Classification of ai

Weak AI

Strong AI

Evolutionary AI

Weak ai (NARROW AI)

Able to perform dedicated task with intelligence

Can’t perform beyond it’s field

Not concerned with how Task is performed, but is concerned with efficiency of tasks

Exp:

- Chatbots (Siri)

Strong ai

Study and Design of machines that simulate human mind to perform intelligent task

Operating through deep learning, neural networks, and machine learning, strong AI aims to replicate human cognitive abilities and problem-solving skills.

Exp: Deep Blue

Evolutionary ai

It is the study and design of machines that simulate simple creatures and attempt to evolve

Exp:

- Ants, Bees etc

Super ai

Hypothetical

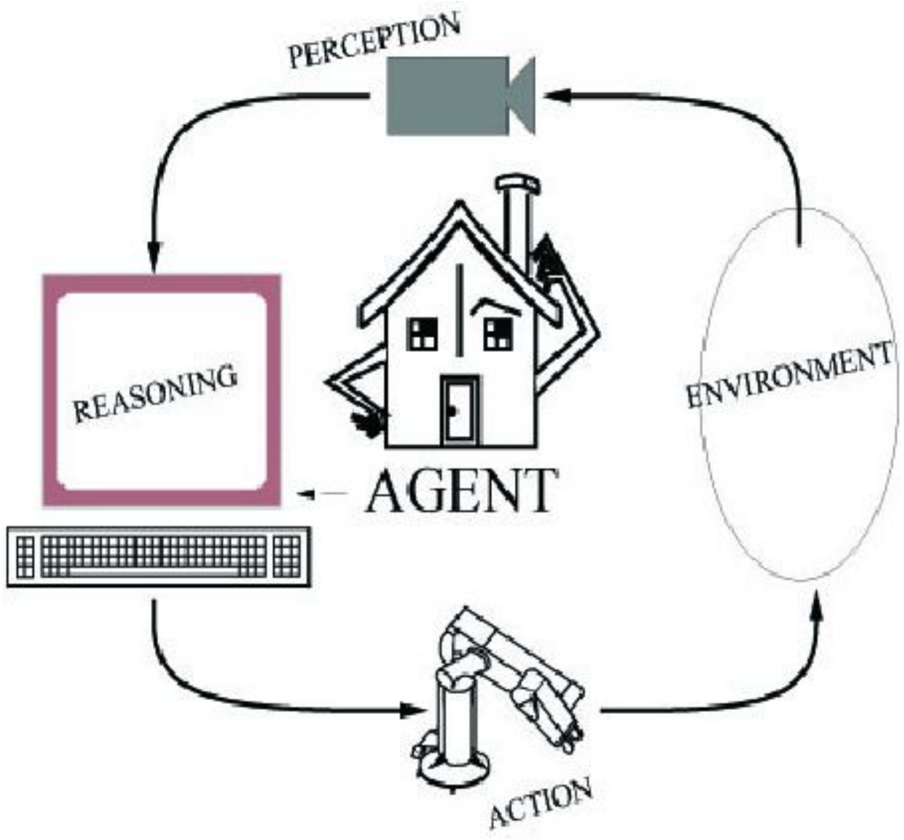
Machines that can be more intelligent than humans

Intelligent Agents

BS(AI)-III

Abdul Haseeb

Agent



An agent perceives its
environment
through sensors and acts on the
environment through actuators.

Human: sensors are eyes, ears,
actuators (effectors) are hands,
legs, mouth.

Robot: sensors are cameras,
sonar,
lasers, effectors are
grippers, manipulators, motors

Percept and Percept Sequence

Percept:

- Agent’s perceptual inputs at any given instant

Percept Sequence:

- History of everything agent has perceived so far
- Choice of action depends on everything agent has perceived so far, and doesn’t depend on anything which it hasn’t perceived
- Behavior is described by **agent function**:
  - *Map given percept sequence to an action*

Percept and Percept Sequence

Percept Sequence:

- We can make a table for agent function that describes an agent
- Put a limit on percept sequences to avoid infinity

Agent Program vs Agent Function

Agent function is a mathematical function which does the mapping while Agent program is a practical implementation running within a physical system

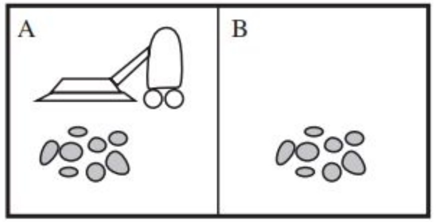


Figure 2.2 A vacuum-cleaner world with just two locations.

