Introduction to Robotics

SAEID KHOSRAVANI

Seneca

Overview

- What is Robotics?
- Robot History
- Classification of Robots
- Robotic Systems
- Why Robots?

Who I am?

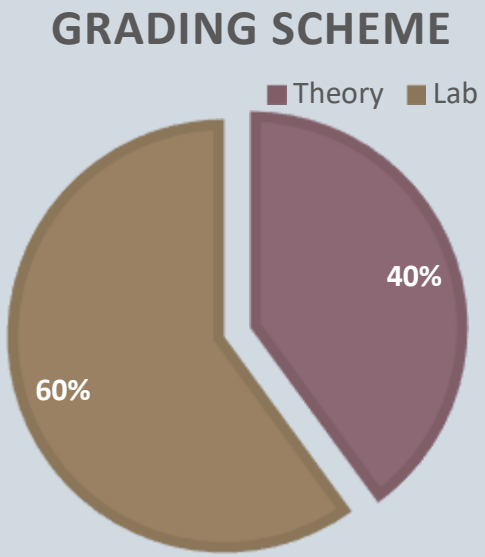
- Name : Saeid Khosravani, 39, married, father
- B.Sc. in Electrical Engineering (2007)
- M.Sc. In Controls Engineering (2011)
- Ph.D. in Mechanical Engineering (U Waterloo - 2016)
- Post Doctoral Fellow at U Waterloo
- Senior Controls Engineer in ADAS for General Motors (2017)
- Founder of SORSYS Technologies (2015)
- Lecturer at North Eastern University
- Lecturer at Seneca College
- Lecturer at Humber College

Hobby : Cycling, Play Station, low-cost home automation

Grading Scheme

- Theory – 45 %
  - Quiz and in Class activities
    - Quiz 1 → 10%
    - Quiz 2 → 15%
    - Quiz 3 → 20%

- Lab and presentation – 55 %
- Lab 1 → 10%
- Lab 2 → 15%
- Lab 2 → 20%
- Final Presentation → 10%




SAFETY FIRST
YOUR LIFE DEPENDS ON IT

UNITED STATES DEPARTMENT OF LABOR

Find it in OSHA

A TO Z INDEX

Occupational Safety and Health Administration

English | Spanish

OSHA | WORKER | EMPLOYER | STANDARDS | ENFORCEMENT | CONSTRUCTION | TOPIC | NEWS/RESOURCES | DATA | TRAINING

Return to Accident Search Results

Accident Report Detail

Accident: 112475.015 - Employee Is Crushed And Killed By Wind-Up Machine

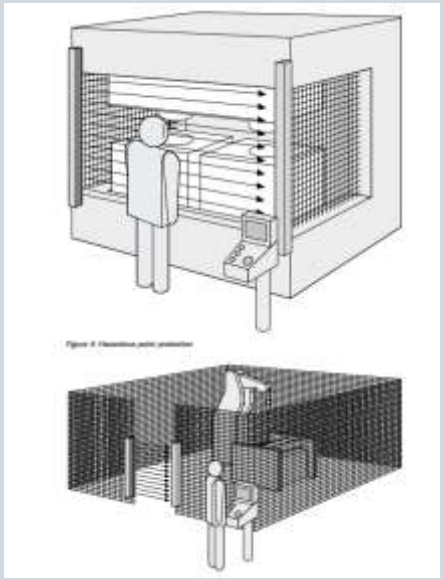
Accident: 112475.015 -- Report ID: 0454712 -- Event Date: 01/10/2019

Inspection	Open Date	SIC	Establishment Name
1370482.015	01/10/2019		Sontara Old Hickory Inc

At 5:45 p.m. on January 10, 2019, an employee was operating the SL-2 wind-up machine. The employee's head was crushed between the primary arm and a stationary component on the SL-2 wind-up machine. The automatically actuated primary arm cycled while the employee's head was in the path of the arm. The employee sustained an acute head injury, with heavy cranial trauma.

Keywords: robot, crushed, lockout/tagout, head

Employee #	Inspection	Age	Sex	Degree	Nature	Occupation
1	1370482.015	59	M	Fatality	Concussion	Machine operators, not specified



