Agents & Environments
Chapter 2

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(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:
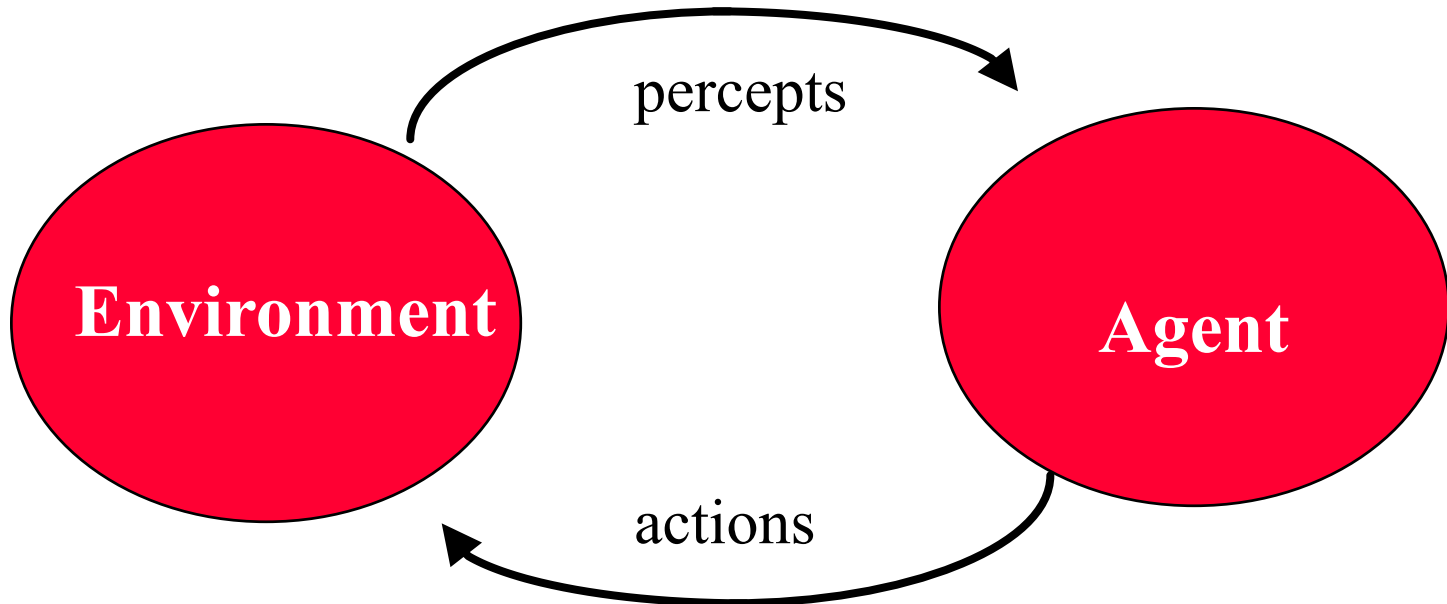 - cameras and laser range finders for sensors
  - various motors for actuators

Examples of Agents

- Intelligent buildings
- Autonomous spacecraft

- Softbots
    - Askjeeves.com
    - Expert Systems
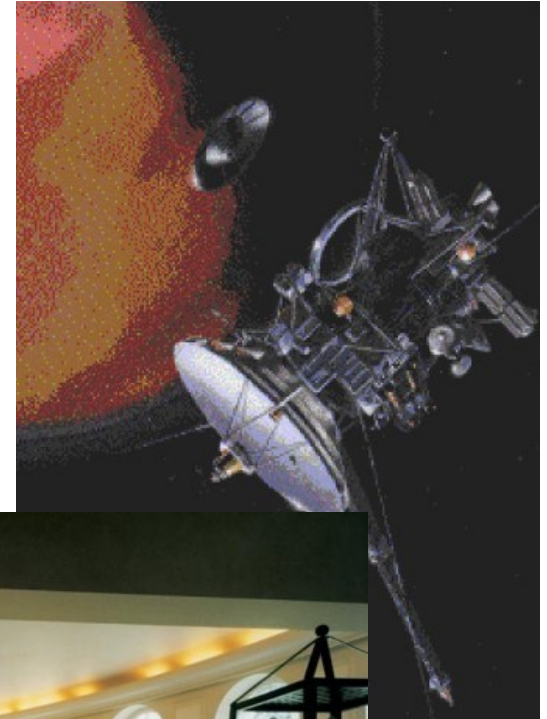
Intelligent Agents

