

Speech-to-speech translation: A massively parallel memory-based approach

Hiroaki Kitano

(Carnegie Mellon University and Sony Computer Science Laboratory, Tokyo)

Boston: Kluwer Academic Publishers
(The Kluwer international series in
electrical engineering and computer
science; natural language processing
and machine translation, edited by
Jaime Carbonell, 1994, xvii + 193 pp.
Hardbound, ISBN 0-7923-9425-9, \$85.00,
£63.75, Dfl 150.00)

Reviewed by
Ngel Ward
University of Tokyo

This book, based on the author's Kyoto University dissertation, describes a system able to translate spoken Japanese to spoken English in real time. For this work, as the back cover notes, Kitano was awarded IJCAI's Computers and Thought Award in 1993, and it is not hard to guess what impressed the award committee. This work not only incorporates many of the key ideas of artificial intelligence—including parallel search algorithms, memory-based reasoning, plan recognition, and meaning-based parsing—it brims with excitement, with statements like “the basic approach taken in traditional [machine translation] systems faces a serious dead-end, and needs a dramatically different paradigm” (p. 35) and “the ideas grown out of this work lead me to propose massively parallel artificial intelligence, which is now being recognized as a distinct research field” (p. xvi).

This review will first discuss the basic idea of the system, then the book itself, and finally the research strategy.

The most significant contribution of the work, according to Kitano, is that it “demonstrated that real-time spoken language translation at the order of milliseconds is attainable” (p. 176). This was achieved by using memory-based reasoning. It is easy to see how this works in the simple case: a system can store all possible input/output sentence pairs in memory, one per processor, enabling it, when given an input to translate, to quickly recognize which sentence matches, and output the appropriate translation. Moreover, this allows efficient speech recognition: after some of the input has been seen, it is easy to predict what might come next, which provides a constraint on the phonemes the speech recognizer has to consider.

But, of course, a system that can only translate sentences that are already stored in its memory is not very useful. How can a memory based model cope with novel sentences? The book provides three possible answers to this crucial question.

Answer 1 is the old argument that, since there are no infinitely long sentences, the number of sentences in any language is finite, and so a sufficiently big memory will suffice. This argument is backed up by reference to an unnamed “empirical study” which “shows that only 0.53% of possible sentences are observed in large corpora” (p. 40); no explanation is given of what this could mean.

Answer 2 is a “memory network” that augments the store of sentences with their

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web yes dolphins and whales are mammals like all mammals they breath air are warm blooded give birth to live young lactate
and have hair the ancestors of whales and dolphins lived on land millions of years ago and it is thought they were small dog
like mammals around 60 million years ago these ancestors began evolving and adapting to