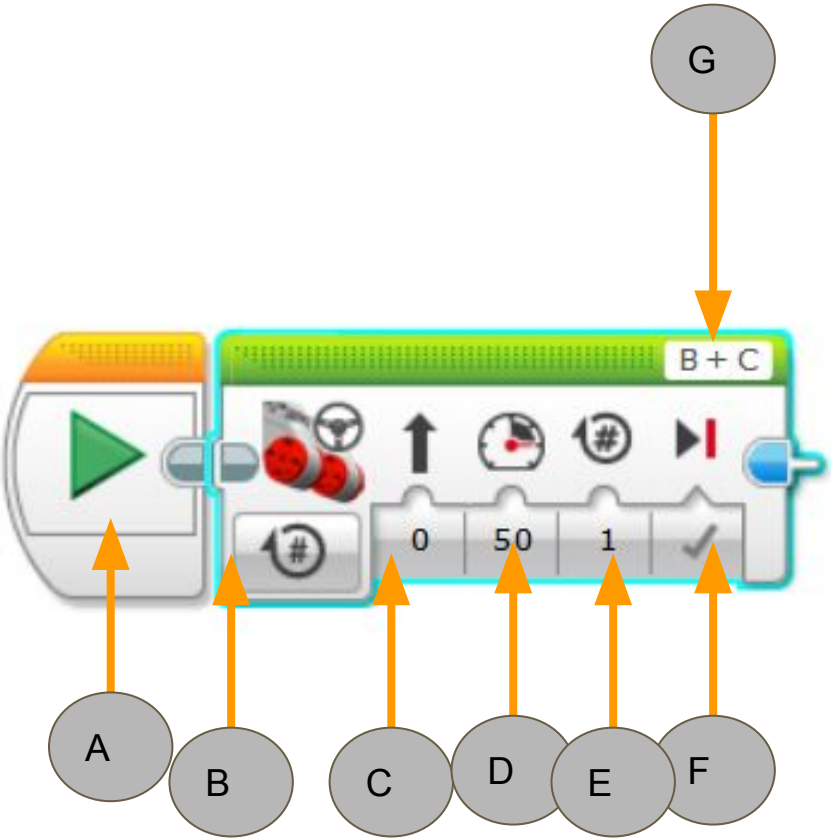
1. Medium Motor Control
2. Large Motor Control (Individual)
3. Steering Control
4. Tank Control
5. Display Control
6. Sound Control
7. Brick Status Light



Blocks

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

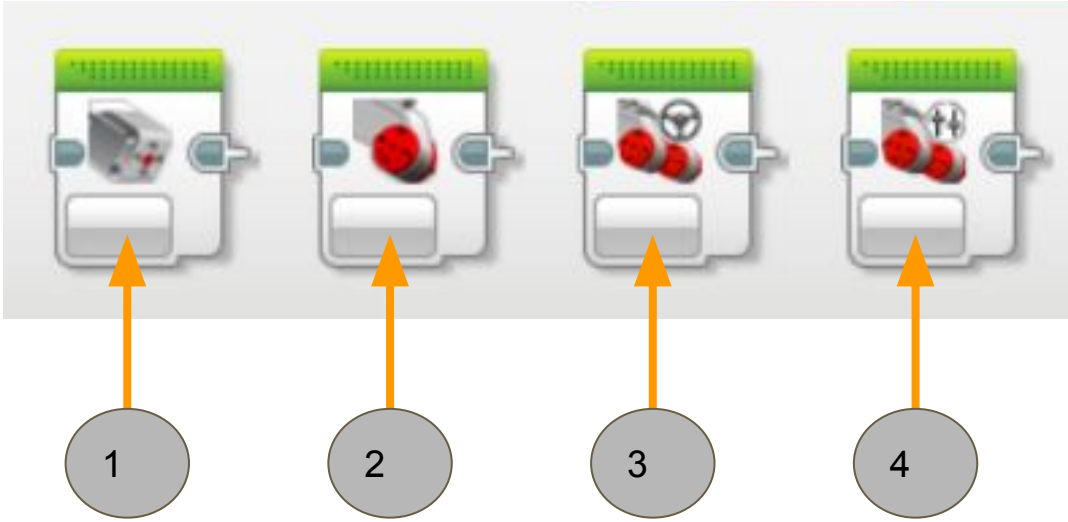
A. Start Block
B. *On For* Statements
C. Steering
D. Power
E. *On For* Condition
F. Brake at End Statement
G. Port Selection



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 **Steering**
4. Allows you to control the Drive Train, with **Di-Motor Control**



