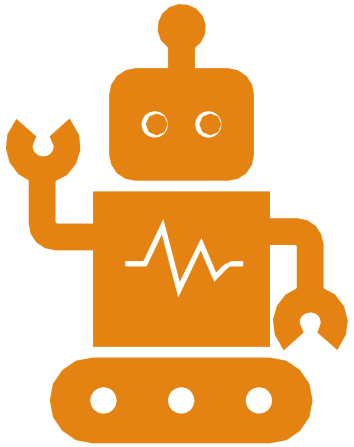
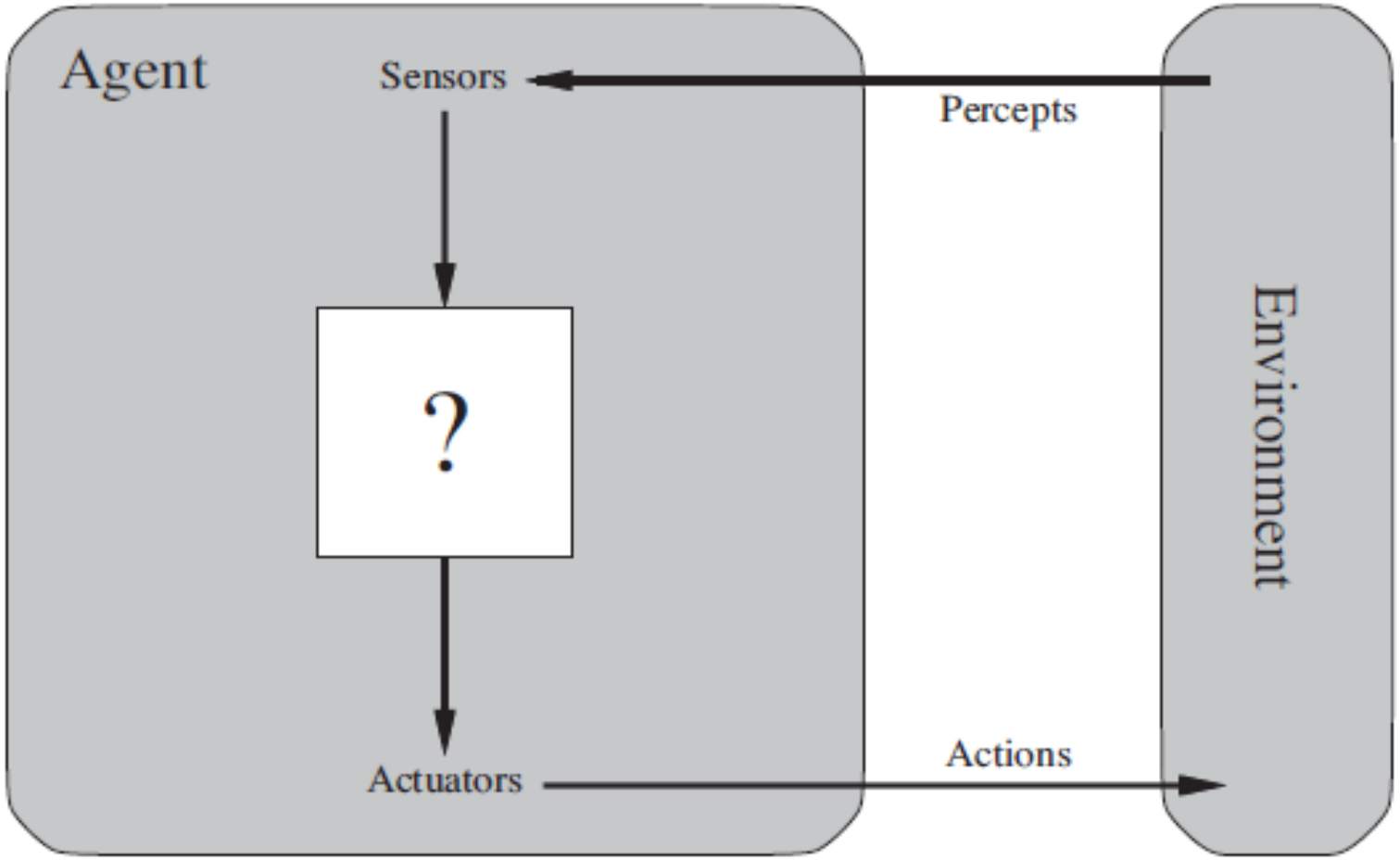


CS341
Artificial Intelligence

Lecture 3

DR. HEBA MOHSEN

Agents and Environments



Agent types

Six basic types in order of increasing generality:

