

Abstracts of Current Literature

Planning Natural Language Utterances

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This paper describes recent research on a natural-language-generation system that is based on planning. A system named KAMP is described that is capable of producing English sentences as part of a plan to enlist the cooperation of another agent in achieving a goal involving a change in the physical state of the world. The planner uses knowledge about the different sub-goals to be achieved and linguistic rules about English to produce sentences that satisfy multiple goals through the realization of multiple illocutionary acts.

Argument Molecules: A Functional Representation of Argument Structure

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Understanding an utterance in an argument crucially requires determining the evidential relations it bears to prior and subsequent propositions in the argument. The memory representation of an argument should, accordingly, indicate which propositions a given proposition counts as evidence for (a *support* relation) or against (an *attack* relation), and which propositions support or attack it in turn. The representation of an argument can thus be viewed as a network of propositions connected by support or attack relations (an *argument graph*). Although this sort of representation can be motivated simply by the need to represent the *content* of an argument, it seems natural to ask whether such argument graphs might further possess any useful *structural* properties, abstracted from the specific propositions they relate.

ARGOT: The Rochester Dialogue System

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We are engaged in a long-term research project that has the ultimate aim of describing a mechanism that can partake in an extended English dialogue on some reasonably well specified range of topics. This paper

is a progress report on the project, called ARGOT. It outlines the system and describes recent results as well as work in progress.

Dividing Up The Question Answering Process

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This paper describes a question answering program which divides question answering into two separate processes: answer formation and answer expression. Rather than gathering possible answers and choosing the best among them, the program accesses the database and finds all components of possible answers, e.g. a causal chain, and then passes this information to an expression program which formulates a proper answer.

Salience as a Simplifying Metaphor for Natural Language Generation

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We have developed a simple yet effective technique for planning the generation of natural language texts that describe photographs of natural scenes as processed by the UMass VISIONS system. The texts follow the ordering on the scene's objects that is imposed by their visual salience — an ordering which we believe is naturally computed as a by-product of visual processing, and thus is available — for free — as the basis for generating simple but effective texts without requiring the complex planning machinery often applied in generation. We suggest that it should be possible to find structural analogs to visual salience in other domains and to build comparably simple generation schemes based on them. We look briefly at how one such analogy might be drawn for the task of tutoring novice PASCAL programmers.

Conceptual Dependency and Montague Grammar: A Step Toward Conciliation

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In attempting to establish a common basis from which the approaches and results can be compared, we have taken a conciliatory attitude toward natural language research in the conceptual dependency (CD)

paradigm and Montague Grammar (MG) formalism. Although these two approaches may seem to be strange bedfellows indeed with often noticeably different perspectives, we have observed many commonalities. We begin with a brief description of the problem view and ontology of each and then create a formulation of CD as logic. We then give "conceptual" MG translations for the words in an example sentence which we use in approximating a word-based parsing style. Finally, we make some suggestions regarding further extensions of logic to introduce higher level representations.

Event Shape Diagrams

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"Event shape diagrams" are proposed as a representation for capturing the nuances of meaning of verbs that describe similar events. These diagrams represent timing, causal relationships between case roles, and typical value ranges for role fillers. Event shape diagrams are expressed in terms of primitive predicates and timing information that we believe could be computed by perceptual systems, and are intended to be a step toward the eventual connection of language systems to perceptual (vision, hearing, and touch) sensing systems. The diagrams are capable of representing modification of verbs by adverbs, can support judgments of the degree of plausibility of various interpretations of a sentence's meaning, and may be useful in figuring out the meaning of certain kinds of metaphors.

An Explanation for Minimal Attachment and Right Association

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This paper describes the principles of Right Association and Minimal Attachment and explains how the Sausage Machine and ATN describe these principles. It is then shown that these two models cannot explain these principles. It is then shown that a production system grammar can both describe these principles as well as suggest why they must be true.

