Robotics: Intro

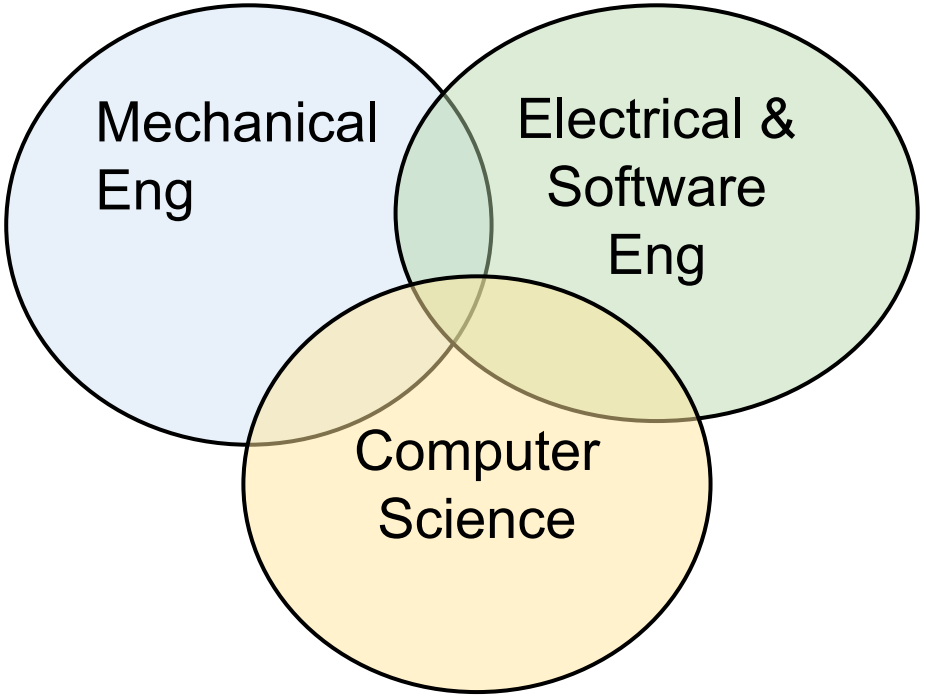
04/26/2021

Announcement

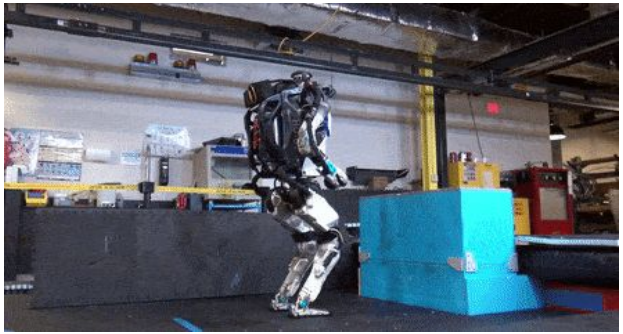
Tomorrow's lab will be hybrid

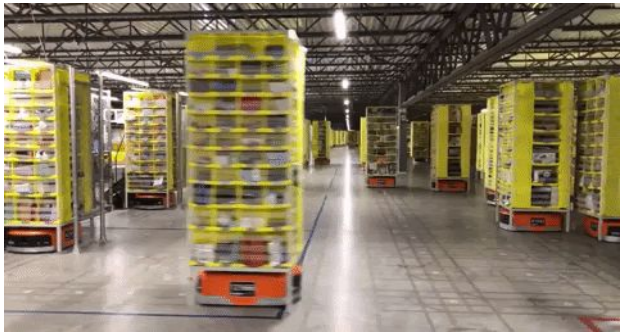
Robotics: It's interdisciplinary field

Definition: science of perceiving and manipulating the physical world through computer-controlled devices.



