Mansoura University
Faculty of Computers and Information
Department of Computer Science
First Semester: 2020-2021

[CS324P] Artificial Intelligence - 1 : INTELLIGENT AGENTS

Grade: Third Year (Computer Science)

Ass. Prof. Taher Hamza

Dr. Sara El-Metwally

Faculty of Computers and Information,

Mansoura University,

Egypt.

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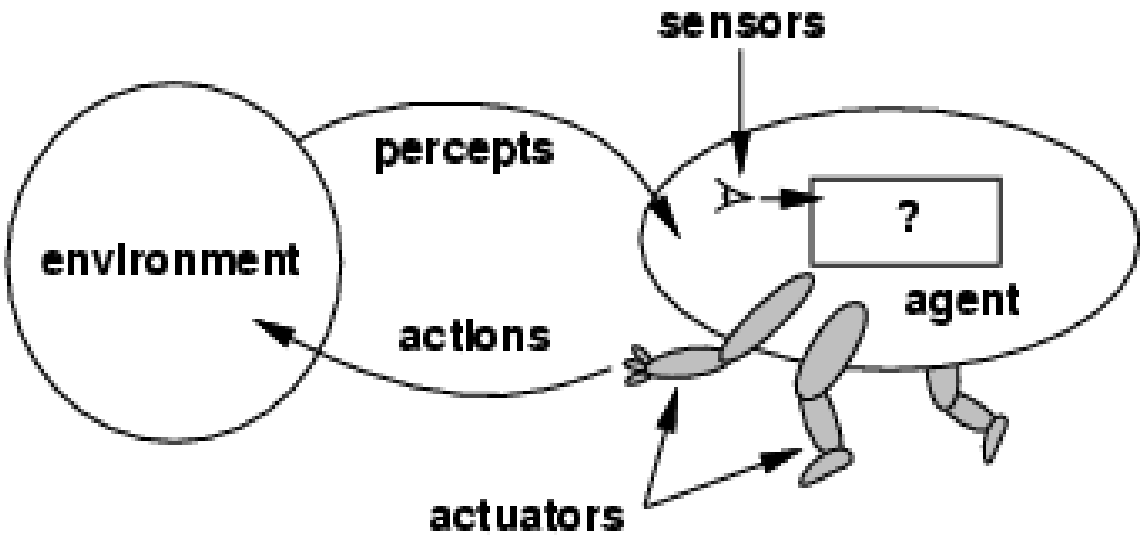
Intelligent Agents

- An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators



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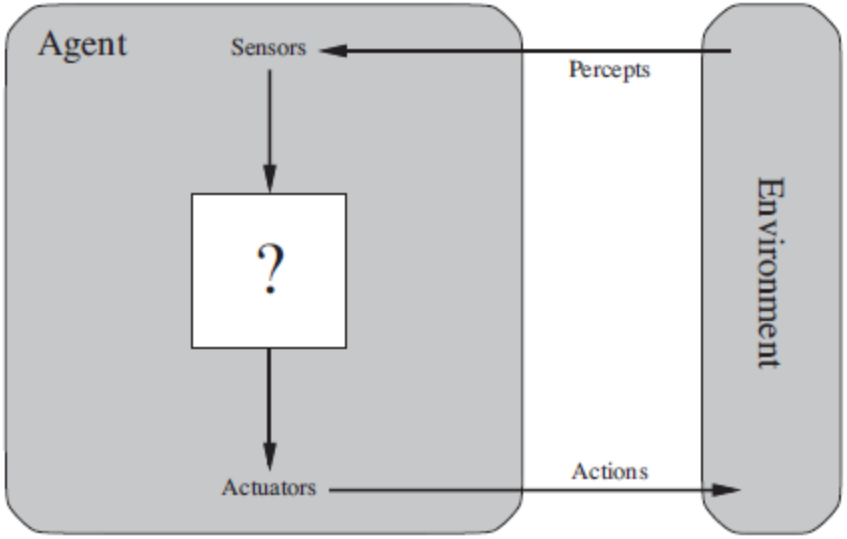
Intelligent Agents



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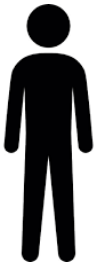
Intelligent Agents, examples



Human Agent	
Sensors	Eyes, ears, nose, skin,..
Actuators	Hands, legs, mouth,..