A Synthetic Approach to Temporal Information Processing

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A representation and processing scheme for temporal (time-based) information is presented. Previous computer science approaches to temporal information processing are analyzed. Linguistic analysis of tense, aspect, and temporal adverbials provides motivation for an automated general temporal understanding system. A synthetic approach is proposed, combining possible-worlds branching time theory with inertia futures, elements of Montague Grammar, a four-valued logic and the interval semantics time model. Key portions of the model are implemented and demonstrated in a PASCAL program.

Word Sense and Case Slot Disambiguation

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The tasks of disambiguating words and determining case are similar and can usefully be combined. We present two cooperating mechanisms that each work on both tasks: MARKER PASSING finds connections between concepts in a system of frames, and POLAROID WORDS provide a protocol for negotiation between ambiguous words and cases. Examples of each in action are given. The cooperating mechanisms allow linguistic and world knowledge to be unified, frequently eliminate the need to use inference in disambiguation, and provide a usefully constrained model of disambiguation.

Word Learning With Hierarchy-Guided Inference

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A technique for learning new words is discussed. The technique uses expectations generated by the context and an ISA hierarchy to guide the inference process. The learning process uses the context of several independent occurrences of the word to converge on its meaning.

Talking to UNIX in English: An Overview of UC**Robert Wilensky**

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UC (UNIX Consultant) is an intelligent natural language interface that allows naive users to communicate with the UNIX operating system in ordinary English. UC is currently capable of handling simple dialogues, including ones which require awareness of the context. UC is being extended to handle requests requiring more complex reasoning to formulate an intelligent response.

An Expert System for Interpreting Speech Patterns**Renato De Mori, Attilio Giordana, and Lorenza Saitta**

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Proc. 1982 AAAI Conf., Aug. 1982, 107-110.

Efficient syllabic hypothesization in continuous speech has been so far an unsolved problem. A novel solution based on the extraction of acoustic cues is proposed in this paper. This extraction is performed by parallel processes implementing an expert system represented by a grammar of frames.

Toward Connectionist Parsing**Steven Small, Gary Cottrell, and Lokendra Shastri**

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The parsing of natural language is the product of dense interactions among various comprehension processes. We believe that traditional models have greatly underestimated the richness of these interactions. We propose a model for low-level parsing which is massively parallel, highly distributed, and highly connected. The model suggests a solution to the problem of word sense disambiguation which is psychologically plausible and computationally feasible. The paper outlines the general connectionist paradigm followed by a brief description of a three-level network to do parsing. Finally we trace through an example to illustrate the functioning of the model.

Why Do Children Misunderstand Reversible Passives? The CHILD Program Learns to Understand Passive Sentences**Mallory Selfridge**

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As children learn language they initially misunderstand reversible passive sentences as if they were active sentences. This error is an important clue to possible mechanisms by which children learn to understand passives in general. This paper reports on how the CHILD program learns to understand passive sentences, initially misunderstanding reversible passives as it does so. It presents an explanation of children's performance based on CHILD, and presents a number of predictions which follow from this explanation.

Plan Understanding, Narrative Comprehension, and Story Schemas**William F. Brewer**

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This paper proposes that a comprehensive theory of stories must include components that deal with: (a) plan understanding, (b) narrative comprehension, and (c) the unique structural and affective aspects of the subclass of narratives that are stories.

Affect Processing for Narratives**Michael G. Dyer**

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This paper presents a theory of AFFECT processing in the context of BORIS (Dyer, 1982) (Dyer, 1981a), a computer program designed to read and answer questions about complex narratives. Here, "complex" entails the coordination, application, and search of many distinct sources of knowledge during both comprehension and question answering. This paper concentrates only on those structures and processes which interact with affect situations. The affect component in BORIS is not a separate module, but rather a series of structures and processes which arise as various lexical items are encountered during narrative comprehension and question answering (Dyer, 1981b).

On Being Contradictory**Margot Flowers**

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Proc. 1982 AAAI Conf., Aug. 1982, 269-272.

