

Problem
ooooooooo

Environment
oooooooo

Agent
ooooooo

Intelligent Agent

CS 470 Introduction To Artificial Intelligence

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Outline

1 Problem

- Environment and agent

2 Environment

- Environment type

3 Agent

- Agent

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1 Problem

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Prolem

- environment
- agent



Warehouse mover - Human agent

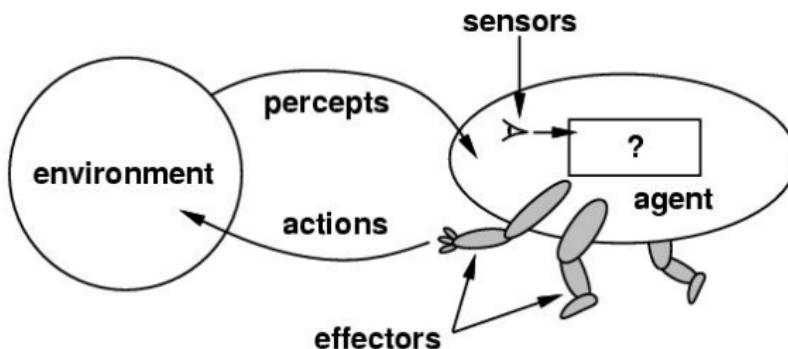


Kiva system - Robot agent

Agent

What is an **agent**?

- **sensor** perceps the environment
- **actuator** acts on the environment



Agent

• Human

- sensor: eye and ear
- actuator: mouth, arm and leg

• Robot

- sensor: camera, infrared range finder and radar
- actuator: robotic arm, robotic leg and wheel



Honda Asimo



Pioneer



Prime air

Rational agent

Define **performance measure** for a problem

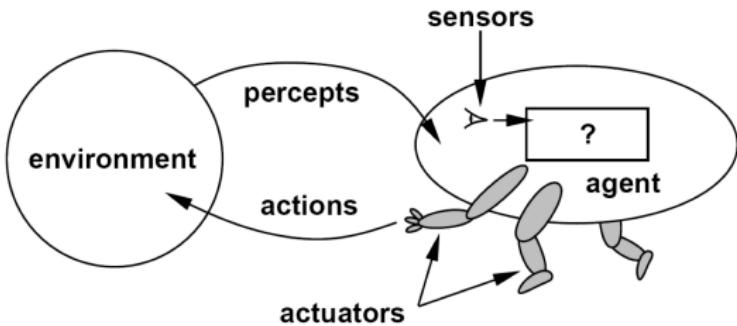
Rational agent acts on the environment to maximize the performance measure by perceiving the environment

How to model the problem?

Model the problem

PEAS

- Performance
- Environment
- Actuators
- Sensors



Model the problem

Driveless car

- Performance ?
- Environment ?
- Actuators ?
- Sensors ?

Model the problem

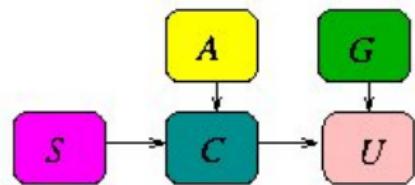
Driveless car

- Performance safety, destination, profits, legality, comfort, . . .
- Environment US streets/freeways, traffic, pedestrians, weather, . . .
- Actuators steering, accelerator, brake, horn, speaker/display, . . .
- Sensors video, accelerometers, gauges, engine sensors, keyboard, GPS, . . .

Model the problem

Decision theory

- States
the set of possible states of nature
- Actions
the set of possible actions
- Consequences
the set of consequences
- Goals
the set of possible agent goals
- Utilities
the set of possible preferences



Model the task

- **Environment + Properties of the Agent**
How to model the problem
- **Intelligence of the Agent**
How to solve the problem

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Problem
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Environment
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Environment

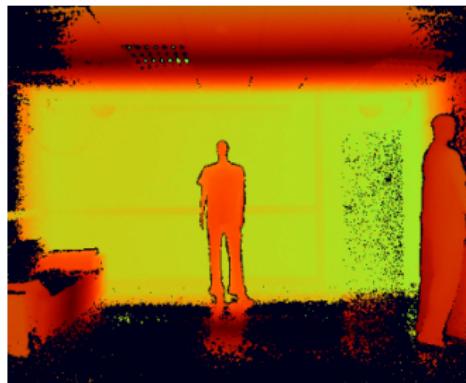
How to model the problem?

