CSCE 452/752 Fall 2025

1. Introduction

TEXAS A&M UNIVERSITY

AARRG

What is a robot?

Weasel words

The editors of Wikipedia had extreme difficulty coming to a consensus on the definition.

- A clockwork car is never considered a robot.[*citation needed*]
- A mechanical device able to perform some preset motions but with no ability to adapt (an automaton) is rarely considered a robot.[*citation needed*]
- A remotely operated vehicle is sometimes considered a robot (or telerobot).[7]
- A car with an onboard computer, like Bigtrak, which could drive in a programmable sequence, might be called a robot.[*citation needed*]
- A self-controlled car which could sense its environment and make driving decisions based on this information, such as the 1990s driverless cars of Ernst Dickmanns or the entries in the DARPA Grand Challenge, would quite likely be called a robot.[*citation needed*]
- A sentient car, like the fictional KITT, which can make decisions, navigate freely and converse fluently with a human, is usually considered a robot.[*citation needed*]

http://en.wikipedia.org/wiki/Robot

Weasel words

The editors of Wikipedia had extreme difficulty coming to a consensus on the definition.

- A player piano is rarely characterized as a robot.[8]
- A CNC milling machine is very occasionally characterized as a robot.[*citation needed*]
- A factory automation arm is almost always characterized as an industrial robot.[*citation needed*]
- An autonomous wheeled or tracked device, such as a self-guided rover or self-guided vehicle, is almost always characterized as a mobile robot or service robot.[*citation needed*]
- A zoomorphic mechanical toy, like Roboraptor, is usually characterized as a robot.[9]
- A mechanical humanoid, like ASIMO, is almost always characterized as a robot, usually as a service robot.[*citation needed*]

http://en.wikipedia.org/wiki/Robot

From one of the pioneers of robotics

You can't define a robot. It's the same as trying to define Mt. Fuji. If a steep hill suddenly protrudes from the flatland, you can draw a line to show where the mountain starts, but Mt Fuji becomes higher so gradually that you can't draw a line. Robots are like Mt. Fuji. It's hard to separate what is a robot from what is not. Asimo is so near the peak, anyone can easily call it a robot. But what about a dishwasher? It can automatically wash dishes, so you might call it a robot. The line is blurry.

– Masahiro Mori

[RAS Magazine, June 2012]

Some defining characteristics

The word “robot” can be surprisingly difficult to define.

However, there are some important **defining characteristics** to look for:

- **Autonomous**: A robot must make its own decisions.
- **Sensor-driven**: A robot needs to collect information about its environment.
- **Physical**: The real world is complicated and unpredictable.
- **Goal-achieving**: A robot should do something useful.

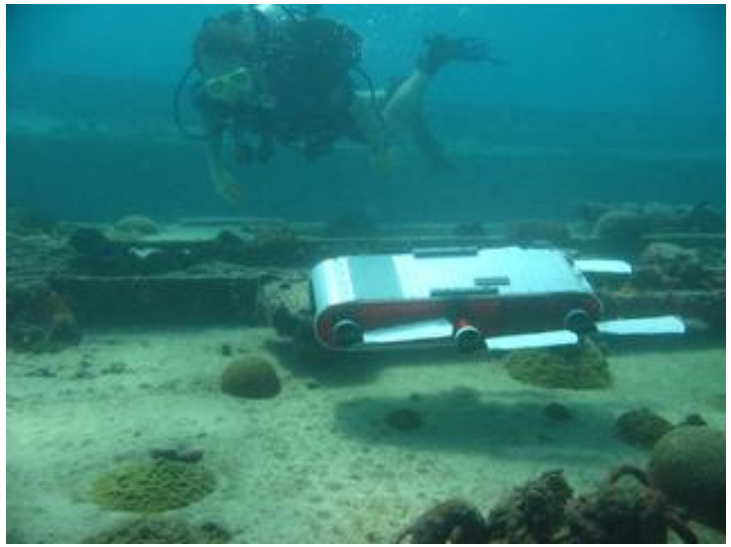
[Mataric, *The Robotics Primer*]

The State of Robotics: Rapid Progress, But a Long Way to Go

[Amazon Robotics]

[Waymo]

