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Terminology and Artificial Intelligence

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Artificial intelligence research pursues the aim of providing the necessary tools for the creation of knowledge based systems, such as expert systems which offer immediate access to expertise and other cognitive capabilities stored in machines. Such systems usually have a high storage capacity for general background knowledge. Besides the surface structure of facts there is a deep structure of concepts which provide access to the entire system. This means that terminological principles have to be observed. Furthermore terminologists also draw great benefit from AI research when building up terminological data banks. They can utilize intelligent user interfaces to represent complete concept systems and to facilitate browsing in such a bank. A new generation of interactive software is introduced in this article which can be easily tailored to terminological needs. (Author)

1. Introduction

Intelligence is the ability to solve problems. Artificial intelligence can be defined as the science of the acquisition, representation and utilization of knowledge by machines. It is applied in the development of knowledge banks, particularly in the design of query systems.

The architecture of artificial intelligence systems is logically and symbolically and not numerically oriented as it is the case with traditional data processing. Particular emphasis is laid upon the relationships between the various units of knowledge. One type of these units of knowledge are the concepts with the terms assigned to them.

In his Terminology Manual, Helmut Felber states the following about the relationship between artificial intelligence and the General Theory of Terminology (GTT): "Since the studies in artificial intelligence and the establishment of expert systems have to deal with concepts, systems of concepts, concept linking, conceptual mapping of reality etc., a stronger affinity between the GTT and computer science is to be expected in the near future." (1).

2. Fundamentals of AI research

The difference between human and artificial intelligence lies in the fact that the latter has to transform all of its tasks into two elementary "mental" processes:

(1) comparison on the basis of identification and analysis of available data.
(2) synthesis according to patterns and rules.

These two operations can be applied when tackling the following tasks:

- decomposition, i.e. splitting of characteristics of the same rank
- filing, i.e. arrangement according to dissimilar characteristics
- abstraction, i.e. selection of essential characteristics and omission of inessential characteristics
- reduction, i.e. omission of irrelevant and equivalent characteristics.

These tasks can be performed by machines and constitute the operational framework of knowledge banks. The determination and recording of characteristics is an essential part of systematic terminology work.

In linguistic data processing it is necessary to abide by certain conditions which are set by the strictly logically oriented operation of machines. This is of particular relevance for the semantic level of the language.

D.F. Robertson points out that these limitations constitute a particular challenge to AI-research: "Originally, AI research proceeded on the assumption that it might be possible to endow computers with symbolic reasoning capabilities similar to those of the human mind by isolating a few fundamental laws of logic, destilling those laws into sophisticated software systems and linking their operation to powerful computers." (2).

This is still a particular challenge to researchers in artificial intelligence who have to co-ordinate and adapt the large number of linguistic, communicative and cognitive abilities in an effective way. But the prize is worth the effort: if they are successful, they can achieve a much higher accessibility of knowledge than in the case of conventional data bases and data banks where titles and texts of papers have to serve as intermediaries.

With regard to semantic abilities there is one major difference: digital machines can only process structures, "meaning" has to be structured therefore. This approach has already been developed by the General Theory of Terminology irrespective of any computer application. Meaning is represented in form of concepts which are parts of systems of concepts.

The forerunners of strict concept systems in knowledge representation are the socalled "semantic networks" which should be correctly named "associative networks" (3).

In knowledge banks one encounters both fixed concept relationships and socalled associative relationships. The later play a very interesting role and can be described as "coming across interesting information" or as simple "browsing". A direct access to the various categories of knowledge is only possible via concepts which are in relationship to each other or have some other kind of linkage. This means that terminological principles have to be observed.

3. Knowledge representation

Hayes and McCarthy (4) divide „knowledge" into two distinctive sections: 1) the epistemological knowledge which consists of data in specific data structures and 2) the heuristic knowledge, which describes how the data has to be handled. Concepts would fall under category 1) and terminological principles under category 2).

