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Empowering Girls, Shaping the Future in STEAM

Topic 3. Robotics and Engineering basics

3.1 Introduction to Robotics

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Content

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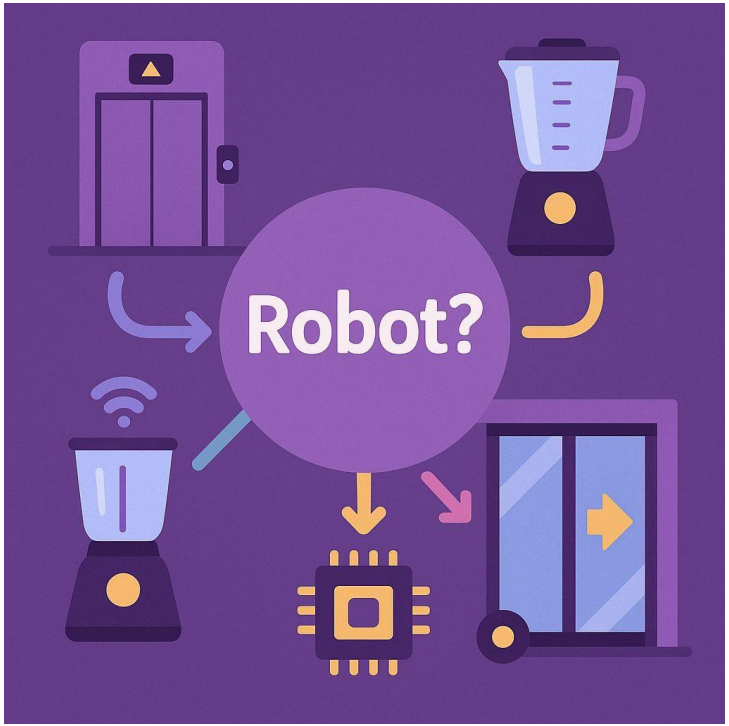
Robot or Just a Machine?

Not every machine is a robot!

A lift, a blender or an automatic door can move and react, but that does not automatically make them robots.

To decide if a device is a robot, we usually look for the main parts and characteristics.



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Robot types

Not every robot is humanoid, with arms, legs and a face!

But in reality, most robots don’t look like humans at all! They are machines built to solve specific problems.

Your robot vacuum, factory machines, farming drones, and even voice assistants are all robots.

So… if robots come in so many forms, **what kinds of robots actually exist?**

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1. Industrial Robots

Articulated robots

Mobile robots

Articulated and mobile robots

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2. Service Robots – Domestic Robots

Robots designed to assist humans in various non-industrial settings, providing services to enhance quality of life, efficiency, and convenience.

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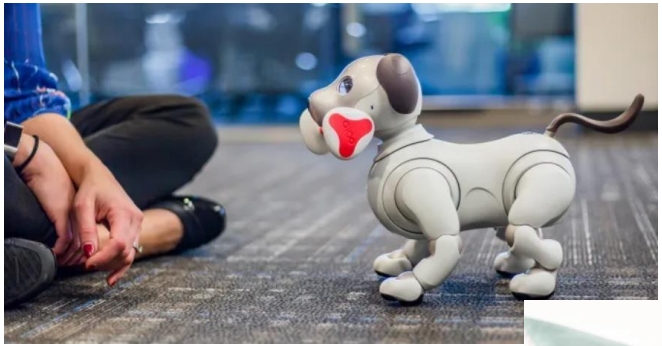
2. Service Robots – Social Robots

Robots designed to assist humans in various non-industrial settings, providing services to enhance quality of life, efficiency, and convenience.



AIBO

PARO

LOVOT

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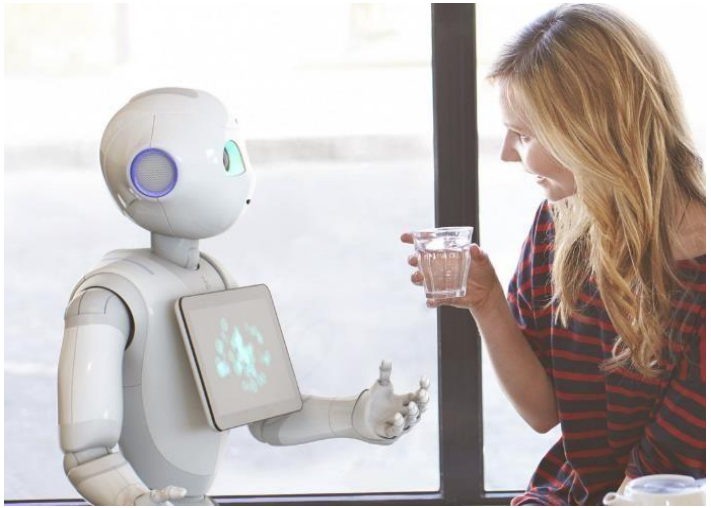
2. Service Robots – Social Robots

Robots designed to assist humans in various non-industrial settings, providing services to enhance quality of life, efficiency, and convenience.

COZMO

SaviOne
“Botlr”



PEPPER

Ohmni

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the European Union

2. Service Robots – Delivery Robots

Robots designed to assist humans in various non-industrial settings, providing services to enhance quality of life, efficiency, and convenience.

Starship

Relay

Zipline

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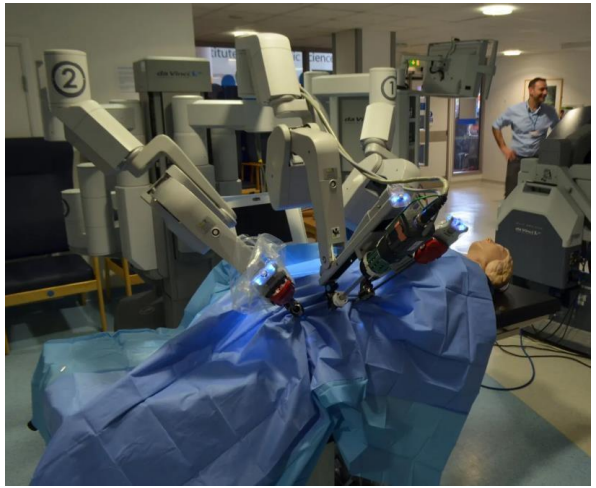
2. Service Robots – Medical robots

Enhanced precision and accuracy in surgeries, support for minimally invasive procedures leading to faster recovery, and the ability to conduct telepresence and remote surgeries, extending medical expertise to underserved areas.



da Vinci Surgical System

CyberKnife System

Xenex Robot

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2. Service Robots – Military robots

Military robotics offer advantages such as increased efficiency, reduced risks to human personnel, and enhanced capabilities, ethical concerns include issues related to autonomous weapons, accountability, and the potential for misuse.

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2. Service Robots – Search and rescue robots

Search and rescue robotics play a crucial role in enhancing the efficiency and effectiveness of emergency response efforts, reducing risks to human responders, and increasing the likelihood of locating and aiding survivors in disaster-stricken areas.

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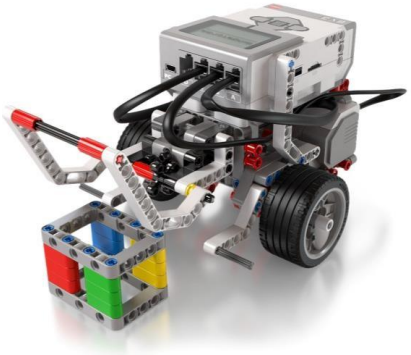
3.Educational Robots

Educational robots can serve various purposes in enhancing learning experiences. They can promote active engagement, problem-solving, and collaboration among students as active learning tools. By introducing robotics in the classroom, children can develop their critical thinking and creativity skills.