Robotic Agent	
Sensors	Cameras, infrared ,…
Actuators	Various motors, wheels,..

A software Agent	
Sensors	Keystrokes, file contents, received network packages…
Actuators	displaying on the screen, writing files, sending network packets,…

Intelligent Agents

- An agent's behavior is described by the agent function which maps from percept histories to actions:

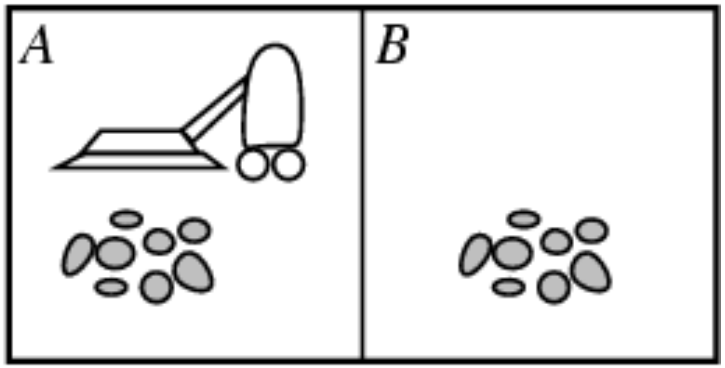
$$\mathbf{f}: P^* \rightarrow A$$

- Agent function will be implemented by an agent program which runs on the physical architecture to produce **f**

agent = architecture + **program**

Intelligent Agents, example

Vacuum-cleaner agent



- Percepts: location and contents, e.g: [A,Dirty]
- Actions: Left, Right, Suck

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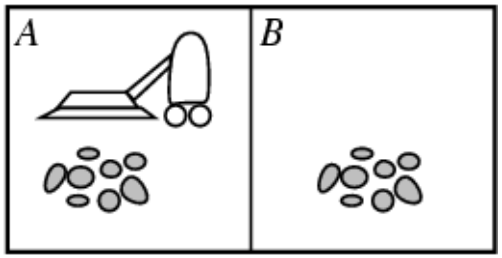
Intelligent Agents

Agent function as look up Table:



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

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Intelligent Agents

Agent function as look up Table:

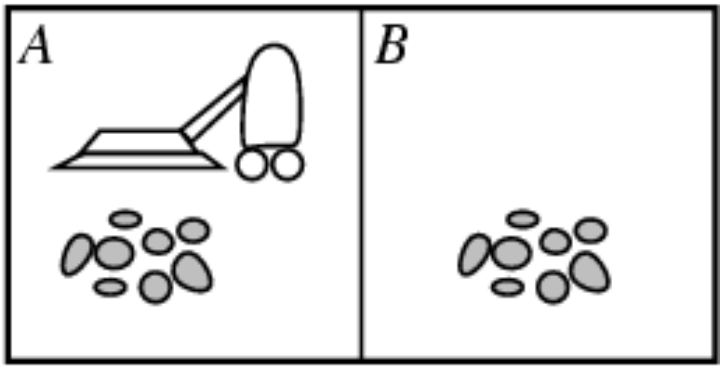
- An agent actions is completely specified by the lookup table

- Drawbacks:
  - Huge table
  - Take a long time to build the table
  - No autonomy

Intelligent Agents

Rational Agent:

- For each possible **percept** sequence, Ideal rational agent should do whatever **action** expected to **maximize performance** measure, on the basis of built-in **knowledge** agent has



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Intelligent Agents

Rational Vs. Perfection !

- Omniscience is the unlimited knowledge
- An omniscient agent knows the actual outcome of its actions, and can act accordingly
- Omniscience is **impossible** in reality

Agent design

Agent Design (PEAS)

- **P**erformance: How agent be assessed?
- **E**nvironment: What elements exists around agent?
- **A**ctuators: How agent change the environment?
- **S**ensors: How agent sense the environment?

