

# Agents & Environments

## Chapter 2

Mausam

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

# Outline

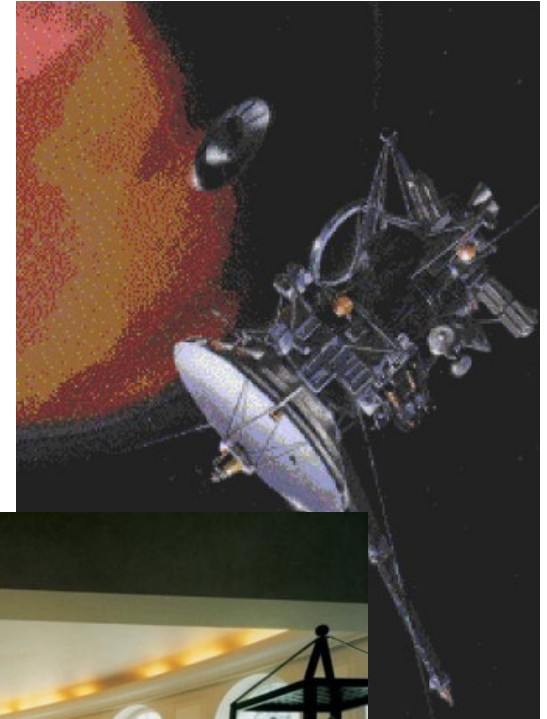
- Agents and environments
- Rationality
- PEAS specification
- Environment types
- Agent types

# 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

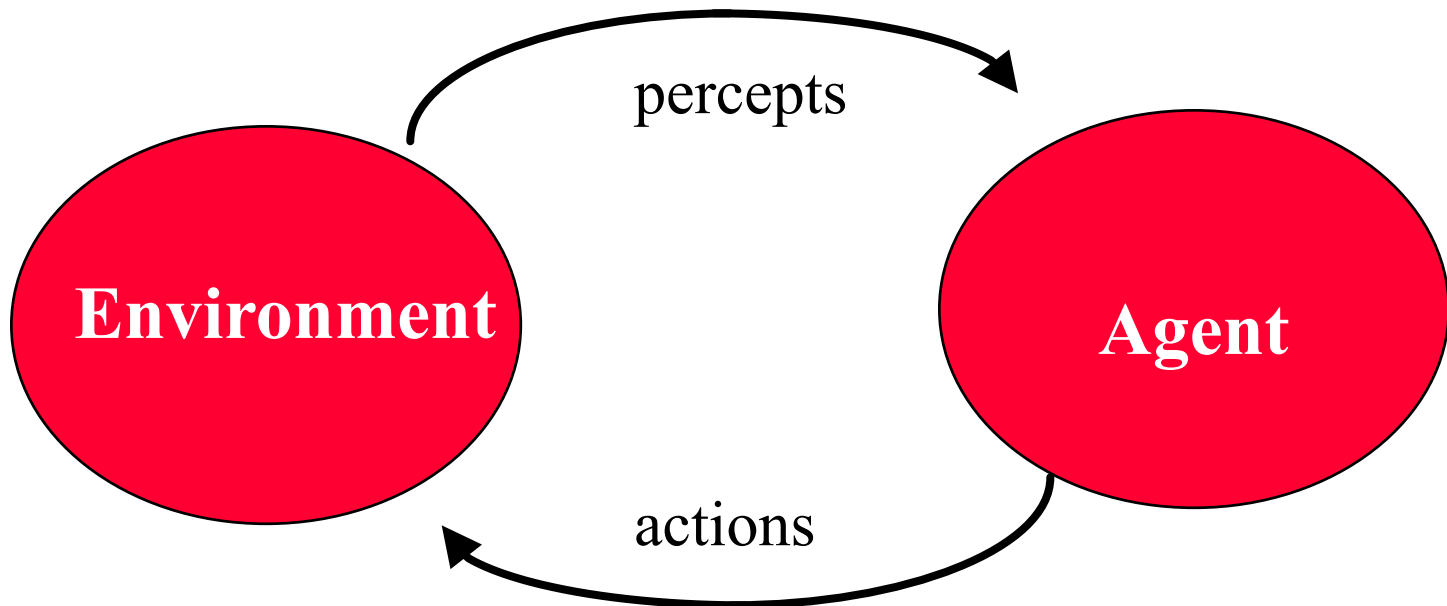
# Examples of Agents

- Physically grounded agents
  - Intelligent buildings
  - Autonomous spacecraft
- Softbots
  - Expert Systems
  - IBM Watson