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

- 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

Bounded Rationality

- We have a performance measure to optimize
- Given our state of knowledge
- Choose optimal action
- ***Given limited computational resources***

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

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)

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)

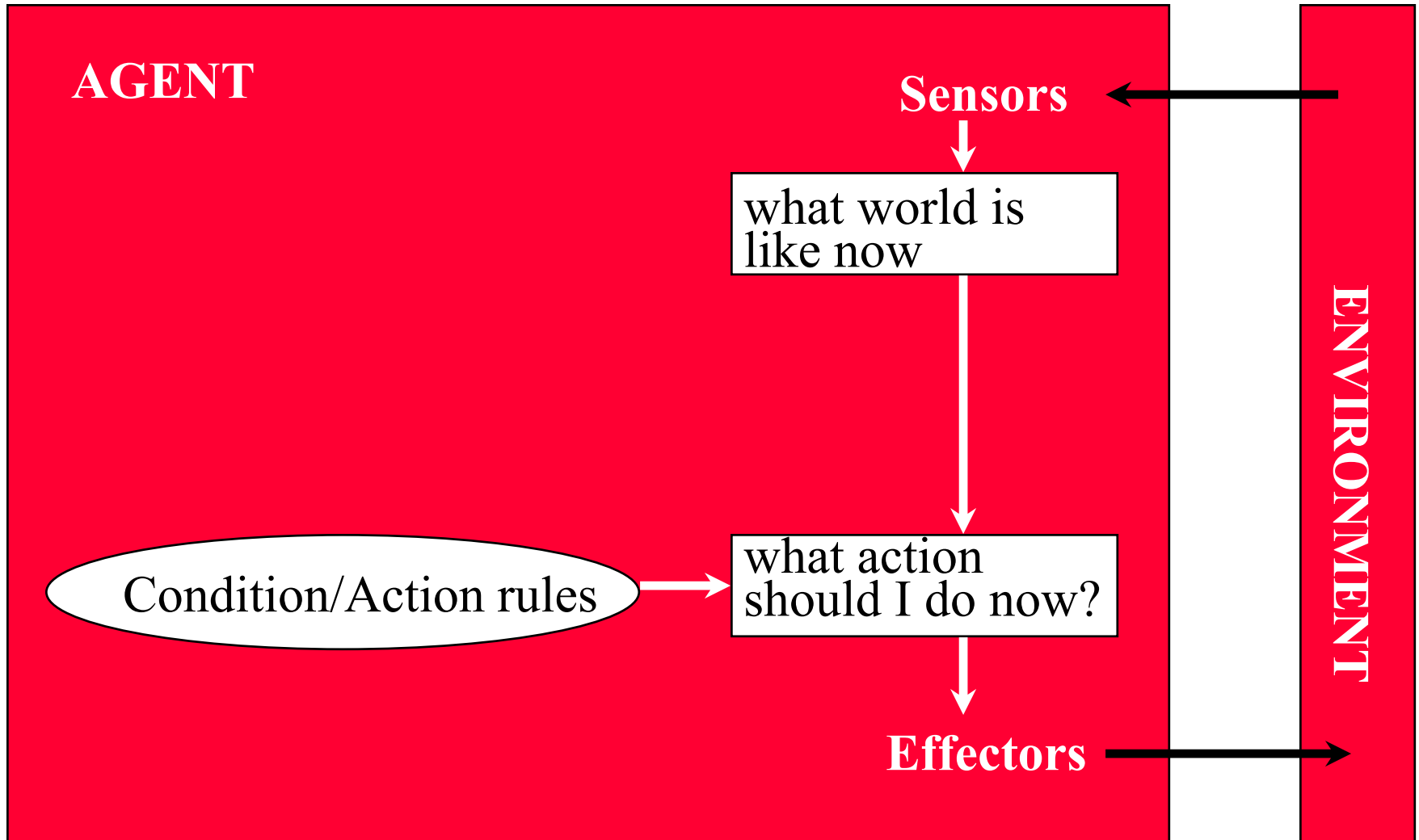# RoboCup vs. Chess
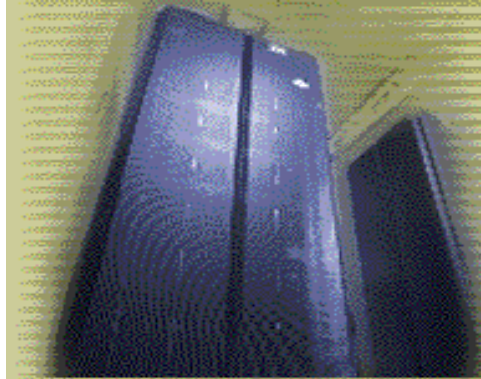
Deep Blue