Agent design

Agent Design (PEAS)

Automated taxi driver

- Performance: Safe, fast, legal, comfortable trip, profits
- Environment: Roads, other traffic, pedestrians, customers
- Actuators: Steering wheel, accelerator, brake, signal, horn
- Sensors: Cameras, speedometer, GPS, engine sensors, keyboard

Agent design

Agent Design (PEAS)

Part-picking robot

- Performance: Percentage of parts in correct bins, speed
- Environment: Conveyor belt with parts, bins
- Actuators: Jointed arm and hand
- Sensors: Camera, joint angle sensors

Agent design

Agent Design (PEAS)

Medical diagnosis system

- Performance: Healthy patient, minimize costs, lawsuits
- Environment: Patient, hospital, staff,.....
- Actuators: Screen display (questions, tests, diagnoses, treatments, referrals)
- Sensors: Keyboard (entry of symptoms, patient's answers)

Agent design

Assignment (1)

Design the agent for your projects?
(PEAS)

Environment Properties

Environment Properties (ODESDA)

- Observable (or, partially observable)

  An agent's sensors give it access to the complete state of the environment at each point in time

- Deterministic (or, stochastic)

  The next state of the environment is completely determined by the current state and the action executed by the agent

- Episodic (or, sequential)

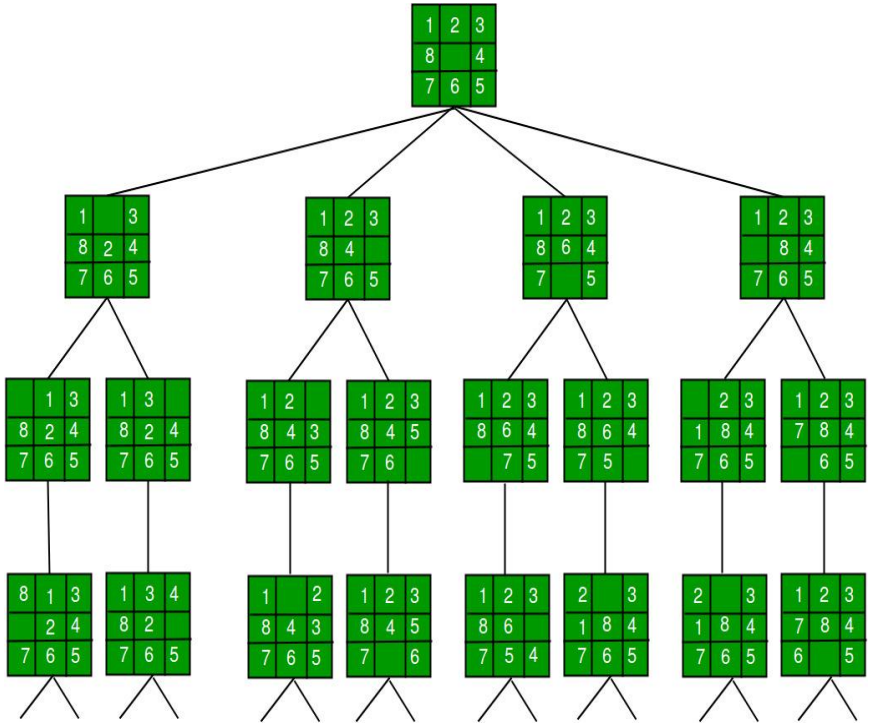
  The agent's experience is divided into episodes, in each episode the agent receives a percept and then performs a single action

Environment Properties

Environment Properties (ODESDA)

- Static (or, Dynamic)
  The environment is unchanged while an agent is deliberating
- Discrete (or, Continuous)
  A limited number of distinct, clearly defined percepts and actions.
- Agent (single/ multi) (cooperative /competitive)
  Number of agent in the environment

Note



https://www.geeksforgeeks.org/8-puzzle-problem-using-branch-and-bound/

https://www.fool.com/investing/what-does-the-future-hold-for-self-driving-cars.aspx

Environment Properties

Environment Properties (ODESDA)

Task Environment	Observable	Agents	Deterministic	Episodic	Static	Discrete
Crossword puzzle Chess with a clock						
Taxi driving Medical diagnosis						

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

Image Credit: Artificial Intelligence A Modern Approach *Second Edition by* Stuart J. Russell and Peter Norvig by 2010.