# 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

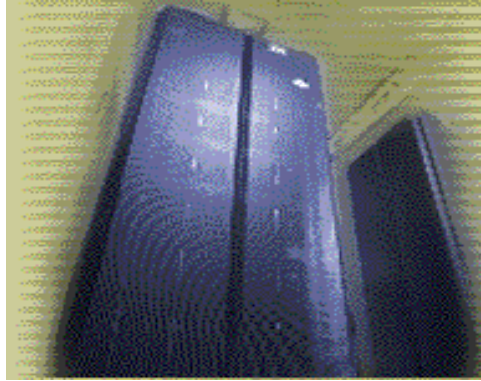
# PEAS

- 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**

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



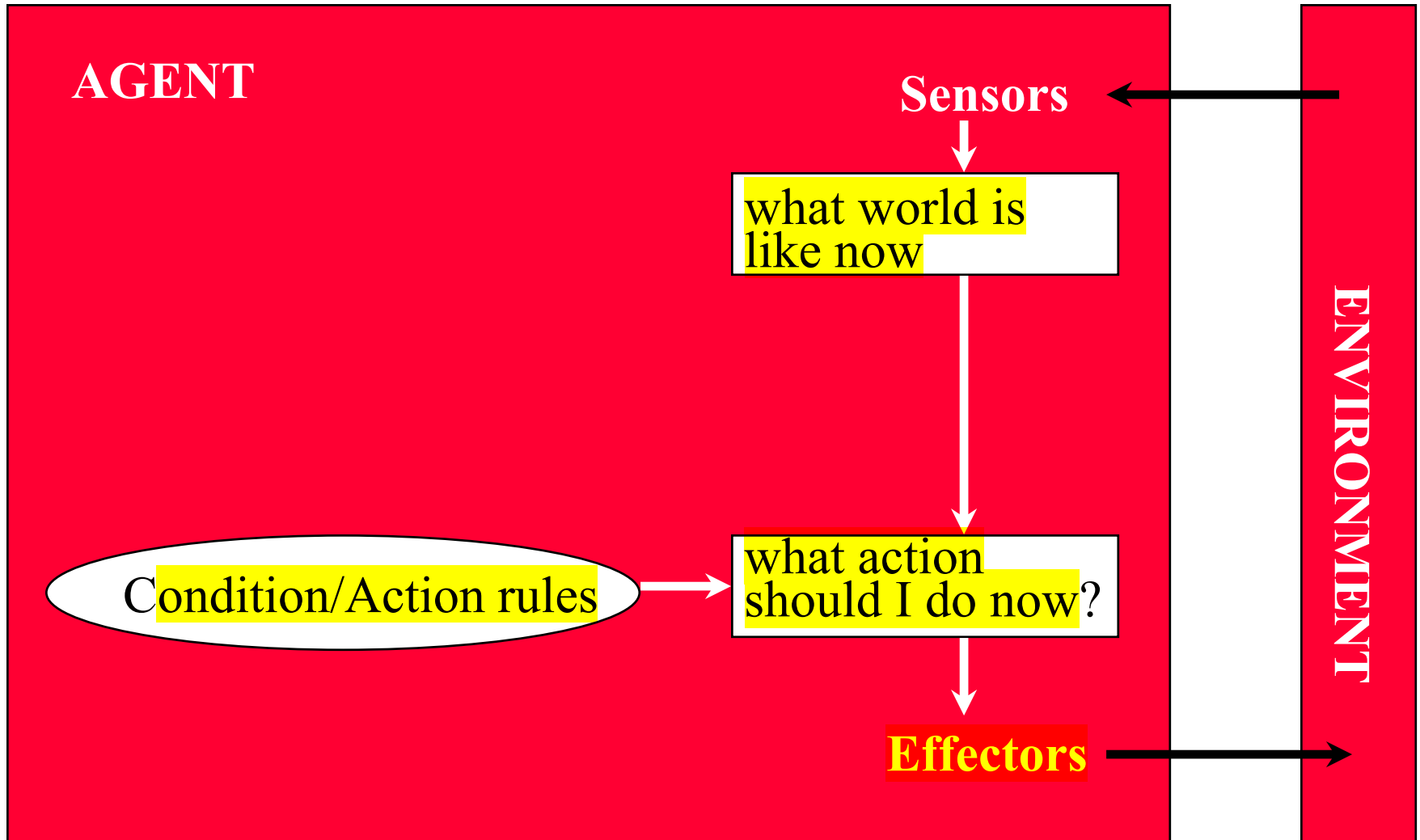
**Robot**

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

