A LOGIC-ORIENTED ATN

Grammar Knowledge as Part of the System's Knowledge

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The system BACON (Berlin Automatic COnstruction for semantic Networks) is an experimental intelligent question--answering system with a natural language interface based on single sentence input[1].

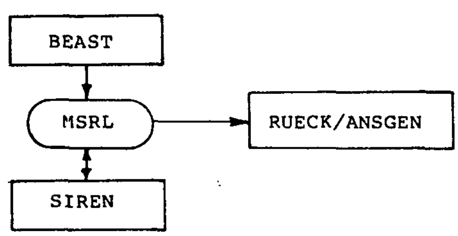

Figure 1: Structure of the BACON-system

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[1] This system has been developed in the project "Automatische Erstellung semantischer Netze" (Automatic construction of semantic networks) at the Institute of Applied Computer Science at the Technical University of Berlin. The project was supported by the Ministry for Science and Technology (BMFT) of the Federal Republic of Germany.

Explanations of the systems structure:

- **BEAST** - "BErlin Automatic Semantic oriented Translation" is the language understanding component[2]
- **SIREN** - "SemantIc REpresentation and Net evaluator" is the knowledge base management component
- **BACK** - performs the retranslation of the semantic representation into natural language to check correctness of understanding
- **ANSGEN** - "ANSwer GENerator" translates the system´s reactions into natural language
- **MSRL** - "Modal Semantic Representation Language" is the representation language of the BACON-system and therefore the center of the whole system.

The syntax of MSRL is recursivly defined following the principles of common logical languages. The basic (finite) set of operators is devided into two disjoint subsets:

- termmakers are operators which describe objects of the world of discourse. They include the term variables.
- formelmakers describe the relations between these objects, between formulas or between objects and formulas.

An operator with its (possibly empty) list of arguments constitutes a well formed MSRL-expression.

A very important concept of MSRL is the concept of sorts. The set of sorts (proper names of sorts) induces a partition of the set of terms. A partial ordering called "compatibility of sorts" induces a lattice structure on the set of sorts. By assigning a list of sorts (one sort for each argument place) called "sortal pattern" to each operator we get additional semantic constraints for MSRL expressions. The construction of the sortal pattern of an operator is based

[2] An earlier implementation of this component has been presented at COLING 78: Habel/Rollinger/Schmidt: "Machine translation of natural language into a modal representation language".

on knowledge about the world of discourse. It determines the semantic category of the operator's arguments. The process of the assignment of meaning by BEAST is based on the sortal classification of terms and the sortal pattern of the operator. This process performs a semantically correct assignment between the operator constituting the sentence and the terms being able to become arguments.

There have been some underlying principles/conditions which affected the special ATN formalism in BEAST:

1. BEAST should emphasize a semantical analysis which constitutes the relationship between the natural language sentence and its meaning representation. The aim is the creation of a MSRL expression that represents the meaning of the input sentence.
2. The grammar component should follow the "principle of minimal information": The process of translation tries to get along with as little information as possible. Only if that does not work, more (not only explicite but also implicit) information contained in the sentence need to be discovered.
3. The ATN had to be programmed in SIMULA since the rest of the system already existed in SIMULA.

Our ATN formalism is founded on the formalism developed by Woods, uses ideas of the semantic ATNs and takes the described principles into account by some modifications, extentions and constraints.

We use an ATN compiling system which translates in a first step the ATN representation of the grammar into a SIMULA program, and in a second step this SIMULA representation together with the other components is translated into an executable machine program.

The main features of these ATNs are:

- they use in addition to syntactic categories semantic categories and constituents

- they use semantic constraints to select the best pass through the network
- and they create semantic representations.

The formalism supports the treatment of alternatives at both sides: at the <u>source language</u> by the possibility of alternative categories for the entries in the word form lexicon, and at the <u>target language</u> where alternatives related to a lemma refer to different sortal patterns of operators.

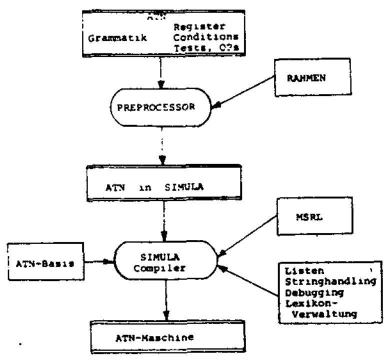

Figure 2: ATN compiling system

The focus of our interest in future development is an integration of the ATN formalism at a higher level, namely the level of the representation language MSRL itself, instead of level of the programming language SIMULA. For this purpose MSRL has to be extended to represent procedural structures like ATNs. The main thing is that these structures are normal MSRL expressions, and therefore on the one hand they are manageble by the knowledge base (storable and retrievable) but on the other hand they are also evaluable. Starting from the fact that the ATN represents the grammatical knowledge of the system we have the ability to handle this knowledge just like the knowledge about the world of discourse: to ask questions about it and to modify it.

In the same way we can represent the lexical knowledge in terms of the representation language. Together with the extension described above there will be the possibility to handle procedural lexical knowledge, especially in the case of ATNs to link a word in the lexicon with a subATN which has the task to perform the next part of the analysis when triggered by the occurance of this word in the natural language sentence.

In our lecture we will carry out the following points:

- the description of the ATN formalism in BEAST
- the projected extensions of MSRL
- the consequences of these extensions on the system concept.