BOOK REVIEWS

MACHINE TRANSLATION: HOW FAR CAN IT GO?

Makoto Nagao
(Kyoto University)

Translated by Norman Cook
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Reviewed by
Dominique Estival
University of Geneva

This is a very short book (150 pages, including index and references), which introduces the basic concepts of machine translation and offers a concise and clear exposition of the problems and issues faced by MT. It was meant for a Japanese audience (this translation appears three years after the original book did), and in some respects it can be seen as self-advertising for the Japanese industry; at the same time, it is also a good description of the specific problems encountered in translating between Japanese and English, and it gives a refreshing view of the history of the field, which has usually been recounted from the Western side. As each example contains the original Japanese text, its transliteration, and a word-for-word gloss as well as the English translation, a reader with no knowledge of Japanese can follow quite easily the explanations that were meant for a Japanese reader.

However, I have a few reservations. The translation is sometimes awkward, especially in the second, more technical, part of the book, and it suffers from not having been checked by a linguist: such expressions as *referent* and *referring* are not used consistently, nor in a standard way (e.g., when a subject NP is said to *refer* to its predicate), and there is one case of actual mistranslation, where Chomsky's theory is referred to as transformational generat*ion* grammar. Another unfortunate choice of terminology is that of *analytical, transformational,* and *generative* grammars instead of the more widely used and theory-neutral grammars for *analysis, transfer,* and *generation* (p. 125).

More important is the lack of references, which raises the question of who the intended audience is. The bibliography is very short and not very representative of the field, either in Japan or the rest of the world. Some works mentioned in the main text (e.g., Nida's on the definition of translation; p. 49) are not referenced. Others are casually mentioned without even any name (e.g., tense and time reference problems are supposed to be greatly clarified by "recent linguistic work"; p. 104). Although it is clear that Nagao's original book was not meant for academic research and that the Japanese version was aimed at the open-minded lay reader, the difficulties resulting from the translation render the English version less easily accessible to the corresponding English public. Nevertheless, in a field where the few books available aim at a specialized audience, Nagao's is a valuable contribution that could prove a good addition to a supplementary reading list in an introductory course in NLP, and could be useful for translators who are not familiar with MT.

The two main issues Nagao addresses throughout the book are those of pivot versus transfer and syntax versus semantics. About the first, Nagao claims that the nuances of Japanese linguistic expressions reflecting Japanese culture preclude the use of the same pivot language to translate both within the European languages and between European languages and Japanese. This is too cursorily expressed, but the whole question of the choice between a pivot language and a transfer technique approach is well explained.

About the second, unsurprisingly and uncontroversially, Nagao advocates a balanced use of syntax and semantics. More open to controversy is his claim that the word order of the source text should be preserved as a means to maintain focus, and thus pragmatic information. To the question "Which syntax?", Nagao unequivocally advocates case grammar, which is presented as a means of "resolving questions of syntax on the basis of the meaning relations between nouns and verbs." To the question "Which semantics?", Nagao answers that the semantic methods, i.e., "meaning tables" or "semantic networks," which he had proposed for sentence generation in 1963, are now recognized as being unavoidable. His assessment that "at that time, linguistics was not dealing with the problem of meaning" would need some qualification, and so would his categorical assertion that Montague semantics, as any truth-value-based semantic theory, has proven inadequate for translation (the ROSETTA project, for instance, cannot be described as a research failure).

Nagao's conclusion that "language is a massive conglomeration of exceptions" is no surprise, nor is his requirement that the design of any MT system should be flexible, robust, and transparent. However, while it is clear that a good MT system must be open ("allowing not only for the handling of a wide variety of phenomena, but also allowing further additions and modifications of the system"), it is less clear what is meant by a system "capable of self-correcting evolution" (p. 12).

Chapter 1, a short history of the field of MT in the world, covers developments in Japan, as might be expected, but also in the Soviet Union, and it ends with an optimistic assessment of the effects of the ALPAC Report, one of

which was an increase in funding for basic research in theoretical linguistics. In contrast to other overviews of the history of MT (e.g., Slocum 1985; Buchmann 1987; Warwick 1987), Nagao describes his personal experience and his own involvement since the early days of MT in Japan.