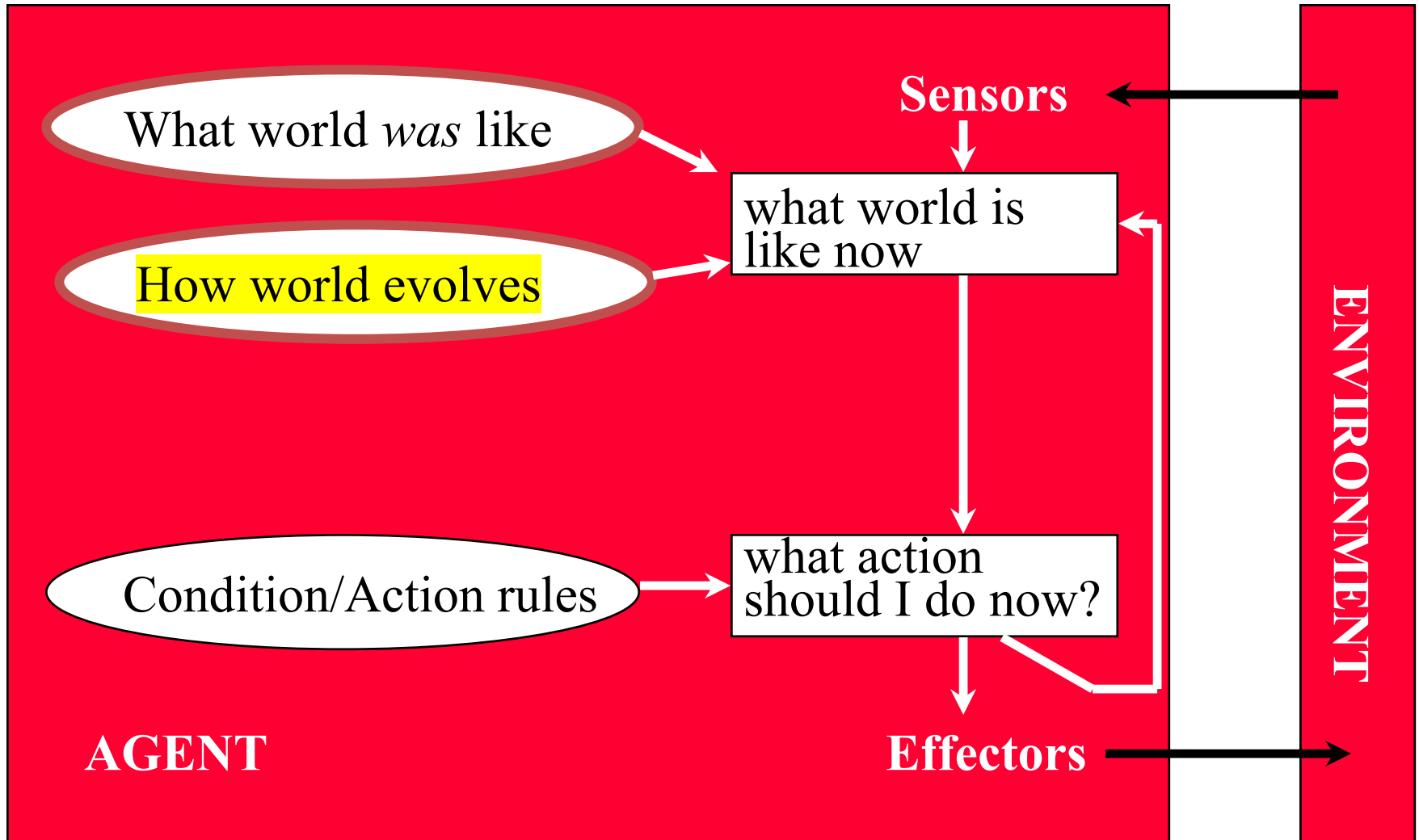
# More Examples

- 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

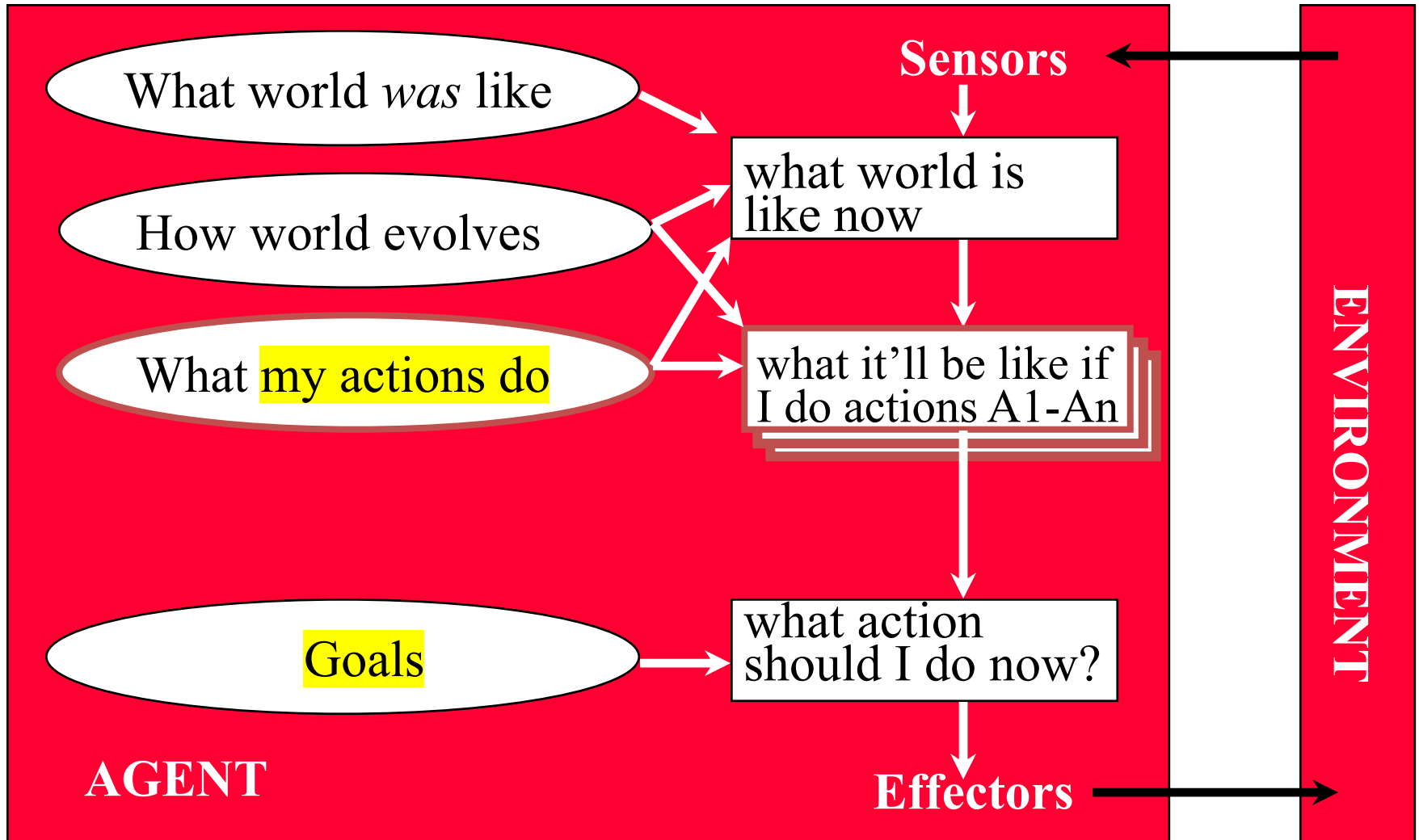


