

# EXPLORE ROBOTICS – CISC 1003

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# Topics

- Class syllabus
- Introduction to Robots
- Introducing the virtual environment

# Course Syllabus

- [Course Syllabus](#)

# Course Syllabus

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Office Location: Ingersol 2156A
- Office hours: Tuesdays, Thursdays 3:30 – 4:30 pm

# Course Syllabus

- Online Course Webpage:  
<http://thalevi.github.io/CISC1003>

Course has 6 units. Each unit includes:

- 1-2 Lectures
- 1-2 virtual labs
- 1-2 assignments

# Course Conflicts

- This class does not support conflicts with other classes/activities
- Attendance is mandatory
- ***We will not be accommodating midterm/final exam conflicts due to taking overlapping class***

# Course Syllabus (Cont.)

- Attendance: This is a hands-on course. There is no option of making up missed labs.
- We will be working with the virtual lab online:
  - [VEX CODE VR](#)
- We will be creating programs with:
  - [VEX Virtual Lab](#)

# Books

- Books:
  - **Elements of Robotics**, Mordechai Ben-Ari and Francesco Mondada
    - <https://link.springer.com/book/10.1007/978-3-319-62533-1>
    - Direct Download Link:  
<https://link.springer.com/content/pdf/10.1007%2F978-3-319-62533-1.pdf>



# Books

- Books:
  - **Introduction to Autonomous Robots**, Nikolaus Correll
    - v1.9, March 6, 2020, Magellan Scientific ISBN-13: 978-0692700877
    - Direct Download Link:  
<https://github.com/correll/Introduction-to-Autonomous-Robots/releases/download/v1.9.2/book.pdf>

# Books

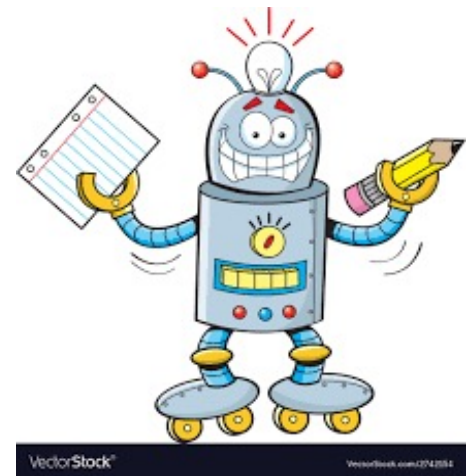
- Books:
  - **The Robotics Primer**, Mataric, 2007
    - Publisher: The MIT Press (September 30, 2007)  
ISBN-10: 026263354X  
ISBN-13: 978-0262633543

# Course Syllabus(cont.)

- Assignments include:
  - Written, take home
  - Quizzes, tests
  - In-class presentation
    - Demonstrations, slide-show, etc.

# Student Introduction

- Please take a minute to introduce yourself:
- Name
- Year
- Department/Major
- Why are you taking robotics

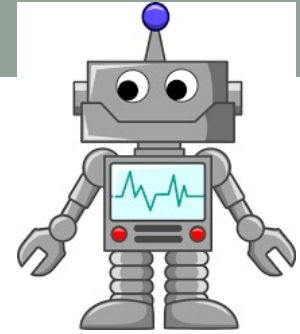


# Questions?



# Unit A - Introduction to Robots

- Why study robotics?
- What is a robot?
- Robots in society
- Robot components
- Introduction to the course robots

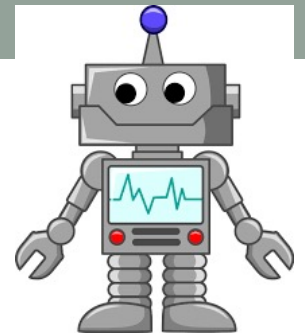


# Why study robotics?

- Introduction to computational aspects of robotics
- Interdisciplinary - related to other disciplines
  - Artificial Intelligence, Computer Vision, Control Systems, Neuroscience, Biology
- Instant feedback
  - Robots moves, makes noises, etc.
- Developing field
  - Robots will change the world we live in
  - Potential future career path...

