and syntax networks is severed, they can no longer constrain each other. The result is a comprehension deficit rather like that of certain agrammatic aphasic patients.

Cottrell's work in some ways resembles my own (Hirst and Charniak 1982; Hirst 1987) and that of Waltz and Pollack (1985). The most important difference is that this other work tried to mix conventional symbolic approaches together with connectionist-like spreading activation for disambiguation. Waltz and Pollack, for example, use a chart parser to build a network that represents the alternative parses of the input sentence. Activation is then spread through the network, causing one of the parses and one meaning of each ambiguous word to be chosen. My own work started from the same psycholinguistic data as Cottrell's. However, lexical disambiguation was performed by a set of parallel cooperating processes, one per word, which drew on the results of spreading activation in a semantic network as just one of several sources of knowledge for disambiguation. Parsing and semantic interpretation were purely symbolic.

As NLU systems go, Cottrell's is pretty dinky; it doesn't do anything new. What's different and important about it is *how* it does what it does. By using localist connectionist networks for everything, Cottrell shows the potential of the approach, and lays a foundation for the development of non-dinky systems. However, the price paid for this is the need to reinvent, almost from scratch, everything that computational linguistics has done in the least 20 years. It seems a little perverse to be slaving away, for example, on a connectionist parser for simple sentences like *Bob barfed badly* when highly sophisticated parsers and grammars are already available.

The reply, of course, is that one day the connectionist systems will outstrip anything that we have now; they'll be faster and more elegant, and so natural that all known principles of parsing and interpretation (and maybe a few more) will be "emergent properties" of the systems. In particular, symbolic systems have had great difficulty with some of the fuzzier aspects of language understanding, such as trading off conflicting preferences in the interpretation of an utterance, and such trade-offs are clearly a strength of connectionism. But while recent research in connectionist NLU suggests that useful systems may indeed be possible, it will remain for quite some time an article of faith rather than science that such a research program can be carried through to completion. It is books like Cottrell's that help to sustain that faith.

Cottrell is excellent at analyzing the strengths and weaknesses of various approaches—his own and those of other researchers—and his discussions of other research are a valuable part of the book. It is also nice to see a book in which the author can so honestly present the good and bad points of his own work. Cottrell has an easy and breezy writing style (with a whimsical canine leitmotif) that is always clear and a pleasure to read. His book is an impressive integration of AI, psycholinguistics, and neurolinguistics, in the best traditions of cognitive science.

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ARTIFICIAL INTELLIGENCE TECHNIQUES IN LANGUAGE LEARNING

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This book is a state-of-the-art review of the techniques of artificial intelligence in computer-assisted language learning (CALL). This is an extremely interesting subject, which has up to now not been treated extensively in AI, nor more especially in natural language understanding. The book's objectives are:

- to examine the current developmental level of computer-assisted language learning (from the point of view of the informed modern language teacher and researcher);
- to disentangle the present state of the art of artificial intelligence as it relates to CALL;
- to establish the extent to which artificial intelligence applications can be applied to the future development of CALL.

First, a survey of CALL is given, explaining the how and why of the evolution of the field up to the present. The next chapter, entitled "What is AI?" tries to "consider the whole question of the nature of AI." The rest of the book is devoted to the presentation and discussion of several areas of AI that the author considers relevant to CALL, such as human/computer interfaces, knowledge representation, and

expert systems. The book ends by considering possible practical applications of AI to CALL and by presenting some relevant and more recent developments in AI-related CALL.

As pointed out by the author, this book is not written for AI specialists but for modern language teachers. The motivation to write this book was his observation that CALL has not made any real advances, because the computer was approached from an "amateur" viewpoint, lacking solid theoretical background. He asserts, modestly enough, that "what I have set out to achieve is to make the first faltering step towards establishing the ground for possible advance, as well as alerting the reader to both the difficulties and the real dangers that may lie ahead" (p. 14). I think that Last's analysis of the situation of CALL and his feelings about AI are correct. But this is perhaps not sufficient to write a book of 170 pages on AI techniques in language learning. So, unfortunately, the objectives of the author are not attained.

In the second chapter ("The story so far"), no real introduction to CALL or to humanities computing is given. The parts of literary and linguistic computing and machine translation contain rather unimportant and long explanations on research organization, rather than investigating, as announced by the chapter, the influence of humanities computing to CALL. CALL developments are not really presented in relation to the language analysis base of these systems, and much space and time is lost on unimportant environmental and organizational questions. For example, we learn that many of the computing pioneers in language and literature are Germanists, and many of them medievalists at that, and why this is so (although no fundamental reason is revealed). The other two objectives are no better attained. Last's view of AI might be summarized in the following sentence: "My approach has been one of cautious inquiry in an area of investigation in which almost as much effort appears to have been expended in the debate between proponents of radically different perceptions of what AI can (and in the view of some, ought to be allowed to) achieve as in producing the actual research work itself" (p. 7). The author seems to me to give a poor evaluation of the state of AI (and its subject areas), confusing the philosophical discussion about AI with the science of AI itself. (Perhaps this discussion is part of AI—I will not debate this here—but it is clear that it is not identical to AI.) I feel that this is a very common misunderstanding, which is perhaps due to the fact that such discussion is much more exciting than the down-to-earth research work actually produced by people working in the field. Thus, little is said in this book about AI techniques (in spite of what might have been expected from the title) and much about the conception of the science of AI.