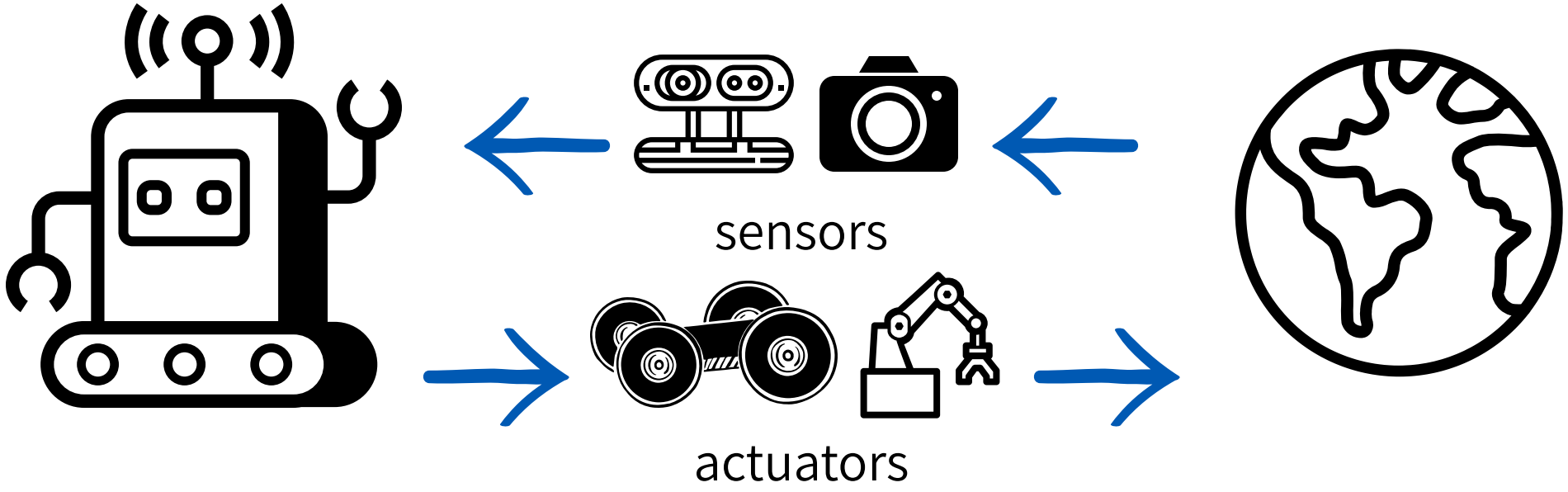
[DJI]



[Independent Robotics]

The Fundamental Problem

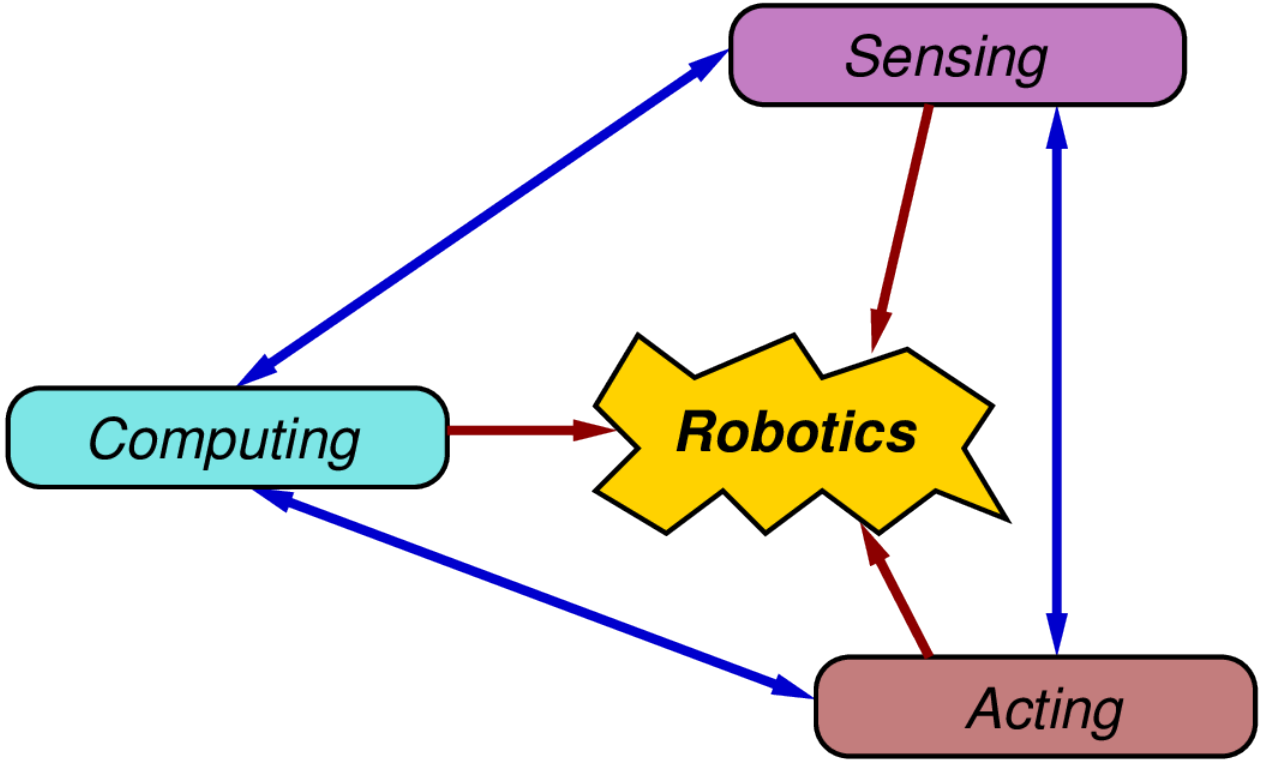
A robot relies on its **sensors** and **actuators** to interact with the world...