<https://edspace.american.edu/perf683/2015/10/02/how-easy-would-it-be-for-a-robot-to-takeover-your-job/>

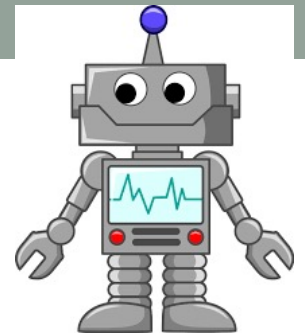
# .What is a robot?



- “A robot (also called a droid) is a machine —especially one programmable by a computer— capable of carrying out a complex series of actions automatically.” — Wikipedia



# What is a robot?



- Robots can be autonomous or semi-autonomous
- can refer to both physical robots and virtual software agents
- We focus on “AUTONOMOUS” mobile robots.
  - These robots can be considered “agents” in the physical world...

# Autonomy



- What is an autonomy (autonomous)?
- Derived from ancient greek:
  - Auto = self, nomos = “law”
    - "one who gives oneself one's own law"
- Be independent, free of constraints
- Able to act on ones own initiative
- For robots ==?
  - No REMOTE CONTROL!

# Agents



- What is an agent?
- Derived from the latin word “AGERE” (todo).
- Acts on behalf of some other entity to achieve goal.
- Depends on the context: Real estate agent, chemical agent, etc.

# Agents

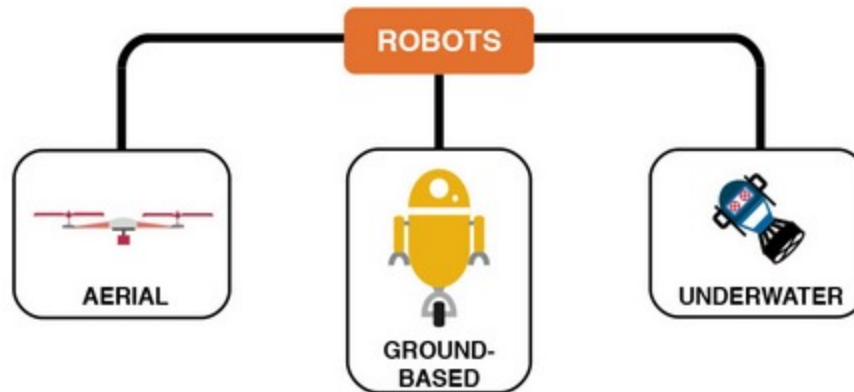


- Autonomous Agent:
  - An agent that works on behalf of someone else
  - but can make decisions on its own
    - guided by feedback (for example, from its sensors).

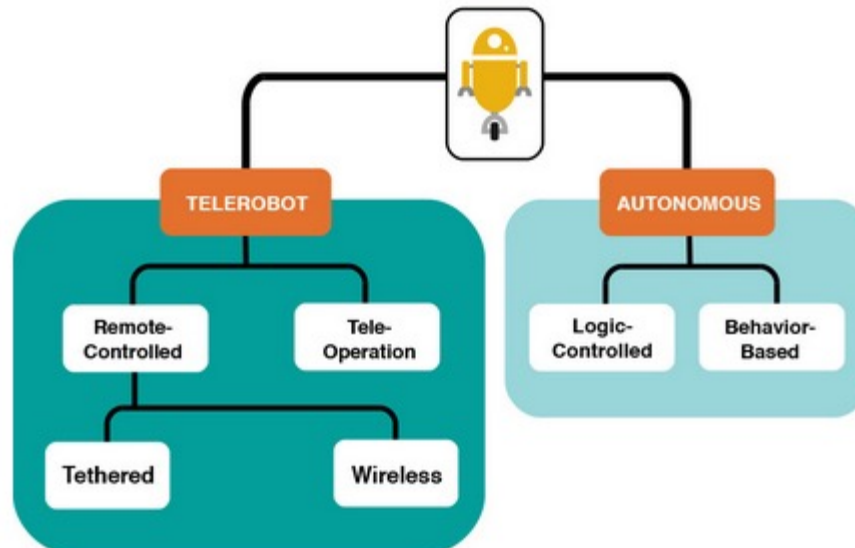
# What is a robot? (Cont.)