Percept sequence	Action
[*A*, *Clean*]	*Right*
[*A*, *Dirty*]	*Suck*
[*B*, *Clean*]	*Left*
[*B*, *Dirty*]	*Suck*
[*A*, *Clean*], [*A*, *Clean*]	*Right*
[*A*, *Clean*], [*A*, *Dirty*]	*Suck*
⋮	⋮
[*A*, *Clean*], [*A*, *Clean*], [*A*, *Clean*]	*Right*
[*A*, *Clean*], [*A*, *Clean*], [*A*, *Dirty*]	*Suck*
⋮	⋮

Figure 2.3 Partial tabulation of a simple agent function for the vacuum-cleaner world shown in Figure 2.2.

```
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
```

Figure 2.8 The agent program for a simple reflex agent in the two-state vacuum environment. This program implements the agent function tabulated in Figure 2.3.

Good Behavior: the Concept of Rationality

Rational Agent does the right thing.

But what does it mean to do the right thing?

When an agent is plunked down in environment:

- ❑ *It generates a sequence of actions according to the received percept*
- ❑ *Sequence of action causes the environment to go through a sequence of states*
- ❑ *If sequence is desirable, then the agent has performed well*
- ❑ *Performance Measure: Evaluates a given sequence of environment states*

What is rational at any given time?

It depends upon four things:

- The performance measure that defines the criterion of success:
  - *Search-rescuce robot: Number of Victims resuced, maximize the number*
- The agent's prior knowledge of the environment:
  - *Robot knows certain areas are hazardous and avoids the risk*
- The actions that agent can perform:
  - *Rationality: Game Playing agent selects moves that lead to wining*
- The agent's percept sequence to date
  - *Robot detects obstacle in path: Use Information, adjust route and avoid collision*

This leads to definition of a rational agent

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

An Example from the Book

- The performance measure awards one point for each clean square at each time step, over a "lifetime" of 1000 time steps.
- The "geography" of the environment is known *a priori* (Figure 2.2) but the dirt distribution and the initial location of the agent are not. Clean squares stay clean and sucking cleans the current square. The *Left* and *Right* actions move the agent left and right except when this would take the agent outside the environment, in which case the agent remains where it is.
- The only available actions are *Left*, *Right*, and *Suck*.
- The agent correctly perceives its location and whether that location contains dirt.

Task Environment/PEAS of an Agent

Use PEAS to describe task

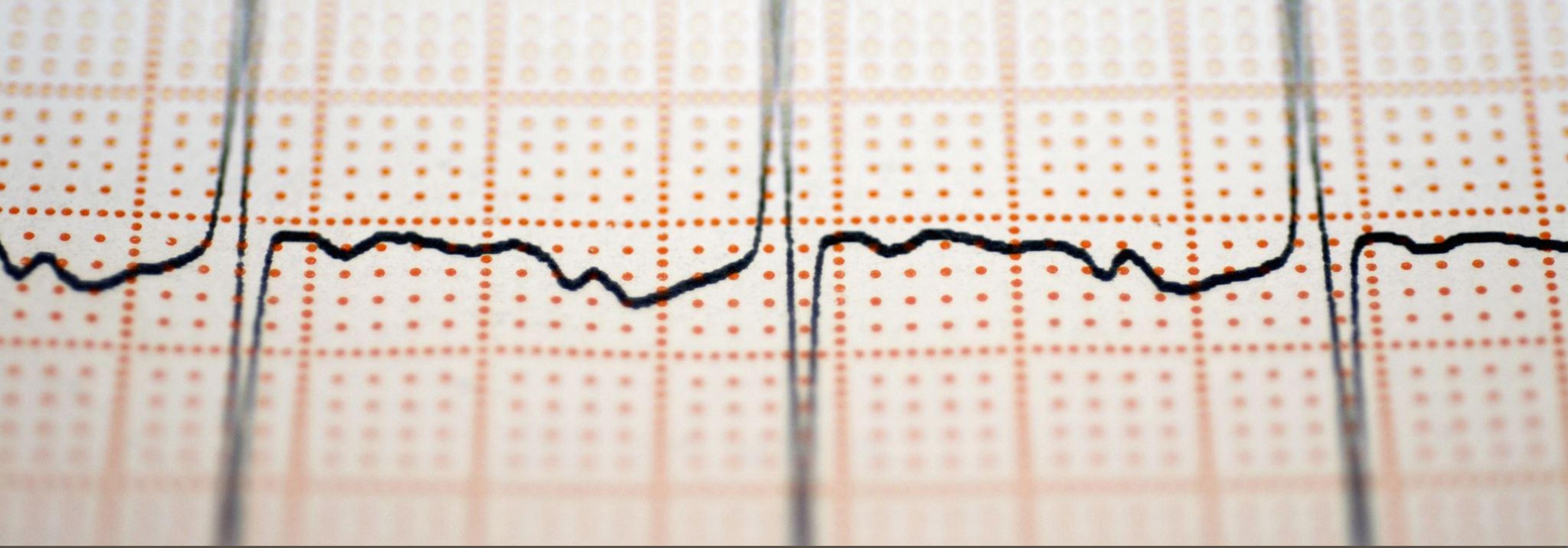
- Performance measure
- Environment
- Actuators
- Sensors

