Agents & Environments
Chapter 2

Mausam

(Based on slides of Dan Weld, Dieter Fox, Stuart Russell)
Outline

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

• An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators

• 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
Examples of Agents

– Intelligent buildings
– Autonomous spacecraft

• Softbots
  – Askjeeves.com
  – Expert Systems
Intelligent Agents

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

Environment ⇆ Agent

- Percepts
- Actions

Performance Measure

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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
PEAS: Specifying Task Environments

• PEAS: Performance measure, Environment, Actuators, Sensors

• Must first specify the setting for intelligent agent design

• Example: 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
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:
  – (entry of symptoms, findings, patient's answers)
Robocup

http://www.youtube.com/watch?v=-Y4H3Sox_4I

http://www.youtube.com/watch?v=iMM_XQXJUUC
Properties of Environments

• Observability: full vs. partial vs. non

• Deterministic vs. stochastic

• Episodic vs. sequential

• Static vs. Semi-dynamic vs. dynamic

• Discrete vs. continuous

• Single Agent vs. Multi Agent (Cooperative, Competitive, Self-Interested)
RoboCup vs. Chess

- Static/Semi-dynamic
- Deterministic
- Observable
- Discrete
- Sequential
- Multi-Agent

Dynamic
- Stochastic
- Partially observable
- Continuous
- Sequential
- Multi-Agent

Deep Blue

Robot

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More Examples

• Classical Planning

• Poker
  – Static – Stochastic – Partially Obs – Discrete – Seq – Multi-agent

• Medical Diagnosis

• Taxi Driving
Simple reflex agents

**AGENT**

Condition/Action rules

**Sensors**

what world is like now

**Effectors**

what action should I do now?
Reflex agent with internal state

What world was like

How world evolves

Condition/Action rules

what world is like now

what action should I do now?

Effectors

Agents

Environment

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Goal-based agents

AGENT

What world was like

How world evolves

What my actions do

Goals

Sensors

what world is like now

what it’ll be like if I do actions A1-An

what action should I do now?

Effectors

ENVIRONMENT

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Utility-based agents

**AGENT**

- What world *was* like
- How world evolves
- What my actions do
- Utility function

**SENSORS**

- what world is like now
- what it’ll be like if I do acts $A_1$-$A_n$
- How happy would I be?
- what action should I do now?

**EFFECTORS**

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Learning agents

What world was like
Learn how world evolves
Learn what my actions do
Learn utility function

what world is like now
what it’ll be like if I do acts A₁⁻Aₙ
How happy would I be?
what action should I do now?

Feedback
Sensors

AGENT

Effectors

ENVIRONMENT

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