

## Abstracts of Current Literature

### Knowledge Representation and Retrieval for Natural Language Processing

A.M. Frisch and J.F. Allen

Computer Science Department  
University of Rochester  
Rochester, NY 14627

*Technical Report TR104, December 1982, 50 pages.*

We are building a computer system called ARGOT that acts as a computer operator conversing with a computer user. Since performance in this domain requires ARGOT to have efficient access to a large body of diverse knowledge, a major part of our research effort has been focused on issues of knowledge representation and retrieval. This paper describes ARGOT's representation language, the retriever used to access a knowledge base of sentences of the language, and how their design has been influenced by the task domain and system organization.

### A Connectionist Scheme for Modelling Word Sense Disambiguation

G.W. Cottrell and S.I. Small

Computer Science Department  
University of Rochester  
Rochester, NY 14627

*Technical Report TR122.*

*Cognition and Brain Theory 6, 1 (1983): 89-120.*

This paper advocates the interdisciplinary development of a computational theory of human language comprehension and proposes a collection of initial constraints from which to start on such an enterprise. The constraints come from several disparate sources, including: (1) human physiology and language malfunctions; (2) human language behaviors under different processing conditions; (3) computational architectures for language comprehension; and (4) human and computer visual understanding. Our modeling effort thus employs an architecture significantly different from the typical computer and closer to that of the human brain. We use a particular spreading activation or active semantic network scheme, called *connectionism*, which entails a massive number of appropriately connected computing units that communicate through weighted levels of excitation and inhibition. This paper surveys a number of fundamental language comprehension issues from the new perspective, and presents some simulation results of a parsing model based on these considerations.

### The HORNE Reasoning System

J.F. Allen, M. Giuliano, and A.M. Frisch

Computer Science Department  
University of Rochester  
Rochester, NY 14627

*Technical Report TR126, October 1983, ~ 60 pages.*

HORNE is a programming system that offers a set of tools for building automated reasoning systems. It offers three major modes of inference: (1) a horn clause theorem prover (a backwards chaining mechanism); (2) a forward chaining mechanism; and (3) a constraint posting mechanism for restricting the range of variables. All three modes use a common representation of facts, namely horn clauses with universally quantified variables, and use the unification algorithm. In addition, they all share the following additional specialized reasoning capabilities: (1) variables may be typed with a fairly general type theory that allows intersecting types; (2) full reasoning about equality between ground terms, and limited equality reasoning for quantified terms; and (3) escapes into LISP for use as necessary. This paper contains an introduction to each of these facilities, and the HORN User's manual.

### Discourse and Problem Solving

D. Litman

Computer Science Department  
University of Rochester  
Rochester, NY 14627

*Technical Report TR130, July 1983, 50 pages.*

*Also, Report No. 5338, Bolt Beranek and Newman Inc.*

This report proposes a plan-based natural language system that incorporates knowledge of both plan and discourse structure of task-oriented dialogues. An initial representation of communicative (discourse) actions is discussed; in particular, how to incorporate knowledge of legal moves as action effects rather than grammars. The subtle differences implicit in various surface realizations are also examined, as well as the structure of these communicative actions in actual dialogues. It is suggested that both local and global discourse structures are necessary (although analysis of the latter has been emphasized here). It is also suggested that planning models need to be extended to include two agent plan execution. Finally, a model of the goal recognition process is presented. Communicative and task knowledge work in parallel, one source dynamically taking control over the other and reducing the search space, depending on the kind of discourse (task-oriented, conversational, etc.). Communicative recognition is hypothesized to be simple, using the knowledge provided by the analysis of surface phenomena and task plan recognition.

### Three Strategic Goals in Conversational Openings

Michael Rosner

ISSCO  
54 Route des Acacias  
1227 Geneva, Switzerland

*Working Paper 46, 1981.*

This paper tries to explain a short transcript of a conversational opening as completely as possible within the framework that takes conversational behaviour as defined by a sophisticated planning mechanism. It is argued that a crucial role is played by the satisfaction, by each participant, of three strategic goals relating to attention, identification, and greeting. Additional tactics for gaining information are also described as necessary to account for this transcript.

### A Poor Man's Flavor System -- Part 1

F. diPrimio and Th. Christaller

ISSCO

54 Route des Acacias  
1227 Geneva, Switzerland

Working Paper 47, 1983.

(Address requests to Michael Rosner at ISSCO.)

This paper is the result of an attempt to understand 'flavors', the object-oriented programming system in Lispmachine Lisp. The authors argue that the basic principles of such systems are not easily accessible to the programming public, because papers on the subject rarely discuss the concrete details. Accordingly, the authors' approach is pedagogical, and takes the form of a description of the evolution of their own flavor system. An appendix contains programming examples that are sufficiently detailed to enable an average LISP programmer to build a flavor system, and experiment with the essential concepts of object-oriented programming.

### A Government-and-Binding Parser for French

E. Wehrli

ISSCO

54 Route des Acacias  
1227 Geneva, Switzerland

Working Paper 48, forthcoming.

(Address requests to Michael Rosner at ISSCO.)

### Computational Explication of Intensionality

J.S. Bien

Institute of Informatics  
University of Warsaw

Report 107, Janusz S. Bien (Ed.), *Papers in Computational Linguistics I*, paper 1.

An obvious requirement for a language understanding system of practical use is that the system tells "the truth and only the truth", and so called "intensionality" of natural languages is one of the main obstacles on the way to formulate a strict definition of truth for natural languages. Although it may be possible to account for it using the apparatus of formal logic, in the present state of art it seems more useful to describe this property of natural language in the terms of computer science. The paper represents the problem of intensionality, shows its relation to some aspects of programming languages and outlines

the way in which the intensionality is to be accounted for in the "multiple environments model of natural language" being developed by the author.

### Parsing Free Word Order Languages in Prolog

J.S. Bien, K. Laus-Maczynska, S. Szpakowicz

Institute of Informatics  
University of Warsaw

Report 107, Janusz S. Bien (Ed.), *Papers in Computational Linguistics I*, paper 2.

The Prolog programming language allows the user to write powerful parsers in the form of metamorphosis grammars. However, the metamorphosis grammars, as defined by Colmerauer, have to specify strictly the order of terminal and nonterminal symbols. A modification of Prolog has been implemented that allows "floating terminals" to be included in a metamorphosis grammar together with some information enabling one to control the search for such a terminal in the unprocessed part of the input. The modification is illustrated by several examples from the Polish language, and some open questions are discussed.

### The Partial Analysis of a Sentence in Montague Grammar

W. Lukaszewicz

Institute of Informatics  
University of Warsaw

Report 107, Janusz S. Bien (Ed.), *Papers in Computational Linguistics I*, paper 3.

Montague translates a simple fragment of English into tensed intensional logic, an extension of the typed  $\lambda$ -calculus. In the following note, we use notational conventions of Montague.

Consider the English sentence,

- (1) John asserts that Mary asserts that a man such that he runs walks.

We shall be interested in an analysis of (1) with respect to the nominal phrases 'a man such that he runs'. This phrase may be introduced on different syntactical levels leading to different derivations of (1). Three of these derivations are displayed in the enclosed diagrams.

### Toward Computational Description of Written Polish

J.S. Bien, S. Szpakowicz

Institute of Informatics  
University of Warsaw

Report 110, Janusz S. Bien (Ed.), *Papers in Computational Linguistics II*, paper 1.

We present briefly the activity of the Warsaw University computational linguistics team. The team is an informal group that consolidates around a seminar at the Institute of Informatics, co-ordinated by Prof. Zygmunt Saloni. The group adheres to a "bootstrap-

ping methodology”: we focus on developing surface linguistic descriptions that should allow us to create efficient tools for low-level processing of natural language texts, in hope that it will pay when more sophisticated problems are attacked.