Table Driven agents

Simple reflex agents

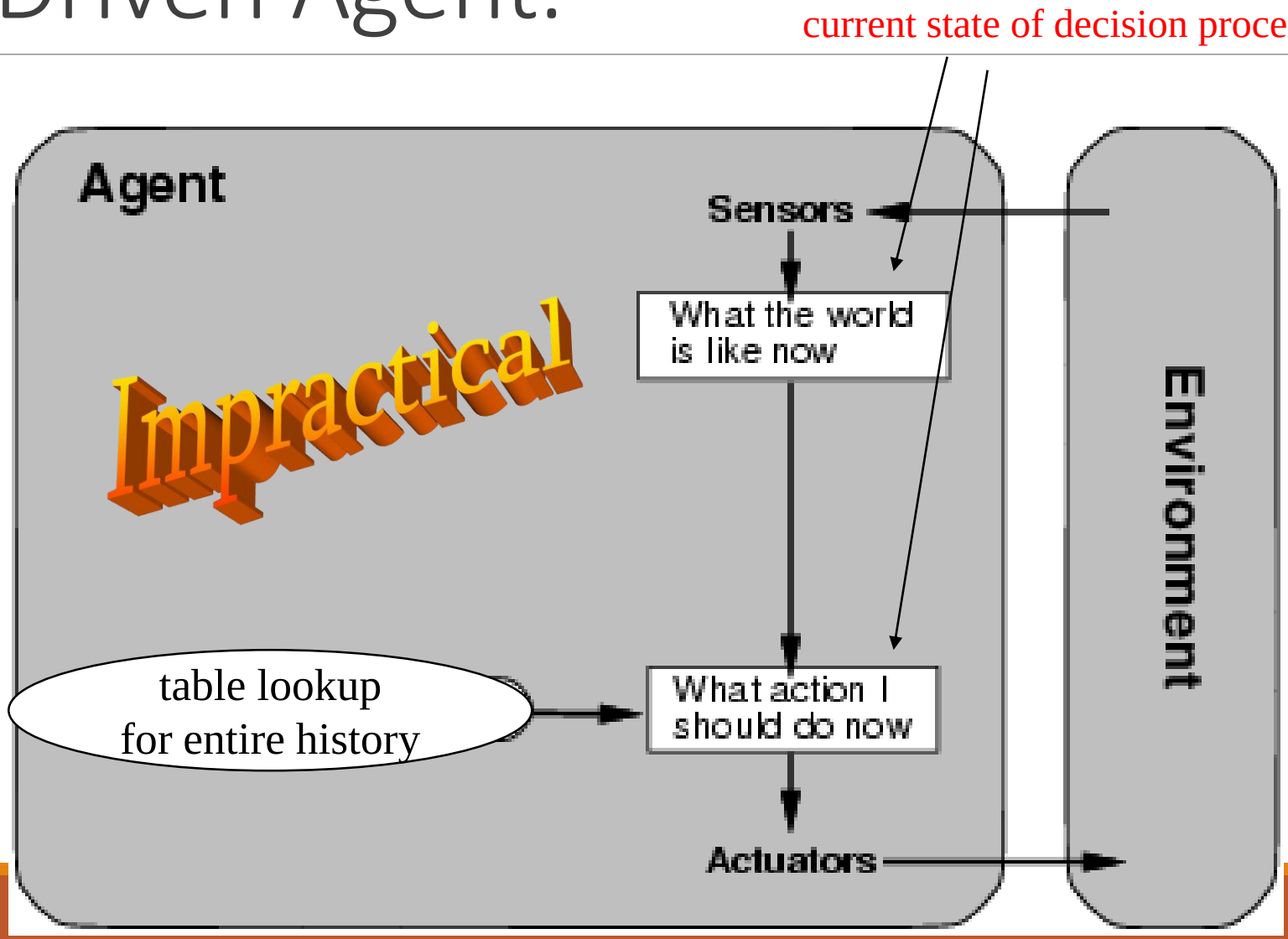
Model-based reflex agents

Goal-based agents

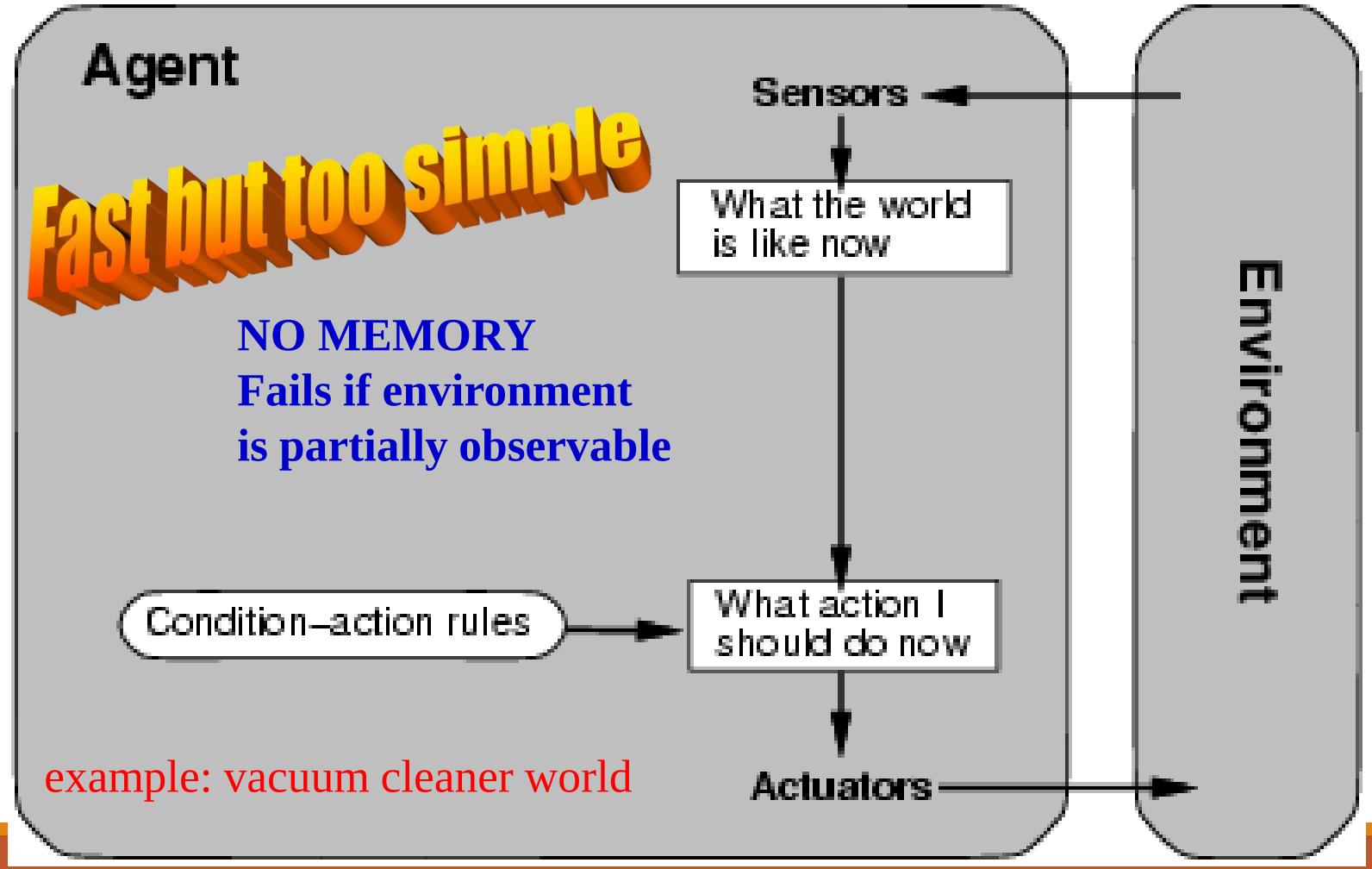
Utility-based agents

Learning agents

Table Driven Agent.



