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A COMPREHENSIVE STUDY ON AN AGENT MODELING IN ARTIFICIAL INTELLIGENCE

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Abstract:-

This paper aims at presenting the working of agent based modelling in Artificial Intelligence. Agent-based models are particularly suited to support the definition of models of such systems, but also to support the design and implementation of simulators. Agent-Based models and Multi-Agent Systems (MAS) have been adopted to simulate very different kinds of complex systems, from the simulation of socio-economic systems to the elaboration of scenarios for logistics optimization, from biological systems to urban planning.

Keywords: - [Agent based, Artificial Intelligence, reflex agents, AI Agents, AI Agent types]

1. INTRODUCTION

Agent Based modelling in Artificial Intelligence is the branch of computer science that aims to create intelligent machines. It has become an essential part of the technology industry. The term was coined in 1956 by John McCarthy at the Massa -chussetts Institute of Technology. Research associated with artificial intelligence is highly technical and specialized. This paper briefly describes how artificial intelligence works and the various techniques used in it. The core problems of artificial intelligence include programming computers for certain traits such as 1) Knowledge, 2) Reasoning, 3) Problem solving, 4) Perception, 5) Learning, 6) Planning, 7) Ability to manipulate and move objects. Knowledge engineering is a core part of AI research. Machines can often Act and react like humans only if they have abundant information relating to the world. Artificial intelligence must have access to objects, categories, properties and relations between all of them to implement knowledge engineering. Initiating common sense, reasoning and problem-solving power in machines is a difficult and tedious approach. Machine learning is another core part of AI. Learning without any kind of supervision requires an ability to identify patterns in streams of inputs, whereas learning with adequate supervision involves classification and numerical regressions. Classification determines the category an object belongs to and regression deals with obtaining a set of numerical input or output examples, thereby discovering functions enabling the generation of suitable outputs from respective inputs. Mathematical analysis of machine learning algorithms and their performance is a well-defined branch of theoretical computer science often referred to as computational learning theory.

Machine perception deals with the capability to use sensory inputs to deduce

the different aspects of the world, while computer vision is the power to analyse visual inputs with few sub-problems such as facial, object and speech recognition.

2. ARCHITECTURE OF AI

Artificial intelligence, or AI, is the field that studies the synthesis and analysis of computational agents that act intelligently. An agent is something that acts in an environment - it does something. Agents include worms, dogs, thermostats, airplanes, robots, humans, companies, and countries.

We are interested in what an agent does; that is, how it acts. We judge an agent by its actions.

An agent acts intelligently when it does is appropriate for its circumstances and its goals, it is flexible to changing environments and changing goals, it learns from experience, and, It makes appropriate choices given its perceptual and computational limitations. An agent typically cannot observe the state of the world directly; it has only a finite memory and it does not have unlimited time to act.

A computational agent is an agent whose decisions about its actions can be explained in terms of computation. That is, the decision can be broken down into primitive operation that can be implemented in a physical device. This computation can take many forms. In humans this computation is carried out in "wetware"; in computers it is carried out in "hardware." Although there are some agents that are arguably not computational, such as the wind and rain eroding a landscape, it is an open question whether all intelligent agents are computational.

The central scientific goal of AI is to understand the principles that make intelligent behaviour possible in natural or artificial systems. This is done by Analysis of natural and artificial agents;

Formulating and testing hypotheses about what it takes to construct intelligent agents; and Designing, building, and experimenting with computational systems that perform tasks commonly viewed as requiring intelligence.

As part of science, researchers build empirical systems to test hypotheses or to explore the space of possibilities. These are quite distinct from applications that are built to be useful for an application domain. Note that the definition is not for intelligent thought. We are only interested in thinking intelligently insofar as it leads to better performance. The role of thought is to affect action.

The central engineering goal of AI is the design and synthesis of useful,

intelligent artifacts. We actually want to build agents that act intelligently. Such agents are useful in many applications.

3. WORK FLOW OF AGENTS IN AI

In artificial intelligence, 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 (i.e. it is rational) Intelligent agents may also learn or use knowledge to achieve their goals. They may be very simple or very complex: a reflex machine such as a thermostat is an intelligent agent, as is a human being, as is a community of human beings working together towards a goal.

