, 2022

Concept and Logic (Agents Principles)

Agents

AI metaphor

Dr. Bilal Hoteit

Introduction to Artificial Intelligence

Table of contents

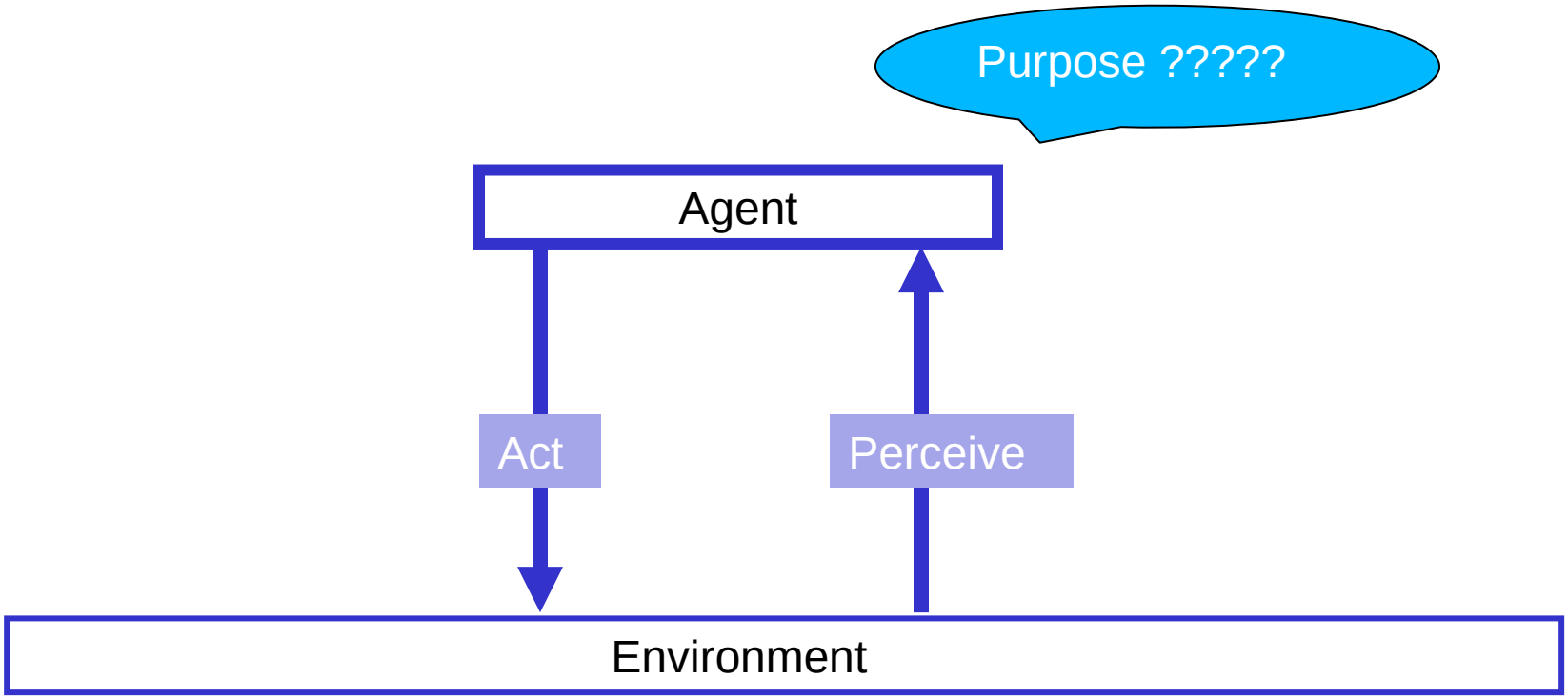
- Agents and Environments
- Rationality
- PEAS (Performance measure, Environment, Actuators, Sensors)
- Environment types
- Agent types

