



Introduction to Robotics

CSE 461

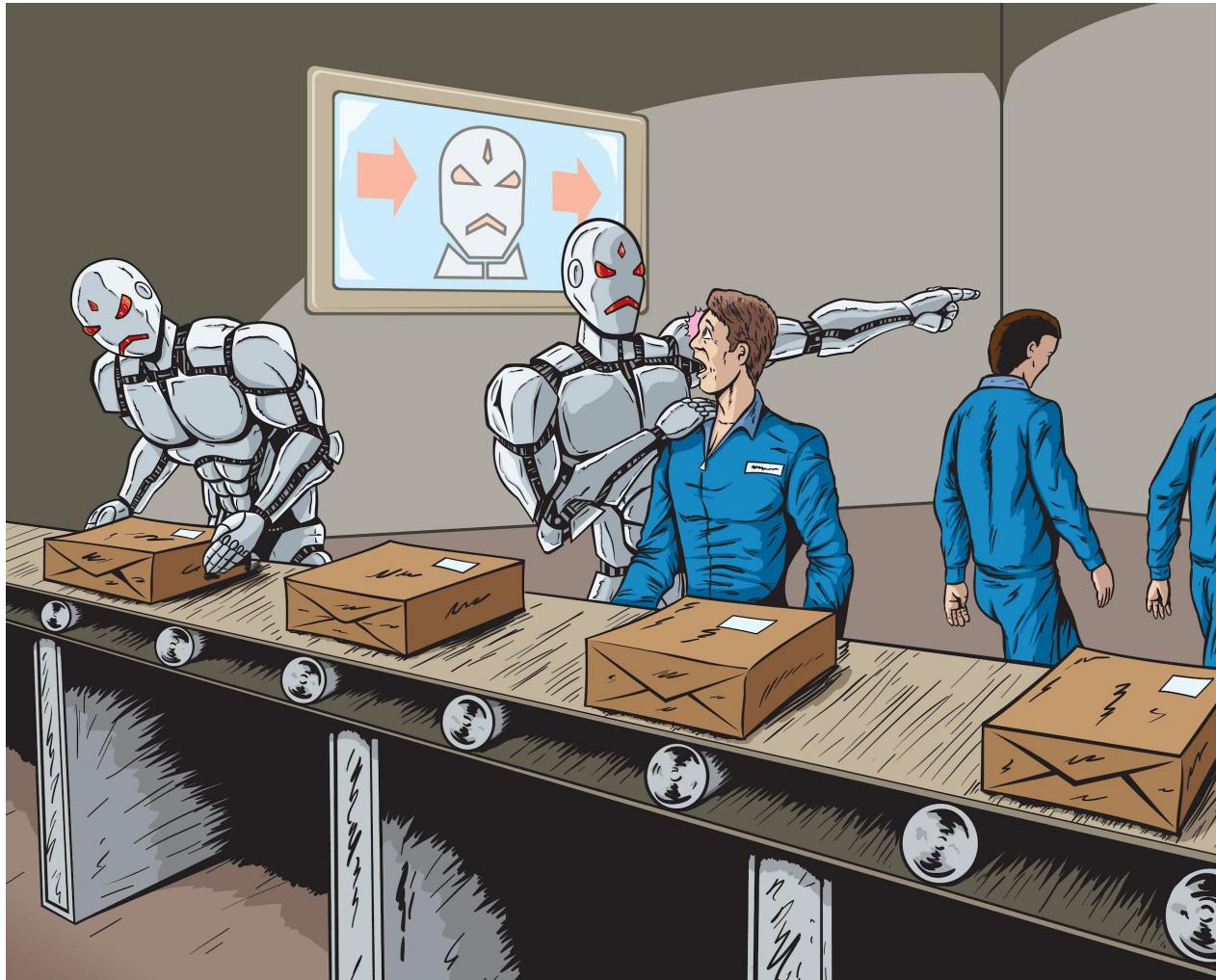
Lecture 2 : Chapter 1(Introduction to robotics: basics)

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Law of Robotics

1. A robot **must not harm human being**, nor through in action allow one to come to harm.
2. A robot must **always obey human beings**, unless that is in conflict with the first law.
3. A robot must **protect from harm**, unless that is in conflict with the first two laws.
4. A robot always should **have a kill switch**.

Will robots make
people Jobless ?



