Questions and Information Systems

Thomas W. Lauer, Eileen Peacock, and Arthur C. Graesser, editors
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The handling of questions in a computational system falls into one of the more obvious convergences of natural language processing and human factors. The relationship of a user to an information system is fundamentally that of inquiring; at the same time, questions are asked in many different forms other than the simply interrogative, and much contextual knowledge must be maintained in order to understand what question is really being asked and what is the most informative answer. In *Questions and Information Systems*, Lauer, Peacock, and Graesser present 15 articles with the goal of presenting a wide, multi-disciplinary perspective on questioning. What is successful about the book, however, is not the breadth of perspective but rather the focus on descriptive models and the empirical studies that underlie them.

The book is a compilation of amplified papers originally presented at a 1990 conference at Oakland University, Michigan. The articles in the book are organized along the following general topics: determining system information requirements (Chapters 2–5), design of computer interfaces (6–9), questions and large databases (10–12), and understanding complex decision processes (13–16). Regardless of the functional discussion, though, the articles in the book generally present ways of gathering empirical data on questioning behavior, and of representing this behavior in terms of question types. These two themes are the bases of the topics in the book. Both the approach toward data collection and the various representation schemes proposed are generally departures from the work of editor Graesser. In that sense, Chapter 9 (Graesser et al., "Mechanisms that generate questions"), together with Chapter 12 (Graesser et al., "Answering questions about information in databases") state the fundamental principles of most of the work reported in the book.

In Chapter 9, the authors zero in on a particular (empirically motivated) type of questioning, that of genuinely desiring to solicit new information. These "inquiries" are not always in the surface form of a question, of course, leading to an appeal to the Modern Language Philosophy concept of "speech act" (Searle 1969) to distinguish between the form of what is said and the intended effect on the hearer. The usage of "speech act" here is a bit less than rigorous, and that of "taxonomy" almost a misnomer, but the point is successfully conveyed that there are derivable, motivated categorizations of inquiries based on the mechanisms of generating inquiries (similar to what Searle would derive as perlocutionary force): correction of knowledge deficit, monitoring common ground, social coordination of action, and control of conversation and attention.

In Chapter 12, Graesser et al. detail the QUEST model of question answering, intended to account for human question-answering behavior. Its major components

are: interpreting the question (parsing and identifying the question type); accessing information sources (a variety of generic and episodic knowledge representation structures); using convergence mechanisms (intersecting the nodes on the retrieved knowledge structures), and verifying pragmatics (conformance to goals, informativeness, etc.). Essentially, the QUEST model maps the logical form of question into a structured set of structured knowledge representations, these latter structures being of a variety of forms (taxonomies, conceptual graphs, causal models, etc.) depending on the nature of the relationships obtaining among relevant concepts in the knowledge structure. (Chapter 3, Gordon and Gill's "Knowledge acquisition with question probes and conceptual graph structures" expands on representational structures.) Structures may be episodic (instances of experience) or generic (generalizations over many such episodes). These knowledge sources are accessed, the relevant parts retrieved, and then intersected to form a set of possible answers. These possible answers are finally filtered by informativeness and usefulness in the setting in which the question was created (intended goal of asker/answerer, for instance). The difficulty in this model, as in every human knowledge representation model, is the size and shape that the information sources must be to accommodate the sorts of general questioning and answering that humans do all the time. Therefore the implementation of QUEST-based computational systems has the onus of structuring huge amounts of knowledge, and even then limiting the domain scope of a QUEST prototype in an empirically motivated way. Nevertheless, QUEST is a very useful model against which to consider individual issues in question answering.

The reference to the importance of pragmatics in Chapter 12 is an extremely important one, especially in the context of the nature of cooperation implicit in asking questions. A fuller explication of the role of pragmatics in an extension to the QUEST model is described in Chapter 11 (Golding et al., "WHEN: A model for answering 'when' questions about future events"). Here, conversational maxims (Grice 1975) are cited as a basis for determining not the truth but the relevance, informativeness, clarity, etc., expected of a reply. The authors describe an experiment in which scenarios with varying "now" and "then" parameters were queried. The responses indicate the appropriateness of day-name responses versus calendar dates and relative dates.