This paper discusses recognizing and producing contradictions. After illustrating the phenomena of contradiction, the paper presents conceptual classes of contradiction and gives an overview of how they can be recognized. The next part discusses the construction of contradictions, in particular with respect to contradicting historic events. The object of this paper is to examine the computational logic of contradictions, using contradictions as an example of how reasoning processes can and must exploit semantic knowledge and episodic memory, and to illustrate the kind of metaknowledge needed to use certain reasoning devices correctly and effectively.

GIST English Generator**Bill Swartout**

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This paper describes a prototype English generator which can produce English descriptions of program specifications written in Gist, a program specification language being developed at ISI. Such a facility is required because although Gist is a high level specification language, specifications written in it, like those in all other formal specification languages, are unreadable. There are several reasons for this unreadability: strange syntax; redundancy elimination; lack of thematic structure; implicit remote interactions; no representation of the motivation or rationale behind the specification; and a strict reliance on textual presentation. The current generator deals with the first two problems and part of the third. Our plans for dealing with the rest are outlined after a description of the current generator.

Automatic Schema Acquisition in a Natural Language Environment**Gerald DeJong**

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Proc. 1982 AAAI Conf., Aug. 1982, 410-413.

This paper outlines an approach to schema acquisition. The approach, called *explanatory schema acquisition* is applicable in problem solving situations and is heavily knowledge-based. Basically, learning is viewed as a fundamental part of the understanding process. Understanding a situation for which there is no existing schema involves generalizing the new event into a nascent schema. The new schema is then available to aid in future processing. This approach to learning is unique in several respects: it is not inductive and so is capable of one trial learning, it does not depend on failures to drive the learning process, and it is incremental and learns comparatively slowly. The learning procedure is outlined briefly with an example, a taxonomy of situations involving explanatory schema acquisition is given, and there is a brief discussion on the scope of the learning mechanism.

Monitors as Responses to Questions: Determining Competence**Eric Mays**

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This paper discusses the application of a propositional temporal logic to determining the competence of a monitor offer as an extended response by a question-answering system. Determining monitor competence involves reasoning about the possibility of some future state given a description of the current state and possible transitions.

Natural Language Processing Using Spreading Activation and Lateral Inhibition**Jordan Pollack and David Waltz**

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The knowledge needed to process natural language comes from many sources. While the knowledge itself may be broken up modularly, into knowledge of syntax, semantics, etc., the actual processing should be completely integrated. This form of processing is not easily amenable to the type of processing done by serial "von Neumann" computers. This work in progress is an investigation of the use of a spreading activation and lateral inhibition network as a mechanism for integrated natural language processing.

Using the Dance to Investigate the Pragmatic/Semantic Boundary Between Artificial and Natural Languages

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This work addresses the pragmatic and semantic distinctions between natural and artificial languages by the development of a context-free generative grammar to describe motions in modern dance. The dance is a particularly good vehicle as it conveys meaning, but is undescribed by a generative grammar. Whether or not a grammar describing dance motion can be considered to be for a natural or artificial language is unclear.

Recognizing Humor in Newspaper Cartoons by Resolving Ambiguities Through Pragmatics

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Newspaper cartoons can graphically display the results of ambiguity in human speech. The result can be unexpected and funny. Captioned cartoons derive their humor from a sudden incongruity which can be made to follow by a human being who can automatically use stored world knowledge to resolve the ambiguous situation. Likewise, computer analysis of natural language statements also needs to successfully resolve ambiguous situations. Computerized understanding of dialogue that takes place between humans must not only include syntactical and semantical analysis, but also pragmatical analysis. Pragmatics consists of an understanding of the speaker's intentions, the context of the utterance, and social implications of polite human communication.

Computer techniques have already been developed to use restricted world knowledge in resolving ambiguous language use. This paper illustrates how these techniques can be used in resolving ambiguous situations arising in cartoons.

Pragmatic Factors in Pronoun Reference Assignment

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Identifying factors that influence pronoun reference assignment is a challenge to anyone attempting to characterize the process of language understanding. Because a pronoun itself carries only a small part of the meaning that the understander is expected to assign to it, he or she must use contextual information to assign the pronoun an unambiguous referent. Characterizing aspects of the context which are used for this purpose is an active area of psychological research.