Environment Properties

Assignment (2)

Specify the agent's environment for your project?
(ODESDA)

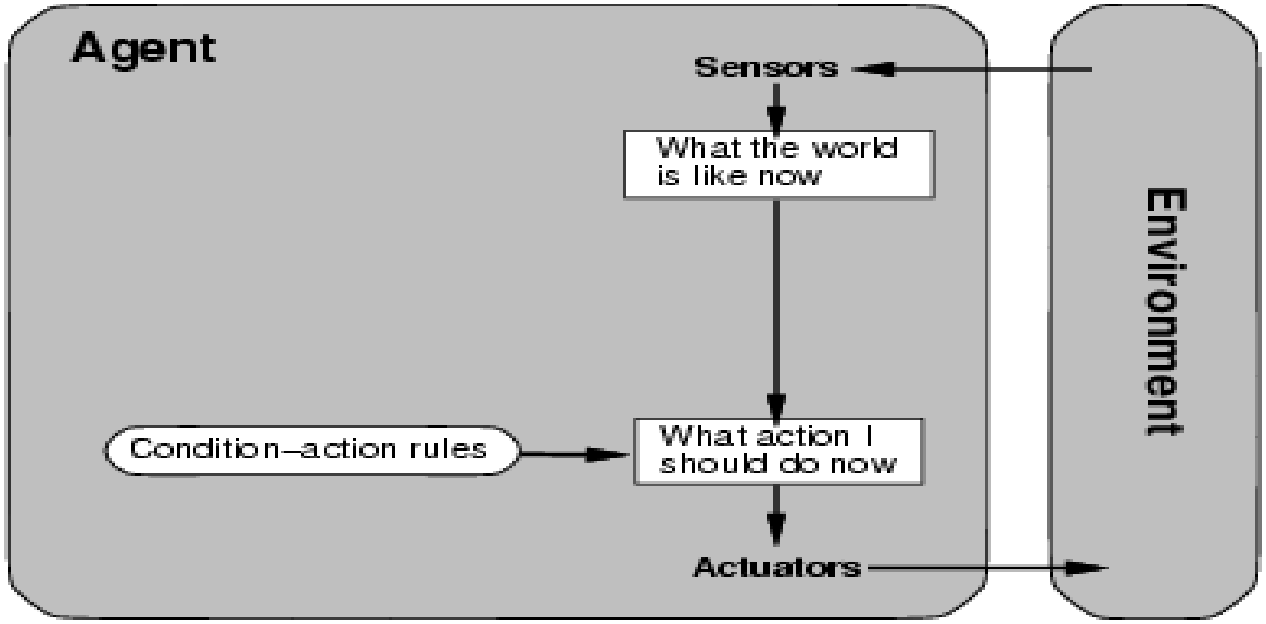
Agents Types

Agent Basic Types:

- Simple reflex agents
- Model-based reflex agents
- Goal-based agents
- Utility-based agents

Agents Types

Simple reflex agents



- Choose actions only based on the current percept
- Ignore the precept history (no memory)
- Use condition-action rule

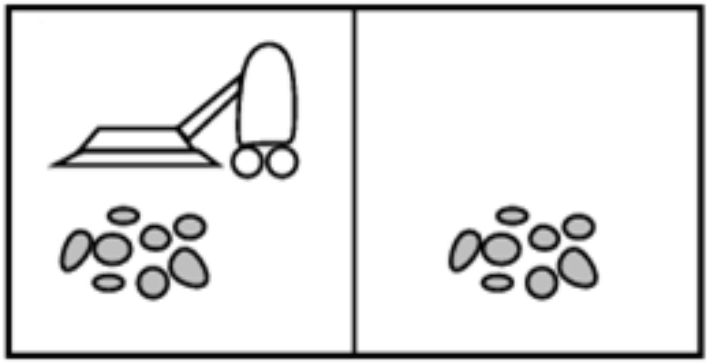
Very simple !