Some robots

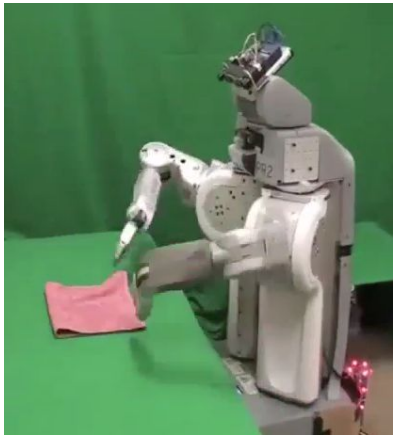


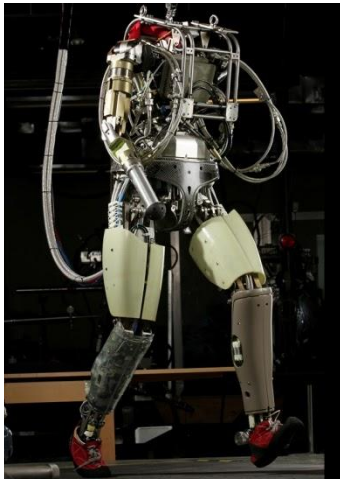


Credits to Boston Dynamics, Amazon, and other online resources

Applications

- Vehicles
- Rescue
- Soccer!
- Lots of automation…
- Planetary exploration,
- Industrial robotics arms in assembly lines,
- Manipulators that assist surgeons. [thrun et al]





Images from UC Berkeley, Boston Dynamics, RoboCup, Google

The Robot Dog Got a Job at Chernobyl

In this economy!

// BY COURTNEY LINDER OCT 28, 2020

SCIENCE & TECHNOLOGY

Robots to retrieve radioactive remnants from Fukushima, other retired nuclear plants

The £12 million 'LongOps' project is a collaboration between Japan and UK

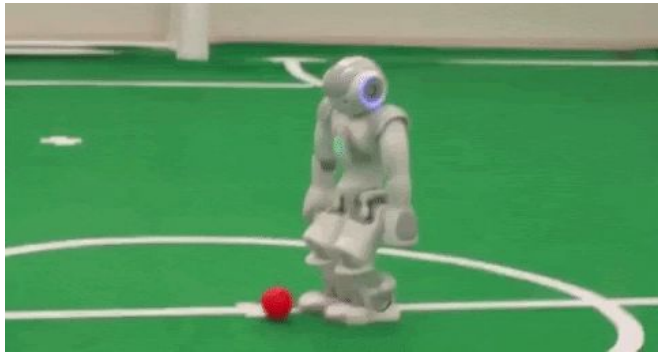
NEXT NEWS ❯

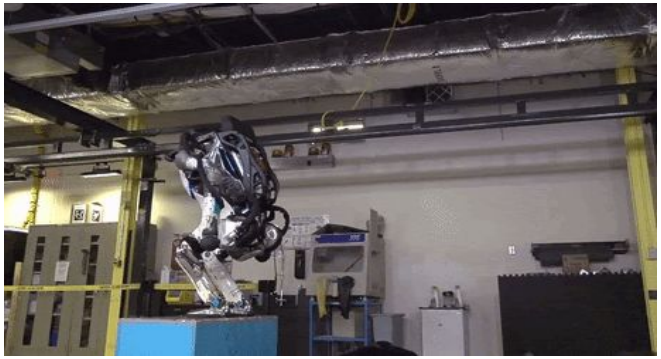
By DTE Staff
Published: Thursday 21 January 2021