Many recent studies have considered the role of syntactic context, that is, the effect of structural constraints on pronoun reference in a fragment of text, typically a sentence, without recourse to constraints which might be found in the meaning of the text. Investigators have also examined the role of semantic factors within sentences in directing the assignment of referents. The studies reported here focus on the use of pragmatic constraints in resolving anaphoric pronouns. We are concerned with characterizing two major sources of contextual information in paragraph-length texts, and evaluating their influence on pronominal reference assignment.

Bi-Directional Inference

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Inference can be viewed as a search through a space of inference rules. Backward and forward inference differ in the direction of the search: backward inference searches from goals to ground assertions; forward inference searches from ground assertions to goals. This paper describes an inference procedure, called bi-directional inference, which limits the number of inference rules searched. Bi-directional inference results from the interaction between forward and backward inference and loosely corresponds to bi-directional search. We show through an example that, when used throughout a session of related tasks, bi-directional inference sets up a conversational context and prunes the search through the space of inference rules by ignoring rules which are not relevant to that context.

Natural Problem Solving Strategies and Programming Language Constructs

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Step-by-step natural language specification provides powerful intuitions for novice programmers using a programming language. We hypothesize that these intuitions take the form of frame-like *plans* — regular but flexible techniques for specifying how to accomplish a task. Programming knowledge also involves frame-like plans. While an individual programming language plan may have many lexical and syntactic similarities to a corresponding natural language plan, the two plans often have incompatible semantics and pragmatics. Many novice programmers' misconceptions derive directly from these incompatibilities. In this brief report we show an example of natural language and programming language plans. Using those plans we discuss transcripts of novice programmers using a natural language plan while attempting a programming language problem. We conclude with a brief discussion of the implications of this work.

Question Answering: Two Separate Processes

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I have developed a question-answering program that will answer questions about simple stories. In my program, question-answering is divided into two processes: (1) answer formation and (2) answer expression. The program first looks down a causal chain which is formed by the story-understanding program and figures out in what part of the chain the answer lies. The answer can also be a subset of the chain, sometimes a quite long one. The second part of the program takes this long chain and decides what things are important to express to the questioner. This answer expresser uses general rules of expression to figure out what it needs to include to make the answer understandable, informative and interesting.

This solution is different from other question-answering algorithms which view question answering as one process. These programs gather possible answers, and then choose the 'best' answer from among them. My program works in conjunction with PAMELA, a story-understanding program that specializes in goal-based stories.

Exploded Connections: Unchunking Schematic Knowledge

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In this short paper, we suggest a framework for the study of schematic aspects of natural language comprehension. The approach draws from previous work in schematic representation and reasoning, spreading activation, parsing, speech recognition, psycholinguistics, and computer vision. By decomposing schematic knowledge into diffuse units and by studying the way these facets of knowledge are connected inferentially, we expect to show important results in several areas. We use a particular spreading activation or active semantic network scheme, called *connectionism*, which consists of a massive number of appropriately connected computing units that communicate through weighted levels of excitation and inhibition. We show how a number of classical problems in the theory of schemata might be approached in a new way. Three principal issues are discussed: (1) comprehension takes place on a number of interacting levels of processing; (2) multiple hypotheses are simultaneously maintained at a number of diffuse processing loci; and (3) context affects processing in both top-down and bottom-up directions.

The Context Model: Language Understanding in Context

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This paper describes the language understanding component of the Unix Consultant (UC) system being developed at the Berkeley Artificial Intelligence Research project. The purpose of UC is to hold a conversation with a naive user of the Unix operating system while he or she is working on the computer, answering questions and solving problems for the user. The system has several other components, including the common sense planner PANDORA and the plan understander PAMELA. Our natural language understanding system contains as a subpart the PHRAN phrasal analysis program. The current system attempts to deal with the fact that PHRAN by itself is unable to deal with reference, and cannot disambiguate unless the linguistic patterns used require a particular semantic interpretation of the words. In addition, we wish to account for the fact that the same utterance may be interpreted differently in different contexts.