Image Credit: Artificial Intelligence A Modern Approach *Second Edition by* Stuart J. Russell and Peter Norvig by 2010.

Agents Types

Simple reflex agents: (dis-advantage)

- The agent will work only if the correct decision can be made on the basis of the current percept that is only if the environment is **fully observable**
- Infinite loops are often unavoidable – escape could be possible by randomizing



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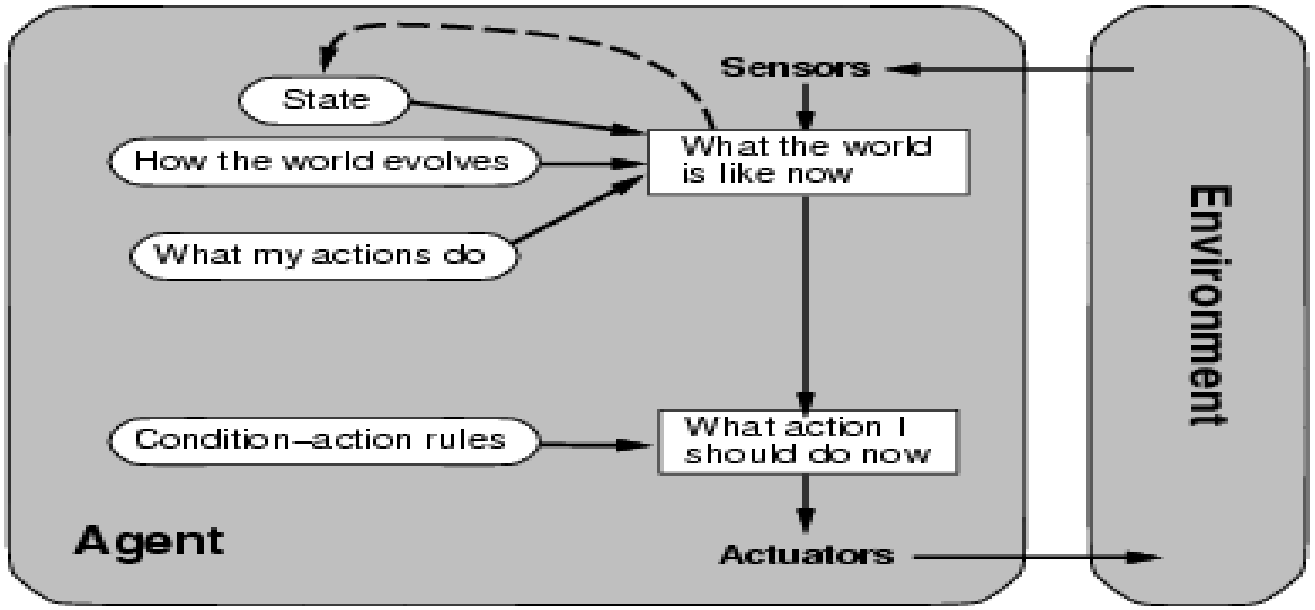
Agents Types

Model-based reflex agents



- Action depend on history or unperceived aspects of the world
- Need to maintain internal world model (state)

Without clear goal it is unclear to know what to do!

