Lecture 2

Agents & Environments
(Chap. 2)

Based on slides by UW CSE AI faculty, Dan Klein, Stuart Russell, Andrew Moore
Outline

• Agents and environments
• Rationality
• PEAS specification
• Environment types
• Agent types
• Pac-Man projects
Agents

• An agent is any entity that can perceive its environment through sensors and act upon that environment through actuators

• Human agent:
  Sensors: Eyes, ears, and other organs
  Actuators: Hands, legs, mouth, etc.

• Robotic agent:
  Sensors: Cameras, laser range finders, etc.
  Actuators: Motorized limbs, wheels, etc.
Other Types of Agents

• **Immobots (Immobile Robots)**
  - Intelligent buildings
  - Intelligent forests

• **Softbots**
  - Askjeeves.com (now Ask.com)
  - Expert Systems
  - Microsoft Clippy
Intelligent Agents

- Have sensors and actuators (effectors)
- Implement mapping from percept sequence to actions
- Maximize a Performance Measure
Performance Measures

• Performance measure = An objective criterion for success of an agent's behavior

• E.g., vacuum cleaner agent performance measure:
  amount of dirt cleaned up, amount of time taken, amount of electricity consumed, amount of noise generated, etc.
“For each possible percept sequence, does whatever action maximizes expected performance on the basis of evidence perceived so far and built-in prior knowledge.”
A rational agent is autonomous if it can learn to compensate for partial or incorrect prior knowledge.

Why is this important?
Task Environments

• The “task environment” for an agent is comprised of PEAS
  (Performance measure, Environment, Actuators, Sensors)

• E.g., Consider the task of designing an automated taxi driver:
  Performance measure = ?
  Environment = ?
  Actuators = ?
  Sensors = ?
PEAS

- PEAS for 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, touchpad or keyboard
• **PEAS for 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)
Properties of Environments

- **Observability: full vs. partial**
  Sensors detect all aspects of state of environment relevant to choice of action?

- **Deterministic vs. stochastic**
  Next state completely determined by current state and action?

- **Episodic vs. sequential**
  Current action independent of previous actions?

- **Static vs. dynamic**
  Can environment change over time?

- **Discrete vs. continuous**
  State of environment, time, percepts, and actions discrete or continuous-valued?

- **Single vs. multiagent**
Fully observable vs. Partially observable

Can the agent observe the complete state of the environment?
Single agent vs. Multiagent

Is the agent the only thing acting in the world?

vs.
Deterministic vs. Stochastic

Is there uncertainty in how the world works?
Episodic vs. Sequential

Does the agent take more than one action?

vs.

[Image of Netflix queue vs. Pac-Man game]
Discrete vs. Continuous

Are the states, actions etc. discrete or continuous?

vs.

[Chessboard] vs. [Robot playing chess]
Agent Functions and Agent Programs

- An agent’s behavior can be described by an agent function mapping percept sequences to actions taken by the agent.
- An implementation of an agent function running on the agent architecture (e.g., a robot) is called an agent program.
- Our goal: Develop concise agent programs for implementing rational agents.
Implementing Rational Agents

• Table lookup based on percept sequences
  Infeasible
• Agent programs:
  Simple reflex agents
  Agents with memory
  • Reflex agent with internal state
  • Goal-based agents
  • Utility-based agents
Simple Reflex Agents

AGENTS

Sensors

Percept

what action should I do now?

Effectors

Condition-Action rules

ENVIRONMENT
Simple Reflex Agents
Famous Reflex Agents
Reflex Agent with Internal State

AGENT

state

Sensors

Estimate of world state

Effectors

what action should I do now?

Condition-Action rules

What my actions do

How world evolves

ENVIRONMENT
Goal-Based Agents

How world evolves

What my actions do

Goals

state

Estimate of world state

what it’ll be like if I do action A

what action should I do now?

Effectors

Sensors

Agent

Environment
Utility-Based Agents

[Diagram showing the flow of information from the environment to the agent.]

- **State**: How world evolves
- **Sensors**: What my actions do
- **Utility function**: How happy would I be in such a state?

- **Estimate of world state**: what it’ll be like if I do action A
- **Effectors**: What action should I do now?
While driving, what’s the best policy?

- Always stop at a stop sign
- Never stop at a stop sign
- Look around for other cars and stop only if you see one approaching
- Look around for a cop and stop only if you see one

What kind of agent are you?
- reflex, goal-based, utility-based?
To Do

• Project 0: Python tutorial

• Finish chapters 1 and 2; start chapter 3