Robust, Incremental Parsing and Disambiguation for a Dialog Agent

Lenhart K. Schubert, PI (Computer Science)
James F. Allen, co-PI (Computer Science)
Gregory N. Carlson, co-PI (Linguistics)

CONTACT INFORMATION
Department of Computer Science, University of Rochester
Rochester, NY 14627-0226
Email: schubert@cs.rochester.edu
Phone: (716) 275-8845
Fax: (716) 461-2018
WWW page: http://www.cs.rochester.edu/u/schubert/

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SUMMARY
Our general interest lies in robust natural language processing in the context of purposeful, spoken human-machine dialogs. This particular project focuses on robust techniques for incremental parsing, dialog structure processing and disambiguation (with use of syntactic, semantic, and prosodic information). As such it is intended to extend and complement past and current the work on NL interaction and planning assistance in the TRAINS transportation planning domain at U. Rochester. A special challenge to robust processing lies in the fragmentation and "nonlinearity" of actual dialogs, i.e., their organization into dialog segments and subdialogs (e.g., for acknowledgements, corrections and clarifications) whose boundaries often do not coincide with sentence boundaries. Incrementality and on-line disambiguation are crucial here in order to model mid-sentence turn-taking, characteristic of human dialogs.

A central tenet in the proposed research is that *hypotheses about dialog structure should be able to influence hypotheses about sentential and phrasal structure* (not only the converse). Thus parsing will be integrated with discourse processing, and will employ a multi-utterance chart structure reflecting the discourse segment structure. These dialog charts will support a flow of multiple kinds of information in multiple "directions". On the one hand, phrasal and lexical constituency, turn-taking, prosodic cues, and anaphoric relations all supply (more or less firm) constraints on discourse structure; on the other, discourse structure supplies (more or less firm) constraints on phrase structure, particularly the formation of discontinuous constituents straddling corrections, acknowledgements, etc.; it also supplies constraints on anaphoric relations, which will be disambiguated in accordance with principles that are emerging from computational and psycholinguistic studies.

While the research will initially consider written language transcribed from spoken dialogs, the aim is to move into direct speech interaction as quickly as possible, using state-of-the-art speech recognition and synthesizer equipment. A corpus of spoken dialogs has been collected at Rochester, and major portions have been transcribed and prosodically annotated. These dialogs will serve as an empirical basis for the investigation. In addition, Treebank data will be used to derive lexical, syntactic and semantic preferences for a preference-based parser.

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AREA BACKGROUND

We might describe our project as falling into the area of "dialog agents", or more precisely "conversational problem-solving assistants". This is an emerging area, and as such is not covered by any standard surveys or reference books, beyond basic background on NL processing, such as [Allen'94, Pereira & Grosz'94]. But a dialog agent cannot be built using traditional NLP techniques alone. First, natural problem-solving dialogs involve intertwined discourse that breaks up normal sentence structure and layers a complex segmental structure on top of it. A dialog agent needs to be able to understand such structures, and participate in their creation. Second, by definition a problem-solving assistant has a job to do, beyond conversing. It needs to have extensive knowledge about the problem-solving domain; it needs to be able to solve (at least low-level) problems in that domain; it must be able to make inferences from its interaction with the user about user beliefs, goals, and plans; and it must be able to collaborate with the user, contributing its own beliefs, suggested goals and plans, and work towards a mutually agreed-upon solution to the task at hand. Third, optimal communication often requires multiple modalities, such as spoken and written language, images, menus, etc., so that these modalities need to be integrated into a single communicative framework.

With this array of requirements, the area naturally remains eclectic, drawing not only on the NLP literature but also on the literature concerning the intentions and plans that drive communication (e.g., [Cohen *et al.*'90]), knowledge representation, reasoning and planning (e.g., [Genesereth & Nilsson'87], [Allen *et al.*'90]), and miscellaneous work on speech processing, psycholinguistics (e.g, [Clifton *et al.*'94]), formal semantics, discourse processing, multimodal communication, hybrid reasoning, and architectures for intelligent systems.

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RELATED PROGRAM AREAS

Other Communication Modalities, Adaptive Human Interfaces.