

**Generating referring expressions** by R. Dale, MIT Press, Cambridge, MA, 1992; pp 277, £33.75, ISBN 0-262-04128-6.

The complexity of natural language was one of those many underestimations of human intelligence made by early AI practitioners. Over the past 30 years the discipline of computational linguistics has emerged as researchers have attempted to tackle the problem of natural language processing, and a considerable body of results is finally being established. The discipline may be decomposed into three subfields: the declarative statement of knowledge of language, parsing (determining syntactic well-formedness of a sequence of words and producing some representation of the string's semantics), and generation (generating an appropriate sequence of words from some semantic representation). Generation and parsing are not simply inverse operations: generation requires a degree of planning, as well as some mechanism for deciding how to refer to objects, for example. Furthermore, semantics and pragmatics (which are typically ignored in parsing) must play major roles. It is perhaps because of these added complexities in generation that most research has focused on syntax and parsing. The tide now appears to be turning, and it seems likely that Dale's book will soon be one of many exploring the problems of natural language generation.

Dale presents generation as mutual recursion between subprocesses which determine what to say and how to say it, but his primary interest is in the generation of noun phrases—expressions which refer to things. When, for example, can an object be referred to by a pronoun? When is an indefinite description suitable? When, for the purposes of reference, does one object become two, or two become one? How can processes be referred to?

Following much work in declarative syntax, a unification-based framework is adopted within which to explore the issues, although the mathematical rigour (and consequent complexity) often present in unification-based computational linguistics is absent here. The ideas presented are framed within the domain of cookery recipes, a surprisingly complex domain involving both objects and processes which transform and merge those objects, and embodied in the EPICURE system.

Dale makes no bones of the fact that he is engineering a solution to the problem of referring expression generation, and that the book describes an enterprise in computational linguistics rather than pure cognitive science (if such a thing exists): the work is informed by some psycholinguistic results, for instance, but it is not intended to be read as a theory of how people generate referring expressions.

*Generating Referring Expressions* begins with an introductory chapter providing a general background to natural language generation and the book's specific aims. Four central chapters follow, each of which addresses a substantive issue in natural language generation: the representation of entities; the generation of connected discourse; the generation of referring expressions; and the generation of anaphoric references. A sixth chapter presents a fully worked example.

Chapter 2 considers the representation of entities. Essentially, the discussion revolves around building a representation language that supports the types of objects which language refers to and the relevant properties of those objects. Chapter 3 describes in some detail the overall structure of the EPICURE system. In brief, a discourse planner takes a goal and, utilising knowledge from a plan library, a world model and a hearer model, constructs a discourse specification which is then fed to a discourse generator. This constructs a discourse model (including information about, for example, focus) and calls upon a clause generator to produce individual fragments of text.

Essentially Chapters 2 and 3 are necessary background for the meat of the book: the generation of referring expressions. Chapter 4 considers general problems in constructing noun phrases. Noun phrases should be unambiguous though not overly specific, and must take into account a model of the intended hearer's knowledge. An algorithm is then described which maps knowledge base entities via several levels of structure to a surface syntactic structure. Dale extends the coverage in Chapter 5 by considering the generation of anaphoric expressions—expressions which refer to, or make use of, an entity already in the discourse model. This includes the use of pronouns (e.g. *soak some beans and then drain them*), the use of definite determiners in subsequent reference (e.g.  *fry the beans*), and the use of "one" anaphora (e.g. *a ring of onion and one of green pepper*).

The book is based on Dale's PhD research, and it has the feel of a PhD thesis. Whilst it does more than simply describe the EPICURE generation system, its appeal is probably limited to those directly working in natural language generation (both researchers and practitioners). It is, on the other hand, well structured and well written, and perhaps made more accessible by its avoidance of mathematical tools such as lattice theory and linear logic. Such tools may have allowed a more rigorous specification of the object domain and the generation algorithms, but at the same time they may have further limited the potential audience.

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