Agent Concept

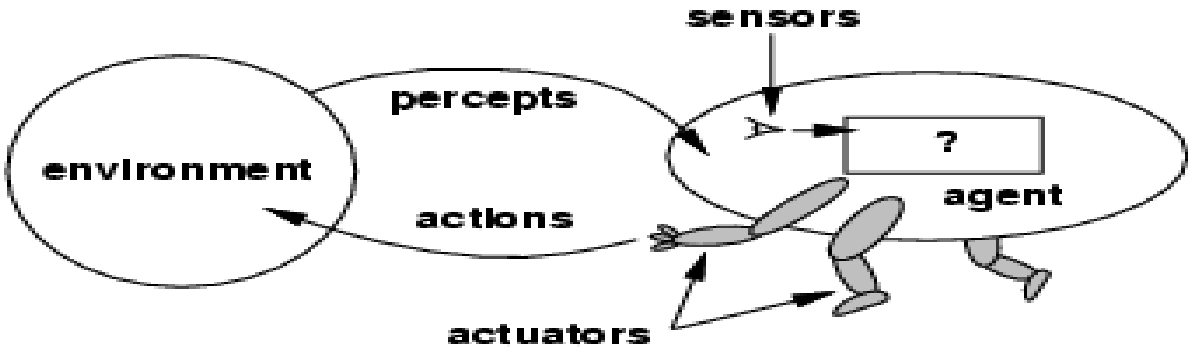
- An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators.
- Human agent:
  a. eyes, ears, and other organs for *sensors*;
  b. hands, legs, mouth, and other body parts for *actuators.*
- Robotic agent
  a. cameras and infrared range finders for sensors;
  b. various motors for actuators

Agent Model

- An agent includes all aspects of AI in one object-oriented model:

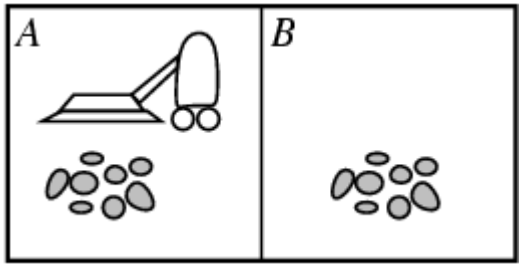


Agents and environments



- The agent function maps from percept histories to actions:
- The agent program runs on the physical architecture to produce *f*

$[f: \mathcal{P}^{\star} \rightarrow \mathcal{A}]$



- Percepts: location and contents, e.g., [A, Dirty], [A, Clean]
- Actions: *Left*, *Right*, *Suck*, *No-Op*

Rational agents

- An agent should do the right thing. (Actions ⟹ More Success)
- Agent success ('rationality') is evaluated based on performance measure.
- Factors in rationality :
  - PEAS: Performance measure, Environment, Actuators, Sensors.

a) performance measure – goals may be in conflict – can't all be achieved.

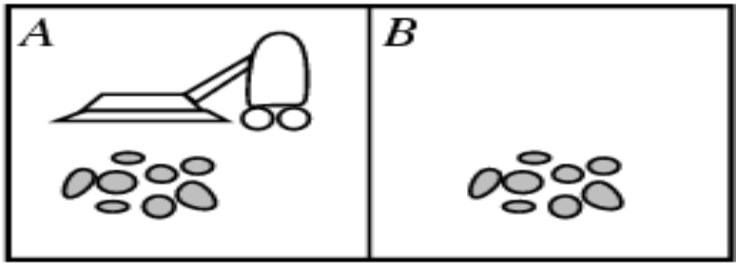
b) perceptions – agent may not have all the facts. (environment modelling).

c) actions available. (outcome of actions are not known).

d) experience – agent may not yet have accumulated all available relevant data. (autonomous ⟹ learn from experience).

performance measure

- performance measure of a vacuum-cleaner agent could be:



a. amount of dirt cleaned up,
b. amount of time taken,
c. amount of electricity consumed,
d. amount of noise generated,
e. etc.

Environments

- real or virtual.
- may contain other agents. (Multi-Agent: competitive, cooperative, etc.).
- factors relevant to the agent are called the state of the environment
    a. perceptions give agent information about the state.
    b. actions of agent change the state.
- Environment types :
    a. fully - partly observable (state of the environment)
    b. static – dynamic. (environment and agent deliberating)
    c. deterministic - stochastic. (current state and action)
    d. sequential – episodic. (agent's experience)
    e. discrete – continuous. (percepts and actions)
    f. Single agent (vs. multi-agent).

