# A Review of Intelligent Agents

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**ABSTRACT** – An intelligent agent (IA) is an autonomous entity which observes through sensors and acts upon an environment using actuators (i.e. it is an agent) and directs its activity towards achieving goals. Intelligent agents are often described schematically as an abstract functional system similar to a computer program. For this reason, intelligent agents are sometimes called abstract intelligent agents (AIA).

**Keywords**— IA, AIA, PSA

## INTRODUCTION

Intelligent agents in artificial intelligence are closely related to agents in economics, and versions of the intelligent agent paradigm are studied in cognitive science, ethics, the philosophy of practical reason, as well as in many interdisciplinary socio-cognitive modeling and computer social simulations.

Intelligent agents are also closely related to software agents (an autonomous computer program that carries out tasks on behalf of users).

Agent applications can be classified in four areas; interface agents, information agents, believable agents, and cooperative problem solving and distributed AI.

## STRUCTURE OF AGENTS

A simple agent program can be defined mathematically as an agent function which maps every possible percepts sequence to a possible action the agent can perform or to a coefficient, feedback element, function or constant that affects eventual actions:

$$f : P^* \to A$$

Agent function is an abstract concept as it could incorporate various principles of decision making like calculation of utility of individual options, deduction over logic rules, fuzzy logic, etc

The program agent, instead, maps every possible percept to an action.

## COMPONENTS FOR AGENTS

- learning element - responsible for making improvements.
- performance element - what we have up to now considered to be the entire agent. Takes percepts and then decides on actions.
- critic - gives the learning element feedback on how the performance element is doing and if it needs to be modified.
- problem generator - it suggests actions that lead to new and informative experiences.

## TYPES OF AGENTS

### 1. COLLABORATIVE AGENTS

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Agents whose implemetation is focused into autonomy and cooperation are collectively called, *collaborative* . Some of them exhibit learning capabilities as well, but this property is not of primary importance to them. Collaborative agents use sophisticated notions of autonomy, responsiveness and proactiveness to achieve negotiation. They usually appear in coarse-grained muti-agent systems, and most of the time they are static. They may or may not feature mentalistic attributes that govern their behavior. Collaborative agents are most suitable for:

Situations where the problem is too large for a single agent and must be distributed due to resource limitations.

- Situations where there is a need for interconnection of multiple existing systems
- Problems whose nature is itself distributed.
- Problems whose solution requires accessing a distributed set of resources
- Situations in which the problem-solving capacity is distributed
- Situations in which the enhancement of modularity is of prime interest.

## 2. INTERFACE AGENTS

Agents focused in autonomy and learning and whose goal is to perform tasks for their owner are called *interface* agents. Typically, such agents observe the actions of the user, interact with him/her and attempt to learn by imitation, or direct feedback. Their abilities in negotiation are limited and most of their interactions with other agents (if any) relate to receiving advisory information. Interface agents are seemingly smart software pieces that help their owner automate and perform tasks. Applications include:

- Personal Assistants/Organizers
- Preferential Information Filters
- Financial Decision Systems
- Entertainment
- Miscellaneous Aids
- Tutorial Systems

## 3. MOBILE AGENTS

Mobile agents are software processes capable of moving around wide area networks, interacting with remote hosts, collectiing information on behalf of their owner and consequently returning to their "home" host. Mobile agents exhibit sophisticated social ability, proactiveness and autonomy. They are mainly used in:

- Situations where local resources are limited (CPU or storage for example) and there is a need to use remote resources to complete tasks.
- Situations where asynchronous distributed computation needs to be achieved.
- Situations where coordination is complex.
- Situations where the cost of bringing vast amount of remote information to the local node is big, thus necessitating the use of a mobile agent to set off and fetch it.

## 4. INFORMATION AGENTS

Information agents are tools that coordinate the retrieval, management, selection and manipulation of information. They may be mobile or collaborative, and perharps they will exhibit many of the properties (esecially the learning ones) of interface agents. They find application ground in situations where the amount of information available for a user or the solution to a problem is unmanageably large and some way to filter it down to a selection of the most essential and useful pieces is needed.