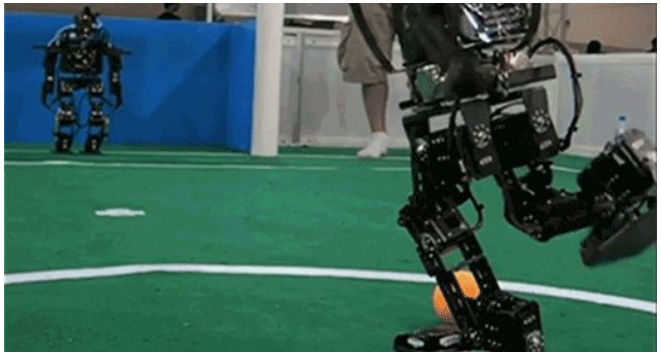
Some robots

Credits to the university of tokyo

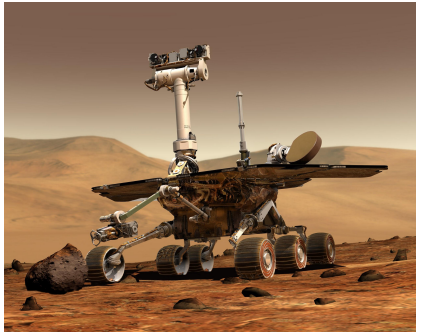
Robotics is difficult

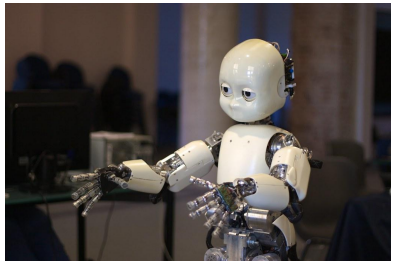






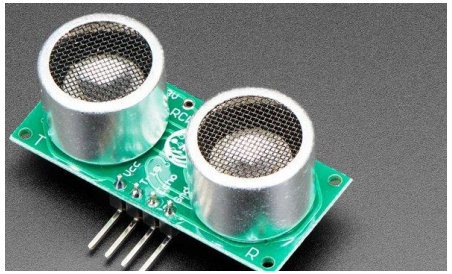
Robot types





Robot's Hardware

Sensors for perception



Sonar

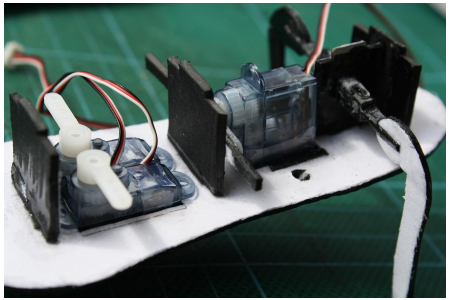
RGB-d

Laser

Robot's Hardware

Motors for actuation:

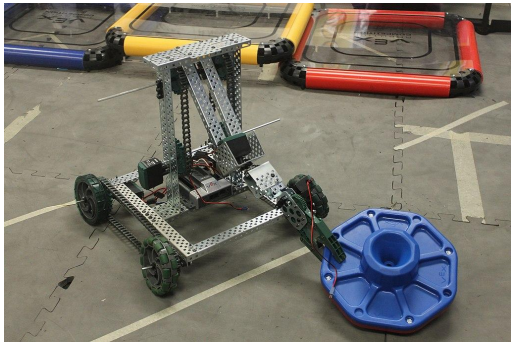
DC, stepper, servo, … motors



Robot's Hardware

Computation power

Mechanical design



Uncertainty in Robotics

Robot ***environments*** are inherently unpredictable.

Sensors are limited in what they can perceive.

- Range and resolution
- Noise
- Can break and detecting faulty sensor might be hard

Uncertainty in Robotics

Robot ***actuation*** involves motors that are unpredictable:

- Wear and tear
- Control noise

Software:

- Internal models are approximate
- Real-time systems have limited computation

Uncertainty in Robotics

Industrial robots have less environmental uncertainty while a robot operating in residential environment deals with more uncertainty

Robot motion (Act)