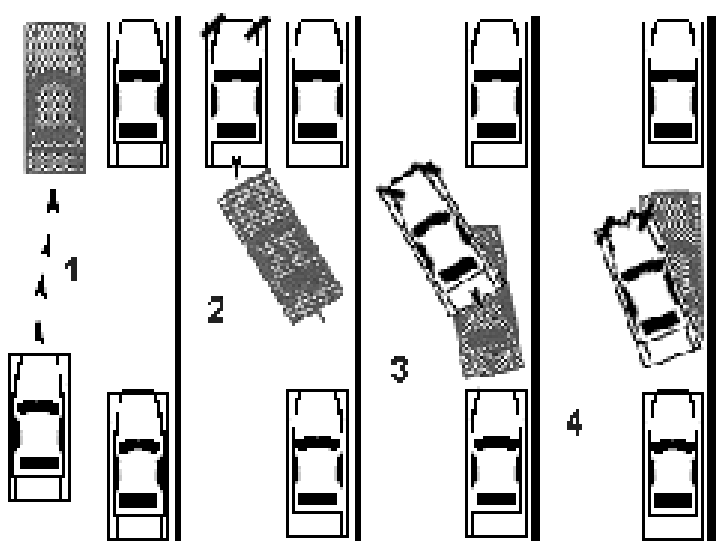
...but the world is **complex** and **unpredictable**.
...and the hardware is often **limited** or **unreliable**.

The Fundamental Problem

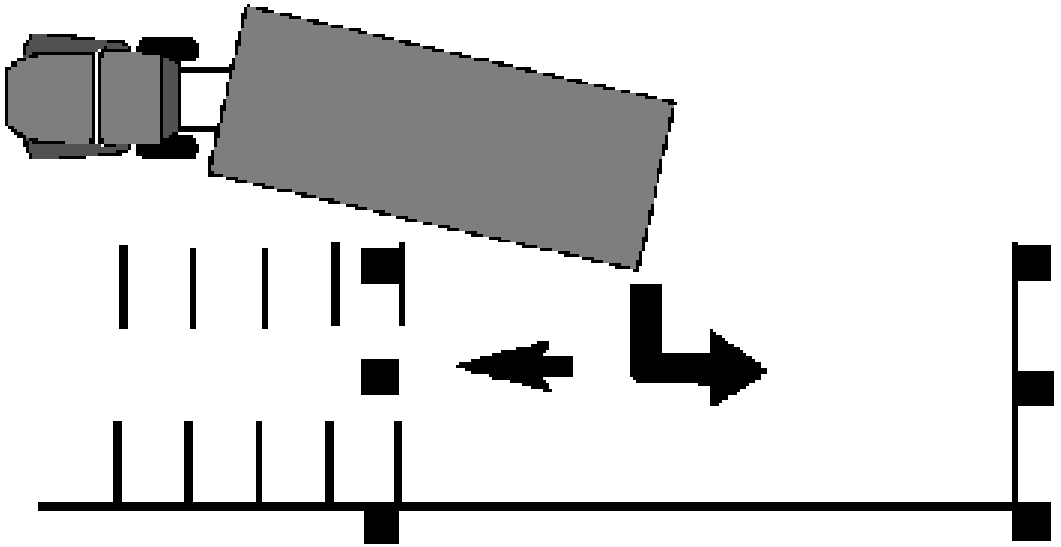
Robotics problems exist at the intersection **computation**, **action**, and **sensing**.



