

Robotics: Intro

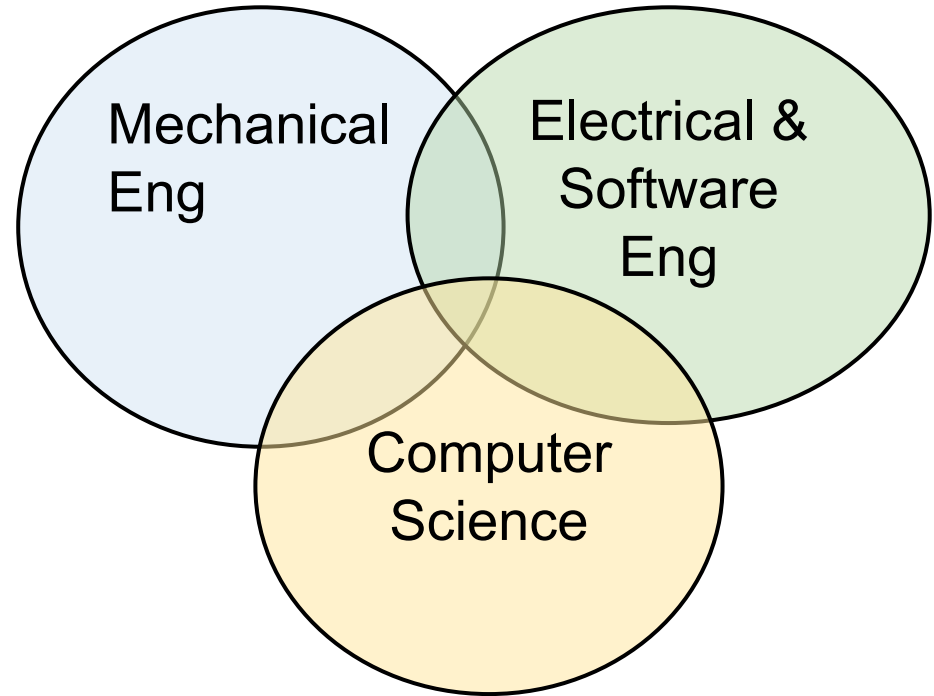
04/26/2021

Announcement

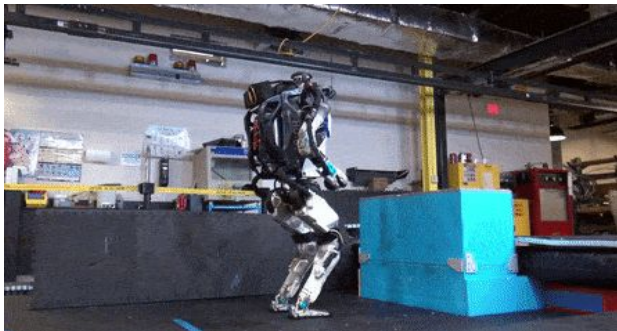
Tomorrow's lab will be hybrid

Robotics: It's interdisciplinary field

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



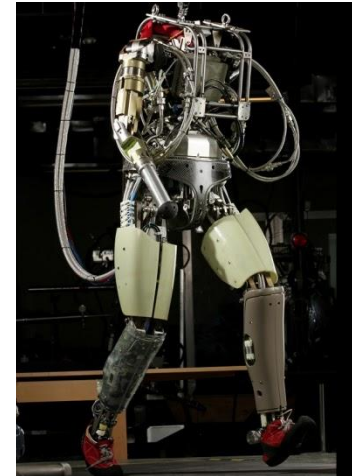
Some robots



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



IFRR Colloquium on Fukushima Ten Years After



Remotely controlled machines utilized for the response of accident of nuclear power plant (Domestic Machines)



