DESIGN OF A BELIEF MAP AS A REPRESENTATION OF AN ALGORITHMIC KNOWLEDGE PROFILE

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SUMMARY

CARINA is a metacognitive architecture for cognitive agents that have an algorithmic knowledge profile that is a profile that has the local state of a cognitive function in the form of local algorithmic states. The semantic representation of knowledge is essential to achieve a mechanism that protects the information that a cognitive agent gathers from the world and from himself. This article presents a semantic representation of an algorithmic knowledge profile; this semantic representation in the CARINA architecture is necessary to identify the information found in an algorithmic knowledge profile and thus be able to access it for the location of reasoning failures. Subsequently, a Profile of Algorithmic Knowledge is presented in the form of belief that is the minimum unit of declarative knowledge in the semantic memory of CARINA.

Key words: Profile of Algorithmic Knowledge, Knowledge Semantic Representation, Beliefs, CARINA cognitive architecture.

I. INTRODUCTION

The semantic representation of knowledge is a type of representation that tries to model the available knowledge using tools that formally symbolize concepts that are part of a field of study [1]. The semantic representation of knowledge handles lexical resources to represent knowledge through methods and mechanisms that consist of developing a specific type of software [2].
According to [2], the characteristics of a system of semantic representation of knowledge are the following: i) Purpose: which is the source of knowledge and modeling mechanisms; ii) Source of knowledge: unstructured or semi-structured; iii) Method: Components of knowledge representation (semantic networks, beliefs, etc.).
A belief is the minimum unit of declarative knowledge that an agent has about his environment [3]. Beliefs constitute the knowledge that an agent has about him and other agents [4]. In this article, beliefs will be used as a method of representation of semantic knowledge.
According to [5], a cognitive architecture is a representation of the human mind that has an intelligent agent allowing it to compute behavior simulations computationally. A metacognitive architecture provides a specific approach to the specific modeling of processes in an AI agent for a higher level of reasoning about itself [6], [7]. CARINA is a metacognitive architecture of artificial intelligent agents [8]. CARINA focuses on self-regulation and metamemory with the help of metacognitive mechanisms for introspective monitoring and control at the metalevel [6]. An algorithmic knowledge profile (AKP) is a profile that contains the local state of a cognitive function in the form of local algorithmic states of an intelligent agent [9] AKP in CARINA is used to monitor cognitive function taking into account all input data [8]. This AKP is stored in the Self Model of CARINA and has updated data on the cognitive functions that are executed at the Object Level [9].
In CARINA, semantic memory represents knowledge in the form of beliefs, allowing this metacognitive architecture to store and relate the

information of the world and about itself.
Currently, the CARINA metacognitive architecture executes algorithmic knowledge profiles in its own model using its working memory, but CARINA has no mechanisms to store them in its semantic memory. For this reason, the contribution of this document is to show the Semantic Representation of a Algorithmic Knowledge Profile that allows these AKPs to be permanently stored in the CARINA Semantic Memory.

II. BELIEF AND THE STRUCTURE OF A BELIEF

According to [10] Semantic memory can consciously store and declare knowledge, because it is a type of long-term memory. It is organized by beliefs, which are constantly processed in the Working Memory.
CARINA's semantic memory stores the information it receives from the world in the form of beliefs and links them with other beliefs. Beliefs are simple structures of explicit knowledge that help metacognitive architectures to represent declarative information about their environment and their own reasoning [11]
Belief is represented as follows:
$\beta = \langle I\,S\,A, H\,A\,S \rangle$
Where $\beta \in B$ and B is a set of SMU, with:
ISA is a set of fields, where $f \in ISA \wedge f \in B \wedge ISA \neq \{\}$.
HAS is a set of fields, where $f \in HAS \wedge (f \in B \vee f$ it's a basic data type).
In the formula, β is a semantic memory unit (SMU) that is the minimum unit of information that a cognitive agent (based on CARINA) stores in its semantic memory [3]. Semantic memory units are elements that are extracted from knowledge after it is 'calculated' [12]. An SMU has several ISA fields; Therefore, it is necessary to know the context of each of the semantic memory units to disambiguate the semantic relations within the declarative memory and the HAS fields refer to the relations of descriptive fields [3]. A belief is made up of two essential parts: i) ISA Field: specifies the category to which a belief belongs and that is directed to other beliefs that are stored in semantic memory; ii) HAS Field: refers to the other fields that determine these particular beliefs.

```
"dog":  {
 "is a (TypeSMU)": {
        "CGR"
  },
 "has":  {
            "gender": "male",
            "number": "singular"
            "type": "SUS"
  }
```

Fig. 1. Representation of a belief

The belief represented in the figure shows the semantic knowledge that CARINA has about a dog. The dog's belief has two components: "is a" and "has." The dog's belief is of the SMU type, it is also a grammatical category and has the following fields: male gender, a singular number and a type of grammatical category that is substantive ("sustantivo" in Spanish) A memory network is one that is structured by nodes and links between those nodes and each node represents an SMU [12]. In the CARINA metacognitive architecture, each SMU is a belief. As evidenced in the example, each of the nodes is related to another, forming connections between them, thus developing the web of beliefs. The semantic memory of CARINA is structured by a network of beliefs in which declarative knowledge is based on the relationships between beliefs. A belief network is a useful instrument to represent knowledge [13]. Organize the knowledge that comes from the environment and build relationships with other knowledge [3].