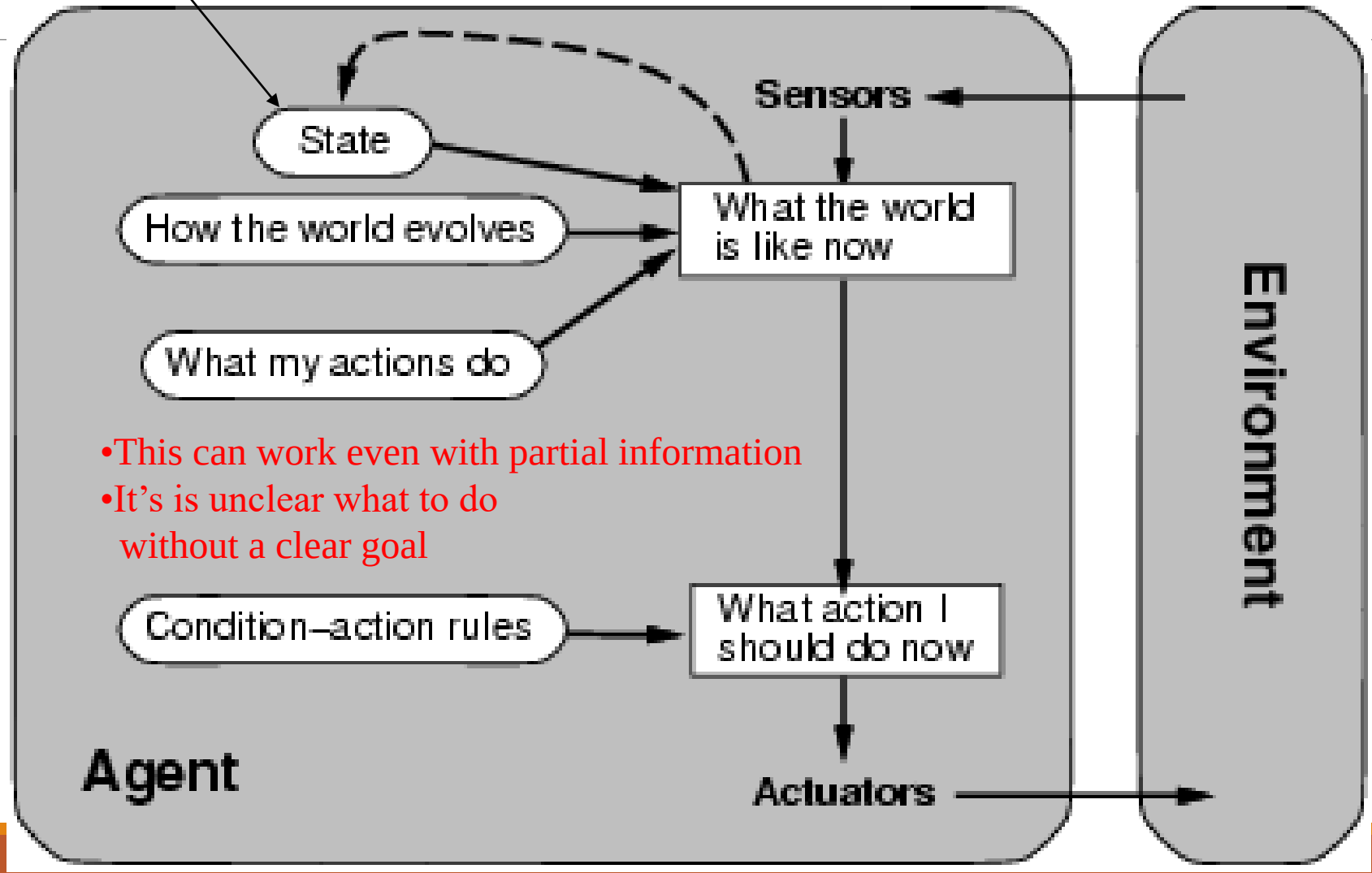
Simple reflex agents



Model-based reflex agents

description of
current world state

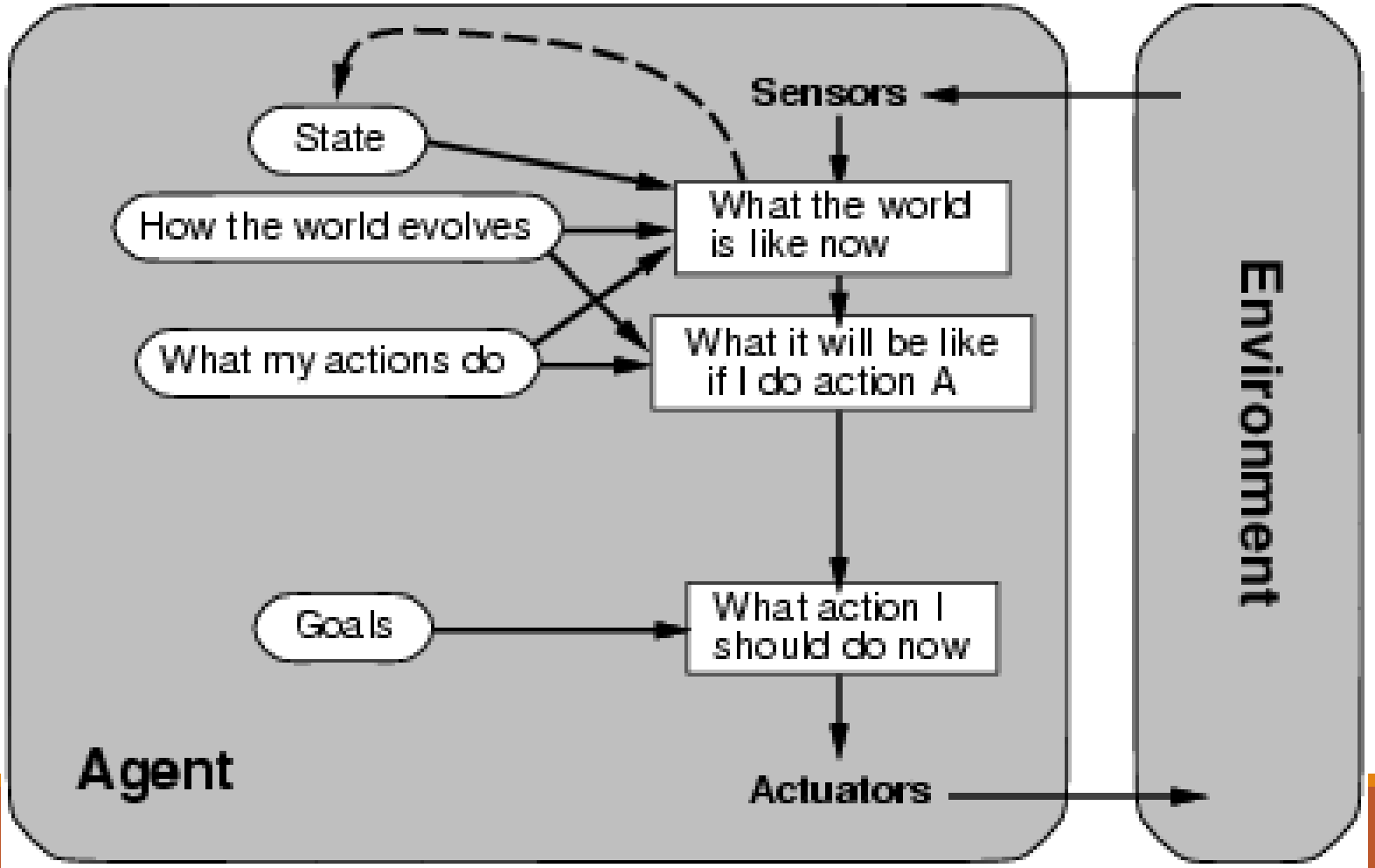
Model the state of the world by:
modeling how the world chances
how it's actions change the world



- This can work even with partial information
- It's is unclear what to do without a clear goal

