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Research Article

AI based Evolution from IoT to IoE

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Abstract

Agents evolve in as microcosms of the Internet of Everything (IoE), communities, cities, and enterprises stand to benefit the most from connecting people, process, data, and things. An Internet of Everything (IoE) it is a digital nervous system that integrates data, people, processes and systems (non-biological and biological). The social structure is based on the network of interdependent relationships that exist between a given set of social positions, roles, institutions, groups or other components of the social reality of the same or different level.

We want to describe our research actual status with the objective to study the dynamic and collective behavior of our architecture of intelligent agents (Rago, 2018). In order to express the control problem of an agent system, we assume as performance measure an entropy function following Saridis (Saridis, 1984).

Keywords: IoT; IoE; Research

Introduction

The internet of things, or IoT, is a system of interrelated computing devices, mechanical and digital machines that are provided with unique identifiers and the ability to transfer data over a network. IoT is a technology that finds functional amplification in AI. Through the technology with autonomous agents we can create the capsules in which the processes live, possibly creating those that Edelman calls BBD (brain-based devices) integrating Agents with neural networks.

Agents represent only the first layers of multi agents architecture: after having experimentally tested the Phenomenological Layer and the Conceptual layer [1] it is necessary to guarantee the processes that allow the finalization of such processing in a logic of a bigger system.

Agents evolve in as microcosms of the Internet of Everything (IoE), communities, cities, and enterprises stand to benefit the most from connecting people, process, data, and things.

Agents are digital system integrated Sensors and Actuator and processes can be AI classical (planning, clustering ...).

A network of communicating Agents or Internet of Everything (IoE) it is a digital nervous system that integrates data, people, processes and systems. The interactions between these entities are creating new types of smart applications and services.

The social structure is based on the network of interdependent relationships that exist between a given set of social positions, roles, institutions, groups, classes or other components of the social reality of the same or different level.

This note describes the research poster currently being worked on, with the proposed objectives and the partial results achieved.

Methods

Computational theories of agents

Recent research in artificial intelligence has developed computational theories of agents' involvements in their environments. Although inspired by a great diversity of formalisms and architectures, these research projects are unified by a common concern: using principled characterizations of agents' interactions with their environments to guide analysis of living agents and design of artificial ones.

Interactions between agents and their environments guide explanation and design. The designer's goal is to ensure that the entire family of these interaction trajectories has certain properties. One way to characterize this family of trajectories is in terms of a differential equation that relates changes in the control variables to the current values (and perhaps the ongoing rates of change, or past values, or both) of the output variables.

Control theory, of course, provides only one way of thinking about interactions. It is tied to a particular model of interaction (through output and control variables), its historical development has been profoundly influenced by the need for safety and conservatism in relatively well-behaved systems, and it is thoroughly mathematical.

A principled characterization of interaction, though, need not have any of these qualities to provide a useful guide to the design of artificial agents and the explanation of natural ones.

The important thing is that our characterization of interaction should allow us to address questions like these:

- What will our agent do in a given environment?
- Under what conditions will it achieve its goals or maintain desired relationships with other things?
- In what kinds of environments will it work?
- How do particular aspects of an environment, such as topography or mutability or the workings of artifacts, affect particular types of agents' abilities to engage in interactions that have particular properties?
- What forms of interaction permit an agent to learn particular knowledge or skills?

To ask these questions, we need to understand the relationships among the properties of agents, environments, and forms of interaction between them. Of course, it is doubtful that any single theory can give a complete account of this vast topic.

It can be assumed that multi-agent systems can be compared to biological cellular systems. We must try to extract significant data and make predictions from spurious sets of data produced by both the receptive fields of the agents and the communication between them.

We need to evaluate both the information content and the information flow. Hence, we need to model behavior and not just structure.

In recent years much attention has been paid to mobile and distributed systems and this has led to the definition of formal languages with syntax and semantics capable of representing the possible behaviors of these systems in an unambiguous way.

Process algebras

Process algebras were introduced in the late 1970s by Tony Hoare and Robin Milner to model the peculiarities of competing systems in a rigorous way. They include a few. Elementary actions are identified by lower case letters and processes indicated with capital letters:

- Sequencing Of actions and processes (A.P)
- Parallel composition of processes (P | Q),
- Non-deterministic composition of processes (P + Q),
- Declaration of new names (new a),
- Operator of choice [x = y],
- Recursion (rec X. P).

The process constructs available in the calculus for communication:

- Input prefixing c(x). P where P is a process waiting for a message that was sent on a communication channel named c before proceeding as, binding the name received to the name x.
- Output prefixing c<x>. P describes that the name x is emitted on channel c before P proceeding as P.

The formal semantics of these calculations is usually provided in an operational way by exploiting the operational approach introduced by Gordon Plotkin is based on axioms and rules of inference (Plotkin, G.).

The dynamic behavior of the systems represented is expressed by means of transition systems which are essentially oriented labeled graphs. The states represent system configurations and transitions actions that a system can perform to change configuration. Transition labels provide information on the type of action which they represent.