Robot

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

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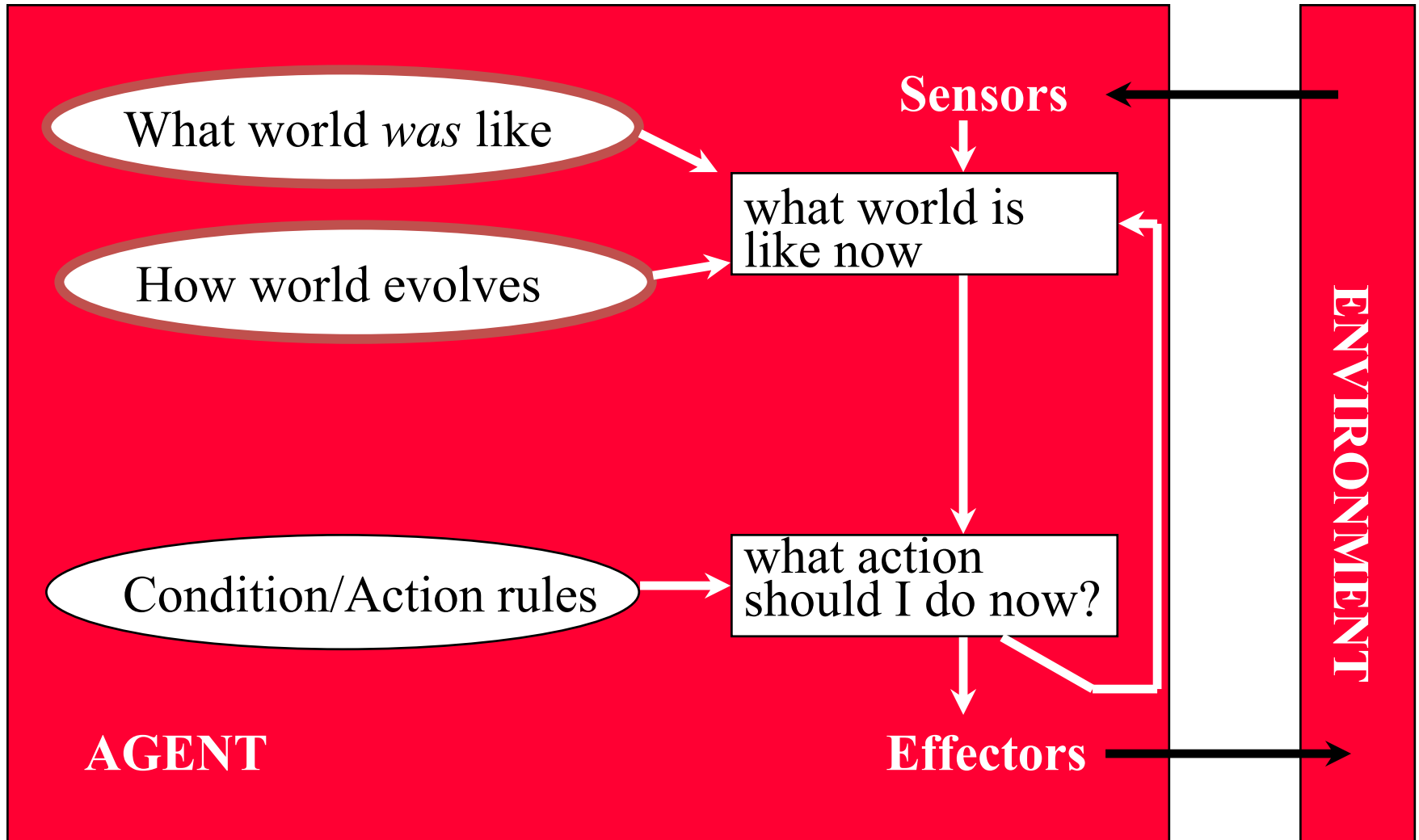- ➢ Sequential
- ➢ Multi-Agent