Figure (2) shows a segment of a Belief Network that represents a small part of the declarative knowledge stored in CARINA.

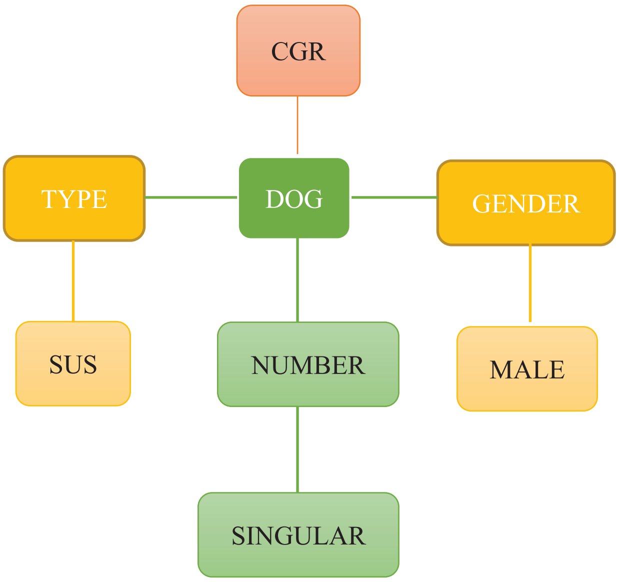

Fig. 2. Represents a Network of Beliefs

III. ALGORITHM KNOWLEDGE PROFILE

An algorithmic knowledge profile (AKP) is a profile that maintains the local state of a cognitive function in the form of local algorithmic states [9]. An algorithmic knowledge profile controls all the input data of each of the cognitive functions. The AKP saves and updates the data in its own model taking into account each cognitive function that is executed at the object level. [9] An algorithmic knowledge profile controls all the input data of each of the cognitive functions. The AKP saves and updates the data in its own model taking into account each cognitive function that is executed at the object level.

An algorithmic knowledge profile is structured as follows:

A profile (P) of a cognitive function (χ) consists of a set of data λ, a set of algorithms α and a feeling of trust ν.

Where λ represents the local state of the system with respect to an object-level cognitive function.

Según [9]; [8], this set of data λ is the set of values related to the development and performance of cognitive function (χ). The formal representation of this data set λ is presented below:

λ= {ID, B, E, S, C, IP, OP, σpre , σpost, γ, zγ, år, SD},

With: ID is the identifier of the cognitive function.

B is the initial timestamp of cognitive function.

E is the terminal timestamp of cognitive function.

S is the state of cognitive function, s ∈ S and S = {active, inactive}

C is a priority level to focus attention, c ∈ C and C= {low, medium, high}.

IP is the set of input parameters of cognitive function.

OP is the output of cognitive function.

σpre is the preconditional mental state to execute cognitive function.

σpost is the postconditional mental state generated after the cognitive function is executed.

γ is the objective of cognitive function.

zγ is the set of sub-goals that belongs to the main objective of cognitive function.

år It is a set of rules that were triggered to achieve the main objective of cognitive function.

SD is a sequence of states that has been modified by sub-goals that belong to the cognitive function.

The set of algorithms symbolizes the behavior of a cognitive function, having as input a local state, in a time interval [9]. Given a local state <λi, αi, νi> in Pχ, the following possibilities can be found*: i) αi = {}, ii) αi = {a1}, iii) αi = {a1, ..., an},* con *ai* It is an algorithm.

IV. BELIEF MAP

It is essential to develop a Semantic Representation of an Algorithmic Knowledge Profile because the CARINA metacognitive architecture needs to store the local algorithms of each of the cognitive functions in its semantic memory so that it can recover the information acquired at any time, these Knowledge Profiles Algorithmic should be stored in belief networks as they provide access to cognitive function data for future metacognitive processes that CARINA can execute.