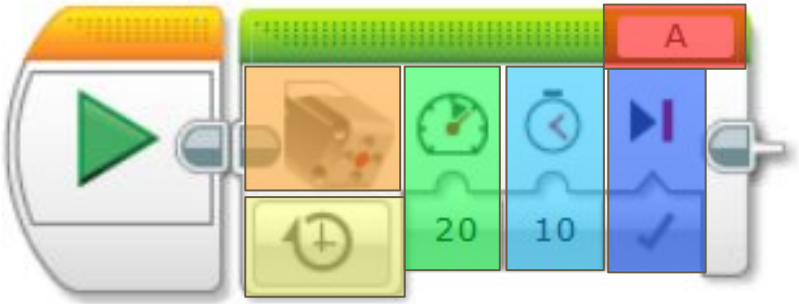
Steering allows for rotation, and is much easier to program. However, it is much harder to control the robot.

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

Pseudo Code Example 1A

Lets go over some **Pseudo 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**



Pseudo Code Example 2A

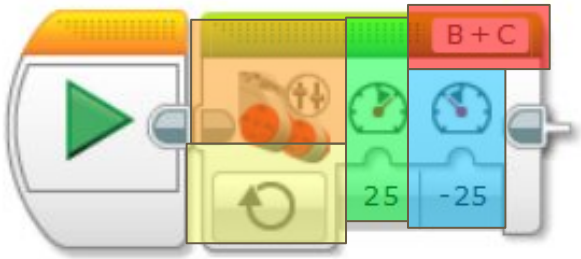
- ON PORT D
- ON LARGE MOTOR
- RUN MOTOR BASED ON ROTATIONS
- RUN MOTOR AT 50% POWER
- RUN FOR ONE ROTATION
- STOP MOTOR AT THE END

Pseudo 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

Pseudo 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



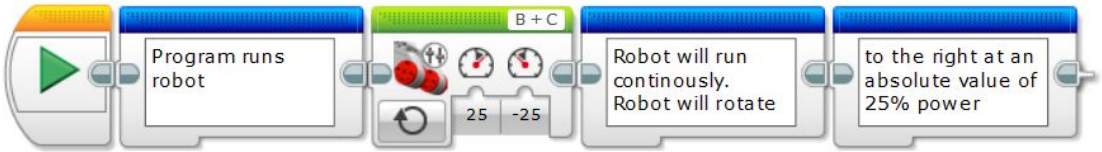
Comments

These are Comments (Notes)!

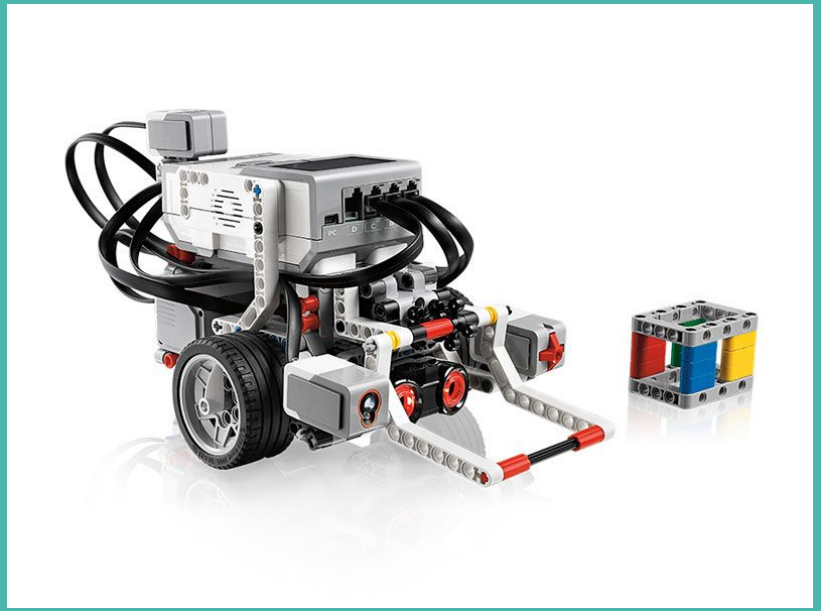
Comments are used to tell people what your code does.

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!