More Examples

- 15-Puzzle
  - Static – Deterministic – Fully Obs – Discrete – Seq – Single

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

- Medical Diagnosis
  - Dynamic – Stochastic – Partially Obs – Continuous – Seq – Single

- Taxi Driving
  - Dynamic – Stochastic – Partially Obs – Continuous – Seq – Multi-agent
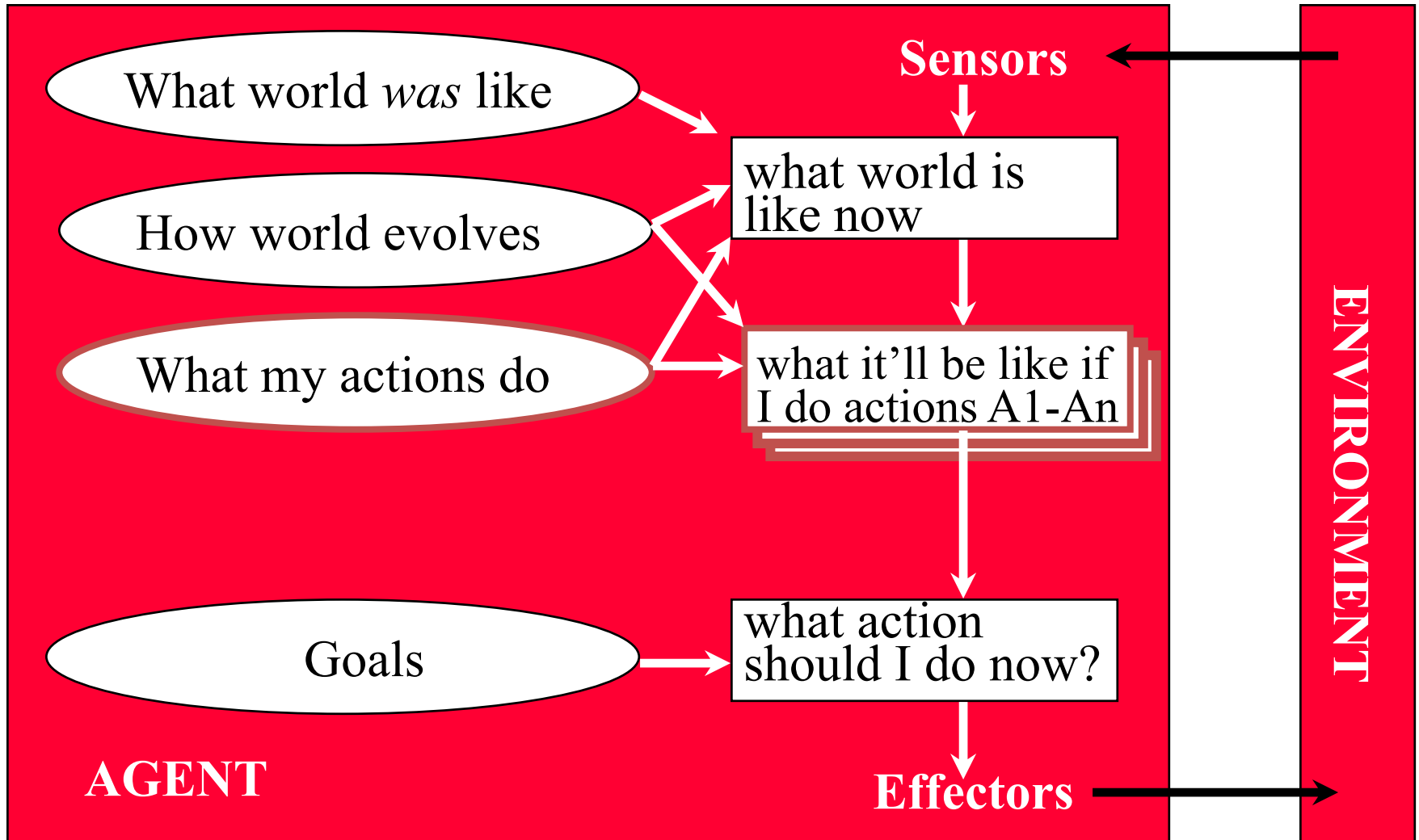
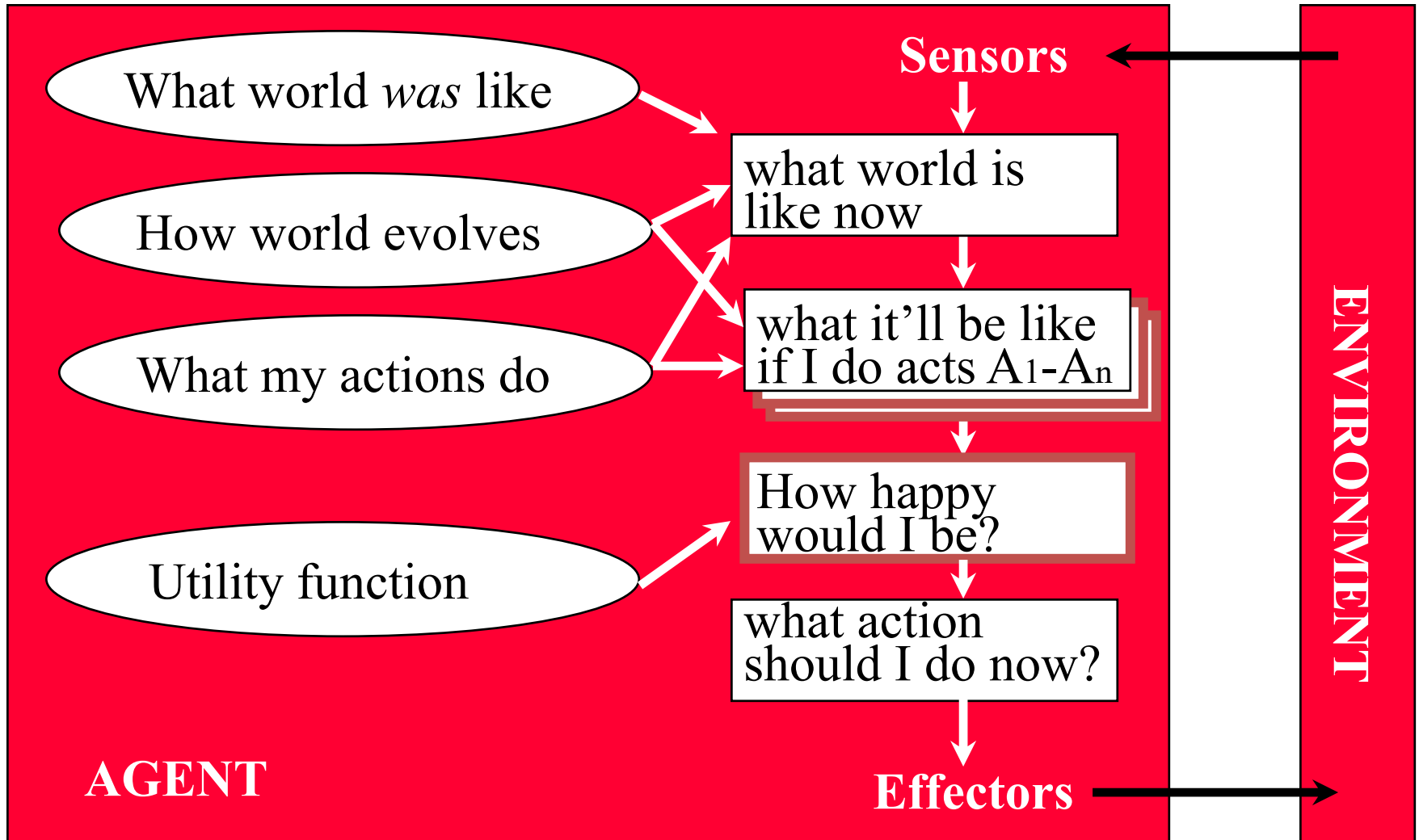# Simple reflex agents

Reflex agent with internal state

Goal-based agents

Utility-based agents

Learning agents

Feedback Sensors

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 A_1-A_n

How happy would I be?

what action should I do now?

AGENT

Effectors

ENVIRONMENT