

EXPLORE ROBOTICS – CISC 1003

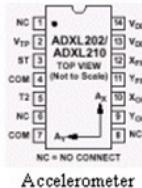


EXPLORING ROBOTICS

– UNIT C

Sensors

Sensors



Accelerometer



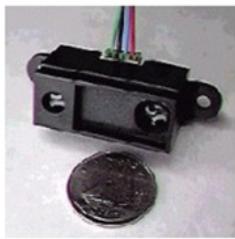
Gyro



Pendulum Resistive
Tilt Sensors



Metal Detector



Digital Infrared Ranging



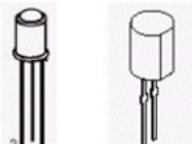
CDS Cell
Resistive Light Sensor



Resistive Bend Sensors



UV Detector



IR Pin
Diode



IR Sensor w/lens



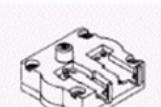
Limit Switch



Mechanical Tilt Sensors



Touch Switch



Pressure Switch



IR Reflection
Sensor



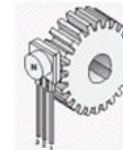
IR Amplifier Sensor



Thyristor



Magnetic Sensor

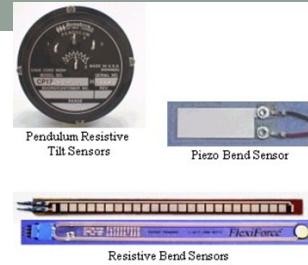


Hall Effect
Magnetic Field
Sensors



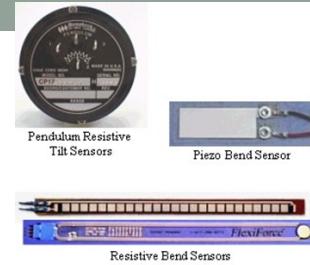
IRDA Transceiver

Sensors are for Perception



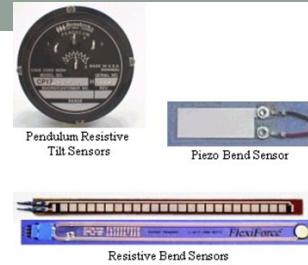
- Sensors are physical devices that measure physical quantities.
 - Such as light, temperature, pressure
- Perceptual system of a robot includes:
 - *Proprioception* (internal) system
 - *Exteroception* (external) system
- Sensors produce uncertainty challenge
 - Sensor noise and errors are inherent in physical measurement

Sensors are for Perception



- Issues with Sensors:
 - Sensors produce signals, not symbols.
- May be continuous or multi-dimensional
- Signal-to-symbol problem:
 - How to form an intelligent response from sensor input when system requires a symbolic input form.
 - Such as a camera waiting for a person to smile (symbol) before taking a photo (response).

Sensors are for Perception



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- Sensor Fusion: Combining multiple sensors to get better information about the world.

Switches

- Switches measure current to detect an open or closed circuit.



Levels of Processing

- Electronics (low level): such as measuring voltages
- Signal processing (medium level): such as separating voice from noise
- Computation (high level): such as recognizing an object from an image

Levels of Processing

- Examples:
 - Bump Sensors (low)
 - Odometer (low)
 - Sonar (medium)
 - Speech (medium)
 - Vision (high)

Levels of Processing

- Given the sensor input:
 - Both simple and complex sensors can be used to answer the question:
What should a robot do? (action in the world)
 - Complex sensors can also be used to answer the question:
What was the world like? (reconstruction of the world)

Locating People

- What kind of sensor would you use to locate people in a room?



