COURSE STUDENT ZONE

This is Robots Got Talents Students Zone, here you will find all the course topics, activities and explanation guides. We hope you enjoy this course (:

Lesson One	Lesson Two
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Project 1	Project 2
Project 3	Project 4

ROBOTS GOT TALENTS™ CLASSROOM COURSES

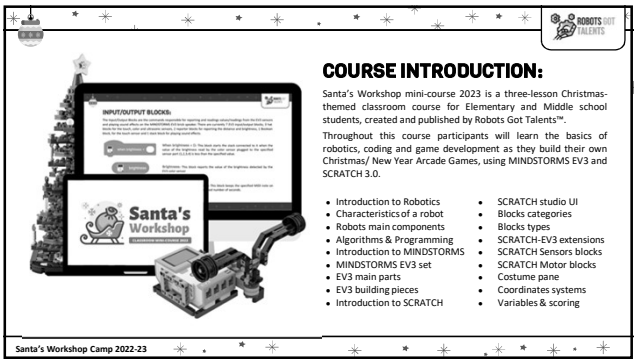
This Course is created and published by Robots Got Talents, RGT is a volunteer-based Educational Platform founded in 2017 aiming to spread Robotics and Coding Knowledge all over the world by creating and publishing online free STEM educational content for Educational institutes and Individuals. In the past years RGT curriculums were used by hundreds of schools over in 90 countries. Learn More About RGT

THIS COURSE IS AVAILABLE ON:

CLASSROOM ROBOTICS
BY ROBOTS GOT TALENTS

ROBOAPP
ACTIVATING CREATIVITY MODE

ROBOTS GOT TALENTS



COURSE INTRODUCTION:

Santa's Workshop mini-course 2023 is a three-lesson Christmas-themed classroom course for Elementary and Middle school students, created and published by Robots Got Talents™.

Throughout this course participants will learn the basics of robotics, coding and game development as they build their own Christmas/ New Year Arcade Games, using MINDSTORMS EV3 and SCRATCH 3.0.

- Introduction to Robotics
- Characteristics of a robot
- Robots main components
- Algorithms & Programming
- Introduction to MINDSTORMS
- MINDSTORMS EV3 set
- EV3 main parts
- EV3 building pieces
- Introduction to SCRATCH
- SCRATCH studio UI
- Blocks categories
- Blocks types
- SCRATCH-EV3 extensions
- SCRATCH Sensors blocks
- SCRATCH Motor blocks
- Costume pane
- Coordinates systems
- Variables & scoring

TOPICS COVERED:

- **Introduction to robotics**
- **MINDSTORMS robotics**
- **Introduction to EV3 set**
- **EV3-SCRATCH Programming**
- **SCRATCH Studio UI**
- **Blocks categories**
- **Coordinates system**
- **Project 0**
- **Building Exercise 1**

WHAT IS THE FIRST THING THAT COMES TO YOUR MIND WHEN YOU THINK OF A ROBOT ?

For many people, it is a machine that imitates human begins or has superpowers like the androids in Star Wars or the Terminator. However most of these robots which capture our imagination, only inhabit Science Fiction Movies, and it is impossible to find them wandering in the streets anytime soon, although many organizations from all over the world are working on creating similar humanoid robots like Honda's Asimo, Pepper by Softbank, and Atlas by Boston Dynamics, but, of course, no one has reached the level of Awesomeness we see in SCI-FI Movies or read about in novels, yet. The types of robots that you will encounter most frequently are robots that are developed for doing tasks that are too dangerous, boring, onerous, or repetitive. Let's take for example the robots that work in factories (Industrial Robots), some of these robots were designed for lifting heavy objects, while others were developed for doing operations that need a very high accuracy level, in that case, although these two robots work in the same application/use, each one comes up with a certain design, shape and size. It is very important to understand that robots have unlimited applications and uses, from Space Exploration to Entertainment.

A ROBOT HAS THESE ESSENTIAL CHARACTERISTICS:

You might now be asking what is the standard definition for a robot? or how could I define the word robot? Although we have been dealing with robots for decades, there is no standard definition for the word robot. However, there are some essential characteristics that a robot must-have, which would help you decide whether a certain machine is a robot or not and It will also help you decide what features or parts does a machine needs to be counted as a robot.

Sensing: A robot must be able to sense its surroundings using one or many methods, this is done using electronic devices names sensors

Movement: A robot must be able to move in its environment, either moving all its parts or moving any of them, of course mechanical movements could be done using different types of motors.

Power/ Energy: A robot must also be able to power itself, which could be done using a new power source, wired or wireless power source

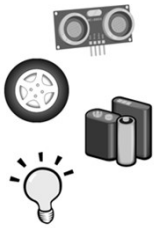
Intelligence: A robot must be able to take decisions and do tasks correctly according to its code/program, this is done using the Microcontroller, which is considered the brain of the robot.

SENSING: First of all a robot should be able to sense its surroundings It would do this in ways that are not similar to the way that we sense our surroundings, but robots need sensors to do that. Giving your robot sensors as light sensors (eyes), touch and pressure sensors (hands), chemical sensors (nose), hearing and sonar sensors (ears), and taste sensors (tongue) will give your robot awareness of its environment.

MOVEMENT: Moreover a robot needs to be able to move around its environment. Whether rolling on wheels, walking on legs or propelling by thrusters or even moving a claw. To count a machine as a robot either the whole robot moves or just parts of the robot moves.

POWER: Also a robot needs to be able to power itself. It might be solar-powered, electrically-powered, or even battery-powered. The way your robot gets its energy will depend on what your robot needs to do.

INTELLIGENCE: Finally A robot needs some kind of Intelligence this is where programming enters the picture, a programmer is a person who gives the robot its 'intelligence' The robot will have to have some way to receive the program so that it understands what it is developed to do.



MAIN COMPONENTS OF A ROBOT

6V Rechargeable Battery

Power source: In order to function a robot must have power. For example human beings get their energy from food, the food is broken down and converted into energy by our cells. Most robots get their energy from electricity. Stationary robotic arms like the ones that work in car factories can be plugged in like any other appliance. Robots that move around are usually powered by batteries. Our robotic space probes and satellites are often designed to collect solar power.

Microcontroller: The Microcontroller is the main part of the robot which coordinates all motion of the mechanical system by delivering power from the power source to the motors according to the program/code, The Microcontroller also receives and uses inputs from the environment through the sensors.

ATMEGA328 Microcontroller

MAIN COMPONENTS OF A ROBOT

Ultrasonic Sensor

Sensors: A sensor is a device, module, machine, or subsystem whose purpose is to detect events or changes in its environment and send the information to the Microcontroller, giving your robot sensors as light sensors (eyes), touch, pressure and force sensors (hands), chemical sensors (nose), hearing and sonar sensors (ears), and taste sensors (tongue) will give the robot awareness of its environment.

