

# Intelligent Agents

Scott Wallace

CS 440

WSU Vancouver



# Outline

- Agents and environments
- Rationality
- PEAS

*Performance measure,*

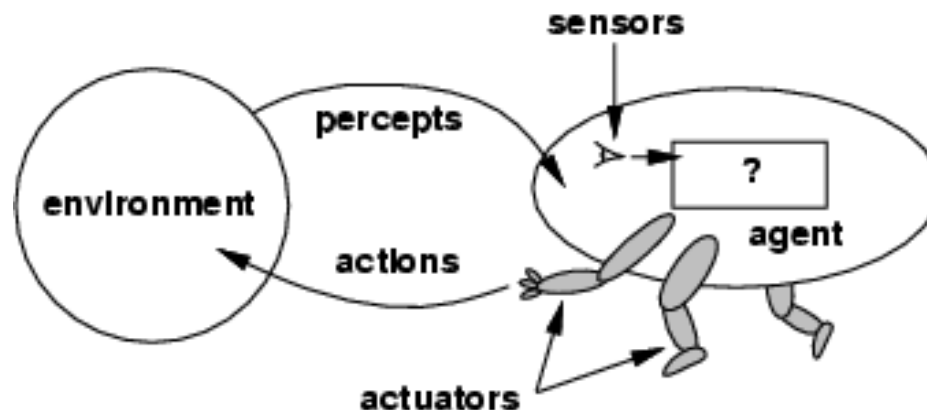
*Environment, Actuators, Sensors*

- Environment types
- Agent types

# Agents

- A black box with sensors and actuators
- Human agent:
  - eyes, ears are sensors
  - Legs, arms are actuators
- Robotic agent:
  - cameras and IR range finders are sensors
  - various motors are actuators

# Agents and Environments



- The agent function maps percept (histories) to actions:  
 $[f. P^* \rightarrow \mathcal{A}]$
- The agent program runs on a physical architecture to produce  $f$
- **agent = architecture + program**
- Often we say 'knowledge' instead of 'program'

# Rational Agents

- Selects actions expected to maximize its performance measure
- Bases decision on:
  - Performance measure
  - Available actions
  - Percept sequence (current and past)
  - Built-in (or acquired) knowledge

# Definition of Rationality

*For each possible percept sequence, a rational agent should select an action this is expected to maximize its performance, given the evidence provided by the percept sequence and whatever built-in knowledge the agent has.*

# Rational Agents

- Rationality is distinct from omniscience
  - May not know what **actual outcomes** will be
  - Should know what the **expected outcome** is
- Agents can perform actions in order to modify future percepts
  - information gathering
  - exploration

# Where Does Knowledge Come From?

- Percepts
- Learning



**Environment**

- Designer



**Built in**

# Autonomy

- Often, we hope agents will also be relatively **autonomous**, or able to act on their own.
  - Can the agent adapt to changes in its environment?
  - Does the agent rely heavily on knowledge of its designer?

# Agents and Environments

- Design of the agent system revolves around properties of the task environment
  - What actions can/should the agent consider?
  - What percepts will the agent have?
  - How will we gauge performance?
  - What is the environment like?

# PEAS

- PEAS:
  - Performance measure
  - Environment
  - Actuators
  - Sensors
- Specifies the setting for agent
- This paves the way for the agent design

# PEAS – Medical Agent

- **Performance measure:** patient health, costs, etc
- **Environment:** Patient, hospital, staff
- **Actuators:** Screen (questions, tests, diagnoses, treatments, referrals)
- **Sensors:** Keyboard (entry of symptoms, findings, patient's answers)

# Environment Types

- **Fully observable vs. Partially observable**
- An agent's sensors give it access to the complete state of the environment at each point in time (full observability)

# Environment Types

- **Deterministic vs. Stochastic**
- Next State of the environment is determined by the current state agent's action (deterministic).
- If the environment is deterministic except for the actions of other agents, then the environment is **strategic**
- Usually, think of this from agent's perspective

# Environment Types

- **Episodic vs. Sequential**
- The agent's experience is divided into atomic "episodes" (percepts then action)
- The **choice of action** in each episode **depends only on the episode itself**
- Episodes can exist at various levels

# Environment Types

- **Static vs. Dynamic**
- No changes occur while an agent is deliberating (static).
- The environment is **semi-dynamic** if only the agent's performance score changes during deliberation

