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AN APPROACH TO A MULTILEVEL REPRESENTATION SCHEME

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ABSTRACT

In this work we study the relationships between two different bodies of knowledge one being the representation of the other, and the nature of such relationships.

We propose a multilevel representation scheme R*; and the definitions of "Reproduction Form" between two bodies of knowledge with the aim of clarify the nature of the relationships between them.

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0. INTRODUCTION

Knowledge Representation (**KR**) in Artificial Intelligence systems has been understood as an enterprise of developing and realizing new representational schemas and notations such as semantics nets, procedural representations, frames and scripts, etc. **/MINS75, MYLO80, SCHAN75, ZADEH81,82/**. This research has led to some controversies such as procedural/declarative approaches.

We focus the attention of this work to elaborate some reflections on a selected aspect of **KR**, specifically the study of the nature of the relationship between two different bodies of knowledge one being a representation of the other.

We propose an analysis methodology of reality based on Wittgenstein's **Philosophical Investigations (PI)** and **Tractatus Logico-Philosophicus (TLP)**, and in the improvement and implementation of the model proposed by Furbach et al **/FURB84/**.

1. ANALYZING REALITY

Let **M** be the universal set of all events of given reality; and **R** a definition process (or processes) of objects and structures of **M**, which allows their interpretation. **M*** contains the set of logical images of **M** (as in **TLP $2.18, 2.19**), this will enable to formalize a logical analysis of the relationship between **M** and **M***.

Let **R*** be a set of processes and definitions in **M** which enables to represent the events of **M**. We will call R^* a

Representation Scheme. The application of a transformation (c) to **R*** allows the interpretation of the represented events of **M**. Then our model of a Knowledge Representation System has the form: **(M,R,M*,R*,c)** as has been proposed by Furbach et al **/FURB84/**.

Let **I** be the set of all possible images of **M**. In this context, we will accept an image as a model of an event of **M** (**TLP** $2.12). The relation between the elements of the image enables its existence, the existence of this relation gives a structure, called **image's structure** (TLP $2.15). It is possible to think in the image's structure as the coordination relation between an image and an event of the reality **M**.

Let us call this the **reproductive relation (TLP** $2.153,2.1514). The reproductive relation allows the representation of the existing properties of the objects and the relations between them in an event E_1 of **M**. We will call the **reproduction form (c)** to that function which allows to relate an event E_1 of **M** with an image e_1 of **I** (**TLP** $2.17,2.172).

It is possible to extend this analysis to the propositions of natural language. Let **P** be the set of all propositions of natural language with a correct syntactic and semantic structure. A proposition P_1 of **P** is an image of **M** (as in **TLP** $4.01), then all that a proposition communicates about an event of **M** is its **reproductive relation** (**TLP** $4.03); this is the fact that a name corresponds to an object, another name corresponds to another object and the relation between them in an event of **M** (**TLP** $4.0311).

The sets **I** and **P** are subsets of **M*** then a proposition r_1 of **R*** could be used to represent an event of **M** that is, we are interested in refering R^* in such way that R^* contains the possibility of using the propositions of use the propositions of P and the images of I to describe indistintay some event of M, withan image or a proposition (see figure 1).

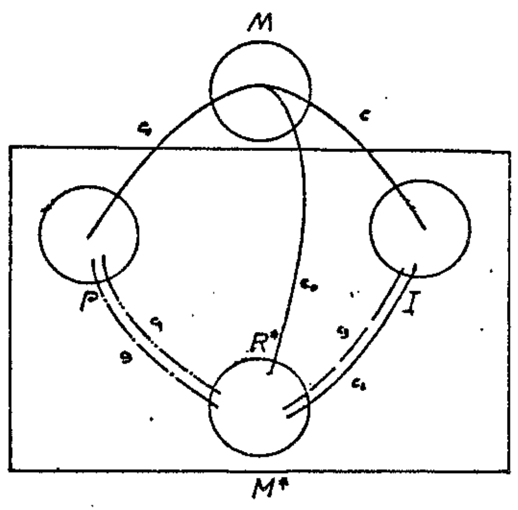

FIGURE 1. THE STRUCTURE M^*

2. A MULTILEVEL REPRESENTATION SCHEME

The structure (M,R) provides a complete determination of types or objects and relations which are defined in M. The existence of this structure brings the opportunity of tailoring specific representation systems.