			ent Date	Report ID	Fat	SIC	Event Description
			/10/2019	0454712	X		Employee Is Crushed And Killed By Wind-Up Machine
			/12/2017	0418600			Worker Sustains Fractured Hip When Struck By Robot
			27/2017	0214500			Employee Is Injured When Struck By 100 Pound Bag Of Flour
			/17/2017	0950644			Employee Is Struck By Robot Arm And Sustains Fractured Stern
			/16/2013	0454712	X	3711	Employee Is Struck By Axis Arm< Later Dies
			07/2013	0452110	X	3714	Maintenance Worker Is Struck And Killed By Robot
			/15/2012	0552652	X	3465	Robot Crushes And Kills Worker Inside Robot Work Cell
☐	8	202509683	11/29/2012	0950622		5099	Employee Suffers Head Injures In Fall On Energized Track
☐	9	200785285	08/02/2011	0626300	X	2051	Employee Is Killed When Caught In Equipment
☐	10	202475737	07/21/2009	0950636	X	5141	Employee Is Killed By Robotic Palletizer
☐	11	200052975	05/13/2007	0728900	X	2821	Employee Dies After Being Struck By Robotic Arm
☐	12	201391489	10/31/2006	0552652	X	3542	Worker Is Killed, Lockout Procedures Not Followed
☐	13	200631406	07/24/2006	0316400	X	3489	Employee Is Killed When Crushed By Robot
☐	14	200623742	03/22/2006	0454712	X	3465	Employee Dies When Struck By Robotic Equipment
☐	15	201634839	11/16/2004	1054112		3325	Employee Fractures Chest When Crushed By Robot
☐	16	202075727	03/30/2004	0453730	X	3714	Employee Was Killed By Industrial Robots
☐	17	200991081	12/13/2003	0551800	X	3714	Employee Is Killed When Caught In Robotic Arm
☐	18	171063340	07/28/2003	0854910	X	3949	Employee Is Killed When Crushed By Equipment
☐	19	202313102	01/15/2002	0950612		3674	Employee Amputates Fingers While Examining Scanner
☐	20	200101236	12/29/2001	0522300	X	3714	Employee Killed When Robot Pinned His Neck

ROBOTIC HISTORY

ROBOTIC HISTORY

WHAT IS THE BIG DEAL?!

What is a robot?

The word robot has many definitions.
What is the simplest, or most relevant to the robot you need?

Merriam-Webster:

1. “a machine that resembles a living creature in being capable of moving independently and performing complex actions”
2. “a device that automatically performs complicated, often repetitive tasks”

Robotics Industry Association (RIA), 1985:

“a re-programmable, multi-functional manipulator designed to move material, parts, tools, or specialized devices […] for the performance of various tasks”

What is a robot

- A robot is a machine that can carry out a series of action autonomously or given command by humans.
- A robot can be as small as an insect or as large as a building.
- A robot can perform the most simplest task to advance task that humans can’t even perform.
- Robots help humans to live their lives easier and safer by performing mundane and dangerous tasks for them

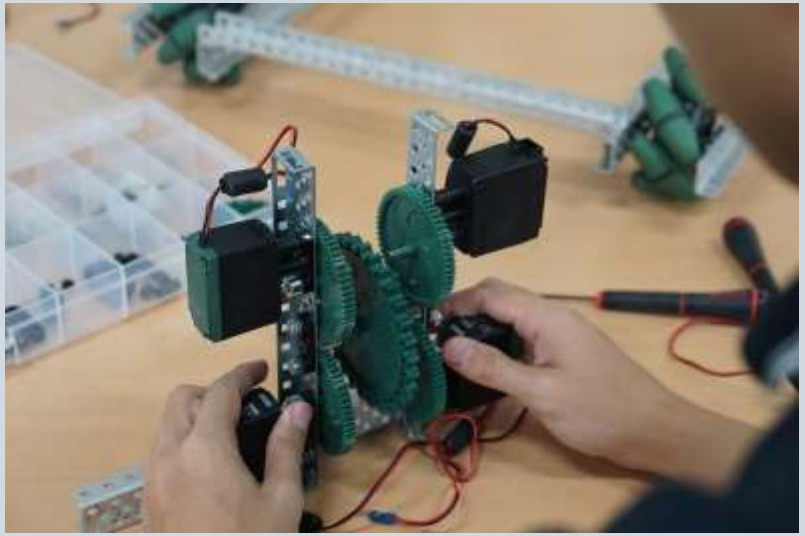
All are robots

Why would you want to learn to make a robot

-More and more of our daily tasks are replace with robots.

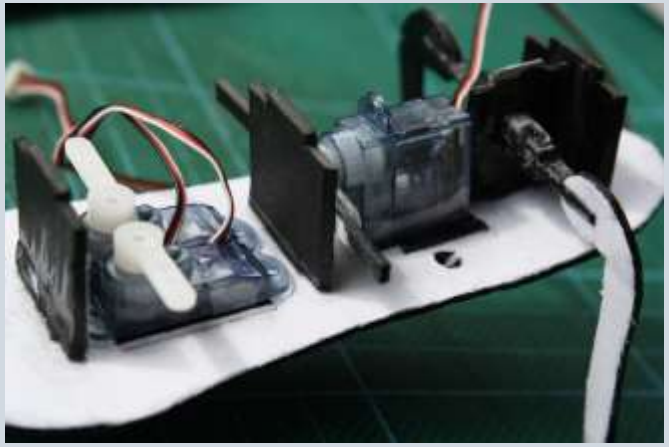
-The market for robots grows steadily as we speak and the need to robots keeps on growing