Environment types

- fully observable vs partially observable
- single agent vs multi-agent
- deterministic vs stochastic
- episodic vs sequential
- static vs dynamic
- discrete vs continuous
- known vs unknown

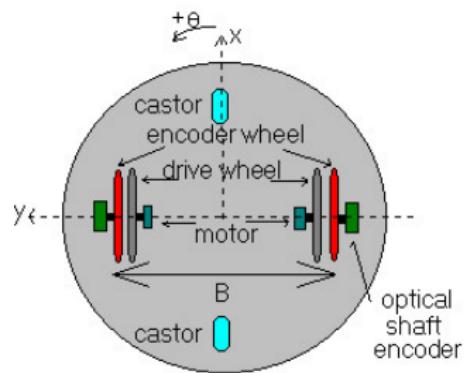
Fully Observable vs Partially Observable

full observable



Kinect depth view

partially observable



Roomba odometry

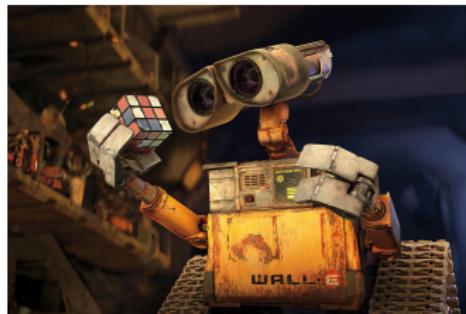
Problem
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Environment
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Single Agent vs Multi-agent

single agent



Wall-E

multi-agent



Kilobot - Harvard

Problem
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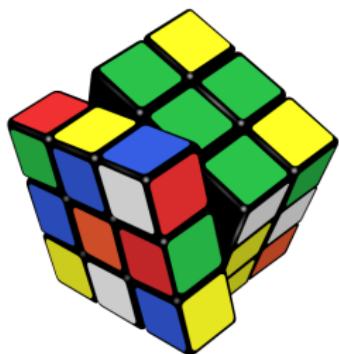
Environment
oooo●oooo



Agent
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Deterministic vs Stochastic

deterministic



Rubik's Cube

stochastic



Perfect storm

Episodic vs Sequential

episodic



Vending machine

sequential



House building

Static vs Dynamic

static



Kuka industrial robot

dynamic



Driverless car

Problem
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Environment
ooooooooo



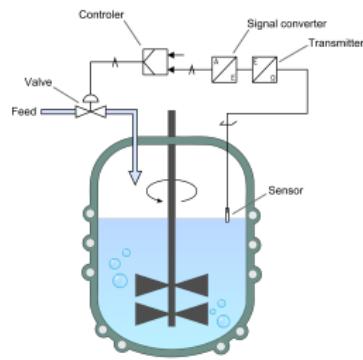
Discrete vs Continuous

discrete



Chess game

continuous



Process control

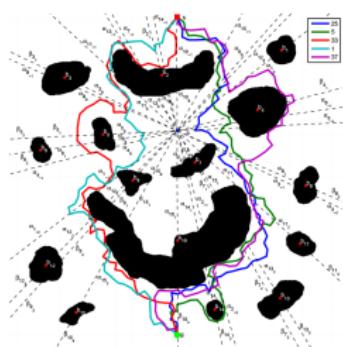
Problem
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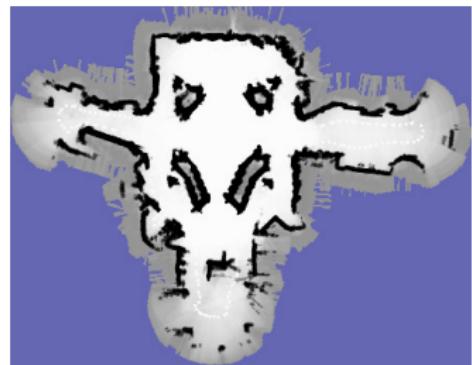
Known vs Unknown