The system we are currently constructing has a mechanism, called the *context model*, which contains a record of knowledge relevant to the interpretation of the discourse, with associated levels of activation. There are rules governing how elements introduced into the context model are to influence it and the system's behavior.

Judgmental Inference: A Theory of Inferential Decision-Making During Understanding

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In the course of understanding a text, a succession of decision points arise at which readers are faced with the task of choosing among alternative possible interpretations of what they're reading. Careful analysis of a wide range of sample texts reveals that such decisions are often based on complex evaluations of the interpretation being constructed, and sometimes cause the reader to construct and discard a number of intermediate inferences before settling on a final interpretation for a text. This paper describes Judgmental Inference theory as a proposed scheme of evaluation metrics and mechanisms, derived from examination of inference decisions arising during text understanding. A series of programs, ARTHUR, MACARTHUR, and JUDGE are briefly described, which incorporate some of the metrics and mechanisms of Judgmental Inference, enabling them to understand texts more complex than those that can be handled by other understanding systems.

On the Interaction of Knowledge Representation and Reasoning Mechanism in Discourse Comprehension

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The process of discourse comprehension presupposes close co-operation of two subsystems of an understanding system — its knowledge (memory) subsystem and reasoning subsystem. The authors present a concrete mechanism called SCENE SURVEYOR for guiding reasoning in a text understanding system TARLUS. The SCENE SURVEYOR is an active structure which makes use of the knowledge of the world and the knowledge of the regularities of text construction.

Its active character is manifested in posing questions about incoming data and looking for answers to these questions in order to recognize higher level situations (events not mentioned in the text explicitly), and secondly, in keeping track of scenes and their changes in the text.

An Expert System for Speech Decoding

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Efficient syllabic hypothesization in continuous speech has been so far an unsolved problem. A novel solution based on the extraction of acoustic cues is proposed in this paper. This extraction is performed by parallel processes implementing an expert system represented by a grammar of frames which is a generalization of an attributed grammar.

Parallel Processing of Natural Language

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An approach to parallel processing of natural language is described. It exploits the phenomenon of locality of text elements and is based on a multiprocessor system architecture which is aided by a special type of table grammars. The operation of the system is illustrated by an example of syntactic parsing in a subset of English. We describe the Friendly-Neighbours and Pyramid algorithms for parallel parsing.

User Modelling in Anaphora Generation: Ellipsis and Definite Description

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This paper shows how user modelling can improve the anaphoric utterances generated by a dialogue system. Two kinds of anaphora are examined: contextual ellipsis and the anaphoric use of singular definite

noun phrases. In connection with ellipsis generation, anticipation of the way in which the user would be likely to reconstruct a given utterance can help to ensure that the system's utterances are not so brief as to be ambiguous or misleading. When generating noun phrases to characterize specific objects with which the user is not familiar, the system may take into account the existential assumptions, domain-related desires, and reference beliefs ascribed to the partner. These applications of user modelling are illustrated as realized in the dialogue system HAM-ANS, and some possible generalizations and extensions of the strategies described are discussed.

An Experiment Towards More Efficient Automatic Translation

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Proc. 1982 European AI Conf., July 1982, 228-231.

This paper outlines a program that translates in the restricted context of cooking recipes from French into Arabic. It consists of two completely independent phases: the comprehension phase receives the French recipe text and outputs a sequence of elementary actions; the second phase generates from that sequence several texts all expressing, in Arabic, the same original recipe. Thus the translation is actually done text for text. The two phases are not fully developed here; but we describe a general scheme of the program and point out the analogy between them.

Steps Towards Natural Language to Data Language Translation Using General Semantic Information

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The aim of the work reported here is to maximize the use of general semantic information in an AI task processor, specifically in a system front end for converting natural language questions into formal database queries. The paper describes the translation component of such a front end, which is designed to work from the question meaning representation produced by a language analyser exploiting only general semantics and syntax, to a formal query relying on database-specific semantics and syntax. Translation is effected

in three steps, and the paper suggests that the rich and explicit meaning representations using semantic primitives produced for input sentences by the analyser constitute a natural and effective base for further processing.

