Robotics: the art of intelligent motion

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TechCamp @POLIMI

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We will talk about robots!

What is a robot?

An automatically controlled, reprogrammable, multipurpose manipulator programmable in three or more axes, which can be either fixed in place or mobile for use in industrial automation applications

(ISO 8373:2012)

Well, not about all robots...

Is this a robot?

Well, it moves, but it cannot manipulate the environment moving parts.
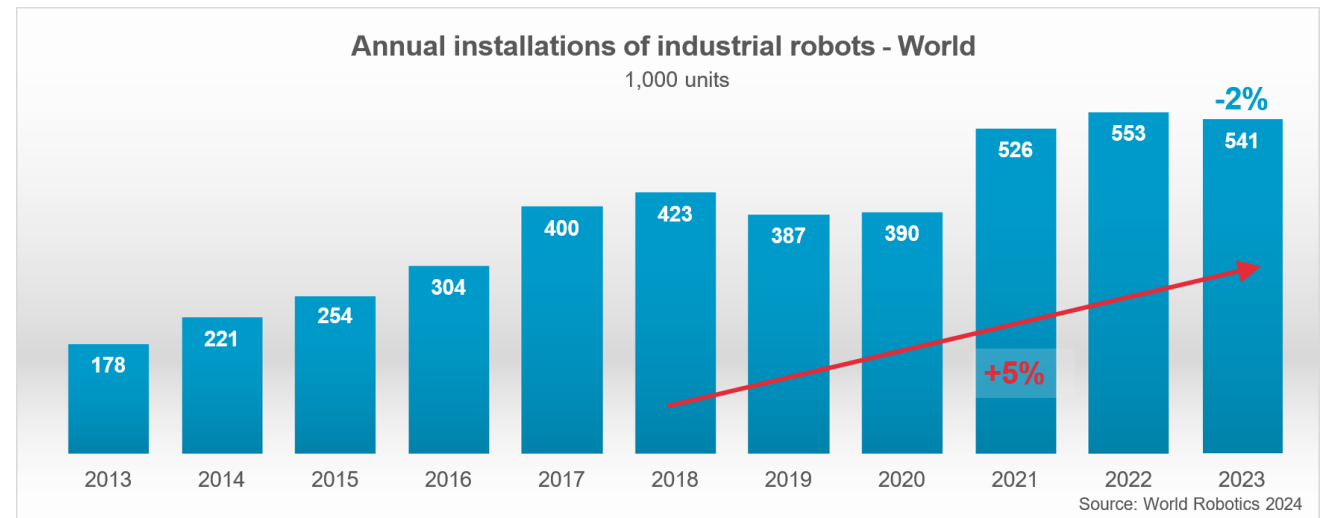
So it is not a robot by our definition

And a generic artificial intelligence product (a chatbot for example)? No, it is not a robot.

Robots in action

Industrial robots are more and more used

Annual installations of industrial robots - World
1,000 units

2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
178	221	254	304	400	423	387	390	526	553	541