LEGO Mindstorm EV3

Replicator+

EMYS

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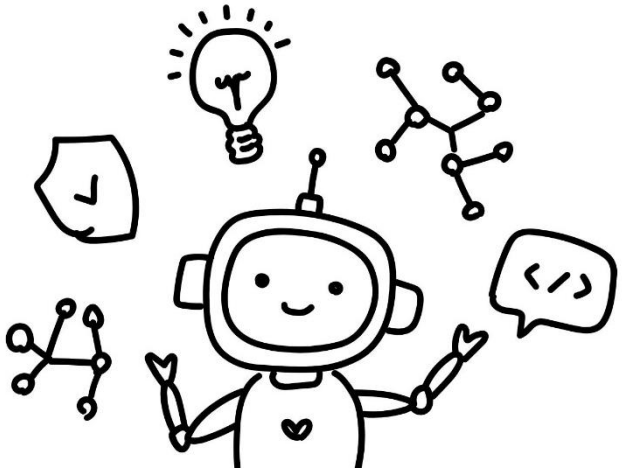
What do all these robots have in common?

Robot definition: A robot is a machine that can move in different directions and can perform tasks on its own without needing a person to control it all the time.



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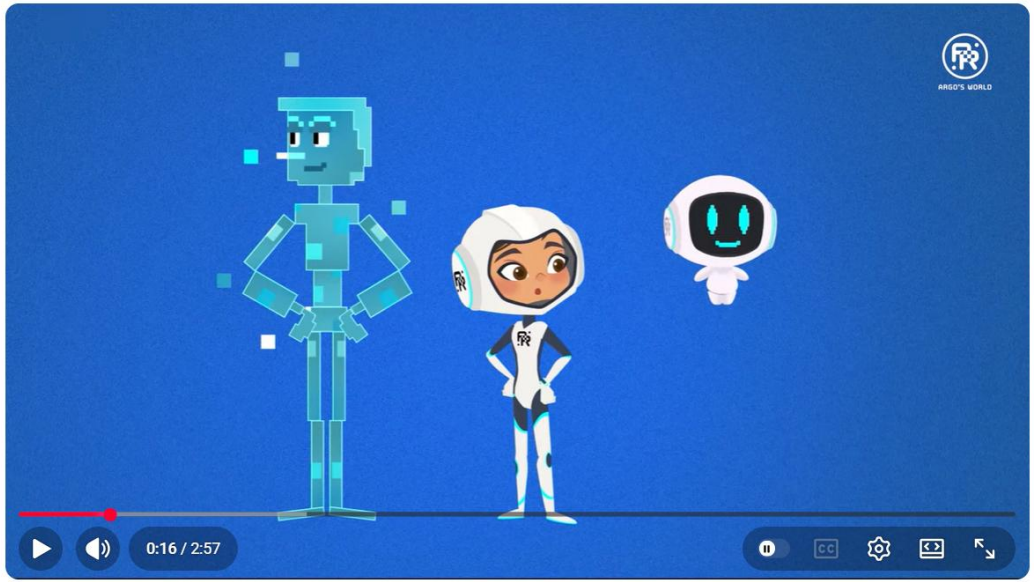
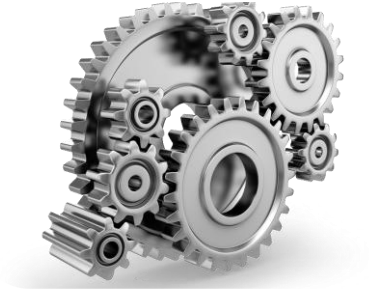
Main Parts of a Robot



https://www.youtube.com/watch?v=CrQ5atmjSqQ

Main Parts of a Robot



1. Mechanical Parts

They move the robot (e.g.wheels, brackets, motors).

They move the robot (e.g. wheels, brackets, motors)

2. Sensors

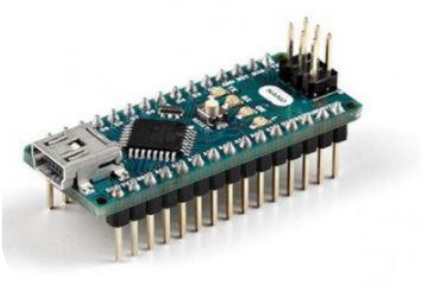
They detect the environment (e.g. obstacles)

They detect the environment (e.g. obstacles)

3. Power supply

Gives power to the robot (e.g. batteries)

Gives power to the robot (e.g. batteries)



4. Controller

The "mind" that gives orders and controls the parts

The "mind" that gives orders and controls the parts

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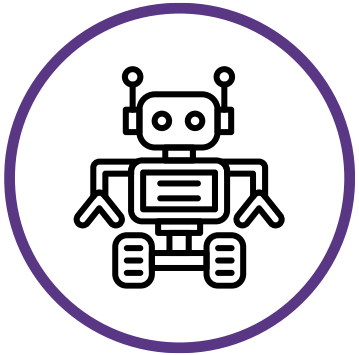
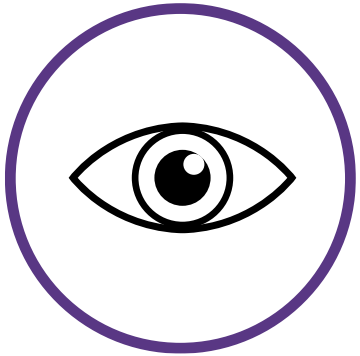
Features



ROBOTS

=



SENSING

THINKING

ACTING

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3.2 Basic programming and automation

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#Activity 1: How do robots think?

Roles:

- Students = Programmers 👩‍💻
- Educator = Robot 🤖

Mission:

Guide the robot to, reach a target, avoid obstacles, pick an object and return to start.

Evaluation:

1. Did we sense correctly?
2. Did we think correctly?
3. Did we act correctly?

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Computational thinking

Computational thinking is a way of solving problems so that a computer or robot can understand the solution.

It means:

- Breaking a big problem into smaller steps
- Organizing those steps in the correct order
- Looking for patterns
- Testing and improving the solution

💡 It is not about being “good at computers.”
It is about learning how to think clearly and logically.

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Algorithm

An algorithm is a clear set of step-by-step instructions used to complete a task.

We use algorithms every day!

Wrong example: Pack a bag - too vague

Correct example: Open the bag, check the timetable, choose the correct books and notebooks, add the pencil case and close the bag. - When the “robot” fails, you can immediately see where the algorithm was incomplete or unclear.

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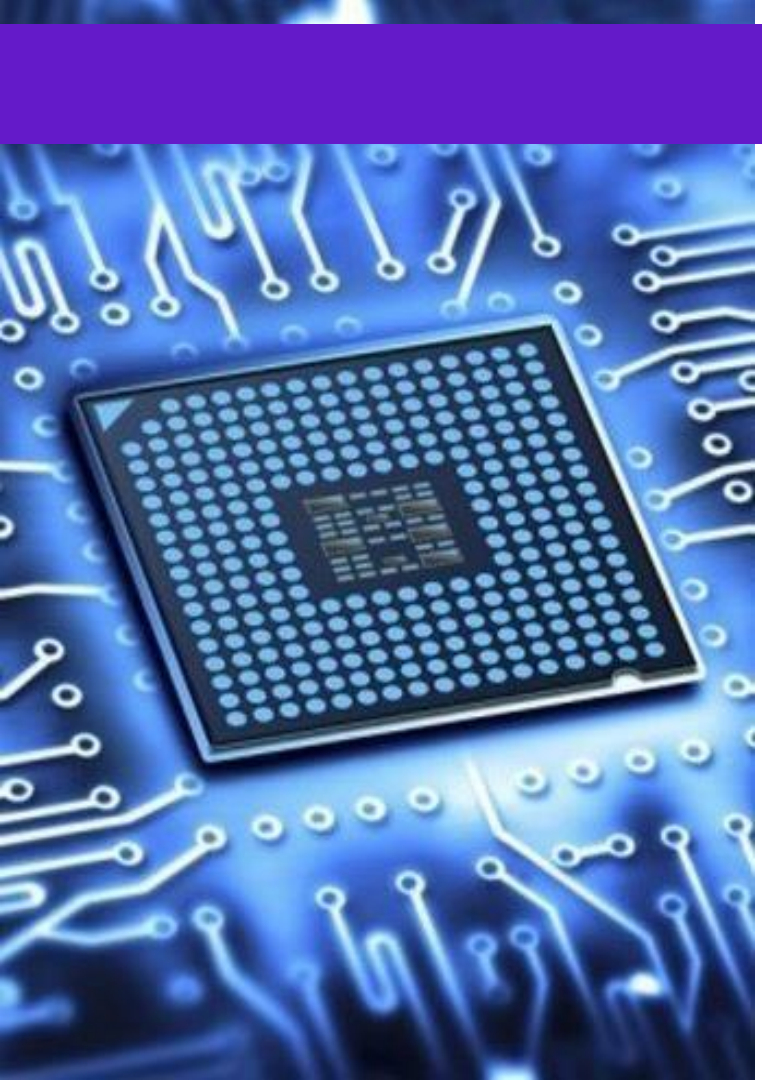
The brain of operation



A controller is a computing unit that controls the motion and actions of a robot in a programmable way.

