



Lecture 1-1: From Teleoperation to Autonomy

Reading: Chapter 1

Objectives:

- Define a robot, intelligent robot, autonomous robot
- List and define the three robotic primitives for intelligence
- Describe the three robotic paradigms
- Describe the behaviors of some of the first robots
- Define the difference between teleoperation and semi-autonomous control
- List the seven main areas of artificial intelligence

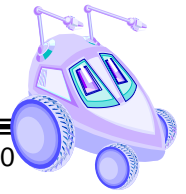
_____ - a mechanical creature which can function **autonomously**, derived from the Czech word “robota” for *menial labor*. The word became popular in Prague from the first performance of Karel Capek’s play, *Rossum’s Universal Robots* on socialism.

_____ - it can make decisions about the world and is not controlled by a human

There are 3 qualities that define robotics (the study of robots interacting with the physical world)

- _____
- _____
- _____

_____ - is when a human controls a robot from a distance. It is used when AI techniques are not near the level of human competence. In particular with regard to perception and decision making.



ECE 497 – Introduction to Mobile Robotics
Some of the drawbacks to teleoperation are:

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- _____
- _____
- _____

Levels of control

_____ - the human may control the robot sometimes, the robot is a peer

_____ - the human is involved but routine or safe tasks are handled autonomously by the robot

_____ - the human provide the robot with tasks but may interrupt with feedback or perceptual inputs

_____ - the human provides the tasks but does not interact after execution

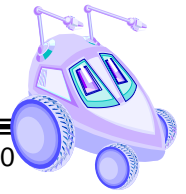
In Autonomous Mobile Robotics, there are three questions to answer:

1. _____ (perception, localization)
2. _____ (planning)
3. _____ (motion generation)

_____ - the science of making machines act intelligently

There are **seven** main areas of artificial intelligence:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

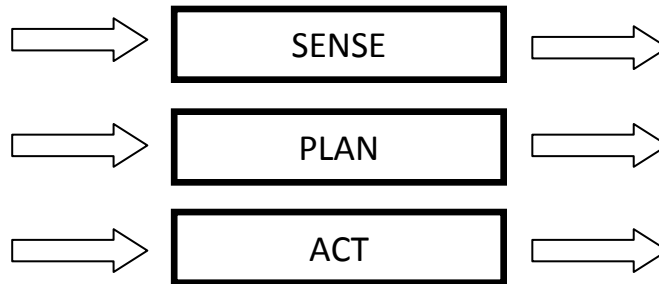


7. _____

There are **three** paradigms for organizing robot intelligence:

- a. Purely deliberative (hierarchical) control
- b. Reactive (behavior-based) control
- c. Hybrid (deliberative/reactive) control

These paradigms can be described in terms of the 3 robotic primitives

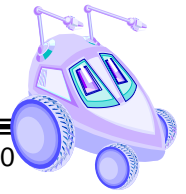


Hierarchical (1967) (S-P-A)	Reactive (1986) (S-A)	Hybrid Deliberative/Reactive (1990) (P, S-A)

Robots are ideal for applications that are

- _____
- _____
- _____

One of the first robot's was _____. It contained a photocell to sense light levels, one bump sensor, one rechargeable battery, and three motors for 3 wheels. The robot's behaviors were find a light, head toward the light, back away from bright light, recharge the battery.



The first AI-inspired robot was _____ in 1970. It was built at Stanford Research Institute. It used spatial data from cameras and laser range measurements to recognize objects and move toward them. It would create the path to an object and push it over when it found it.

Challenges

Physical/Mechanical/Electrical Issues

- Sensors are prone to errors
- Sensors have limited range and resolution
- Sensors are subject to noise and break
- Sensors require lots of processing power
- Actuators drain batteries and may not be small or powerful enough
- Actuators are unpredictable because of noise, wear and tear and mechanical failure

Knowledge Representation & Retrieval

- How to represent the real world in a robot's memory
- How to extract relevant information from large amounts of sensor data
- How does the robot adapt to dynamically changing and unpredictable environment

Uncertainty

- _____
- _____
- _____