When Designing agent first step should be to describe the task as fully as possible

Agent Type	Performance Measure	Environment	Actuators	Sensors
Taxi driver	Safe, fast, legal, comfortable trip, maximize profits	Roads, other traffic, pedestrians, customers	Steering, accelerator, brake, signal, horn, display	Cameras, sonar, speedometer, GPS, odometer, accelerometer, engine sensors, keyboard

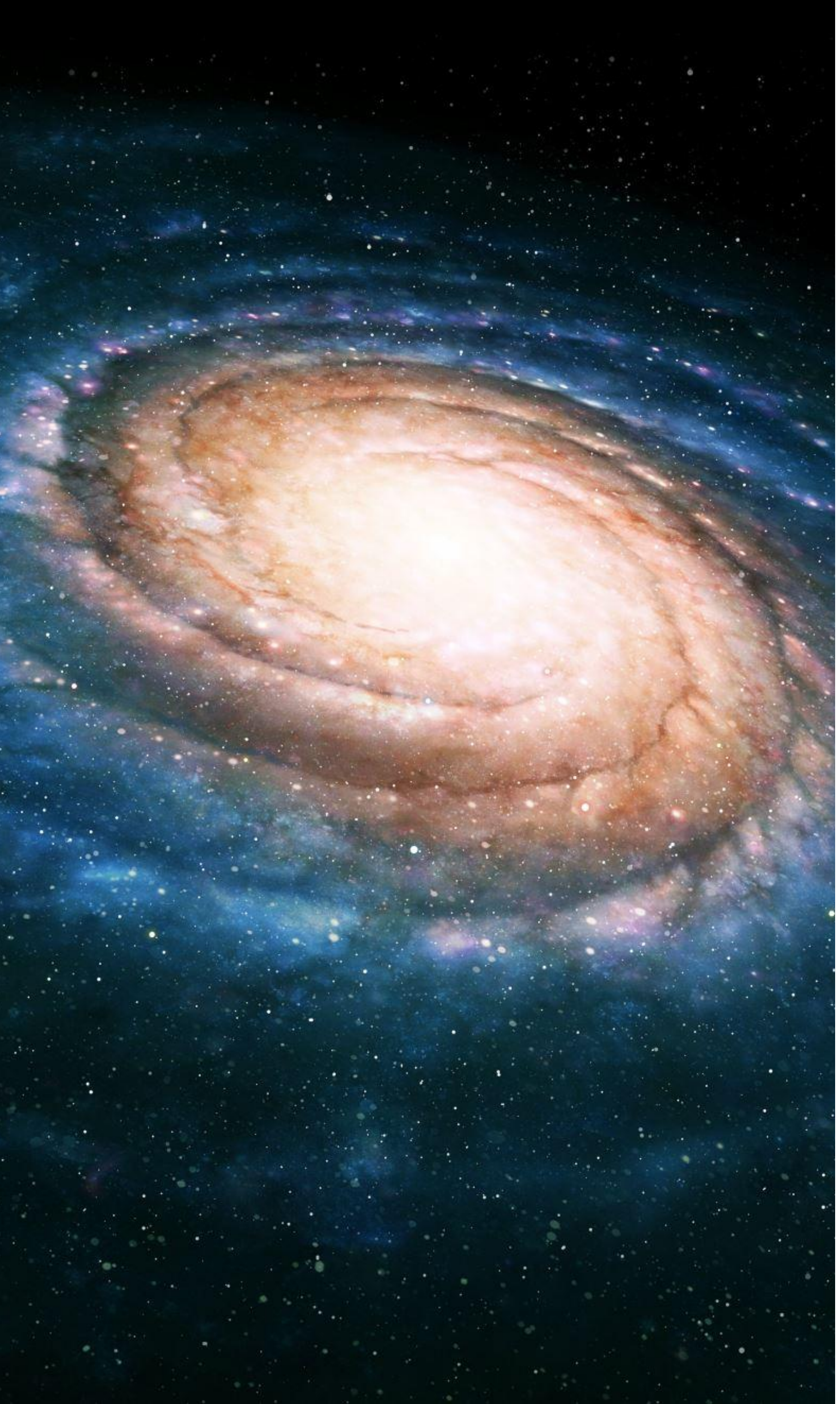
Figure 2.4 PEAS description of the task environment for an automated taxi.