Motors: Robot bodies consist of metal, plastic and similar materials. Inside these bodies are small motors, which mimic the action of human muscle to move parts of the robot's body. The simplest robots consist of an arm with a tool attached for a particular task. Robot vehicles need to move around on wheels or treads. Humanoid robots have arms and legs that mimic human movement. There are many types of motor each has its own use.

12V DC Motor

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Ultrasonic Sensor

SENSING

ATMEGA328 Microcontroller

INTELLIGENCE

12V DC Motor

MOVEMENT

6V Rechargeable Battery

POWER

MINDSTORMS ROBOTICS

The LEGO®MINDSTORMS® robots may not be a type of robots that will go buy the breakfast every day or take care of your grandfather, but it could teach many things that will help you in your life from computational thinking to building LEGO® models. Since the creation of the MINDSTORMS Platform in 1998, Each version of the system includes an intelligent brick: A computer that controls the system (microcontroller), a set of modular sensors and motors, and LEGO® parts from the Technic line.

History of MINDSTORMS: There have been four generations of the MINDSTORMS® platform: the original Robotics Invention System (RCX), NXT, EV3, and MINDSTORMS Robot Inventor 51515. With each platform release, the motor and sensor capabilities expanded. The latest available system, LEGO®MINDSTORMS® EV3, was released on September 1, 2013. Since MINDSTORMS NXT, LEGO usually creates two versions of each new MINDSTORMS platform, the Retail Edition and the Educational Edition. Unfortunately, the MINDSTORMS series was discontinued by LEGO in 2022.

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LEGO MINDSTORMS EV3
LEGO® MINDSTORMS® EV3 is the third-generation robotics kit in LEGO®'s MINDSTORMS® line. It is the successor to the second generation LEGO® MINDSTORMS® NXT 2.0 kit. The "EV" designation refers to the "evolution" of the MINDSTORMS® product line. "3" refers to the fact that it is the third generation of the MINDSTORMS® series. It was officially announced on January 4, 2013, and was released in stores on September 1, 2013. The education edition was released on August 1, 2013. The LEGO®MINDSTORMS® EV3 Education set consists of 1X Smart Brick, 2X Large Motors, 1X Medium Motor, 1X color sensor, 1X ultrasonic sensor, 2X touch sensor, 1X Gyro Sensor and 540+ LEGO® technic pieces.
The LEGO®MINDSTORMS® EV3 has the 4 main characteristics of robots mentioned before, so you can guess that motors are responsible for movement, sensors are responsible for sensing, batteries are responsible for power and the Smart Brick is responsible for Intelligence.
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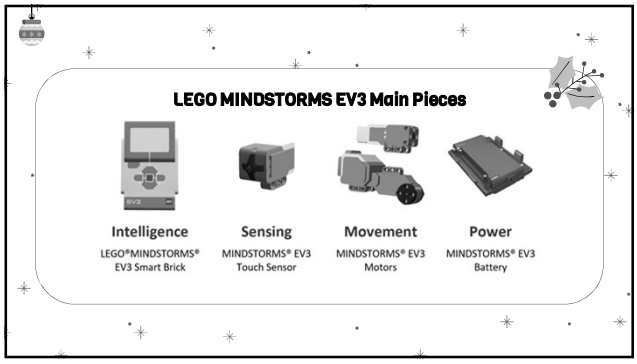
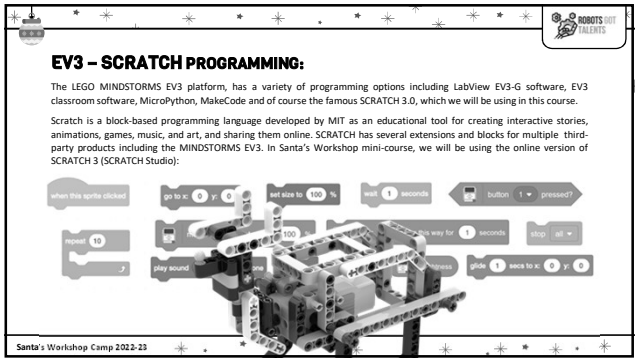

LEGO MINDSTORMS EV3 Main Pieces
Intelligence
LEGO®MINDSTORMS® EV3 Smart Brick
Sensing
MINDSTORMS® EV3 Touch Sensor
Movement
MINDSTORMS® EV3 Motors
Power
MINDSTORMS® EV3 Battery


EV3 – SCRATCH PROGRAMMING:
The LEGO MINDSTORMS EV3 platform, has a variety of programming options including LabView EV3-G software, EV3 classroom software, MicroPython, MakeCode and of course the famous SCRATCH 3.0, which we will be using in this course.
Scratch is a block-based programming language developed by MIT as an educational tool for creating interactive stories, animations, games, music, and art, and sharing them online. SCRATCH has several extensions and blocks for multiple third-party products including the MINDSTORMS EV3. In Santa's Workshop mini-course, we will be using the online version of SCRATCH 3 (SCRATCH Studio):
when this sprite clicked
go to x: 0 y: 0
set size to 100 %
wait 1 seconds
button 1 pressed?
repeat 10
play sound
glide 1 secs to x: 0 y: 0
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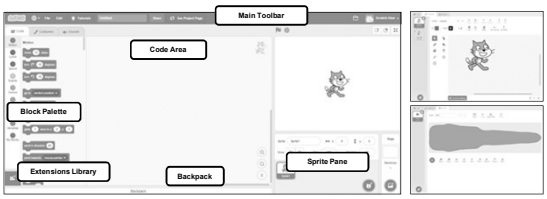
SCRATCH STUDIO UI:

Scratch Studio has a very simple user interface, which includes awesome features and capabilities. Scratch UI is made up of three main panes: the Code pane, the Sounds pane and the Costumes and Backdrop Pane, the following components covered below are available in the code pane screen:



Scratch UI Components:

Main Toolbar: This is where you can find important project controls, like language, File, Edit, Tutorials, Project name in the image below, Share, Save, Revert, and New, User name, and open project folder are located.

Block Palette/Code Pane: The area which includes all the Scratch Block, which are divided into 9 groups/ Categories; Motion, Looks, Sound, Events, Control, Sensing, Operators, Data, My Blocks in addition to the extensions. To use any drop just drag it from its group then drop it in the Code Area, You can either click press on any of the Category buttons or use the Scroll Bar, to find a block.

Extensions Library: To open the Extensions Library, press the blue button in the bottom of the Blocks Palette. There you can find 3rd party extensions, which add blocks to your blocks palette giving your projects extra features, the Extensions Library Includes Blocks for LEGO MINDSTORMS EV3, LEGO Education WeDo 2.0, LEGO Boost, Micro:bit and much more.

Code Area: This is the large empty area to the right of the Block Palette, where you drop the selected blocks from the Block Palette to form codes/scripts.

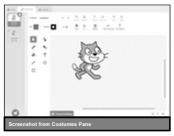
Backpack: This is an area where you save objects that you can use later in other projects. The objects can be costumes, sprites, backdrops, sounds, blocks, and codes. You can drag and drop these objects into the backpack and later drag and drop them from the backpack to reuse in other Scratch projects.