-The most important part is that, it is really fun and great learning experience



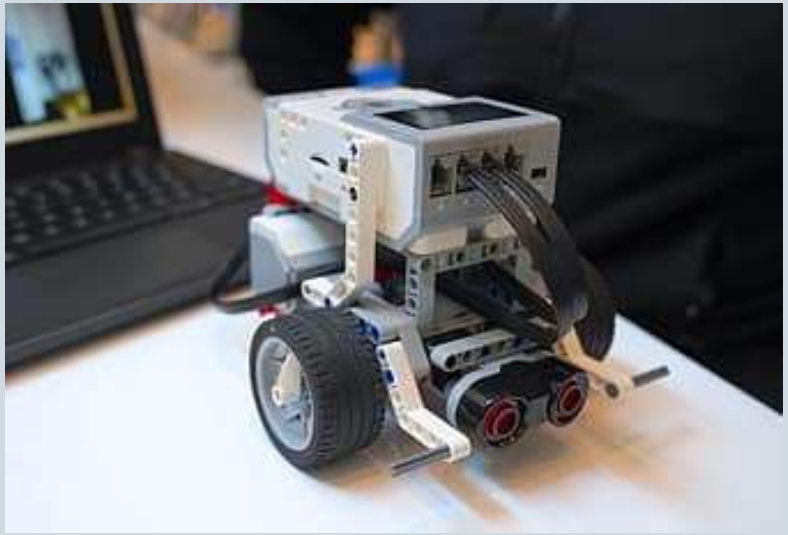
What makes a robot

- Depending on what the purpose, budget and material. Robots can vary differently
- But two very important parts robots must have are Controllers and Sensors
- Some example of other parts are encoders, manipulator, endeffector, motor



Controller

- Controller is the brain of the robot
- Controller processes the code that we write into commands that the robot follows and processes any data and feedback the robot collects



What do you need a robot for?

Consider what you would like to use a robot for: what does it need to do, what doesn't it need to do?

Robots can be used for a wide range of specialized applications, determining what you need it for will be a great beginning to building your own!

- Household applications
- Extreme environments
- Industrial applications
- Entertainment
- Navigation
- Healthcare
- Competitions
- Education / Learning

Industrial robots

Educational robots

Competition robots

Examples!

Extreme environment robots

Household robots

Fun Facts

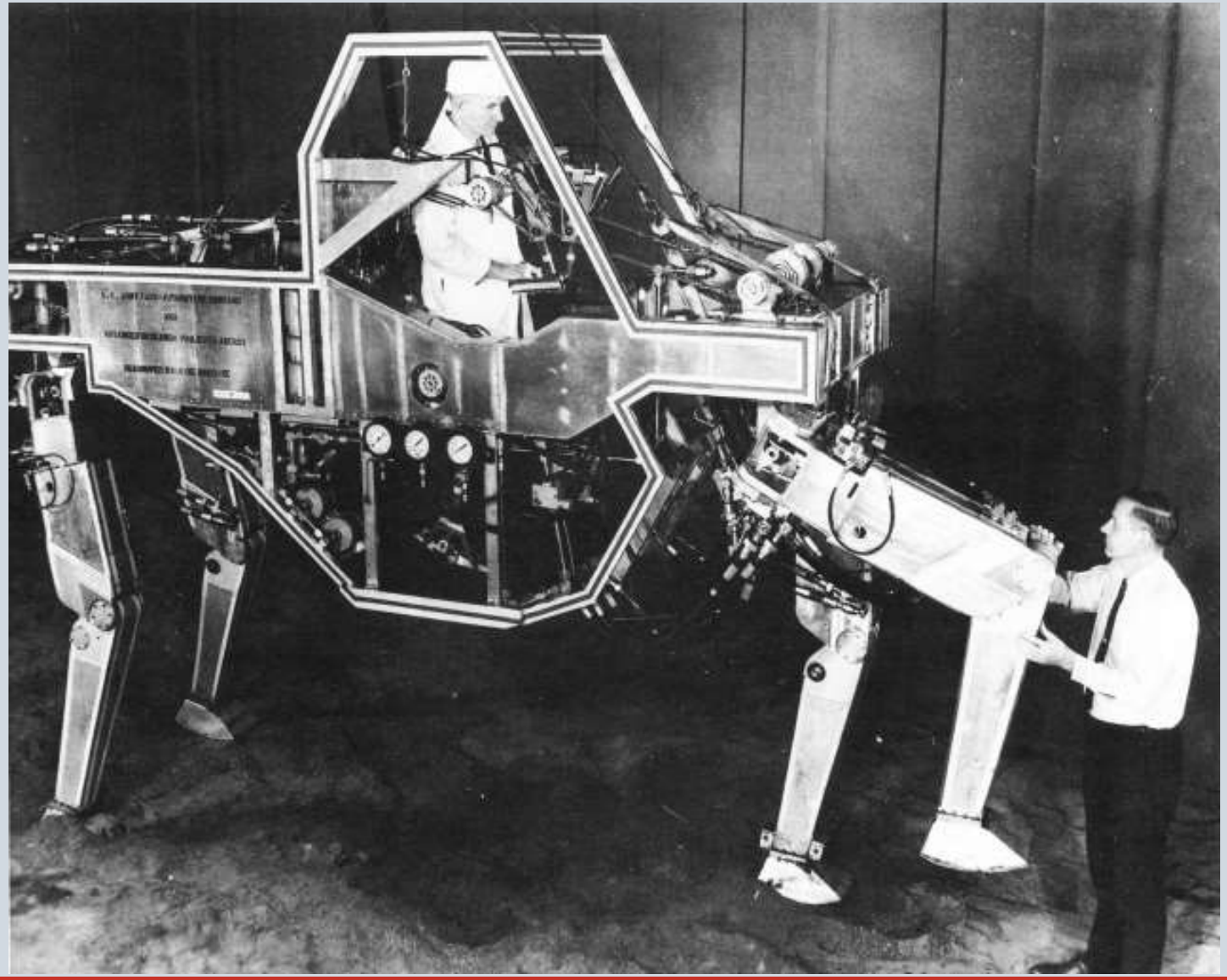
1952: First Numerically Controlled

The first modern industrial robots: “Unimates”