known



AUV map

unknown



Robotic mapping

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Agent

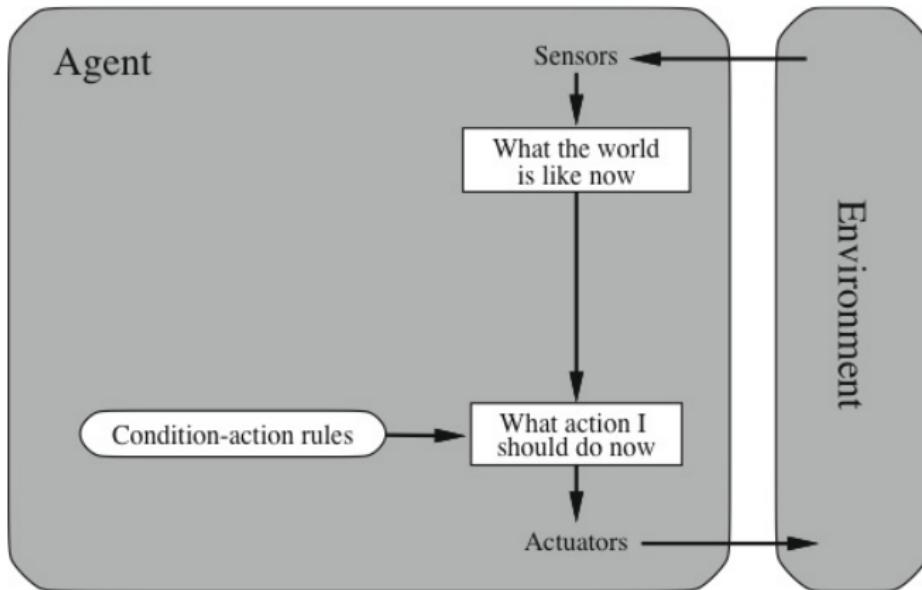
How to solve the problem?

Agent type

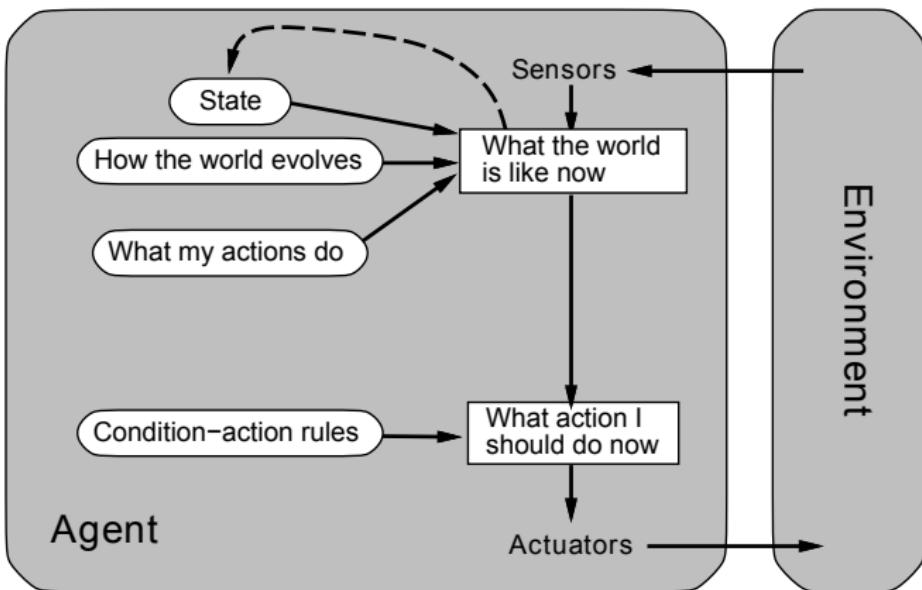
- Programmed agent
 - Simple-reflex agent
 - Model-based reflex agent
 - Goal-based agent
 - Utility-based agent
- Learning agent