As a consequence of the fact that systems become more "intelligent" and perform more demanding tasks, there is an increase of ambiguous meanings or contradictions within the special language used. This requires explanatory dialogues between systems and users, in order to elucidate for instance why the systems has come to a certain conclusion and what the user could do if

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he is not satisfied with a certain result. Seeing this problem from the terminological point of view one can say that especially definitions and explanations contribute considerably to the transparency of a system.
H.J. Levesque mentions a further advantage of definitions and justifies terminological access systems to knowledge representations as follows: "Why should a representation scheme that is interested only in expressing knowledge about a world have to deal with statements that carry no information? The answer, I believe is that definitional mechanisms facilitate the interaction between a user (man or machine) and the KB. The addition of terminology is not a matter of truth of falsity but a matter of convenience to the user. In particular, the definitional mechanisms of a language should help structure and should organize what eventually will be said or asked about the world." (5).

Thus the following preparatory work has to precede the creation of a knowledge bank:

1) an investigation of the structure of the respective subject terminologies and their applicability in a modified form as documentation languages.
2) the selection and further development of universal and hierarchically structured ordering systems.
3) the development of computer programmes for a user-oriented and automatic reshuffling of knowledge-units. Implicitly contained knowledge has to be made explicit by generating references and indexes. This is the case in information extracting and condensing systems which have the capability to "comprehend" machine-readable texts and to extract relevant information. Such capabilities are particularly important for automatic abstracting and machine translation.

Eugen Wüster has developed practice-oriented methods for conceptual ordering and economy. Especially the relationships between concepts can be used as signposts for tracing knowledge units in a bank. Furthermore they facilitate the following functions of machines with artificial intelligence: classification (structuring), condensation, abstraction and association.

All these functions are directly dependent upon the type of characteristics which determines the criteria for subdivision and creation of schemes. It also allows purpose-oriented abstraction which has a screening function and is a prerequisite for the operation with relevant data only (6).

4. Expert systems as a practical application of AI research

Expert systems are knowledge-based systems which provide immediate access to expertise and other cognitive capabilities stored in machines. Expert systems can be distinguished from traditional information systems on grounds of their inference functions and their storage capacity for general background knowledge. They are designed for heterogenous and complex subject fields rather than for homogenous and mass data and serve as interactive advisory units. For this reason it is necessary to use adequate access mechanisms such as structured terminologies and concept systems. The essential aspect in this matter is not so much the contents but the structure of the data, i.e. the relationships between the data elements. Besides the surface structure of facts there is a deep structure of concepts which provide access to the entire system.

The role that artificial intelligence research has assumed in this matter is explained by D.F. Robertson: "When computer reasoning power was found to be a function of intensive knowledge about a limited domain of facts and heuristics, the focus of AI research naturally shifted to the development of expert systems possessing an enormous quantity of highly structured information about a well-defined set of problems." (7)

This is a very important task, because only structured and categorized knowledge is of use to the expert. It goes without saying, that these complex processes have to be investigated very thoroughly and have to be made operational for the respective field of application. It has to be emphasized, however, that the further development and full implementation of the General Theory of Terminology will enrich the spectrum of possible solutions and will guarantee the practice-orientation of this interdesciplinary field of research.

5. Intelligent user interfaces for terminology

The crucial point in establishing a knowledge bank is the selection of an adequate database management system. The development in this field is quite rapid and one can say that there is a general trend towards more user-friendliness.

Michael Stonebraker summarized the requirements for user-friendliness as follows: "Hopefully, the next generation DBMSs (database management systems) should be noticeably better than the current ones. I would like to see DBMSs that deal much more intelligently with complex objects (e.g. forms, maps, icons, etc.) and relationships (e.g. generalization, inheritance, and associations)." (8).

It is typical for many advisory or consultancy situations that the expert does not only draw upon his own expertise but also on external databases which contain formated mass data and which cannot be part of his own memory. It is now up to the skill of the consultant to combine these two sources in the most efficient way and to interpret the stored facts on the grounds of his expertise. If these functions are to be carried out by a knowledge bank, it is necessary to develop specific aids for user guidance as can be seen in teletex and videotex systems.

Users usually judge their database by the capabilities of the user-interface. Therefore it is very important to give this aspect sufficient consideration.