+5%   -2%

Source: World Robotics 2024

Anthropomorphic

The typical dexterous robotic arm

SCARA

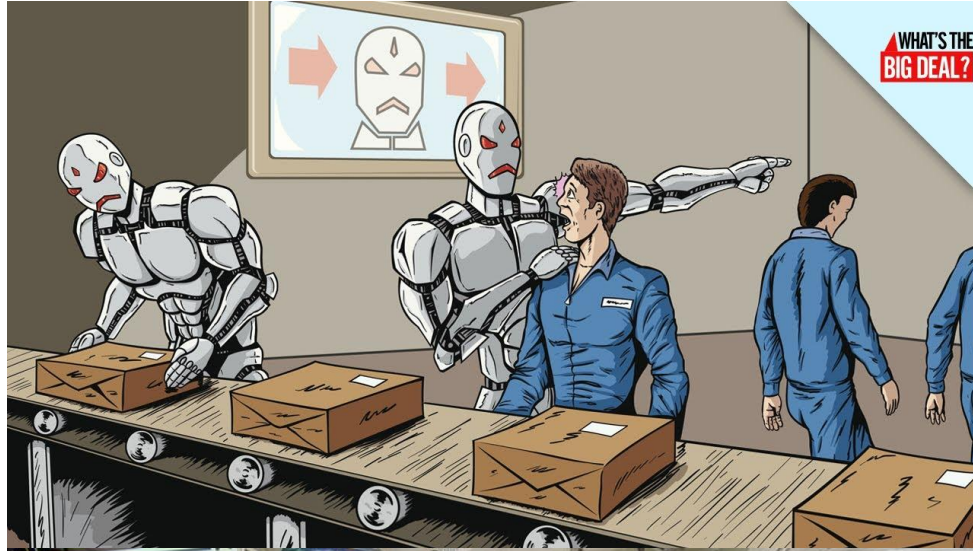All vertical axes, very fast

Delta

Fast pick and place
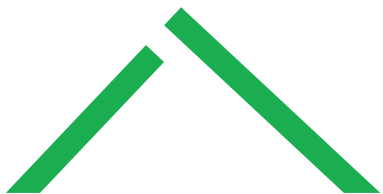
New robots

Dual-arm collaborative robots

Collaborative robots (cobots) are robots that can operate close to the human.

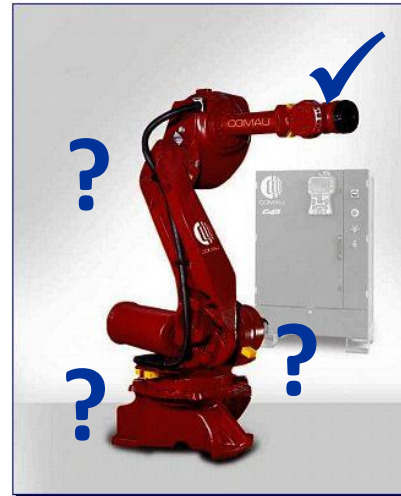It's the new frontier of industrial robotics
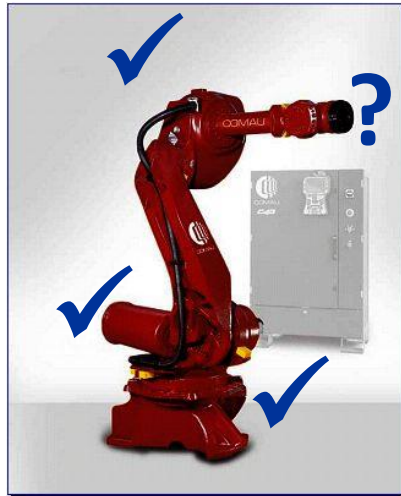
Ethical issues

Robotics and employment

We will stimulate discussions on these themes

How to describe motion?

The robot kinematics

We will study the direct and the inverse kinematics

How to make a robot move?