Stochastic process algebras

The theory of process algebras has been extended with quantitative information. Jane Hillston has introduced a stochastic variant of a process algebra. The basic idea is to enrich the sequential prefixes of process algebras with a probabilistic distribution: the new ones therefore, prefixes have the form (a, F), where a is the standard action of the process algebras and F is the continuous probabilistic distribution.

At this point, the support for the execution time of the calculation is made probabilistic by introducing the concept of tender among all the actions that are enabled to be performed in a given configuration. The idea is that all enabled actions try to execute theirs task, but only the fastest one succeeds. A fundamental theorem of continuous distributions ensures that the probability that two enabled actions terminate simultaneously is zero. This makes the mechanism for choosing the enabled shares unambiguous. At this point, the transition system coincides, with small technical adjustments, with a stochastic process that can be studied to have quantitative measurements of the system it represents by referring to standard techniques.

IoE Processes

Now we will briefly describe how process algebras can represent the IoE processes similar to biological systems. The processes are networks of agents that interact having in common the model of structural contexts where operate.

To have a more detailed parallel between biological systems and process algebras we can consider the interacting agents as concurrent processes and operations (send and receive) on the same channel of communication model communication of channels that alter the topological structure of the interconnection network. Indeed, if a certain process receives a new channel name, from that moment on he can use it to communicate with all other processes who know him. On the contrary, if a certain process consumes the name of a channel to make a communication about him, he can no longer communicate with the processes who know that channel until does not acquire the name again. The accurate description of the quantitative aspects that guide the processes it is incorporated using stochastic process algebras in which the transitions are governed by probabilistic distributions. The calculation of distributions to be associated with the transitions is based on the observation of the interaction between agents.

Coordination of systems of agents

The coordination layer is a structure serving as an interface between agents. It is essential for dispatching organizational information. Its objective is the actual formulation of the control problem. The cost of control problem can be expressed as an entropy which measures the uncertainty of selecting an appropriate control to execute a task. By selecting an optimal control, one minimizes the entropy, e.g. the uncertainty of execution. The entropy may be viewed in the respect as energy in the original sense of Boltzmann. as in Saridis [2].

The trajectories of the system are defined for a fixed but arbitrarily selected control u(z,t) from the set of admissible feedback controls Ω_u.

In order to express the control problem in terms of an entropy function one may assume that the performance measure V(x_o, t_o, u(x, t)) is distributed in Ω_u, according to the probability density p(u(x,t)) of the controls u(z,t). The optimal performance should correspond to the maximum value of the associated density p(u(x,t)). Equivalently the optimal control u*(z, t) should minimize the entropy function H(u).

This is satisfied if the density function is selected to satisfy Jaynes' Principle of Maximum Entropy (1956). The average performance measure of a feedback control problem corresponding to a specifically selected control is an entropy function. Equivalent measures between information theoretic and optimal control problems and provides the information and feedback control theories with a common measure of performance.

Results and Discussions

Dynamic analysis techniques provide a behavior model starting from the description, a transition system such as a oriented graph in which the nodes represent system states and event transitions that cause the change of state. The property that you can study with these techniques they can be either qualitative than quantitative. Among the first they remember the causality between transitions and events, the location where certain transitions take place, the competition of transitions. The study of the causal relationship between transitions (the first causes the second if it is a condition necessary for the second and influences it execution) allows to determine a dynamic model of a process the triggering events and also allows to accurately trace behavior of the shares. Hence the concept of predictive model if through these analysis it is possible to foresee new behaviors. An important property to consider is the competition, that is the possibility for two or more transitions to take place at the same time. Moving on to quantitative properties, remember how transition systems can, with small manipulations, to be interpreted as stochastic processes when the arches are labeled using probabilistic distributions (typically exponential in time continuous).

The main attempts to shape quantitative behavior of agent systems dynamic are based on ordinary or stochastic differential equations, on simulation methods discreet that can refer to the techniques Monte-Carlo, Bayesian networks. Each of the mentioned approaches is able to capture some of the specific aspects of the mechanisms between agents.

Essential to get good results is the validation phase of models using process algebras in order to get from the model all known behaviors of the system considered by applying techniques of analysis. In conclusion it can certainly be affirmed that the dynamic aspects of agent systems are a field of research for early and probably will dominate the scene of the coming years with highly interdisciplinary activities. Indeed, to validate the behavior patterns that lead to predictive techniques is absolutely necessary to interact with the managers of industrial, corporate and community systems to fully understand the results of the analyzes. Hence the need to create an international scientific community that is a straddling the science disciplines of the life and the information sector [3-9].

Conclusion

In conclusion it can certainly be affirmed that the dynamic aspects of agent systems are a field of research that probably will dominate the scene of the coming years with highly interdisciplinary activities. Indeed, to validate the behavior patterns that lead to predictive techniques is absolutely necessary to interact with the managers of industrial, corporate and community systems to fully understand the results of the analyzes. Hence the need to create an international scientific community that is straddling the science disciplines of the life and the information sector.

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