The controller can be:

- A microcontroller (small board inside the robot)
- A specialized controller
- A computer

The controller does not “think” by itself,
it follows instructions that we give it.

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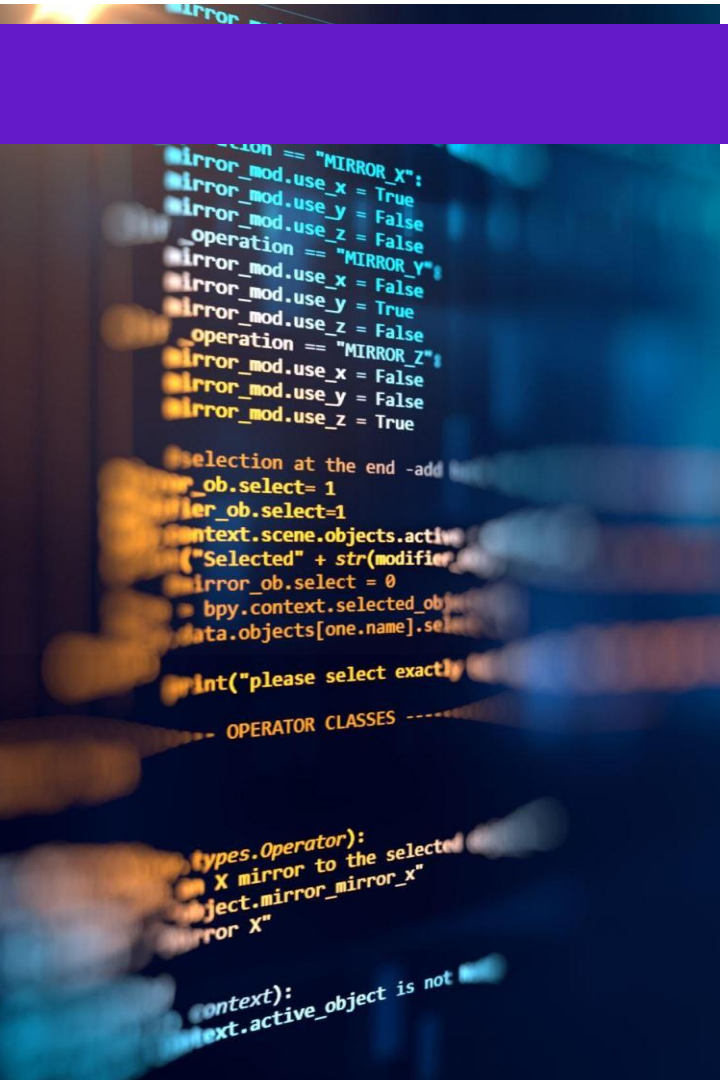
Programming robots



Languages :

- C/C++
- Python
- Java
- **Scratch**
- MatLab

Programming environments:

- Arduino IDE
- **MakeCode**
- LabVIEW
- RoboDK
- ROS

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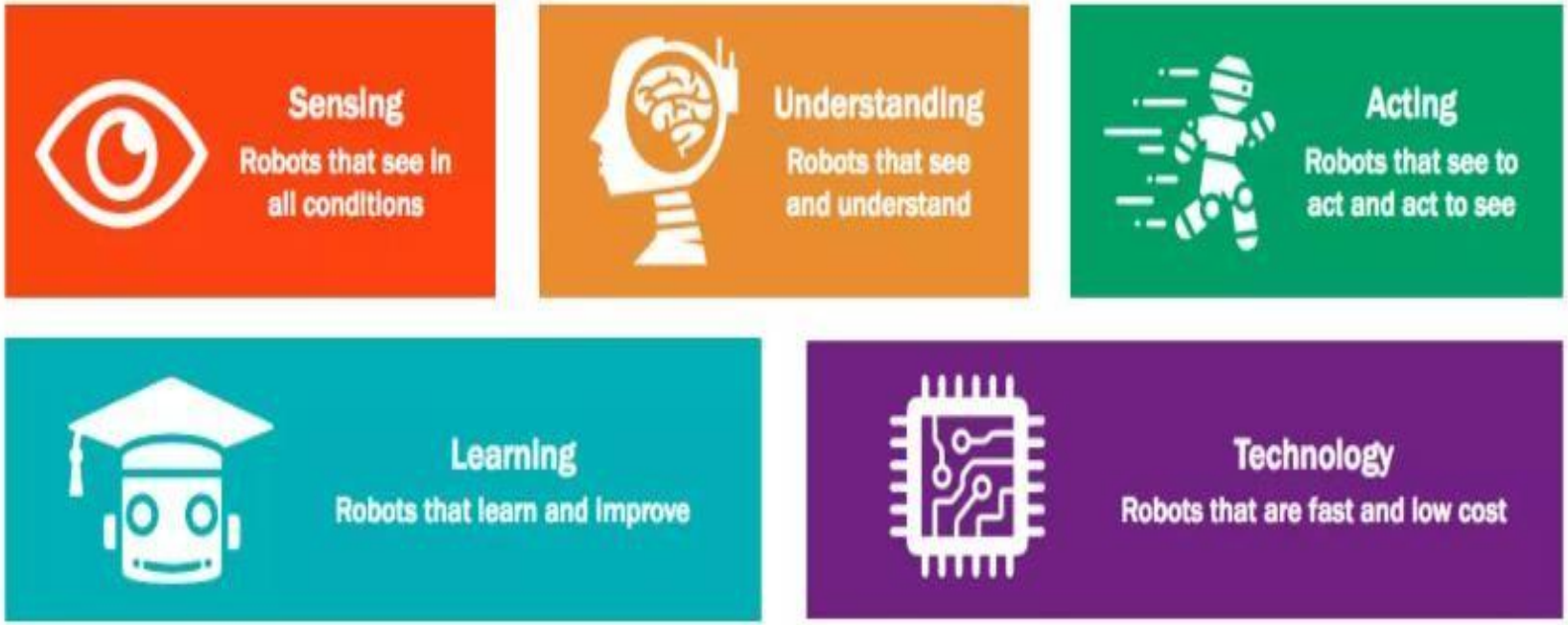
Integration with AI



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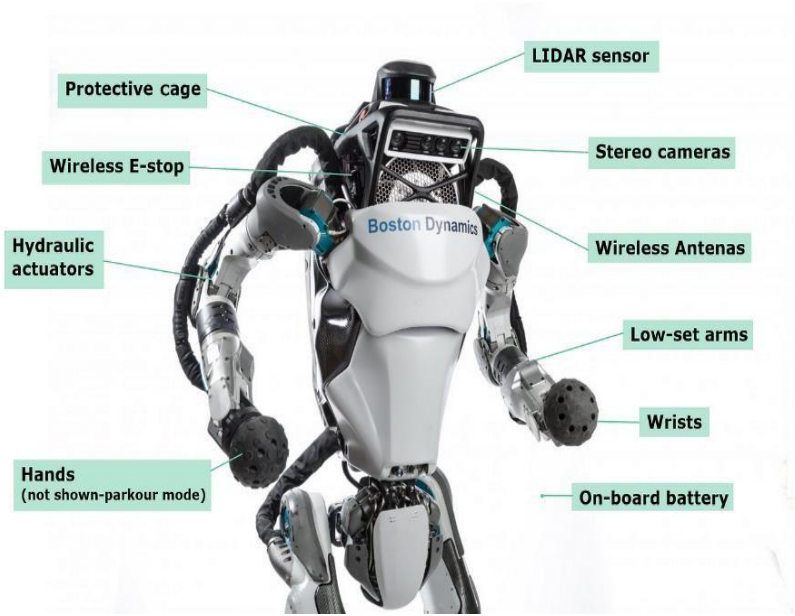
Atlas robot