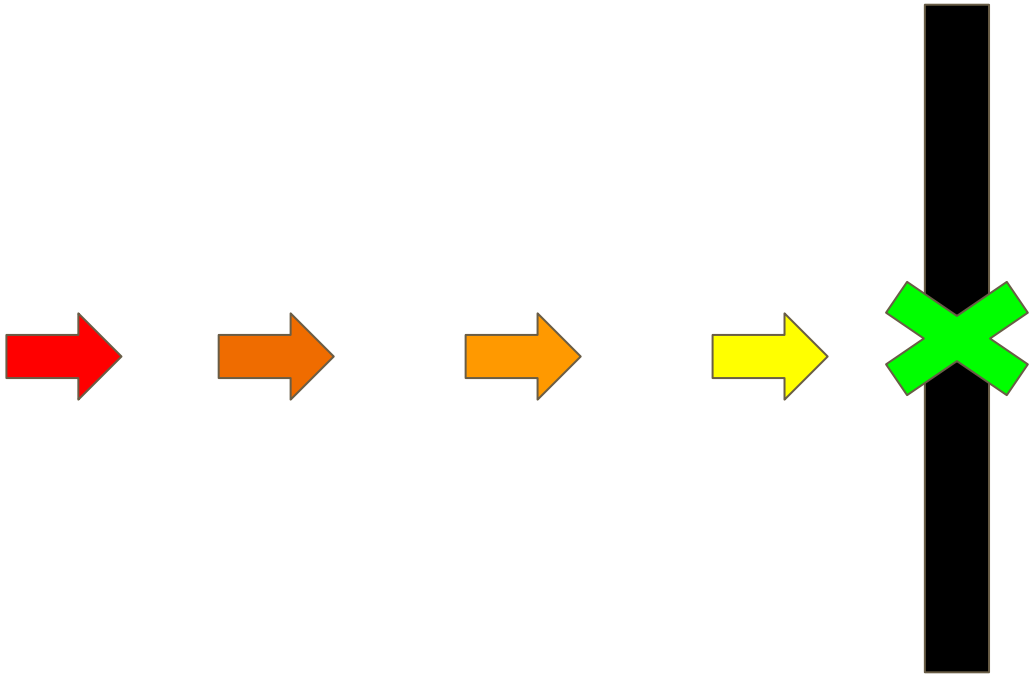
Time for the Challenges!



Land Here!

This is the Land Here Challenge! The point of the Challenge is to stop at the black line!

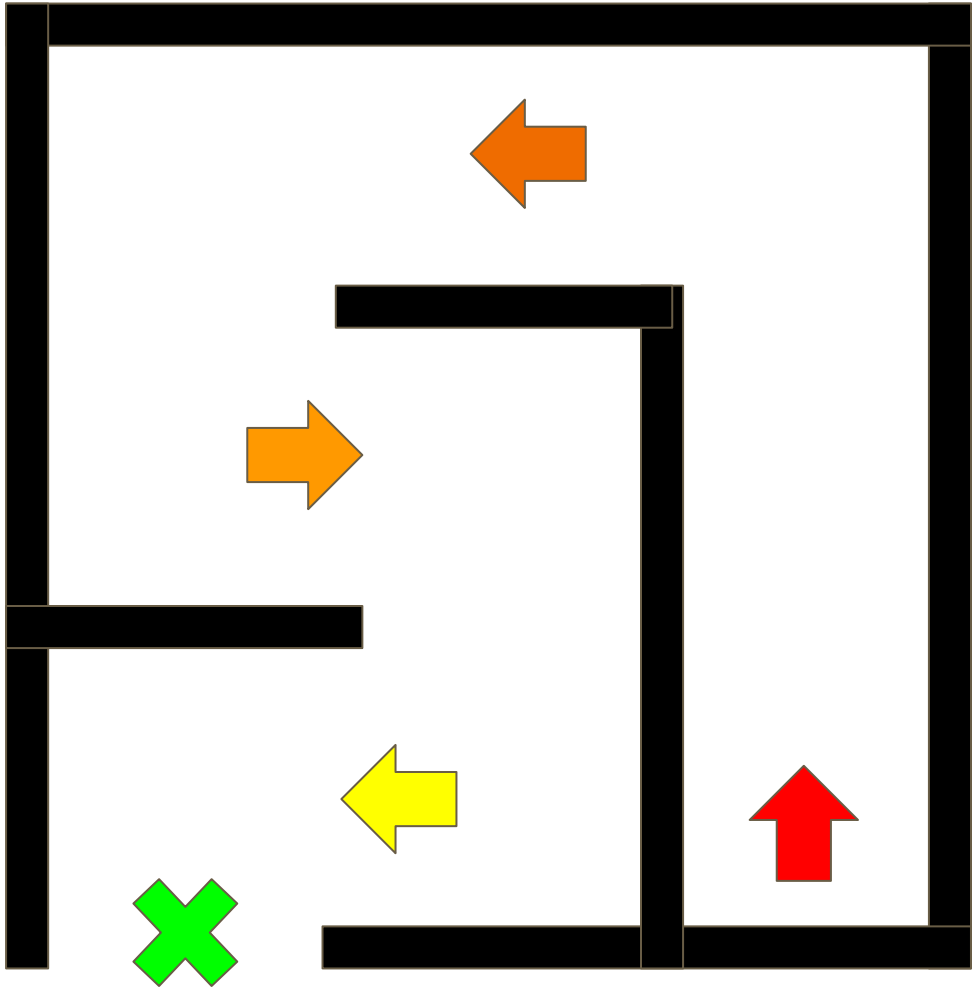
The robot will start at a random position directly in front of the black line. The robot must stop around the black line.