This bias toward empirical data collection is shared widely by the authors of the book, and is a welcome theme to foster, particularly in knowledge representation and in discourse, both relevant to question answering. In particular, Chapter 5 (Lipp et al., "The evolution of questions in successive versions of an expert system for real estate disposition") describes a rather intense data-collection task using real-estate experts, asking each other questions about cases, to develop a knowledge base, and to learn about the nature of informed questions at the same time. The empirical theme, aimed toward modeling question types and contexts, is continued in Chapter 4 (Lauer et al., "Question generation and the systems analysis process"), Chapter 6 (Carroll and Rosson, "Design by question: Developing user questions into scenario representations for design"), and Chapters 13 (Lauer and Peacock, "Question-driven information search in auditor diagnosis"), 14 (Steinbart, "The role of questioning in learning from computer-based decision aids"), and 15 (Paradice, "A question-theoretic analysis of problem formulation: Implications for computer-based support").

Two papers differ significantly from the overall themes of the book. The first article (Chapter 2, LaFrance, "Questioning knowledge acquisition") challenges the ordinary assumptions about the relationship of knowledge to questions, as if to depart from the general focus of the rest of the chapters before the reader encounters them. LaFrance claims that questions are themselves informative, in fact, that it is questions, not static knowledge representations, that organize the knowledge of the answer. Thus there are

no static bodies of knowledge in the expert's head; these structures are instead generated as a response to questions as the organizing principle. This axiom, that questions do not "extract" information (though they do cause its acquisition), is one of six challenging axioms involving the deep interaction of knowledge engineer and expert, of what the question really does and the actual truth, completeness, and generalizability of the answer. Surprisingly, the claims are not entirely incompatible with the adherents of the QUEST-type models, despite the latter's dependence upon pre-existing knowledge structures: the focus on the interaction as the center of the question and its answer, particularly in establishing common conversational ground, is a position that LaFrance shares.

Indeed, Chapter 16 (Kass, "Question asking, artificial intelligence, and human creativity") may provide a connecting point between the divergent positions on knowledge structures. Kass's AI system adapts to answer novel questions by asking itself questions. Thus, at the same time it creates knowledge structures in LaFrance's sense and makes generalizations from episodic knowledge in Graesser's sense.

The second departure from the general theme of the book is Chapter 10 (Dahlgren, "Interpretation of textual queries using a cognitive model"). This paper essentially describes the design of the Interpretext natural language text-understanding system, in terms of the generally accepted precision–recall advantages of such designs over keyword searches. Dahlgren has the opportunity here to address the interesting implications of adding querying to modern message understanding. But she shies away from this, though, essentially adding a passage about the advantages of using the same understanding mechanism to process both queries and the text to be retrieved. In slighting that discussion, the author misses the focus that connects text understanding to the book's themes.

Chapter 10 is one of a number of places that would have been appropriate for a discussion of discourse problems compounded by question–answer scenarios. In natural language interfaces to databases (NLIs), the sequence of question/retrieval/re-question has always been a particular challenge. Beyond the usual text anaphoric reference problems, here an anaphor can point either to the previous answer or to the previous question, and thus both structures need to be present and accessible in the natural language processing. The issue is not addressed in the book, though a well-articulated QUEST-type information structure could in theory accommodate it. Chapter 8 (Lang et al., "Question-asking in human–computer interfaces") has a useful overview of NLIs, various compromises of them (e.g., the Texas Instruments guided NLI approach of the mid 1980s), and a fair sample of other interfaces used for computer tasks that involve human questioning. Again, no explicit reference is made to the NLI discourse problem noted above. However, the Point & Query model interface proposed creates a guided question-asking system (more like the TI model than they concede) in a mixed-initiative environment that should allow the handling of follow-up queries directly through the use of feedback.

While not entirely encyclopedic in covering the salient issues in question answering, then, Lauer et al. have focused on ground that is important to cover (the importance of empirical study and development of comprehensive, descriptive models). And the book has covered this ground successfully, which will ensure its usefulness both for future experimental study and for future implementations of questioning and answering systems.

References

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