

Book Reviews

Plan Recognition in Natural Language

Sandra Carberry

(University of Delaware)

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This book is essentially a reworking of Carberry's 1985 thesis, and although six years have passed since the bulk of the research was done, the issues that it addresses are still very relevant to researchers and developers of natural language systems.

As the title suggests, this book can be viewed from two perspectives, depending upon one's persuasion. It first presents a method for identifying and tracking a speaker's changing task-related goals and plans, showing how plan recognition can be done in the dynamic domain of an ongoing conversation. It then demonstrates how this technique can be applied to two challenging natural language problems: pragmatically ill-formed utterances and intersentential ellipsis. These sections are bracketed by two discussions of related work, covering the research before and since her thesis. The latter discussion (entitled "Plan inference: The next generation") gives the impression of being an afterthought; it attempts to bring the research up to date by pointing out several changes in how the plan recognition problem is currently viewed, but it does not always resolve the consequences of this new view with respect to the earlier chapters.

Tracking an ongoing dialogue is one of those tasks that humans perform so effortlessly that they are often unaware that they are doing it. It is only when we attempt to automate this process that we realize how complicated the task really is. Carberry proposes a two-tiered approach to plan recognition in a dialogue situation. In the first (local) level, the speaker's immediate goal is identified, and eight plan identification heuristics are used to propose candidate focused goals and plans. These heuristics are derived from Allen's inference rules (Allen and Perrault 1980). A typical heuristic is this:

If IS [the information seeker] wants a proposition P to be true and P is not currently satisfied, P becomes a candidate focused goal, and those plans that contain P on their primary effect list become associated candidate focused plans.

The result of this local phase is a set of goal-plan pairs, any of which could potentially be the one the user is focused on. Global analysis then takes over to fit these pairs into a context tree. The root of this tree is the most general plan the user could be considering, and branches indicate unresolved ambiguities between more

specific subplans. Focusing heuristics are used to identify the most appropriate new focused plan, based on the current focus and the topology of the context tree. Generally, these rules select the candidate plan that is "closest" to the current focus, since large context shifts are more difficult (and thus presumably less likely).

This plan recognition framework is one of the first that cleanly handles dynamically changing plans and goals in a natural language dialogue. This is an important result in its own right, but it turns out that the information collected during this process can be used to give straightforward solutions to several historically difficult natural language problems. Carberry illustrates this with two specific problems: understanding pragmatically ill-formed queries, and understanding intersentential ellipsis.

Pragmatic ill-formedness has been addressed many times before, but usually only with isolated queries. However, proper understanding often depends on the context of the dialogue. For instance, the question "Which apartments are for sale?" is ill formed if apartments cannot (individually) be sold. It could be reinterpreted in two different ways, depending on whether the speaker was considering purchasing a single residence or making a multi-million-dollar investment. By using the information in the context model, Carberry's method proposes substitutions to create revised queries, and these are narrowed to a single choice on the basis of relevance and semantic similarity.

The second application, understanding intersentential ellipsis, is based on the premise that the speaker and listener share a set of mutual beliefs about the discourse knowledge, and that the ellipsis refers to a plan or goal contained in this knowledge. Once again, this knowledge is already maintained by the plan recognition process, and can be used to build a stack of discourse expectations. These contain both discourse goals such as "obtain information" and domain goals. Another set of rules selects the most reasonable interpretation.

The large number of heuristic rules (no less than 65) is one of the more interesting aspects of this book. Since this work predates the recent flourish of quantitative plan analysis, there are no actual probabilities assigned to plan alternatives. But the heuristics do give a way to express preferences among competing explanations for the speaker's utterance. They serve to capture the intuitions behind many of our natural interpretations of dialogues. One thing that is lacking is a discussion of completeness: do the heuristics cover all of the cases that will occur? For some classes of rules (such as those dealing with the topology of the context tree), it is fairly easy to come up with a completeness result. But with many of the others, the answer is not obvious.

Unlike most work in this area, Carberry's book can actually be read as a book. She doesn't get bogged down in obscure notation, and each technical point is immediately illustrated by an example. Someone with a rudimentary knowledge of basic plan recognition techniques could read the book straight through and emerge with a good understanding of her approach. However, the structure of the book occasionally gets in the way of a more detailed reading. For instance, the heuristic rules are scattered throughout the entire book, and it is up to the reader to collect and compare them. A simple summary of each chapter's rules would have helped a lot.

One thing I found slightly frustrating involves the tantalizing glimpses we get of how this approach is grounded in the real world. On page 14, Carberry says that "to develop the hypotheses and strategies presented in this book, dialogues from many different domains were analyzed." This analysis is referenced several times through the book as a justification for particular heuristics, but we never get to see the analysis itself. In fact, it is often not clear which of the examples in the book are "live" and which are contrived. It would have been much more interesting and informative to have a larger discussion of how the theory was affected by the dialogue analysis and how well they performed on the dialogues.

These reservations aside, people on either side of the plan recognition/natural language fence should find this book both interesting and useful.

Reference

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