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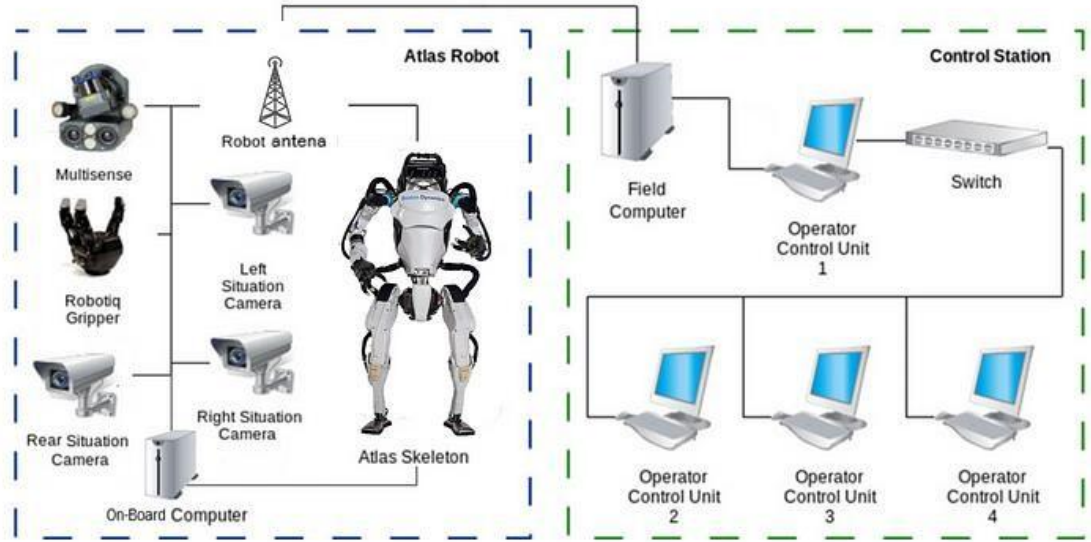
- Atlas requires rapid behavior and dynamic locomotion.
- It needs connections between perception and control for on-the-fly adaptation.
- Two computers are essential for operating Atlas to meet these requirements.
- Atlas features a wireless communication link for sending sensor data to the operator.
- When the signal is strong, the operator can send commands back to the robot.
- The control unit operator addresses issues from robot sensors and commands.
- An onboard computer in Atlas runs basic functions, including motor control and sensor management.



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The Beginning of Your Tomorrow I Boston Dynamics

https://www.youtube.com/watch?v=sd8ivhpjI6g

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Topic 3. Robotics and Engineering basics

3.3 Exploring engineering fields

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Career opportunities in Robotics

Robotics combines many different fields!

You could become:

- Robotics engineer
- Software developer
- AI specialist
- Mechanical designer
- Electronics engineer
- Data scientist
- UX designer (designing how humans interact with robots)

Robotics is teamwork. It needs different talents.

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Skills and responsibilities

Technical Skills

- Programming
- Problem-solving
- Logical thinking
- Math and physics

Human Skills

- Creativity
- Communication
- Teamwork
- Critical thinking
- Ethical awareness

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Challenges – Human safety

Robots work in factories, hospitals, homes, and even on roads. If something goes wrong, people can get hurt. For example, a robot arm moving too fast, a self-driving car misreading the road, a drone losing control.

How do we overcome it?

- Careful testing before use
- Emergency stop systems
- Safety sensors
- Clear rules and regulations
- Continuous monitoring
- Engineers must design robots that put *human safety first!*

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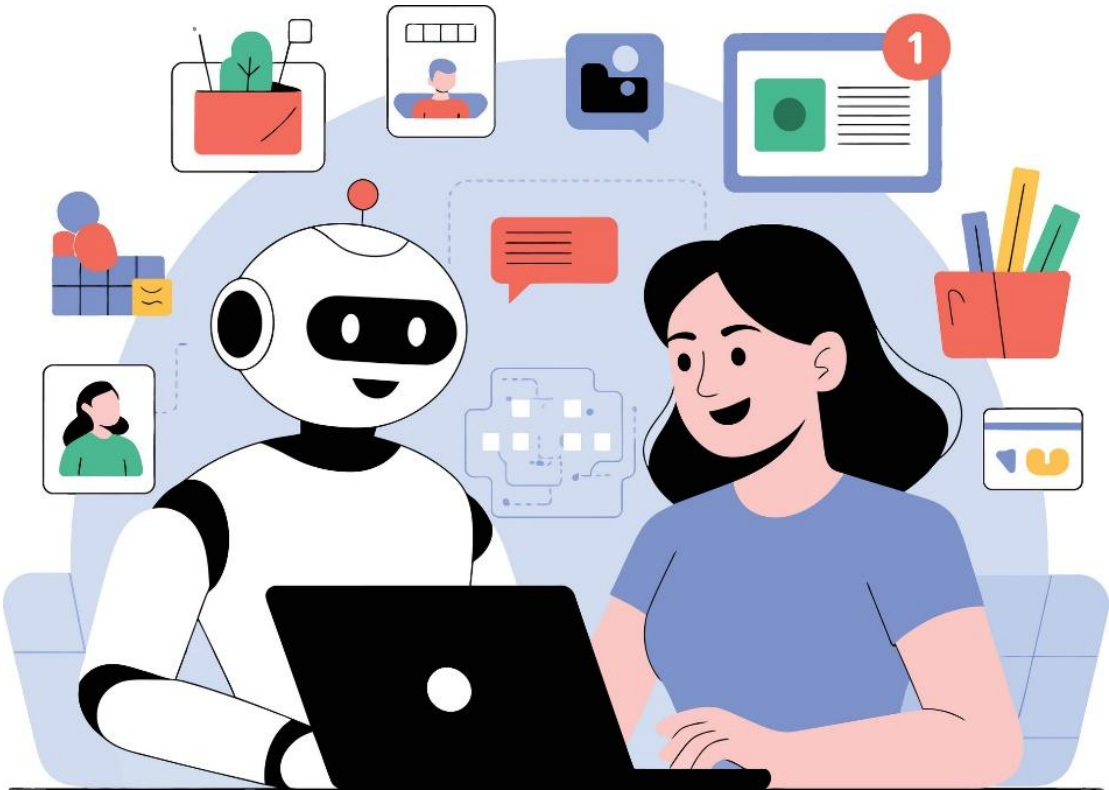
Challenges – Jobs and automation

Some robots can assemble products, deliver items, perform repetitive tasks. This can change the job market. Should people be worried of losing their job?

How do we overcome it?

- Reskilling and upskilling workers
- Creating new tech-related jobs
- Focusing robots on dangerous or repetitive tasks
- Combining human creativity with robotic efficiency

Robots should support humans, not replace human value!



Challenges – Privacy and data

Many robots use cameras, microphones, and sensors. They collect information about our homes, our faces, our voice, our behavior etc.

How do we overcome it?