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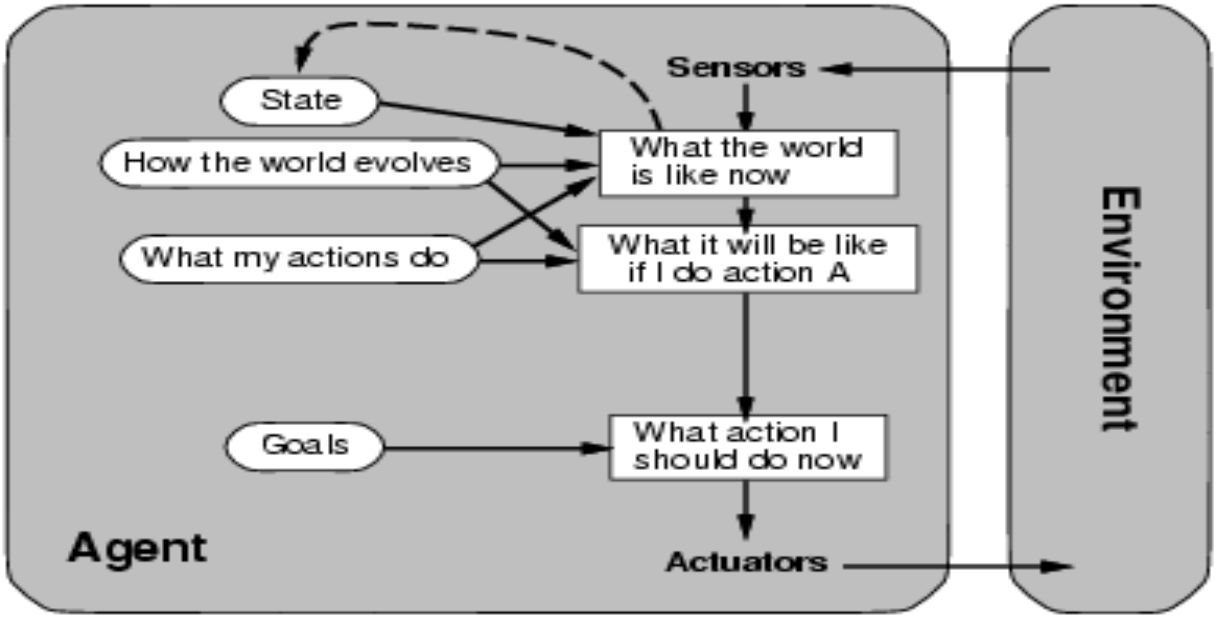
Agents Types

Goal-based agents



- Agents of this kind take future events into consideration
- Agent has some goal information, choose actions according to goal

Some solutions to goal states are better than others!
What happed if we have conflicting goals!

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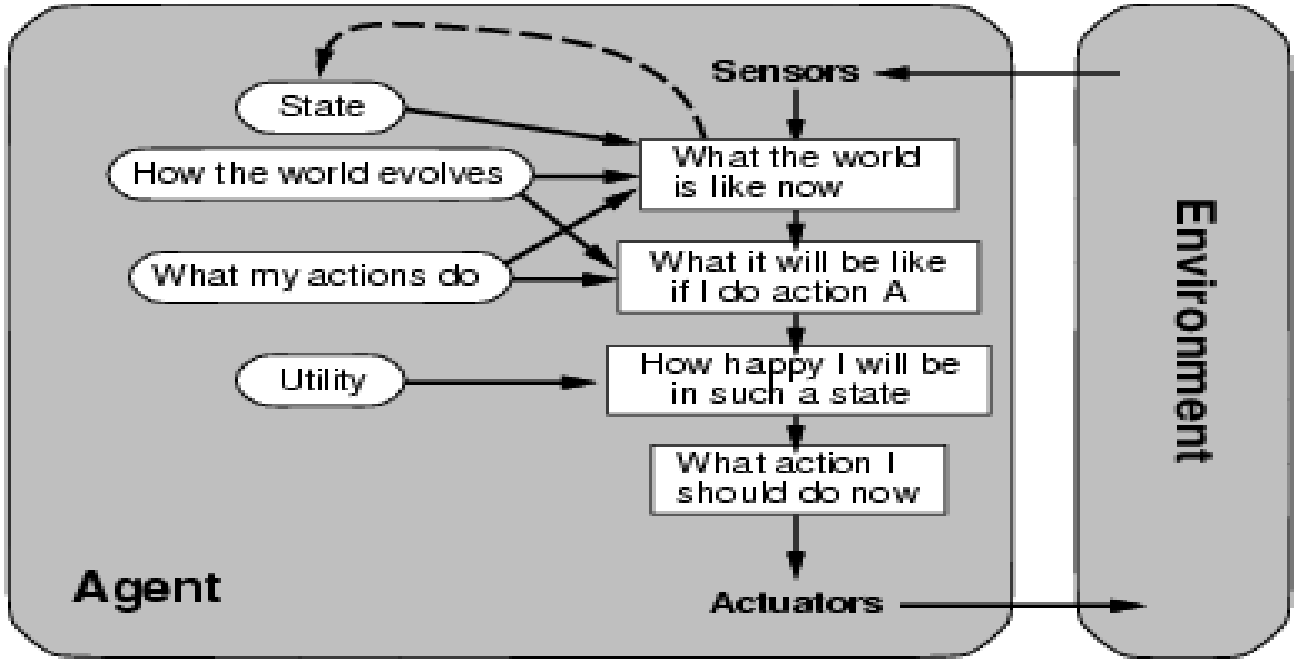
Agents Types

