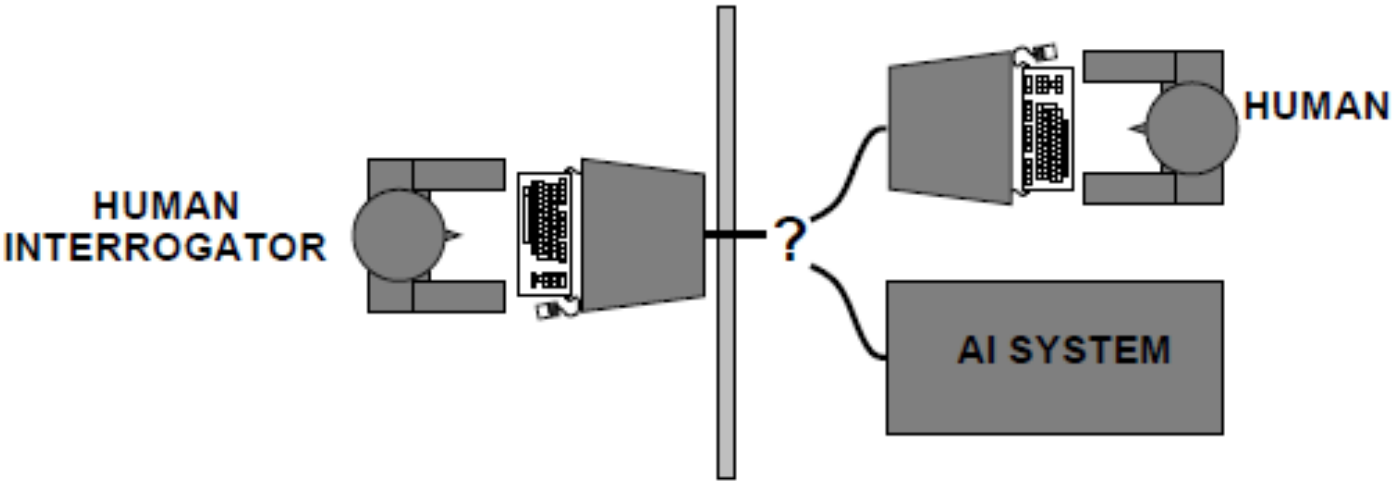
Some History
and
Intelligent Agents

Turing Test

- Turing (1950) “Computing machinery and intelligence”:
- “Can machines think?”
- “Can machines behave intelligently?”
- Turing Test:



Defining AI

- The Turing Test: The ability to achieve human-level performance on cognitive tasks, sufficient to fool an interrogator.
  - Requirements:
    - » natural language processing
    - » knowledge representation
    - » automated reasoning
    - » machine learning
    - » (computer vision)
    - » (robotics)
  - The last two requirements are for the total Turing Test, which does not allow physical separation between the interrogator and the subject

Defining AI (cont'd)

- But what qualifies a system as being "intelligent"?
- One division of AI definitions is into weak AI or strong AI categories:
  - **weak AI** = systems that behave intelligently
  - **strong AI** = system that actually think, and are intelligent