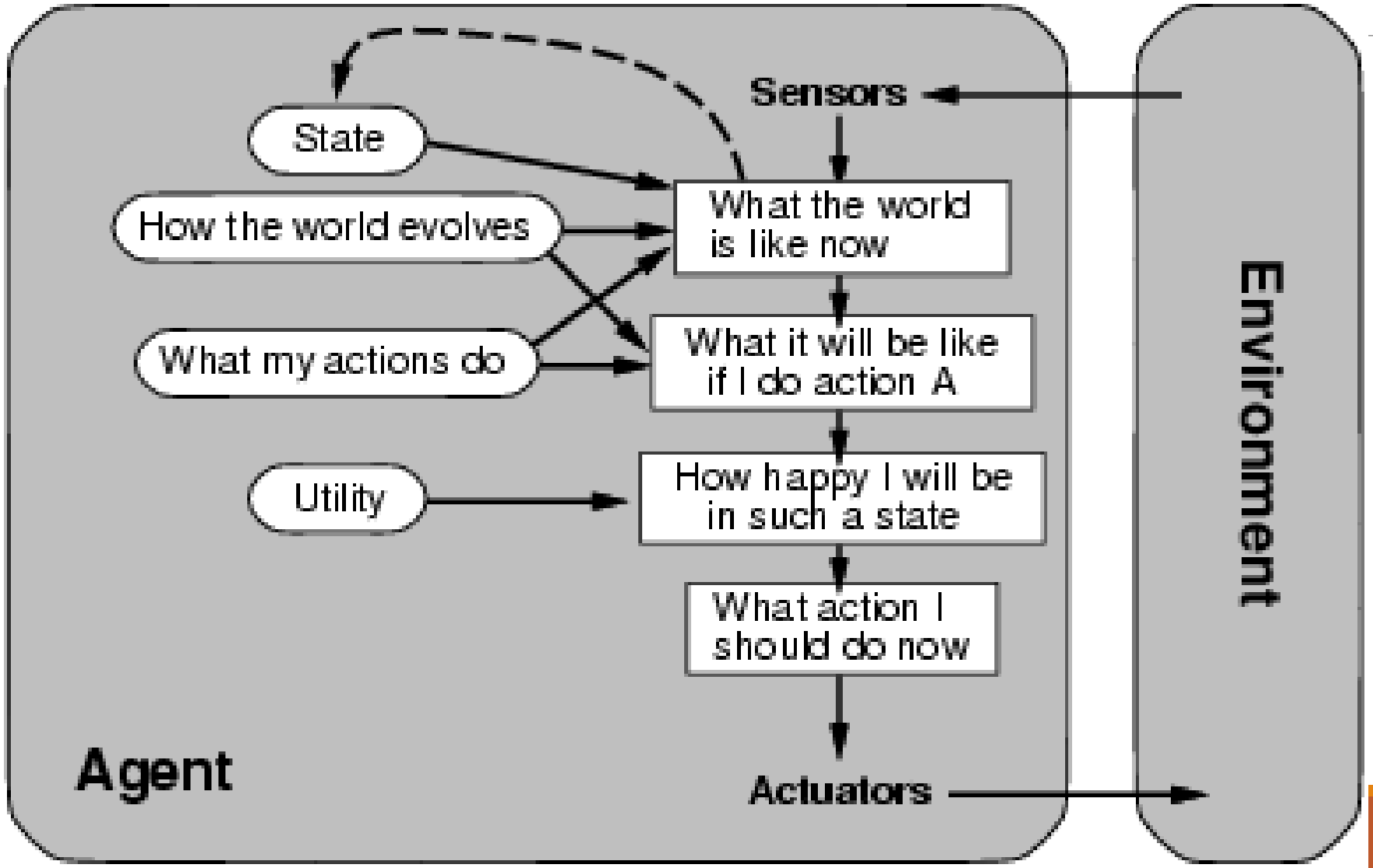
Goal-based agents

Goals provide reason to prefer one action over the other.
We need to predict the future: we need to plan & search



Utility-based agents

Some solutions to goal states are better than others.
Which one is best is given by a utility function.
Which combination of goals is preferred?