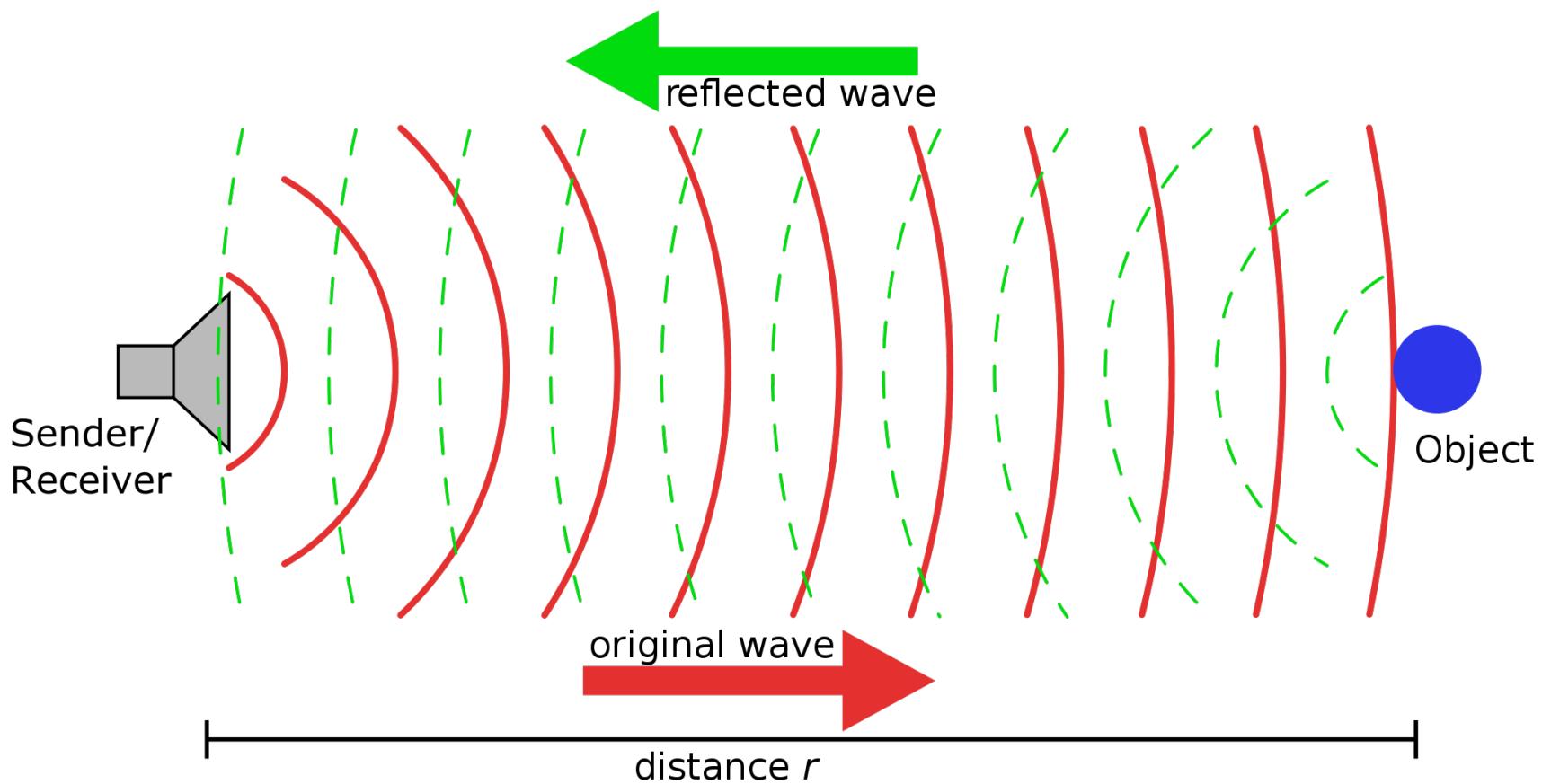
Locating People

- What kind of sensor would you use to locate people in a room?
 - *Camera*: most obvious,
 - but the most complex to process the signal.
 - *Temperature*: locate objects within human body temperature.
 - *Motion Detector*: locate objects moving that are a certain size.
 - *Color Detector*: locate objects of skin color, or human clothes.
 - *Distance*: locate objects that block a previously open area

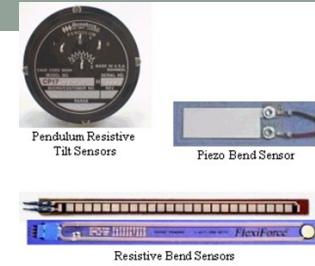
Locating People

- The sensors will need to be calibrated before use in the robot.
 - To help achieve accurate readings