### **A Simple Dialogue in Polish: Interactive Railway Guide**

**S. Szpakowicz, M. Swidzinski**

Institute of Informatics  
University of Warsaw

*Report 110, Janusz S. Bien (Ed.), Papers in Computational Linguistics II, paper 2.*

In this paper we present the results of an experiment in computational linguistics: the design and implementation of an interactive train timetable information system. The experiment was completed in early 1979. It is a rather simple case study in dialogue system construction. Our system can hardly be compared with such sophisticated systems as GUS or HAMP-RPM. However, we do not pretend to compete with them, because our system is the very first program for conversing in Polish that performs full analysis of the input data. Although the system cannot handle the anaphoric references, it covers a variety of types of syntactic structures occurring in typical timetable dialogues in Polish. It is worth emphasizing that highly inflected languages such as Polish provide a number of specific problems to be solved, such as inflection, congruence, free word order, etc.

### **On Surface-Syntactic Analysis of Polish**

**J.S. Bien, S. Szpakowicz**

Institute of Informatics  
University of Warsaw

*Report 110, Janusz S. Bien (Ed.), Papers in Computational Linguistics II, paper 3.*

By surface syntax we mean such a structural description of a sentence that is sufficient to disambiguate practically all purely morphological ambiguities concerning the words that constitute the sentence. After describing briefly the operations prerequisite to the syntactic analysis, we present the existing parsers of Polish. Although the parsers are based on sound linguistic principles and produce surface-syntactic structures of quite complicated sentences, they do not capture many correct word order variations. We show a few linguistic phenomena related to word order that present serious difficulties in designing a more general parser of Polish.

### **Toward a Parsing Method for Free Word Order Languages**

**J.S. Bien, S. Szpakowicz**

Institute of Informatics  
University of Warsaw

*Report 110, Janusz S. Bien (Ed.), Papers in Computational Linguistics II, paper 4.*

Formal syntactic descriptions have usually been based either on the immediate-constituents or on the dependency philosophy. Neither of them seems directly applicable to free word order languages. We try to take a fresh start and reanalyse the basic notions of syntax and parsing. Certain relations between sentence components help disambiguate the morphological properties of individual words without resorting to their meanings; these relations constitute the level of syntax. By the syntactic structure of a sentence we understand some explicit representation of all the syntactic relations between its components. Parsing is a process of establishing all syntactic structures of a given text. We adopt Marcus's wait-and-see strategy as a general hint and our own IC-based syntactic description of Polish as a starting point in our future work on a parser for Polish.

### **Constraining a Deterministic Parser**

**J. Bachenko, D. Hindle, and E. Fitzpatrick**

Computer Science and Systems Branch  
Information Technology Division  
Naval Research Laboratory  
Washington, DC 20375

*Proceedings of AAAI, August 1983: 8-11.*

At the Naval Research Laboratory, we are building a deterministic parser, based on principles proposed by Marcus, that can be used in interpreting military message narrative. A central goal of our project is to make the parser useful for real-time applications by constraining the parser's actions and so enhancing its efficiency. In this paper, we propose that a parser can determine the correct structures for English without looking past the "left corner" of a constituent, i.e., the leftmost element of the constituent along with its lexical category (e.g., N, V, Adj). We show that this Left Corner Constraint, which has been built into our parser, leads quite naturally to a description of verb complements in English that is consistent with the findings of recent linguistic theory, in particular, Chomsky's government and binding (GB) framework.

### **Tracking User Goals in an Information-Seeking Environment**

**Sandra Carberry**

Department of Computer Science  
University of Delaware  
Newark, DE 19711

*Proceedings of AAAI, August 1983: 59-63.*

This paper presents a model for hypothesizing and tracking the changing task-level goals of a speaker during the course of an information-seeking dialogue. It allows a complex set of domain-dependent plans, forming a hierarchical structure of component goals and actions. Our model builds the user's plan as the

dialogue progresses, maintains both a local and a global plan context, and differentiates between past goals and goals currently pursued by the user. This research is part of a project to develop a robust natural language interface. If an utterance cannot be interpreted normally or a response cannot be generated due to pragmatic overshoot, the strong expectations about the utterance provided by our context model can be used as an aid in processing the input and producing useful responses.

### **QE-III: A Formal Approach to Natural Language Querying**

**James Clifford**

Graduate School of Business Administration  
New York University  
New York, NY

*Proceedings of AAAI, August 1983: 79-83.*

In this paper we present an overview of QE-III, a language designed for natural-language querying of historical data bases. QE-III is defined formally with a Montague Grammar, extended to provide an interpretation for questions and temporal reference. Moreover, in addition to the traditional syntactic and semantic components, a formal pragmatic interpretation for the sentences of QE-III is also defined.

### **Repairing Miscommunication: Relaxation in Reference**

**Bradley A. Goodman**

Bolt Beranek and Newman Inc.  
10 Moulton Street  
Cambridge, MA 02238

*Proceedings of AAAI, August 1983: 134-138.*

In natural language interactions, a speaker and listener cannot be assured to have the same beliefs, contexts, backgrounds or goals. This leads to difficulties and mistakes when a listener tries to interpret a speaker's utterance. One principal source of trouble is the description constructed by the speaker to refer to an actual object in the world. The description can be imprecise, confused, ambiguous or overly specific; it might be interpreted under the wrong context. This paper explores the problem of resolving such reference failures in the context of the task of assembling a toy water pump. We are using actual protocols to drive the design of a program that plays the part of an apprentice who must interpret the instructions of an expert and carry them out. A primary means for the apprentice to repair such descriptions is by relaxing parts of the description.

### **Phonotactic and Lexical Constraints in Speech Recognition**

**Daniel P. Huttenlocher and Victor W. Zue**

Department of Electrical Engineering and Computer Science  
Massachusetts Institute of Technology  
Cambridge, MA 02139

*Proceedings of AAAI, August 1983: 172-176.*

We demonstrate a method for partitioning a large lexicon into small equivalence classes, based on sequential phonetic and prosodic constraints. The representation is attractive for speech recognition systems because it allows all but a small number of word candidates to be excluded, using only gross phonetic and prosodic information. The approach is a robust one in that the representation is relatively insensitive to phonetic variability and recognition error.

### **RESEARCHER: An Overview**

**Michael Lebowitz**

Department of Computer Science  
Columbia University  
New York, NY 10027

*Proceedings of AAAI, August 1983: 232-235.*

Described in this paper is a computer system, RESEARCHER, being developed at Columbia that reads natural language text in the form of patent abstracts and creates a permanent long-term memory based on concepts generalized from these texts, forming an intelligent information system. This paper is intended to give an overview of RESEARCHER. We will describe briefly the four main areas dealt with in the design of RESEARCHER: (1) knowledge representation, where a canonical scheme for representing physical objects has been developed; (2) memory-based text processing; (3) generalization and generalization-based memory organization that treats concept formation as an integral part of understanding, and (4) generalization-based question answering.

### **An Overview of the Penman Text Generation System**

**William C. Mann**

USC Information Sciences Institute  
4676 Admiralty Way  
Marina del Rey, CA 90291

*Proceedings of AAAI, August 1983: 261-265.*

The problem of programming computers to produce natural language explanations and other texts on demand is an active research area in artificial intelligence. In the past, research systems designed for this purpose have been limited by the weakness of their linguistic bases, especially their grammars, and their techniques often cannot be transferred to new knowledge domains.