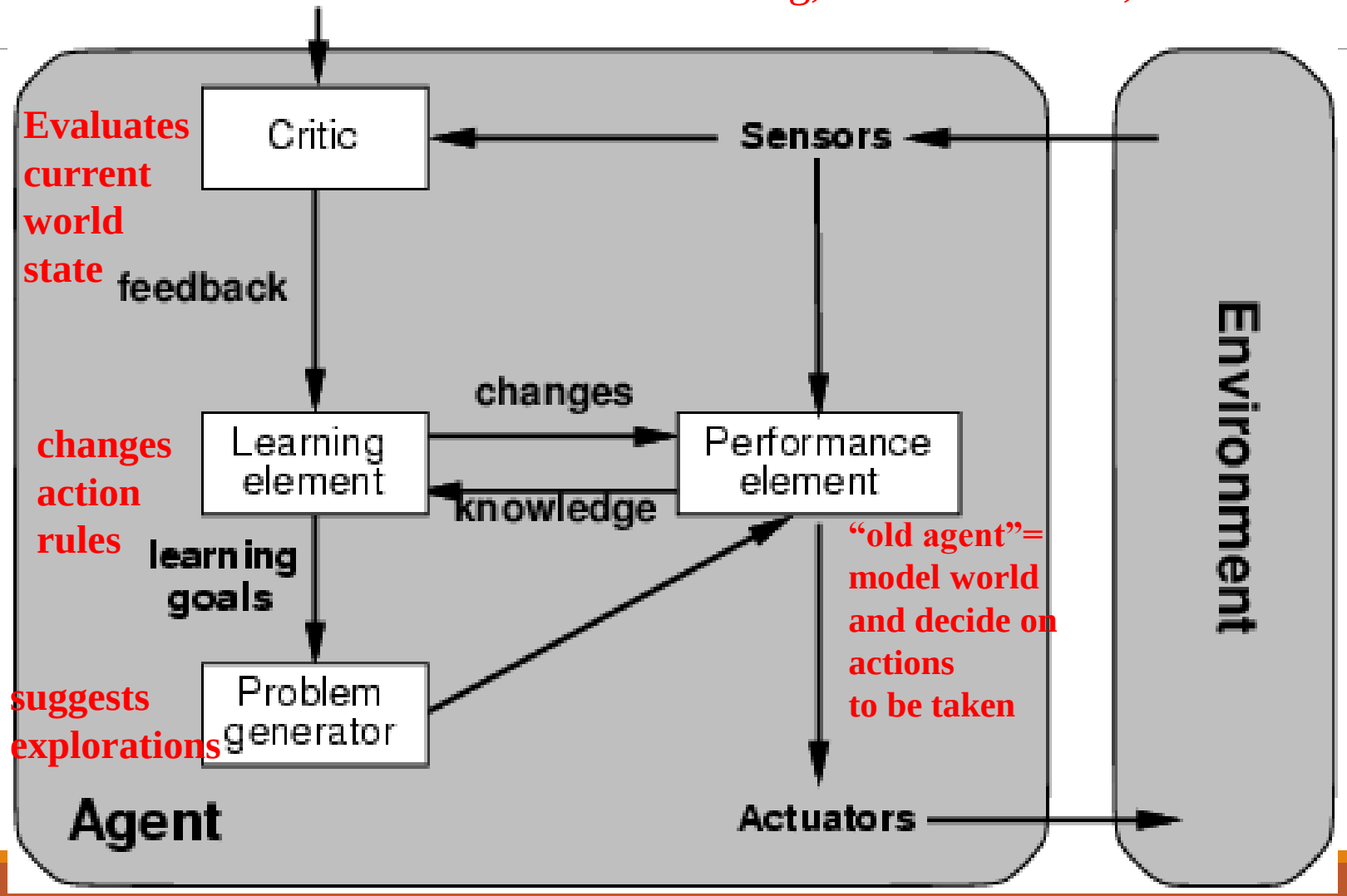


Learning agents

How does an agent improve over time?

By monitoring it's performance and suggesting

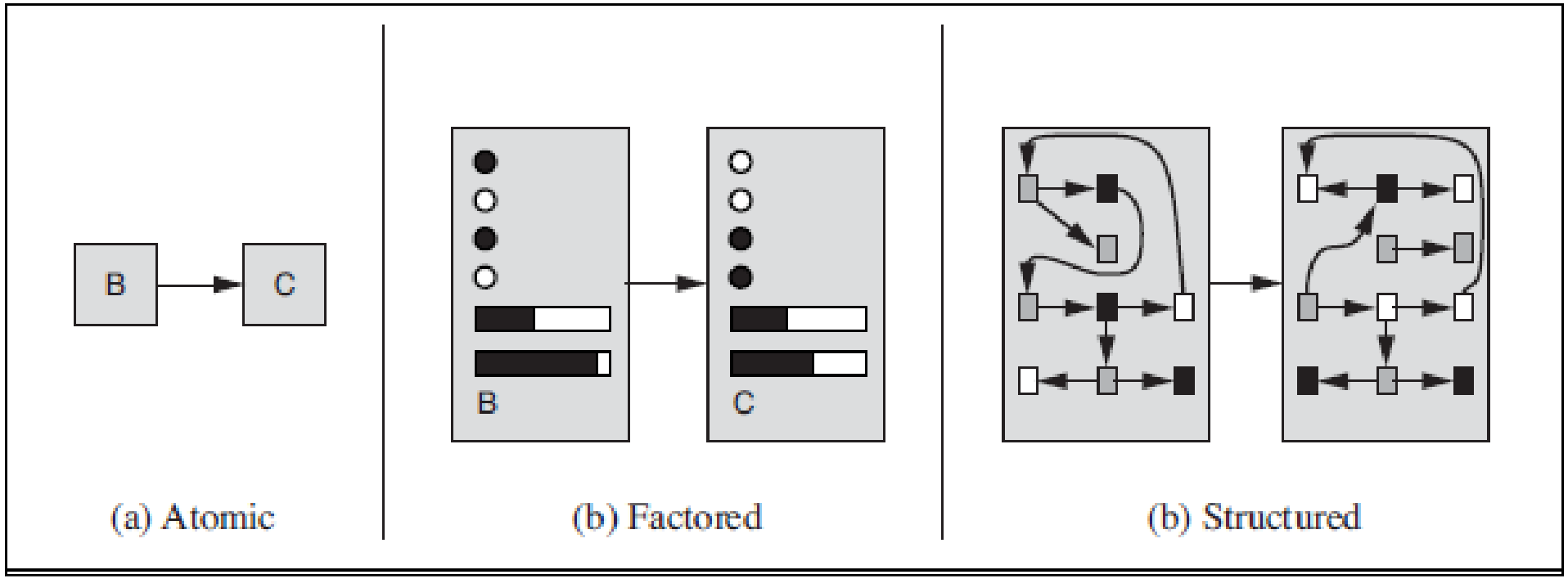
better modeling, new action rules, etc.



How the components of agent programs work

- Agents consists of various components whose function is it is to answer questions such as:
  - "What is the world like now?"
  - "What action should I do now?"
  - "What do my actions do?"
- There are various ways that the components can represent the environment that the agent inhabits.
- These ways of representation divided into three categories

Components representation



Problem Solving Agents

- The reflex agents were the simplest agents which base their actions on a direct mapping from states to actions However, these agents cannot operate well in environments for which this mapping would be too large to store and would take too long to learn
- Goal-based agents consider future actions and the desirability of their outcomes
- **problem-solving agent** is a kind of goal-based agent which use atomic representations.
- Considering the simplest kind of task environment, for which the solution to a problem is always a *fixed sequence* of actions

Simple Task Environment

Static no attention to changes in environment

known it knows which states are reached by each action

Observable it knows its states at all times.

Deterministic no new percepts are necessary, we can predict the future perfectly given our actions and each action has exactly one outcome.