Remotely Controlled
Construction Machines



Quince



Quince 2



Quince 3



Survey Runner



JAEA-3



ROV



FRIGO-MA



ASTACO-SORA



Robot for
Decontamination



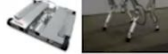
MEISrER



Inspection Robot
Of upper part of S/C



Water Surface
Inspection Robot



Quadruped Robot
& Inspection Robot



Sakura



Rosemary



Inspection robot
for high location



Robot for Measurement
of S/C Water Level



Inspection Robot for
Lower part of S/C



Manipulator



UUV



Transform



PMORPH



Scorpion Robot



Mini ROV



Stack Demolition Robot



Arounder



Underwater Floor
Mobile Robot



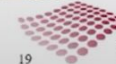
Sledge Carriage



THE UNIVERSITY OF TOKYO

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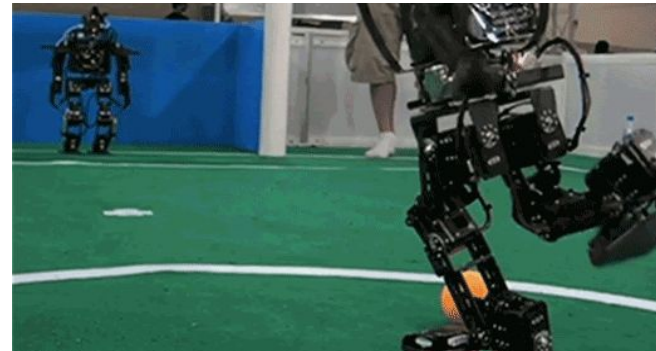
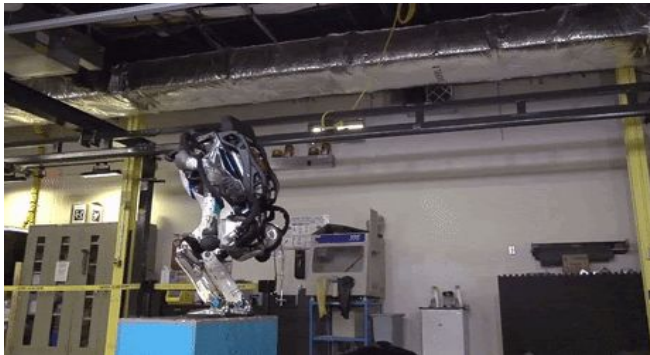
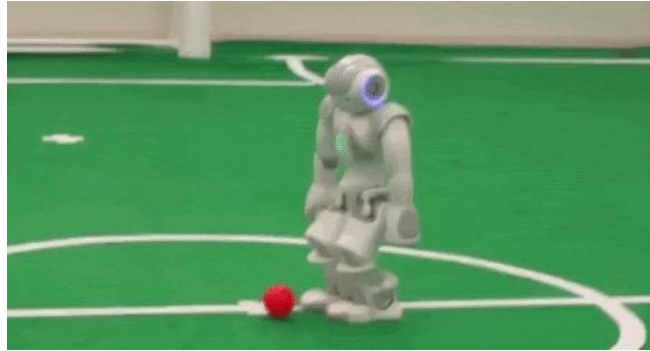
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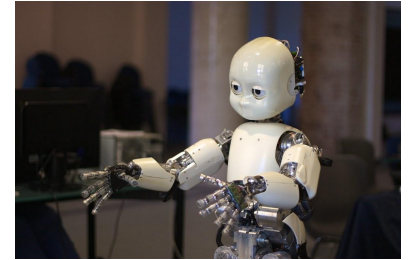
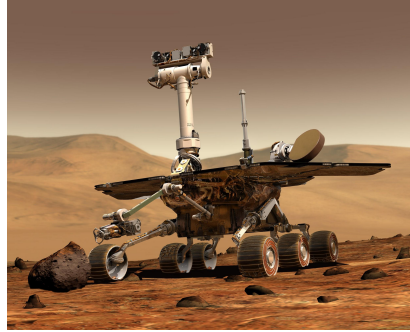
Hajime Asama
Dept. of Precision Engineering
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Credits to the
university of tokyo

Robotics is difficult

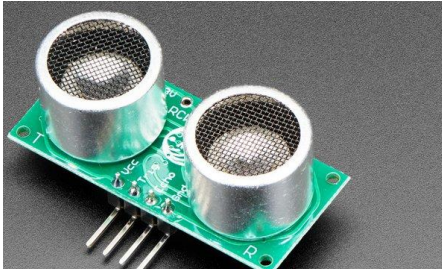


Robot types

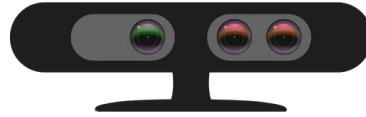


Robot's Hardware

Sensors for perception



Sonar



RGB-d

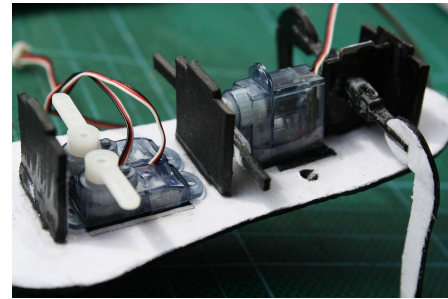


Laser

Robot's Hardware

Motors for actuation:

DC, stepper, servo, ... motors

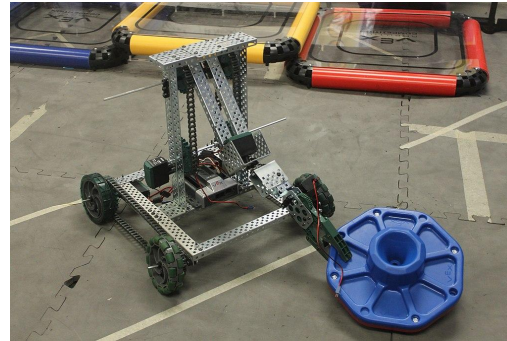


Robot's Hardware

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

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

Type of surface,

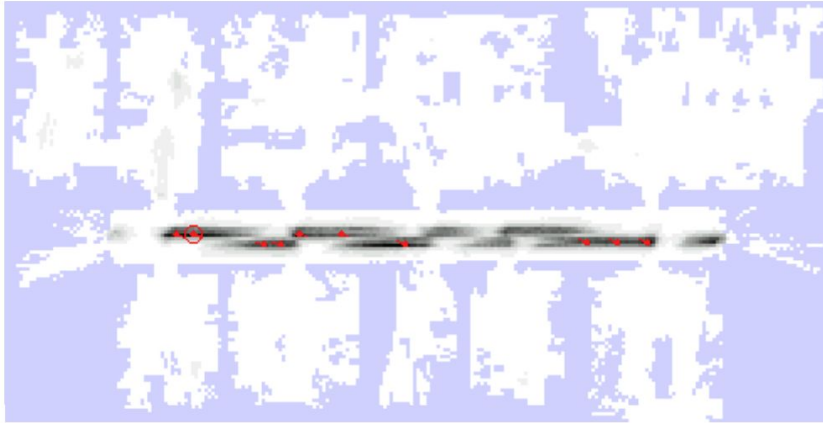
Tires, Robot's geometry



Robot perception (Sense)

We need to find some model of robot motion

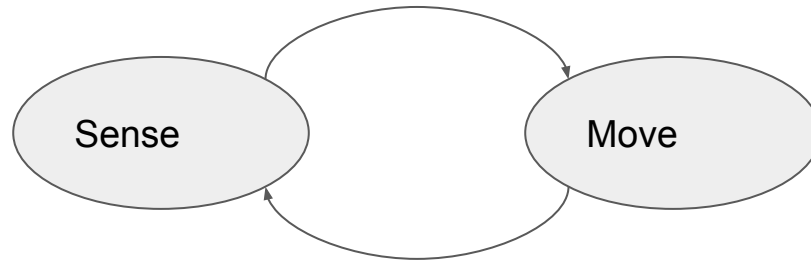
$$p(z_t | x_t, m)$$



Localization:

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

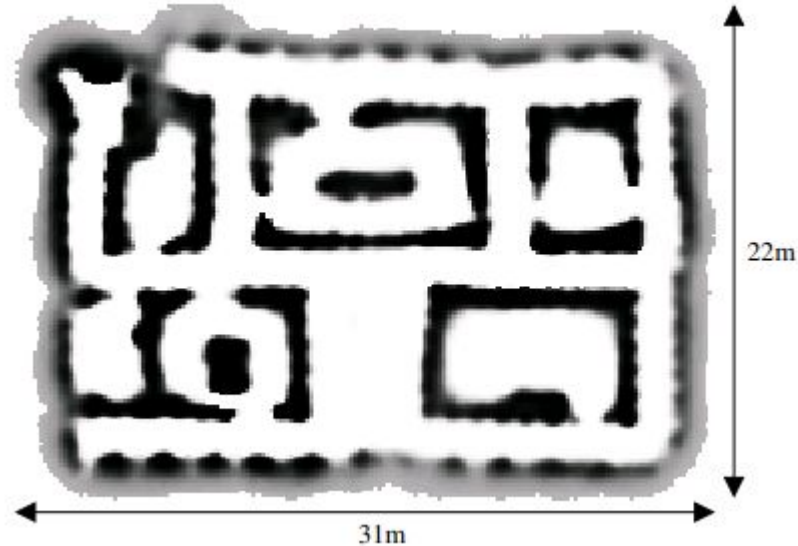
Given the map of the environment, it needs to localize itself based on sensor readings and motion.