- Our definition of robot (for our purposes):
  - An autonomous agent, acting independently. Our environment is the real world.
  - The robot can sense its environment (including its own internal state)
    - and act on it to achieve pre-defined goals.
- Robotics: The study of robots
  - their design, construction, capabilities and purpose.

## BASIC CATEGORIES FOR ROBOTS



## TWO BASIC CATEGORIES OF ROBOT OPERATION



# Robots History



- From the Slavic word robota (“forced laborer”)
- First applied as a term for artificial automata in a 1920 play
  - R.U.R. (Rossum’s Universal Robots) , by the Czech writer, Karel Čapek
- Self-operating machines date back to the ancient China, Greece and Ptolemaic Egypt.
  - Resembling humans and animals

# Robots History



- Isaac Asimov, scientist and Sci-Fi author coined the word “Robotics” to describe the field of study.
- Asimov proposed in "Runaround" (1942) the 3 Laws of Robotics



# Asimov's laws of robotics

- A robot may not injure a human being or, through inaction, allow a human being to come to harm.
- A robot must obey any orders given to 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.

# Robots History

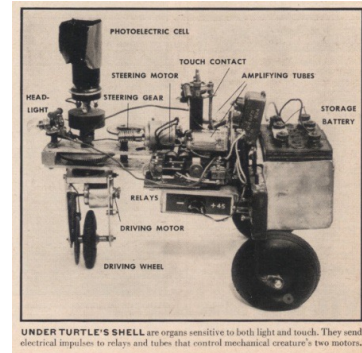


- What was the goal of these rules?
  - Ensure that robots always serve and obey humans
- Who broke these rules?
  - Hollywood broke these rules in “The terminator” [1984], “Transformers”[2007] movies



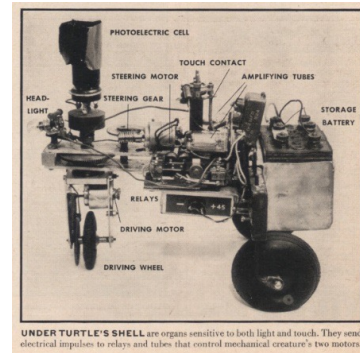
# The First Robots

- Grey Walter's Tortoises (1940):
  - Simulated biological systems (biomemetic).
  - Machines with simple sensors that could:
    - React to light - detect/follow/avoid light.
    - Track/Move/Avoid obstacles.
    - Feed (recharge batteries) – robots could find their way to a recharging station when they ran low on battery power



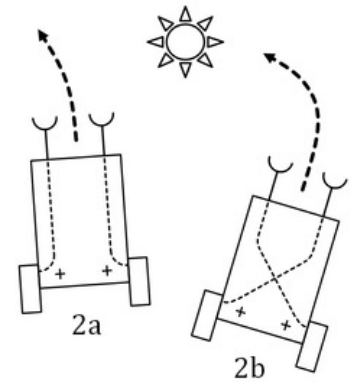
# The First Robots

- Grey Walter's Tortoises (1940):
  - Simple reasoning:
    - Reactive control using a collection of prioritized “reflexes”.
    - Could still lead to complex behavior (emergent phenomena).



# The First Robots (cont.)

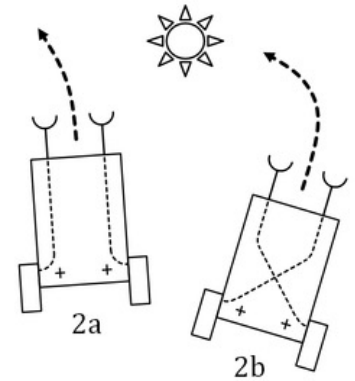
- Braitenberg's vehicles (1984):
  - Not actually built (by him) but proposed.
  - Started out with a single motor and a single light sensor
  - gradually progressed to more motors and more sensors
    - and more interesting connections between them.



\*image from [https://en.wikipedia.org/wiki/Braitenberg\\_vehicle](https://en.wikipedia.org/wiki/Braitenberg_vehicle)

# The First Robots (cont.)

- Braitenberg's vehicles (1984):
  - Excitatory and Inhibitory Connections
    - Stronger signals could induce stronger response.
    - For example, a light sensor could be connected directly to the wheels
      - so the stronger the light, the faster the robot moved, or even the inverse of the strength.