Modeling the robot's state transition

$p(x_t \mid u_t, x_{t-1})$

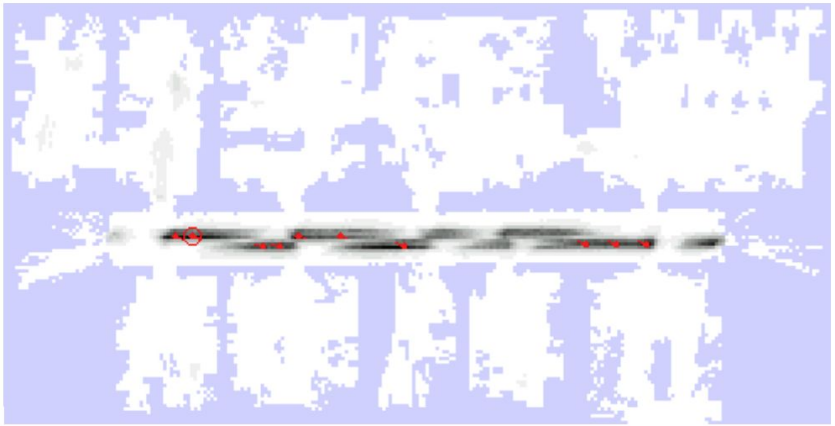
Type of surface,

Tires, Robot's geometry

Robot perception (Sense)

We need to find some model of robot motion

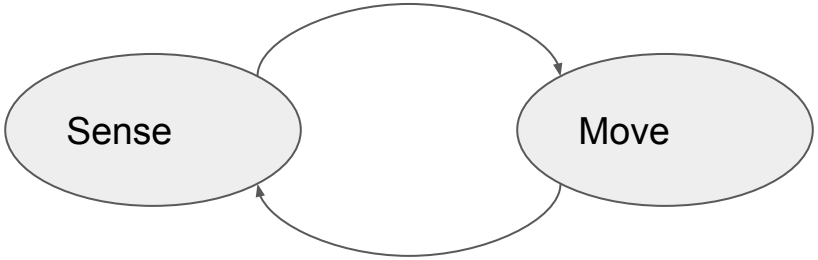
$p(z_t | x_t, m)$



Localization:

The problem of estimating a robot's coordinates relative to an external reference frame.

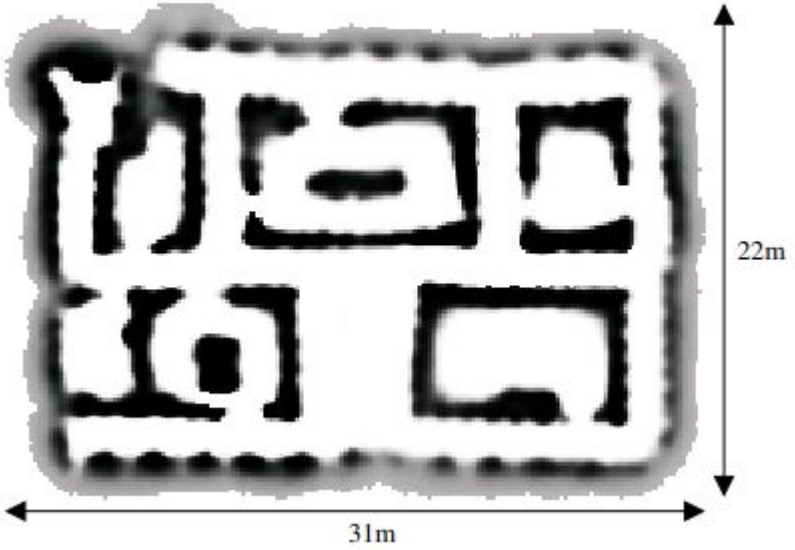
Given the map of the environment, it needs to localize itself based on sensor readings and motion.