Uses of robots

4D

Do Things that Living Things Can't



- **Fukushima**
- **World Trade center**
- **RANA Complex**
- **Tajrin fashion**



Dull, Dirty, difficult and Dangerous



Dull, Dirty, difficult and Dangerous



Dull, Dirty, difficult and Dangerous



Thumb Rules on the decision of a Robot Uses

- The first rule to consider, what is known as the **Four D of Robotics**, i.e. is the task dirty, dull, dangerous, or difficult? If so, a human will probably not be able to do the job efficiently. Therefore, the job is appropriate for automation or for robotic labor.
- The second rule is that a robot may **not leave a human jobless**. Robotics and automation must serve to make our lives more enjoyable, not miserable.
- A third rule involves **asking whether you can find people who are willing to do the job**. If not, the job is a candidate for automation and Robotics.
- A four rule of thumb is that the use of robots or automation must **make short-term and long-term economic sense**.

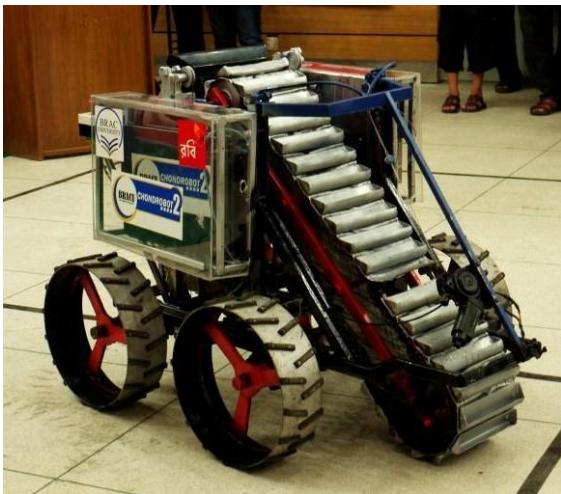
Some Special Vehicles

Uncrewed Vehicle

An uncrewed vehicle, also known as an **unmanned vehicle** or an **autonomous vehicle**, refers to a vehicle that operates **without human presence onboard**.



Remote control vehicle (RC)



Unmanned ground vehicle (UGV)



<https://youtu.be/cZTCmx6N7Xc>

Unmanned aerial vehicle (UAV)



Unmanned combat aerial vehicle (UCAV)

Miniature UAV (SUAV)

Delivery drone

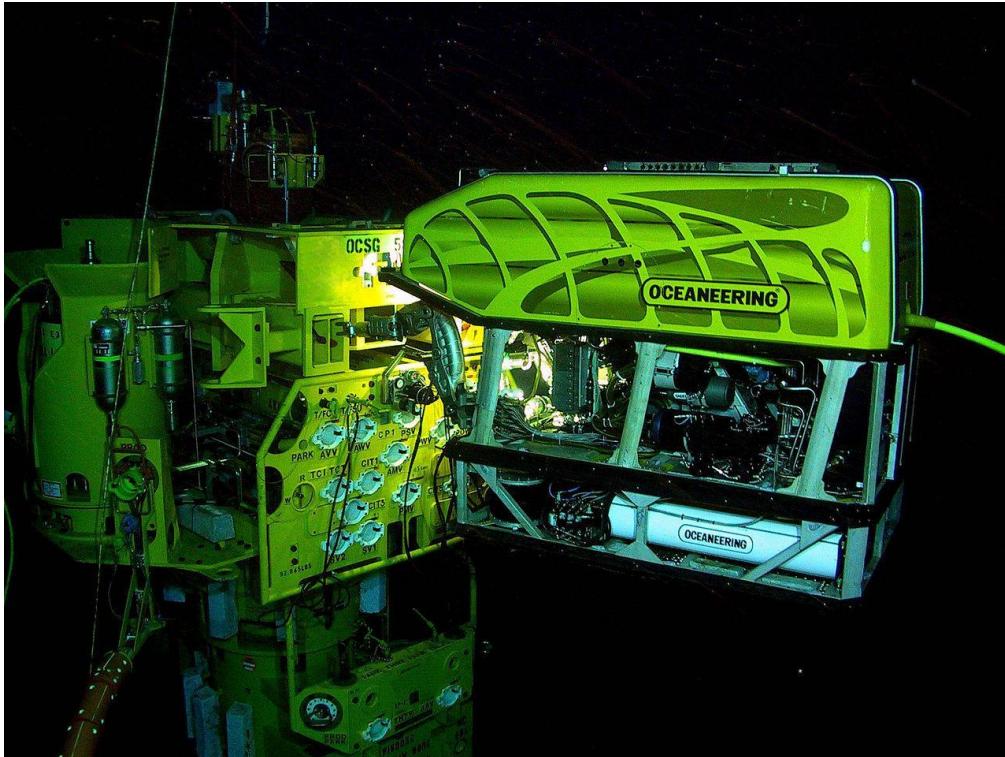
Micro air vehicle (MAV)

