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Knowledge and Reasoning in Practical Dialogue Systems

Introduction to the Special Issue

This ETAI Special issue contains selcted papers from the 1999 IJCAI Workshop on Knowledge and Reasoning in Practical Dialogue Systems.

The motivation for the worskhop was the fact that applications utilizing spoken natural language interaction were becoming increasingly common, mainly due to the development of speech technology, and it was thus important to bring together researchers to discuss the knowledge and reasoning that these practical dialogue systems need. Apart from the technology in speech recognition and speech synthesis, spoken dialogue systems require dialogue capabilities that allow users to be engaged in a natural and efficient interaction.

Two main approaches for managing interaction can be distinguished. For the sake of robustness and portability, practical dialogue systems tend to rely on simple models for dialogue management (e.g. state transition diagrams or dialogue grammars) and simple representations (if any) of domain or task knowledge (e.g. frames). For certain applications, such as information retrieval from a database, these models actually appear to be sufficient. On the other hand, dialogue models developed within Artificial Intelligence tend to emphasize the relation between utterances and the speaker's goals and plans, the agent's ability to reason about the other agents' beliefs and intentions, and the need for domain knowledge and discourse representation for resolving anaphoric and deictic references. Somewhere in between we also find proposals that either augment the simpler dialogue models with generic and specific domain knowledge, or restrict the role of plan inference to specific situations. The workshop was meant to provide a meeting point for these kinds of projects, which aim at unifying elaborated reasoning with the practical demands of spoken dialogue systems.

The workshop attracted about 40 participants, and the presentations focused on knowledge and reasoning in dialogue systems from both theoretical and practical perspectives. Besides the innovative aspect of research, an emphasis was also laid on the importance of implemented dialogue systems as test-beds for evaluating the usefulness of theories and ideas, and on improvements in practical system abilities supporting a more natural and efficient interaction.

The current special issue grew from the workshop presentations as an extended workshop publication with a further submission and reviewing process according to the ETAI policy. The authors were asked to submit a revised version of their workshop presentation to the ETAI, the submissions were available on the web, and the workshop reviewers as well as the the authors were invited to take part in the discussion on the submitted papers.

After the first round, the final decisions were made by the ETAI guest editors.

The special issue is organised according to the workshop topics, and follows their logical order when designing building practical dialogue systems. The first papers deal with the question of the relation between different proposed knowledge sources, such as discourse models, task models, domain models, conceptual models and user models, and their reusability in building dialogue systems. The next papers describe working dialogue systems, and the integration and coordination of knowledge into dialogue models. The last papers discuss especially the representation of dialogue knowledge and its use in practical systems for the treatment of some particular dialogue phenomenona.

In the paper *Representing Knowledge of Dialogue, Domain, Task and User in Dialogue Systems - How and Why?*, Annika Flycht-Eriksson presents a thorough analysis of knowledge sources and models in dialogue systems. The roles of the various knowledge sources and the relations between them are discussed in light of the capabilities needed by dialogue systems to achieve natural interaction with users. The mapping between capabilities and the knowledge sources they rely on is presented in a table that can be used as tool to support design of dialogue systems.

In Anke Kölzer's paper *Universal Dialogue Specification for Conversational Systems* the problems of re-use and generality of systems are attacked. Kölzer develops a solution containing a meta dialogue model and a set of tools that go with it to support specification in a visual language, consistency checking, code generation, dialogue module libraries and system transformations. The focus is on dialogue flow using dialog statecharts as the basis for modelling.

Staffan Larsson, Robin Cooper, Elisabet Engdahl and Peter Ljunglöf in their paper *Information states and dialogue move engines* present the Gothenburg Dialogue System, GoDiS, a generic dialogue system for information-seeking dialogue. GoDiS is based on TRINDIKIT, a framework for experimenting with implementations of different theories of information state, information state update and dialogue control. In the paper the specific informations state utilised in GoDiS is presented along with the update rules needed to accomodate various uterances.

The paper *Language-Processing Strategies and Mixed-Initiative Dialogues* by Johan Boye, Mats Wirén, Manny Rayner, Ian Lewin, David Carter and Ralph Becket investigates the requirements on linguistic processing in a system that supports a variety of user strategies in the travel domain. In particular, they investigate and compare the performance of two linguistic processors, the Core Language Engine performing deep analysis and a keyword-based shallow analyser. Interestingly, their hypothesis that the two systems would be required for different parts of the dialogue is not quite borne out.

In the paper *Towards a Dialogue Capability in a Bayesian Argumentation System* Richard McConachy and Ingrid Zukerman present the argumentation-generation process and dialogue capabilities of NAG (Nice Argument Generator) an ideal automated argumentation system. A novel feature of the system is that the user can, through a hypertext interface, investigate the system's arguments and consider various aspects of an argument. The paper also present two small evaluations indicating that NAGs arguments were persuasive and that the exploratory interactions were helpful.

Representation of local dialogue context is needed to react appropriately to meta-dialogue. In the paper *Representations of Dialogue State for*

Domain and Task Independent Meta-Dialogue by David R. Traum, Carl F. Andersen, Waiyian Chong, Darsana Josyula, Yoshi Okamoto, Khemdut Purang, Michael O'Donovan-Anderson, and Don Perlis a representation of local dialogue structure is presented. The paper presents the Alma Carne Dialog Manager which utilise the six component representation suggested for reasoning about the internal aspects of sub-dialogues needed to, in particular, reasoning about contradictions.

The paper *A Practical, Declarative Model of Dialog* by Susan W. McRoy and Syed S. Ali presents a computational model of dialogue for collaborative tutoring systems. The dialogue system allows for incremental presentation and interpretation of vague and fragmented utterances. The dialogue is modeled on five levels of representation, thoroughly presented in the paper. One prominent feature is the systems ability to recognise and repair misunderstandings through the use of argument schemata.

We wish to thank the workshop's programme committee for their commitment in making the workshop a stimulating event, and for providing comments and constructive reviews in the ETAI discussion period. The programme committee consisted of: Masahiro Araki, Kyoto University, Japan, Rolf Carlson, KTH, Sweden, Koiti Hasida, ETL, Japan, Diane Litman, AT&T Labs Research, USA, Susan McRoy, University of Wisconsin-Milwaukee, USA, Massimo Poesio, University of Edinburgh, UK, Mieke Rats, Compuleer, The Netherlands, Norbert Reithinger, DFKI, Germany, David Sadek, France Telecom, France, David Traum, University of Maryland, USA, and Ingrid Zukerman, Monash University, Australia.

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Guest editors