A new text generation system, Penman, is designed to overcome these problems and produce fluent multi-paragraph text in English in response to a goal presented to the system. Penman consists of four major modules: a *knowledge acquisition* module that can perform domain-specific searches for knowledge relevant

to a given communication goal; a *text planning* module that can organize the relevant information, decide what portion to present, and decide how to lead the reader's attention and knowledge through the content; a *sentence generation* module based on a large systemic grammar of English; and an *evaluation and plan-perturbation* module that revises text plans based on evaluation of text produced.

Development of Penman has included implementation of the largest systemic grammar of English in a single notation. A new semantic notation has been added to the systemic framework, and the semantics of nearly the entire grammar has been defined. The semantics is designed to be independent of the system's knowledge notation, so that it is usable with widely differing knowledge representations, including both frame-based and predicate-calculus-based approaches.

### Recursion in Text and Its Use in Language Generation

Kathleen R. McKeown

Department of Computer Science  
Columbia University  
New York, NY 10027

*Proceedings of AAAI, August 1983: 270-273.*

In this paper I show how *textual structure* is recursive in nature; that is, the same rhetorical strategies that are available for constructing the text's macrostructure are available for constructing its sub-sequences as well, resulting in a hierarchically structured text. The recursive formalism presented can be used by a generation system to vary the amount of detail it presents for the same discourse goal in different situations.

### Reasons for Beliefs in Understanding: Applications of Non-Monotonic Dependencies to Story Processing

Paul O'Rorke

Coordinated Science Laboratory  
University of Illinois at Urbana-Champaign  
Urbana, IL 61801

*Proceedings of AAAI, August 1983: 306-309.*

Many of the inferences and decisions which contribute to understanding involve fallible assumptions. When these assumptions are undermined, computational models of comprehension should respond rationally. This paper crossbreeds AI research on problem solving and understanding to produce a hybrid model ('reasoned understanding'). In particular, the paper shows how non-monotonic dependencies enable a schema-based story processor to adjust to new information requiring the retraction of assumptions.

### Inference-Driven Semantic Analysis

Martha Stone Palmer

SDC - A Burroughs Company  
and University of Pennsylvania  
Philadelphia, PA

*Proceedings of AAAI, August 1983: 310-313.*

A primary problem in the area of natural language processing is the problem of semantic analysis. This involves both formalizing the general and domain-dependent semantic information relevant to the task involved, and developing a uniform method for access to that information. Natural language interfaces are generally also required to have access to the syntactic analysis of a sentence as well as knowledge of the prior discourse to produce a semantic representation adequate for the task. This paper briefly describes previous approaches to semantic analysis, specifically those approaches which can be described as using *templates*, and corresponding multiple levels of representation. It then presents an alternative to the template approach, inference-driven semantic analysis, which can perform the same tasks but without needing as many levels of representation.

### Interactive Script Instantiation

Michael J. Pazzani

The MITRE Corporation  
Bedford, MA 01730

*Proceedings of AAAI, August 1983: 320-326.*

The KNOBS (Engelman 1980) planning system is an experimental expert system that assists a user by instantiating a stereotypical solution to his problem. SNUKA, the natural language understanding component of KNOBS, can engage in a dialog with the user to allow him to enter components of a plan or to ask questions about the contents of a data base that describes the planning world. User input is processed with respect to several knowledge sources including word definitions; scripts that describe the relationships among the scenes of the problem solution; and four production system rule bases that determine the proper data base access for answering questions, infer missing meaning elements, describe how to conduct a conversation, and monitor the topic of the conversation. SNUKA differs from GUS (Bobrow 1977), a dialog system similar to SNUKA in its goals, in its use of a script to guide the conversation, interpret indirect answers to questions, determine the referents to nominals, perform inferences to answer the user's questions, and decide upon the order of asking questions of the user to maintain a coherent conversation. SNUKA differs from other script-based language understanders such as SAM (Cullingford 1978) and FRUMP (DeJong 1979) in its role as a conversational participant instead of a story understander.

### Deterministic and Bottom-Up Parsing in Prolog

Edward P. Stabler, Jr.

University of Western Ontario  
London, Canada

*Proceedings of AAAI, August 1983: 383-386.*

It is well known that top-down backtracking context free parsers are easy to write in Prolog, and that these parsers can be extended to give them the power of ATN's. This report shows that a number of other familiar parser designs can be very naturally implemented in Prolog. The top-down parsers can easily be constrained to do deterministic parsing of LL(k) languages. Bottom-up backtrack parsers can also be elegantly implemented and similarly constrained to do deterministic LR(k) parsing. Very natural extensions of these LF(k) parser designs suffice for deterministic parsing of natural languages of the sort carried out by the Marcus (1980) parser.

### **MCHART: A Flexible, Modular Chart Parsing System**

Henry Thompson

Department of Artificial Intelligence  
University of Edinburgh  
Hope Park Square, Meadow Lane  
Edinburgh EH87 9NW Scotland

*Proceedings of AAAI, August 1983: 408-410.*

One of the most attractive properties of the active chart parsing methodology (Kay 1980, Thompson and Ritchie 1983) is the distinction it makes possible between essential bookkeeping mechanisms, scheduling issues, and details of grammatical formalisms. MCHART is a framework within which active chart parsing systems can be constructed. It provides the essential bookkeeping mechanisms, and carefully structured interfaces for the specification of scheduling and grammatical formalism. The resulting flexibility makes it useful both for pedagogical purposes and for quick prototyping. The system is available in UCILISP, FranzLisp, and Interlisp versions, together with a simple lexicon facility, example parsers and detailed documentation.

### **Mapping Between Semantic Representations Using Horn Clauses**

Ralph M. Weischedel

Computer and Information Sciences  
University of Delaware  
Newark, DE 19711

*Proceedings of AAAI, August 1983: 424-428.*

Even after an unambiguous semantic interpretation has been computed for a sentence in context, there are at least three reasons that a system may map the semantic representation R into another form S.

1. The terms of R, while reflecting the user view, may require deeper understanding, e.g., may require a version S where metaphors have been analyzed.
2. Transformations of R may be more appropriate for the underlying application system, e.g., S may be a

more nearly optimal form. These transformations may not be linguistically motivated.

3. Some transformations may depend on non-structural context.

Design considerations may favor factoring the process into two stages, for reasons of understandability or for easier transportability of the components.

This paper describes the use of Horn clauses for the three clauses of transformations listed above. The transformations are part of a system that converts the English description of a software module into a formal specification, i.e., an abstract data type.

□ □ □ □

The following abstracts refer to papers in *Proceedings of the Eighth International Joint Conference on Artificial Intelligence 8-11 August 1983, Karlsruhe, West Germany*. International Joint Conference on Artificial Intelligence, Inc., 1983. Distributor: William Kaufmann, Inc., 95 First Street, Los Altos, CA 94022.

### **Phrase Structure Grammars and Natural Languages**

Gerald Gazdar

Cognitive Studies Programme  
University of Sussex  
Brighton BN1 9QN

*Proc. Eighth IJCAI, August 1983, Vol. 1: 556.*

During most of the last two decades, computational linguists and AI researchers working on natural language have assumed that phrase structure grammars, despite their computational tractability, were unsatisfactory devices for expressing the syntax of natural languages. However, during the same period, they have come to realize that transformational grammars whatever their linguistic merits, are computationally intractable as they stand. The assumption, unchallenged for many years, that PSGs were inadequate for natural languages is based on arguments originally advanced by transformational linguists in the late 1950s and early 1960s. But recent work has shown that *none* of those arguments were valid. The present paper draws on that work to argue that (i) there is no reason, at the present time, to think that natural languages are not context-free languages; (ii) there are good reasons to think that the notations needed to capture significant syntactic generalizations will characterize phrase structure grammars or some minor generalization of them; and (iii) there are good reasons for believing that such grammars, and the monostatal representations they induce, provide the necessary basis for the semantic interpretation of natural languages. If these arguments are valid, then the prospects for a fruitful interaction between theoretical linguistics and AI are much brighter than they would otherwise be.