Environment types

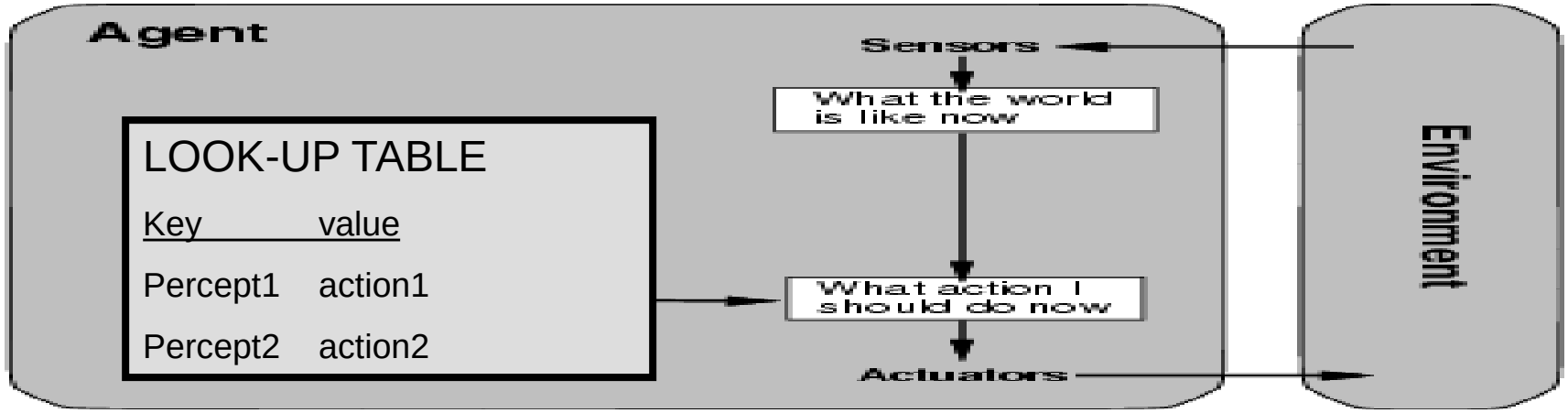
	Chess with a clock	Chess without a clock	Taxi driving
Fully observable	Yes	Yes	No
Deterministic	Strategic	Strategic	No
Episodic	No	No	No
Static	Semi	Yes	No
Discrete	Yes	Yes	No
Single agent	No	No	No

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

Agent Structure

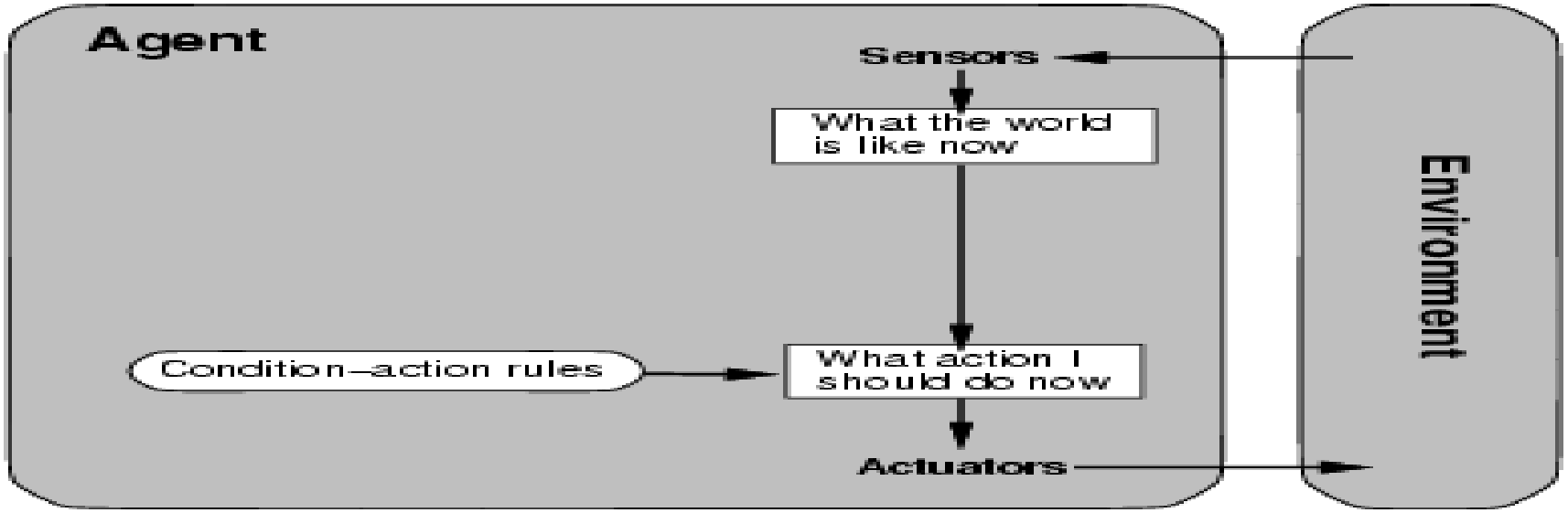
- An agent is completely specified by the agent function. (find a way to implement the rational agent function concisely).
- Several types based on functionalities and PEAS:
  a. Table-lookup agents
  b. Simple reflex agents
  c. Model-based reflex agents
  d. Goal-based agents (Solving-problem or Planning agents)
  e. Utility-based agents
  f. Learning agents