The generation of motion

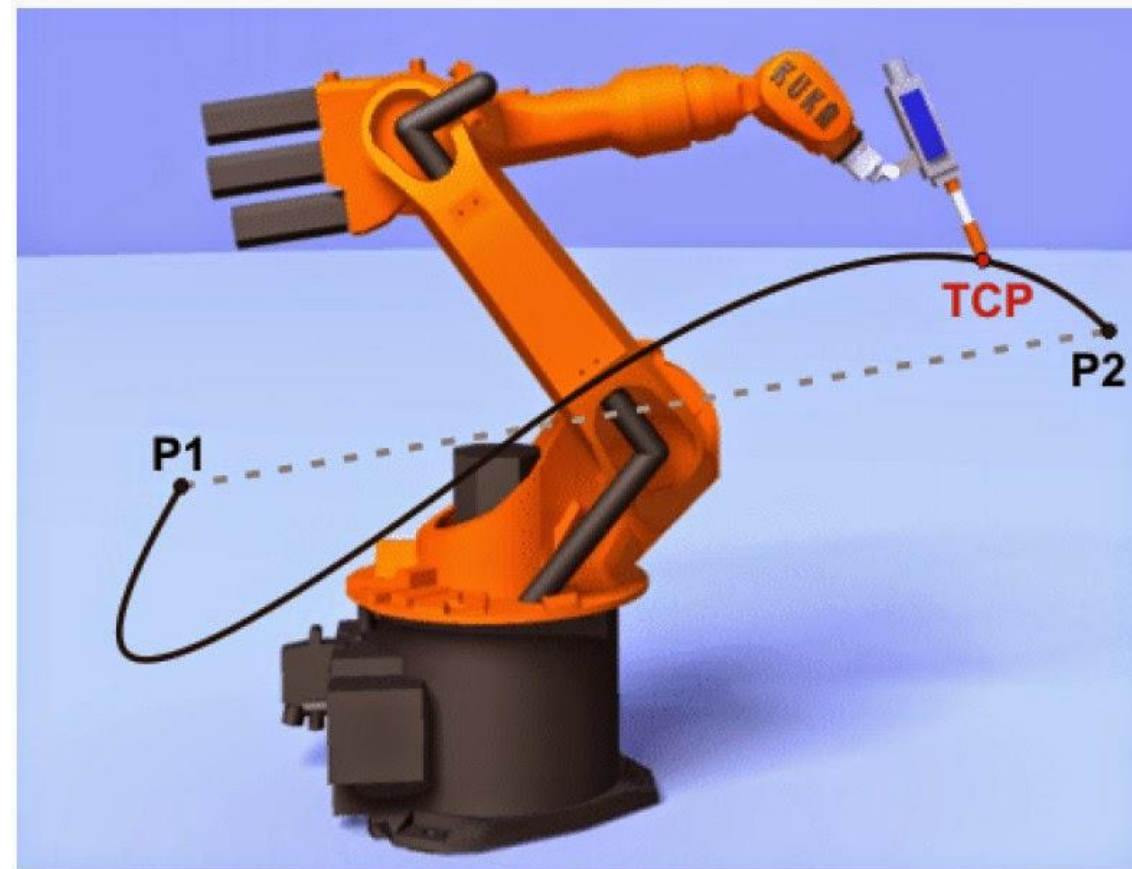The robot is just a collection of mechanical bodies.

How can we make it move in space?

How to make a robot move?

The generation of motion

We need to decide how the robot has to move: what points in space should it cover? and how fast?
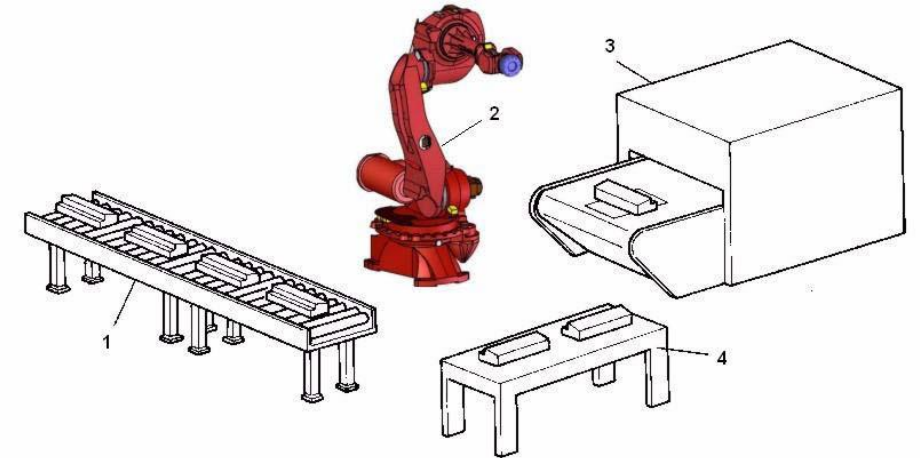
How to program a robot?