Discrete we can enumerate all possibilities where at any given state there are only finitely many actions to choose from

Single Agent No other agents interacting with your cost function

Sequential Decisions depend on past decisions

Problem-Solving Agents

Reach goals through sequences of actions

1. Formulate the goal(s) based on the current situation and the agent's performance measure and formulate the problem to decide what actions and states to consider given a goal
2. Search for a sequence of actions to reach a goal state
   A solution is a sequence of actions from initial state to a goal state
3. Execute the sequence of actions

Formulating the Problem

- This process is to decide which actions and states to be considered, given a goal
- A well-defined problem is defined by:
  - Initial state = starting state for the agent
  - A description of the possible Actions available
  - A description of what each action does
    - Given a state and a set of actions, the successor function gives the possible next states
    - Initial state + successor function yields the state space (The set of all states reachable from the initial state)

Formulating the Problem

- The goal test determines if a state is a goal state
- The path cost function assigns a numeric cost to each path
  - A path is a particular sequence of states, connected by particular actions
  - Optimal solution: a solution with minimal path cost

Vacuum world state space graph

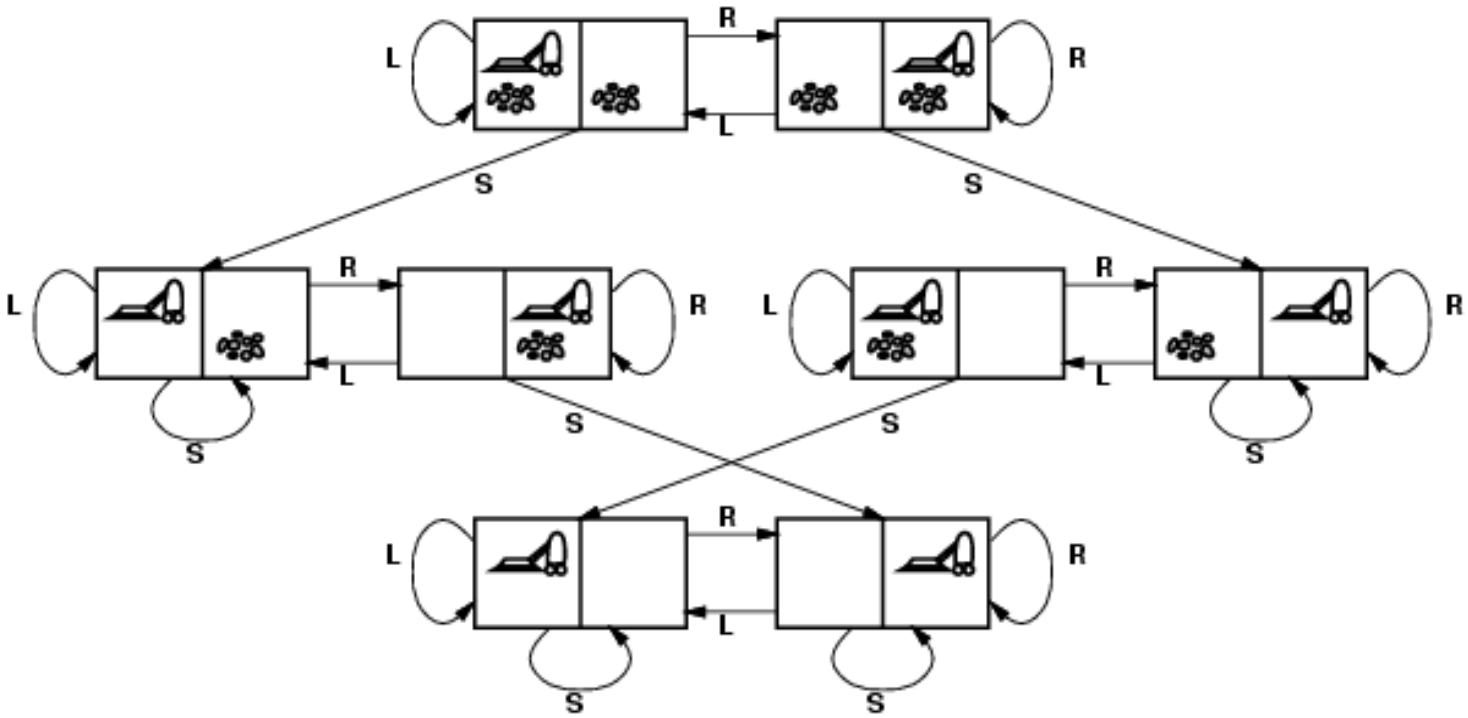
states? discrete: dirt and robot location

initial state? any

actions? *Left*, *Right*, *Suck*

goal test? All the squares are clean

path cost? 1 per action



All possible world states = $2 \times 2^2 = 8$

Example: The 8-puzzle

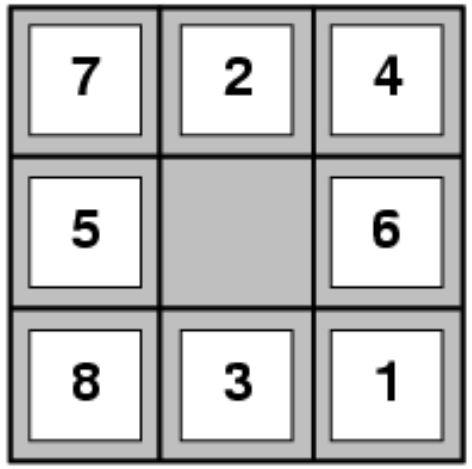
states? locations of tiles

initial state? given

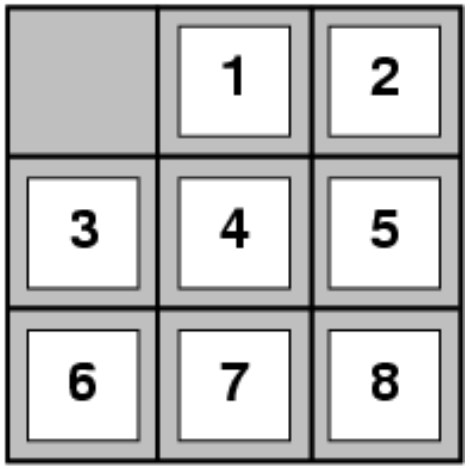
actions? move blank left, right, up, down

