and high level sources of knowledge (concepts). The function of the parser is to produce a segmentation of the sentences in a case frame structure, thus determining the meaning of prepositions, polysemous verbs, of the noun group etc. But the function of this parser is not to produce an output to be interpreted by semantic routines, but to start the parsing process and to proceed until a concept relevant to the theme of the text is recognized. Then the concept (a cluster of production rules) takes control of the parsing process overriding the low level linguistic processes. The concept continues supervising and guiding the parser until the sentence has been understood, that is, the meaning of the sentence has been mapped into the final internal representation. Thus a text is parsed directly into the final knowledge structures.

Results

The area that I have chosen to test the ideas expressed above has been the understanding of programming problems stated in natural language. A program, called LLULL, has been implemented following the ideas summarized above. The program has understood ten programming problems taken verbatim from introductory books to programming. It runned in the DEC20/20 of the Dept. of Computer Science (DSU) under UCI Lisp. Now, the necessary changes are being introduced to make it to run in a VAX11/780 under Franz Lisp.

Future Plans

I intend to continue the work at both the theoretical and experimental level. Immediate plans are to extend LLULL so that it will have capability to understand a large class of programming problems. Next, I will extend my ideas to other domains. The final theoretical goal is the development of a theory that explains the relation between natural language understanding and problem solving. The reference below contains a summary of the basic ideas as well as the background literature.

References

Fernando Gomez "Understanding programming problems stated in natural language", OSU-CISR-TR-81-9, FEB 81.

Natural Language Database Query Project
General Motors Research Laboratories

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Project Goals: a. Developing small-scale solutions to current problems in NL understanding (e.g., anaphora). b. Incorporating these solutions into a NL database query system. c. Performing "human factors" experiments to evaluate various database interfaces, including NL interfaces. d. Modelling the relationship between database structures and natural language semantics.

Accomplishments:

A small-scale natural language database query system has been implemented in LISP. This system utilizes a case grammar approach to parsing, based on the RUS parser developed at BBN (see The RUSGRAMMAR Parsing System, William S. Mark and G. Edward Barton, Jr., GMR-3242, General Motors Research Laboratories, Warren, MI)1980).

The system consists of an ATN grammar, a case frame semantic interpreter, a database interface, and a small relational data management system.

Current Focus:

a. Expanding the linguistic coverage of the system. b. Developing a principled approach to the representation of database knowledge.

Future Plans:

a. Designing and implementing a discourse model of database query dialogues, to be used for resolving anaphoric expressions. b. Research on understanding time references in database queries

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Intelligent Fact Retrieval
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An important problem facing people working in the field of Natural Language Processing is specifying, representing, and organizing the knowledge necessary for understanding. As humans, we build up

that knowledge from experience. But, how can we represent and organize the right kinds of knowledge in the computer? Furthermore, as new information gets added to the computer memory, how can we make the computer automatically integrate that knowledge into memory in smart ways so that it can be easily accessed and "remembered" when necessary for understanding, and without irrelevant knowledge getting in the way?

The AI Project at Georgia Tech is addressing these problems. The theme of our research is "intelligent fact retrieval". We are extending previous research done by Janet Kolodner at Yale University on the CYRUS (Computerized Yale Retrieval and Updating System) (Kolodner, 1980, 1981a) program.

CYRUS is an intelligent fact retrieval system which stores and retrieves episodes in the lives of Secretaries of State Cyrus Vance and Edmund Muskie. When given a new fact about Vance or Muskie, CYRUS integrates the new event into its already-existing memory organization, making sure that it preserves accessibility of events in the data base. It then answers questions posed to it in English about the events it stores, using retrieval strategies to direct search. Thus, CYRUS addresses both the problems of automatically organizing knowledge in a memory and directing retrieval of that knowledge based on cues provided by Natural Language queries. The following is an actual dialog with CYRUS:

```
>Was Vance in Europe last year?
   YES, MOST RECENTLY IN MADRID.
>Was he welcomed there?
   YES, BY FOREIGN MINISTER MARCELINO
   OREJA AGUIRRE.
>Who did he talk to?
   A GROUP OF SPANISH OFFICIALS.
>Did he also go to Holland?
   YES, AFTER THE TRIP TO SPAIN.
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Currently, we are extending CYRUS' capabilities in three new projects. For information about the problems we are addressing in these projects, see Kolodner (1981b).

1. Knowledge-based self-organizing memory: The first project is concerned with sophisticated methods for memory reorganization. Called ALEX, the program will work in CYRUS' domain, keeping track of Secretary of State Alexander Haig and the people he comes in contact with. It extends CYRUS in four ways: (1) It will be able to infer information only implicitly in memory. (2) It will have learning capabilities which will enable it to build up and retrieve information about the people Haig comes in contact with (in addition to retrieving information about Haig). (3) It will have learning capabilities which will enable it to reorganize its memory based on the questions it is asked. (4) It will use knowledge about goals, goal progressions, level within memory's hierarchies, and degrees of differences from norms to control automatic memory reorganization.

2. Implicit fact retrieval: The emphasis of the second project is use of memory organization to retrieve facts only implicitly in memory. This project will work in the domain of Middle East politics and will extend CYRUS in the following ways: (1) It will look into the representation of complexly interconnected events. (2) It will be able to retrieve information only implicitly in memory. (3) It will be able to make predictions based on past experience. Information fed into both of these systems is collected from the UPI news wire.

3. Expert fact retrieval: Our third project explores the use of long term memory in expert reasoning and fact retrieval. While conventional "expert systems" research has concentrated on extracting the rules experts use and developing problem solving methodologies for dealing with those rules, human experts are able to introspect about their knowledge and learn from past experience. This is the view of expertise which this project explores. It addresses the following problems: What makes an expert expert? What kind of processing capabilities are implied when we say somebody is an expert? What kind of understanding capability does an expert have that a novice does not? What are the processes that comprise expert reasoning?

In answering these questions, we are drawing on CYRUS' strategies for organizing and retrieving events in a long term memory. We are also observing physicians as they make decisions. As a result of the observations, we are developing a theory of expertise based on past experience, and are implementing that theory in a computer program called SHRINK. The program will automate psychiatric diagnosis. It uses previous diagnostic experience to diagnose and treat emotional disorders. Through feedback, the system will be able to learn from its experiences, updating its knowledge base over time. Two doctors at the Atlanta V.A. hopital are also involved in this project.

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