\*image from [https://en.wikipedia.org/wiki/Braitenberg\\_vehicle](https://en.wikipedia.org/wiki/Braitenberg_vehicle)

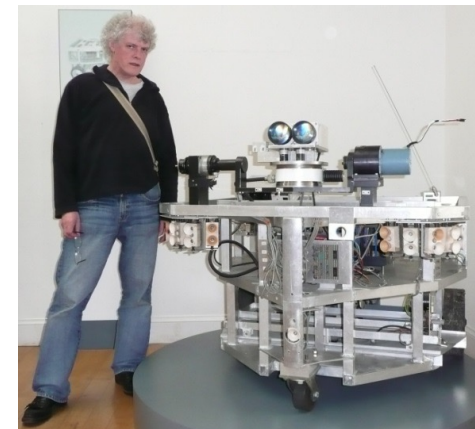
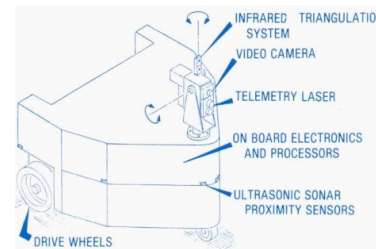
# Artificial Intelligence (AI)



- The study of "intelligent agents"
  - “devices that perceive their environment, take actions to maximize their chance of success at some goal”  
\*Wikipedia
- Field created in 1956
  - Minsky, McCarthy, Newell, Simon
  - Produced “Ground breaking” programs that could:
    - Play and win checkers, solve word problems, prove logical theorems, speak English.

# Early AI Inspired Robots

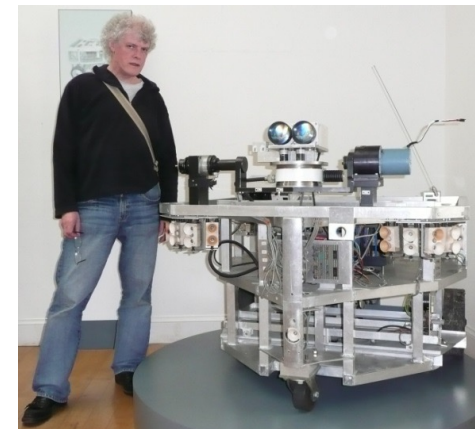
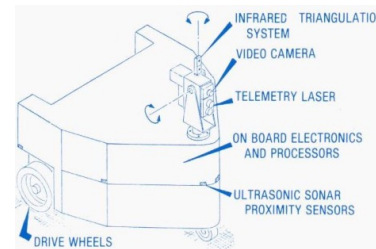
- Shakey the robot (66 – 72)
  - First general-purpose mobile robot to use “reasoning”
    - Could analyze commands, break them down into basic actions and execute them by itself.
  - Used a camera & bumper sensors to create a “map” of its environment to help it create and execute plans





# Early AI Inspired Robots

- HILAIRE(1970's)
  - Camera, ultrasound sensors, laser rangefinder.



# AI Inspired Robots (cont.)

- Rover (60's – current):
  - A space exploration vehicle
  - Some were fully autonomous
  - Camera and Ultrasound



\* <http://cyberneticzoo.com/cyberneticanimals/1977-hilare-autonomous-mobile-robot-french/>

\*\* [https://en.wikipedia.org/wiki/Rover\\_\(space\\_exploration\)](https://en.wikipedia.org/wiki/Rover_(space_exploration))

# Robots History

- [History of Robots](#)

# Robots Today and in the Future

- If a job is repetitive
  - Only requires basic direction following and decision making skills
- => A robot can AND will wind up doing it.
  - Corporations are profit driven.
  - Machines will replace humans

# Future of Robotics

GIZMODO

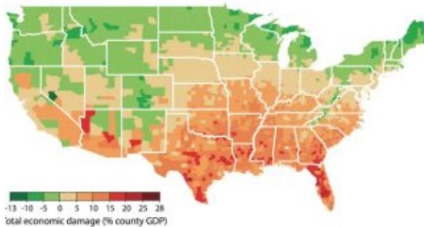
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Today 5:00pm