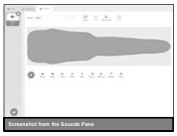
Scratch UI Components:

Sprite Pane: This is the information panel located to the right of the Scripts Area and in the bottom of the stage there you will find a thumbnail for each sprite in your project. When selected, the thumbnail will appear highlighted and its details will show in the Sprite Header located above the list of sprites.

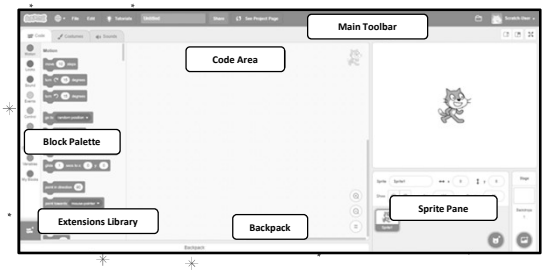
Sounds Pane: The last tab in the top left area of the interface enables you to create, upload and manipulate sounds.

Costumes/Backdrop Pane: The costume and backdrop panes can be accessed by clicking the middle tab in between the "code" tab and the "sounds" tab. This is where we can create and manipulate sprites and backdrops. To switch between costume and backdrop panes, select the desired thumbnail in the sprite info pane.





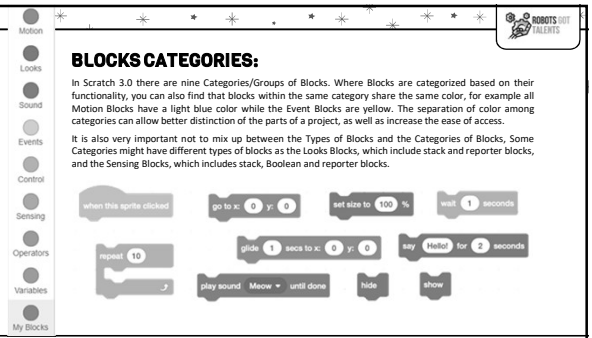
SCRATCH Studio Code Pane



BLOCKS CATEGORIES:

In Scratch 3.0 there are nine Categories/Groups of Blocks. Where Blocks are categorized based on their functionality, you can also find that blocks within the same category share the same color, for example all Motion Blocks have a light blue color while the Event Blocks are yellow. The separation of color among categories can allow better distinction of the parts of a project, as well as increase the ease of access.

It is also very important not to mix up between the Types of Blocks and the Categories of Blocks, Some Categories might have different types of blocks as the Looks Blocks, which include stack and reporter blocks, and the Sensing Blocks, which includes stack, Boolean and reporter blocks.



BLOCKS CATEGORIES:

Motion

Motion blocks deal with the movement of sprites. They relate mainly to the x and y position and direction of the sprite, as almost all the blocks correspond to them. The Stage does not contain any Motion blocks since it is a still object. There are currently 18 Motion blocks: 15 stack blocks and 3 reporter blocks.

Events

Events blocks are related to various triggers in a project, or when one part signals another to run. The Events blocks used to be part of the Control category prior to Scratch 2.0. The "Events" category consists mostly of hat blocks, as there are currently 6 Hat blocks and just 2 Stack blocks.

Looks

Looks blocks are related to the appearance of sprites and the stage. Some of the functionalities are changing costumes and applying graphic effects. There are currently 20 Looks Blocks: 17 Stack blocks and 3 Reporter blocks. 14 are for sprites, and 4 are for the Stage.

Sound

Sound blocks are related to playing various sounds, whether they be MIDI notes or saved sounds. There are currently 9 Sound blocks: 8 Stack blocks and 1 Reporter block.

Control

Control blocks run the basic flow of a project in the desired fashion, whether it be organized or unexpected. They provide functions for looping various blocks and scripts. They "control" the project and enhance its running. There are currently 11 Control blocks: 1 Hat block, 5 C blocks, 3 Stack blocks and 2 Cap blocks. Some types of blocks are only available in the control blocks as you read there are some types of Blocks are only available in the Control Blocks as the C Blocks and the Cap Blocks.

Sensing

Sensing blocks associate with sprites and the stage detecting conditions. For example, sensing blocks can be used to detect when one sprite touches another. They consist of many Booleans and can work with Control blocks to stabilize a project' a flow. There are currently 18 Sensing blocks: 3 stack blocks, 5 Boolean blocks and 10 reporter blocks.

Operators

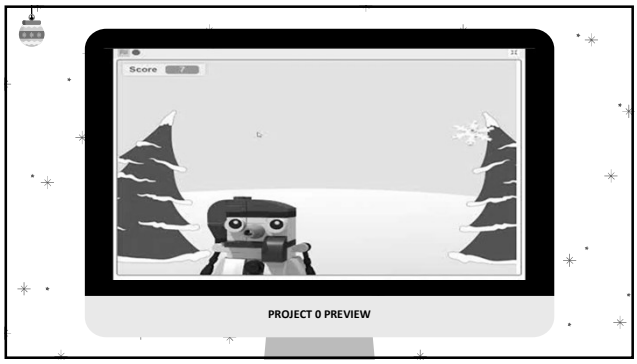
Operator's blocks deal with many mathematical functions within a project and provide the capabilities of simple to complex mathematical operations. "Operators" also contains blocks for modifying strings and implementing them into various uses. There are some Boolean blocks, too, in which some are related to mathematical outputs, while others are used for adjoining other Booleans into one or a different output condition. There are currently 18 Operators blocks: 7 Boolean blocks and 11 Reporter blocks.

Variables

Data blocks include two subcategories, Variables and Lists, but both are related to storing and accessing data. Prior to Scratch 2.0, this category was called "Variables". Data blocks are used for storing information, such as a score in a project, and using it in scripting and other beneficial purposes. There are currently 17 Variables blocks: 11 Stack blocks, 5 Reporter blocks, and 1 Boolean block. There are 5 variable blocks and 12 list blocks.

My Blocks

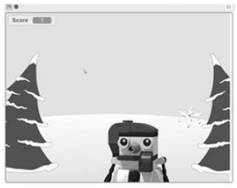
My blocks are blocks that hold custom procedures for a selected sprite. The blocks are useful for running a script without screen refresh and organization of the scripts. Clicking Make a Block brings up a dialogue allowing the user to make a procedure. Once OK is pressed, the new block appears in the palette and an empty definition appears in the code area. When the procedure runs, Scratch will run the blocks below the corresponding Define block.



PROJECT 0 PREVIEW

How Does it work?

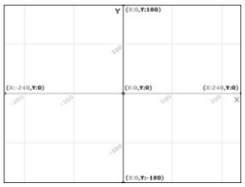
- When the right arrow is pressed the snowman moves to the right
- When the left arrow is pressed the snowman moves to the left
- Snow falls from random areas in the sky
- If the snowman catches a snowball, he turns happy, and the score increases by 1
- If the snowman did not catch the snowball it falls to the ground and disappears



Download game files

COORDINATES SYSTEM (X & Y)

Scratch determines where to display sprites through a coordinate system, or a mathematical grid of infinite values. It uses the Cartesian coordinate system in which on a two-dimensional plane, a point has two values to locate or reference its exact position.