- Data protection laws
- Encryption and secure systems
- Transparent policies
- Limiting unnecessary data collection

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3.4 Simple robotics projects

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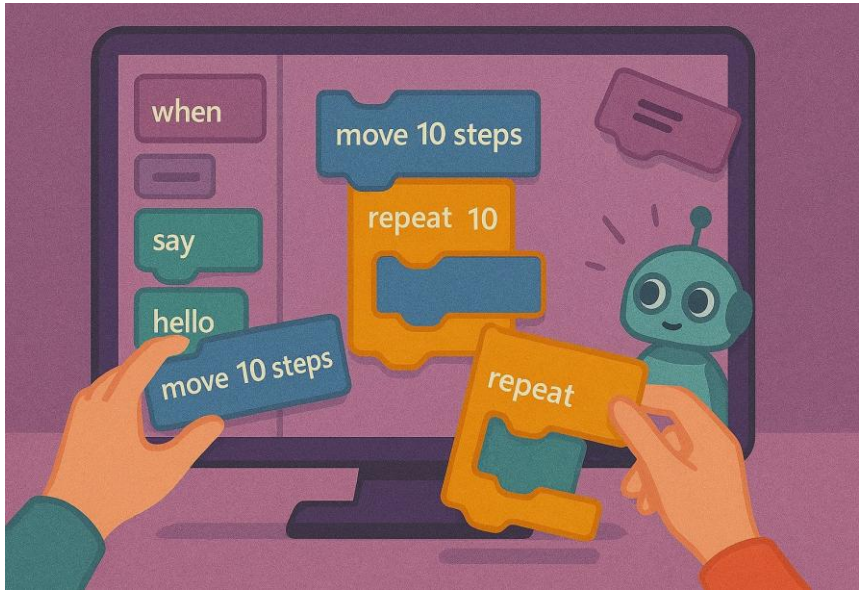
Blocked-based programming

Block-based programming allows beginners to create programs by dragging and snapping visual blocks together. Each **block** represents a specific **action** or instruction. Blocks only fit together in ways that are **syntactically correct.**



This means students do not need to worry about:

- Punctuation
- Brackets
- Spelling errors

Instead, they can focus on what really matters, **the logic of their ideas!**

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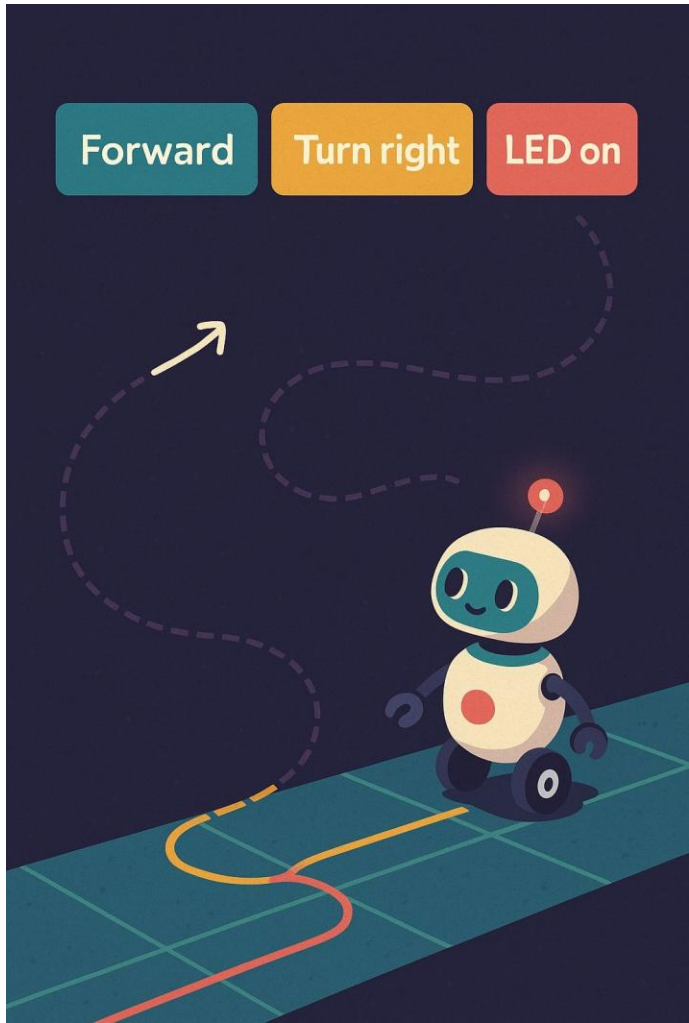
Blocked-based programming

To control a robot, we often need only a small set of basic instructions:

- Move forward
- Turn left
- Turn right
- Stop
- Switch a light ON or OFF



Even with just these simple commands, we can create many **different behaviors**. Programming is not about having many commands, but about combining them logically.

Blocked-based programming

Every program needs a starting signal. This is called an **event**.

On a computer, an event could be:

- A mouse click
- A key press

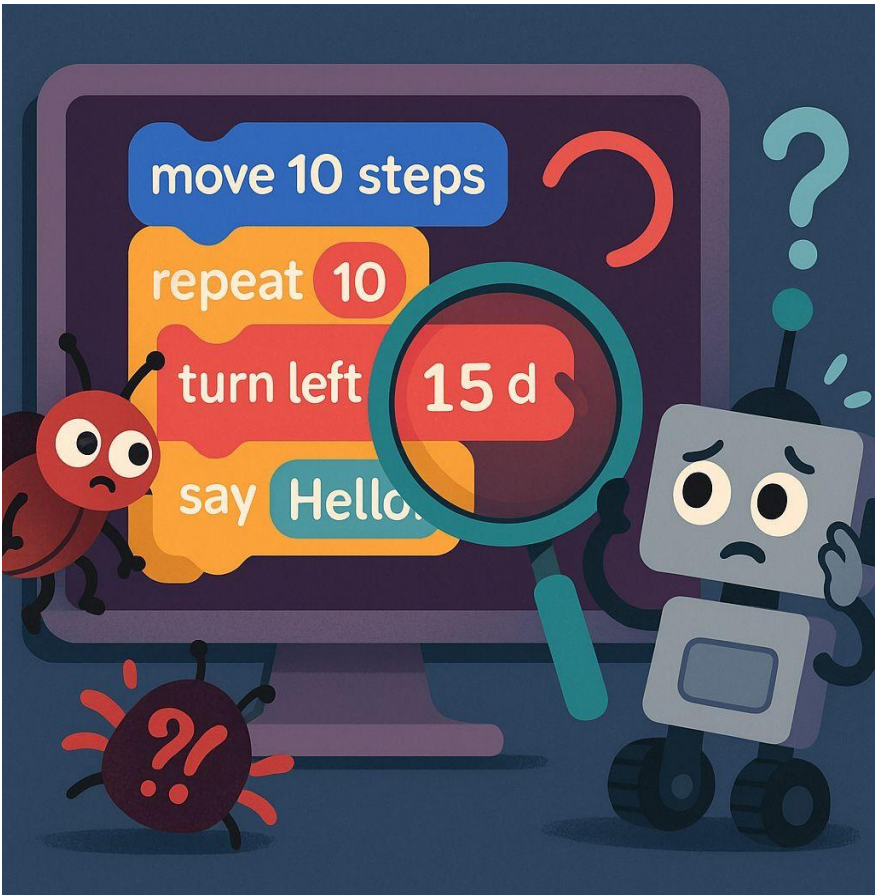
On a robot, it could be:

- A button press
- A timer
- A sensor detecting something

Without an event, even a perfectly written program will never run!

Blocked-based programming

When a robot behaves strangely, it is simply doing exactly what the program tells it to do, step by step. If something looks wrong, the program probably needs improvement.



Debugging is the process of finding and fixing errors in our algorithm or code.