### Formal Theories of Language Acquisition: Practical and Theoretical Perspectives

**Daniel N. Osherson**

Center for Cognitive Science  
Massachusetts Institute of Technology  
Cambridge, MA 02139

**Michael Stob**

Department of Mathematics  
Calvin College  
Grand Rapids, IL 49506

**Scott Weinstein**

Department of Philosophy  
University of Pennsylvania  
Philadelphia, PA 19104

*Proc. Eighth IJCAI, August 1983, Vol. 1: 566*

Learning Theory is the study of systems that implement functions from evidential states to theories. The theoretical framework developed in the theory makes possible the comparison of classes of algorithms that embody distinct learning strategies along a variety of dimensions. Such comparisons yield valuable information to those concerned with inference problems in Cognitive Science and Artificial Intelligence. The present paper employs the framework of Learning Theory to study the design specifications of inductive systems which are of interest in the domain of language acquisition.

### Transportability and Generality in a Natural-Language Interface System

**Paul Martin, Douglas Appelt, Fernando Pereira**

Artificial Intelligence Center  
SRI International  
Menlo Park, CA 94025

*Proc. Eighth IJCAI, August 1983, Vol. 1: 573*

This paper describes the design of a transportable natural language (NL) interface to data bases and the constraints that transportability places on each component of such a system. By a **transportable** NL system, we mean an NL processing system that is constructed so that a domain expert (rather than an AI or linguistics expert) can move the system to a new application domain. After discussing the general problems presented by transportability, this paper describes TEAM (an acronym for Transportable English data base Access Medium), a demonstrable prototype of such a system. The discussion of TEAM shows how domain-independent and domain-dependent information can be separated in the different components of an NL interface system, and presents one method of obtaining domain-specific information from a domain expert.

### Focus Constraints on Language Generation

**Kathleen R. McKeown**

Department of Computer Science  
Columbia University  
New York, NY 10027

*Proc. Eighth IJCAI, August 1983, Vol. 1: 582*

Computer generation of natural language requires the ability to make reasoned choices from a large number of possible things to say as well as from a large number of expressive possibilities. This paper examines in detail how one influence on a generated text, focus of attention, can be used to constrain the many possibilities that a generation system must consider. A computational treatment of focus of attention is presented that can be used to constrain what the system needs to consider when deciding what to say next. In this process, information is produced that provides constraints on which words and syntactic structures best express the system's intent, thus ensuring that its resulting text is coherent. This analysis has been used in the fully implemented TEXT system, which generates paragraph length responses to questions about data base structure.

### Beyond Domain Independence: Experience with the Development of a German Language Access System to Highly Diverse Background Systems

**W. Hoepfner, T. Christaller, H. Marburger, K. Morik, B. Nebel, M. O'Leary, W. Wahlster**

Research Unit for Information Science and Artificial Intelligence

University of Hamburg  
Mittelweg 179

D-2000 Hamburg 13, F.R. Germany

*Proc. Eighth IJCAI, August 1983, Vol. 1: 588*

For natural language dialog systems, going beyond domain independence means the attempt to create a core system that can serve as a basis for interfaces to various application classes that differ not only with respect to the domain of discourse but also with respect to dialog type, user type, intended system behavior, and background system. In the design and implementation of HAM-ANS, which is presently operational as an interface to an expert system, a vision system and a data base system, we have shown that going beyond domain independence is possible. HAM-ANS is a large natural language dialog system with both considerable depth and breadth, which accepts typed input in colloquial German and produces typed German responses quickly enough to make it practical for real-time interaction. One goal of this paper is to report on the lessons learned during the realization of the system HAM-ANS. This paper introduces the overall structure of the system's processing units and knowledge sources. In addition we describe some of the innovative features concerning the strategy of semantic interpretation.

## TELEGRAM: A Grammar Formalism for Language Planning

Douglas E. Appelt

Artificial Intelligence Center  
SRI International  
Menlo Park, CA 94025

*Proc. Eighth IJCAI, August 1983, Vol. 1: 595*

Planning provides the basis for a theory of language generation that considers the communicative goals of the speaker when producing utterances. One central problem in designing a system based on such a theory is specifying the requisite linguistic knowledge in a form that interfaces well with a planning system and allows for the encoding of discourse information. The TELEGRAM (TELEological GRAMmar) system described in this paper solves this problem by annotating a unification grammar with assertions about how grammatical choices are used to achieve various goals, and by enabling the planner to augment the functional description of an utterance as it is being unified. The control structures of the planner and the grammar unifier are then merged in a manner that makes it possible for general planning to be guided by unification of a particular functional description.

## An Indirect Approach to Types of Speech Acts

Jeremy Ellman

Department of Psychology  
University of Warwick  
Coventry, UK

*Proc. Eighth IJCAI, August 1983, Vol. 1: 600*

Considerations of the similarity between direct and indirect speech act understanding give rise to the notion that taxonomies of speech acts may not be helpful in modelling language understanding. A computer model that treats representations of direct and indirect speech acts similarly and successfully has been implemented without any such taxonomy and without an explicit representation of the difference between direct and indirect speech acts.

## Mutual Beliefs in Conversational Systems: Their Role in Referring Expressions

Gopalan Nadathur, Aravind K. Joshi

Department of Computer and Information Science  
University of Pennsylvania  
Philadelphia, PA 19104

*Proc. Eighth IJCAI, August 1983, Vol. 1: 603*

Shared knowledge and beliefs affect conversational situations in various ways. One aspect in which they play a role is the choice of referring expressions. It is of interest to analyse this role since a natural language system must be able to decide when it can use a particular referring expression; or alternatively what a particular expressions refers to. In this paper we attempt to formally characterise conditions for these.

Specifically, we differ with the traditional notion of mutual knowledge and belief, state a conversational conjecture that convinces us to do so, express a weakened notion in a formal system for reasoning about knowledge, and show how this might be used to decide on satisfactory referring expressions. It is desirable to express a weakened notion of mutual belief that parallels that for mutual knowledge; this aspect is currently being investigated.

## Some Issues in Generation from a Semantic Representation

Laurence Danlos

Laboratoire d'Automatique Documentaire et Linguistique  
(CNRS)

Artificial Intelligence Project (Yale University)

*Proc. Eighth IJCAI, August 1983, Vol. 1: 606*

This paper investigates certain problems in the production of text from a language-free representation and proposes a model of generation to treat these problems. We deal with generation of connected text. We show that the generation of a connected text cannot be reduced to a simple combination of phrases expressing sub-parts of the representation, but must be based on patterns of discourse structure reflecting the whole representation.

## Generation in a Natural Language Interface

Paul S. Jacobs

Division of Computer Science  
Department of EECS  
University of California  
Berkeley, CA 94720

*Proc. Eighth IJCAI, August 1983, Vol. 1: 610*

The PHRED (PHRasal English Diction) generator produces the natural language output of Berkeley's UNIX Consultant system (UC). The generator shares its knowledge base with the language analyzer PHRAN (PHRasal ANalyser). The parser and generator, together a component of UC's user interface, draw from a database of pattern-concept pairs where the basic unit of the linguistic patterns is the phrase. Both are designed to provide multilingual capabilities, to facilitate linguistic paraphrases, and to be adaptable to the individual user's vocabulary and knowledge. The generator affords extensibility, simplicity, and processing speed while performing the task of producing natural language utterances from conceptual representations using a large knowledge base. This paper describes the implementation of the phrasal generator and discusses the role of generation in a user-friendly natural language interface.