Artificial intelligence functions are of particular importance for the creation of user-interfaces, i.e. the software that mediates between a person and the programmes shaping the system into a tool for specific goals. The specific task that has to be kept in mind in this context is terminology work in general and as an access function to expert systems in particular.

The user of such a system should be confronted as directly as possible with the network of concepts. This can be facilitated by means of a dialogue which points out the possible relationships to other concepts or subjects.

Artificial intelligence research has given rise to a new

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generation of interactive software which are offered to the customer as "windows", "menues", "icons", and "pointing devices". The display frames called windows make it possible to present a number of activities on the screen at one time. Menues of possible next steps are displayed; icons represent objects as concrete images. A pointing device (sometimes called a mouse) is pushed about to move a pointer on the screen and thereby select particular windows, menue items or icons.

A combination of all these devices can be found in a simulation kid called "dynamic spreadsheet" which has a remarkable degree of direct leverage for the user and which is ideal for terminological purposes. Spreadsheets are a common tool in accounting and are usually organized into a rectangular array of cells. Each cell can be imagined as having several layers behind the sheet that determine the format of the presentation. Each cell has a "value rule" specifying how its value is to be determined. Every time a value is changed anywhere in the spreadsheet, all values dependent on it are recomputed instantly and the new values are displayed either as numbers or as pieces of a text. Among the multiple applications of spreadsheets there is one which is of particular interest to terminologists: it is the interactive browser. Browsing is an efficient way to access hierarchically organized data files, such as concept systems, by pointing to successive schedules each representing a different level of abstraction. The generic concept is typed into the first pane of the display causing the specific concepts of the first layer of abstraction to be retrieved and displayed in the cells below it. One of its concepts can be chosen by pointing to it with a mouse. It is then automatically entered at the head of the next column causing its subordinate concepts to be retrieved. So it goes on until the desired concept is reached. By activating the appropriate latch cell, a definition and adequate factual data can be retrieved as it is examplified in the illustration below (9).

As regards software engineering, the entire concept browser can be programmed in the spreadsheet with just three rules. It is certainly a design for an interface which confers direct leverage and which enables users to tailor concept and expert systems to their wants. It is one step towards the creation of an interface with some semblance of artificial intelligence by giving the user the appropriate cues that direct him into a particular context step by step. A hierarchial approach simplifies this procedure considerably. The General Theory of Terminology on the other hand provides the principles and methods for the hierarchical structuring of language and thinking. The protean nature of the computer is such that it can act like a language to be shaped and exploited once the rules are laid down because it is a medium that can dynamically simulate the details of any other medium including media that cannot exist physically such as conceptual thinking.

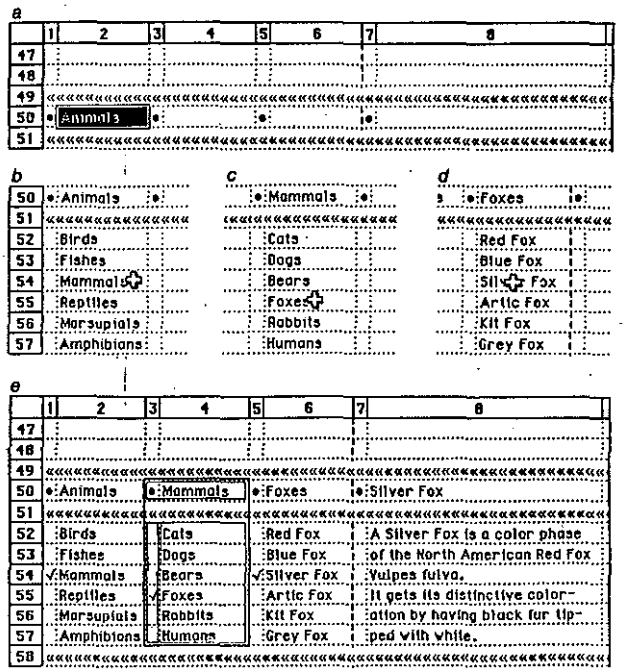

Abb. 1

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