- The "x" number is the horizontal position, with positive numbers being "to the right of the middle" and negative numbers being "to the left of the middle".
- The "y" number is the vertical position, with negative numbers being "below the middle" and positive numbers being "above the middle".

The screen is a 480x360 rectangle with the origin in the center, such that the X position can range from 240 to -240, and the Y position can range from 180 to -180.

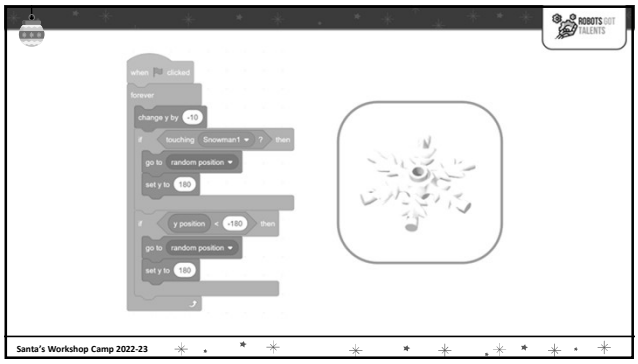
STEP (1) – Programming the snowball

- The ball should appear at any random place on the sky
- Get coordinates (y-axis) for the top position (sky) which the snowball should fall from
- The snow should fall from this position till it reaches the snowman's hand or the floor, so you would need to get coordinates for the floor as well
- If the snowman did /did not catch the snowball, it should reappear at any random position in the sky

STEP (2) – Programming the snowman

- When the game starts snowman is in the center of the screen and the score variable is equal to zero
- When the right keyboard arrow is pressed snowman moves right (x-axis)
- When the left keyboard arrow is pressed snowman moves left (x-axis)
- If the snowball touches snowman's it turns happy (change costume) and it score increases by 1 (score is made using variables)

BUILDING PROJECT 0


when clicked
forever
change y by -10
if touching Snowman1 ? then
go to random position
set y to 180
if y position < -180 then
go to random position
set y to 180
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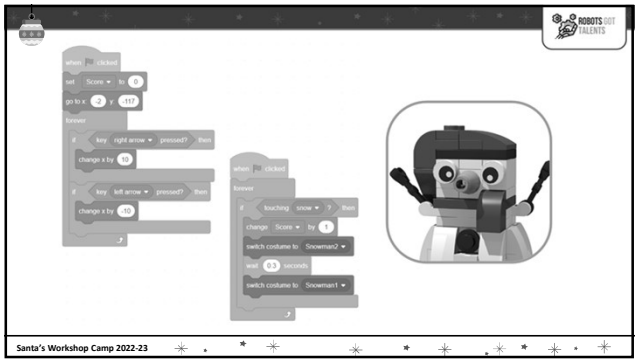
when clicked
set Score to 0
go to x: -2 y: -117
forever
if key right arrow pressed? then
change x by 10
if key left arrow pressed? then
change x by -10
when clicked
forever
if touching snow ? then
change Score by 1
switch costume to Snowman2
wait 0.5 seconds
switch costume to Snowman1
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Santa's
Workshop
CLASSROOM MINI-COURSE 2023
Download Instructions
LEGO EV3: brightness
SNOW (
PROJECT 1 - BUILDING EXERCISE

TOPICS COVERED:

- Algorithms & Programming
- EV3 main parts
- Blocks types
- EV3-SCRATCH extension
- Input/Output blocks
- Costume pane
- Project 1
- Building Exercise 2
- Project 2

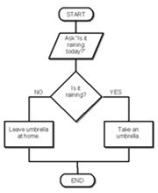
ALGORITHMS:

Of course, a robot won't be a robot without a program or in other words code and that's what would give your robot the forth robotic characteristic Intelligence, and that is what will be discussed now but we should know what is meant by an Algorithm. The word "algorithm" may not seem relevant to you, but the truth is that algorithms are all around us, governing everything from the technology they use to the worldly decisions they make every day. Algorithms are fascinating and, although some are quite complex, the concept itself is actually quite simple. An algorithm is a detailed step-by-step instruction set or formula for solving a problem or completing a task.

Algorithms are not just related to Programming or Computer Science they are everywhere. A recipe for making food is an algorithm, the method you use to solve addition or long division problems is an algorithm, the process of folding a shirt. Even your morning routine could be considered an algorithm.

PRESENTING ALGORITHMS

FLOWCHART



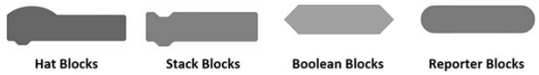
PSEUDOCODE

```
1. PRINT "Please enter the length of the side in cm "
2. INPUT Side
3. Area = Side * Side
4. PRINT Area " cm²"
```

```
1. PRINT "Please enter the length of the side in cm "
2. INPUT Side
3. Area = Side * Side
4. PRINT Area " cm²"
```

PROGRAMMING BLOCKS:

Blocks are puzzle-piece shapes that are used to create a code in Scratch. The blocks connected to each other vertically similar to a jigsaw puzzle, where each data type (hat, stack, reporter or Boolean) had its own shape and a specially shaped slot for it to be inserted into, which prevented syntax errors. Series of connected blocks were called scripts. There are 4 main types of blocks:



Hat Blocks | Stack Blocks | Boolean Blocks | Reporter Blocks

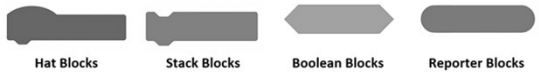
Types of blocks

Hat Block: A block that starts a code when a specific event occurs. All hat blocks are either Control blocks, Events blocks, or Blocks from the Extensions.

Stack Block: A block that is shaped to fit above and below other blocks. Stack blocks make up the majority of the blocks available in Scratch, being available in every group except Operators.

PROGRAMMING BLOCKS:

Blocks are puzzle-piece shapes that are used to create a code in Scratch. The blocks connected to each other vertically similar to a jigsaw puzzle, where each data type (hat, stack, reporter or Boolean) had its own shape and a specially shaped slot for it to be inserted into, which prevented syntax errors. Series of connected blocks were called scripts. There are 4 main types of blocks:



Hat Blocks | Stack Blocks | Boolean Blocks | Reporter Blocks

Types of blocks

Reporter Block: A block that reports a value to the device. Values could be anything from strings and numbers to sensors readings.

Boolean Block: A block that reports Boolean values. When the block is used, it acts as a reporter block, reporting "true" or "false" string values or the numbers "1" and "0".