Table-Driven agent



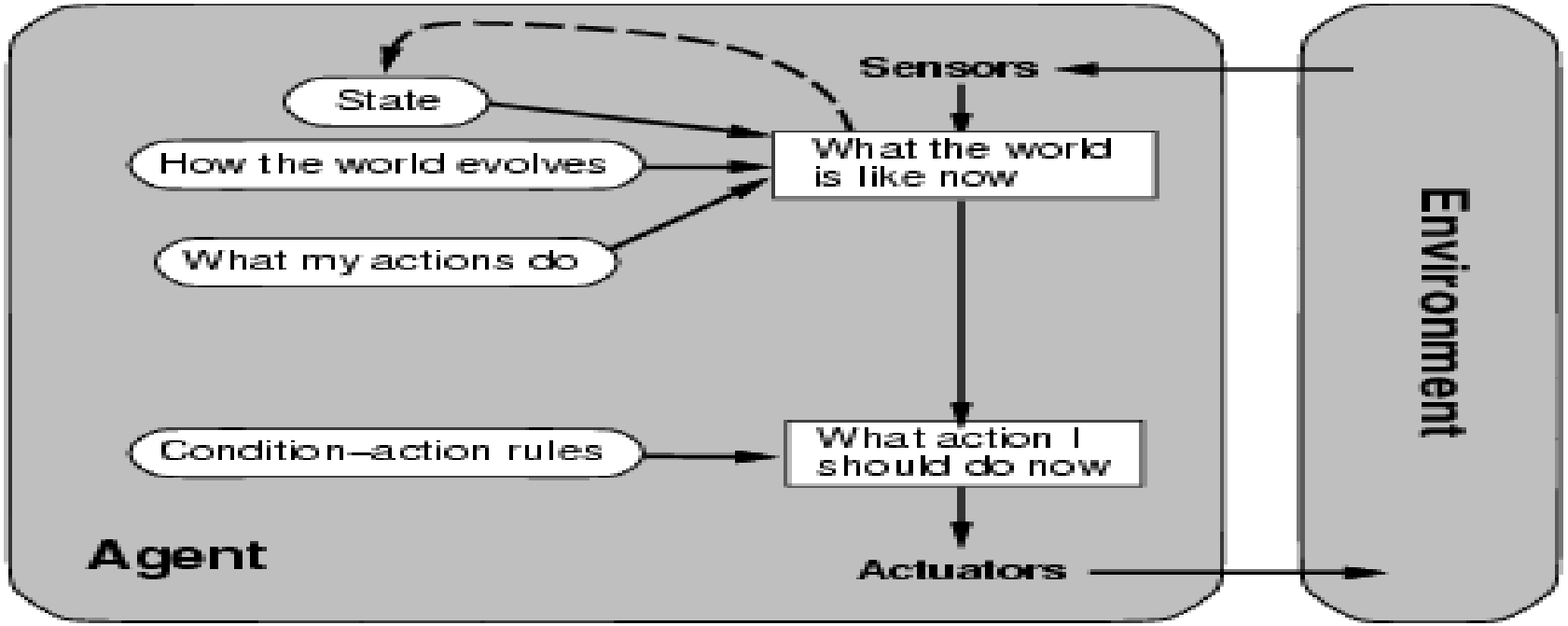
- Drawbacks:
  a. Huge table
  b. Take a long time to build the table
  c. No autonomy
  d. Even with learning, need a long time to learn the table entries