Mapping:

Occupancy grid maps:

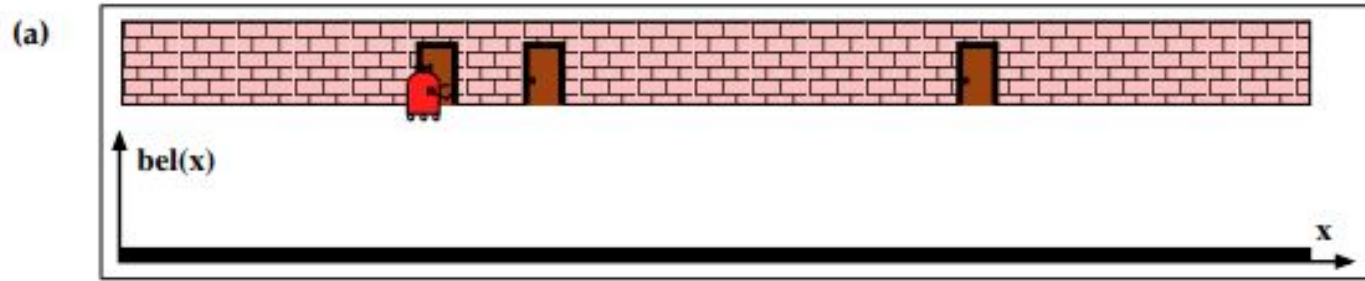
To each x,y location a binary value is associated to show if that location is occupied or not.



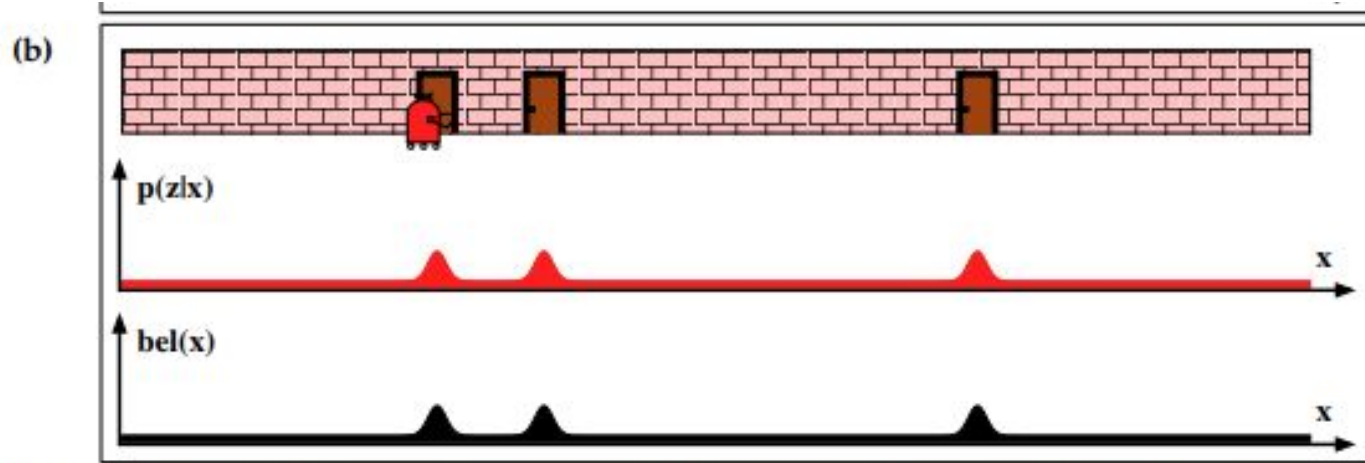
Why Mapping?

- 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.