Example: Parallel parking



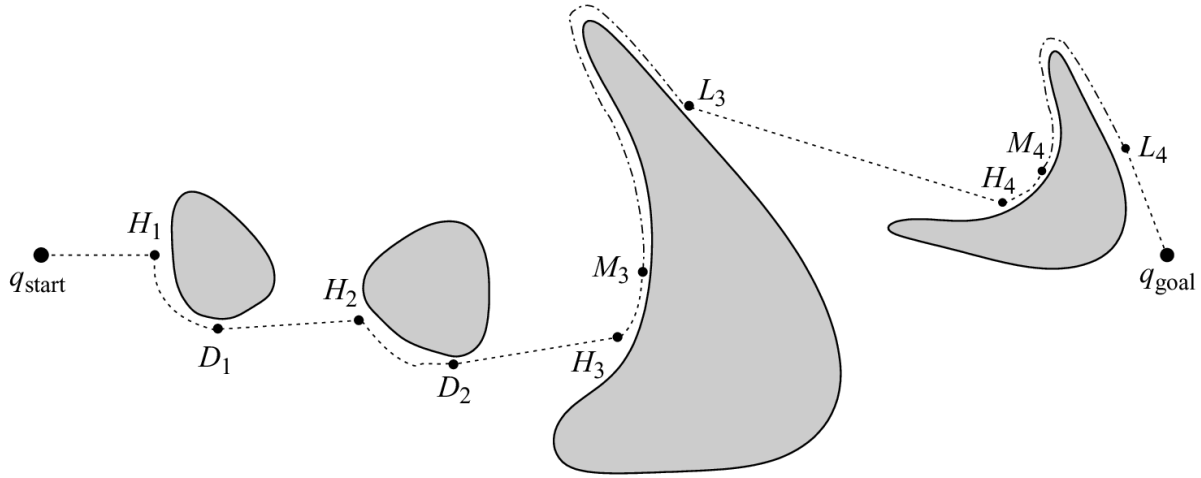
(a)



(b)

Core problems: Navigation and motion planning

Get from here to there.



[Choset+, ch 2]