Simple reflex agents



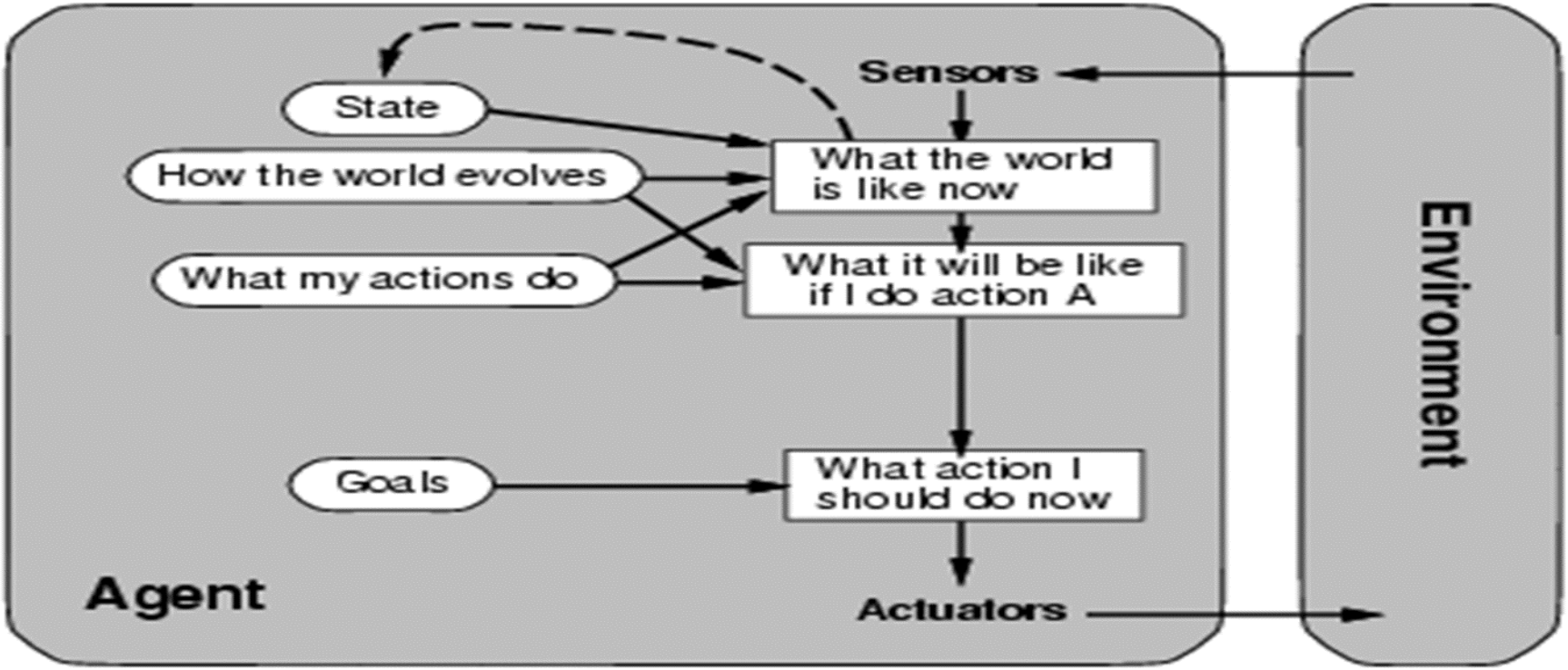
- Criteria:
  a. based on current perception only. (NO percepts history)
  b. i.e., no instance variables in the agent object; (No state)
  c. ‘condition-action’ rules (if then else algorithm)