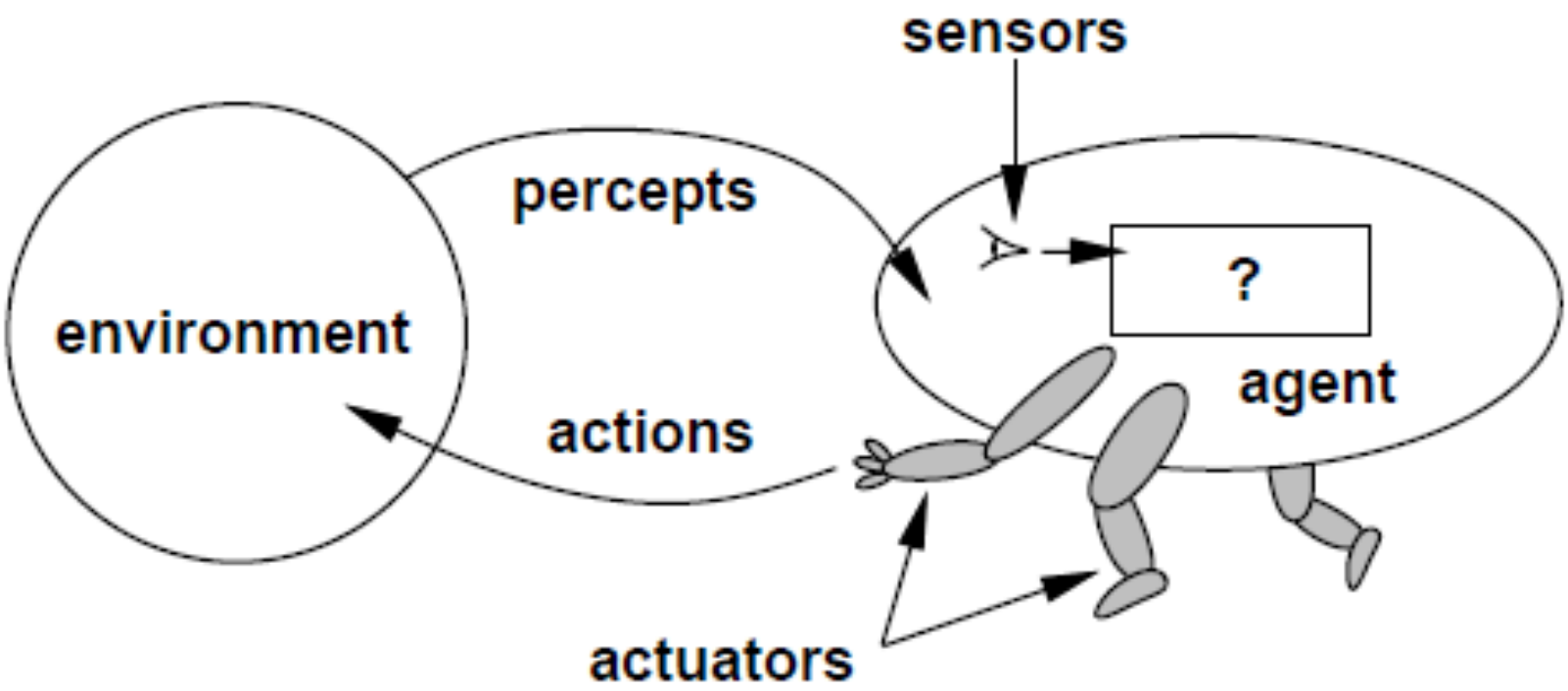
Practical Applications of AI

- Robots
  - automated cars, volleyball-playing robots
- Game playing
  - Deep Blue (chess)
- Speech recognition
- Language understanding
  - translation software, Google
- Expert systems
  - animal classification, medical diagnosis, computer configuration
- Artificial life
  - personal avatars
- Computer vision
  - handwriting recognition, face recognition

Our main focus: Rational Agents

- An **agent** is an entity that exists in an **environment** and that **acts** on that environment based on its **perceptions** of the environment
- Our interest is to build **rational agents**
- Agents that act **rationally**:
  - Do the right thing: maximize expectation / goal achievement, given the available information

Agents and Environments



- Agents can be humans, robots, softbots, thermostats, etc.

Degrees of Intelligence

- Focusing on rational agents (agents that try to do the best thing under the circumstances), one tends to measure the intelligence of the agent according to:

  1. the ability to perceive and understand a variety of circumstances
  2. the ability to adopt complex goals and manage them to arrive at an optimal objective
  3. the ability to learn effectively
  4. the ability to adapt to new circumstances

Intelligent Agents

- R2D2

Intelligent Agents

- Chess
  - The Turk (late 18th century)

Intelligent Agents

- Chess
  - Deep Blue

  (On May 11, 1997, the machine won a six-game match by two wins to one with three draws against world champion Garry Kasparov.)

Agent Environments

Vacuum-cleaner world

- » **environment**: rooms, with connections in between, and dirt in zero or more rooms
- » **perceptions**: current room, adjacent rooms, and existence of dirt
- » **actions**: suck, move, no-op
- » **goal**: remove dirt from all rooms

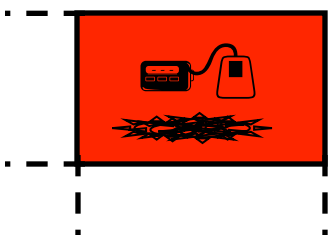
Planning, moving according to given movement rules

PEAS

- To design a rational agent, we must specify the **task environment**
- Consider, e.g., the task of designing an automated taxi:
  - **P**erformance measure? safety, profits, fast, legality, comfort, …
  - **E**nvironment? roads, traffic, pedestrians, weather, …
  - **A**ctuators? steering, accelerator, brake, horn, speaker/ display,…
  - **S**ensors? Cameras, sonar, speedometer, engine sensors, keyboard, GPS,…

