SGIA – Self Growing Intelligent Agent

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Abstract

We live in a world where the use of agents is getting bigger by day. Each intelligent agent has a list of basic characteristics that must be followed and respected. The aim of this article is to study and create new techniques for an agent to have one more characteristic: that to create, by itself, new services and new functionalities in order to automatically adapt to new challenges or environment changes. In other words, we want to give to an agent the power to create code that will helps it in his purpose – the power of course is restricted by well defined rules.

1. Introduction

Nowadays, the computerized machines / tools are used almost everywhere: from our digital clock to airplanes and cars; they are helping us in doing our job faster, better and cheaper and in same cases tasks that humans are not yet capable in doing them.

After these things that were achieved, the mankind has a bigger idea, a bigger ambition, to make machines (computers) to think for us – an idea that raises many ethical and philosophical questions.

"Artificial Intelligence is a combination of cognitive science, linguistics, ontology, physiology, psychology, philosophy, operations research, economics, control theory, neuroscience, computer science, probability, optimization and logic. AI is a very large subject-matter. It consists of many different fields, from machine vision to expert systems.

The aim of all the fields is the creation of machines that can "think". Researches hope that AI machines will be capable of reasoning, knowledge, learning, communication, planning, perception and the ability to move and manipulate objects."[1]

Every human / machine process fallows a standard or a non-standard flow. We can design for each process a well defined, standard, flow chart.

Our aim, within this article, is to create this new agent characteristic – that through which the agent can grow by auto generating source code and compile it in new modules – based on flowcharts (logical schemes).

Continued on article you will find sections, in the given order, describing: an intelligent agent, the SGIA concept, the Logical Schema Builder (identified also through LSB), the proposed learning, growing, forgetting processes, some security constrains and the conclusions taken after this first stage of research in artificial intelligence field.

2. State of the art

The field of intelligent agents is a vast one and a lot of research was done. Still, what we intend to research and develop is not yet, as far we now, published. This new characteristics is to be build upon the core of a previous developed tool called Logical Schema Builder. This tool is original through idea, design and implementation. The tool core is responsible in translating flowcharts into source code.

So this approach, based on flowcharts, is new in the field.

3. Intelligent Agent

As the science and world expands the amount of information is bigger for humans to handle. A solution for this is to build intelligent systems that can find, filter and process information and take care of a certain tasks for us.

For example, you want to keep track with all the article that appear in different web magazines but you do not have the time necessary to navigate on web to grab the news and read them. Instead of you searching them you can use an agent that search on the web for you favourite magazines and grabs the latest news / articles and present them to you in one place faster than you do.

There some key characteristics of an agent: autonomy, persistence, the ability to interact with its environment, cooperation and learning, communication, pro-activeness and reactivity. Others researchers in the field would disagree these characteristics and/or can prioritize others.

"An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through effectors. A human agent has eyes, ears, and other organs for sensors, and hands, legs, mouth, and other body parts for effectors. A robotic agent substitutes cameras and infrared range finders for the sensors and various motors for the effectors. A software agent has encoded bit strings as its percepts and actions."[2]

4. SGIA – Self Growing Intelligent Agent Concept

SGIA – Self Growing Intelligent Agent – wants to be an intelligent agent that besides its fundamental characteristics has another important one: the capacity to grow and evolve form a small to complex online entity.

The process of growing wants to be more human like, meaning that the agent will have, besides the common agent's functionalities, the next functionalities from which some of them are common to all agents and other not:
- capability to learn by observing, learning and experiencing;
- capability to adapt to different environments;
- autonomy and persistence over time and space;
- sociability – will be able to interact with other agents and communicate with them even if they spoke a different "language"
- capability to literally grow in size and knowledge, meaning: capability to develop new skills and ways to lean and interact with different agents and environment.

5. The Logical Schema Builder

The Logical Schema Builder is a software tool through which flowcharts (logical schemes) can be designed, analyzed and translated to source code (for now only to Java or C# is supported).