Simple-reflex agent

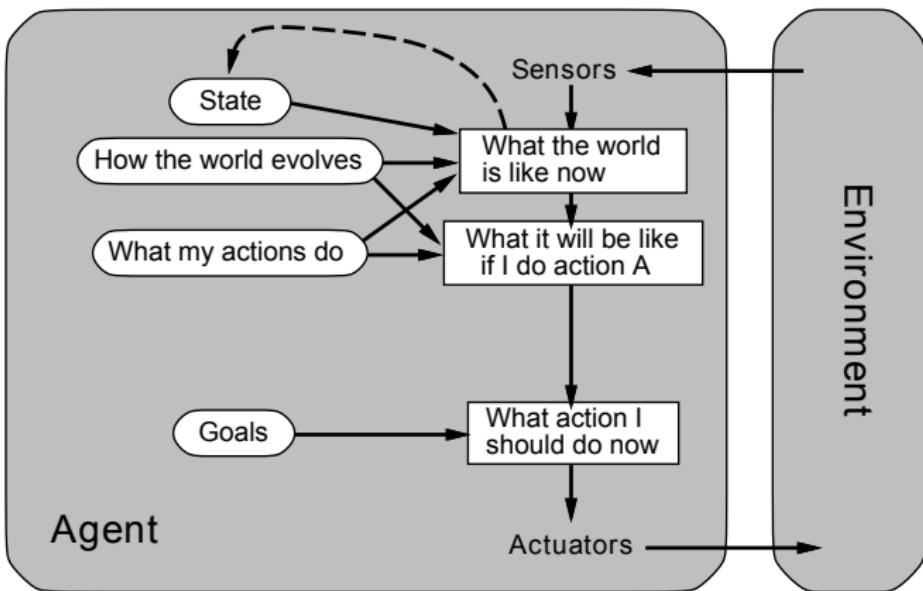
condition-action rule



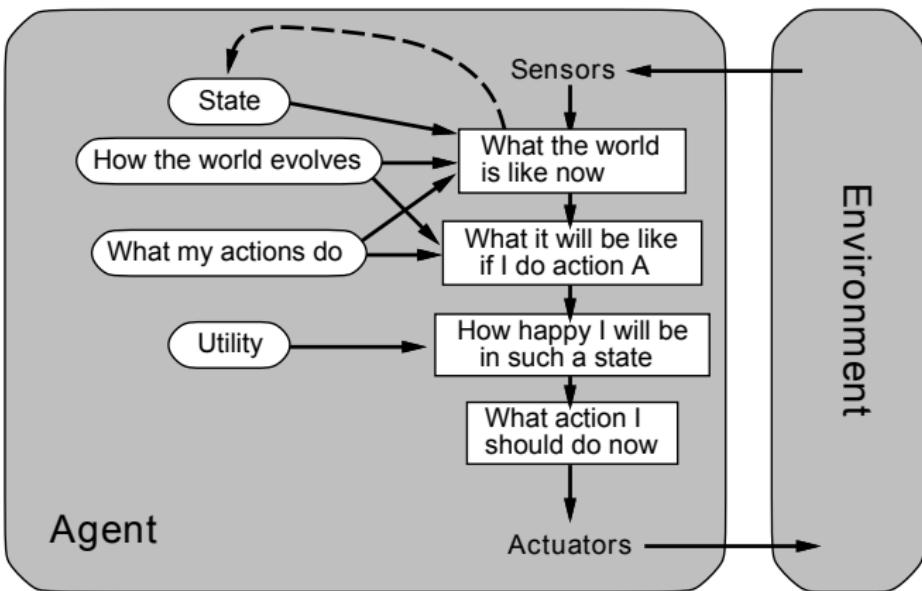
Model-based reflex agent



Goal-based agent



Utility-based agent



Learning agent