Finding Distance using Sonar



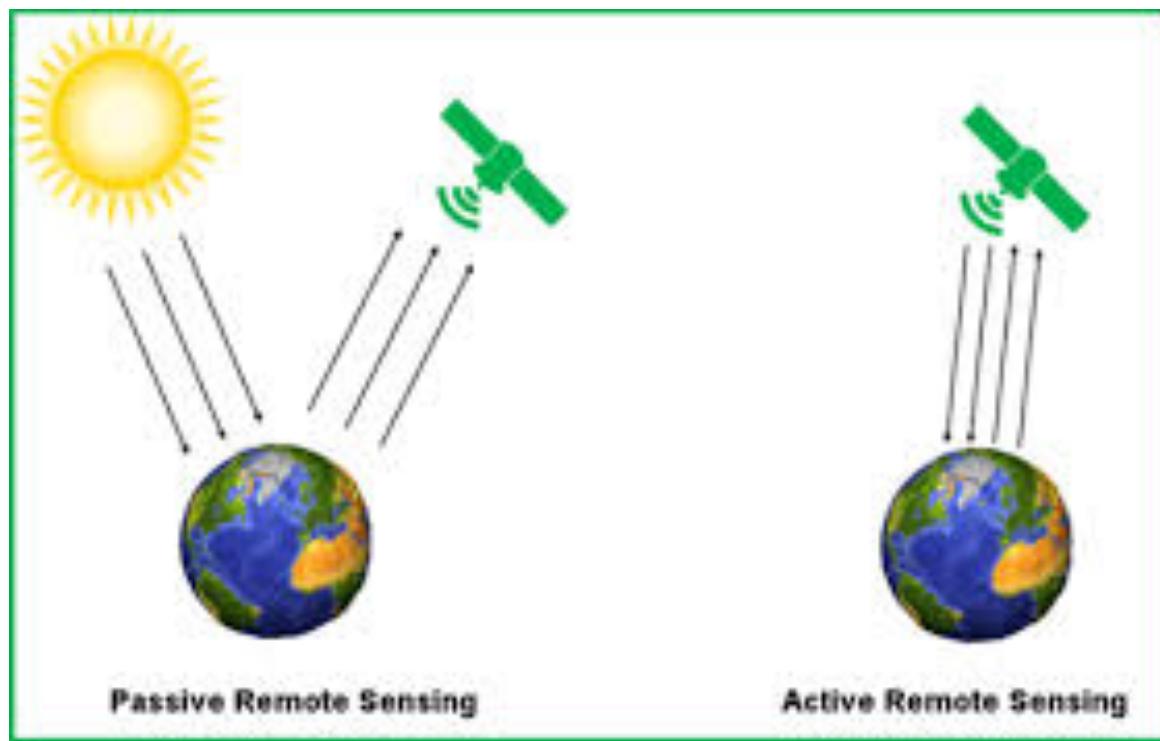
Sensor Types



- Simple Sensors: sensors that don't require a lot of processing.
- Passive vs. Active (both simple or complex):
 - **Passive**: measures a physical property only, with a detector
Ex: switches, resistive light sensors, cameras
 - **Active**: provides own signal/stimulus, with both an emitter and a detector
Ex: reflectance and break beam, ultrasound and laser.