## Robots Are Already Replacing Human Workers at an Alarming Rate



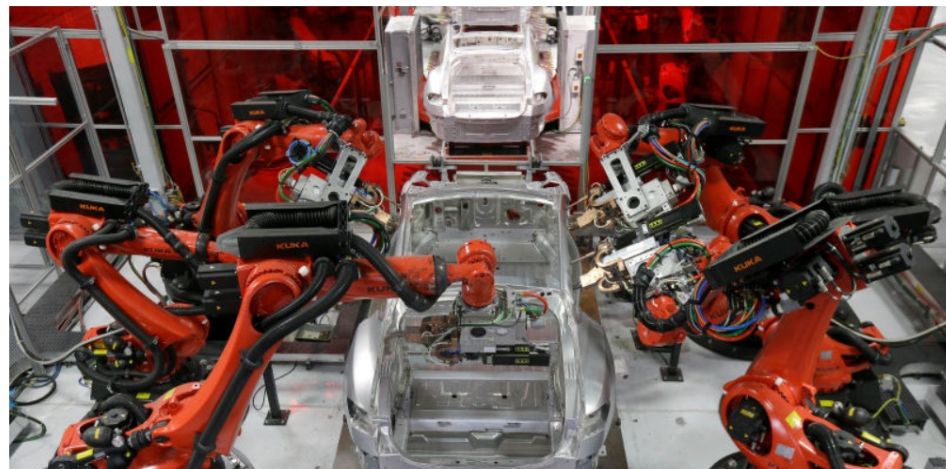
George Dvorsky

3/28/17 2:02pm • Filed to: AUTOMATION

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# Future of Robotics (cont.)

AE Q SEARCH

The New York Times

TECHNOLOGY

## *Robots Will Take Jobs, but Not as Fast as Some Fear, New Report Says*

By STEVE LOHR JAN. 12, 2017





# Future of Robotics (cont.)

**the guardian**

tion sports soccer tech arts lifestyle fashion business travel environment

≡ browse all sections

## Robots will eliminate 6% of all US jobs by 2021, report says

Employees in fields such as customer service and transportation face a 'disruptive tidal wave' of automation in the not-too-distant future



**Most popular in US**

Netflix develops marijuana strains based on its original shows

Hurricane Harvey: Texas battered by 'marathon' storm amid flooding fears - latest updates

Party poopers: rightwing rally cancelled in San Francisco amid dog poo protest

By 2021, robots will have eliminated 6% of all jobs in the US, starting with customer service representatives and eventually truck and taxi drivers. That's just

# Robot Components

- Reminder:
  - For our purposes, a robot is an autonomous agent, acting independently. Our environment is the real world.
  - The robot can sense its environment (including its own internal state)
    - and act on it to achieve pre-defined goals.





# Robot Components

- The robot needs to have:
  - A physical body – robots act in the physical world
  - Sensors
    - receive information from the outside world
  - A controller
    - Includes a computer for the needed computations