Target drone

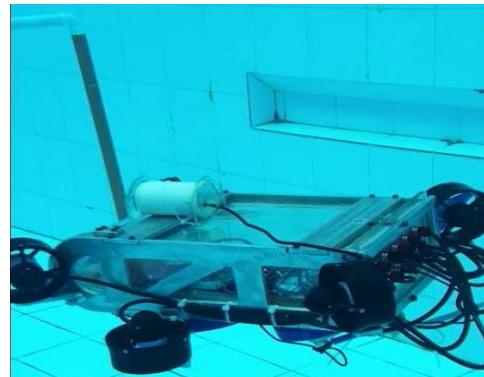
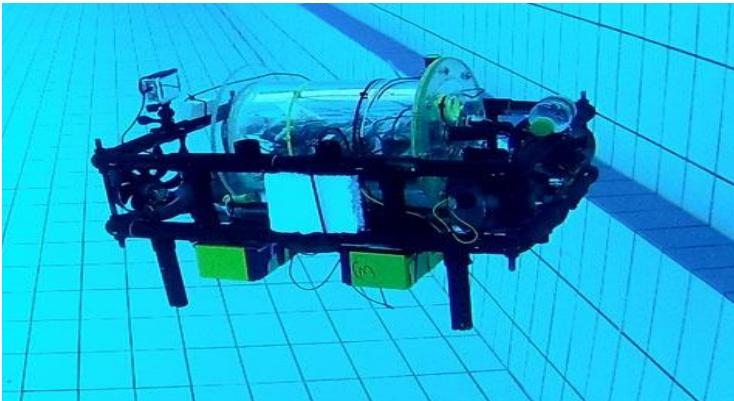
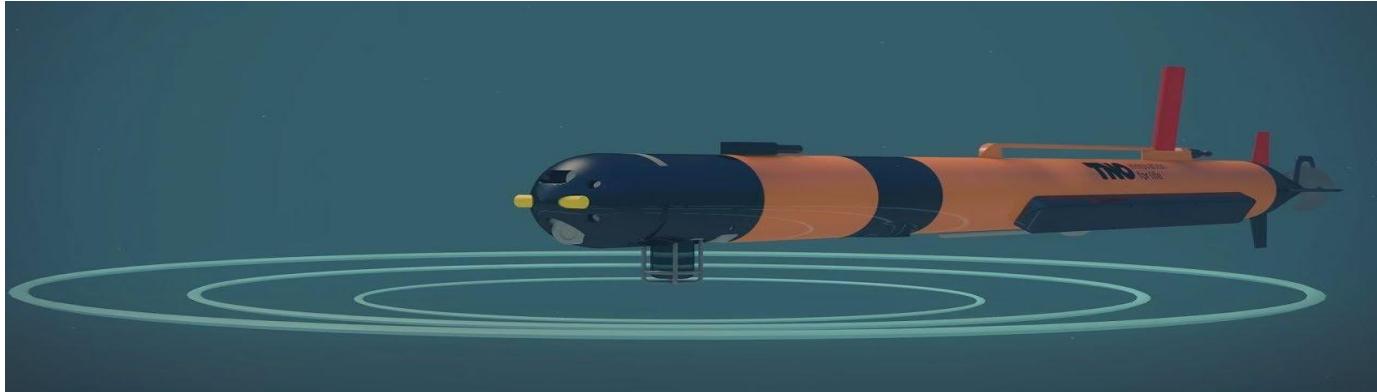
Unmanned surface vehicle (USV)