Passive vs. Active Sensors

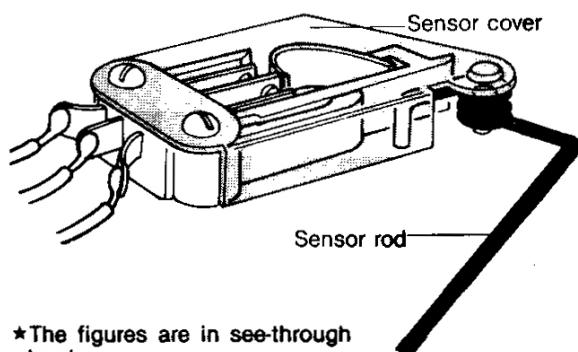
- Global satellite system



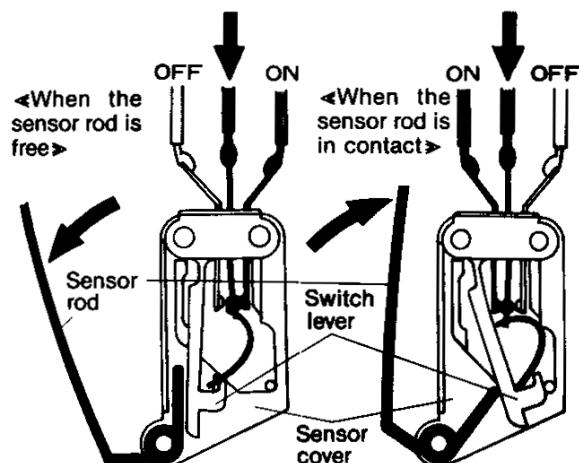
Global satellite system

- Sun constantly emits light energy and is only source of natural light for earth
 - earth's surface produce natural emissions
- Passive sensors measure this energy or power
 - as a function of physical temperature, roughness and other physical characteristics related to earth
- Active sensors throw their own energy source towards earth
 - Energy reflected from earth's surface
 - Measured by active sensors

Sensor Types (cont.)



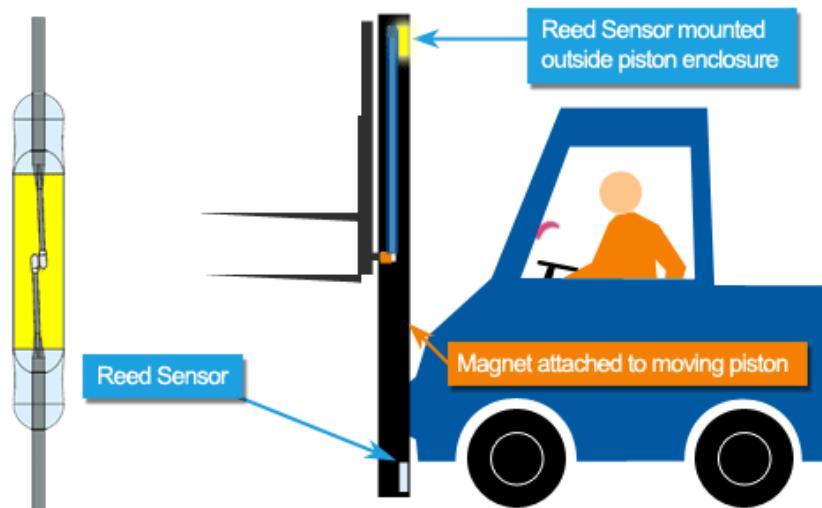
*The figures are in see-through drawings.



«About the sensor»

The sensor rod will activate the switch lever for turning on and off one of the two motors.

Contact Sensor



Limit sensor

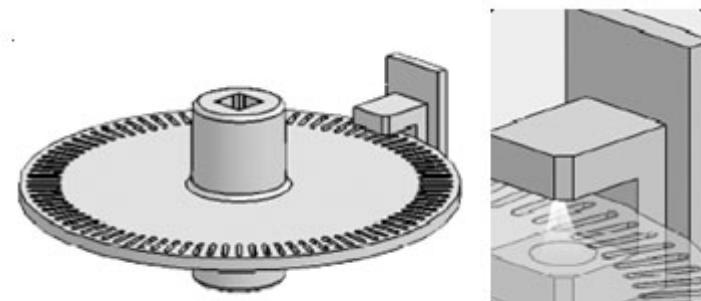


Figure 2. Optical shaft encoder disk

Shaft encoder
sensor

Light Sensors

- Photocells convert light intensity to resistance in the circuit
 - Work even with invisible light (such as infrared)
 - Could be used for measuring intensity, difference in intensity or break in continuity
- Reflectance sensors: active sensors with emitter and detector side by side
- Break beam sensors: emitter and detector face each other
- Calibration is used to reduce noise