THE EV3 BRICK

The main component in the set is a brick-shaped microcontroller called the EV3 Smart Brick. It can read inputs from up to four sensors and control up to four motors. Motors (Outputs) are plugged in letters (A, B, C, D) and sensors (Inputs) are plugged in numbers (1,2,3,4) via a modified version of RJ12 cables. Moreover, the brick features an illuminated six-button interface that changes color to indicate the brick's active state, a high-resolution black and white display, built-in speaker, USB port, a mini SD card reader. The EV3 brick also supports Bluetooth and Wi-Fi communication with other devices and has a programming interface that enables programming and data logging directly from the brick.

Bottom View | Top View | Side Views

Brick Status Light:

The Brick Status Light that surrounds the Brick Buttons represent the current status of the EV3 Brick, here are some of the Brick Status Light Codes:

Red: Startup, Update, Shutdown

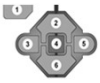
Red pulsing: Busy

Orange: Alert, Ready

Orange pulsing: Alert, Running

Green: Ready

Green pulsing: Program Running

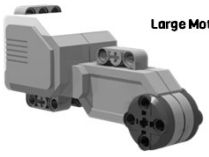


(1) Back: this is used to navigate backwards or exit a running program or shut down the device.
(2) Up: Used to navigate through the menu options.
(3) Left: Used to navigate through the menu options.
(4) Center: it's the 'OK' button and is used to select the currently highlighted option.
(5) Right: Used to navigate through the menu options.
(6) Down: Used to navigate through the menu options.

EV3 MOTORS

The MINDSTORMS® EV3 set includes two large motors and a medium motor, but you can add an additional motor in the empty port as the brick has four output ports (A, B, C, D). A motor is an electrical machine that converts electrical energy distributed by the battery in the Brick into mechanical energy, also the MINDSTORMS Motor includes an encoder, which determines the degrees turned by the motor, and that is the main reason we cannot refer to the EV3 motors as Outputs, as they do also send an input to the Brick.

Large Motor



Medium Motor

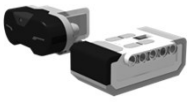
MINDSTORMS EV3 SENSORS

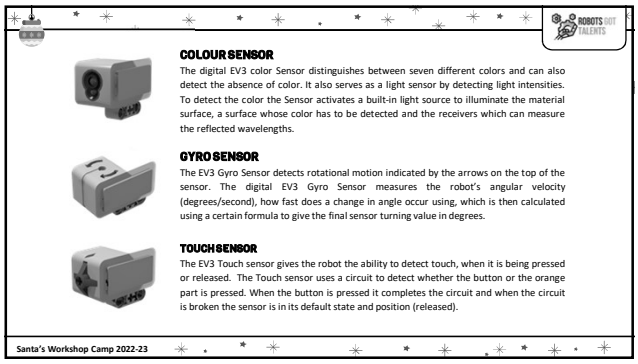
ULTRASONIC SENSOR

The EV3 Ultrasonic Sensor measures distance in centimetres and inches. It is able to measure distances from 0 to 255 centimetres with a precision of +/- 1 cm. The Ultrasonic Sensor generates sound waves and reads their echoes to detect and measure the distance from objects.

IR REMOTE & BEACON

The digital EV3 Infrared Seeking Sensor detects proximity to the robot and reads signals emitted by the EV3 Infrared Beacon. Proximity measurement of approximately 50-70 cm, Working distance from the beacon of up to two meters. Note: The IR Remote and Beacon are only available in the EV3 Home Edition set.





COLOUR SENSOR

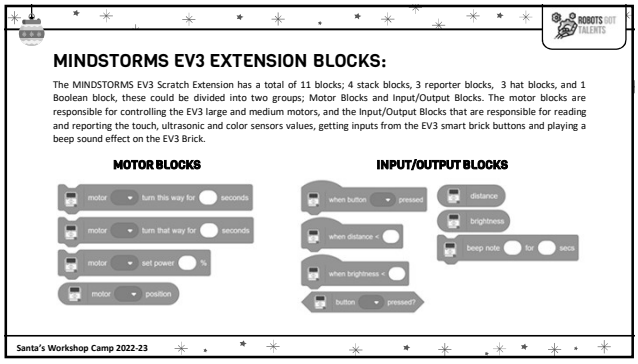
The digital EV3 color Sensor distinguishes between seven different colors and can also detect the absence of color. It also serves as a light sensor by detecting light intensities. To detect the color the Sensor activates a built-in light source to illuminate the material surface, a surface whose color has to be detected and the receivers which can measure the reflected wavelengths.

GYRO SENSOR

The EV3 Gyro Sensor detects rotational motion indicated by the arrows on the top of the sensor. The digital EV3 Gyro Sensor measures the robot's angular velocity (degrees/second), how fast does a change in angle occur using, which is then calculated using a certain formula to give the final sensor turning value in degrees.

TOUCH SENSOR

The EV3 Touch sensor gives the robot the ability to detect touch, when it is being pressed or released. The Touch sensor uses a circuit to detect whether the button or the orange part is pressed. When the button is pressed it completes the circuit and when the circuit is broken the sensor is in its default state and position (released).

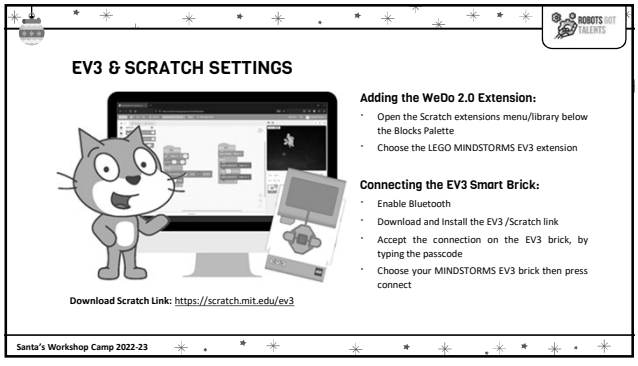


MINDSTORMS EV3 EXTENSION BLOCKS:

The MINDSTORMS EV3 Scratch Extension has a total of 11 blocks; 4 stack blocks, 3 reporter blocks, 3 hat blocks, and 1 Boolean block, these could be divided into two groups; Motor Blocks and Input/Output Blocks. The motor blocks are responsible for controlling the EV3 large and medium motors, and the Input/Output Blocks that are responsible for reading and reporting the touch, ultrasonic and color sensors values, getting inputs from the EV3 smart brick buttons and playing a beep sound effect on the EV3 Brick.

MOTOR BLOCKS

INPUT/OUTPUT BLOCKS



EV3 & SCRATCH SETTINGS

Download Scratch Link: https://scratch.mit.edu/ev3

Adding the WeDo 2.0 Extension:

- Open the Scratch extensions menu/library below the Blocks Palette
- Choose the LEGO MINDSTORMS EV3 extension

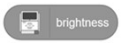
Connecting the EV3 Smart Brick:

- Enable Bluetooth
- Download and Install the EV3 /Scratch link
- Accept the connection on the EV3 brick, by typing the passcode
- Choose your MINDSTORMS EV3 brick then press connect

INPUT/OUTPUT BLOCKS:

The Input/Output Blocks are the commands responsible for reporting and readings values/readings from the EV3 sensors and playing sound effects on the MINDSTORMS EV3 brick speaker. There are currently 7 EV3 input/output blocks; 3 hat blocks for the touch, color and ultrasonic sensors, 2 reporter blocks for reporting the distance and brightness, 1 Boolean block, for the touch sensor and 1 stack block for playing sound effects.