Programming environments

```
PROGRAM pack
VAR
    home, feeder, table, discard :
POSITION
BEGIN CYCLE
    MOVE TO home
    OPEN HAND 1
    WAIT FOR $DIN[1] = ON
-- signals feeder ready
    MOVE TO feeder
    CLOSE HAND 1
    IF $DIN[2] = OFF THEN
-- determines if good part
        MOVE TO table
    ELSE
        MOVE TO discard
    ENDIF
    OPEN HAND 1
-- drop part on table or in bin
END pack
```

The program moves pieces from a feeder to a table or to a discard bin, depending on digital input signals:

1. Feeder
2. Robot
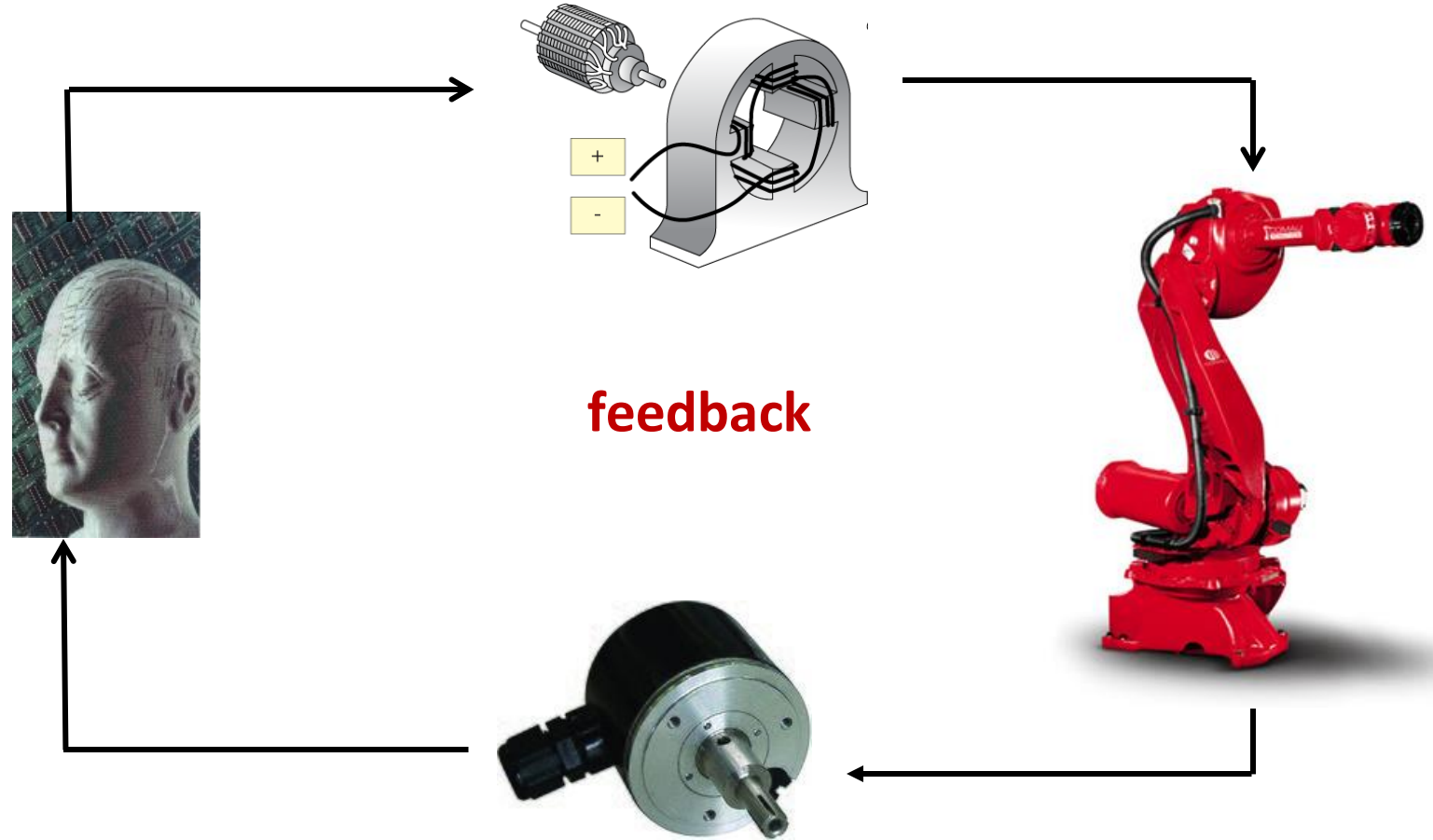3. Discard Bin
4. Table

How to program a robot?

Teaching by demonstration

How to control a robot?