# Reflex agent with internal state

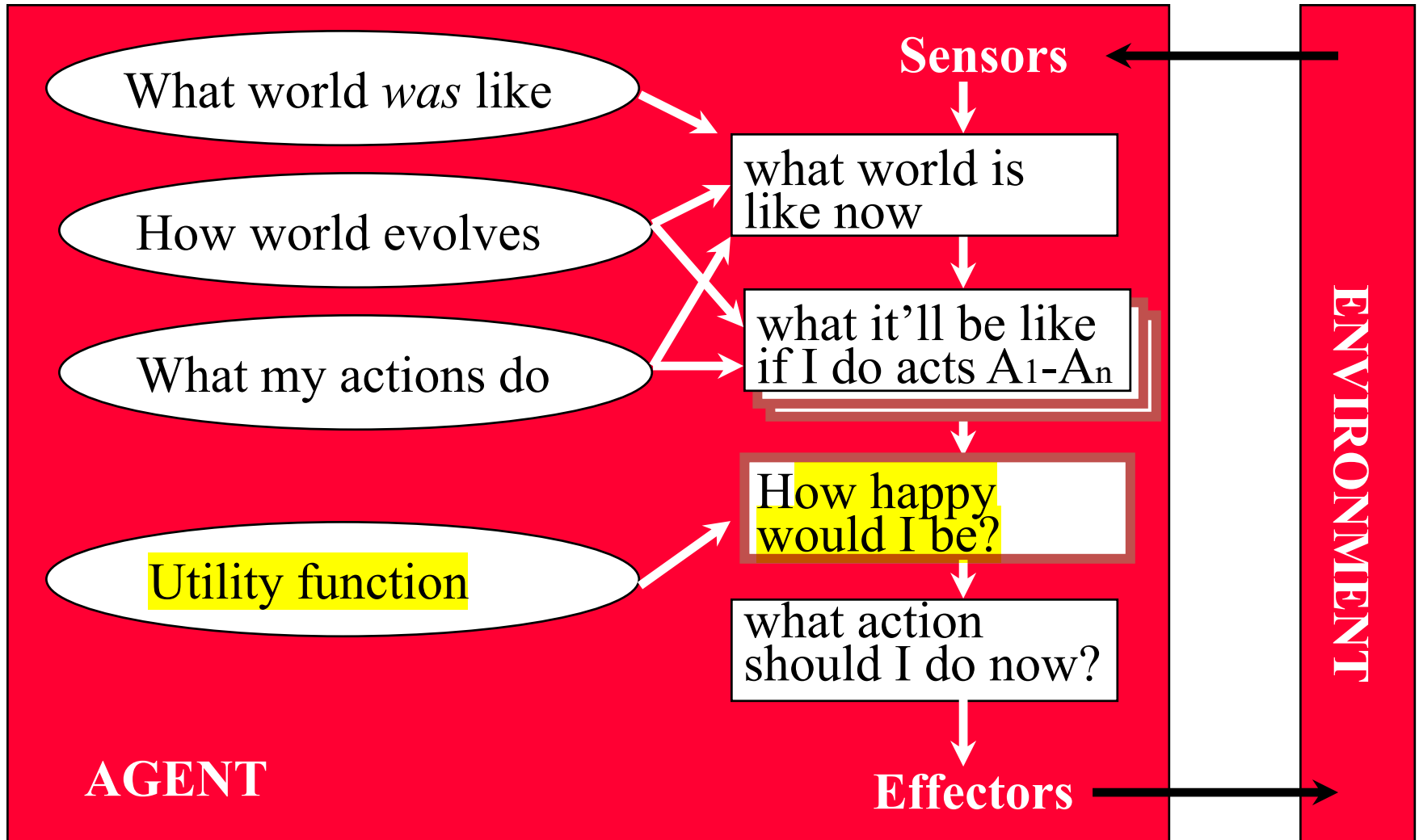




# Goal-based agents



# Utility-based agents



# Learning agents

