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NEWS

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From Grid'5000 to Aladdin

An interview with Thierry Priol, Aladdin Director and leader of the Paris project team at INRIA Rennes-Bretagne Atlantique.

Following the success of the experimental version of Grid'5000, INRIA is initiating a technology development action to ensure that it attains professional standards over the next four years. Called Aladdin[1], this initiative marks the passage from a prototype to a real tool designed for scientific research.

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INédit : *Aladdin has sprung up in the footsteps of Grid'5000. What are its goals in the short and long term?*

Thierry Priol: The goals of Aladdin, which we are now calling Aladdin-Grid'5000, are similar to those of Grid'5000. This means creating a distributed computing platform intended for use by researchers (see Inédit No. 59 for a full report on Grid'5000). We are nevertheless moving to a higher plane, since Grid'5000 was a trial platform and Aladdin seeks to attain professional standards by increasing their robustness and ensuring its maintenance. This work is critical to developing the infrastructure into a research tool designed to service an increasing number of scientific communities with experimental needs in the field of distributed systems.

This new stage was made possible by INRIA's involvement in this project in the form of a technology development action (TDA). The Aladdin TDA brings together researchers and engineers and is intended to coordinate work done on this widely distributed infrastructure. Grid'5000's other partners (the CNRS, Renater, the Ministry of Research, etc.), as well as new contributors such as the Telecommunications Institute have expressed interest in this approach. The creation of a scientific interest group is today being used to unite everyone's efforts into a common project that would thus enable us to increase the size of the infrastructures.

« In Europe, Aladdin will offer service of unmatched quality »

Our goal over the longer term is to extend the platform to other European countries, especially those that are also developing grids and who have expressed a desire to contribute to the construction of such a tool, such as the Netherlands with its DAS-3 project. A project of this scope, coordinated by France - which has gained considerable experience and much renown in this field, would seem to me to be indispensable to maintaining the pole position we gained with Grid'5000. We are also planning to collaborate on the international level with similar initiatives such as the one recently launched by the NSF in the United States.

INédit : *Will this tool offer researchers the potential to do Cloud computing, a service that has been offered for just over a year now by certain American operators such as Google and Amazon?*

Thierry Priol: Cloud computing represents the possibility of meeting the demand with a set of machines in order to download a software stack ranging from the operating system to the program. This enables users to test their software directly without having to adapt to a specific operating system and middleware. In fact, France is a pioneer in this approach since this type of service has already existed for four years on Grid'5000. In practical terms, from the outset, the project was undertaken with the aim of developing a generic platform capable of adapting to all the research needs of parallel and distributed systems. Nevertheless, the technological solutions developed are different. Amazon, for example, shares the infrastructure ...

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Robots taking baby steps: first lessons

INRIA has just initiated an exploratory activity[1] on a subject that can't help but surprise us: the ability of robots to acquire new know-how...as inspired by theories from child development psychology. This innovative approach defines an emerging field of study called "computational developmental systems", which includes contributions from various disciplines including psychology, biology, mathematics and robotics.

Can you imagine having a robot capable of identifying things, exploring and adapting itself to a new environment while at the same time developing know-how and ancillary knowledge without the help of an engineer? This is a classic image from science-fiction, still a far cry from the current abilities of robots. Although today these machines are indeed capable of learning, this is merely a type of skills acquisition determined ahead of time by their designers. For example, in order for a robot to learn to walk, its designer will set up a criterion for "proper" walking, along with motor and perceptual parameters relevant to this task. The machine will then try to optimize those parameters in relation to the criterion for proper walking. "*These devices are not capable of learning to deal with unforeseen events, and that is why they become fragile as soon as they encounter a problem or a new environment*" notes Pierre-Yves Oudeyer, the person in charge of the Flowers research initiative.

According to this scientist's who spent the first eight years of his career at Sony, artificial intelligence up to now has been based on an approach consisting of depicting and using pre-existing knowledge and heuristics in order to solve problems that we surmise require intelligence. Even though, in historical terms, this has resulted in a number of interesting applications such as systems for automatically proving theorems, no truly significant progress has been made in the ability to confront new situations.