## CLASSES OF INTELLIGENT AGENTS

1. simple reflex agents
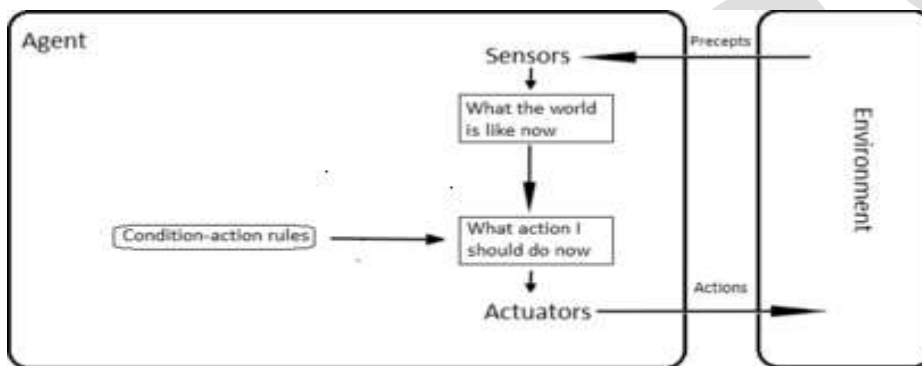2. model-based reflex agents

3.  goal-based agents
4.  utility-based agents
5.  learning agents

## 1. SIMPLE REFLEX AGENTS

Simple reflex agents act only on the basis of the current percept, ignoring the rest of the percept history. The agent function is based on the *condition-action rule*: if condition then action.

This agent function only succeeds when the environment is fully observable. Some reflex agents can also contain information on their current state which allows them to disregard conditions whose actuators are already triggered.

Infinite loops are often unavoidable for simple reflex agents operating in partially observable environments. Note: If the agent can randomize its actions, it may be possible to escape from infinite loops.



## 2. MODEL BASED REFLEX AGENTS

A model-based agent can handle a partially observable environment. Its current state is stored inside the agent maintaining some kind of structure which describes the part of the world which cannot be seen. This knowledge about "how the world works" is called a model of the world, hence the name "model-based agent".

A model-based reflex agent should maintain some sort of internal model that depends on the percept history and thereby reflects at least some of the unobserved aspects of the current state.
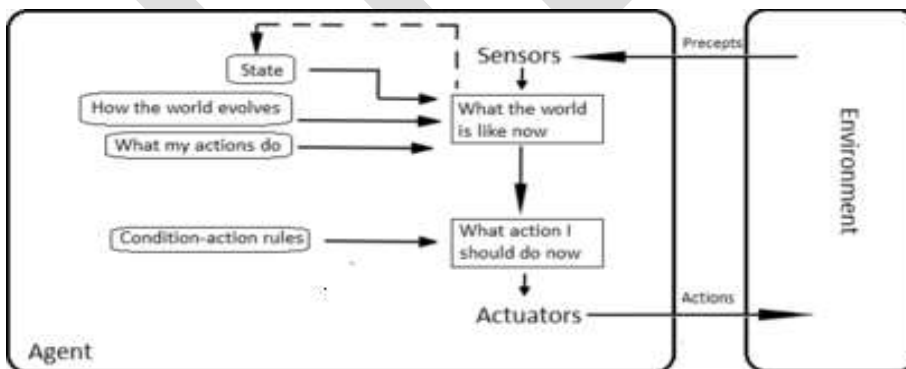
## 3. GOAL BASED AGENTS