Labyrinth!

This is the Labyrinth Challenge!

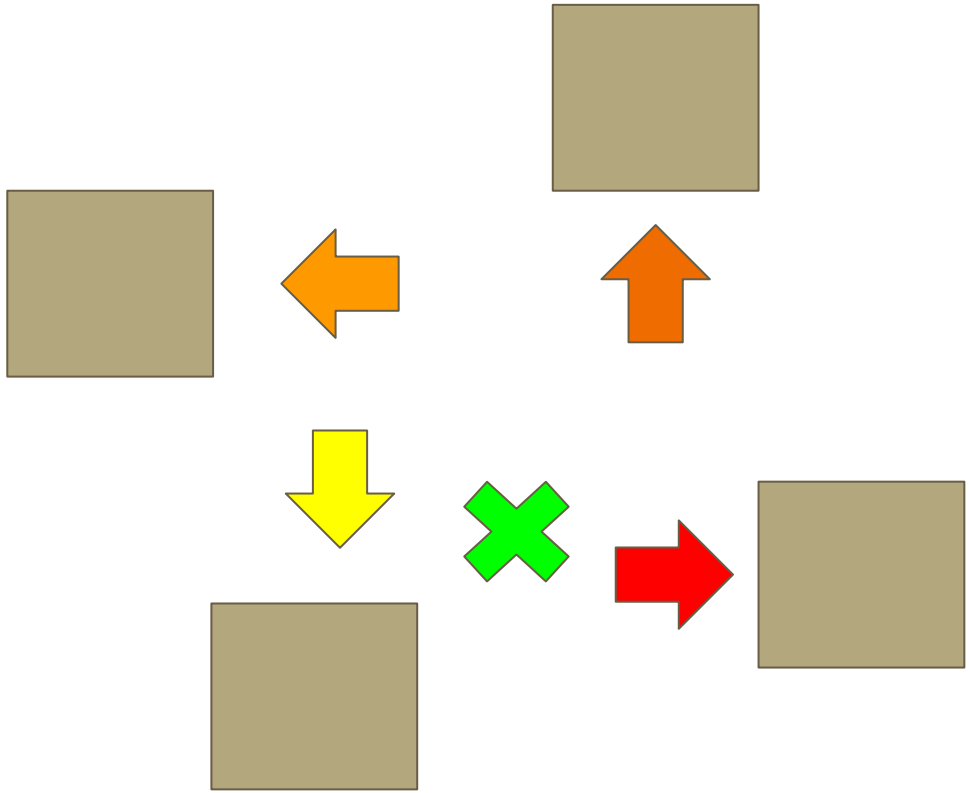
In Labyrinth challenge, your robot must navigate out of the labyrinth without touching any of the walls.



Touch Mad!

This is the Touch Mad Challenge!

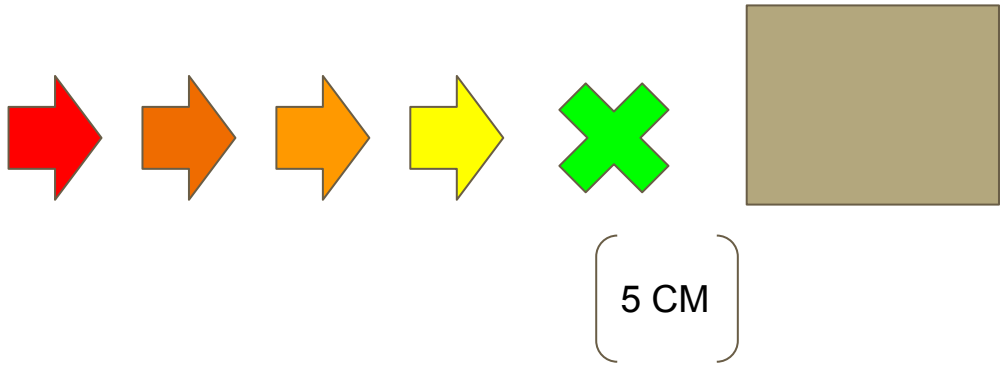
The robot must touch each of the boxes, move backwards, and turn to go to the other box.



Stop at 5!

This is the Stop at 5 Challenge!

For this challenge, your robot must stop 5 Centimeters away from the object, however, the robot will start at a random distance in front of the robot.



Follow the Line!

This is the follow the line challenge!

Your robot must follow the black line into the center.