1962: GM Installed its first Unimation

First Walking Robot

Walking Truck large (3,000 pounds) four legged robot that could walk up to four miles per hour. The walking truck was the first legged vehicle with a computer-brain, developed by Ralph Moser at General Electric Corp in 1960.



Robotics Norms

A robot may not injure a human being

A robot must obey the orders given it by human beings, except where such orders would conflict with the first law.

A robot must protect its own existence as long as such protection does not conflict with the first or second law.

Parts of a Robot

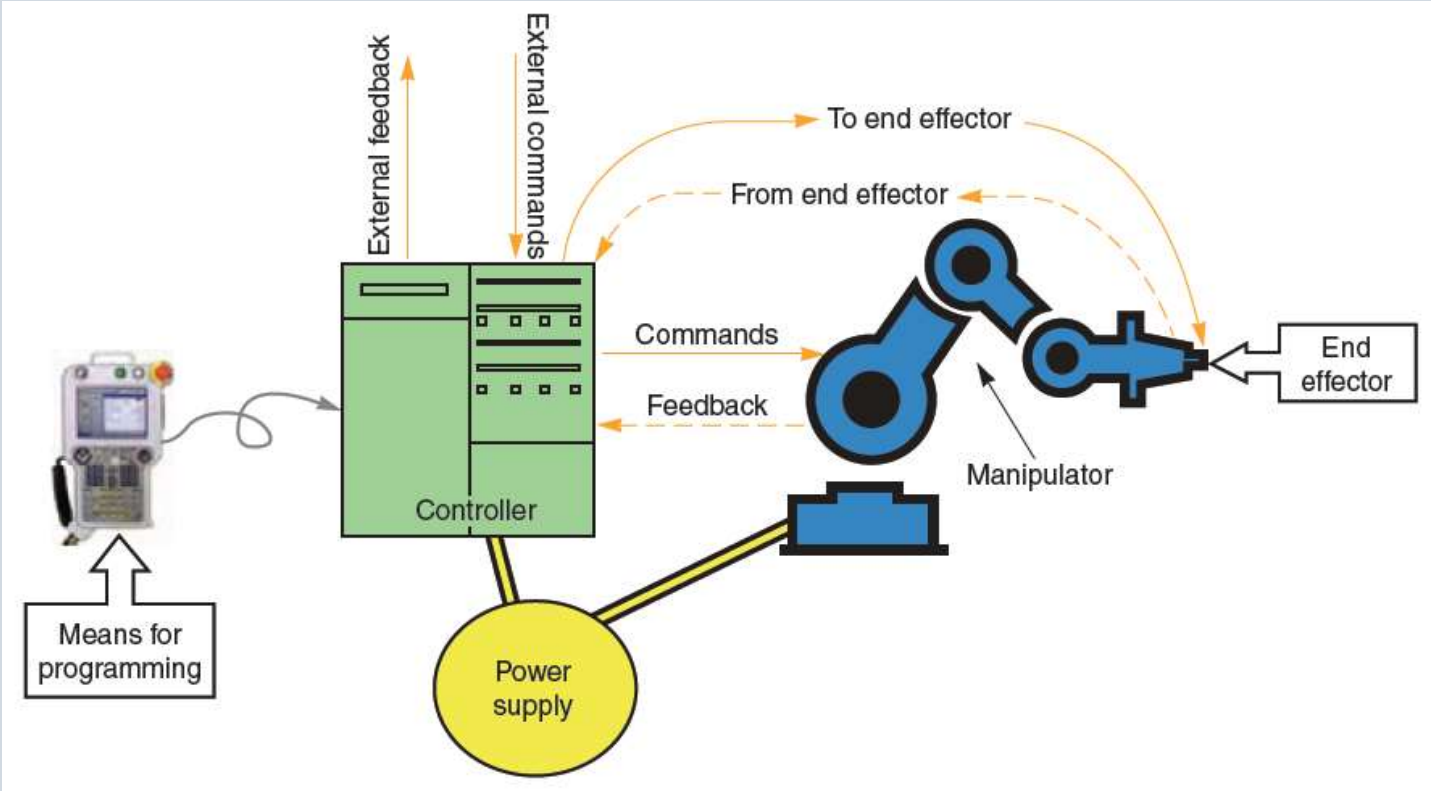
Manipulator

End Effectors

Controller

Power Supply

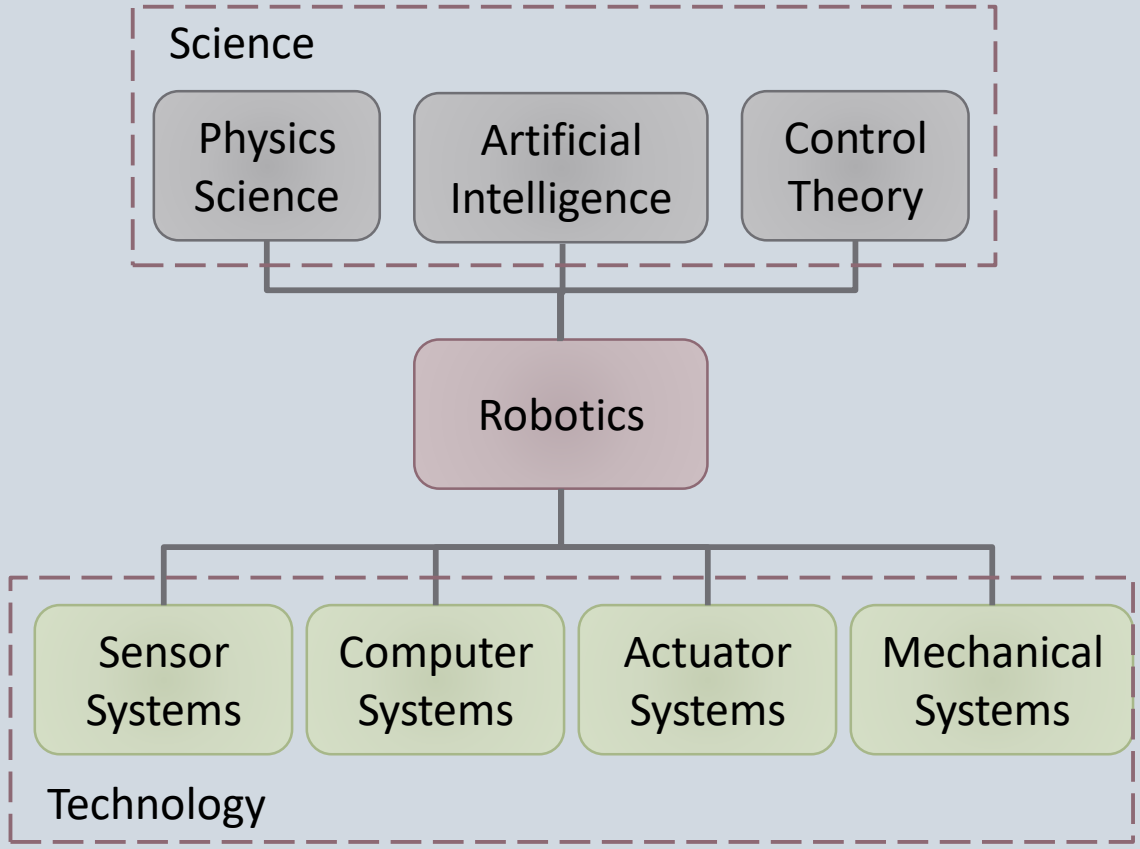
Programming



What is Robotics?

Robotics is the study of robots, autonomous embodied systems interacting with the physical world.

Robotics addresses **perception**, **interaction,** and **action**, in the physical world.



What is Robotics?

Most real-world robots today do perform such “obligatory work” in highly controlled environments, e.g. Factory automation (e.g. : car assembly)