ROOMBA

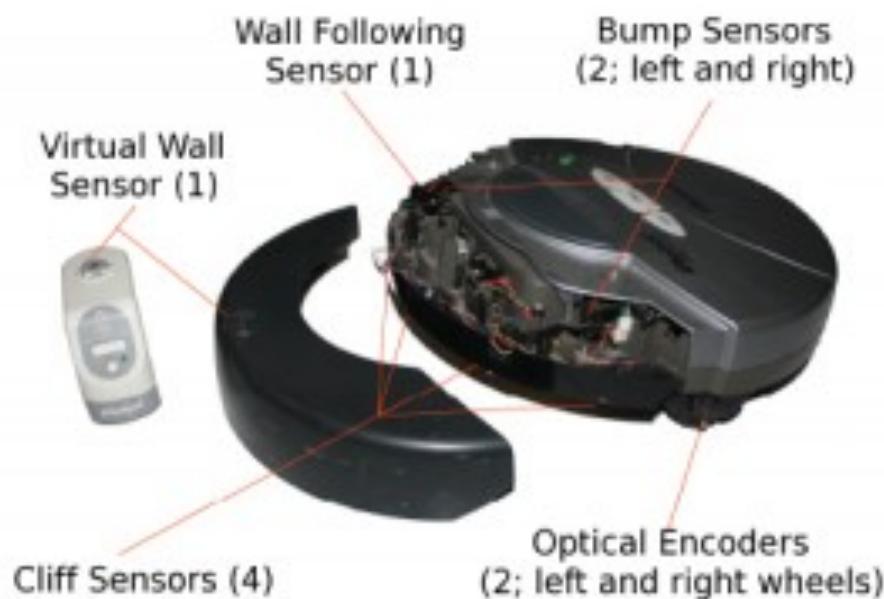
iRobot ROOMBA

- The Roomba vacuums your floors and rugs at the press of a button, helping to maintain a cleaner home.
 - Self-navigation around corners and doors.
 - Combines input from smart sensors
 - Requires minimal human input
 - System Includes virtual wall units
 - Sends infra-red signals that cause robot to turn

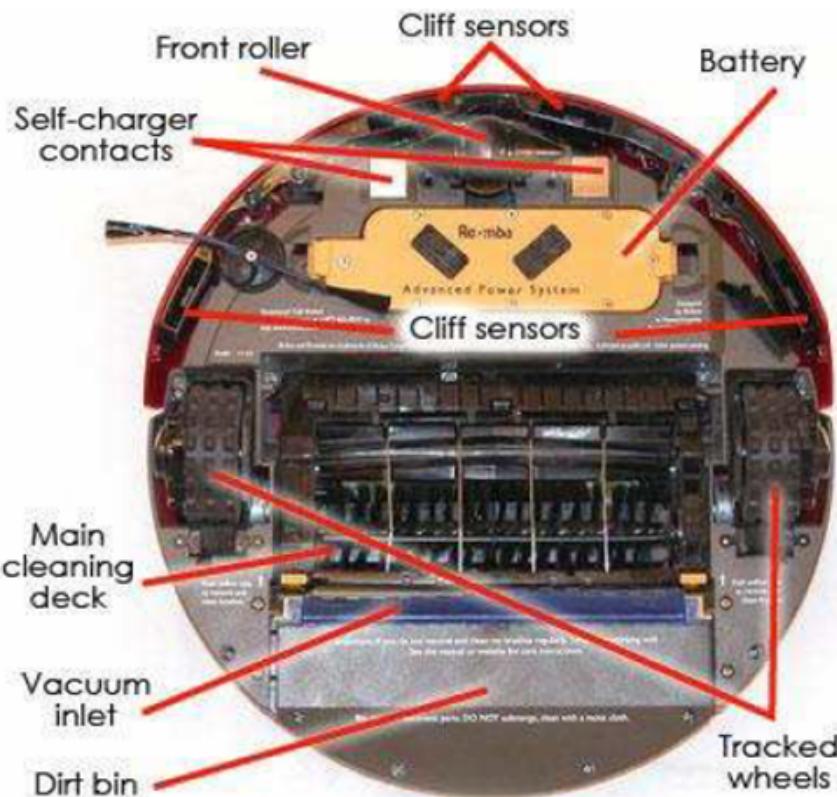
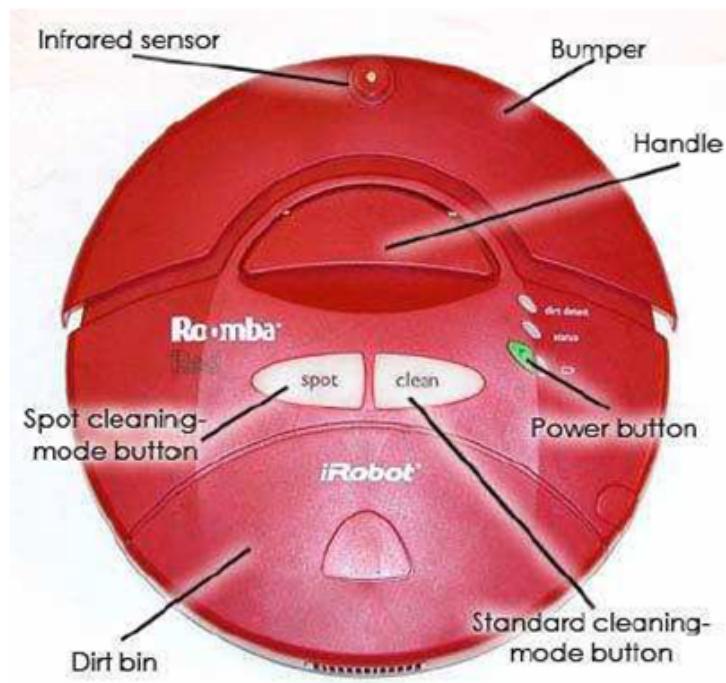