# Environment Types

- **Discrete vs. Continuous**
  - A limited number of distinct, well defined percepts and actions (discrete)
- **Single-Agent vs. Multi-Agent**
  - An agent operating by itself in an environment
  - Competitive vs. Cooperative multi-agent settings

# Environment Types

	Chess with a clock	Chess without a clock	Taxi driving
Fully observable	Yes	Yes	No
Deterministic	Strategic	Strategic	No
Episodic	No	No	No
Static	Semi	Yes	No
Discrete	Yes	Yes	No
Single agent	No	No	No

- The environment type largely determines the agent design
- The real world is (of course) partially observable, stochastic, sequential, dynamic, continuous, multi-agent

# 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
- **Aim:** find a way to implement the rational agent function concisely

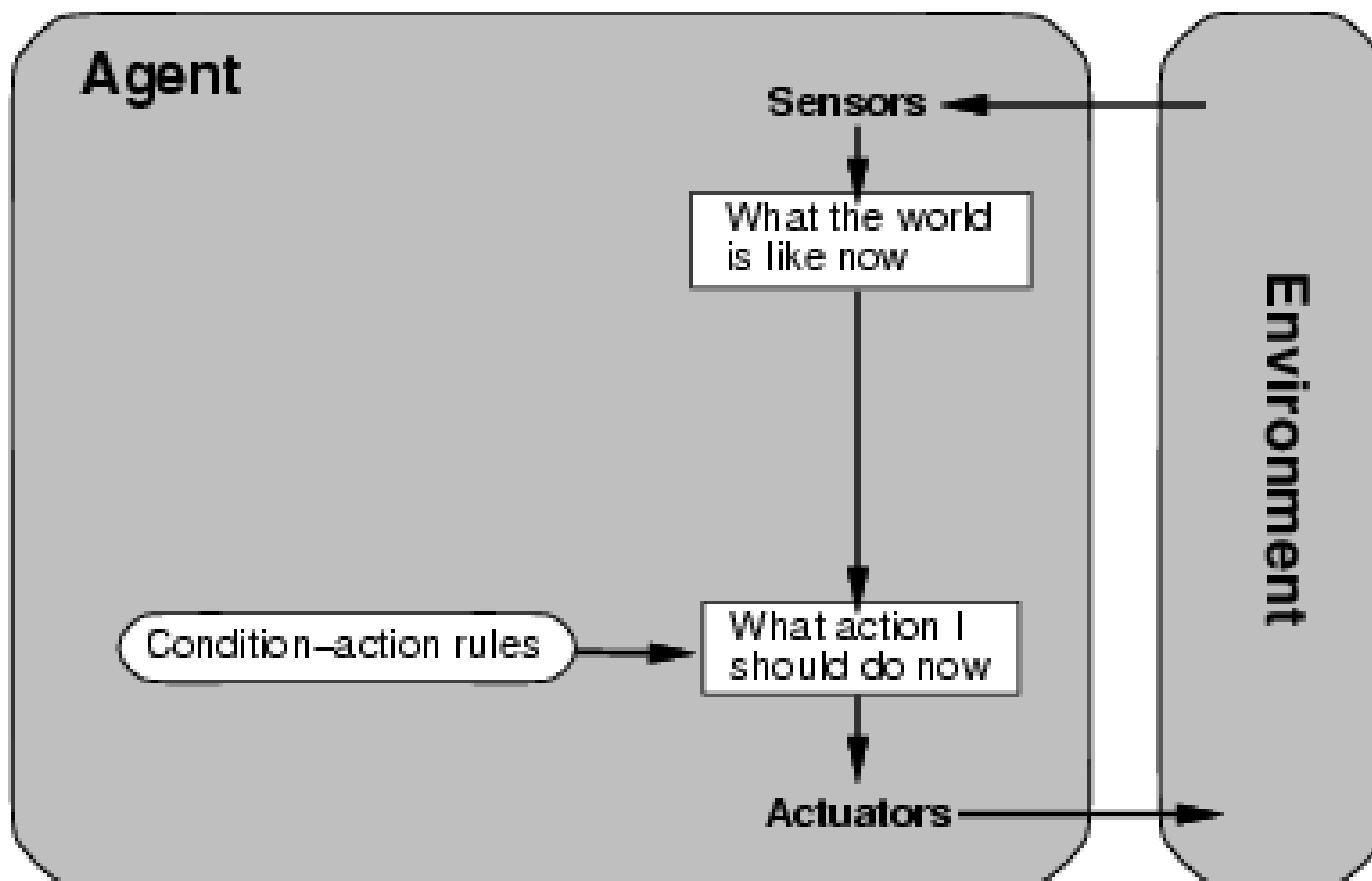
# Table-lookup Agents

- Keep a history of percepts, use it to look up an action from a table
- Drawbacks:
  - Huge table
  - Take a long time to build the table
  - Autonomy could be quite poor
  - Even with learning, need a long time to learn the table entries

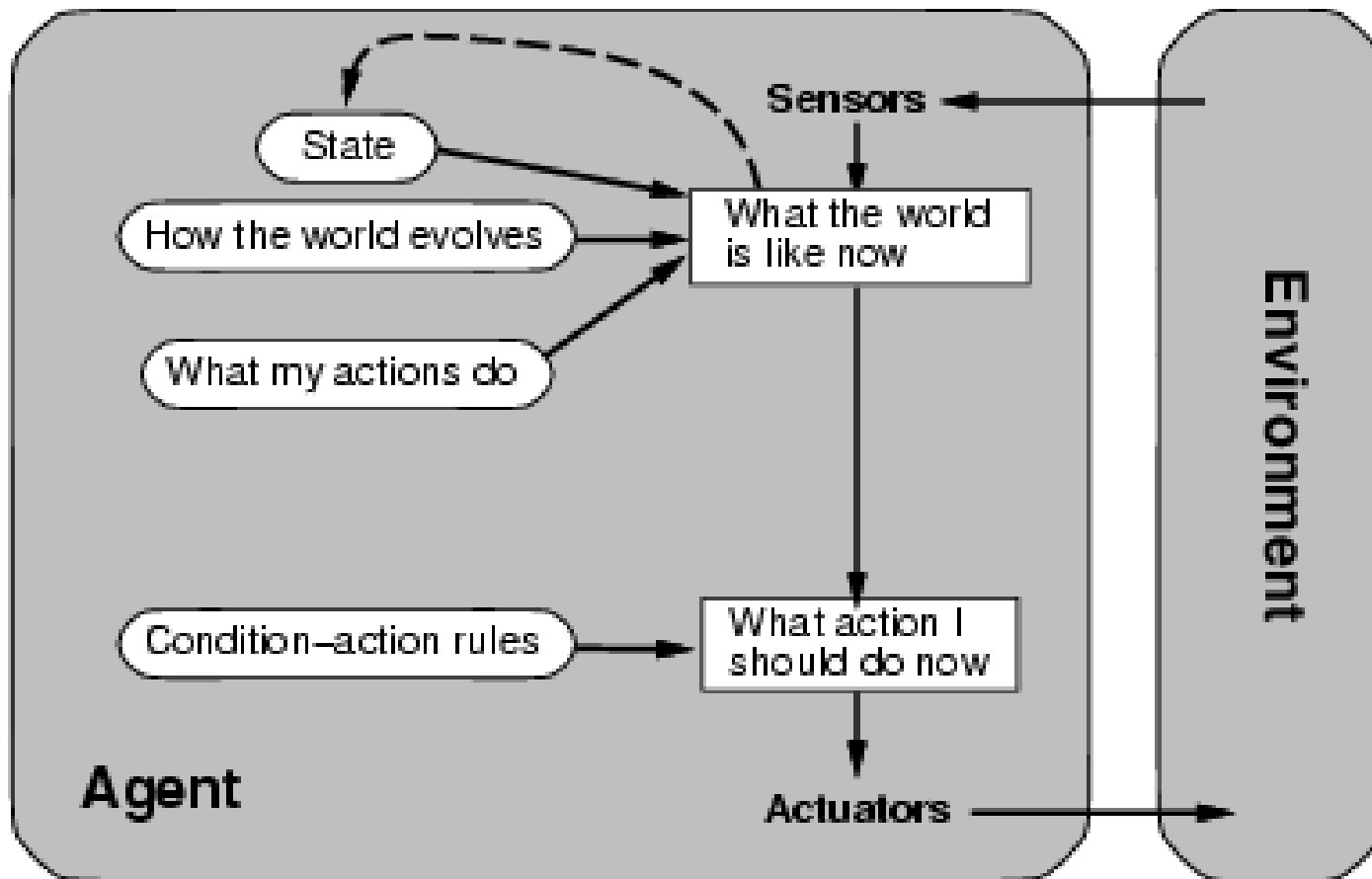
# Basic Agent Types

- Simple Reflex Agents
- Model-Based Reflex Agents
- Goal-Based Agents
- Utility-Based Agents
- Learning Agents