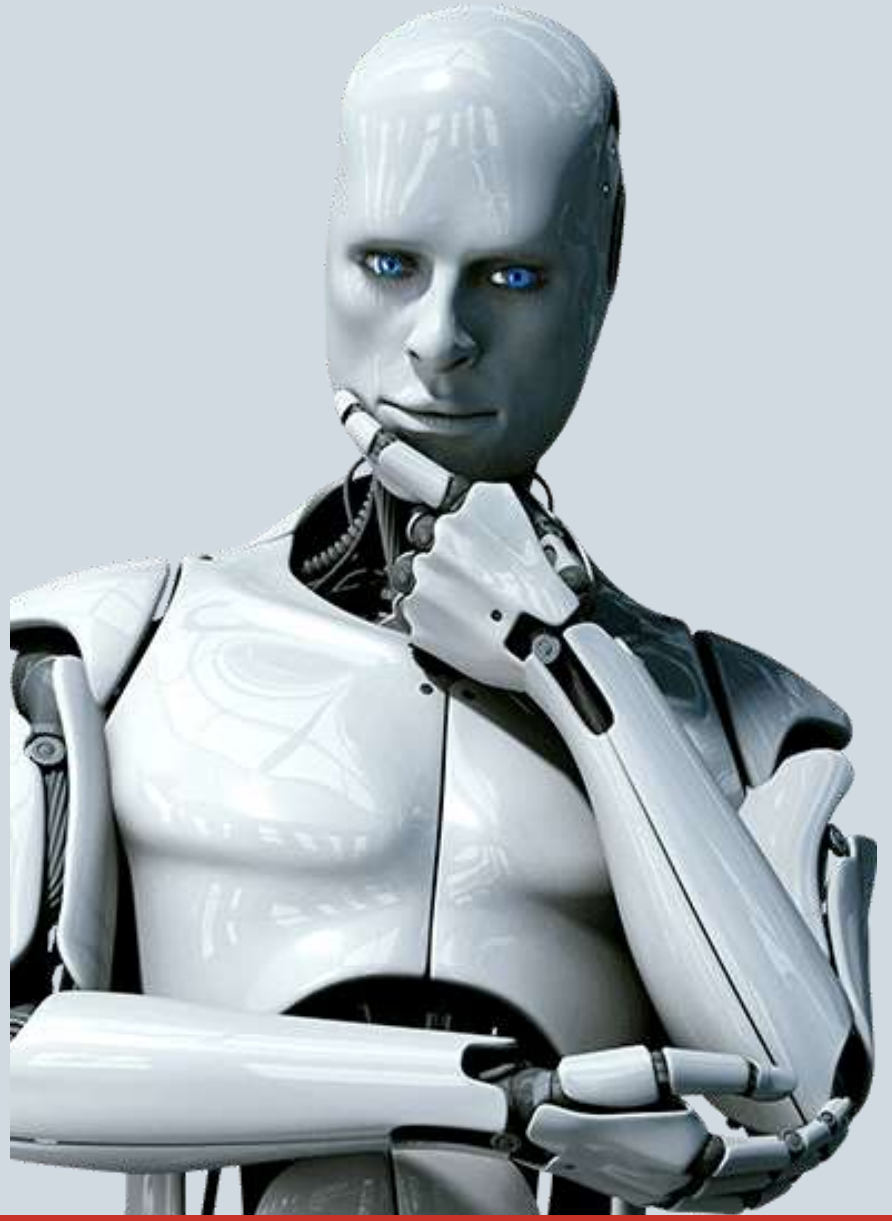
But that is not what the robotics research is about. The robots are becoming more intelligent and functional in non-controlled environments.

What is Robotics?

Karel Capek's 1921 play RUR (Rossum's Universal Robots) coined the work robot.

It is (most likely) a combination of two Czech words:

- **robota** (obligatory work)
- **robotnik** (worker)



What is Robotics?

There is no widely accepted definition of robot.

Robotics Industry Association (RIA), 1985

- "A re-programmable, multi-functional **manipulator** designed to move material, parts, tools, or specialized devices […] for the **performance of various tasks**"

An **autonomous** system which exists in the **physical world**, can **sense** its environment and can **act** on it to achieve some goals

Classification of Robots

Some of the possible classification schemes are based on:

Anatomy (Body)