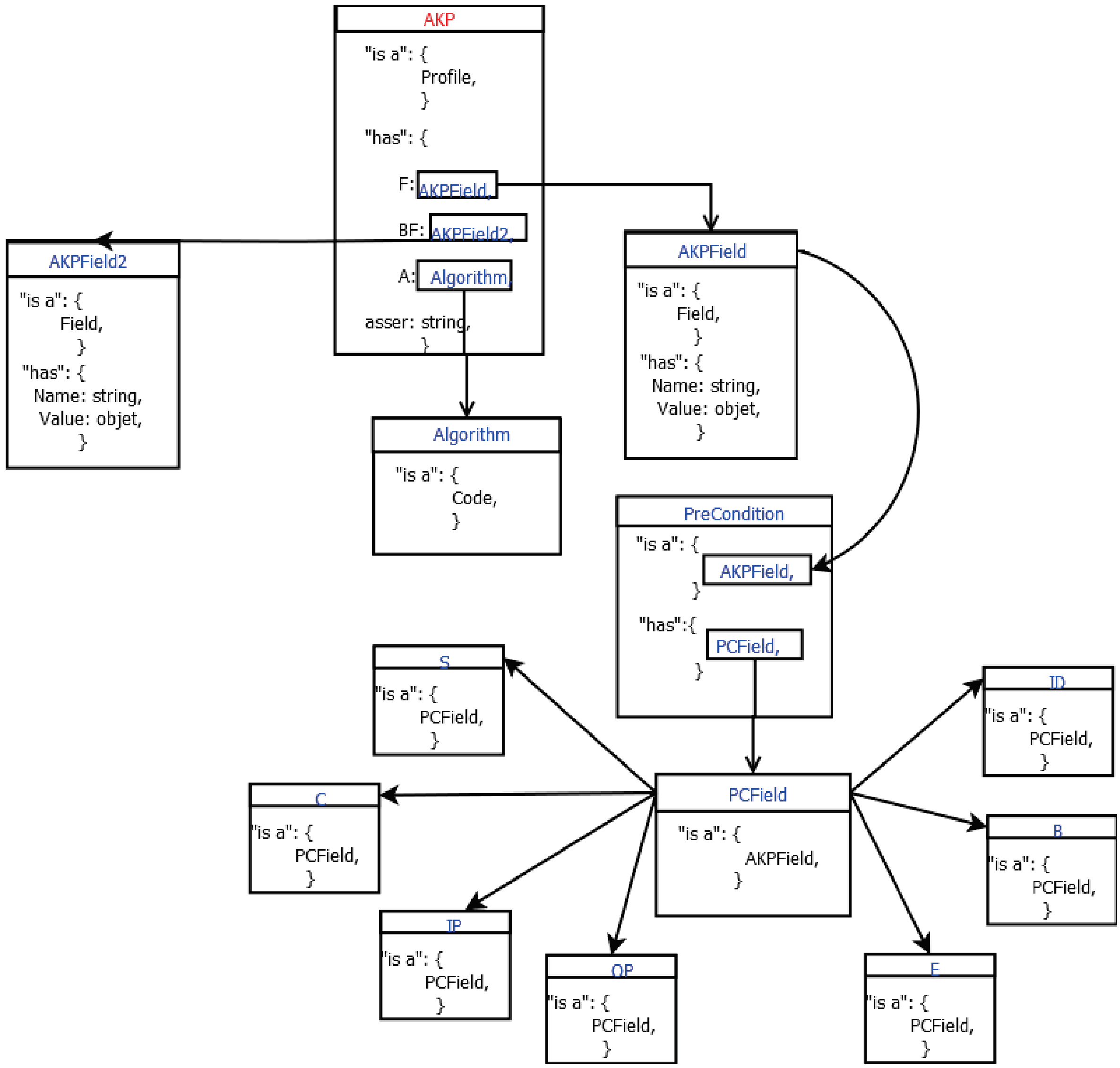

Fig. 3. The Representation in Semantics of an Algorithmic Knowledge Profile (AKP) in CARINA.

The belief network represented in Figure (3) shows the semantic representation of an algorithmic knowledge profile (AKP) in CARINA. An AKP is a profile, which has three fields in it *has* element: i) F of type AKPfield, ii) BF of type AKPfield, iii) A of algorithmic type. The AKPfield belief constitutes a type of abstract data that classifies the fields in which the AKP is structured, therefore, it is a type of field and has a name and a value, in this way most of the fields to which it belongs The AKP are classified within the AKPfield belief, it has ID, which constitutes the identifying number of each cognitive function that is collected in the AKP of type AKPfield, it also has the information of that cognitive function; The precondition is of the AKPfield type and has a field in its element that is of the PCfield type, this PCfield is of the AKPfield type and has the following data: function status, start time, end time, identification, parameters and data output . Subsequently there is an algorithm that is of the algorithm type and has only one field that is of the code type.

V. CONCLUSIONS

An algorithmic knowledge profile (AKP) maintains the local state of a cognitive function as local algorithmic states; this algorithmic knowledge profile is responsible for monitoring cognitive functions according to the input data. In CARINA, semantic memory is constituted by a network of beliefs. A belief is a simple structure that has the declarative knowledge that an agent receives from its environment, this belief has two components: i) is a, ii) has. The semantic representation of an AKP is made up of an F field, which belong to the fields corresponding to a cognitive function, among these is an ID that is an AKP field, an AKP field that has a precondition, this precondition has a PCfield field that indicates the status of the function, the input, the output, the parameters and the data output. This semantic representation of knowledge is necessary to have a mechanism that stores all the information found in the CARINA self-model and that is executed in its working memory. For future work, this research continues to use this information that is now stored in the semantic memory of CARINA to be able to access that information at any time and thus develop mechanisms to detect reasoning failures that CARINA has had in the past.

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