

Generating Referring Expressions

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This book describes the author's research on the automatic generation of referring expressions in English. The work is encapsulated in EPICURE, a natural language generation system that produces cookery recipes from three basic sets of data structures: a set of entities corresponding to the ingredients of the target recipe; a set of planning operators that describe the necessary cooking actions and their effects on the dish; and a model of the cook's capabilities.

The recipes produced by EPICURE are composed of two ordered structures: a list of the required basic ingredients and another of the basic preparatory (e.g., soaking, draining, peeling) and cooking actions (e.g., sautéing, simmering, boiling) to be carried out on them. Given the focus of the work, the recipes themselves are rather simple in that they do not, for example, contain explanations of why particular actions are to be performed, and thus do not involve the types of complex sentences often found in action-oriented discourses (e.g., sentences with means-, rationale-, or purpose-clauses). The sophistication of the text lies squarely in the way in which pronouns, anaphoric definite noun phrases, and *one*-anaphoric phrases are used to pick out complex entities in the discourse.

The organization of the book closely follows what one would normally expect of a doctoral thesis, from which it is drawn (Edinburgh 1989); contrary to what is usual in such cases, this organization works well here.

Chapter 1 presents a brief description of the class of referring expressions under consideration, the foundations of the work carried out, and an overview of EPICURE. It provides an excellent introduction to the book, set in terms that are easily accessible to nonlinguists or non-computer scientists.

Chapter 2 introduces the notions of entities and outlines the complexities that underlie a typical ingredients list:

- the relation between the role of individual ingredients within a recipe and their potential for appearing in conjunctive (e.g., four eggs and three egg whites) and disjunctive specifications (e.g., one large or two small potatoes);
- the determination of appropriate reference to ingredients with complex names (e.g., *the garlic* for a garlic clove, but *the apple* as opposed to *the eating* for an eating apple);
- the specification of quantity of an ingredient (e.g., in terms of the

standard metrics for liquids and solids (with varying degrees of exactness), or in rather vague units of measurement such as *drops*, *dashes* or *pinches*);

- the specification of a property (e.g., a *button* mushroom or a *ripe* avocado);
- implicit instructions for actions (e.g., *three thinly sliced potatoes*); and
- derived objects (e.g., *grated orange rind*).

The author presents a knowledge representation language capable of dealing with these phenomena. The language makes use of two basic classes of entities: generalized physical objects and eventualities, each with an associated index, a specification of all the information known about it (including its substance and structure).

In Chapter 3, the author shows how the ontology can be applied to a wider framework for discourse generation: deciding the content of the recipe to be generated; modeling the discourse and domain structures, and the reader; and generating clauses. Content determination makes use of tried and tested techniques in computational linguistics, building on the work of Allen, Cohen, Levesque, and Perrault (e.g., Allen and Perrault 1980; Cohen and Perrault 1979; Cohen and Levesque 1980; Sacerdoti 1977). Planning operators in EPICURE are underspecified events; these are used in conjunction with a simple model of the reader (her knowledge of particular domain actions and entities) to determine the required level for a given plan. The approach to discourse modeling is based on the work of Grosz and Sidner (1986). Clause generation applies mapping rules to domain eventualities to build an intermediate representation of the recoverable semantic content of an utterance: *recoverable semantic structures*. These structures are in turn submitted to rules, which results in a second intermediate level, that of *abstract syntactic structures*, which are then unified with the grammar to produce surface linguistic expressions.

The 'meat' of the book lies in Chapters 4 and 5, which provide a detailed account of how EPICURE generates the range of referring expressions set out in Chapter 2. Referring expressions are generated by means of the same two-step process used for clause generation. Recoverable semantic structures, which represent the reader's knowledge of the intended referent and the uniqueness of its description in the context, are built by means of property-addition rules. Rules for mapping these onto abstract syntactic structures address issues of initial and subsequent reference, mass and count, specified and unspecified cardinality, and sets specified by quantity. Algorithms for immediate pronominalization are presented in Chapter 5, along with suggestions for handling long-distance pronominalization. The author provides here a detailed account of the chosen approach for generating *one*-anaphora, which overcomes some of the limitations of other approaches, in particular that of computational expense. Although adequate for English, this approach appears unlikely to meet such success in some other languages. Brief mention is made of its limitations with respect to Dutch.

The reader is presented in the final chapter (Chapter 6) with a worked example, providing a detailed account of how EPICURE generates a simplified version of a recipe for butter bean soup taken from Rose Elliot's *Bean Book*.

This book fulfills its promise of providing a detailed account of useful algorithms and data structures for the generation of referring expressions in a dynamic domain. The work is presented with admirable clarity and its limitations and possible extensions are well articulated.

To date, books on natural language generation are either revisions of doctoral theses or collections of papers from the European and International Series of Natural

Language Generation Workshops. Of these, this volume comes closest to what is a much-needed textbook on generation, and is also much more affordable than most. I shall certainly be recommending it to my students and colleagues.

References

- Allen, James F., and Perrault, C. Raymond (1980). "Analyzing intention in dialogues." *Artificial Intelligence*, 15, 143–178.
- Cohen, Philip R., and Levesque, Hector J. (1980). "Speech acts and the recognition of shared plans." *Proceedings, Third Conference of the Canadian Society for Computational Studies of Intelligence*, Victoria, B. C.
- Cohen, Philip R., and Perrault, C. Raymond (1979). "Elements of a plan-based theory of speech acts." *Cognitive Science*, 3, 177–212.
- Grosz, Barbara J., and Sidner, Candace L. (1986). "Attention, intentions, and the structure of discourse." *Computational Linguistics*, 12, 175–204.
- Sacerdoti, Earl D. (1977). *A structure for plans and behavior*. North Holland.

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