Types of Agents

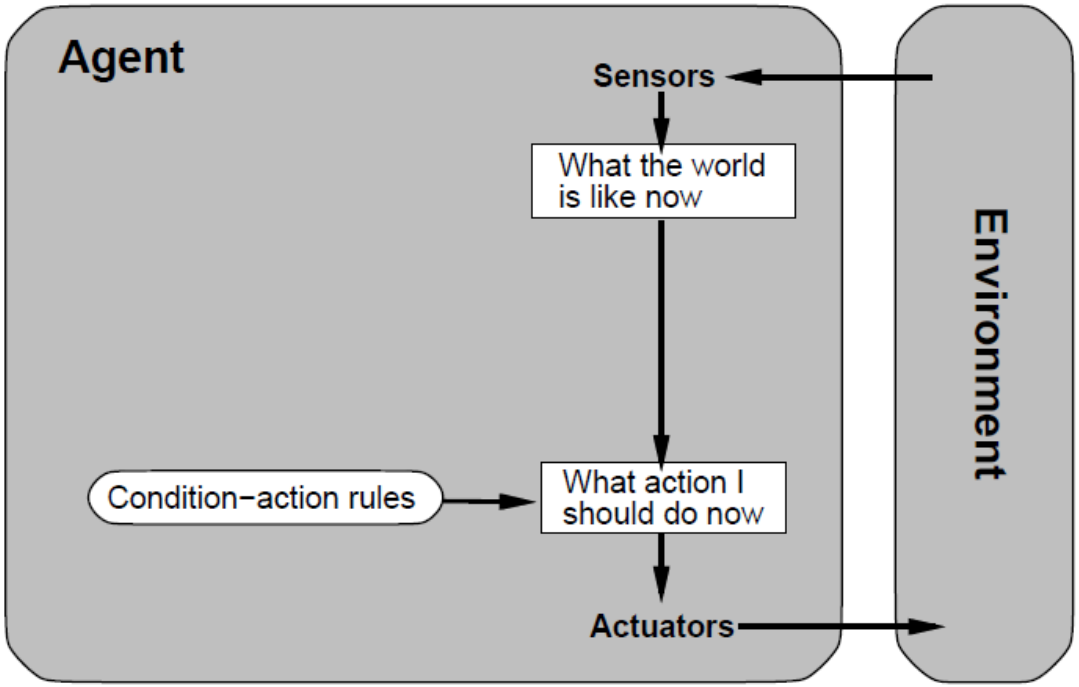
- Simple reflex agents
  - operate on current state of environment, ignores all past perceptions (knee-jerk reactions)
  - very simple, not very intelligent
  - VC example:
    - » if dirt exists, suck
    - » move to random room



  - hard to verify success for complex tasks
    - » good for simple agents (bar code scanners, e.g.)

Types of Agents (cont'd)

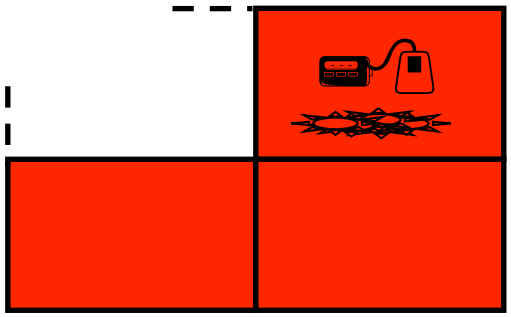
- Simple reflex agents




```
function REFLEX-VACUUM-AGENT( [location,status]) returns an action
    if status = Dirty then return Suck
    else if location = A then return Right
    else if location = B then return Left
```

Types of Agents (cont'd)

- Model-based reflex agents
  - Also act on current state, but keeps track of the other parts of the world that it can't currently see
  - Needs to store a representation of the current world, somehow