The AIBO robot, developed by Sony, is used by scientists to study how a system of curiosity may enable it to learn about its environment on its own (a) and what the mechanisms are that enable it to learn the names of objects tested in interactions with humans (b).

Self-directed learning

The question still stands of how to create a device capable of learning and evolving on its own. Pierre-Yves Oudeyer has started using an entirely different model, that of early childhood and our extraordinary capacity for exploring and learning at that stage of life. Developmental psychology has long been studying very young children and has built up an entire set of theories on initial learning and the discovery of their own bodies, and of their relationships to the surrounding physical and social environment. This particular scientist is drawing on these theories to try to formalize the concepts involved and use them on robots. "*I got particularly interested in what motivates a human being to investigate and test out his environment. This is what psychologists call 'intrinsic motivation', a term referring to the pleasure found in doing something for its own sake which is also at the root of our curiosity and spontaneous interest in exploring*", explains Pierre-Yves Oudeyer.

Implementing curiosity

How can one endow a robot with a sense of curiosity? One way to do so is to command it to take an interest in new or surprising things. As is already the case in robotics, the machine will learn to predict the consequences of its actions and self-evaluate the level of confidence it has in those predictions. Based on that, it can directly measure the degree of newness of a situation, or the level of surprise if, for example, the opposite happens of what it had predicted with great confidence would happen. One can then create an architecture that explicitly pushes it to investigate those situations. But taking an interest in novelty is not enough to learn in an effective and evolutionary manner. And such

situations still have to be adapted to the robot's capacities. To that end, one can, for example, refine the system by asking the robot to become interested in situations where it will progress quickly, meaning those in which its errors in prediction are rapidly reduced.

This type of architecture produces results from both applied and theoretical points of view that are of interest to the disciplines in question. *"The experiments I conducted at Sony on learning movements and displacement across space showed that a robot can learn a set of skills that are re-usable without its designer having specified them one by one. They also revealed that, in terms of sensorial-motor tasks, a robot builds a model of the world much more efficiently than through the use of traditional exploratory techniques"*, explains Pierre-Yves Oudeyer. *"In return, the application of theoretical concepts derived from psychology and testing them out on robots allow us to make pertinent contributions to certain scientific controversies. Such was the case, for example, of an early work done in the field of language learning. One of my experiments showed that, based on rather basic processes, one can bring about the spontaneous emergence of a culturally-shared system of sounds. That provided key data for contributing to the debate over the innate and cultural aspects of language learning."*


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Guiding learning through language

Learning about one's body and space, which are linked to curiosity and the phenomenon of language, have up to now been studied separately by scientists. The novelty of the work undertaken by the Flowers researchers at INRIA is in linking together these two aspects of learning already innately coexist in an infant. This linking draws on other concepts derived from child development research. We might take the particular concept of "affordance" that guides a baby's learning of the meaning of its first words based on potential actions associated with the objects that are their referents and not simply on the form or color of those objects. A chair is "something on which one sits," a property one learns on his own by trying it out, and the name for which is learned in the course of a social interaction.

This pairing offers the advantage of enabling societal guidance of the learning process which, added to the internal guidance provided by curiosity, allows us to correlate the world constructed independently by a robot with the one constructed by man. These social interactions thus can be used to characterize, in the most natural way possible, the robot's learning accomplishments so that these correspond to user expectations regardless of their environment. This clearly points to the value of prolonged spadework that would turn up many applications in the expanding field of companion robots, that of video games, and the realm of ambient intelligence and communicative intelligent objects.

[1] *Flowers is one of the exploratory initiatives set up by INRIA to promote the emergence of new areas for research. http://www.inria.fr/recherche/ae/index.fr.html*

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among several users thanks to the use of a virtualization technology, which optimizes the use of the machines. This solution provides a response to a number of commercial needs, but its implementation may disrupt user's programs. For our part, we assign one physical segment to one user, on an exclusive basis, which is important for an experimental service intended for researchers. Aladdin will doubtlessly constitute a testing platform essential for facing our many scientific challenges! In terms of fault tolerance, for example, as well as for testing Cloud architectures, virtualization or the search for new service paradigms.

[1] *Aladdin: A LArge-scale Distributed and Deployable INfrastructure.*

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