Control of movement

Kinematics/Geometry Structure

Energy Source

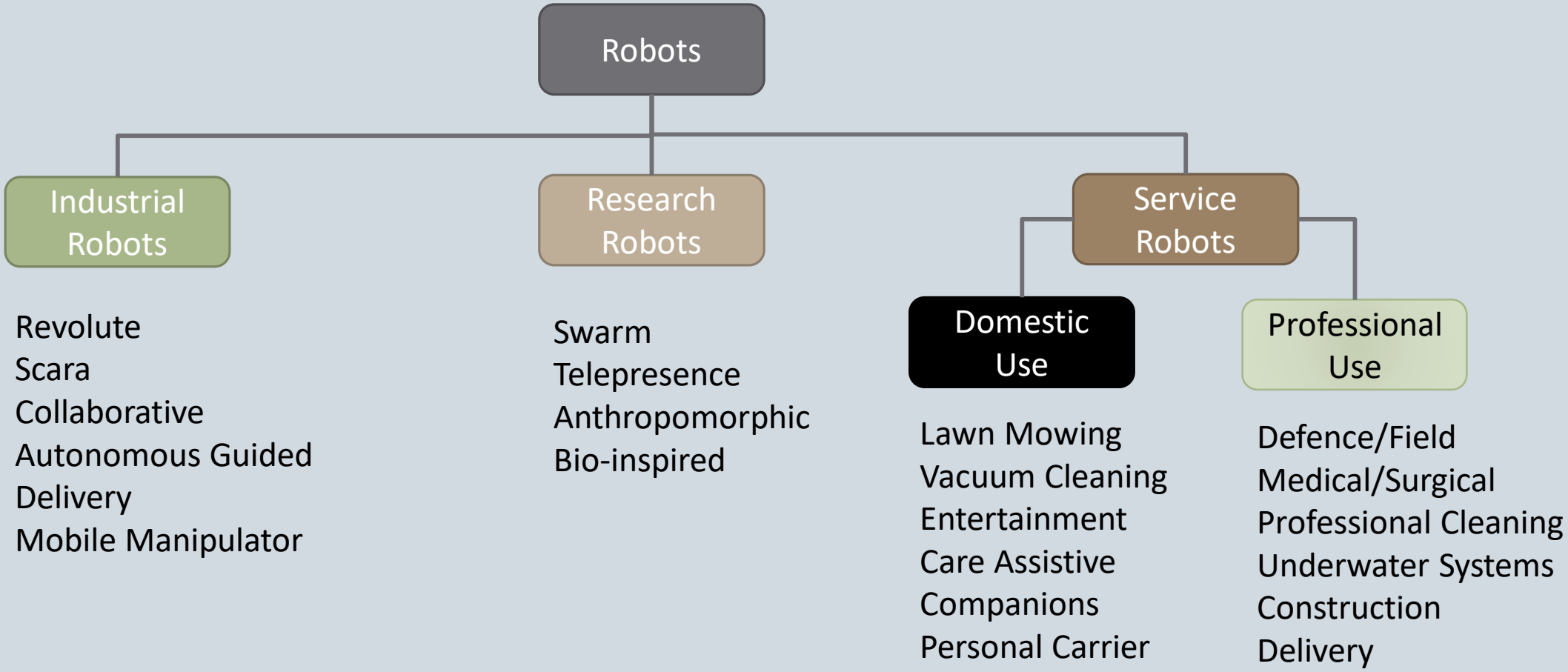
Industry/Non-industry

Technology Level

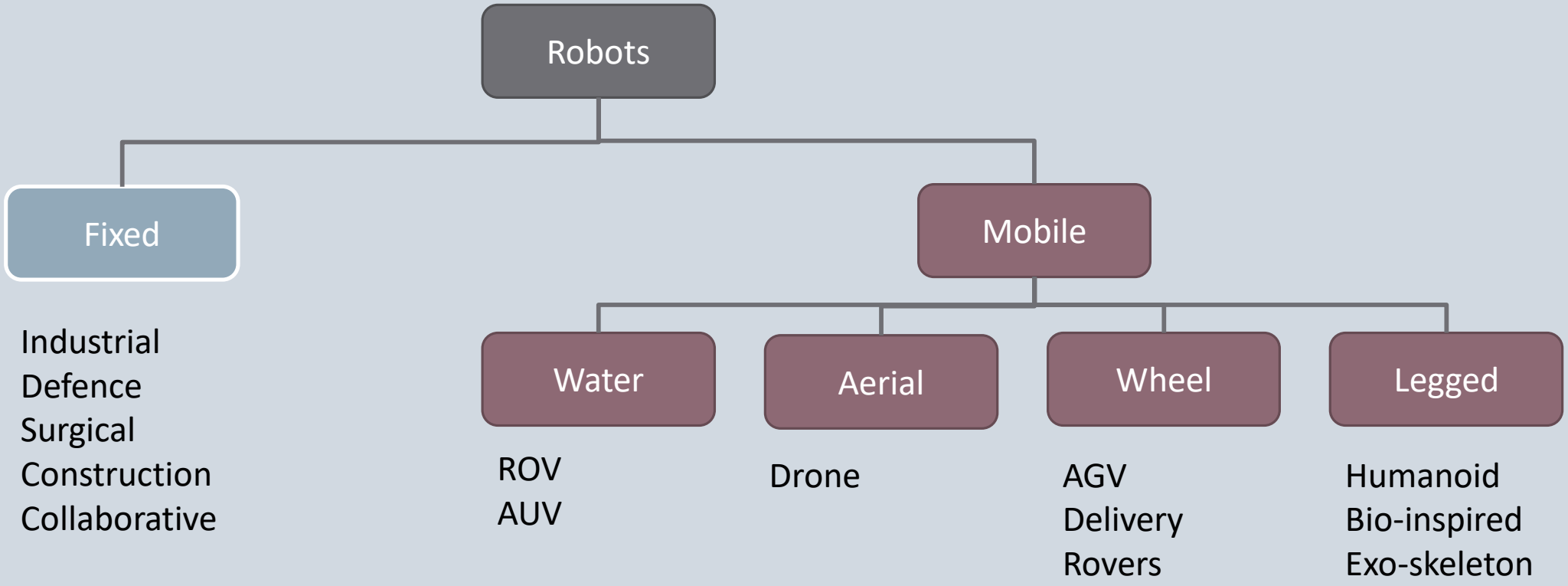
Application

Often robots could fall into several categories

Classification of Robots



Classification of Robots



Robotic Systems

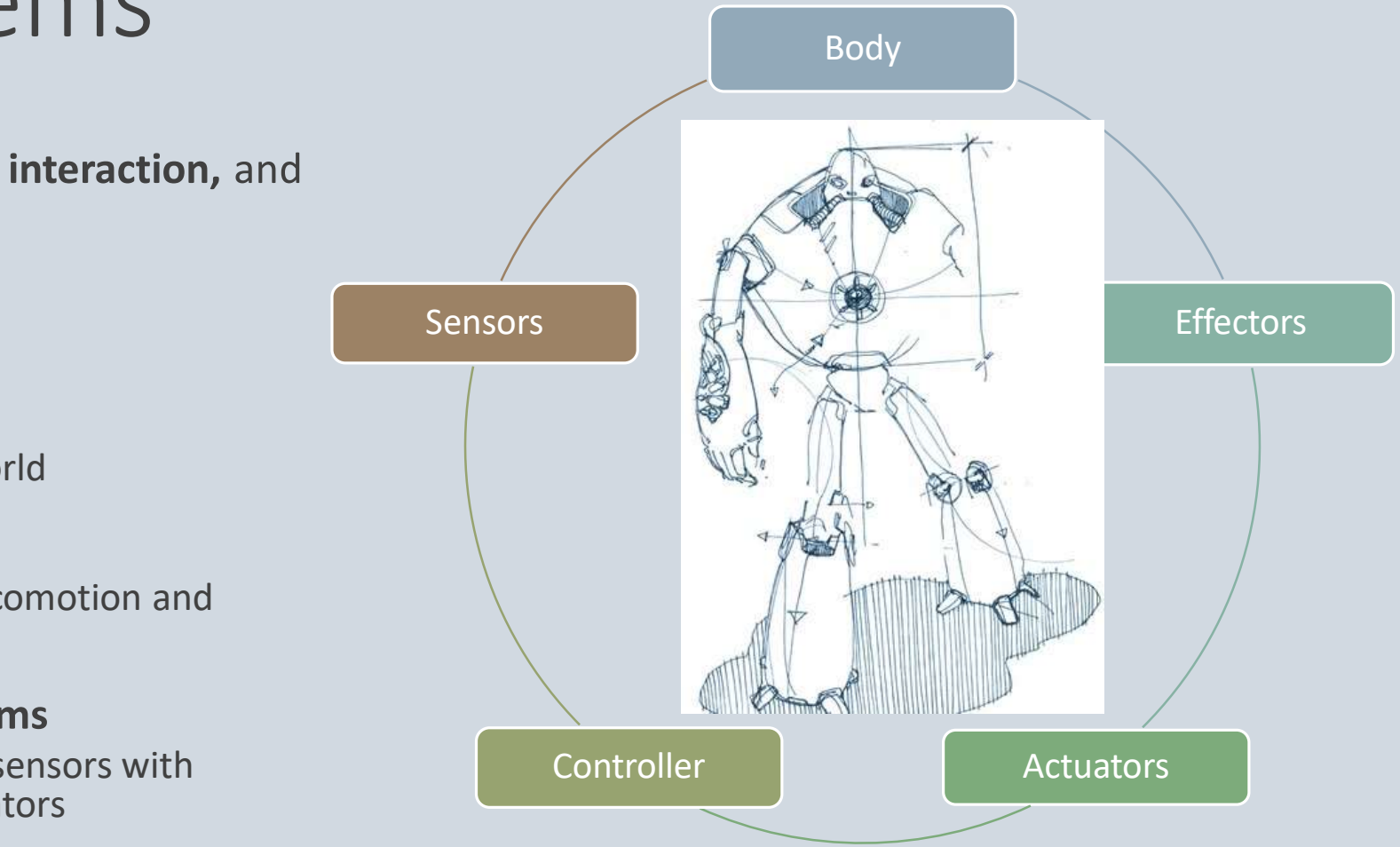
Robotics addresses **perception**, **interaction,** and **action**, in the **physical world**.

Body
- Mechanical parts

Sensors
- Allows the perception of the world

Effectors and Actuators
- Used for action in the world (locomotion and manipulation)

Controllers for the above systems
- Coordinating information from sensors with commands for the robot's actuators



Why Robots?

There is a lot of motivation to use robots to perform task which would otherwise be performed by humans.