Core problems: Navigation and motion planning

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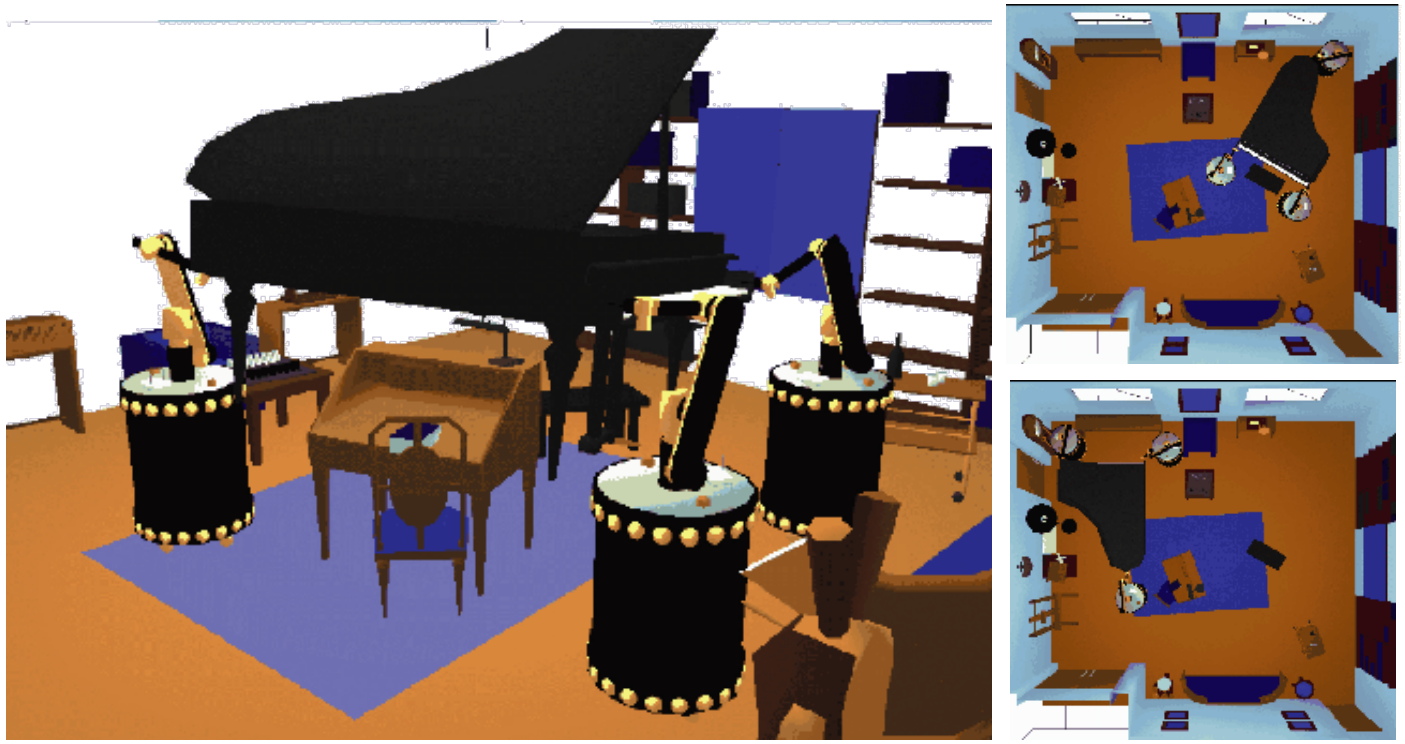
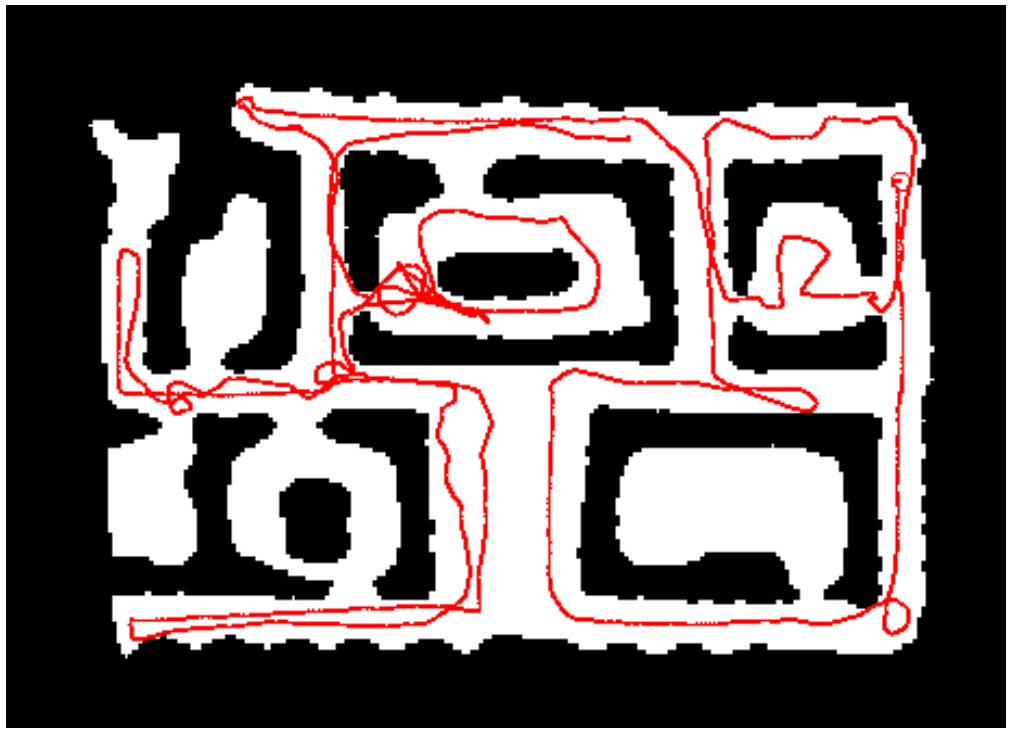
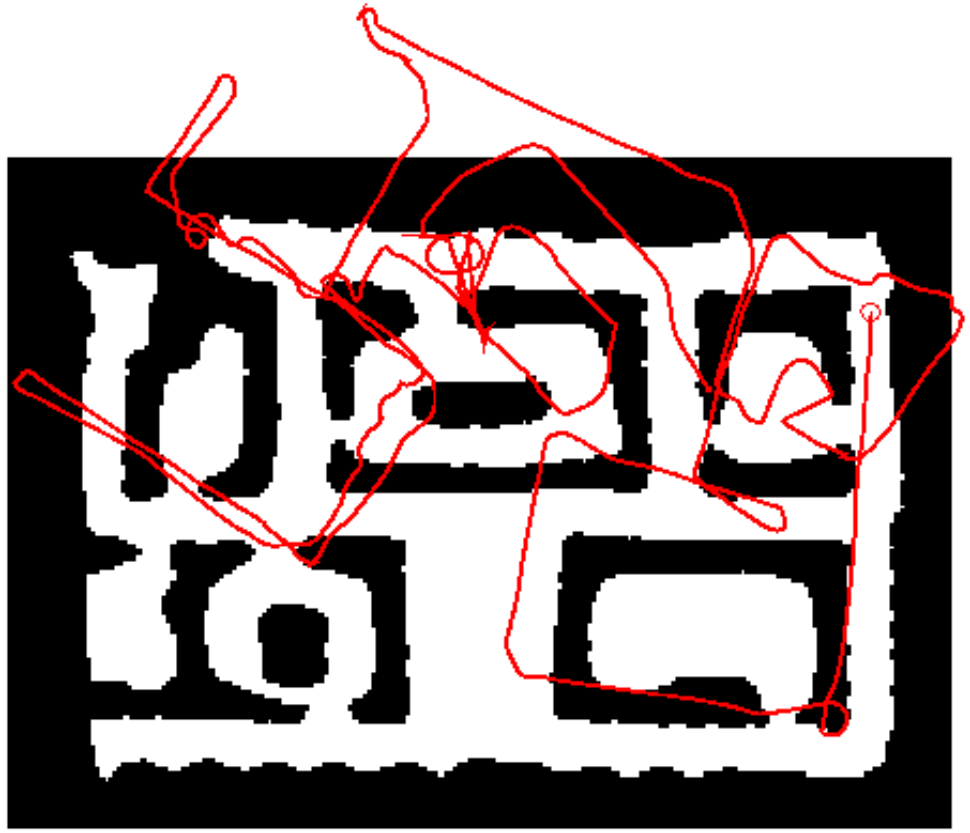


[J. Cortes, *Institut National Polytechnique de Toulouse*]

Core problems: Localization and mapping

Where am I? What is around me?