<u>It involves:</u>

- Observing carefully
- Thinking about what might be wrong
- Testing small changes
- Trying again

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Robotics and STEAM

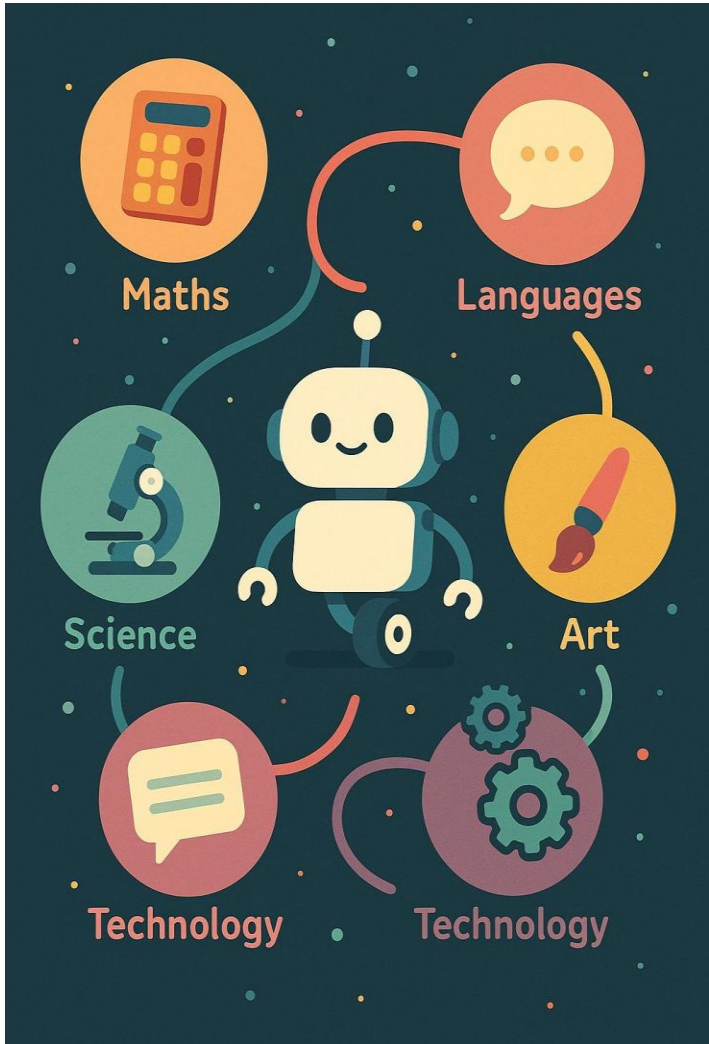
Robotics is not just about technology! A single robotics project can naturally connect many school subjects.

🔬 **Science** explains forces, motion, friction, energy, batteries, and how sensors work

📐 **Mathematics** is used for measurements, angles, speed, timing, and patterns

📚 **Language** is needed to write instructions, explain algorithms, present ideas, and document the project

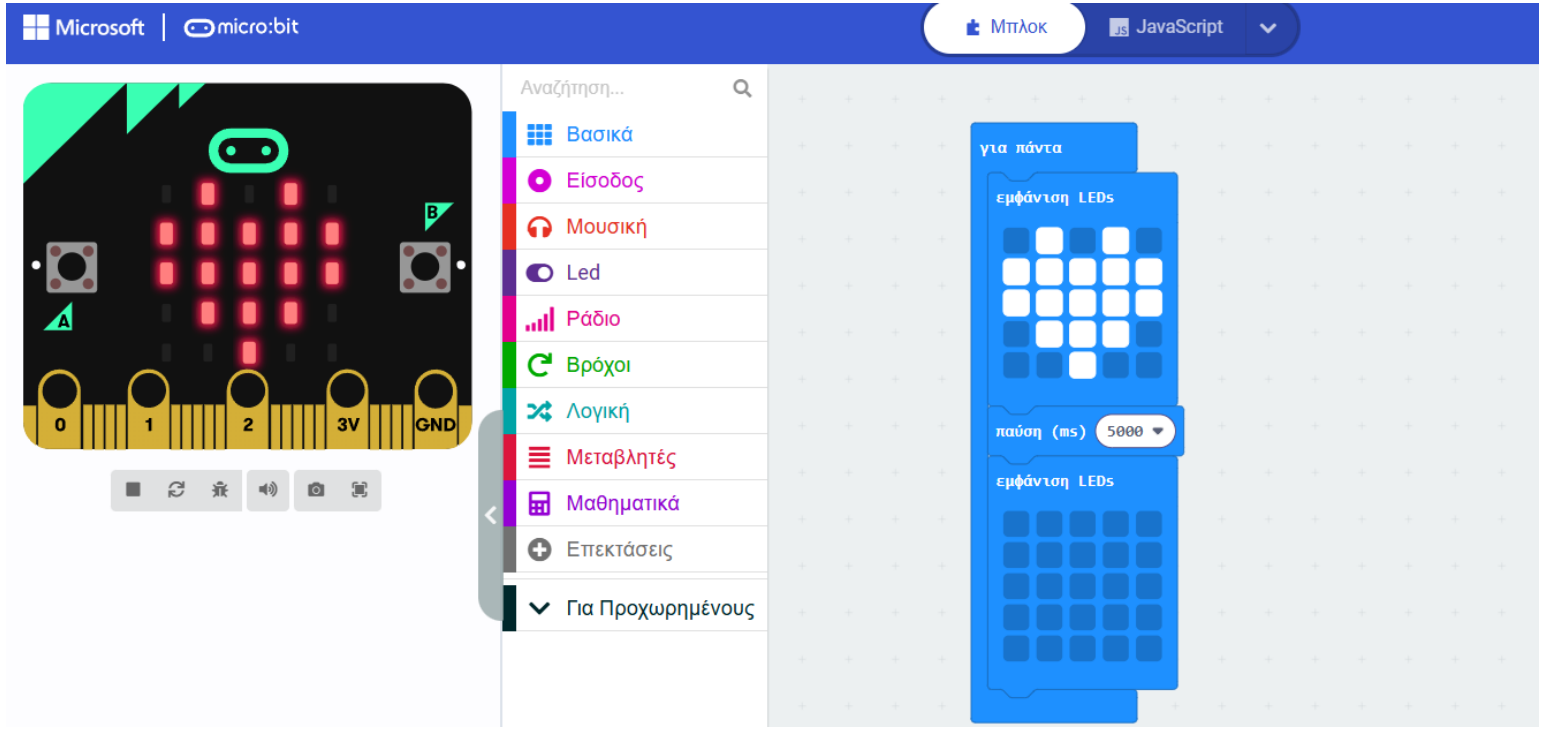
🎨 **Art and creativity** is used to design the robot's appearance, create courses, and build stories around the activity



Activity #2: Micro:bit

How is it programmed?

It can be programmed with a block-based graphical environment, where we create programs by dragging and dropping blocks.



Πηγαίνετε στο: https://makecode.microbit.org/

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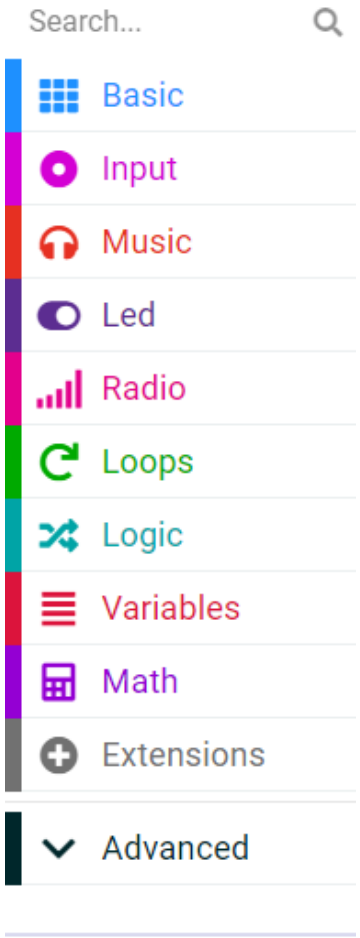
Activity #2: Micro:bit



- **Basic:** Blue category. Function: Includes basic commands such as displaying icons and text on the LED display, delays, and other simple functions.
- **Input:** Purple category. It includes input-related commands such as pressing buttons, using the accelerometer, reading the light sensor
- **Radio:** Commands for radio wave communication with other micro:bits. It is used to send and receive messages.