When brightness < (): This block starts the stack connected to it when the value of the brightness read by the color sensor plugged to the specified sensor port (1,2,3,4) is less than the specified value.



Brightness: This block reports the value of the brightness detected by the EV3 color sensor

Beep Note () For () Secs: This block beeps the specified MIDI note on the EV3 brick for the specified number of seconds.

PROJECT 1 PREVIEW

How Does it work?

- The snowball starts at the center of the screen
- The snowball moves from the right corner to the left corner until the color sensor is covered
- When the color sensor detects a black color (being pressed) the snowball moves towards the snowman
- If the snowball touches the snowman, he turns happy, and say SNOW (:

Download game files

STEP (1) – Programming the snowball

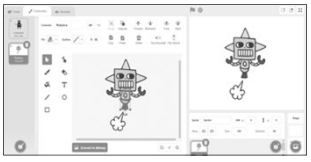
- The snowball starts far from the snowman (lower value on the y-axis)
- The snowball should move from the two corner on screen (same y-axis coordinates, change in x-axis)
- When the color sensor detects a dark color (being covered) the snowball should move towards to snowman (increase in y-axis)
- The snowball should return to sliding from the corners after successfully hitting the snowman or failing to hit it.

STEP (2) – Programming the snowman

- The snowman should be far from the snowball
- If the snowball touches snowman's it turns happy (change costume) and it say "SNOW (:"

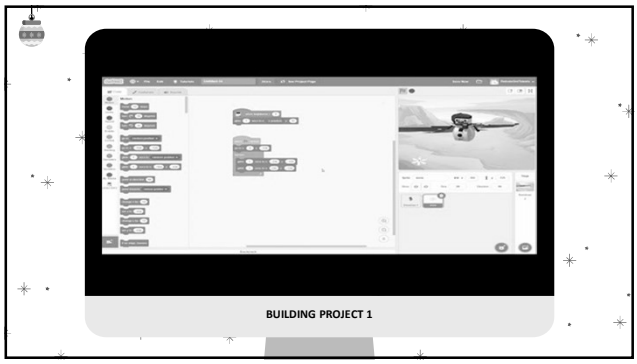
COSTUME PANE

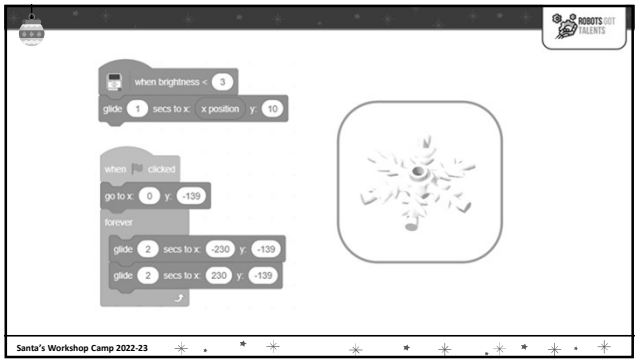
The Costume Pane which includes the Paint Editor is an easy-to-use built-in Image Editor available in SCRATCH Studio, where you can edit or even create your own sprites and backdrops. This is one of the main features which makes Scratch different from many other programming tools.



Editing Sprites

The costumes are placed vertically in right side of the costume pane. The layout consists of the thumbnails of each costume along with a few properties. Underneath the costume thumbnail is the costume name and resolution. In the top-left of the thumbnail is a small digit representing the costume's value. By selecting any costume, it will appear on the Paint Editor, so you can edit anything if needed.


BUILDING PROJECT 1


when brightness < 3
glide 1 secs to x: x position y: 10
when clicked
go to x: 0 y: -139
forever
glide 2 secs to x: -230 y: -139
glide 2 secs to x: 230 y: -139
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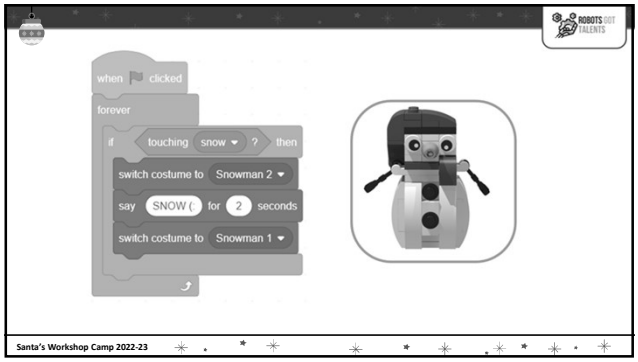
when clicked
forever
if touching snow ? then
switch costume to Snowman 2
say SNOW (for 2 seconds
switch costume to Snowman 1
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INPUT/OUTPUT BLOCKS:

The Input/Output Blocks are the commands responsible for reporting and readings values/readings from the EV3 sensors and playing sound effects on the MINDSTORMS EV3 brick speaker. There are currently 7 EV3 input/output blocks; 3 hat blocks for the touch, color and ultrasonic sensors, 2 reporter blocks for reporting the distance and brightness, 1 Boolean block, for the touch sensor and 1 stack block for playing sound effects.

button () pressed?: This block checks whether the touch sensor plugged to the specified port is pressed or not and returns a Boolean result.

When button () pressed: This block starts the stack connected to it when the touch sensor pugged to the specified sensor port (1,2,3,4) is pressed.

When distance < (): This block starts the stack connected to it when the distance between the ultrasonic sensor plugged in the specified port (1,2,3,4) and the nearest object is less than the distance specified.

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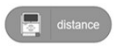
INPUT/OUTPUT BLOCKS:

The Input/Output Blocks are the commands responsible for reporting and readings values/readings from the EV3 sensors and playing sound effects on the MINDSTORMS EV3 brick speaker. There are currently 7 EV3 input/output blocks; 3 hat blocks for the touch, color and ultrasonic sensors, 2 reporter blocks for reporting the distance and brightness, 1 Boolean block, for the touch sensor and 1 stack block for playing sound effects.

button () pressed?: This block checks whether the touch sensor plugged to the specified port is pressed or not and returns a Boolean result.

When button () pressed: This block starts the stack connected to it when the touch sensor pugged to the specified sensor port (1,2,3,4) is pressed.



Distance: This block reports the (reading of the ultrasonic sensor) distance between the ultrasonic sensor and the nearest object.

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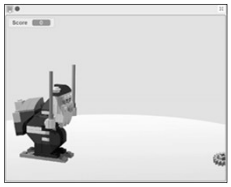
How Does it work?