## Generation of Japanese Sentences from Conceptual Representation

Shun Ishizaki

Electrotechnical Laboratory  
1-1-4 Umezono Sakura-mura Niihari-gun  
Ibaraki, Japan 305

*Proc. Eighth IJCAI, August 1983, Vol. 1: 613*

This paper describes an attempt to generate Japanese sentences from conceptual representation. This generator infers the temporal order of events included in the conceptual representation using causal chains and MPOs. Appropriate conjunctives between the events and case markers for subjects are used based on the representation. This generator was first built as part of the Machine Translation Project in the Computer Science Department of Yale University in 1982. It has subsequently been improved at ETL in Japan. About 15 stories are parsed into conceptual representations from Spanish newspaper stories (Lytinen and Shank 1982) and then Japanese sentences are generated.

## Impression Monitoring in Evaluation-Oriented Dialog. The Role of the Listener's Assumed Expectations and Values in the Generation of Informative Statements

Anthony Jameson

Department of Social Psychology  
University of Nijmegen  
6500 HE Nijmegen, The Netherlands

*Proc. Eighth IJCAI, August 1983, Vol. 2: 616*

A prototype dialog system is presented which specializes in responding to the questions of a user who is assumed to be attempting to form an evaluation of a given object. On the basis of explicit assumptions concerning the evaluator's standards and prior expectations, the system goes beyond the direct answering of the questions by selecting additional comments according to their anticipated impact on the evaluator's impressions of the object. The system may be positively or negatively biased in its selection of comments; taking into account the (possibly different) bias which it assumes the evaluator to ascribe to it, it anticipates how the fact that it has failed to make certain comments is likely to be interpreted. The system's central concepts are also used to quantify the notion of the relatedness of a given comment to a given topic and to guide the selection of connectives and sentential adverbs.

## Shifting Meaning Representations

Karen Sparck Jones

Computer Laboratory  
University of Cambridge  
Corn Exchange Street  
Cambridge CB2 3QG ENGLAND

*Proc. Eighth IJCAI, August 1983, Vol. 2: 621*

This paper argues that a number of different kinds of meaning representation, between which *partial* translations can be made as needed, are all required for a reasonably comprehensive language processing system. These representations capture different and possibly complementary aspects of a text's form, content and reference worlds, and are suited to different subtasks of the language processor. Initial testing of the proposition via a system designed for natural language access to databases is described, showing how different types of meaning representation with different characteristics are called for, related, and used.

## Frame Activated Inferences in a Story Understanding Program

Peter Norvig

Division of Computer science  
Department of EECS  
University of California  
Berkeley, CA 94720

*Proc. Eighth IJCAI, August 1983, Vol. 2: 624*

An effective story understander must be able to reason about characters in the story, their affects, actions, plans, and goals, as well as the settings and important points of the story. In many systems this has been done with separate inference mechanisms for each class of knowledge structure. This paper proposes a story understander with a unified frame-based inference component used on each class of knowledge structure.

## Structural Relations -- A Case Against Case

Ingeborg Steinacker, Harald Trost

Department of Medical Cybernetics  
University of Vienna  
Austria

*Proc. Eighth IJCAI, August 1983, Vol. 2: 627*

Usually semantic parsers of NLU systems rely on some type of 'deep case' (Riesbeck and Schank 1976, Trost and Steinacker 1981) to control analysis. While we do not want to deny the advantages of such an approach (we use it ourselves), we propose to apply a different approach in order to analyse words that derive their meaning from the semantic category of their dependent constituents. The algorithm we present in this paper disambiguates such words by making use of one of the important properties of an SI-Net (Brachman 1979), the strict distinction between structure and contents of the net. Structurally, all semantic relations are represented in the same way; therefore we evaluate this level to find out if there is a relation between the representation of the constituents of such a word. After a link has been found, its semantic interpretation is taken to be the sense of the word. Besides being used for disambiguation, the algorithm is applicable to solve other problems related to parsing as well, e.g.,

interpretation of metaphors or problems related to resolution of definite anaphora.

### The FOPHO Speech Recognition Project

Mary O'Kane

School of Information Science  
Canberra College of Advanced Education  
P.O. Box 1  
Belconnen, 2616 AUSTRALIA

*Proc. Eighth IJCAI, August 1983, Vol. 2: 630*

The FOPHO (FOREIGN PHONETICIAN) speech recognition project concerns the development of a system to produce a reasonably high quality phonetic transcription output from continuous speech input. The system is developed to perform in a way which approximates the actions of a phonetician trying to transcribe a foreign tongue (in the case of FOPHO, Australian English). Because of this central philosophy, FOPHO is a very interactive system and has facilities for automatic learning and analysis of its own performance. Good quality recognition is achieved through algorithms which are very context-dependent and which are sensitive to a variety of possible productions of similar sounds even though the system itself is speaker independent.

### A System for Improving the Recognition of Fluently Spoken German Speech

Joachim Mudler

Institut für Nachrichtentechnik  
Technische Universität Braunschweig  
Schleinitzstr. 23  
D-3300 Braunschweig, Fed. Rep. Germany

*Proc. Eighth IJCAI, August 1983, Vol. 2: 633*

A research project for improving the recognition of fluently spoken German speech is presented. The work is in progress at present.

It should be investigated, how far aspects of semantics and inferences could improve the automatic speech recognition. The work is part of a speech recognition system that receives speech signals, converts them into forms suitable for further actions and finally puts out the spoken text in characters. The system itself operates at three stages. Within the first one the signal analysis is performed using a well-known method. This analysis segments the signal into certain subword units and, for each segment, produces a set of weighted candidates. At the second stage these candidates are used to generate weighted word hypotheses with the aid of an extensive lexicon. The hypotheses have to be verified or falsified within the following processing steps at the third stage. Thereby the algorithm uses a best-first strategy (hypotheses with highest weight first).

Besides syntactic/grammatical aspects, semantic analysis and inferences mentioned above are the

methods that should lead to a certain text comprehension.

### Allophonic and Phonotactic Constraints are Useful

Kenneth W. Church

Massachusetts Institute of Technology  
Cambridge, MA 02139

*Proc. Eighth IJCAI, August 1983, Vol. 2: 636*

This paper argues that allophonic and phonotactic cues are a source of *constraint*, not a source of *noise* as many speech researchers have assumed in the past. These constraints are formulated so that they can be exploited with well-known parsing techniques.

### A Recognition Method of Connected Spoken Words with Syntactical Constraints by Augmented Continuous DP Algorithm

Sei-ichi Nakagawa

Department of Information and Computer Science  
Toyohashi University of Technology  
Toyohashi, 440 Japan

*Proc. Eighth IJCAI, August 1983, Vol. 2: 639*

The technique of dynamic time warping by using dynamic programming is powerful for isolated word recognition.

An augmented continuous dynamic programming algorithm is proposed for connected spoken word recognition with syntactical constraints. The algorithm is based on the same principle of two level DP and level building DP. Although our algorithm obtains a near optimal solution for the recognition principle based on pattern matching, it is computationally more efficient than the conventional methods and also does not require many memory storages. Therefore it is useful for connected word recognition with syntactical constraints in a large vocabulary. The amount of computation is almost the same as that for isolated word recognition.

