Adaptive Agent's Integration in a New Environment: Interactions as a Source of Learning

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ABSTRACT
In psychology, adaptation is a dynamic process in which behavior and physiological mechanisms of an individual continually change to adjust variations in the environment. Following this logic using a multi agents system, we can simulate the behavior of a person wishing to integrate easily and quickly a new environment using its interactions with the others. Indeed, we consider that information exchanges can essentially be done during the process of communication and interaction. In this paper, we present a protocol-based communication and exchange model for an adaptive agent.

Categories and Subject Descriptors
I.2.11 [**Artificial Intelligence**]: Distributed Artificial Intelligence – *Multi Agent Systems.*

General Terms
Theory, Experimentation.

Keywords
Social learning, adaptation, language, interactions

1. INTRODUCTION
In psychology, adaptation is a dynamic process in which behavior and physiological mechanisms of an individual continually change to adjust variations in the environment. Vygotsky formulated a theory of cognitive development based on a student's ability to learn socially relevant tools (e.g. hands, computers) and culturally based signs (e.g. language, writing) through interactions with other students and adults who have socialized them into their culture [9]. Thus, we can ascertain the learning process from a psychological point of view concerns two aspects: an individual aspect where the acquisition of knowledge is done alone and a collective aspect where learning is strongly influenced by the interactions of the individuals.

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Similarly, social skills might be beneficial to the artificial agents which are expected to interact with other natural or artificial agents in order to learn. When we evoke this idea, naturally, we think immediately about works in robotics, namely, on language learning that has been developed over the last ten years [8], [5]. More and more efforts have been made to try to draw a parallel between the human language and the "artificial" language of robots [6].

On basis of this theory, we have tried to introduce some psychological concepts into multi agents systems, in order to simulate human behavior. For this, we have supposed that an agent, completely novice in a field, wishes to communicate with others to exchange its point of view. Although it is easier for agents to communicate when they use different words that have the same meaning or refer to the same concrete or abstract object [2], this becomes much more difficult when an agent understands few words (i.e. words with different semantic).

The aim of this paper is to present our protocol-based communication and exchanges model for an adaptive agent. In particularly, we have developed three successive steps that an agent must perform in order to integrate a new environment: a first step of "passive listening" to all messages exchanged between agents, a second step of questioning the other agents about the significant of a word heard during the first step and a third step of learning and updating our new agent's ontology.

The remainder of the paper is organized as follows: Section 2 describes working hypothesis employed in the different steps of new agent's integration. And, in section 3, we summarize our findings and outline our future projects.

2. AGENT'S INTEGRATION
Initially, we assume an environment in which several agents communicate by sending and receiving messages, defined in natural language. Also, we suppose a new agent (we call it "learner agent") which wants to integrate this new environment and communicate with the others. Initially, he has a basis of words and a set of words which characterize its ontology. In our approach, we maintain that any new agent has an "a priori" ontology from which it is able to define a given word inside a context. So, its "a priori" ontology can be inadequate and the agent hears some words it is unable to understand related to this ontology. Therefore, it must execute an integration process in view to enhance its ontology. We consider that this integration process is performed in three steps: a first step of listening and monitoring, a second step of questioning and calculating

credibility, then, during the last step, the agent essentially learns new words and concepts and dynamically updates its ontology.

2.1 Step 1: Passive listening of conversations exchanged

In order to have a basic knowledge of the other agents and their roles (i.e. acquaintances) in this environment, the learner agent will, at first, use a process "passive listening" to all exchanged messages. This process can be broken down into two steps:

- **A linguistic analysis** founded on the recognition of the words having for a goal the extraction of new and important words
- **A statistical analysis** founded on the relative frequency of apparition of a word (except "stop words") at the time of the exchanges. This allows us to quantitatively determine the importance of this word for our learner agent. As soon as this phase of listening ends, our new agent has a data base, which contains words with its relative frequency and the name of agents that have pronounced them.

2.2 Step 2: Questioning and calculating credibility by agents

For every unknown word in the base of words, the learner agent is going to try to learn it while questioning the other agents on its semantic and its use (in a first time, it will summarize to define a word's concept). When the new agent questions the other agents on the meaning of a word, three situations can appear:

- The first situation is when a word containing in our learner's base is pronounced by only one agent. Our leaner will question this particular agent on the meaning of the word and will later learn and update its ontology during the third step.
- The second situation is when a word is pronounced by several agents and the definitions given by these agents are in concordance for the learner agent. During the third step, the word is automatically assimilated and the ontology is updated to take into account the new meaning of the word in context, or, if the word did not exist before, it is quite simply added to learner agent's ontology.
- The third situation is when a word is pronounced by several agents and their definitions are in discordance. The learner agent must choose which definition it will take into account and with which agent it will grant the most credibility. To solve this problem, we have made the hypothesis that the new agent can give more or less credibility to the answer given according to the confidence level towards the interlocutor. To quantitatively determine this confidence degree, we have decided to base our proposition on Pléty's study [7] and the formula developed by George [3]. So, our credibility is a value between 1 (equivalent to a weak credibility) and 4 (equivalent to a strong credibility).

At the end of this second step, our learner agent has a base of words and concepts but it must learn all of them and reconstructs its ontology during the third step.

2.3 Step 3: Learning and updating an ontology

We consider that this step is the most important for our learner agent because at the end of this, it can communicate easily with the other agents and find a place in this environment. We think that all research developed in the domain of ontology is very interesting because in successful communication and in collaborative performance of tasks, agreement between different agents with respect to the ontology is crucial or, at least, the agents should be aware of existing discrepancies [1]. So, if agents don't use the same meaning of a word when they speak, a lot of mistakes could arrive and a situation of confusion could ensue. In this step, our objective is to construct an ontology in suitable for the environment in which our learner is located, so that it will be able to understand all exchanged words. Our process of learning is based on explanation based learning because all words learned by our agent are assimilated after it has questions all agents on a word's meaning.

3. CONCLUSION AND FUTURE WORKS

In this article, we have demonstrated how the problems of social learning in a multi agent system can be managed through interactions and communication in a natural language between different agents. We have described how a new agent in an environment can learn different new words using its interactions with the others.

Furthermore, we have proposed model of the integration process of a new agent in three successive steps. To test the utility and the relevance of these diverse steps, we have developed software in Java, based on framework DIMA [4]. We have also imagined scenarios in natural language where each word has its importance in a particular context: chess games, medical domains… In the future, we will continue to investigate how an agent can learn different words if other agents lie and how he can detect this lie.

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