Goal-based agents further expand on the capabilities of the model-based agents, by using "goal" information. Goal information describes situations that are desirable. In some instances the goal-based agent appears to be less efficient; it is more flexible because the knowledge that supports its decisions is represented explicitly and can be modified
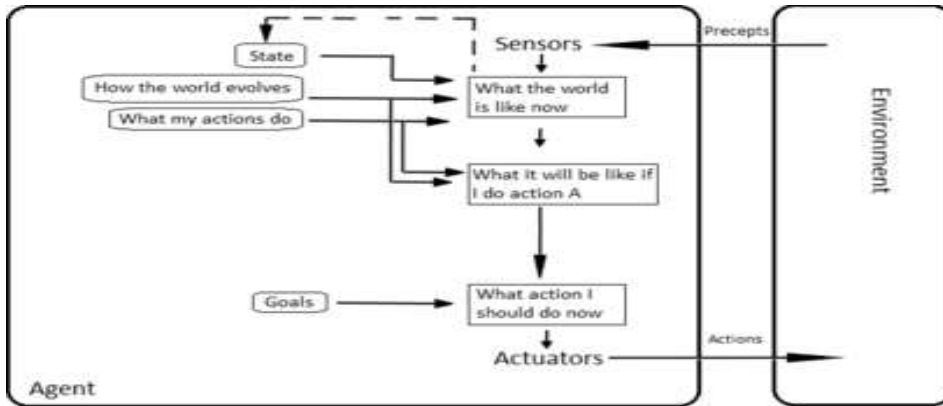


## 4. UTILITY BASED AGENTS

Goal-based agents only distinguish between goal states and non-goal states. It is possible to define a measure of how desirable a particular state is. This measure can be obtained through the use of a *utility function* which maps a state to a measure of the utility of the state. A more general performance measure should allow a comparison of different world states according to exactly how happy they would make the agent. The term utility, can be used to describe how "happy" the agent is.

A rational utility-based agent chooses the action that maximizes the expected utility of the action outcomes- that is, the agent expects to derive, on average, given the probabilities and utilities of each outcome. A utility-based agent has to model and keep track of its environment, tasks that have involved a great deal of research on perception, representation, reasoning, and learning.
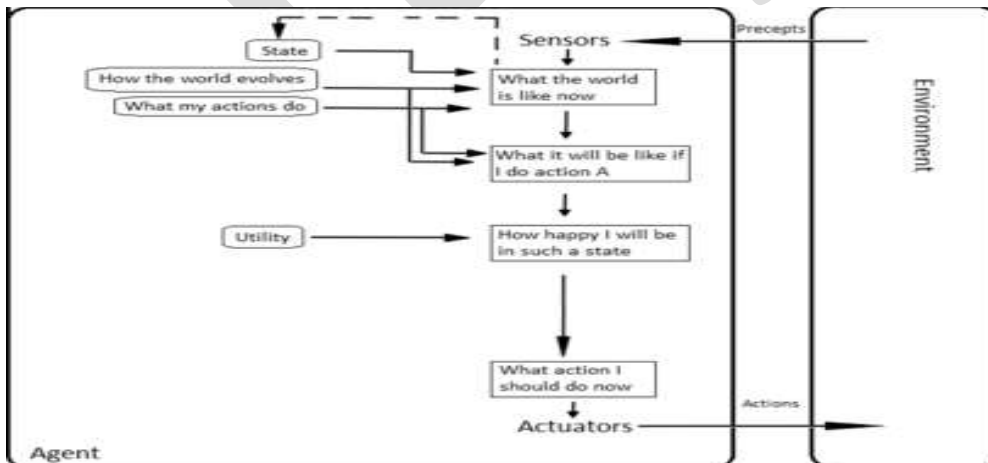
## 5.LEARNING AGENTS

Learning has an advantage that it allows the agents to initially operate in unknown environments and to become more competent than its initial knowledge alone might allow.

The learning element uses feedback from the "critic" on how the agent is doing and determines how the performance element should be modified to do better in the future. The performance element is what we have previously considered to be the entire agent: it takes in percepts and decides on actions.