Formalizing Factors in Metaphorical Extension

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This paper presents an approach to a computer analysis of simple metaphorical statements which provides a framework in which factors salient to the metaphor as well as conceptual information essential to the interpretation can be consistently incorporated. This approach considers both "what is happening," i.e. predicative or explicit information, and the impression which the speaker/writer wishes to create, as represented by modifying or implicit information.

The predicative aspect provided the basis of a previously implemented system, which was based on abstracted attributes and relations, but also allowed for evaluative and magnitudinal factors; this system paraphrased statements including metaphorically used verbs. The proposed expanded system allows for the incorporation of effects or impressions on the participants of the metaphorically expressed conceptualization, on "outside observers" and, indirectly, on the hearer/reader. The concept of force, which is seen as frequently structuring motivations for and conditions on changes of state, constitutes one of the factors shown to be useful in the analysis of such effects.

Automatic Understanding with a Linguistically Based Knowledge Representation

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Information systems with natural language access to stored data range from rather simple systems for specific purposes up to experimental projects of natural language understanding systems compiling also the data in an automatic way. Many of these projects use a trial-and-error approach; to make such a system more general, it seems advisable to include a relatively complete analysis of language structure; this ensures a general base, which can be simplified with respect to particular applications. Using operational tests for distinguishing between meaning and factual knowledge, ambiguity and indistinctness, etc., the Prague

research group has formulated the level of meaning as a set of underlying representations consisting in dependency trees with nodes labelled by complex symbols, every lexical unit having its valency (case) frame. The relationships between this level of meaning and the domain of cognitive structures is handled by means of inference rules. The system described is being prepared for experiments in question-answering, based only on input texts and inference rules.

Supporting Natural Language Updates in Database Systems

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Although a great deal of research effort has been expended in support of natural language (NL) database querying, little effort has gone into NL database update. One reason for this is that in NL querying one can tie nouns and stative verbs in the query to database objects (relation names, attributes and domain values). In many cases this correspondence seems sufficient to interpret NL queries. NL update seems to require database counterparts for active verbs, such as *hire*, *schedule* and *enroll*. We suggest a database counterpart for active verbs, which we call verbgraphs, that may be used to support NL update. A verbgraph is a structure for representing the various database changes that a given verb might describe. Other possible uses of verbgraphs include specification of defaults, prompting of the user to guide user interaction, and enforcing database integrity constraints.

An Informative, Adaptable, and Efficient Natural Language Consultable Database System

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Within a unique formalism, logic is a powerful theoretical basis allowing one to represent a database and to express the different types of processing — syntactic, semantic and deductive — involved when this database is consulted in natural language. In this framework we describe a complete system using a three-truth valued logic, rigorously defined. This logic allows a very fine representation of question semantics

and lays the theoretical basis for the creation of an informative system consulted by casual or non-expert users. We compare the performance of our system with that of related ones, and outline possible extensions.

Taking the Initiative in Natural Language Data Base Interactions: Monitoring as Response

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This note is intended as a status report on our ongoing work in the area of natural language interaction with dynamic knowledge bases. Specifically, we discuss that portion of our research involving the offer by the question-answering system to monitor for future changes in the knowledge base.

Applying a Chart Parser to Speech Understanding

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We describe GLP, a chart parser that will be used as a SYNTAX module of the Erlangen Speech Understanding System. After a brief outline of the speech system's architecture we introduce the concept of chart parsing. The parser itself realizes a multiprocessing structure using an agenda, which easily allows the application of various parsing strategies in a transparent way. Finally we discuss which features have to be incorporated into the parser in order to process speech data: direction independent island parsing, handling of scores, and the interaction with higher level components like SEMANTICS.

How to Write a Story

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A scenario for story writing is presented which attempts to improve that of TALE-SPIN. The overall model presented attempts to simulate Goal Directed Behavior of characters as well as intentions of the story written. The scenario of a computer program ROALD based on a sub-set of the model is presented.