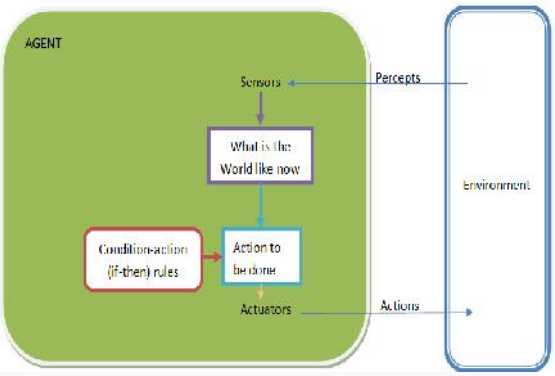

Figure 1: Work flow of agents in AI

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) to distinguish them from their real world

implementations as computer systems, biological systems, or organizations. Some definitions of intelligent agents emphasize their autonomy, and so prefer the term autonomous intelligent agents

4. STRUCTURE OF AGENTS

A simple agent program can be defined mathematically as an agent function [5] 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:

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

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.

We use the term percept to refer to the agent's perceptional inputs at any given instant. In the following figures an agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators.

5. INTELLIGENT AGENTS CLASSES

Russell &Norvig (2003) group agents into five classes based on their degree of perceived intelligence and capability:

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

5.1 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.

5.2 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. It then chooses an action in the same way as the reflex agent.

5.3 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. This allows the agent a way to choose among multiple possibilities, selecting the one which reaches a goal state. Search and planning are the subfields of artificial intelligence devoted to finding action sequences that achieve the agent's goals.

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.

5.4 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.

5.5 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 most important distinction is between the "learning element", which is responsible for making improvements, and the "performance element", which is responsible for selecting external actions.

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.

6. OTHER INTELLIGENT AGENT CLASSES

According to other sources], some of the sub-agents not already mentioned in this treatment may be a part of an Intelligent Agent or a complete Intelligent Agent. They are:

Decision Agents (that are geared to decision making);

Input Agents (that process and make sense of sensor inputs – e.g. neural network based agents);

Processing Agents (that solve a problem like speech recognition);

Spatial Agents (that relate to the physical real-world);

World Agents (that incorporate a combination of all the other classes of agents to allow autonomous behaviours).

Believable agents - An agent exhibiting a personality via the use of an artificial character (the agent is embedded) for the interaction.

Physical Agents - A physical agent is an entity which percepts through sensors and acts through actuators.

Temporal Agents - A temporal agent may use time based stored information to offer instructions or data acts to a computer program or human being and takes program inputs percepts to adjust its next behaviours.

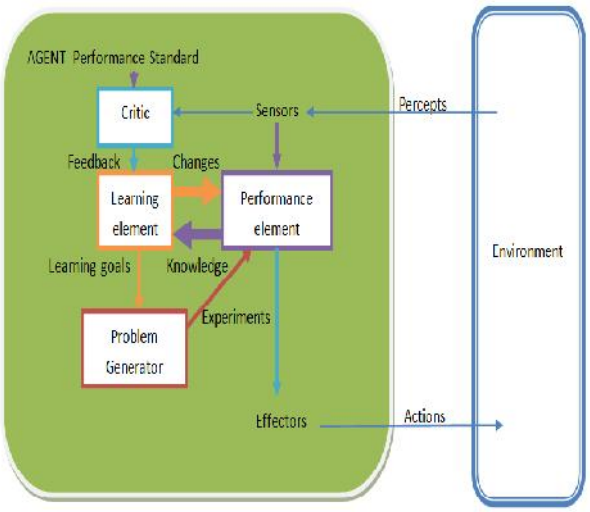

Figure 2: Other Process in AI agents

Agent based modelling in Artificial Intelligence. Agent-based modelling can be done using general, all-purpose software or programming languages, or it can be done using specially designed software and toolkits that address the special requirements of agent modelling. Agent modelling can be done in the small, on the desktop, or in the large, using large-scale computing cluster, or it can be done at any scale in-between these extremes. Projects often begin small, using one of the desktop ABMS tools, and then grow in stages into the larger-scale ABMS toolkits. Often one begins developing their first agent model using the approach that one is most familiar with, or

the approach that one finds easiest to learn given their background and experience.

We can distinguish implementation alternatives to building agent-based models on the basis of the software used. Spread sheets, such as Microsoft Excel, in many ways offer the simplest approach to modelling. It is easier to develop models with spread sheets than with many of the other tools, but the resulting models generally allow limited agent diversity, restrict agent behaviours, and have poor scalability compared to the other approaches. Some macro-level programming is also needed using the VBA language.

CONCLUSION

AI has spawned some useful applications like expert systems and game AI, but the truly pervasive use of AI is still to come as more research and improved technology surfaces in the future. Intelligent agents can be applied as automated online helpers, where they perceive and execute the needs of customers in a more personalized way. Such type of agents can be associated with Expert system. Till now the agent approach with AI is unresolved. The agents constructed using this approach require novel ideas and better solutions.

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