

**MACHINE TRANSLATION: LINGUISTIC  
CHARACTERISTICS OF MT SYSTEMS AND GENERAL  
METHODOLOGY OF EVALUATION**

**John Lehrberger and Laurent Bourbeau**

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This book (which has been long in the making!) is a compilation of a large number of papers written over the years (1971–1981) dating from the first attempts (circa 1968) at this system. It describes in full detail TAUM (Traduction Automatique de l'Université de Montréal), a second-generation transfer-based MT system, as opposed to a first-generation, direct (i.e., word-for-word) translation or a third-generation, knowledge-based (i.e., *interlingua* MT system). (For illustrative purposes, the authors include a detailed flowchart of a typical second-generation MT system in Appendix B.)

In particular, this book highlights the operational system produced by the TAUM project—TAUM MÉTEO—which translates telegraphic weather reports issued by Environment Canada from English into French. (The experimental systems produced from TAUM were TAUM-71, TAUM-73, TAUM-76 and TAUM-AVIATION.) TAUM MÉTEO has been operational since 1977 and is universally acclaimed as “the closest approximation to fully automated high-quality (machine) translation among currently operational systems” (Nirenburg 1987). Because of MÉTEO’s stereotypic format, the research from this project has led to a very important development in a branch of linguistic analysis concerned with the sublanguage concept, connected with the names of Lehrberger, Richard Kittredge, and Ralph Grishman (see a discussion in Hutchins 1986).

In Chapter 2, five characteristics of MT systems are identified. The first pertains to the degree of automation in the system, whether it be machine-aided human translation, human-aided machine translation, or fully automatic machine translation. Secondly, the extent to which the source language is analyzed, either locally or at the sentence level, is discussed. The authors stress *the* major presupposition of fully automatic (high-quality) MT—the depth of analysis of an MT system is indicative of the level of understanding implicit in the system.

Next, the type of information transfer (e.g., direct or use of a pivot language) between source and target language is considered. The authors conclude that designing a *universal* pivot language, one that is “totally

independent of any particular natural language” is not feasible. This conclusion seems somewhat dated. A recent experimental MT system KBMT-89, developed at Carnegie Mellon University (CMU-CMT 1989) for bidirectional Japanese-English translation of computer hardware manuals is based on this model. What makes KBMT-89 different from previous attempts at building such interlingual systems is its systematic reliance on a large and independently motivated model of the domain of translation, which serves as the basis for developing the interlingual representations.

The last two system characteristics deal with the organization (and advantages) of modular MT processing and the domain dependency of the lexical and syntactic aspects of an MT system, respectively. Additionally, the authors stress the fact that the performance of an MT system depends very much on the domain of application, given its restricted vocabulary and, in some cases, a restricted syntax as well. Consequently, they leave the reader pondering if one domain is necessarily easier to translate than another.

Chapter 3 takes a closer look at the characteristics of an MT system by giving an idea of its architecture in terms of the major linguistic components: lexical, morphological, syntactic, and semantic. The lexical component discusses the number and structure of dictionaries to be used and the information content and form of each lexical entry (including idioms) contained within each lexicon. The morphological component explains the processing and strategies behind inflectional, derivational, and compositional morphology. Simple and complex sentence structure as well as complex constituents are analyzed in the section on syntax. Because local analysis is insufficient for any reasonable level of understanding, the semantic component describes finding the total meaning of a sentence at both the word and syntagmatic levels—resolving homography at the word level and using selectional restrictions and subcategorization information at the syntagmatic.

Chapter 4 discusses two opposing approaches to designing an MT system: the corpus-based approach and the standard grammar approach. The advantages and disadvantages of each are explained. Both approaches have a direct effect on determining the content of the linguistic information present in the dictionaries and grammars of an MT system.