[Choset+, ch 8]

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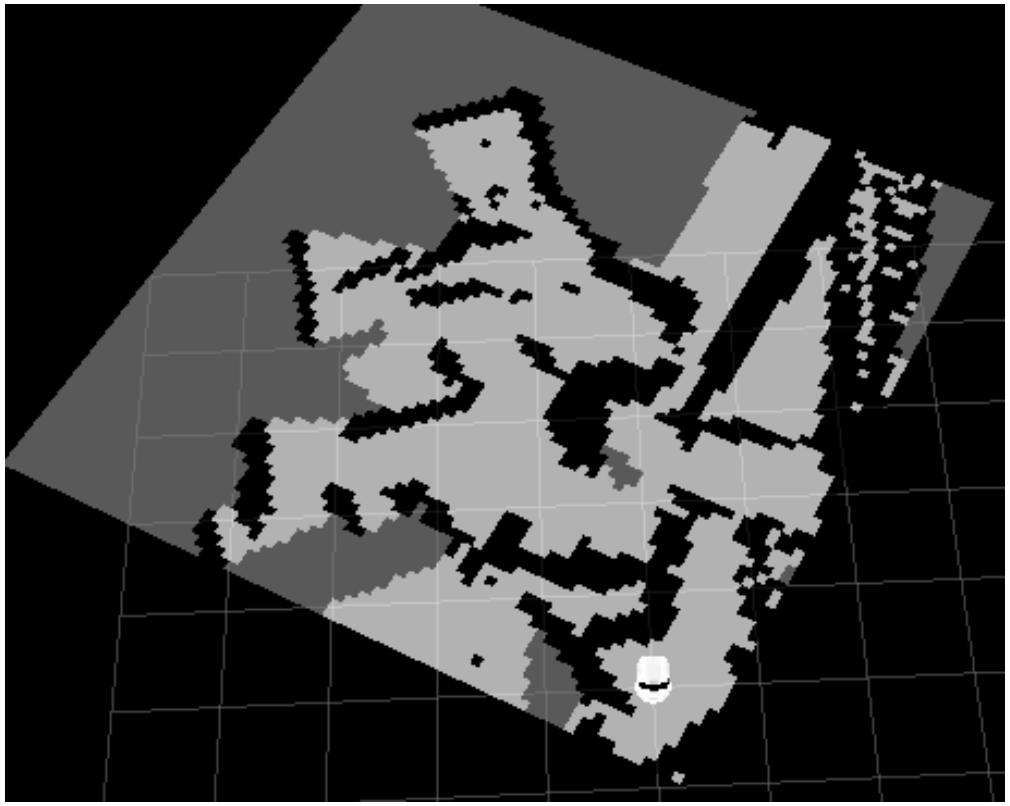