The last component of the learning agent is the "problem generator". It is responsible for suggesting actions that will lead to new and informative experiences.
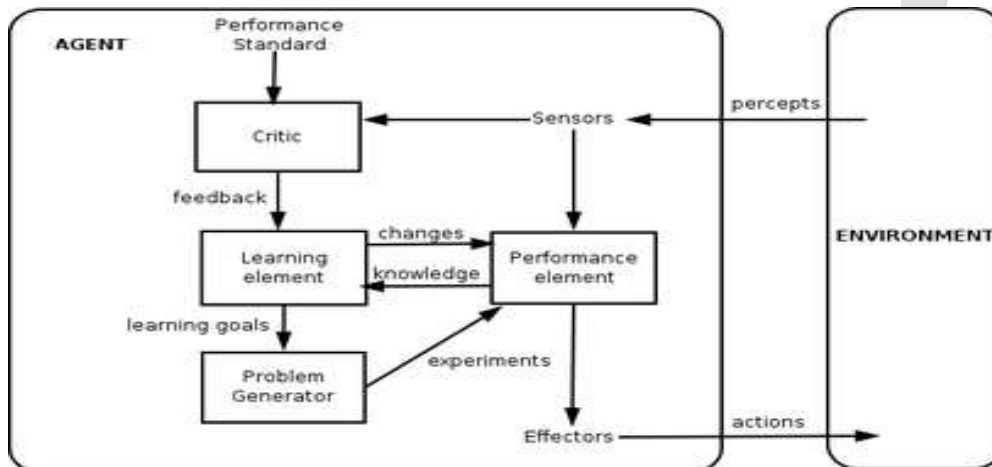


## WHAT KIND OF PROBLEMS INTELLIGENT AGENTS CAN SOLVE

To understand how intelligent agents work, it is best to examine some of the practical problems that intelligent agent can help solve. An intelligent agent can help you find and filter information when you are looking at corporate data or surfing the Internet and don't know where the right information is. It could also customize information to your preferences, thus saving you time of handling it as more and more new information arrived each day on the Internet.

## APPLICATIONS OF INTELLIGENT AGENT

### Customer Help Desk

Customer help desk job is to answer calls from customers and find the answer to their problems. When customers call with a problems, the help desk person manually look up answers from hardcopy manuals, but those hardcopy manuals have been replaced with s earchable CD-ROM collections, and some companies even offer searches over the Internet. Instead of hiring help desk consultants, or having the customers search through the internet for an answer, with intelligent agent, customer describe the problem and the agent automatically searches the appropriate databases (either CD-ROM, or the Internet), then presents a consolidated answer with the most likely first. This is a good example of using intelligent agent to find and filter information.

### Web Browser Intelligent

A web browser intelligent, such as an IBM Web Browser Intelligent is an agent which helps you keep track of what web site you visited and customizes your view of the web by automatically keeping a bookmark list, ordered by how often and how recent you vis it the site. It allows you to search for any words you've seen in your bookmark track, and takes you back to the site allowing you to

find and filter quickly. It also help you find where you were by showing you all the different track you took starting at the current page. It also let you know by notifying you when sites you like are updated, and it could also automatically download pages for you to browse                                                                                              offline.

**Personal Shopping Assistant(PSA)**

IBM's Personal Shopping Assistant uses intelligent agent technology to help the Internet shopper or the Internet shop owner to find the desired item quickly without having to browse page after page of the wrong merchandise. With the Personal Shopping Ass istant, stores and merchandise are customized as the intelligent agent learned the shopper's preferences as he/she enters in any on-line mall or stores or looking at specific merchandise. It could also arrange the merchandise so that the items you like t he most are the first one you see. Finally, Personal Shopping Assistant automates your shopping experience by reminding you to shop when a birthday, an anniversaries, or item that is on sale occurred.

## CONCLUSION

As agents gain a wider acceptance and become more sophisticated, they will become a major factor in the future of the Internet. Intelligent agents will not completely replace surfing altogether, but they will make information gathering much easier for the users or consumer. Instead of searching through lists and lists of unwanted sites, the user could ask their agent to start searching, and in a few moments, it come back with the information that is needed immediately.

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