Model-based agents



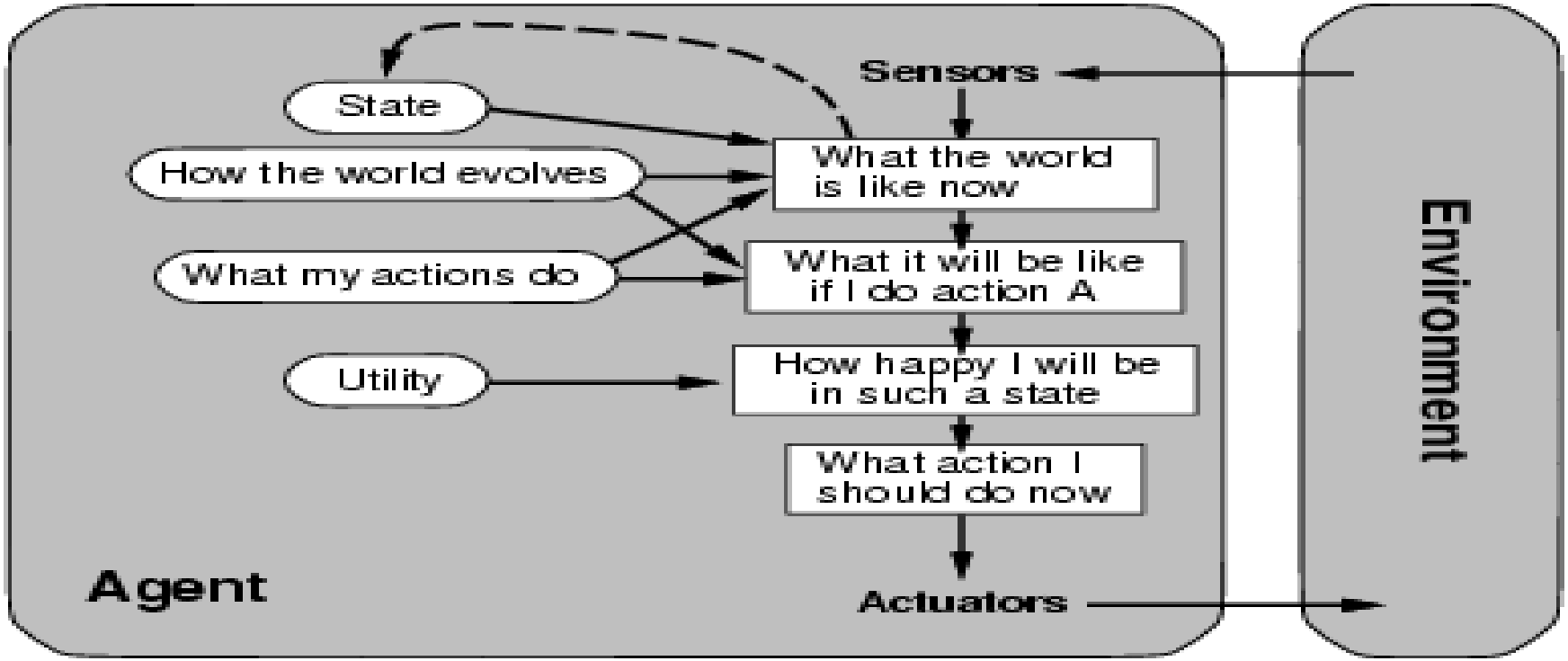
- Criteria:
  a. uses percepts to build internal model of environment -
  b. internal state is ‘memory’ of environment
  c. algorithm based on percepts and internal state