How Roomba works

- The Roomba (sage) contains 10 sensors



Top and bottom views



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Roomba Sensors



- The Roomba avoid steps by using cliff sensors.
 - Constantly send out infrared signals
 - Normally immediately bounce back
 - If approaching a cliff, the signals all of a sudden get lost.
- Wall sensor is located on the right side of the bumper
 - Lets Roomba follow very closely along walls and furniture without touching them.

Roomba Sensors



- Object sensors activated when Roomba touches an obstacle
 - It then performs the sequential actions of backing up, rotating and moving forward until it finds a clear path

Roomba Sensors



- A piezoelectric sensor used to detect dirt
 - Crystal that generates electrical impulses when touched
 - causing the robot to retrace its steps, clean a little slower and more thoroughly second time around
- Newer versions use infrared cameras to create a 'picture' of the room
 - Result in efficient, less random cleaning paths

Home Robots

- Home Robots

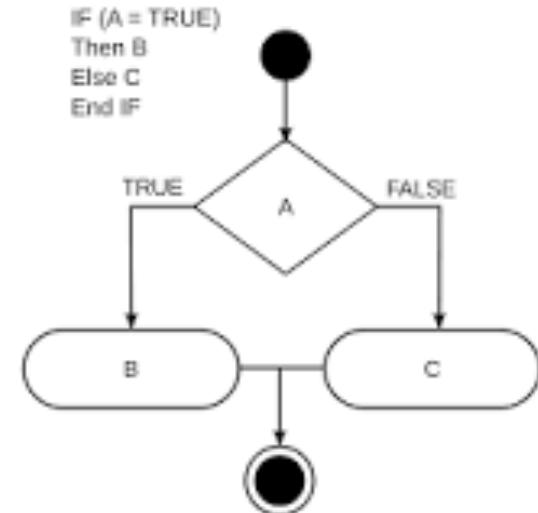
Decision Making



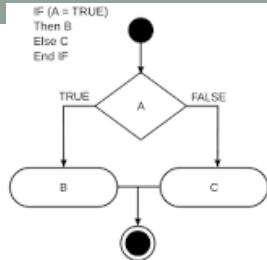
- Sensory inputs will make the robot a little more intelligent
 - such as the value of the light sensor,
- We need a decision-making mechanism
 - To enable robots to react to their environment autonomously (without a human touching it).
- How can we do that?
 - Conditional Execution

Conditional Execution

- Conditional execution used in decision-making
 - in the programming environment.
 - Widely used in programming languages
 - Common example: If–then(–else)



Conditional Execution



- Basic structure of if-then else construct:
 - If (boolean condition) Then
 - (consequent)
 - Else
 - (alternative)
 - End If

LAB

- Let's start working with our virtual environment!