Mapping:

Occupancy grid maps:

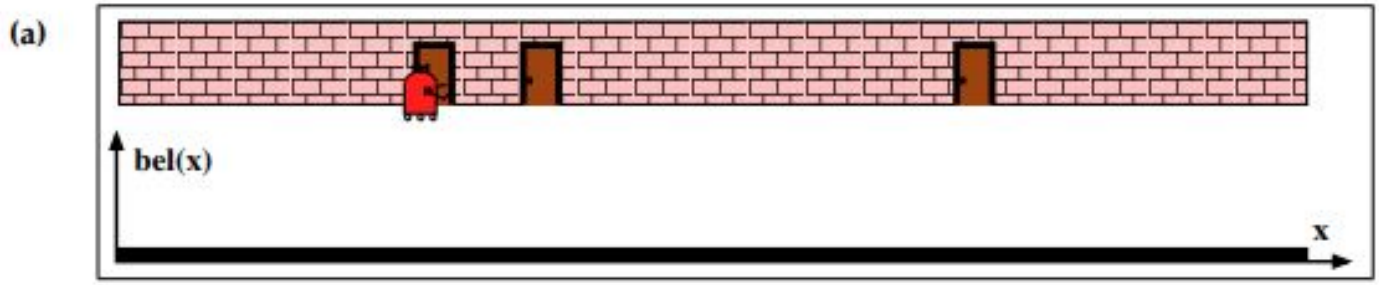
To each x,y, location a binary value is associated to show if that location is occupied or not.



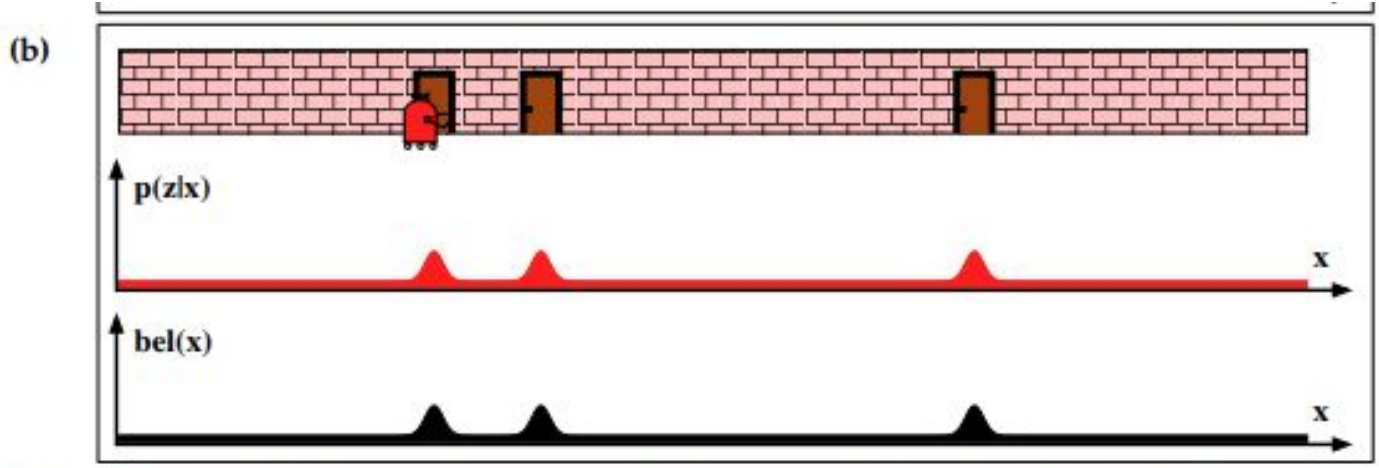
Why Mapping?

- Learning maps is one of the fundamental problems in mobile robotics
- Maps allow robots to efficiently carry out their tasks, allow localization
- Successful robot systems rely on maps for localization, path planning, activity planning etc.