### Over-Answering Yes-No Questions: Extended Responses in a NL Interface to a Vision System

Wolfgang Wahlster, Heinz Marburger

Research Unit for Information Science and Artificial Intelligence

University of Hamburg  
Mittelweg 179  
D-2000 Hamburg 13, F.R. Germany

Anthony Jameson

Psychologisch Laboratorium  
Faculteit der Sociale Wetenschappen  
Katholieke Universiteit  
Montessorilaan 3  
NL-6500 HE Nijmegen, The Netherlands

Stephan Busemann

Research Unit for Information Science and Artificial Intelligence  
University of Hamburg

*Proc. Eighth IJCAI, August 1983, Vol. 2: 643*

This paper addresses the problem of over-answering yes-no questions, i.e. of generating extended responses that provide additional information to yes-no questions that pragmatically must be interpreted as wh-questions. Although the general notion of extended responses has already been explored, our paper reports on the first attempt to build a NL system able to elaborate on a response as a result of anticipating obvious follow-up questions, in particular by providing additional case role fillers, by using more specific quantifiers and by generating partial answers to both parts of questions containing coordinating conjunctions. As a further innovation, the system explicitly deals with the informativeness-simplicity trade-off when generating extended responses. We describe both an efficient implementation of the proposed methods, which use message passing as realized by the FLAVOR mechanism and the extensive linguistic knowledge incorporated in the verbalization component. The structure of the implemented NL generation component is illustrated using a detailed example of the system's performance as an interface to an image understanding system.

### **Demand and Requirements for Natural Language Systems. Results of an Inquiry.**

**Katharina Morik**

Research Unit for Information Science and Artificial Intelligence

University of Hamburg  
Mittelweg 179

D-2000 Hamburg 13, F.R. Germany

*Proc. Eighth IJCAI, August 1983, Vol. 2: 647*

This paper presents the results of a market inquiry on German natural language systems (NLS), which may provide a basis for discussions about applications of AI systems. Features of application areas in which NLS are desired are analyzed and requirements for capabilities of NLS are determined.

### **Varieties of User Misconceptions: Detection and Correction**

**Bonnie Lynn Webber, Eric Mays**

Department of Computer and Information Science  
University of Pennsylvania  
Philadelphia, PA 19104

*Proc. Eighth IJCAI, August 1983, Vol. 2: 650*

This paper discusses some of our research into detecting and reconciling critical differences between a user's view of the world and the system's. We feel there is benefit to be gained by separating misconceptions into two main classes: misconceptions about what *is* the case and misconceptions about what *can be* the case. We review some initial work in both areas and discuss our work in progress.

### **The XCALIBUR Project**

**Jaime G. Carbonell, W. Mark Boggs, Michael L. Mauldin**

Computer Science Department  
Carnegie-Mellon University  
Pittsburgh, PA 15213

**Peter G. Anick**

Digital Equipment Corporation  
Hudson, MA 01749

*Proc. Eighth IJCAI, August 1983, Vol. 2: 653*

The inevitable proliferation of expert systems underscores the need for robust, friendly interfaces requiring minimal user training. The objective of the XCALIBUR project is to meet this need by providing natural comprehension and generation in the context of a focused mixed-initiative dialog. The XCALIBUR architecture is discussed, including its three central components (parser, generator and information manager), its methods of handling ellipsis and imperfect input, and its relation to the underlying expert system.

### **Towards a Computable Model of Meaning-Text Relations Within a Natural Sublanguage**

**Richard Kittredge, Igor Mel'cuk**

Department of Linguistics  
University of Montreal  
Montreal H3C 3J7 CANADA

*Proc. Eighth IJCAI, August 1983, Vol. 2: 657*

A computable linguistic model is proposed for relating texts to their meanings within a natural sublanguage of English (stock market reports). Oriented networks are used to represent meanings which are first established by a linguistic analysis of the paraphrase sets found in the sublanguage. Several types of correspondence rules map fragments of the semantic network onto portions of deep syntactic dependency trees in a recursive process which does not "consume" the network, but rather uses it as a kind of blueprint. Additional representation levels (not illustrated) are required to relate these trees to final texts through surface syntactic and morphological stages. Important features of this model are (1) its capacity to represent the full paraphrastic power of language within an interesting natural sublanguage, and (2) its bidirectionality, allowing the modelling of both analysis and synthesis of texts. Implementation is planned first as a device for synthesizing stock market reports (SMRAD system), but later possible applications include translation or paraphrasing of texts from this natural domain.

### **Q-TRANS: Query Translation into English**

**Eva-Maria M. Mueckstein**

IBM Thomas J. Watson Research Center  
Yorktown Heights, NY 10598

*Proc. Eighth IJCAI, August 1983, Vol. 2: 660*

Q-TRANS, which stands for Query-TRANSLation System, translates formal database queries into English to

enhance the usability of both natural and formal language database access systems. Q-TRANS is designed for the database query language SQL, whose query expressions serve as an abstract representation from which an English paraphrase is generated. Q-TRANS is also intended to be part of the Transformational Question Answering System (TQA system), which provides a natural language interface for database query, analyzing and ultimately translating the English queries into SQL expressions. The concepts and methods used in Q-TRANS to arrive at a query translation are, however, independent from the TQA system except for compatibility of lexical and grammatical coverage of the paraphrases produced. The paraphrases generated are true translations of the SQL expressions which are the input to Q-TRANS and serve in a sense as deep structures that get mapped into English imperatives. The grammatical English structures Q-TRANS produces obey somewhat conflicting constraints in that they preserve as much of the SQL structure as necessary to reflect the internal logic to the user, and at the same time represent as natural English sentences as possible.

### **Understanding Natural Language Through Parallel Process of Syntactic and Semantic Knowledge: An Application to Data Base Query**

**R. Comino, R. Gemello**

CSELT - Centro Studi e Laboratori Telecomunicazioni S.p.A.  
Via G. Reiss Romoli  
274 - 10148 Torino (Italy)

**G. Guida, R. Gemello**

Milan Polytechnic Artificial Intelligence Project  
Milano (Italy)

**C. Rullent, L. Sisto**

CSELT

**M. Somalvico**

Milan Polytechnic AI Project

*Proc. Eighth IJCAI, August 1983, Vol. 2: 663*

This paper describes the main features of the PARNAX system for natural language access (in Italian) to an ADABAS data base. The core of the system is constituted by the analyzer that includes parallel processing of syntactic and semantic knowledge. It is argued that this feature (together with the new macro- and micro-analysis technique which is only shortly mentioned in this paper) allowed the system to reach a good linguistic coverage, still ensuring an acceptable degree of efficiency. After the basic architecture and operation of PARNAX have been described, attention is focused on the parallel syntactic/semantic analyzer which is illustrated in detail. The advantages obtained through parallelism are also shortly discussed. Examples of PARNAX operation are presented. References to related works are mentioned, and directions for future research are outlined.

### **A Framework for Processing Corrections in Task-Oriented Dialogues**

**Philip J. Hayes, Jaime G. Carbonell**

Carnegie-Mellon University  
Pittsburgh, PA 15213

*Proc. Eighth IJCAI, August 1983, Vol. 2: 668*

Mundane discourse abounds with utterances referring to other utterances. These *meta-language utterances* appear with surprising frequency in task-oriented dialogues, such as those arising in the context of a natural language interface to an operating system. This paper identifies some simpler types of dialogue-level meta-language utterance and provides a computational framework to process such phrases in the context of a case-frame parser exploiting strongly-typed domain semantics.