- The start button is pressed to start/restart the game
- The gears should move towards Santa
- Santa should jump when the touch sensor is pressed
- If a gear touches Santa, the game stops
- Each time Santa bounces over a gear the score increase by 1



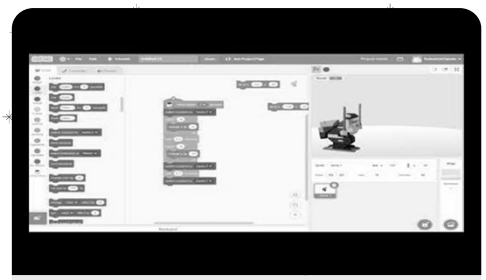
Download game files

STEP (1) – Programming Santa

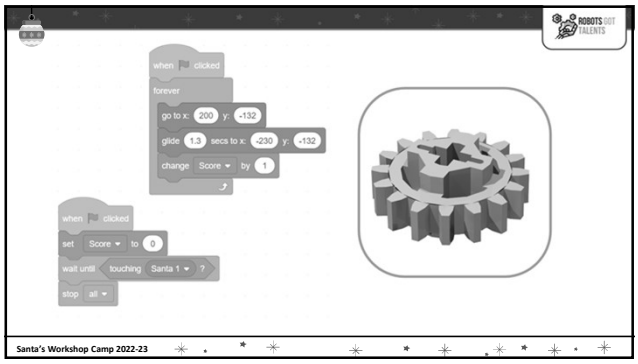
- Santa should Jump from his position when the touch sensor is pressed
- Jumping is change in y-axis
- Change the costume to add the jumping effect
- Increasing/decreasing the jump timing decrease/increase the game difficulty

STEP (2) – Programming the gear

- The gear should move towards Santa (change in x-axis)
- If the gear touches Santa the game stops
- When the gear reaches the end of the screen it appears again from the other side of the screen



BUILDING PROJECT 2



TOPICS COVERED:

- **EV3 building pieces**
- **Building Exercise 3**
- **Motor blocks**
- **Variables & Scoring**
- **Project 3**
- **Building Exercise 4**
- **Project 4**

EV3 BUILDING PIECES:

BEAMS: Beams are used to hold cross-axles and other LEGO® components together, so they are the framework of most TECHNIC and MINDSTORMS® models. There are 2 main types of beams: Straight and Angular. Straight beams are usually found only with circular holes in them while angular beams have a mixture of circular and cross-shaped holes, normally with the cross-shaped ones at either end. The straight beams come in sizes from 2 to 15M.

CONNECTOR PEGS: Connector pegs are used to hold many LEGO® TECHNIC constructions together. There are 3 types of connector pegs:

- Round Pegs
- Cross-shaped Pegs
- Half-half Pegs

The round pegs can be used to connect beams together so that they can both swing freely. The second cross-shaped peg can be used to hold two beams together so that they cannot move, and the last peg can be used to connect a free-spinning beam to a fixed beam. There are also longer versions of the round pegs that can be used to connect multiple beams together. A longer version of the cross-shaped peg is an axle. Some pegs might also be in different colors. The black and blue connectors are friction connector pegs, while the other pegs are smooth.

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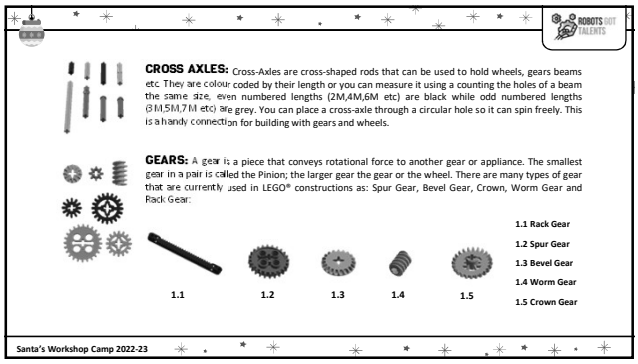
CROSS AXLES: Cross-Axles are cross-shaped rods that can be used to hold wheels, gears beams etc They are colour coded by their length or you can measure it using a counting the holes of a beam the same size, even numbered lengths (2M,4M,6M etc) are black while odd numbered lengths (3M,5M,7M etc) are grey. You can place a cross-axle through a circular hole so it can spin freely. This is a handy connection for building with gears and wheels.
GEARS: A gear is a piece that conveys rotational force to another gear or appliance. The smallest gear in a pair is called the Pinion; the larger gear the gear or the wheel. There are many types of gear that are currently used in LEGO® constructions as: Spur Gear, Bevel Gear, Crown, Worm Gear and Rack Gear:
1.1
1.2
1.3
1.4
1.5
1.1 Rack Gear
1.2 Spur Gear
1.3 Bevel Gear
1.4 Worm Gear
1.5 Crown Gear
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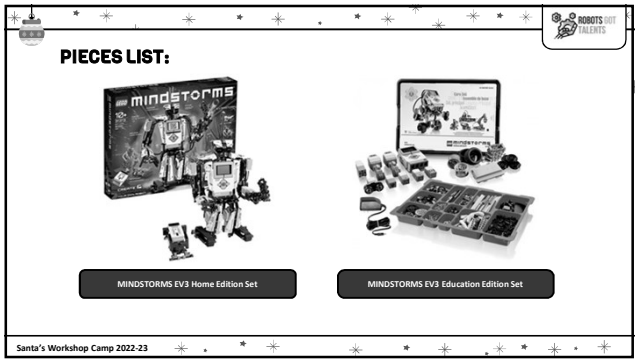
PIECES LIST:
mindstorms
MINDSTORMS EV3 Home Edition Set
MINDSTORMS EV3 Education Edition Set
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Workshop
CLASSROOM MINI-COURSE 2023
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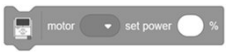
PROJECT 3 - BUILDING EXERCISE

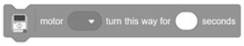
MOTOR BLOCKS:

The Motor Blocks are the commands responsible for controlling the EV3 large and medium motors power, direction and rotation, as well as reading their positions. There are currently 4 Motor blocks, 3 stack blocks, that control the power, direction and rotation of the motor/s and one reporter block, which reports the current position of the selected motor.



Motor () set power ()%: This block sets the power in percentage for the medium or large EV3 motor plugged in the specified port (A, B, C, D).

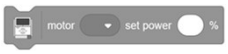
Motor () position: This block reports the current position of the medium or large EV3 motor plugged in the specified port (A, B, C, D).



Motor () turn this way for () seconds: This block turns the medium or large EV3 motor plugged in the specified port (A, B, C, D) clockwise for the inputted number of seconds.

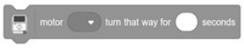
MOTOR BLOCKS:

The Motor Blocks are the commands responsible for controlling the EV3 large and medium motors power, direction and rotation, as well as reading their positions. There are currently 4 Motor blocks, 3 stack blocks, that control the power, direction and rotation of the motor/s and one reporter block, which reports the current position of the selected motor.



Motor () set power ()%: This block sets the power in percentage for the medium or large EV3 motor plugged in the specified port (A, B, C, D).

Motor () position: This block reports the current position of the medium or large EV3 motor plugged in the specified port (A, B, C, D).