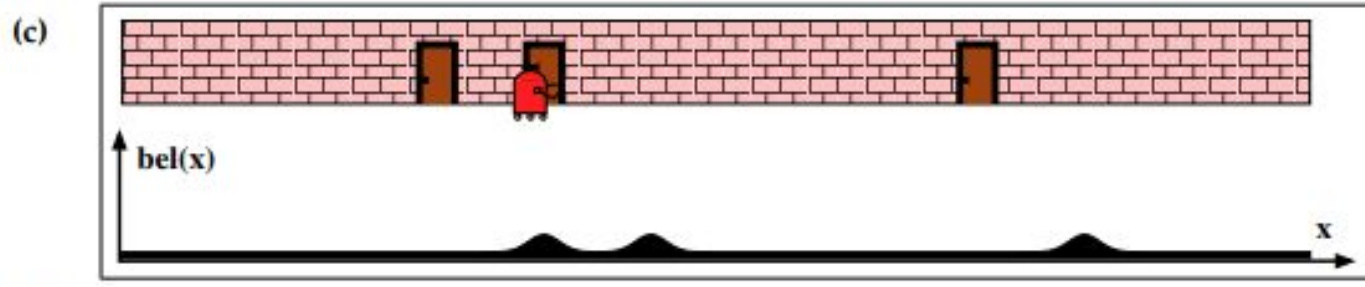
Sense, Act and predict



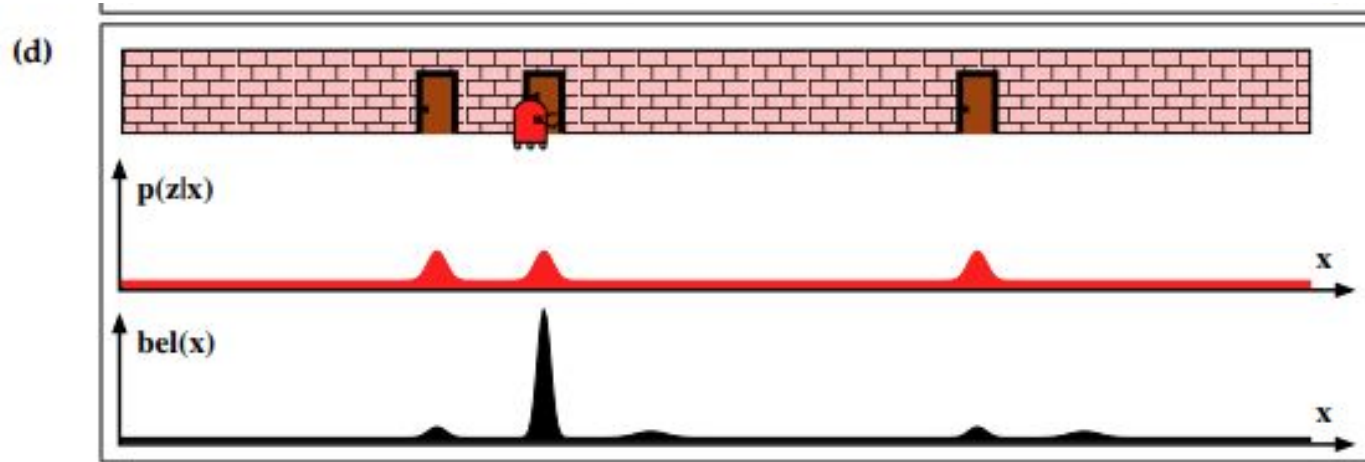
Sense, Act and predict



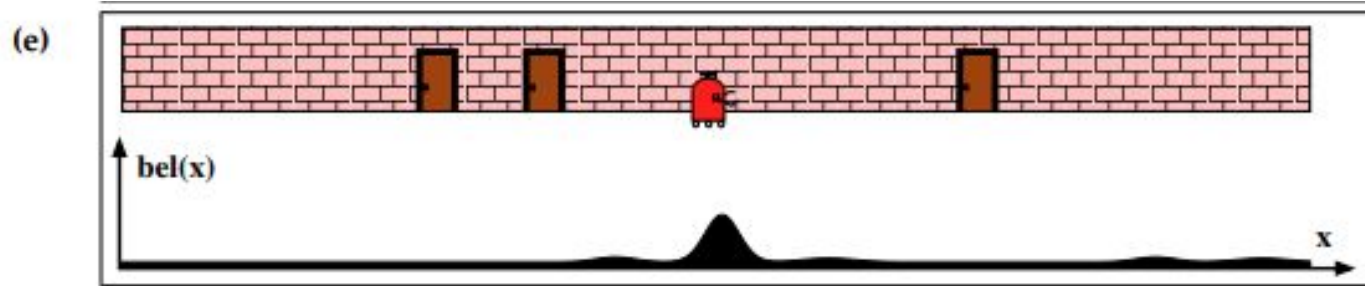
Sense, Act and predict



Sense, Act and predict



Sense, Act and predict

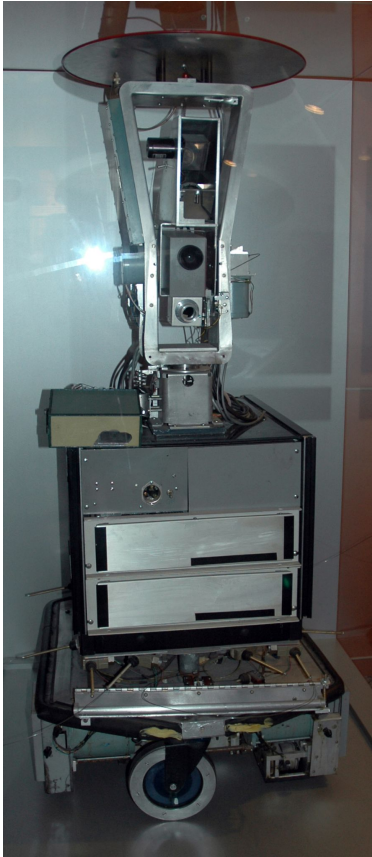


Minerva robot

1' 45": sensors



Shakey the robot



Segbot architecture