Through this tool you can perform the next operations:
- to design flowcharts through the specialized graphical editor
- to transform from flowcharts into intermediary code and validate it
- to transform from intermediary code into virtual machine scripting language
- to compile the generated virtual machine scripting code
- to generate source code – Java, C# - from scripting code

The LSB tool is original by design, idea and implementation. Out there on the market are only translators from source code to flowcharts but not vice versa.

These designed flowcharts can be stored either as Xml files or into specialized tables.

By using the current LSB version, you can define all the statements defined within a method. For the next version the tool is to be extended in order to support also the definition of classes (a UML like approach).

Also the LSB scripting language is to be extended in order to create a standard common growing language.

6. The growing and learning process

The growing process is a time-consuming and slower process. A person can grow in knowledge and in size. We saw, in the previous section, that also a machine can grow in knowledge through different, most human-like, ways of learning; but are a little process in growing in size.

Definition 1 *The growing process is a process through which an intelligent agent can develop new services, new functionalities by itself, for it to have a better reactivity to the environment.*

For example: an agent is first developed to do a certain functionality, let say to read newspapers for you and bring you only those articles in which you are interested. But in time you need more from you agent, to read also blog entries. So, for this new functionality you have to define and implement new logic, new processes into that agent.

We know that an agent can learn and take decisions using different techniques and algorithms. My study is to research and find the better technique to be applied to an intelligent agent for it to learn to create – design, implement – different modules in order to support a wide area of functionalities.

By adding also this capability, we have then an intelligent agent that can think and take some decisions, growing both in knowledge and in "size" – in functionalities.

We can design any process into a flowchart. (i.e. the common coffee maker flowchart).

The SGIA will have a specialized module through which any process is to be defined, step by step, into flowcharts. These flowcharts are to be stored into a huge knowledge repository.

The SGIA will also use the common learning approaches but will try to translate the acquired knowledge, if are processes or actions, into flowcharts.

After the processes flowcharts are defined, the LSB (Logical Schema Builder) core is to be used in order to generate the source code in order to materialize that process and to create support for it.

The optimized LSB core will read, interpret and process any defined knowledge synapses. These synapses are to be created between two or many flowcharts that are used to describe a complex process.

Besides this module, the SGIA will have also templates which will facilitate the support generation and creation of new functionalities.

7. The forgetting process

As we described in the previous sections, the growing and learning process will form a huge knowledge repository.

In order to optimize the memory consummation we introduce the forgetting process.

As human forget the information that is no longer used for a period of time also the SGIA will "forget" the new gained functionalities if they are no longer used more than X% during Y days.

The forgetting process is defined as:
- An SGIA will forget the gained functionalities by disabling the functionality support module, remove it from memory, archive it and creating a reference to it.

Those references shall be used, by the agent if, and only if, an old functionality is needed and the module must be recalled.

This "recall" mechanism will reduce the time necessary for loading the new functionality.

8. Security constrains

Security constrains are to be taken in order to limit the growing process and knowledge repository access.

The knowledge repository access is to be made upon a SGIA-P (SGIA Passport). The passport shall be formed from a unique identifier, IP address of the agent host plus others attributes.

The growing security constrains are to be defined first by the creator and secondly by the end-user through a specialize rules.

The search about these rules is only at an incipient phase so for now we can not specify well-defined rules.

9. Conclusions

The SGIA – Self Growing Intelligent Agent – is a new approach on how intelligent agents can be more adaptable to environment changes. Through more adaptable we understand the fact that besides well defined learn techniques the agent should have also other characteristics: that to write (develop, implement) itself services / functionalities for a more reactivity and for growing not only in knowledge and also in skills.

The learning and growing process is based upon the LSB (Logical Schema Builder) core which will be extended in order to support the future defined common growing language.

The services and new functionalities are to be generated by the LSB core respecting well-defined templates. If there are no templates defined the agent shall try to generate support for the new functionality based on it's previous experience and after given a high level of trust it can standardize that approach and create a template and publish it to the knowledge repository for others to use.

The next steps of research is to standardize the common growing language, to extend the LSB core for support the language and standardize also the growing, learning and forgetting processes.

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