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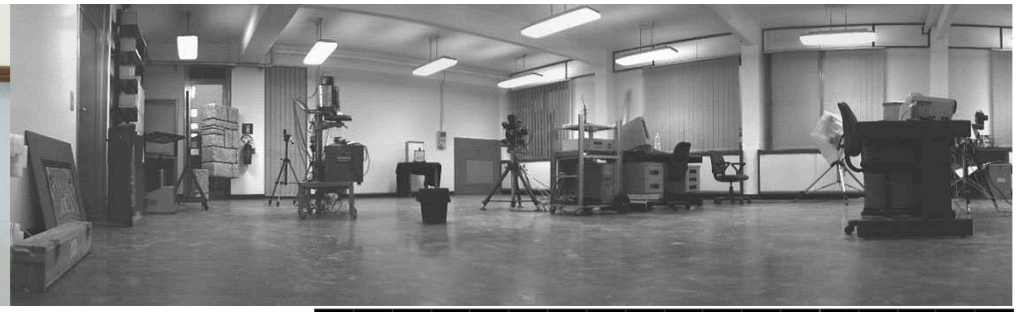
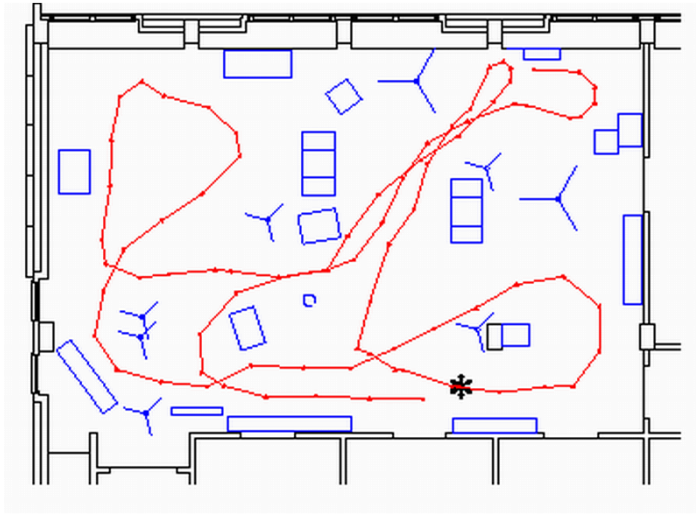
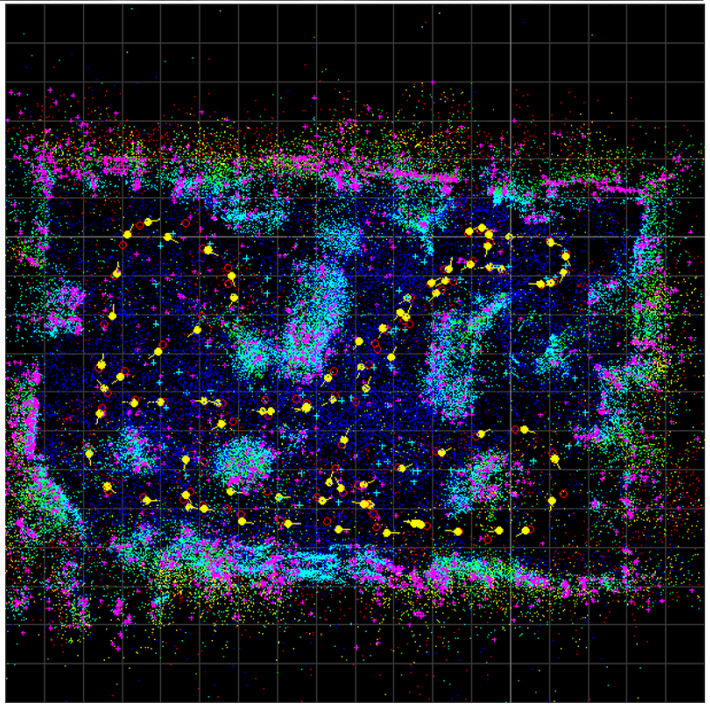