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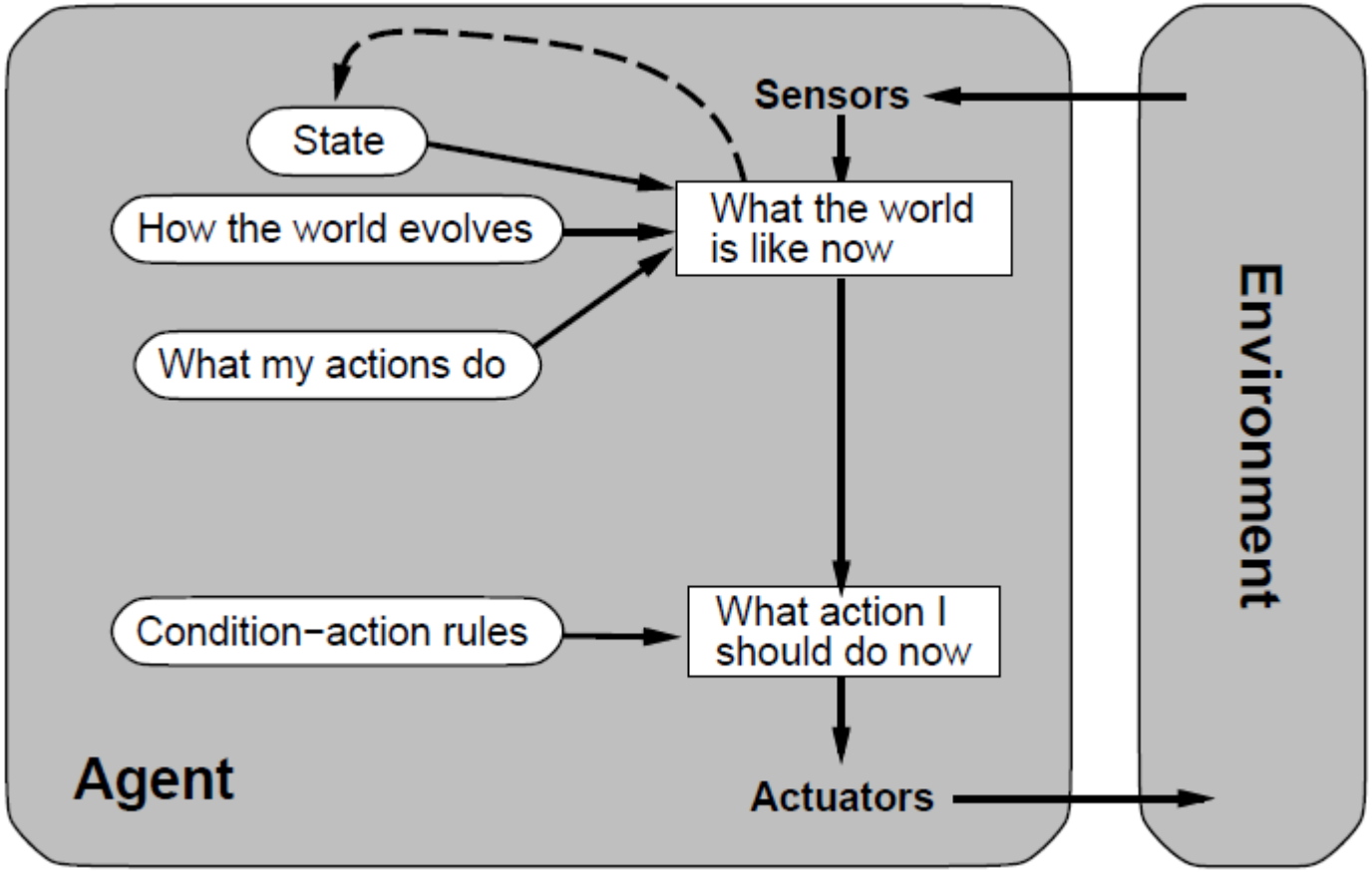
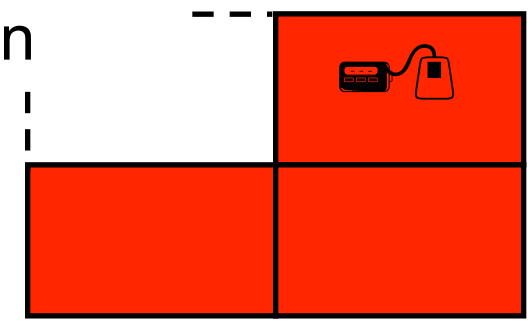


Types of Agents (cont'd)

- Goal-based agents
  - incorporates goals into its decision-making process when selecting an action to perform
  - tries to achieve a desirable state
  - often needs to have more intuition about its environment