Chapter 5 deals with the methodology for linguistic evaluation: identifying the user’s needs and constraints of translation, evaluating the performance of the linguistic components of the system, and evaluating the potential of a system. Additionally, because of the effect on the human translators and revisers who must use the machine, the evaluation of the user environment is also discussed. The authors suggest steps to be followed in deciding on the acceptability of a system and then summarize the fundamental aspects and limitations of the proposed methodology for evaluating MT systems.

An important feature of this book, which sets it aside

from many other writings on the subject, is its discussion of the problem of evaluating MT systems. The proposed methodology is decomposed into three distinct areas: (i) evaluation by the system's designer; (ii) cost/benefit evaluation by the user; and (iii) linguistic evaluation by the user. This delineation serves as the framework for a more detailed and impressive, though by no means final, study contained in Appendix A.

In the conclusion, Lehrberger and Bourbeau discuss the feasibility of MT, its future prospects, and the impact of evaluation methodology on those prospects.

To summarize: I thought that this book was very well written and intended for the mature MT researcher. The impact of the book would be even greater had it been published earlier in the decade.

#### REFERENCES

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#### MEDICAL LANGUAGE PROCESSING: COMPUTER MANAGEMENT OF NARRATIVE DATA

Naomi Sager, Carol Friedman, and Margaret S. Lyman  
 (New York University)

Reading, MA: Addison-Wesley, 1987, xiii + 348 pp.  
 ISBN 0-201-16810-3, \$41.95 (hb)

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The book under review builds on and is an extension of the New York University Linguistic String Project system applied to medical language processing. The system analyzes free text and converts the information 'hidden' in it, the syntactic and semantic regularities, into an informationally equivalent structured form, which is best suited for information retrieval and automatic summarization. From the computational linguistics point of view, the main interesting results consist on the one hand of the demonstration that a real world text processing application of linguistic analysis is possible (i.e., the processing of real textual input), and on the other hand in the fact that the methodology and the techniques used here and described for medical lan-

guage are by and large also applicable to other, completely different, environments. The work also has links to knowledge representation, given that a method for representing and processing semantic information is provided, and the data supplied could be a testbed for knowledge-based systems.

In Chapter 1 a general overview is given of the problems, the methodology, and the theoretical support involved in processing natural language and sublanguage in particular. It is by syntactic clues that a set of semantic statement types are individuated, and therefore semantic results are achieved, but the main methods of analysis are dictionary look-up and pattern matching.

Chapter 2 is of less relevance for linguistics; it is mainly concerned with the medical aspects of the project, and with its practical applications purely from the physician's point of view.

Chapter 3 describes the types of information structures that are typical of the sublanguage of medical narrative and the way in which they are mapped into computer representations, i.e., rather simple information formats. Grammatical paraphrase, deletion of redundant words, and regularization procedures are some of the main procedures used to obtain the information formats from the surface grammatical structure. These format structures, although resembling 'classical' frames, are specifically designed to "reflect the linguistic regularities observed in sublanguage texts, and therefore differ from most uses of frames in artificial intelligence applications." Whether they really differ is perhaps questionable: they both try to capture similar types of regularities and formalize underlying grammatical relations into predicational structures. In my opinion, the real difference is in their suitability as to their application to (and empirical derivation from) real texts.

It is interesting to learn that only six types of information formats, plus seven types of modifier formats, are sufficient for representing information in clinical narrative texts. How many would be necessary if dealing with other types of sublanguage texts? How many for general language? An evaluation of them in other fields and a comparison would be interesting.

Chapter 4 describes how the system uses lists of sublanguage word subclasses, with constraints on the syntactic relations occurring between them, in order to accomplish some linguistic tasks, e.g., to rule out inappropriate prepositional phrase attachments (a typical problem unsolved with pure syntactic analysis) and to select the attachments permitted in the domain. The same method, i.e., checking against a list of well-formed word class patterns, is used for homograph disambiguation. An essential tool is therefore the possibility of classifying lexical entries into a well-defined set of semantic word classes, for which it is possible to state a number of syntactic and semantic properties in the sublanguage being analyzed. These entries do all the work. This approach, which gives good results, is of