Sense, Act and predict



Sense, Act and predict



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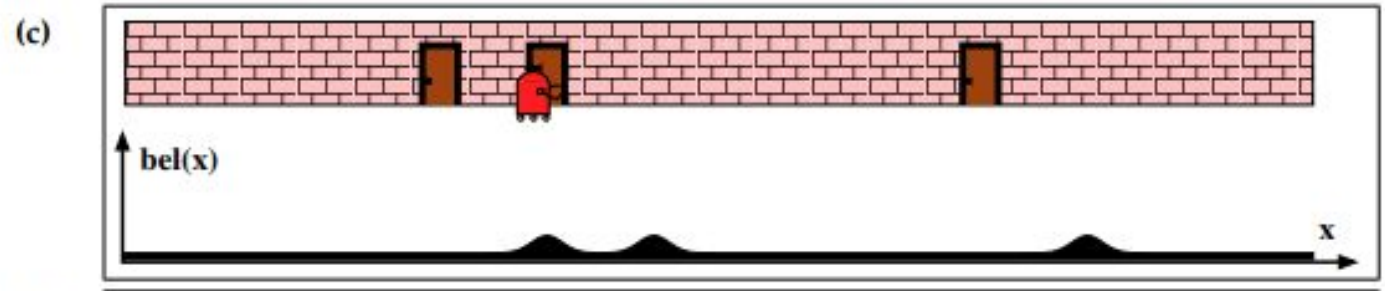

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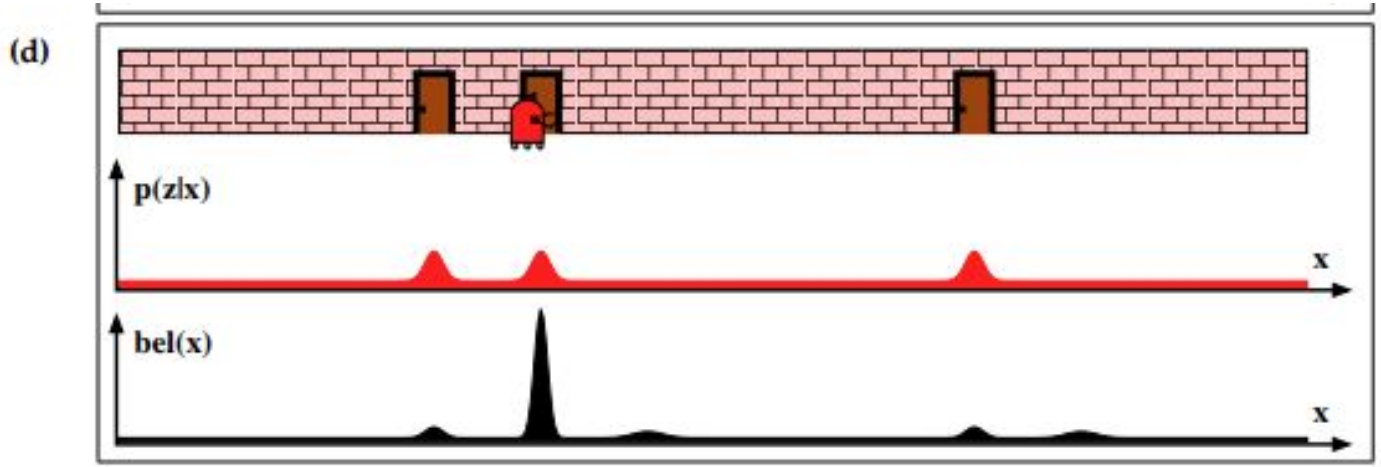
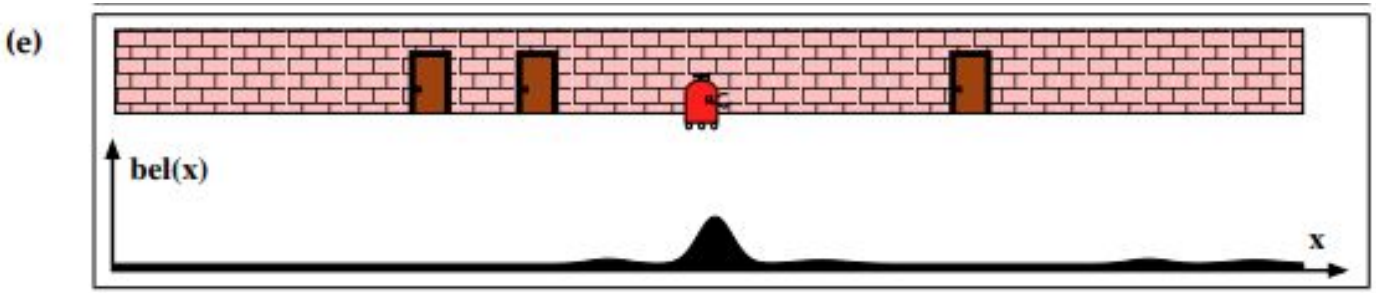