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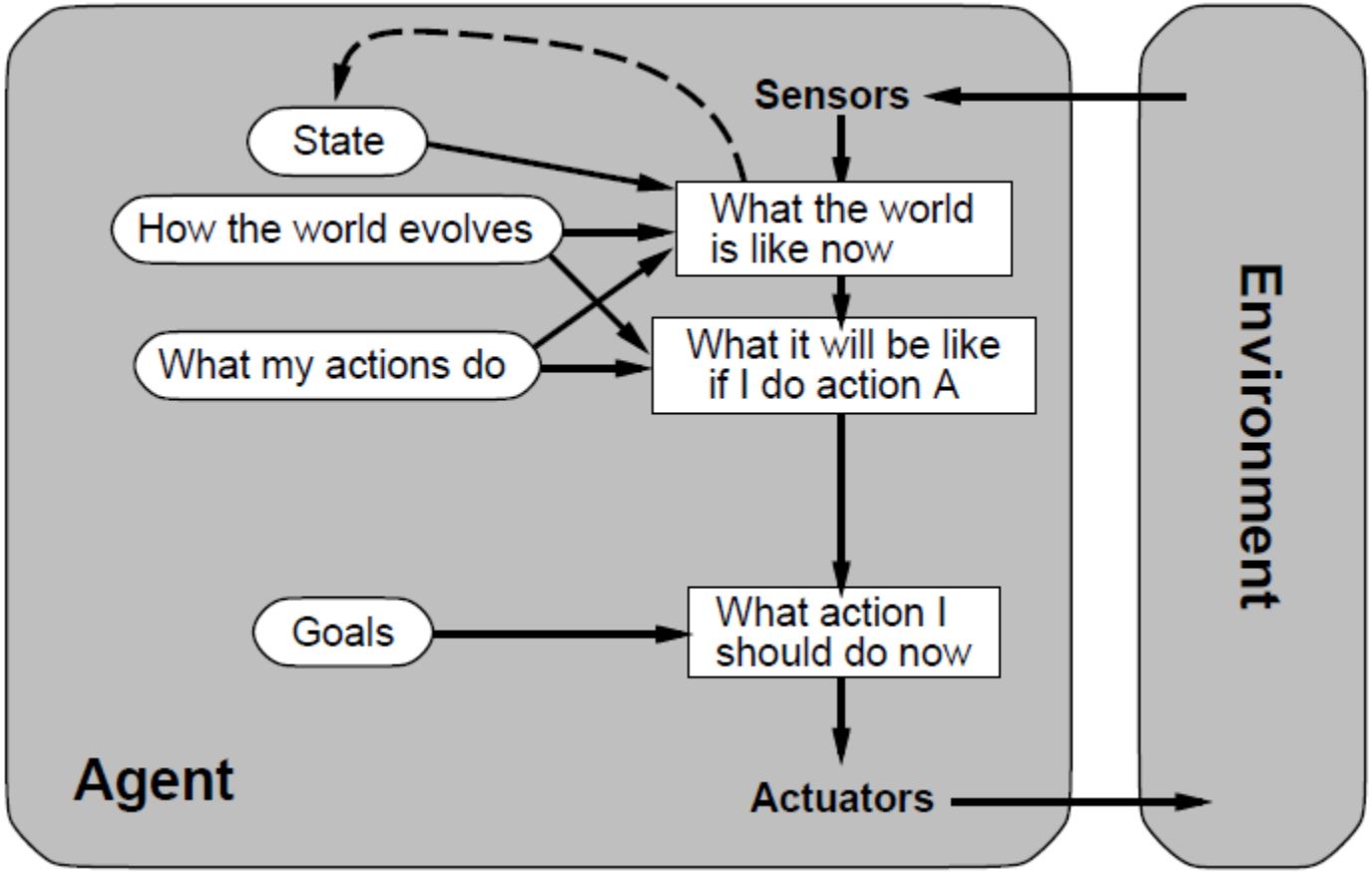
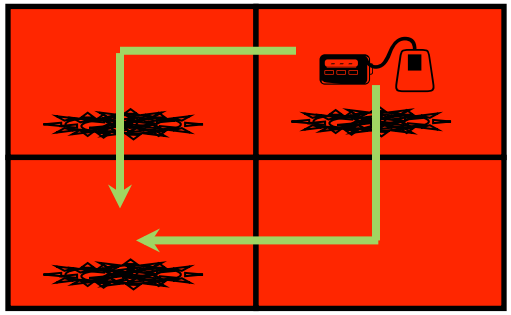


