

Chapter 2 Agents & Environments

Outline

- Agents and environments
- Rationality
- PEAS specification
- Environment types
- Agent types

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Agents

- An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators
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- Human agent:
 - eyes, ears, and other organs for sensors
 - hands, legs, mouth, and other body parts for actuators
- Robotic agent:
 - cameras and laser range finders for sensors
 - various motors for actuators

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Types of Agents: Immobiles

Intelligent buildings
Autonomous spacecraft

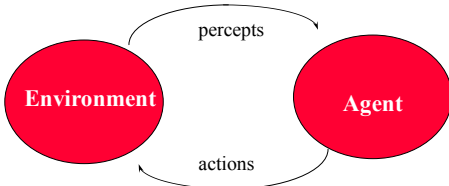
- Softbots
 - Askjeeves.com
 - Expert Systems



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Intelligent Agents

- Have sensors, effectors
- Implement mapping from percept sequence to actions



- Performance Measure

Rational agents

- An agent should strive to **do the right thing**, based on what it can perceive and the actions it can perform. The right action is the one that will cause the agent to be most successful
- **Performance measure:** An objective criterion for success of an agent's behavior
- E.g., performance measure of a vacuum-cleaner agent could be amount of dirt cleaned up, amount of time taken, amount of electricity consumed, amount of noise generated, etc.

Ideal rational agent

“For each possible percept sequence, does whatever action is expected to maximize its performance measure on the basis of evidence perceived so far and built-in knowledge.”

- Rationality vs omniscience?
- Acting in order to obtain valuable information

Autonomy

An agent is autonomous to the extent that its behavior is determined by its own experience (with ability to learn and adapt)

Why is this important?

PEAS: Specifying Task Environments

- PEAS: Performance measure, Environment, Actuators, Sensors
 - Must first specify the setting for intelligent agent design
 - Consider, e.g., the task of designing an automated taxi driver:
- Performance measure
- Environment
- Actuators
- Sensors

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PEAS

- Agent: Automated taxi driver
- Performance measure:
Safe, fast, legal, comfortable trip, maximize profits
- Environment:
Roads, other traffic, pedestrians, customers
- Actuators:
Steering wheel, accelerator, brake, signal, horn
- Sensors:
Cameras, sonar, speedometer, GPS, odometer, engine sensors, keyboard

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DARPA Urban Challenge: 11/2007



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Boss



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Stanley



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PEAS

- **Agent:** Medical diagnosis system
- **Performance measure:**
Healthy patient, minimize costs, lawsuits
- **Environment:**
Patient, hospital, staff
- **Actuators:**
Screen display (questions, tests, diagnoses, treatments, referrals)
- **Sensors:**
Keyboard (entry of symptoms, findings, patient's answers)

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Properties of Environments

- Observability: full *vs.* partial *vs.* non
- Deterministic *vs.* stochastic
- Episodic *vs.* sequential
- Static *vs.* ... *vs.* dynamic
- Discrete *vs.* continuous

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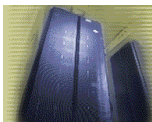
RoboCup-99: Stockholm, Sweden Final



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Dieter Fox, ULM

RoboCup vs. Chess



Deep Blue



Robot

- | | |
|------------------|------------------------|
| • (Semi-) Static | ➤ Dynamic |
| • Deterministic | ➤ Stochastic |
| • Observable | ➤ Partially observable |
| • Discrete | ➤ Continuous |
| • Sequential | ➤ Sequential |

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Agent functions and programs

- An agent is completely specified by the **agent function** mapping percept sequences to actions
- One agent function (or a small equivalence class) is **rational**
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- Aim: find a way to implement the rational agent function concisely
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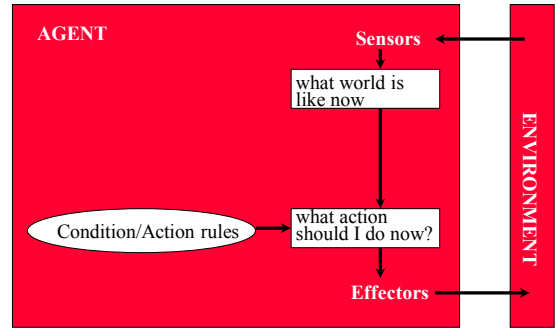
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Implementing ideal rational agent

- Table lookup agents
- Agent program
 - Simple reflex agents
 - Agents with memory
 - Reflex agent with internal state
 - Goal-based agents
 - Utility-based agents

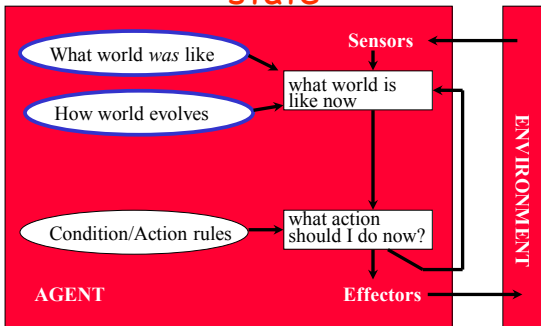
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Simple reflex agents



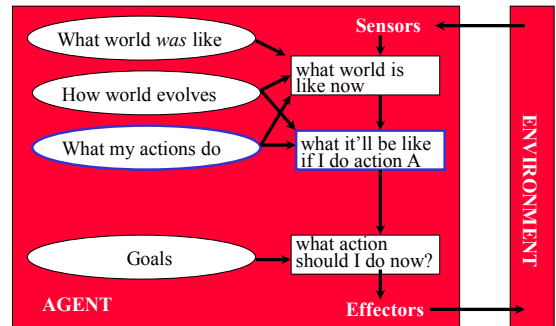
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Reflex agent with internal state



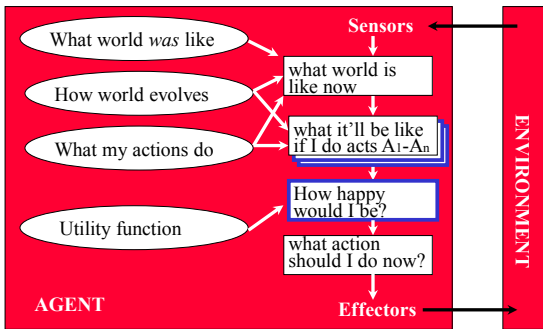
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Goal-based agents



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Utility-based agents



Learning agents