Motor () turn that way for () seconds: This block turns the medium or large EV3 motor plugged in the specified port (A, B, C, D) anti clockwise for the inputted number of seconds.

VARIABLES & SCORING

The variables (data in prior versions of SCRATCH) category is related to storing and accessing data.

To add a scoring variable to your SCRATCH project you would need to create a new variable named score then, you can use it with all the variables blocks; use the set score to block to set your score to certain number, use the change score by block to increase or decrease your score, and to access your score use the score reporter block.

How Does it work?

- Santa starts at the center of the screen
- Gifts appear at random places on the screen and Santa should chase them, one gift is present at a time
- Santa moves in the direction of the EV3 motor
- When a Santa collects a gift, the score increases by 1

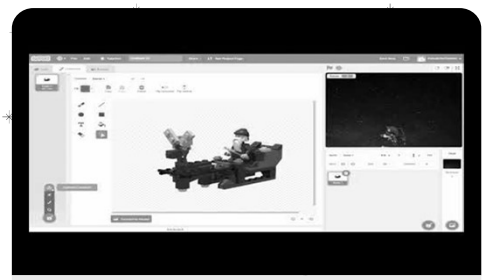
Download game files

STEP (1) – Programming Santa

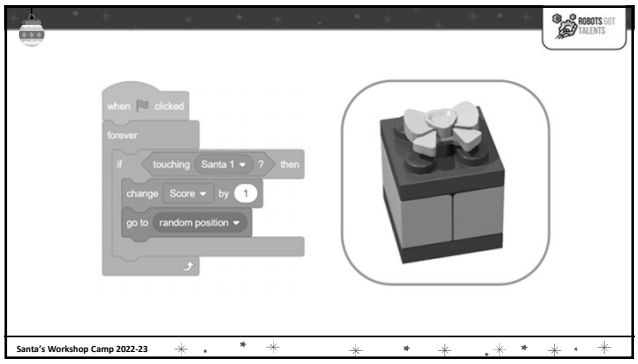
- Santa starts at the center of the screen
- Santa moves in the direction of the EV3 motor
- Change the costume to add the movement effects
- When Santa touches a gift, the score increases by one

STEP (2) – Programming Gift

- The gift appears at different areas on the screen
- When Santa touches a gift, the score increases by one



BUILDING PROJECT 3


when clicked
forever
if touching Santa 1 ? then
change Score by 1
go to random position
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Workshop
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Download Instructions
PROJECT 4 - BUILDING EXERCISE


PROJECT 4 PREVIEW

How Does it work?

- When the up arrow keyboard button the christmas deer's neck turn to the right and snowbot moves its hand up
- When the down arrow keyboard button the christmas deer's neck turn to the left for 0.2 seconds with a power of 20% and snowbot moves its hand down

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STEP (1) – Programming ChristmasBot

- When the up arrow keyboard button the christmas deer's neck (medium motor) turn to the right for 0.2 seconds with a power of 20% and snowbot moves its hand up
- When the down arrow keyboard button the christmas deer's neck (medium motor) turn to the left for 0.2 seconds with a power of 20% and snowbot moves its hand down

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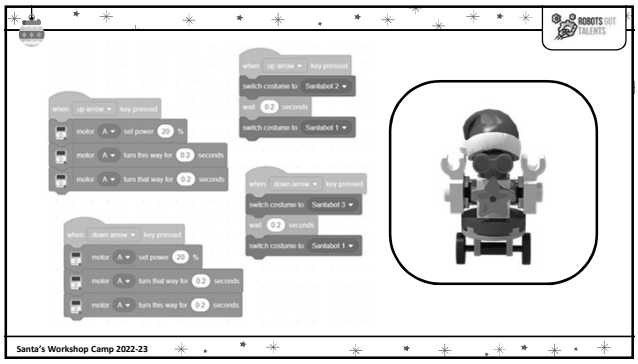
BUILDING PROJECT 4


when up arrow key pressed
switch costume to Santabot 2
wait 0.2 seconds
switch costume to Santabot 1
when up arrow key pressed
motor A set power 20 %
motor A turn this way for 0.2 seconds
motor A turn that way for 0.2 seconds
when down arrow key pressed
switch costume to Santabot 3
wait 0.2 seconds
switch costume to Santabot 1
when down arrow key pressed
motor A set power 20 %
motor A turn that way for 0.2 seconds
motor A turn this way for 0.2 seconds
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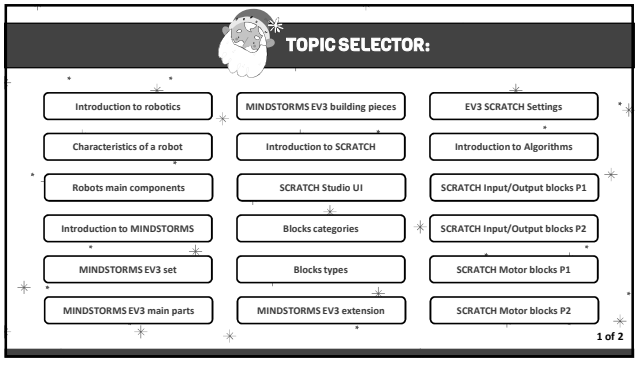
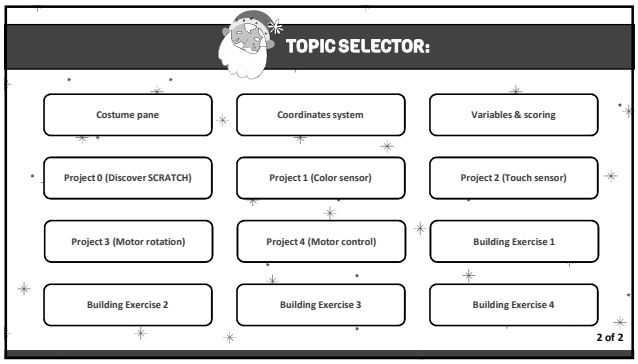
Workshop
CLASSROOM MINI-COURSE 2023


TOPIC SELECTOR:
Introduction to robotics
Characteristics of a robot
Robots main components
Introduction to MINDSTORMS
MINDSTORMS EV3 set
MINDSTORMS EV3 main parts
MINDSTORMS EV3 building pieces
Introduction to SCRATCH
SCRATCH Studio UI
Blocks categories
Blocks types
MINDSTORMS EV3 extension
EV3 SCRATCH Settings
Introduction to Algorithms
SCRATCH Input/Output blocks P1
SCRATCH Input/Output blocks P2
SCRATCH Motor blocks P1
SCRATCH Motor blocks P2
1 of 2


TOPIC SELECTOR:
Costume pane
Coordinates system
Variables & scoring
Project 0 (Discover SCRATCH)
Project 1 (Color sensor)
Project 2 (Touch sensor)
Project 3 (Motor rotation)
Project 4 (Motor control)
Building Exercise 1
Building Exercise 2
Building Exercise 3
Building Exercise 4
2 of 2