Although I agree with many feelings of the author with regard to the unfounded promises made by some scientists in our field, Last proves by many statements that his discussion of AI is not founded on competence in the underlying issues (in AI or in computer science). This is most regrettable in a book about language learning and

teaching, because much could be said of the interest of AI fields and techniques for CALL. Many of the author's considerations appear to me to be wrong, superficial, irrelevant, or even ridiculous. For example:

> So, non-AI programs, even though they may appear to display some of the characteristics of "intelligence," are essentially deterministic, algorithm-based, and deal with a closed problem domain which is completely lacking in ambiguities and deals in black and white issues with no shades of grey between. (p. 100)

Certainly, non-AI programs are not necessarily deterministic. Moreover, why should nondeterminism be a criterion of intelligence? One wonders what could be a program that is not algorithm-based? Or:

> AI is still an aspiration rather than an achievement and should be applied with considerable caution in real learning situations. (p. 130)

—whatever the first part of this sentence could mean!

But my main complaint about this book is the lack of relevant material. The author seems to ignore most of the AI work that is relevant to CALL. Not a single paper on AI and CALL is cited (to give just two arbitrary examples: Schuster 1986; Weischedel 1978). NLU is not even mentioned as one of the key aspects of AI for future CALL developments! And the author's knowledge in this domain seems to be exhausted by an allusion to ELIZA and SHRDLU. More specific topics like anaphora resolution or ambiguities in natural language analysis are addressed without any allusion to relevant work in AI and NLU (see, e.g., Hirst 1987; Webber 1980). Most of the highly interesting and CALL-relevant AI subjects are not at all addressed in this book: representation of (grammatical) knowledge, natural language understanding, user modelling, discourse analysis, error analysis. The book includes a discussion of programming, but does not consider the question of which programming language is best suited for parsing and error analysis.

It is also regrettable that we do not learn anything about the expectations of CALL with respect to AI. This should have been addressed in Chapter 2 (on human/computer interfaces) and in Chapter 8 ("From Theory to Practice"). We might have expected a discussion of problems such as: How should exercises be presented to students? What possibilities are there of interaction for the students (computer language, natural language, graphic interfaces, or a mixture of all three)? Instead, we are given a discussion on the sizes of chairs and tables! The topic addressed in Section 8.3, "What kind of project?," appears essential to me and merits more than half a page. Much could be said about the kind of exercises to set for students and how to conceive them.

On the other hand, some topics addressed in this book do not relate to CALL. No relation to CALL is shown for the

Turing machine (the author asserts that it has never been built!), nonstandard logics, or nonmonotonic reasoning. The chapter on expert systems does not really explain what an expert system is, nor how it works, nor how it could be used by a CALL system. So these topics will be rather confusing for the nonspecialists.

To conclude, it seems to me that this book will not contribute to familiarizing language teachers with notions of computer science and artificial intelligence.

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AN INTRODUCTION TO CHINESE, JAPANESE AND KOREAN COMPUTING

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Readers of *Computational Linguistics* who might have been led by the title of this book to expect an introduction to computational problems in the Chinese, Japanese, and Korean languages will in fact find little of relevance. The title is misleading: the book is not about Chinese, Japanese, and Korean *computing.* It is almost entirely about the problems of input, coding, and display of Chinese *characters.* It has a great deal to say about the nature and history

of Chinese characters, and about the problems of using them in computation. It ignores the phonetic scripts used in conjunction with characters in Japan and Korea, and discusses Chinese characters mainly from the perspective of Taiwan rather than the People's Republic of China.

If you want to learn about Chinese characters, or to develop computer systems for the Chinese market, you should probably read this book, because it has a lot of information on the subject. If not, you might like to read the book for amusement, since rarely does such a personal, egotistic, chauvinistic, and polemic book see the light of day. (It is certainly rare for a book author to give himself "ten thousand thanks" for his own work on a standardization committee; and we do not accept the *yin-yang*–based symbol of the *I Ching* as evidence that the Chinese invented the fundamental theory of computation.)

Chapter 2, "About the Chinese language," is actually about Chinese characters rather than the language. This chapter gives a good account of history, structure, and sounds of characters, and includes many figures and tables. Other chapters and several appendices give statistical data on characters and phonetic symbols. These parts of the book could be very useful to someone interested in the details of Chinese character input, coding, and display.

The book is written in a "Chineselized" version of English (to use a word much favored by the authors). It would have benefited greatly from a reading by an English-speaking copyeditor, and a typographer should have been consulted about the design. The content should also have been checked more carefully, as illustrated by Rule 3 of the *Dai-E* coding method, the complete text of which is: "If the character is comprised of a container without another radical, then rule 3 will not apply" (p. 137).

In Chapter 7, the book goes beyond Chinese I/O to consider Chinese programming languages and operating systems, though the authors seem to have some misconceptions about what is available to non-Chinese speakers. "Total control of a given computer system means that the human users must be able to communicate with the computer system in their human native language without hindrance [sic]" (p. 253). "Could you imagine English speaking people having to write their programs in another language? What would the result be?" (p. 254). "It is not an English operating system, if it cannot communicate with the user in plain English" (p. 255). Readers of *Computational Linguistics* will presumably now step up their research so that they can develop the first English operating system.

FORTH is the sole programming language that merits the authors' approval, seemingly because it emulates Chinese philosophy:

The second similarity between Chinese philosophy and FORTH can be found in the dual functions of the FORTH interpreter/compiler. The FORTH interpreter is an interpretive compiler as well as compilative interpreter. It is one of two, two of one. This is similar to