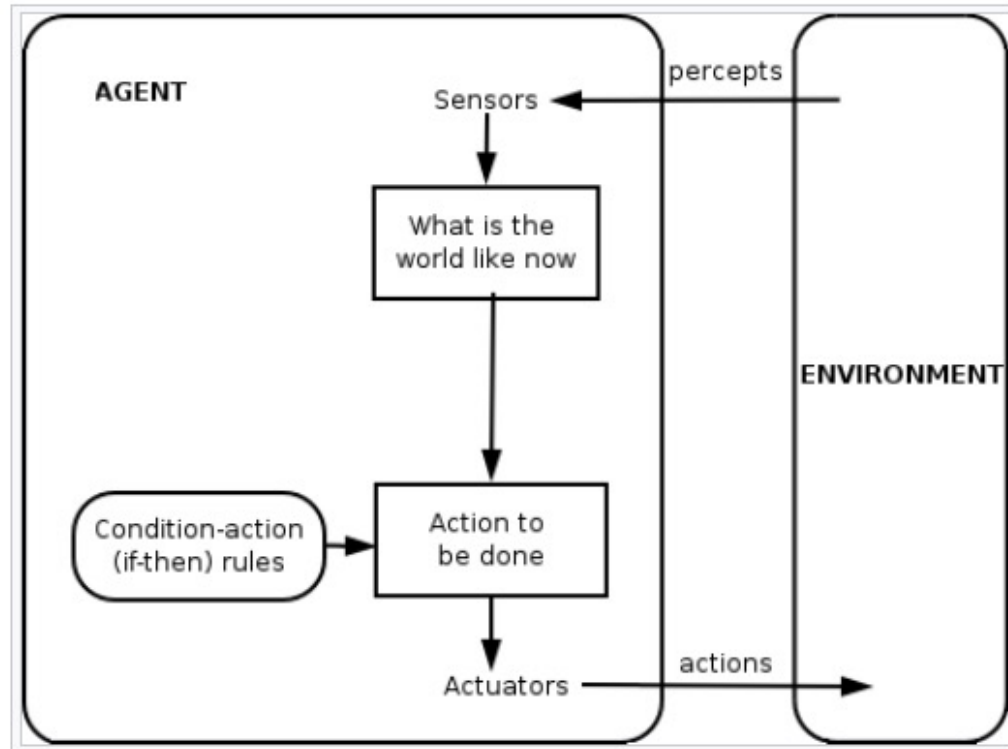


# Robot Components

- The robot needs to have (cont.):
  - Actuators and effectors – devices that enable the robot to affect the environment
    - By exerting forces upon it or moving through it
    - Include artificial muscles and electric motors
  - Power Source – batteries, solar cells, etc. Multiple power sources can be used together



# Robot Components (cont.)

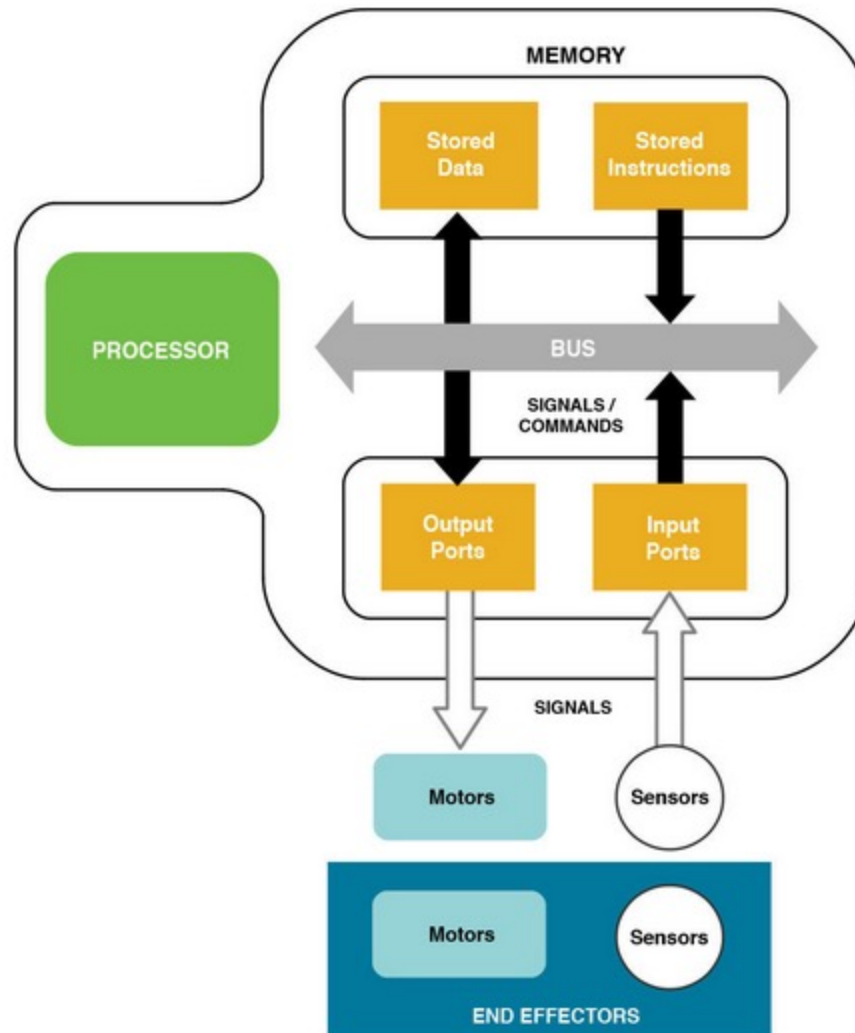


\*[https://en.wikipedia.org/wiki/Intelligent\\_agent](https://en.wikipedia.org/wiki/Intelligent_agent)