goal test? Matches the goal state (given)

path cost? 1 per move

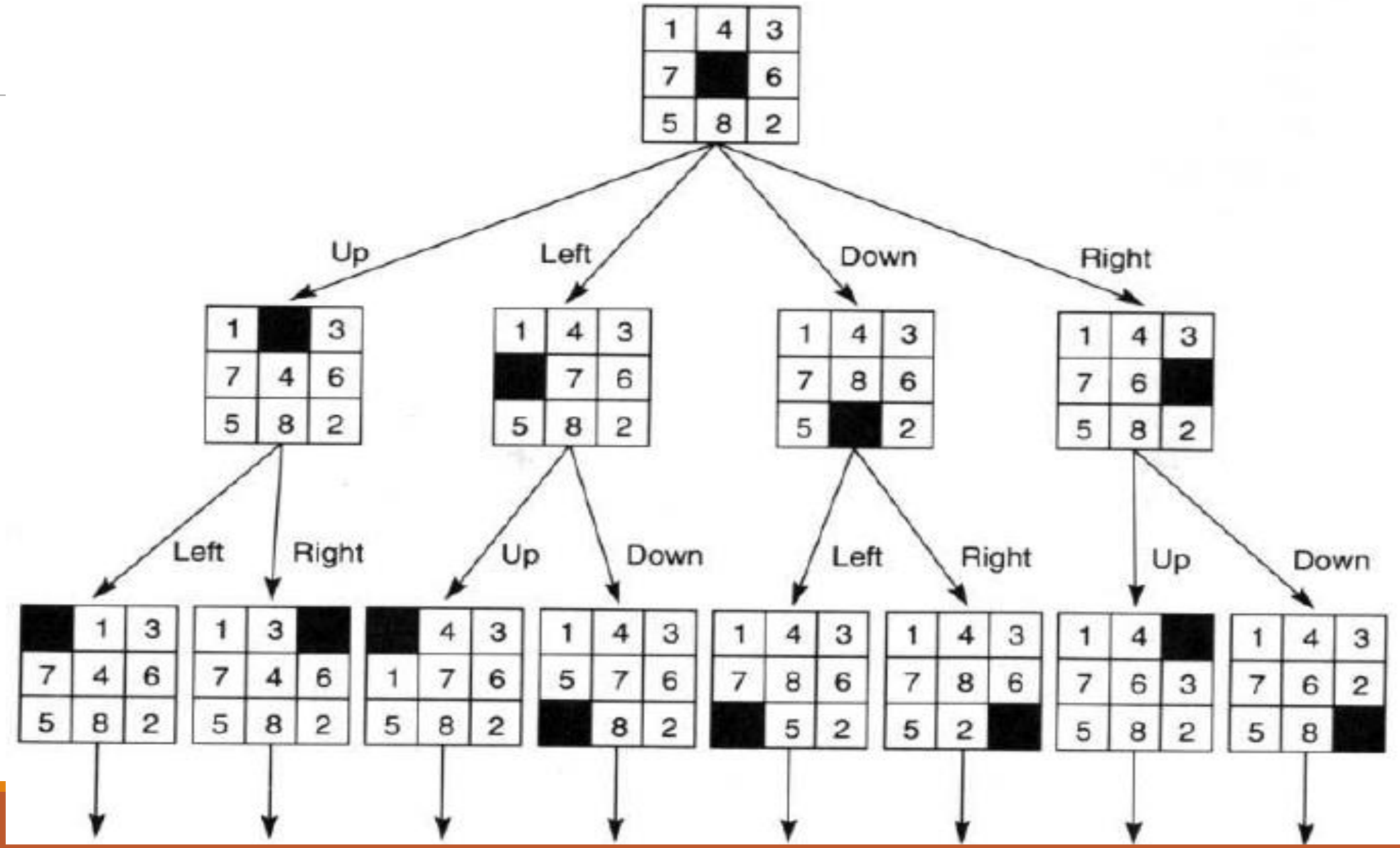


Start State



Goal State

State-space for the 8-Puzzle problem



task environm.	observable	determ./ stochastic	episodic/ sequential	static/ dynamic	discrete/ continuous	agents
crossword puzzle	fully	determ.	sequential	static	discrete	single
chess with clock	fully	strategic	sequential	semi	discrete	multi
taxi driving	partial	stochastic	sequential	dynamic	continuous	multi
medical diagnosis	partial	stochastic	sequential	dynamic	continuous	single
image analysis	fully	determ.	episodic	semi	continuous	single
partpicking robot	partial	stochastic	episodic	dynamic	continuous	single
refinery controller	partial	stochastic	sequential	dynamic	continuous	single
interact. Eng. tutor	partial	stochastic	sequential	dynamic	discrete	multi