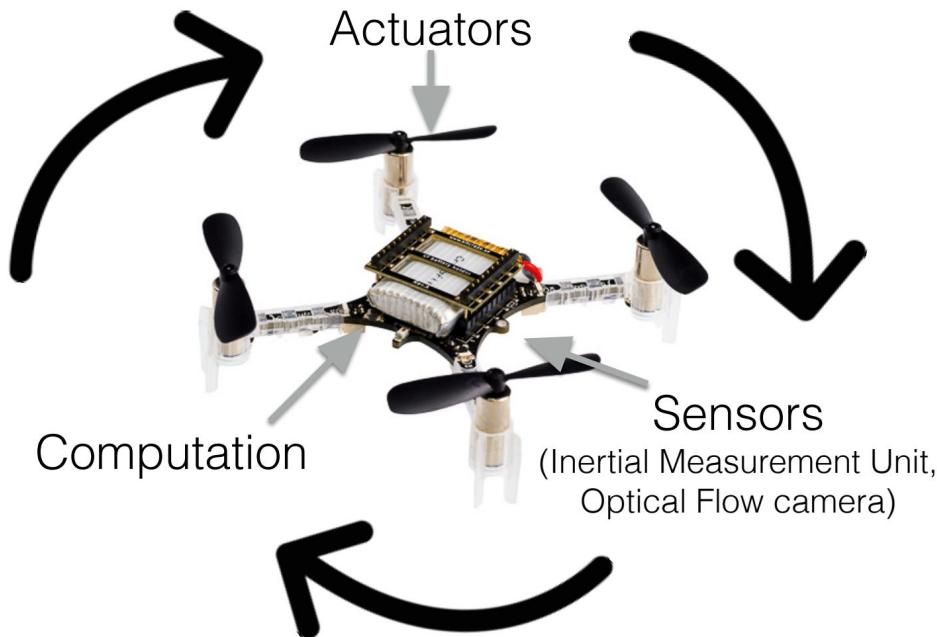
Remotely operated underwater vehicle (ROUV)



Autonomous underwater vehicle (AUV)



Anatomy of a robotic system



“Sense-Think-Act”

AI Primitives within an Agent

SENSE

PLAN

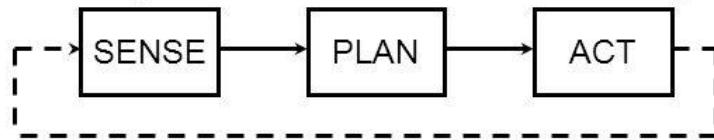
ACT

LEARN

Paradigms of Robotics

The Hierarchical Paradigm

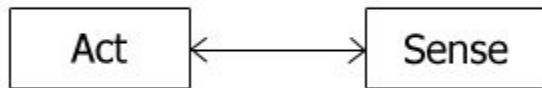
S,P,A organization of Hierarchical Paradigm



Alternative description of how the 3 primitives interact in the Hierarchical Paradigm

ROBOT PRIMITIVES	INPUT	OUTPUT
SENSE	Sensor data	Sensed information
PLAN	Information (sensed and/or cognitive)	Directives
ACT	directives	Actuator commands