Goal-based agents



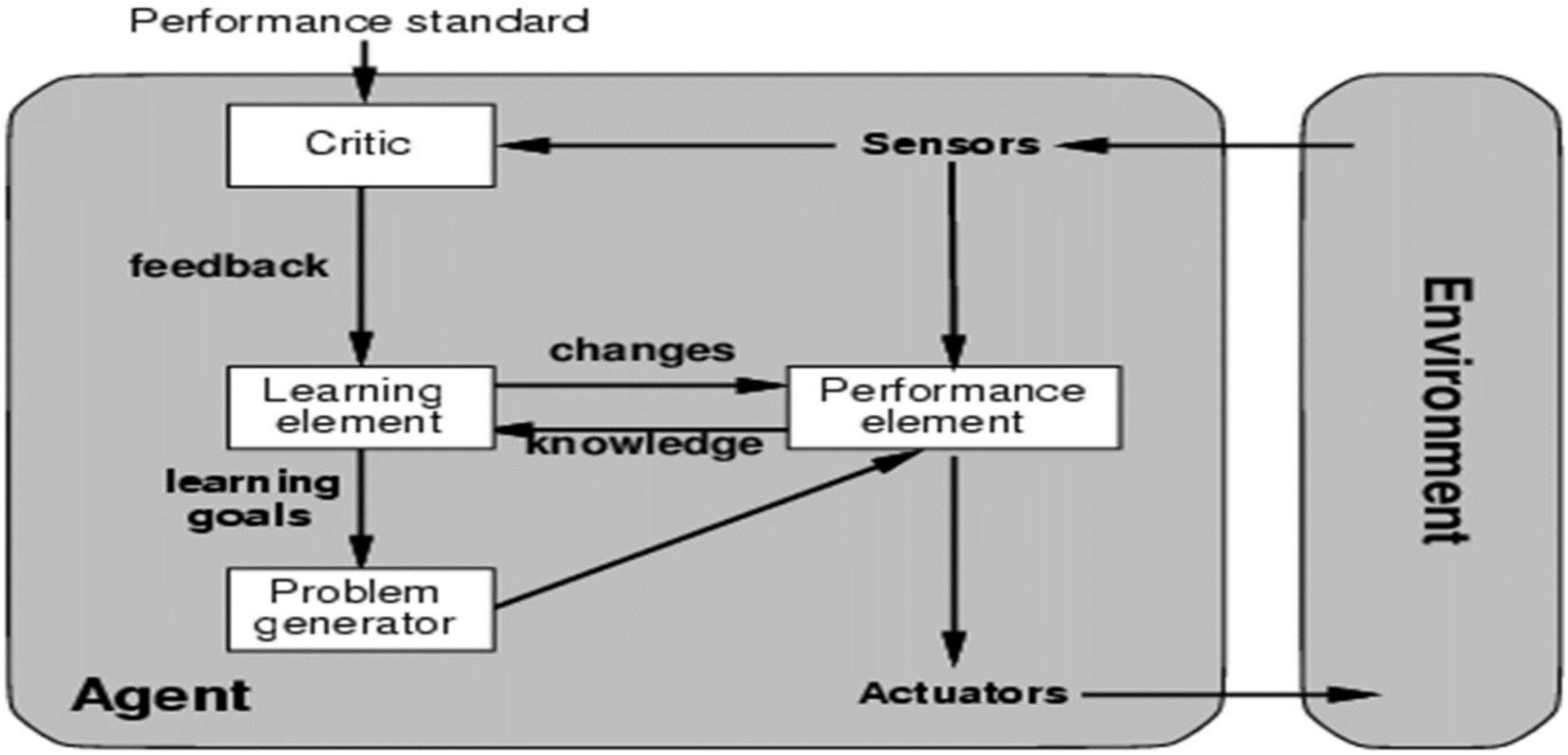
- Criteria:
  a. internal state representing environment.
  b. goals expressed in terms of environment and/or agent states.
  c. NOT REFLEX; 'tries' actions internally and tests results against goals.

Utility-based agents



- Criteria:
  a. internal state representing environment
  b. goals expressed in terms of environment and/or agent states
  c. performance measure rationality
  d. ‘tries’ actions internally and tests results against goals & performance measure

Learning agents



- Criteria:
  a. extra component to evaluate performance and change program (if necessary) to act differently in same state.
  b. many kinds of learning agents

Thank you for your attention!

Questions?