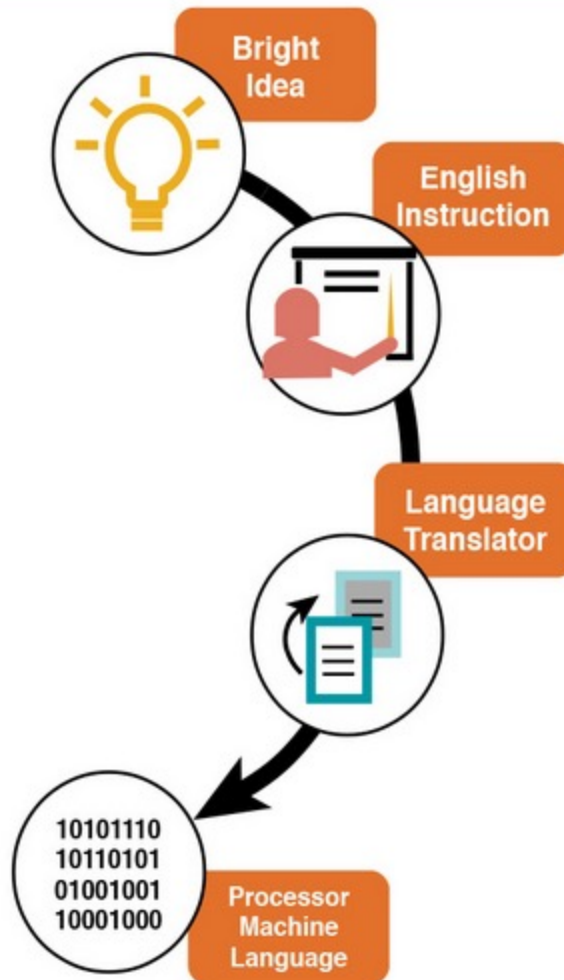
# MICROCONTROLLER

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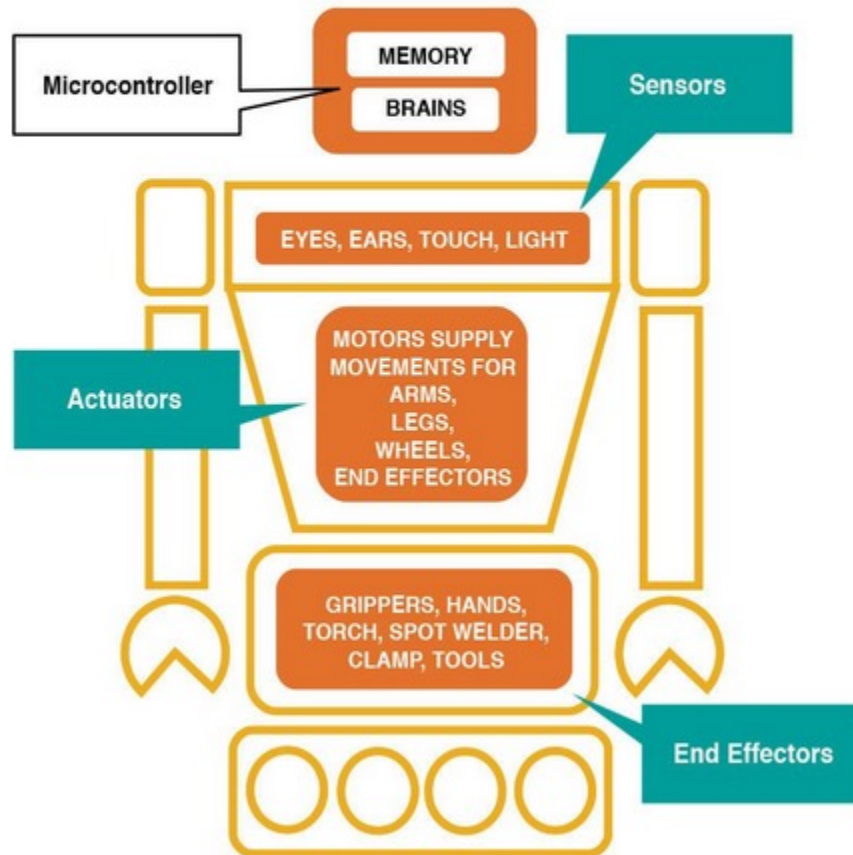
## BASIC MICROCONTROLLER COMPONENTS