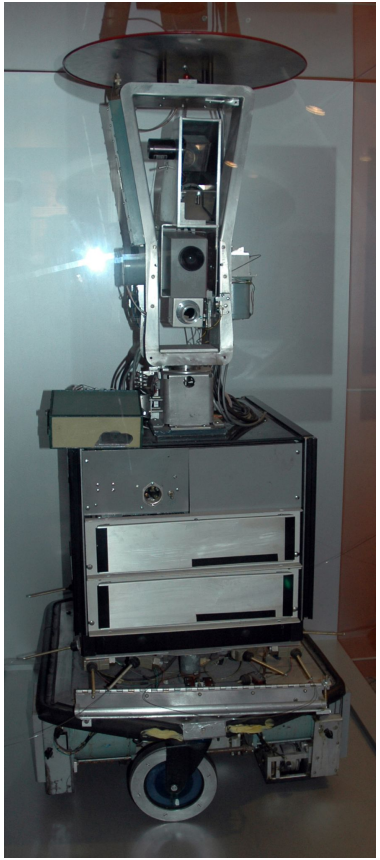
Sense, Act and predict

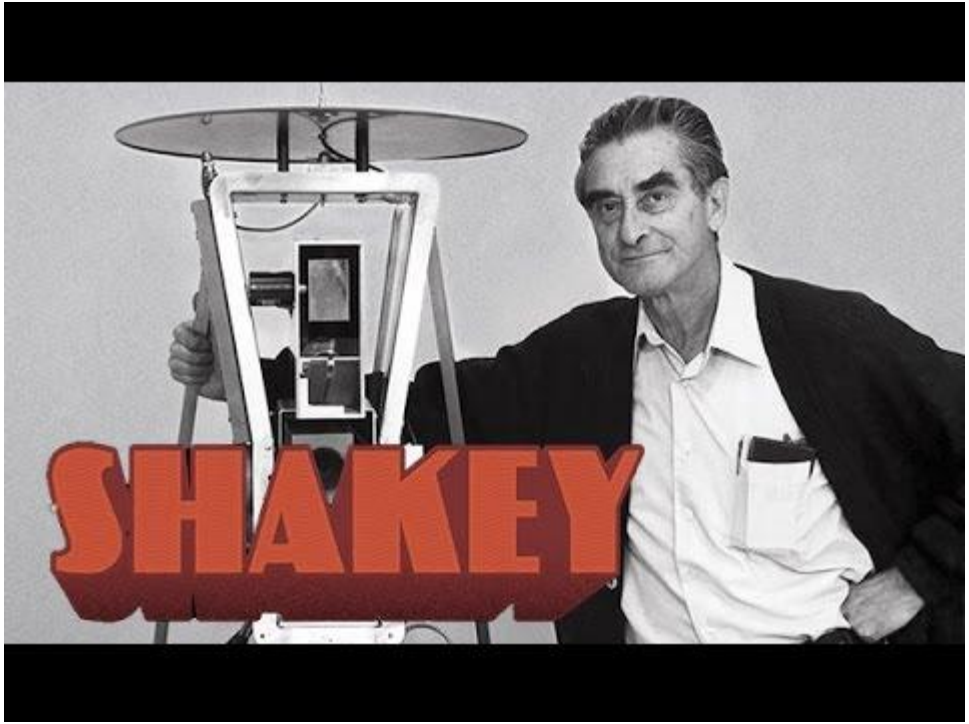


Minerva robot

1’ 45”: sensors

Shakey the robot





Segbot architecture