Utility-based agents



❖Try to Maximize agent expected happiness

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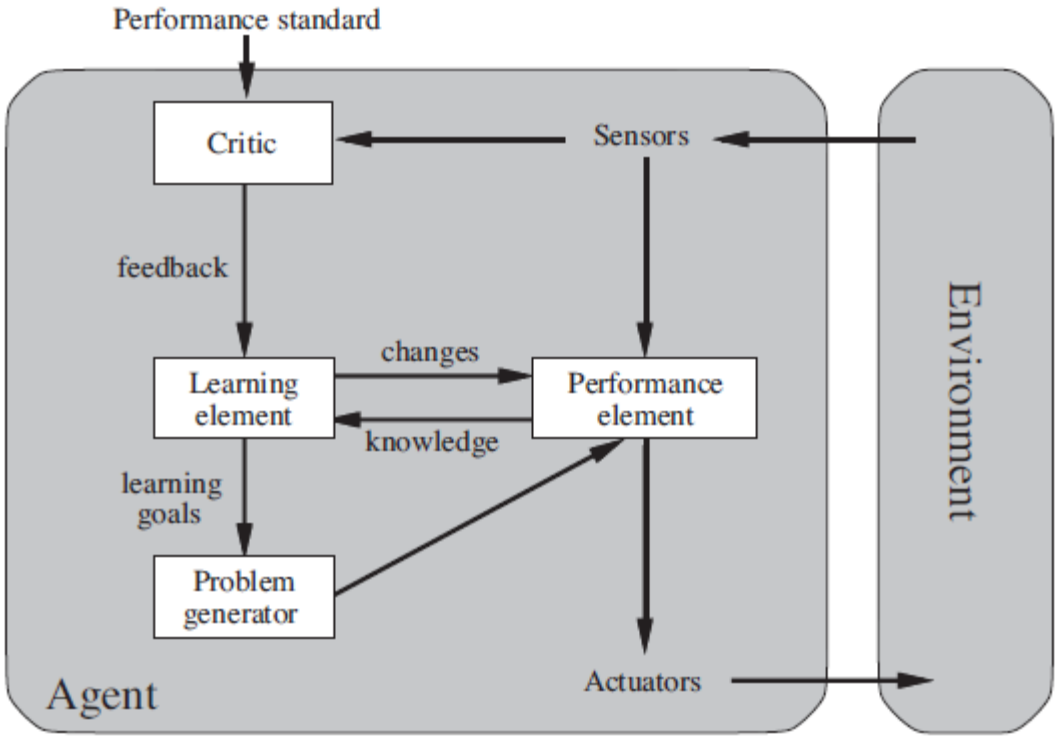
Learning agent



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Agents Types, example

Consider a chess playing agent, What sort of agent would it need to be?

Simple-reflex agent:	If yes? but some actions require some memory (e.g. castling in chess)
Model-based reflex agent:	If yes? but needs to reason about future
Goal-based agent:	If yes? but what about confliction goals?
Utility-based agent:	Might consider multiple goals

Agents Types

Assignment (3)

Describe the agent type for your project?

Simple-reflex agent? Why? Why not?
Model-based agent? Why? Why not?
Goal-based agent? Why? Why not?
utility-based agent? Why? Why not?


Thank You !