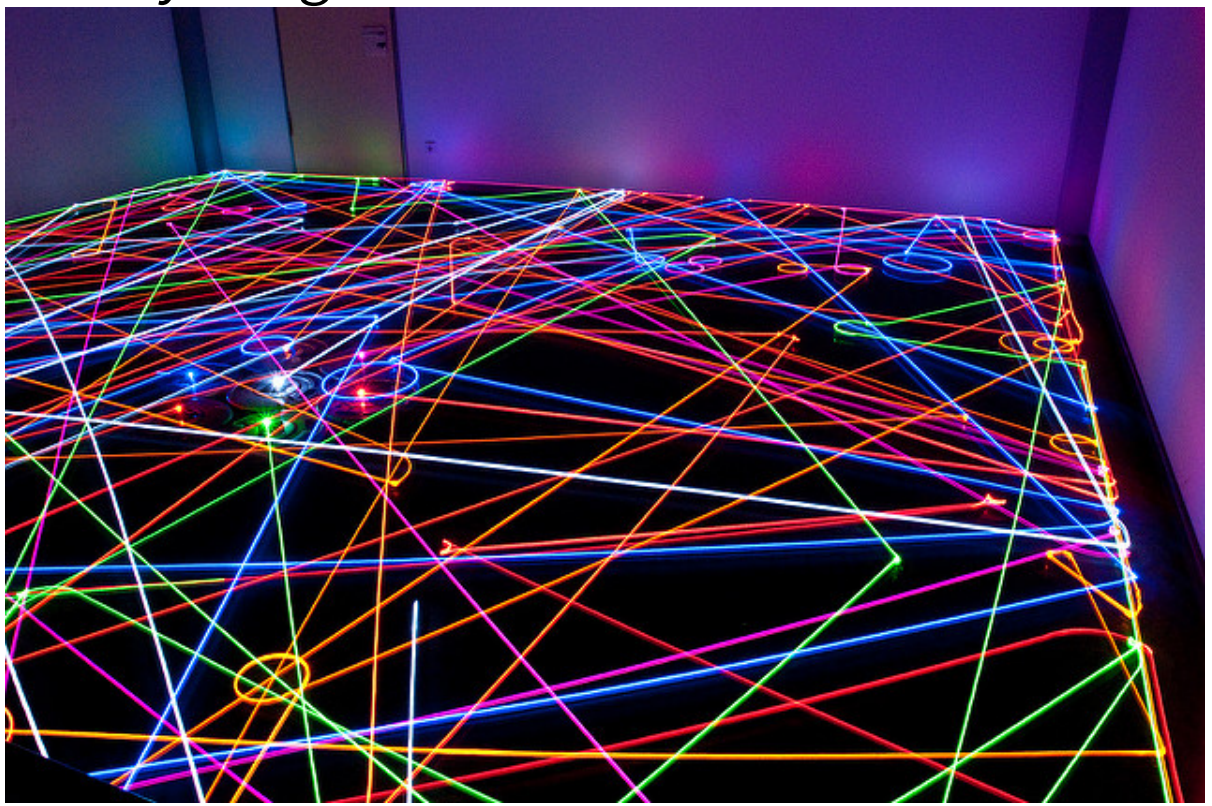


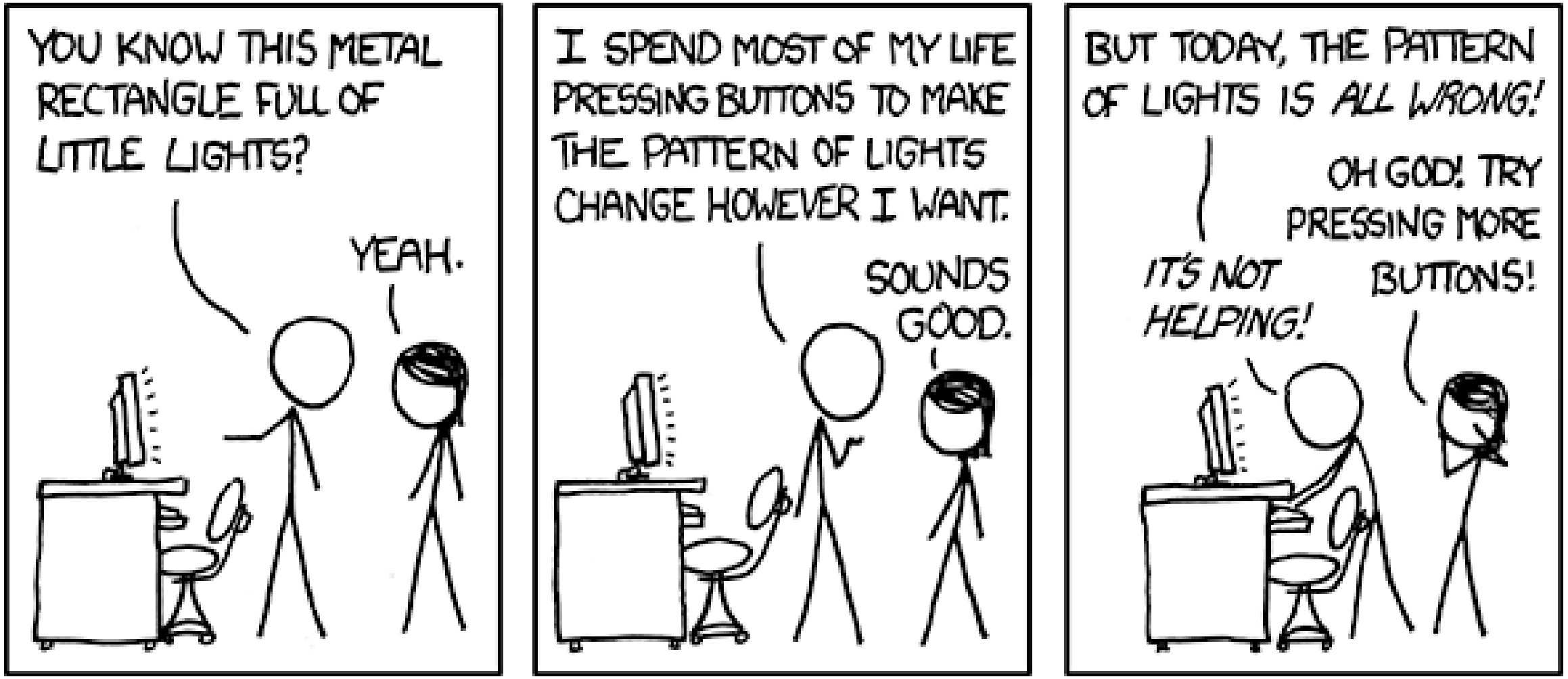
Core problems: Manipulation

Grasp, transport, assemble, or disassemble objects in the environment.

Core problems: Exploration and coverage

Move to see or touch everything in the environment.





http://xkcd.com/722