Automated Taxi (PEAS)/TASK DESCRIPTION



Activity

Medical Diagnosis System **PEAS**



Environment and its types

Environment is the part of universe that surrounds intelligent systems

Accessible vs Inaccessible

Deterministic vs Non-Deterministic

Static vs Dynamic

Discrete vs Continuous

Fully Observable vs Partially Observable

Episodic vs Non-Episodic

Accessible vs Inaccessible

Accessible:

Agent can access complete and accurate information about state's environment

Exp: Room with Temperature as a state

Agent can accurately access and measure the temperature of a room

Inaccessible:

Whole information may not be in agent's reach

Exp: Any Event on earth

Agent can not Determine any event happening on the earth

Deterministic vs Non Deterministic

Deterministic:

Agent's current state and selected action can completely determine the next state of environment

Doesn't worry about uncertainty

Predictable

Exp: Agent playing a tic-tac-toe game, next move depends on current action taken

Non-Deterministic (Stochastic):

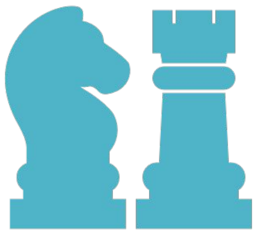
Nature of environment can't be decided by agent alone

It is random in nature (Uncertainty)

Not Predictable

Exp: Agent using a robot arm to pick up objects, now while picking objects the objects(ball) may slip or may be picked up successfully

Static or Dynamic



Static:

Environment doesn’t change its state with the passage of time

Exp:Rules of chess game never change

Dynamic:

Environment changes its state with the passage of time

Exp:Traffic on a road, Condition of a road

Discrete vs Continuous

Discrete:

Finite number of percepts and actions

Exp: Traffic Light (Red, Green or Yellow)

Continuous:

Actions and outcomes are continuous

The environment can be in finite number of states

Exp: Speed and Position of a car

Fully Observable and Partially Observable

Fully Observable:

Agent has complete knowledge of the current state

Chess game: Agent can see the entire board and all pieces

Partially Observable:

Agent has incomplete knowledge of the current state

Exp: The agent can see only it's own card not the others

Episodic vs Non Episodic Environment

Episodic:

- Agent’s experience is divided into separate independent episodes
- Each Episode has start and end
- Agent’s goal is to achieve a specific outcome in that episode
- Agent’s actions in one episode doesn’t affect the other
- Exp: A customer service chat bot

Episodic vs Non Episodic Environment

Non-Episodic:

- Agent's experience is continuous and interconnected
- Actions and decisions have long-term consequences that affect future outcomes
- Agent must consider potential long term effects of its actions
- Exp: **Financial Trading Agent:** The agents actions (buying, selling) have long term effects