The structure (M*,R*) is a set of processes which enables the representation of the events of M. In R* we group a set of structure of this kind:

Image of E_i::=(<name of E_i>(<name>
(<name><relation><name>)
(<name><relation><name>),...,
(<name><relation><name>) NIL)) (1)

and the set processes to classify those structures.

The CDR (**Image of E_i**) corresponds to the reproductive relation. This structure is used to construct a hierarchical representation structure M^* of a particular world M (Figure 2).

```
                  M_*
                   |
     |-----------PARTITIONS--------|
     |                             |
CLASSES-OF-SCENES                  |
     |                             |
   SCENES                 CLASSES-OF-OBJECTS
     |                             |
  OBJECTS                       OBJECTS
```

FIGURE 2. R^* THE STRUCTURE OF M^*.

he **<relation>** between objects is in this particular case a spatial relation. Note that the introduction of the null element **NIL** is due to computational reasons. Each **<name$_i$>** corresponds to an object and its general form of representation is as follows:

<object>::=(<name>,(<physical descriptors>)
(<linguistic descriptors>)) **(2)**

the equations (1) and (2) are general structures, for a complete definition see **/CORT84/**.

2.1. MULTILEVEL CLASSIFICATION

The implementation of a set of processes which enables a machine to construct a particular set of representations of **M**, is the implementation of a **R*** structure. This requires the creation of a specific taxonomy of **M**, as showed in figure 1, and the processes of obtainment, classification, identification and transmition of the information contained in a particular model of reality as an image or representation proposition.

In a particular structure **R*** we can choose as the basic elements the equations (1) and (2). Departing from the study of (2) it is possible to construct a hierarchical representation structure. The first step is to group **<objects>** with common features into a **<class-of-objects>** with the form:

<class of objects>: = (<name>,(<nucleus>),
(list of components)) **(3)**

where **<nucleus>** is the minimal set of common features which permits to classify an object into a given class. The

classification process consists in a set of predicates that works testing the values of the **physical** and **linguistic** descriptors.

The idea of **Class** of has been introduced in order to reduce the searching effort in the process of identification of one structure. **/see FREK81/**.

It is possible to use the **Image** of E_i (1) as a single object and apply the process of classification to the set of images of **M**, the resulting structures the **Classes-of-images** can be used as new objects too. The resulting is **R***, and it is possible to tailor an specific representation structure as in **/CORT84/**.

3. CONCLUSIONS

R* is a general **KR** structure which permits the manipulation of images, propositions or both. The representational **propositions** of **R*** are more general than the proposed by López **de Mántaras /LOPEZ80/**. Our proposition of general **KR** systems **satisfaces** all the theoretical requirements described by Furbach **et al /FURB84/**.

With our representation scheme **R*** it is possible to analyze separately the operations of common reasoning and the operations of representation. This structure can be used as a critical instrument in the study of other schemes.

The notions of **reproduction form** and the **reproductive relation** aim at the clarification of the nature of the relationship between two different bodies of knowledge in the context of general **KR** systems.

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FUZZIFICATIONS OF CRISP CONCEPTS

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ABSTRACT

In this paper the Representation Theorem and the Fuzzification Principle are studied in relation with Operational Research problems as tools to the fuzzification of crisp concepts. It is shown how using each of these tools, different fuzzy concepts may be obtained from a same well defined classical Operational Research concept. Alternative formulations of Fuzzy Mathematical Programming problems and Fuzzy Games are proposed too.

Key Words: Representation Theorem, Fuzzification Principle, Fuzzy Graph, Fuzzy Mathematical Programming problem, Fuzzy Games.

INTRODUCTION

Great part of material studied within the field of Fuzzy Sets and Systems has not developed naturaly through observation of real events but, rather, arising on the eagerness of fuzzifying well known classical concepts. Avoiding entering in the convenience or not of such process, it seems certain that often different path has been followed for fuzzification of the same concept. Its reasons are easy. On one side, the youth of the body of the matter involved, fundamentaly. On the other, the great development and interest aroused -

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