The role of feedback

How can we command the motors such that a certain motion is executed?

feedback

We will use…

And we will visit the lab!

We will use the Dobot magician!

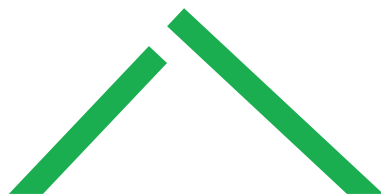The Dobot is a multifunctional and small size robotic arm
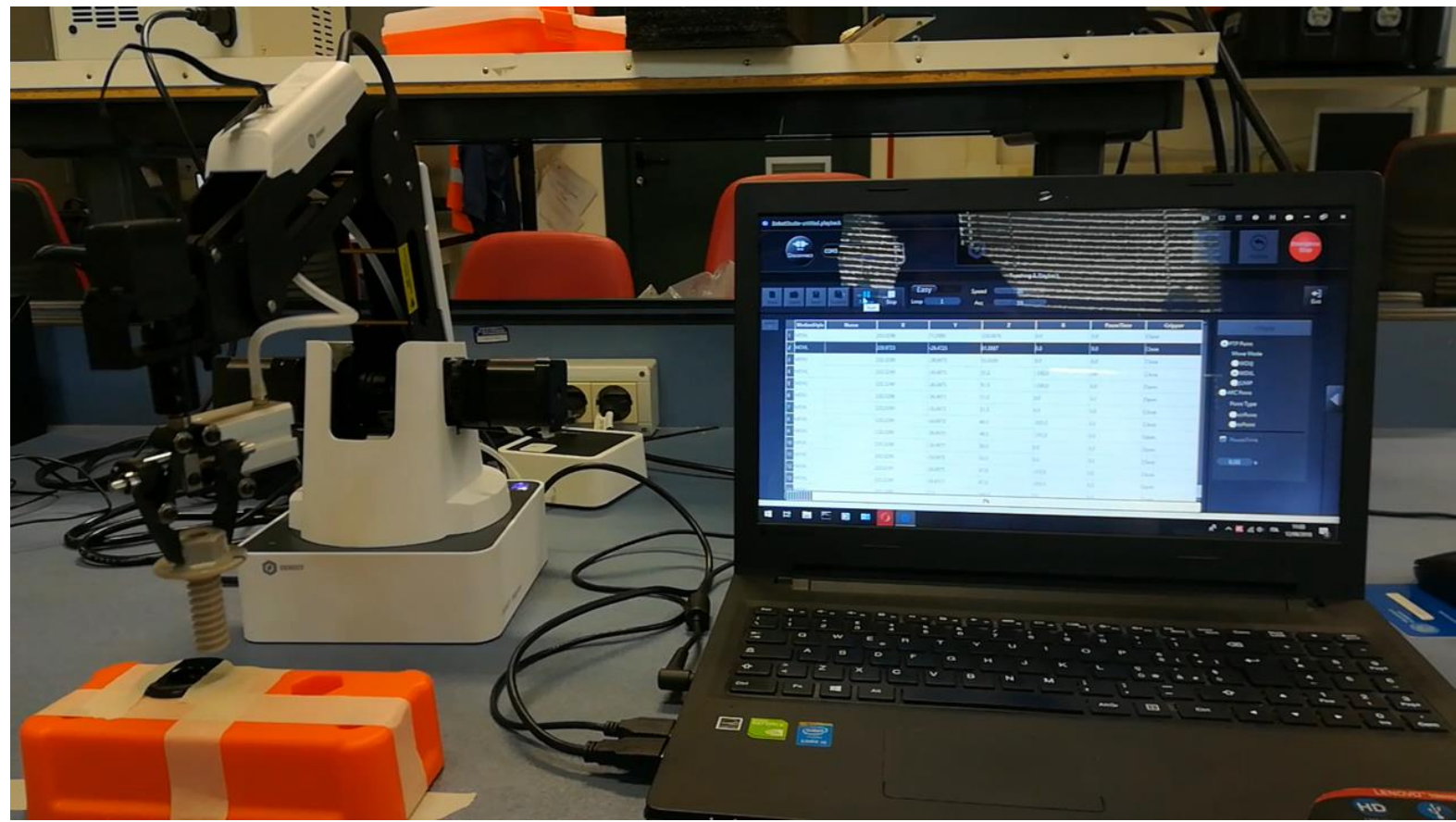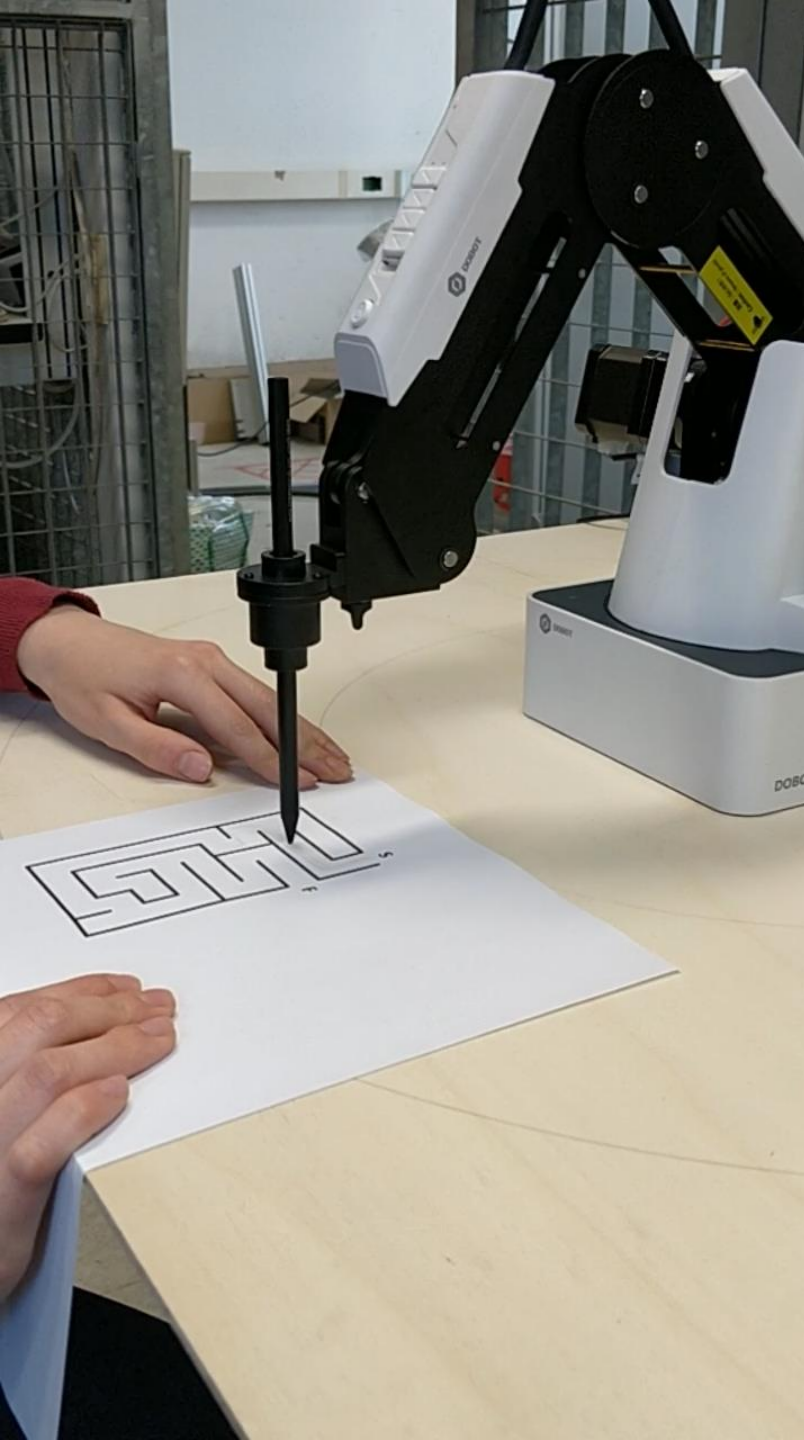
A suction tool

A gripper

A pen

Enjoy robotics!

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