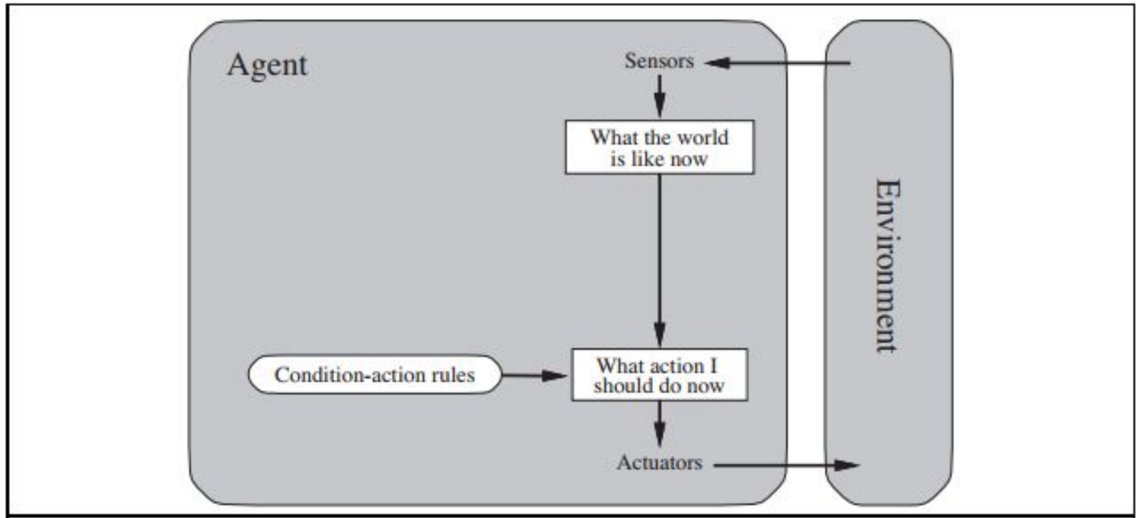


Figure 2.9 Schematic diagram of a simple reflex agent.

```
function SIMPLE-REFLEX-AGENT(percept) returns an action
  persistent: rules, a set of condition–action rules

  state ← INTERPRET-INPUT(percept)
  rule ← RULE-MATCH(state, rules)
  action ← rule.ACTION
  return action
```

Figure 2.10 A simple reflex agent. It acts according to a rule whose condition matches the current state, as defined by the percept.

Types of AI Agents

Simple Reflex Agents:

- ❑ Work only on current situation/perception and ignores the history of previous state
- ❑ Condition-Action Rule is applied

  Exp: Automatic Door Opener: Opens when someone approaches

Limitations

Very Limited Intelligence

Operating in only fully observable environment, otherwise infinite loops

Types of AI Agents

Model based Reflex Agents:

- ❑ Work by finding the rules whose conditions matches the current situations
- ❑ It can work in partially observable environment
- ❑ Maintains internal state which relates to percept history
- ❑ Autonomous Vacuum Cleaner: Navigates around furniture based on internal map

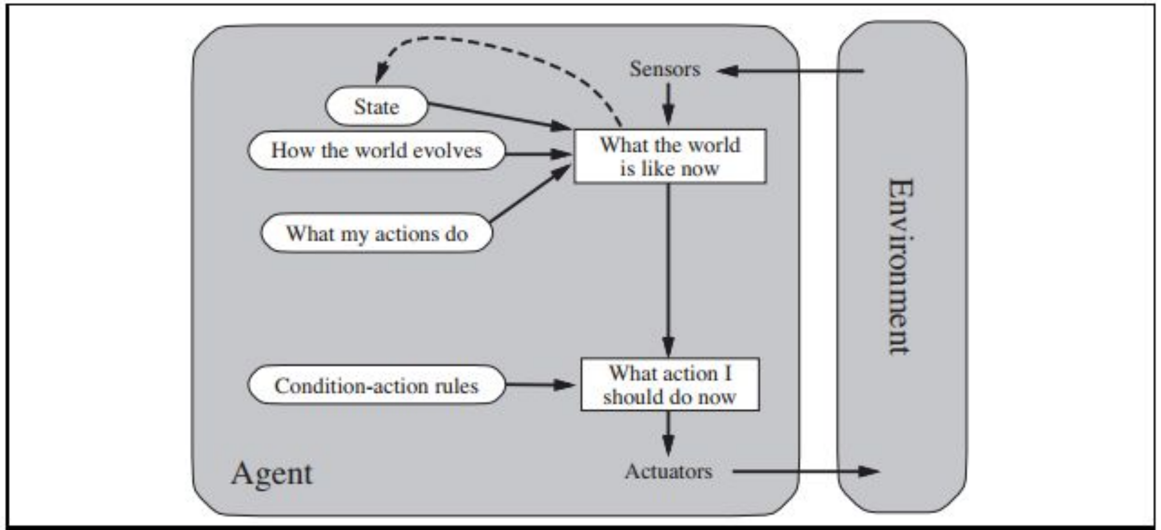


Figure 2.11 A model-based reflex agent.

```
function MODEL-BASED-REFLEX-AGENT(percept) returns an action
  persistent: state, the agent's current conception of the world state
              model, a description of how the next state depends on current state and action
              rules, a set of condition–action rules
              action, the most recent action, initially none

  state ← UPDATE-STATE(state, action, percept, model)
  rule ← RULE-MATCH(state, rules)
  action ← rule.ACTION
  return action
```

Figure 2.12 A model-based reflex agent. It keeps track of the current state of the world, using an internal model. It then chooses an action in the same way as the reflex agent.