Chapter 2, on "Revival in machine translation," is of course out of date since the book was originally written in 1986, but it contains an informative description of the system for translating article titles, developed at the Tsukuba Computer Center of the Industrial Technology Institute. However, with only a vague and optimistic sketch of the EUROTRA project, and a dismissive mention of "little direct research on machine translation in America," this overview of the situation in Japan and other countries does not do justice to the real revival that has occurred over the past five years (e.g., with the creation of the Center for Machine Translation in Pittsburgh in the U.S.; moreover, is it fair to call the TAUM AVIATION project a failure?).

Chapter 3 is concerned with both perspective and evaluation. It raises fundamental questions such as "What is translation?" and "How do we evaluate it?", and presents a realistic assessment of the possibilities of MT systems and of the actual use their output can be put to, with a careful discussion of post-editing. Translation tasks are divided into three categories, according to the level at which the text is meant to be interpreted: factual level, speaker level, or social level. These levels are equated with the levels of syntactic, semantic, and pragmatic adequacy of translation, respectively.

Starting with Chapter 4, Nagao describes his approach to the process of translation. Compositionality is presented as the basis for this process, but as the exposition is rather sketchy, neither formal nor rigorous, "principles of compositionality" appear to be no more than rules for interpreting idiomatic expressions. The main theme is the relation between syntax and semantics; more precisely, the semantic resolution of syntactic ambiguities and the role of semantics in the analysis of sentence structure. Morphology is thus only mentioned as the problem of morphemic analysis in a language written with no space between words. Nagao argues that phrase structure grammar is not adequate for free–word-order languages, and the relative free word order of Japanese, i.e., the lack of significance attached to the actual order of noun phrases, is given as an argument for case grammar.

In a classical vein, parsing is seen as the main problem (recursion in natural language is evoked only as a problem for analysis); when that hurdle is cleared, sentence generation will proceed without too much trouble, provided the internal structural representation is not too complicated. The description of sentence analysis methods in Chapter 5 is a rather superficial discussion of syntax and the examples, of actually very simple structures, are hard to follow (see the discussion of embedded sentences, by which is meant relative clauses).

Chapter 6 is concerned with the selection of words for translation and sentence generation, and presents the solutions adopted in Nagao's system. Nagao points out that the representations from case grammar, or any "deep structure" equivalent, may be viewed as a sort of pivot language, but argues that the idea of a universal pivot must be abandoned in favor of a transfer approach, since "linguistic expressions show differences ... because of social and cultural conditions" and the same internal representations cannot always be used. Another argument given in favor of a transfer approach is the fact that with a pivot approach, the differences in sentence structure between Japanese and English require making correct inferences about the nature of missing arguments, which, given the current state of AI, is often not possible. This is also an argument for not relying on a full semantic interpretation of the text. Nagao is careful to point out that the transfer approach requires a very large number of specific rules, which is particularly crucial with language pairs such as Japanese–English, for which he claims the transfer procedure must be made as detailed as possible (instead of being simplified as in "direct transfer"). Transfer is composed of lexical transfer followed by structural transfer. Lexical ambiguities are assumed to be resolvable from the context and the domain, but there is no hint of what may happen when resolution is not possible.

As for structural transfer, despite the arguments for case grammar found throughout the rest of the book, it turns out to be "complicated and troublesome" (p. 117) to generate directly from case grammar representations, so these are first transformed (top-down and recursively) into phrase structure representations, from which the target strings are generated. The structures given as illustrations for a transformational rule in structural transfer (p. 114) need some explanations; as they stand, the rule looks arbitrary and doesn't bear any discernible relation to its supposed applications.

I do not share Nagao's pessimistic views about whether current linguistic theories could teach us about the "nature of the transformations of the internal structure required [by MT]." This might actually prove to be a fertile testing ground for, e.g., GB's claims about the nature of universal grammar with parameter settings and general principles. What is unfortunate is that researchers in MT tend to dismiss those claims as unrealistic and without any relation to their concerns, while many researchers in theoretical linguistics still perceive MT as a dirty "applied" domain. The nice point Nagao makes about borrowing methodologies from comparative linguistics could apply here as well.