### **Graph Grammar Approach to Natural Language Parsing and Understanding**

**Eero Hyvonen**

Digital Systems Laboratory  
Helsinki University of Technology  
02150 Espoo 15, Finland

*Proc. Eighth IJCAI, August 1983, Vol. 2: 671*

String grammars have been found in many ways inadequate for parsing inflectional languages with "free" word order. To overcome these problems we have replaced linear string grammars and tree transformations by their multidimensional generalization, graph grammars. In our approach, parsing is seen as a transformation between two graph languages, namely the sets of morphological and semantic representations of natural language sentences. An experimental Finnish question-answering system SUVI based on graph grammars has been implemented. In SUVI the role of individual words is active. Each word is associated to a syntactic-semantic constituent type that is represented by a transition network-like graph whose transitions correspond to transformations in the derivation graph. Parsing is performed by interpreting the constituent type graphs corresponding to the words of the current sentence.

### **Articles and Resource Control**

**Jamusz S. Bien**

Institute of Informatics  
Warsaw University  
P.O. Box 1210  
00-901 Warszawa, Poland

*Proc. Eighth IJCAI, August 1983, Vol. 2: 675*

The paper discusses how the resource control hypothesis introduced earlier by the author accounts for the rather mysterious fact that English articles are rendered in Slavonic languages by word order and vice versa. The definite versus indefinite distinction is viewed as a manifestation of the variable depth of

nominal phrase processing. The depth of processing is determined by the availability of resources, which is indirectly controlled by the speaker with sufficient precision; articles appear to be only some of several resource control devices available in natural languages.

### Activation-base Parsing

Mark A. Jones

State University of New York at Stony Brook  
Long Island, New York 11794

*Proc. Eighth IJCAI, August 1983, Vol. 2: 678*

A model is presented that describes natural language parsing in terms of a uniform activation algorithm which operates over an interconnected, declarative structure of nodes and node instances. The algorithm directs the flow of activation and expectation using only local information and, hence, supports substantial concurrency. A representation is introduced to express node relationships and activation agreement. Examples of several linguistic processes and their interrelationships are described.

### Two-Level Model for Morphological Analysis

Kimmo Koskenniemi

Department of General Linguistics  
University of Helsinki  
Hallituskatu 11-13  
SF-00100 Helsinki 10, Finland

*Proc. Eighth IJCAI, August 1983, Vol. 2: 683*

This paper presents a new linguistic, computationally implemented model for morphological analysis and synthesis. It is general in the sense that the same language independent algorithm and the same computer program can operate on a wide range of languages, including highly inflected ones such as Finnish, Russian or Sanskrit. The new model is unrestricted in scope and it is capable of handling the whole language system as well as ordinary running text. A full description for Finnish has been completed and tested, and the entries in the Dictionary of Modern Standard Finnish have been converted into a format compatible with it.

The model is based on a *lexicon* that defines the word roots, inflectional morphemes and certain non-phonological alternation patterns, and on a set of *parallel rules* that define phonologically oriented phenomena. The rules are implemented as parallel finite state automata, and the same description can be run both in the producing and in the analyzing direction.

### A Modular Parser for French

Eric Wehrli

Geneva University Hospital

*Proc. Eighth IJCAI, August 1983, Vol. 2: 686*

In this paper, we describe an efficient parser for French based on an adaptation of Chomsky's

Government-Binding (GB) theory. Reflecting the modular concept of a GB grammar, the parser consists of several distinct procedures corresponding to the subsystems of the grammar (e.g., phrase-structure rules, binding, control, 'theta'-theory, etc.). The interaction of these fairly simple modules produces the kind of complexity required in order to build all the linguistically motivated structures for a given sentence.

### An Object-Oriented Parser for Text Understanding

Brian Phillips

Texas Instruments, Inc.  
P.O. Box 226015, MS 238  
Dallas, TX 75266

*Proc. Eighth IJCAI, August 1983, Vol. 2: 690*

The parser is part of a text understanding system in which structural ambiguity is a major problem. All components of the system use a message-passing control structure. A general advantage of this form of control is that it allows the flexible integration of diverse knowledge sources. The parser transmits sub-sentential constituents for semantic interpretation. A pseudo-parallel version of the left-corner parsing algorithm with top-down filtering is used. As blind transmission would send spurious constituents, a delay mechanism is used to queue constituents until all alternative analyses of a segment have been completed.

### A Prolog Implementation of Lexical Functional Grammar

Uwe Reyle, Werner Frey

Institute of Linguistics  
University of Stuttgart

*Proc. Eighth IJCAI, August 1983, Vol. 2: 693*

Lexical functional grammar (LFG) is an attempt to solve problems that arise in transformational grammar and ATN-formalisms (Bresnan 1982). Another powerful formalism for describing natural languages follows from a method for expressing grammars in logic, due to Colmerauer (1978) and Kowalski (1974), called definite clause grammars (DCG) (Warren, Pereira 1980). Both formalisms are a natural extension of context-free grammars (CFG).

The aim of this paper is to show

- how LFG can be translated into DCG;
- that the procedural semantics of PROLOG provides an efficient tool for LFG-implementations in that it allows the construction of function structures (f-structures) directly during the parsing process. I.e., it is not necessary to have a separate component which first derives a set of functional equations from the parse tree, and secondly generates an f-structure by solving these equations.

## A Breadth-First Parsing Model

John Bear

Linguistics Research Center  
University of Texas  
Austin, TX 78712

*Proc. Eighth IJCAI, August 1983, Vol. 2: 696*

Recent attempts at modeling humans' abilities at processing natural language have centered around depth-first parsing algorithms, and control strategies for making the best choices for disambiguation and attachment. This paper proposes a breadth-first algorithm as a model. The algorithm avoids some of the common pitfalls of depth-first approaches regarding ambiguity, and by using more pre-computed information about the grammar, avoids some of the usual problems of parallel parsing algorithms as well.

## Sentence Disambiguation by a Shift-Reduce Parsing Technique

Stuart M. Shieber

Artificial Intelligence Center  
SRI International  
Menlo Park, CA 94025

*Proc. Eighth IJCAI, August 1983, Vol. 2: 699*

Native speakers of English show definite and consistent preferences for certain readings of syntactically ambiguous sentences. A user of a natural-language processing system would naturally expect it to reflect the same preferences. Thus, such systems must model in some way the *linguistic performance* as well as the *linguistic competence* of the native speaker. We have developed a parsing algorithm – a variant of the LALR(1) shift-reduce algorithm – that models the preference behavior of native speakers for a range of syntactic preference phenomena reported in the psycholinguistic literature, including the recent data on lexical preferences. The algorithm yields the preferred parse deterministically, without building multiple parse trees and choosing among them. As a side effect, it displays appropriate behavior in processing the much discussed garden-path sentences. The parsing algorithm has been implemented and has confirmed the feasibility of our approach to the modeling of these phenomena.

## Word Formation in Natural Language Processing Systems

Roy J. Byrd

IBM Thomas J. Watson Research center  
Yorktown Heights, NY 10598

*Proc. Eighth IJCAI, August 1983, Vol. 2: 704*

Systems which process natural language require a reliable source of information about words. Not only must their lexical subsystems handle a large number of known words; they must also cope with coinages. The morphological principles underlying the notion

“possible word” are under active study by linguists, and are articulated in the theory of word formation. This paper presents a technique for building lexical subsystems which embody these principles by emulating the behavior of word formation rules. These subsystems combine totally idiosyncratic lexical information, stored in a dictionary, with systematic information derived from word structure. Applications for lexical subsystems built along the lines described here will be discussed.