Scenario: Vacuum Cleaner Robot

Initial State:

- The robot is in position (0,0).
- The floor at (0,0) is dirty.
- The robot's internal model reflects that (0,0) is dirty.

Process:

1. **Perception**:
   1. The robot perceives that (0,0) is dirty.
2. **Internal State Update**:
   1. The robot updates its internal state based on this perception. It now knows that the current location is dirty and needs to be cleaned.
3. **Decision Making**:
   1. The robot refers to its rule base:
      1. *Rule: If the current location is dirty, clean it.*
   2. It decides to clean (0,0).

Scenario: Vacuum Cleaner Robot

4. Action:

1. The robot performs the cleaning action at (0,0).
2. As a result, the floor at (0,0) is now clean.

5.World Evolution:

3. The world has evolved: (0,0) has changed from dirty to clean.
4. The robot’s model of the world now needs to be updated to reflect this change.

6.Feedback:

5. After cleaning, the robot may move to the next location, for example, (0,1).
6. The robot perceives the state of (0,1) (e.g., whether it is dirty or clean).

7.Repeat:

7. The process repeats. The robot perceives the state at (0,1), updates its internal state, makes decisions based on its rules, performs actions, and the world continues to evolve.

Types of AI Agents

Goal Based Agents:

- Focus on reaching the goal state
- Agent takes decision on how far it is from the goal state
- Every action is taken to minimize distance to goal state
- Exp: Chess Program where goal is to checkmate the opponent

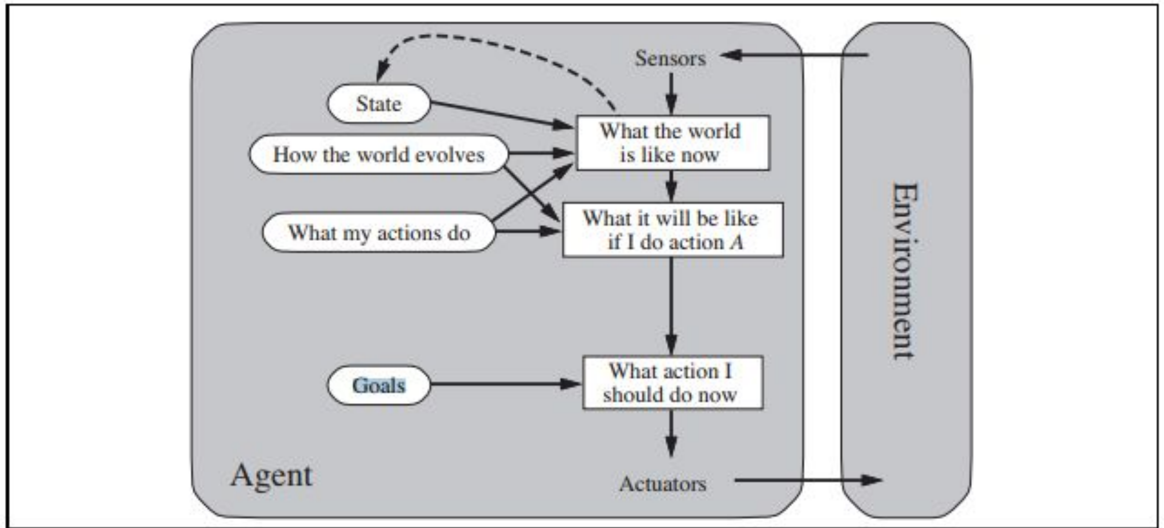


Figure 2.13 A model-based, goal-based agent. It keeps track of the world state as well as a set of goals it is trying to achieve, and chooses an action that will (eventually) lead to the achievement of its goals.

Types of AI Agents

Utility Based Agents:

- More concerned about the utility (preference) for each state
- Utility function measures happiness
- Act based not only on goals but best way to achieve the goal
- Useful when there are multiple possible alternatives, and agent has to choose the best possible.