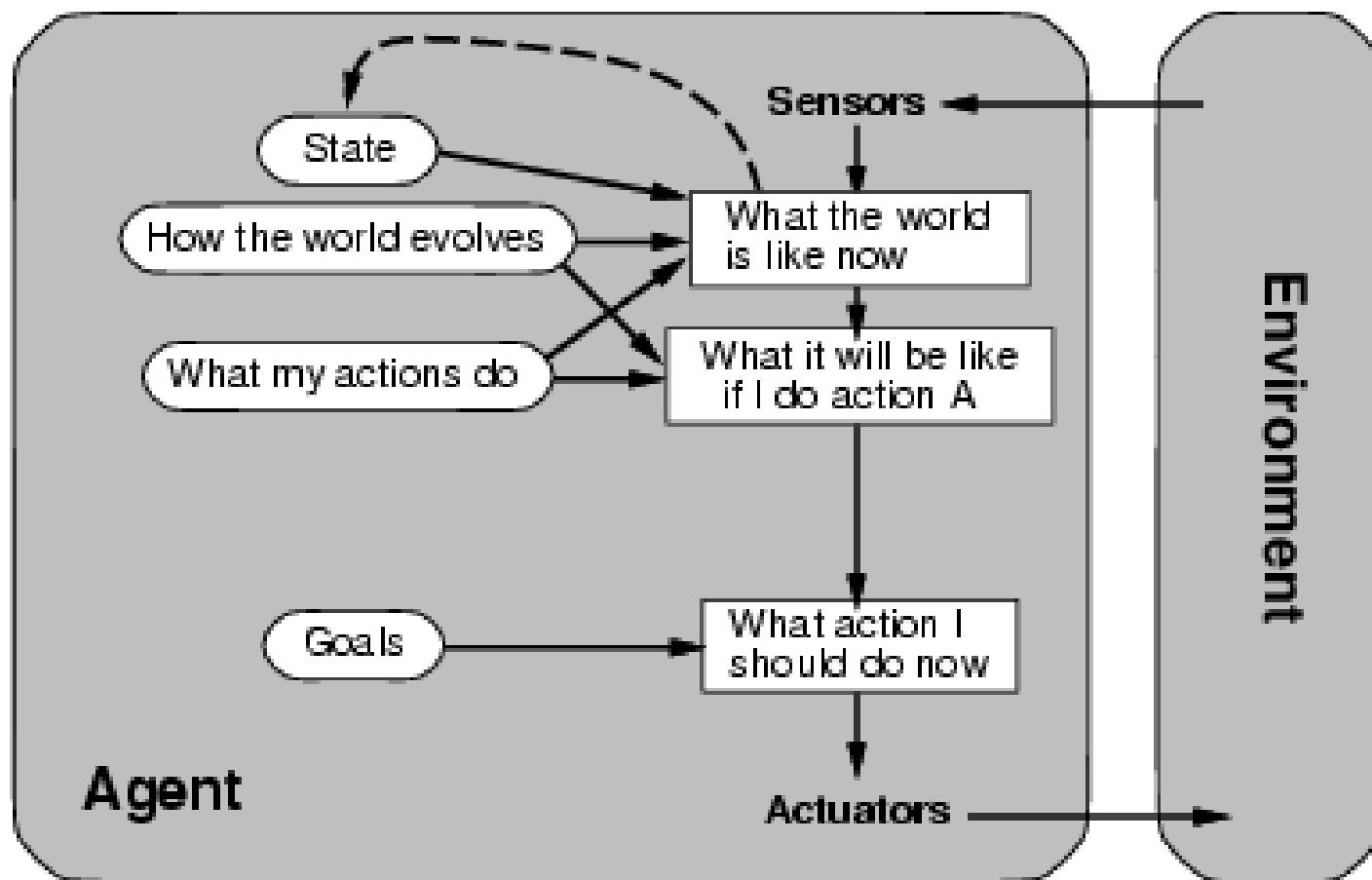
# Simple Reflex Agent



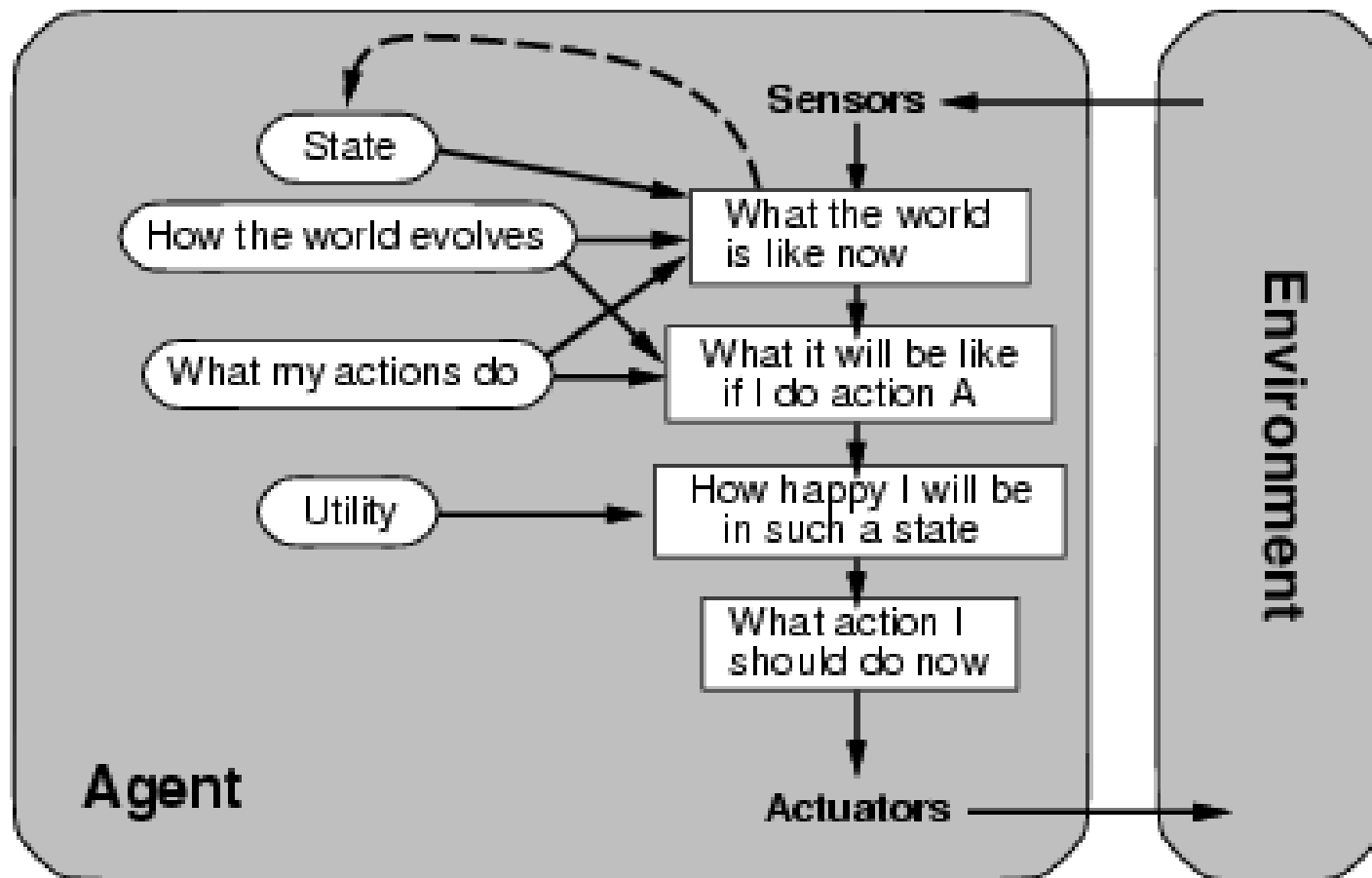
# Model-Based Agent



# Goal-Based Agents



# Utility-Based Agent



# Learning Agents