## BRIGHT IDEA TO MACHINE LANGUAGE TRANSLATION



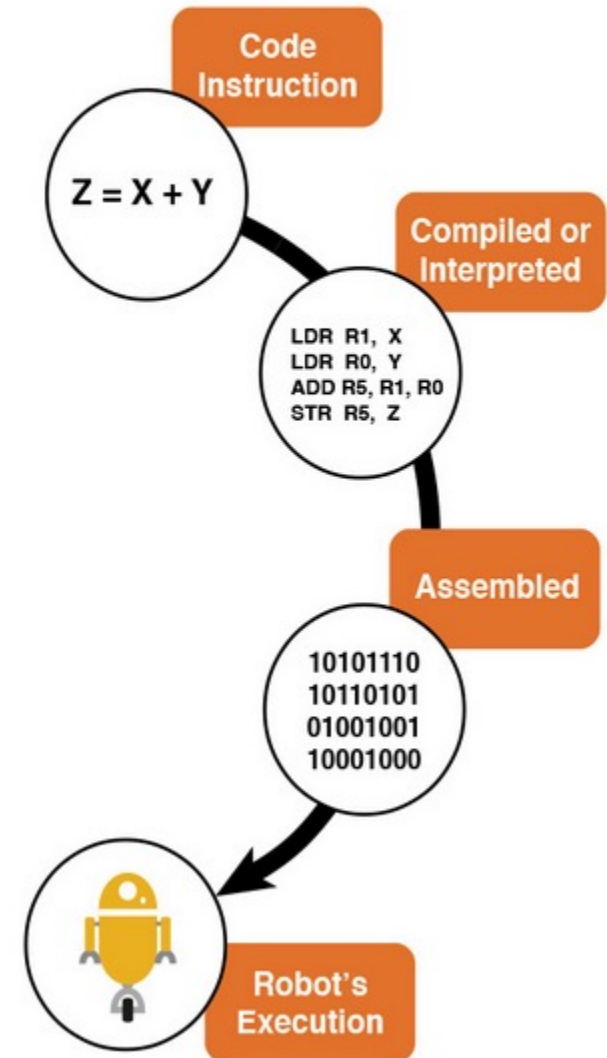
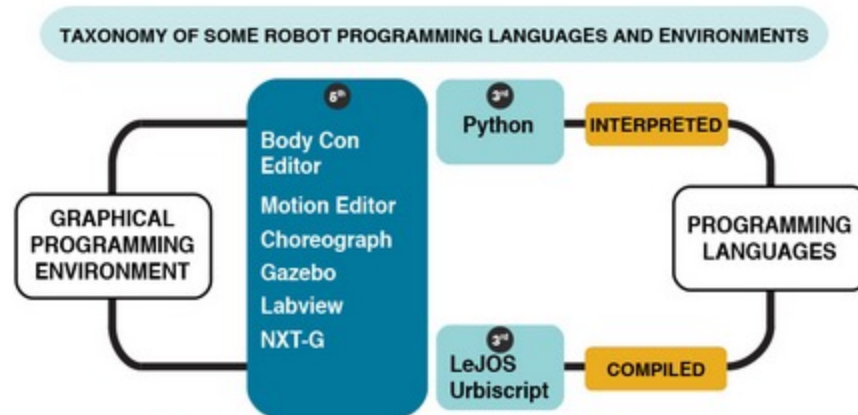
## TRANSLATED ROBOT SKELETON



# Robot Languages

## COMPILER AND INTERPRETER TRANSLATION

- Machine (Binary)
- Assembly
- Puppet Mode
- Graphical Programming





# Virtual LAB

- Let's start working online with robots!