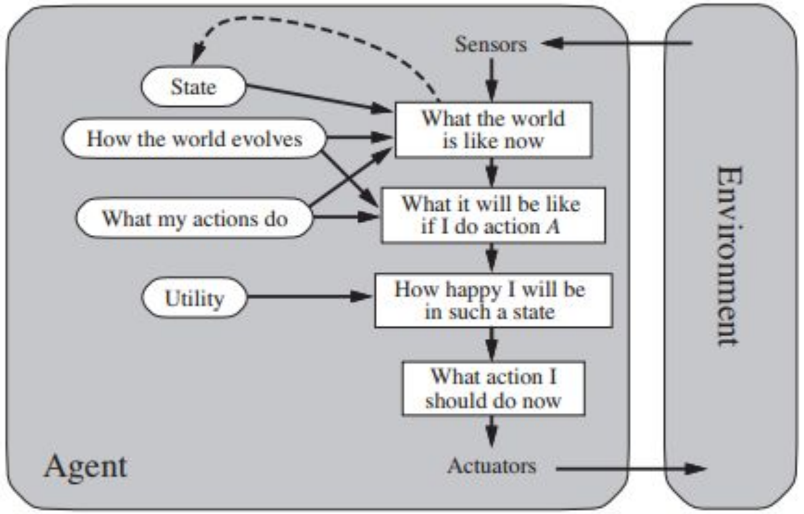


Figure 2.14 A model-based, utility-based agent. It uses a model of the world, along with a utility function that measures its preferences among states of the world. Then it chooses the action that leads to the best expected utility, where expected utility is computed by averaging over all possible outcome states, weighted by the probability of the outcome.

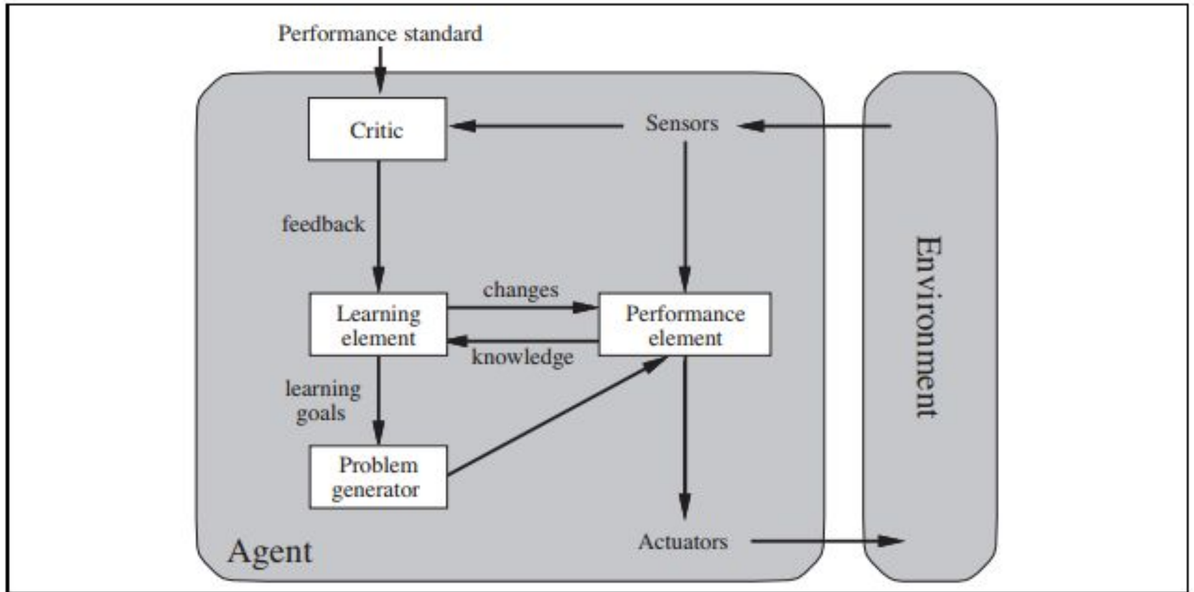


Figure 2.15 A general learning agent.

Types of AI Agents

Learning Agents:

- Can learn from its past experiences
- Starts to act with basic knowledge and then able to act by adapting learning.
- Exp: Game Playing agent improves learning by reinforcement learning