## A Deterministic Syntactic-Semantic Parser

Gerard Sabah, Mohamed Rady

GR22, PARIS VI  
4 Place Jussieu  
75230 PARIS CEDEX 5

*Proc. Eighth IJCAI, August 1983, Vol. 2: 707*

We consider that we have made a decisive step towards determinism in parsing. We agree with Winograd's hesitation to evaluate the determinism hypothesis as formulated by Marcus. However, this does not make us doubt about the possibility of determinism; on the contrary, we examined not only how to improve over Marcus, but also the historical reasons of the non-determinism of most systems.

Our improvements are based on two principles: syntactic-semantic integration, and quasi-simultaneity. The first means that there is no such thing as “the autonomy of syntax” (Marcus); so, we agree with Schank and, further, we showed that local semantic ambiguities could be solved deterministically. (Marcus (Ch. 10) claims that these ambiguities need parallel processing.) The second permits the processing of structures too difficult for PARSIFAL, e.g., locally ambiguous PP attachments.

Detailed examples support our proposals.

## A Deterministic Parser with Broad Coverage

Robert C. Berwick

Artificial Intelligence Laboratory  
Massachusetts Institute of Technology  
Cambridge, MA 02139

*Proc. Eighth IJCAI, August 1983, Vol. 2: 710*

This paper is a progress report on a series of three significant extensions to the original parsing design of Marcus (1980). The extensions are: The range of syntactic phenomena handled has been enlarged encompassing sentences with Verb Phrase deletion, gapping, and rightward movement, and an additional output representation of anaphor-antecedent relationships has been added (including pronoun and quantifier interpretation). A complete analysis of the parsing design has been carried out, clarifying the parser's relationship to the extended I.R(k,t) parsing method as originally defined by Knuth (1965) and explored by Szymanski and Williams (1976). The formal model has led directly to the design of a “stripped down”

parser that uses standard I.R(k) technology and to results about the class of languages that can be handled by Marcus-style parsers (briefly, the class of languages is defined by those that can be handled by a deterministic, two-stack, push-down automaton with several restrictions on the transfer of material between the two stacks, and includes some strictly context-sensitive languages).

### **Narrative Complexity Based on Summarization Algorithms**

**Wendy G. Lehnert**

Department of Computer and Information Science  
University of Massachusetts  
Amherst, MA 01003

*Proc. Eighth IJCAI, August 1983, Vol. 2: 713*

Narrative structures can only be defined in terms of some internal memory representation, but narrative complexity is more properly characterized by information processing requirements. Story grammars, plan and goal hierarchies, and causal chain representations all provide a sense of structure which is largely removed from the processes that produce or access that memory representation. In this paper we introduce the notion of algorithmic equivalence as a means of generating more algorithmically-oriented taxonomies for memory representations. Using memory representations based on plot units, we define two narratives to be algorithmically equivalent if they can be effectively summarized by the same retrieval process. This perspective on representational strategies is an especially natural one from a processing point of view, since the computational complexity of a particular information processing task must be measured in terms of the algorithms involved.

### **Japanese Language Semantic Analyzer Based on an Extended Case Frame Model**

**Akira Shimazu, Syozo Naito, Hirosato Nomura**

Musashino Electrical Communication Laboratory, N.T.T.  
3-9-11, Midoricho, Musashino  
Tokyo, 180, Japan

*Proc. Eighth IJCAI, August 1983, Vol. 2: 717*

This paper describes a Japanese language semantic analyzer based on an extended case frame model, which consists of a relatively large collection of case relations, modalities and conjunctive relations. The analyzer performs four stage analysis using a frame type knowledge base. It also utilizes plausibility scores for dealing with ambiguities and local scene frames for the prediction of omitted case elements.

### **Syntax, Semantics and Pragmatics in Concert: An Incremental, Multilevel Approach in Reconstructing Task-Oriented Dialogues**

**Manfred Gehrke**

Project "Prozedural Dialogmodelle"  
Department of Linguistics and Literature  
University of Bielefeld  
Bielefeld, FRG

*Proc. Eighth IJCAI, August 1983, Vol. 2: 721*

This paper gives an overview of a model for the reconstruction of task-oriented dialogues based on an interactive, multilevel parsing formalism. It is applied to route description dialogues. It will be shown how the pragmatic aspects of such dialogues are taken into account on different levels of processing. The approach described is based on an extension of the concept of cascaded ATNs. Furthermore this approach uses knowledge sources (KSs) for every participant in the dialogue in which knowledge about the world and a partner model is built up during the analysis of a dialogue. These KSs are supplied to the parsing process, as well. In this paper special importance is laid on the description of the interaction and cooperation of the different processing components of this formalism.

### **Event Models for Recognition and Natural Language Description of events in Real-World Image Sequences**

**Bernd Neumann, Hans-Joachim Novak**

Fachbereich Informatik  
Schulterstrasse 70  
0-2000 Hamburg 13, W. Germany

*Proc. Eighth IJCAI, August 1983, Vol. 2: 724*

For an adequate interpretation of image sequences it is not only necessary to recognize objects and object positions but also certain interesting temporal developments of the scene, called events. In this paper we discuss event models for traffic scenes at high-level conceptual structures which permit interfacing to an existing natural language dialogue system. Event models are declarative descriptions of classes of vents organized around verbs of locomotion. They involve components which are directly related to the deep case structure of a corresponding natural language description. Event models may be used for bottom-up scene description as well as top-down question-answering. They may also incorporate expectations about a scene, thus providing an interface to experience and common sense.

### **Automatic Construction of a Knowledge Base by Analysing Texts in Natural Language**

**Werner Frey, Uwe Reyle, Christian Rohrer**

Department of Linguistics  
University of Stuttgart

*Proc. Eighth IJCAI, August 1983, Vol. 2: 727*

We present a system which translates sentences from a subset of German into a database. This database will function as the basis for a question-answering system.

The system is applied to a complete text and not to isolated sentences. As an intermediate stage between the German text and the database we use the Discourse Representation Structures (DRS) invented by Hans Kamp. Kamp's system has been chosen because it handles intrasentential and intersentential relations uniformly. Within Kamp's system one can account for certain types of anaphoric relations for which no other linguistic theory has provided a solution.

The input to our system is analysed by a parser which is based on lexical functional grammar. This is the first attempt to combine research on discourse representation with lexical functional grammar with the help of the formalism of Definite Clause Grammar.

For the construction of the database out of the DRSs, two solutions are proposed. First, a translation of the DRSs into a set of PROLOG clauses enriched with some additional deductive principles. Second, the formulation of inference rules which operate directly on the DRS.

So far we have implemented the following components: parser of German, translation rules which map syntactic trees into DRSs and rules which translate DRSs into PROLOG-clauses.

## Why Good Writing Is Easier to Understand

**John H. Clippinger, Jr.**

**Brattle Research Corporation  
6 Faneuil Hall Market Place  
Boston, MA 02109**

**David D. McDonald**

**Department of Computer and Information Science  
University of Massachusetts  
Amherst, MA 01003**

*Proc. Eighth IJCAI, August 1983, Vol. 2: 730*

Writing is "good" when it anticipates the knowledge that its readers will bring to it – the questions they will implicitly ask – and tailors its content and form accordingly. A large part of this tailoring involves the careful use of "discourse clues"; choices of wording, patterns of phrasing, and specific discourse connectives that signal the structure and intent of a text to the audience. We begin by examining an instance of bad writing, rewriting it to illustrate the importance of discourse conventions in avoiding false interpretations. We continue with an example of a larger scale discourse pattern, and show how the recognition of such patterns captures important inferences "for free", making a general-purpose deduction component largely unnecessary. The paper concludes with a brief discussion of the design of a language understanding system presently under development that uses discourse clues and commonsense reasoning to direct the text understanding process in a flexible and opportunistic manner.