Types of Agents (cont'd)

- Utility-based agents
  - when multiple paths exist to an agent's goals, the possible actions are given a weight called a utility, that allows the agent to select the best action
  - usually involves a utility function that maps the next state to a number value that indicates the agent's "happiness"



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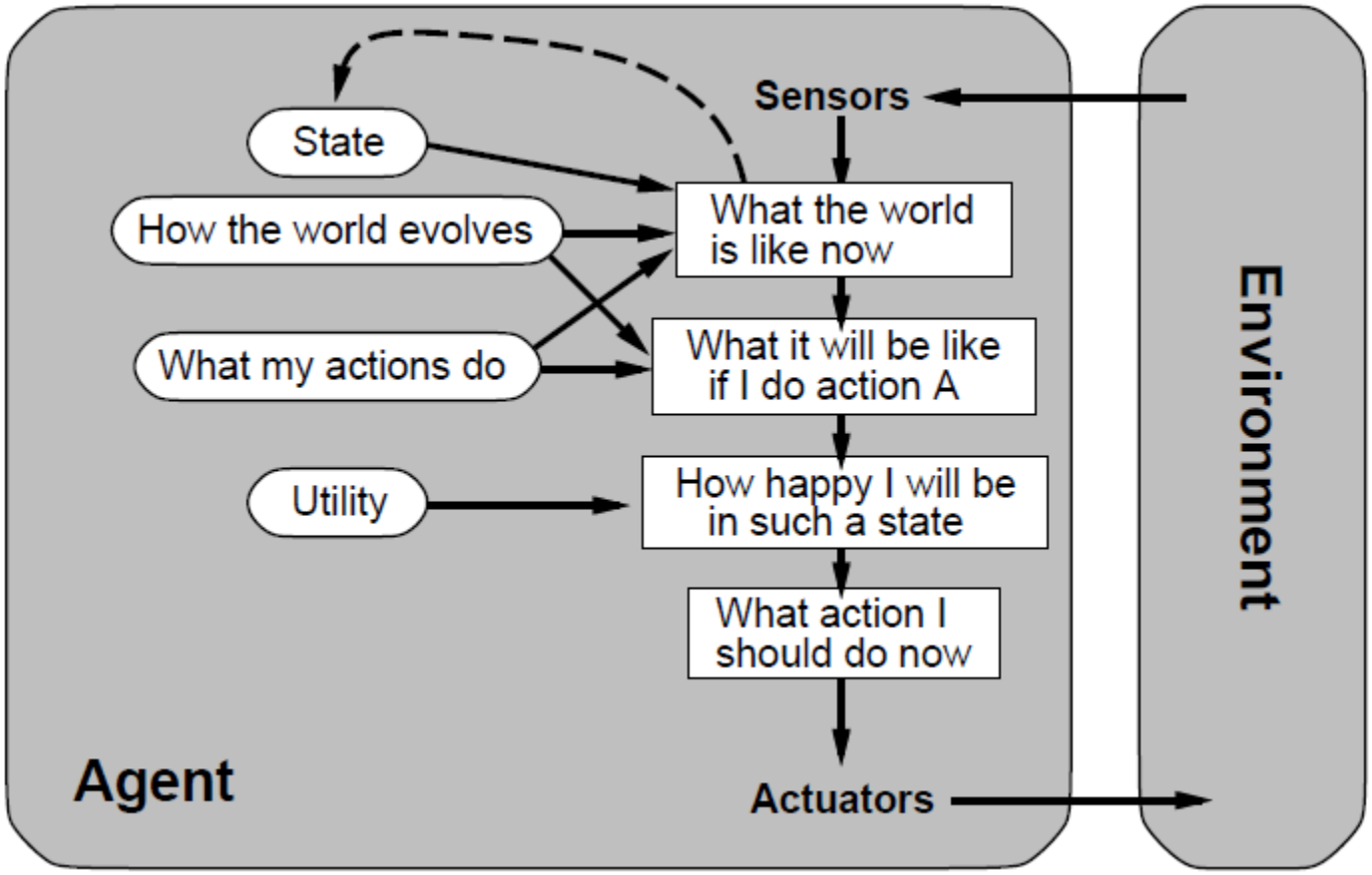
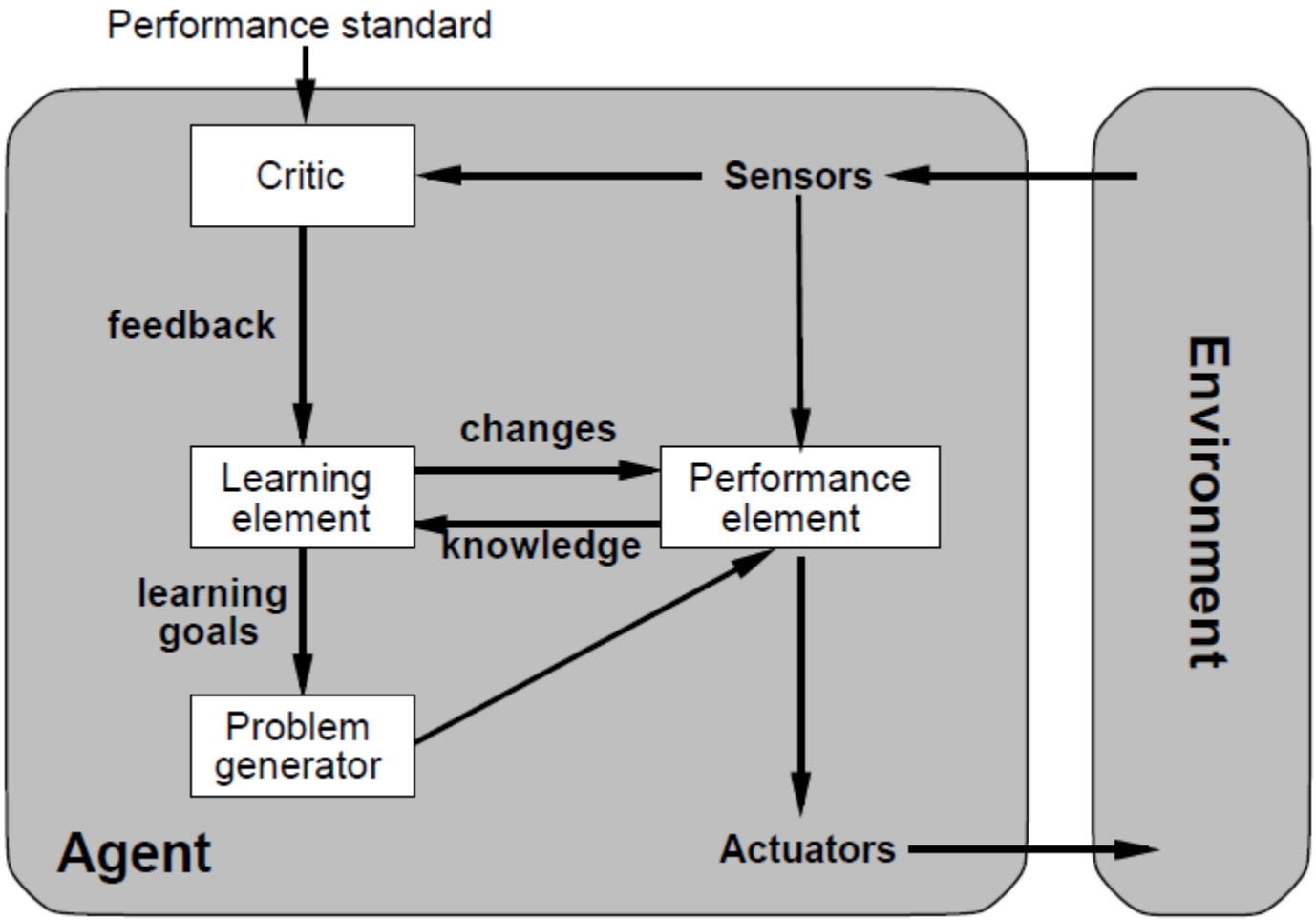


Types of Agents (cont'd)

- Learning-based agents
  - "experiments" with various actions to try to find the set that produce the optimal results, and then follows those actions
  - requires database of actions, performance evaluation, learning mechanism
    - » e.g. car-driving robot

Types of Agents (cont'd)

- Learning-based agents



Multiple Agents

- RoboCup
  - robot soccer league
  - international competition
  - also offers search & rescue, RoboCup junior, and a dance competition

- Radiation cleanup, bomb disposal robots
- Still a lot of current multi-agent research being conducted today

RoboCup

Readings

- Russell & Norvig
  - Chapter 1
  - Chapter 2