Safety

Efficiency

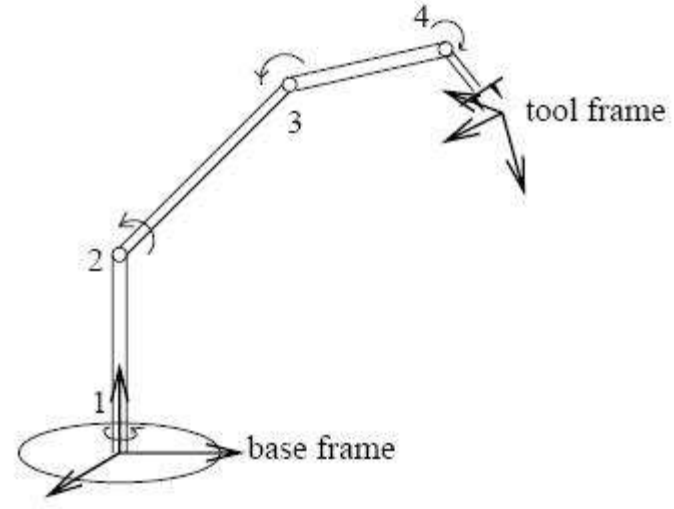
Reliability

Worker Redeployment

Cheaper

Industrial Robots..

- A manipulator is defined by set of links connected through hinges or joints that allows relative motion between two consecutive links



SOME MAJOR ROBOT MANUFACTURERS

Controller

The ***controller*** is the part of a robot that coordinates all movements of the mechanical system. It also receives input from the immediate environment through various sensors. The heart of the robot's controller is generally a microprocessor linked to input/output and monitoring devices.

Means of Programming

The means for programming is used to record movements into the robot's memory. A robot may be programmed using any of several different methods. The ***teach pendant*** teaches a robot the movements required to perform a useful task.