Chapter 7 discusses MT from the point of view of the actual procedures involved. It contains good discussions of pre-editing and post-editing procedures (including the respective merits of redoing a translation from scratch or post-editing a garbled translation), of the advantages gained by merely automating the process of translation (the increase in productivity is a side effect of using MT), as well as of the problem of regressions introduced by changes made during user update and dictionary revision. Nagao addresses the question of the separation between a "core"

fundamental vocabulary (untouchable by the user), and "specific" vocabularies.

The traditional view of MT as a process of tree structure transformation through pattern matching is complemented by the more recent lexical approach in which the description of grammatical usage is stored in the dictionary as part of the information attached to specific words, and in which more specific rules block the more general ones (cf. Nagao 1987). Dictionary construction is therefore essential to the enterprise, and one may hope that Nagao's plea for a standardized dictionary format and international cooperation in the elaboration of lexicons will be answered by the recent dictionary and text database initiatives that have been launched to meet those needs.

As a conclusion, Chapter 8 proposes Nagao's views on the future of MT; these are summarized in the preface by Nagao's Figure 0.1, which predicts a steady improvement in the commercial systems and a sharp rise in the number of MT users during the late 1980s and early 1990s. Nagao also predicts that the improvements due to research in syntax and semantics have basically leveled off, and that further progress will come from research on intersentential components from an AI rather than purely linguistic point of view. For instance, one of the phenomena that MT cannot yet handle is discourse analysis, and both the resolution of intersentential relations and the resolution of referentials without a referent in the text require making inferences about the world. However, Nagao makes the nice point that it is very difficult for an NLP system driven by inferences to deal with new relationships set up in a text, while this is what natural language does all the time (i.e., creates novel sentences that are interpretable). High-level translation capabilities will require long-term basic research both in theoretical linguistics and in cognitive science, going beyond the limits of traditional linguistics on particular languages and toward a theory of translation.

As MT is still in its infancy, Nagao advocates a realistic assessment of its possibilities by following the "engineering practice of limitations based on assumptions about functionality." For example, the problem of voice recognition must be solved for interpreting systems, and because of efficiency considerations, the future of interactive systems probably lies in small-quantity private systems. As a final thought-provoking remark: MT is probably more useful between pairs of languages that do not have many mutual speakers, rather than the classic pairs of well-known languages.

References

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Dominique Estival received her Ph.D. in linguistics from the University of Pennsylvania in 1986. She gained experience in MT when developing a new version of the Weidner system at WCC. After working at Wang Labs on a large NLP system, she is now a researcher at ISSCO, where one of the projects on which she is working is the development of a prototype for an MT system based on unification. Estival's address is: ISSCO, 54 rte des Acacias, CH-1227 Geneva, Switzerland. E-mail: estival@divsun.unige.ch

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Looking Up: An Account of the COBUILD Project in Lexical Computing

John M. Sinclair, editor
(Birmingham University)

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Reviewed by
Branimir Boguraev
IBM T.J. Watson Research Center

"COBUILD" stands for "Collins Birmingham University International Language Database," and reflects the joint nature of the work on lexical computing shared between the University of Birmingham and Collins Publishers. The COBUILD dictionary project, going back to early 1980, resulted in the publication in 1987 of the *Collins COBUILD English Language Dictionary.* There are at least three major factors that set it apart from other learners' dictionaries of English language: it is a wholly new dictionary; it reflects present-day usage of English; and, in style of presentation of entries, it represents a radical departure from existing lexicographic conventions. By its own account, "the techniques used to compile [the dictionary] are new and use advanced computer technology. For the user the kind of information is different, the quality of information is different, and the presentation of information is different" (from the introduction to the *COBUILD Dictionary*).

This difference stems from the interleaving of several basic principles in applied linguistics and dictionary compilation, and the particular ways in which these have influenced lexicographic practice in the course of preparing the dictionary. Language is a constantly changing dynamic system; consequently, no existing—and by that token already out-of-date—reference materials (including other dictionary sources) have been used in the process of compiling COBUILD. Rather, the analysis of words, from decisions concerning the makeup of the word list to the specific