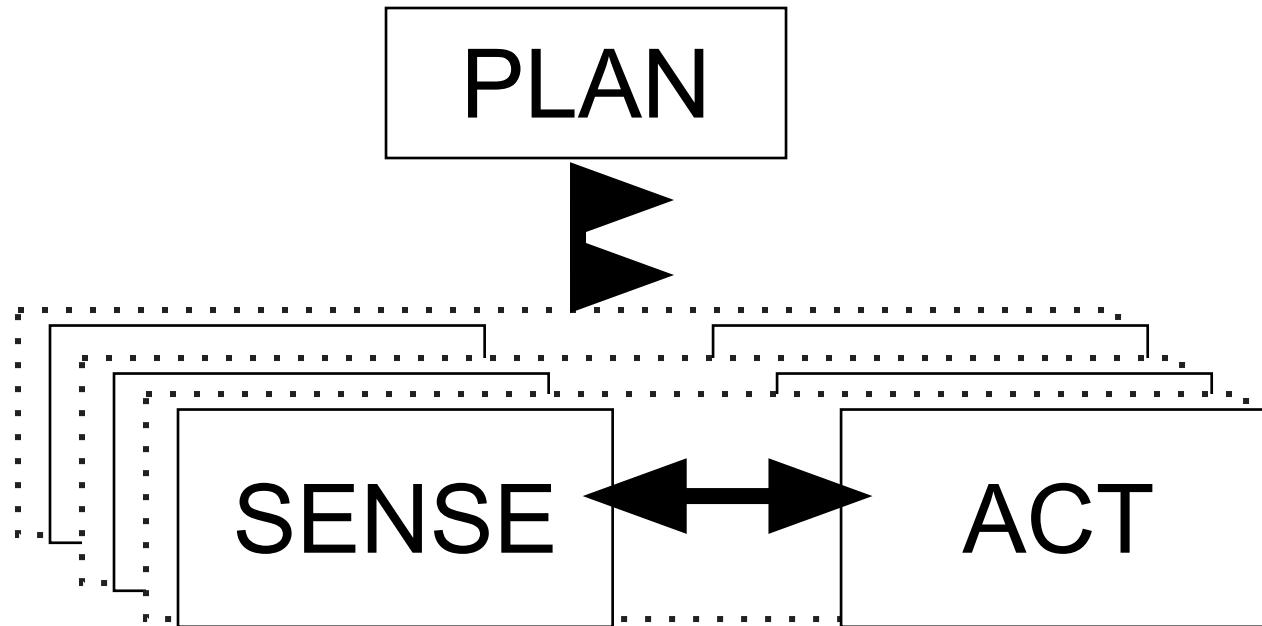
Reactive Paradigm



Robot Primitives	INPUT	OUTPUT
SENSE	Sensor Data	Sensed Information
PLAN		
ACT	Sensed Information	Actuator Commands

A flowchart illustrating the Reactive Paradigm. At the top, two boxes labeled 'Act' and 'Sense' are connected by a double-headed arrow. Below this, a table shows the relationships between robot primitives, their inputs, and their outputs. The 'SENSE' row shows 'Sensor Data' entering the 'Sensed Information' output. The 'ACT' row shows 'Sensed Information' entering the 'Actuator Commands' output. A diagonal line connects the 'Sensed Information' output of the 'SENSE' row to the 'Actuator Commands' input of the 'ACT' row.

Hybrid deliberative/reactive paradigm



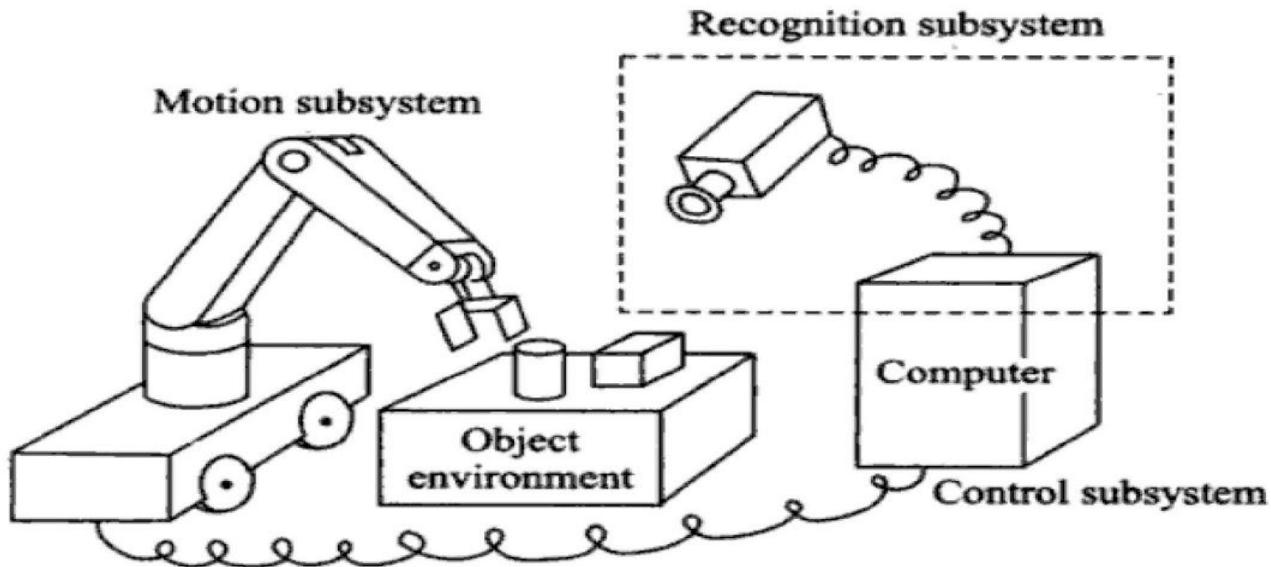
Advantages

- Asynchronous processing technique allows to function Independently
- Planner can slowly computer next goal while robot can perform reactive task
- First reactive updates then global panner for planning
- Good software Modularity

Local and Global Model

- Reactive for Local control
- Deliberative for Global control
- However; Robot behavioral management requires to know its current mission, state and environment beside path-planning, map-making, monitoring etc. So, both local and global models are required to be considered for a robot performance.

Three primitives of robotics



- Sense
- Plan
- Act

Next Class

- Subsystem

Thank You