Πηγαίνετε στο: https://makecode.microbit.org/

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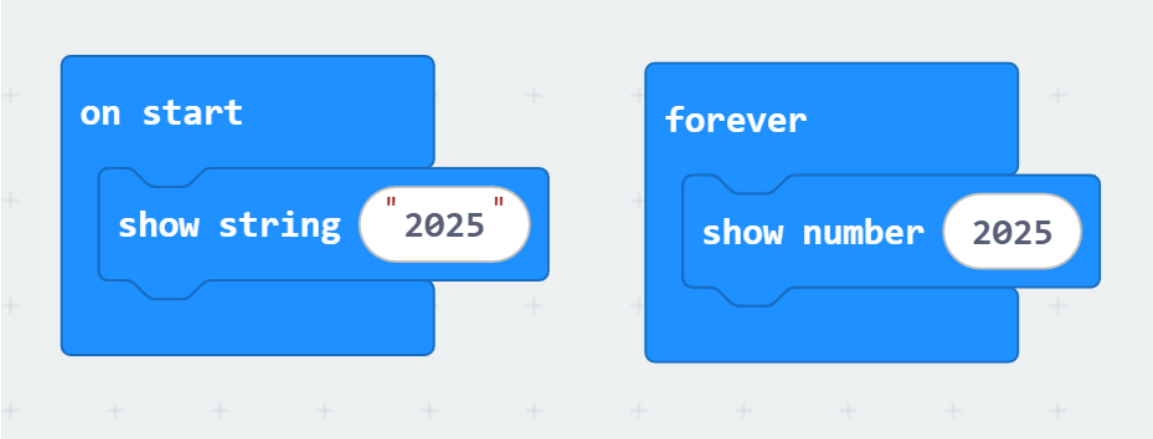
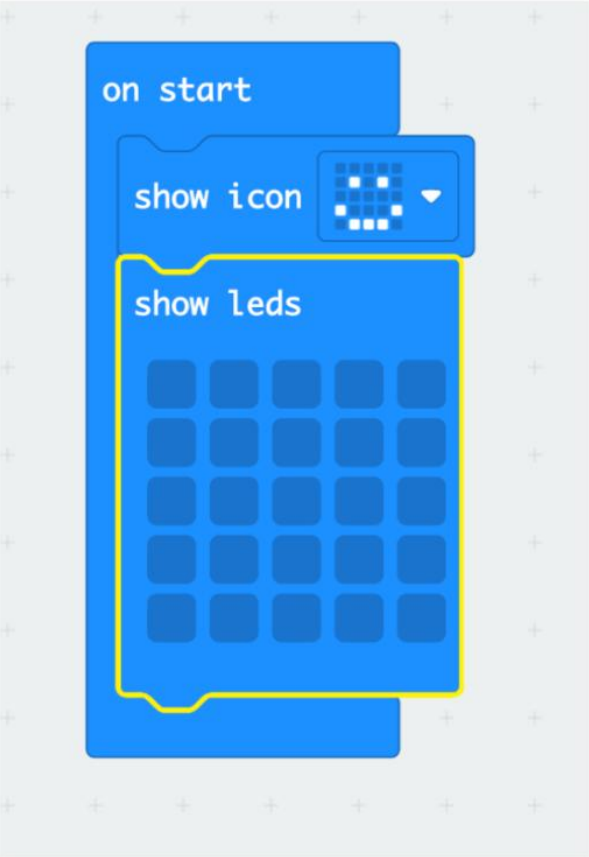
Activity #2: Micro:bit

1st Exercise

Create a program where:

- It will appear in the current year once.
- It will appear in the current year forever.
- We use the show leds command.





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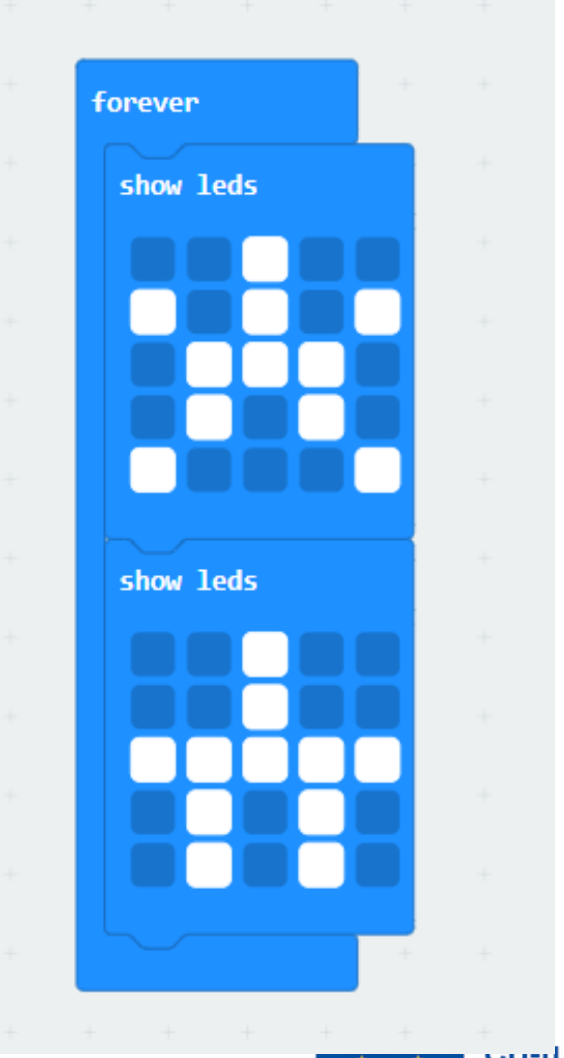
Activity #2: Micro:bit

2nd Exercise

Create a program where:

- They will constantly change icons to give the impression of movement to the LEDs.
- Basic>Show Icon>For ever. The paus command can be used



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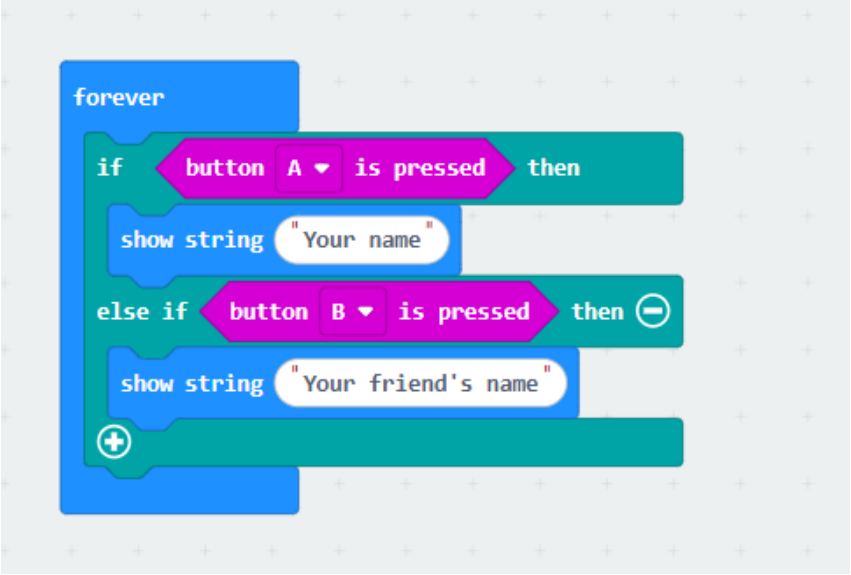
Activity #2: Micro:bit

3rd Exercise

Create a program where:

- Have your name displayed when you press the A button.
- The classmate's name when you press the B button.
- A heart appears when we press both A and B.



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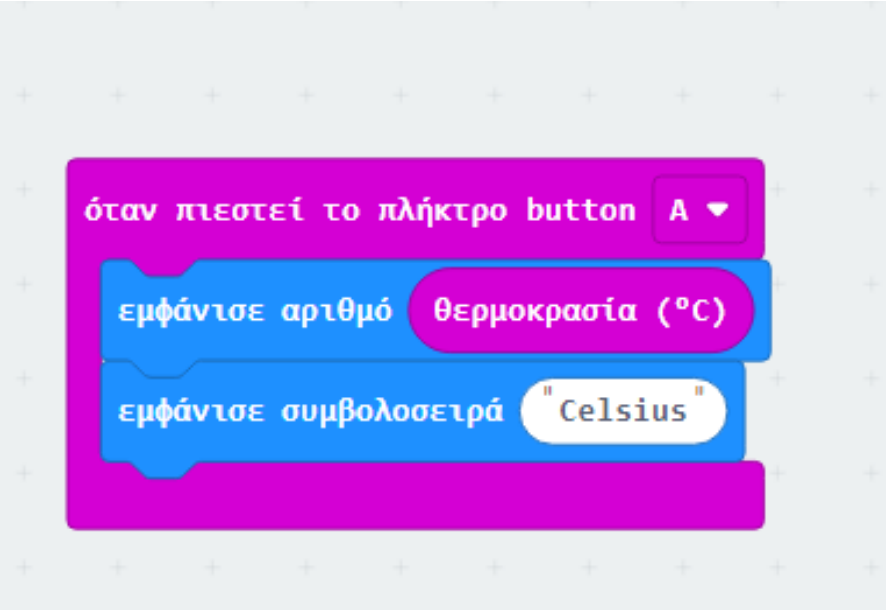
Activity #2: Micro:bit

4th Exercise

Create a program where:

- It will measure the temperature of the room



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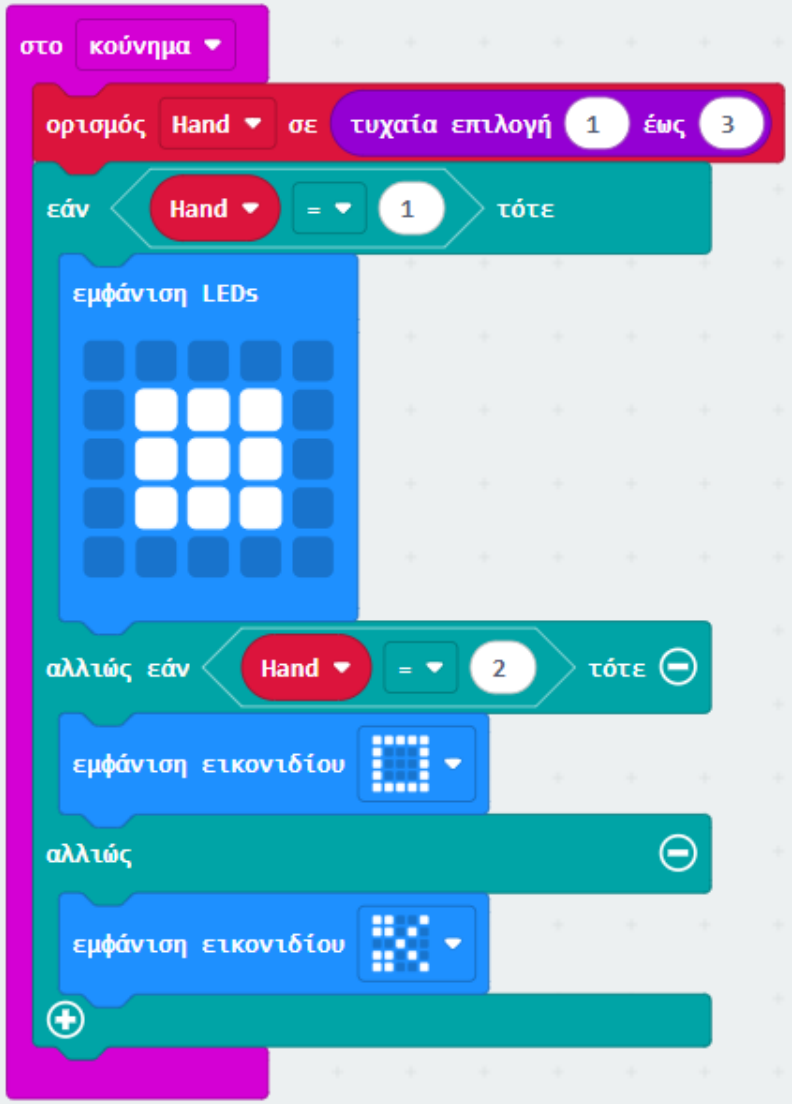
Activity #2: Micro:bit

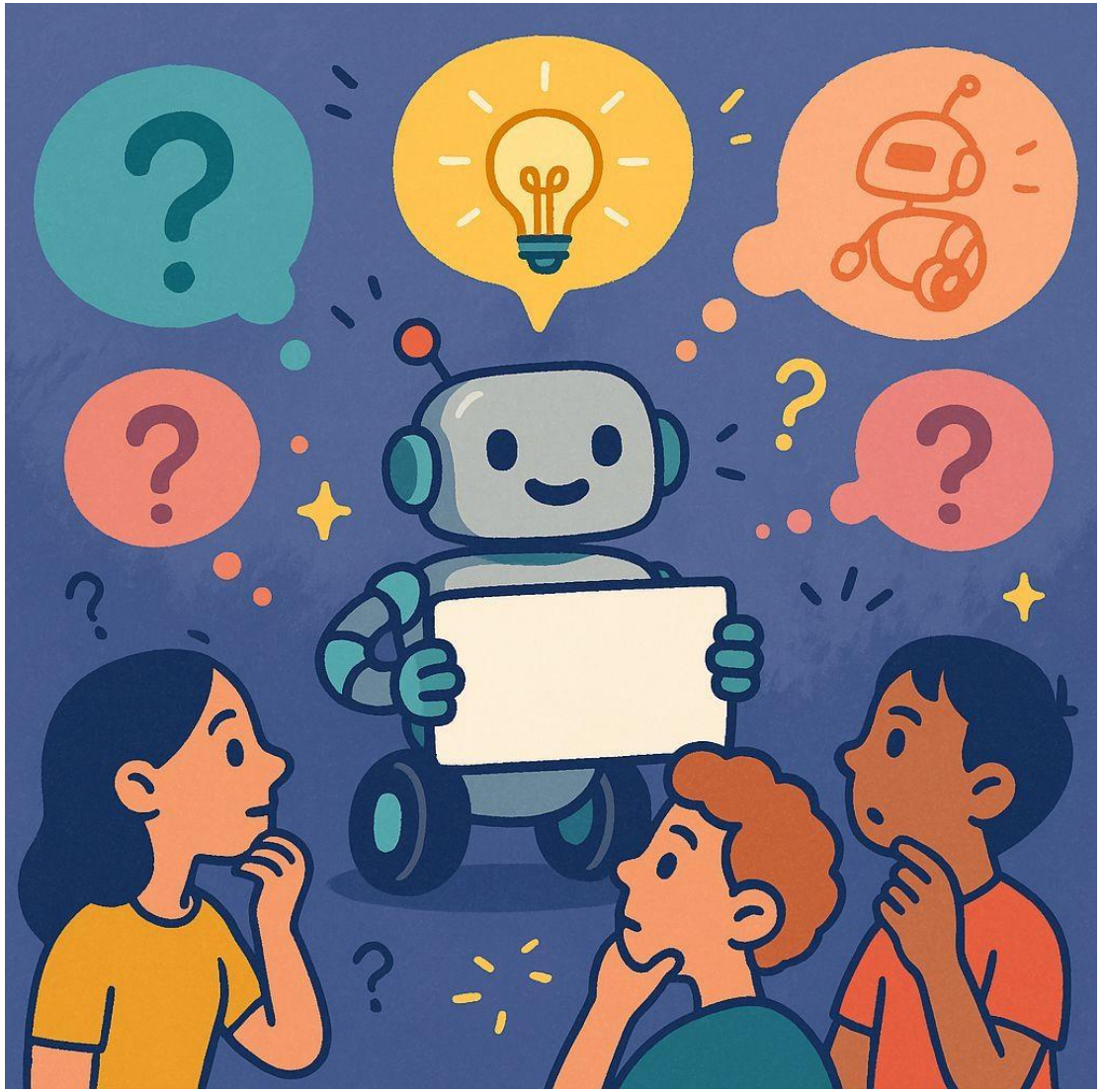
5th Exercise

Create a program where:

- You will wave the micro:bit and play STONE – SCISSORS – PAPER



QUESTIONS OR IDEAS?



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Thank you!

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