

QUESTIONS AND DISCUSSION

SEBEOK: I propose that we discuss the papers in reverse order of presentation and I, therefore, call for questions regarding either Professor Oettinger's or Mr. Sherry's talk.

HAYS: I will take it for granted that, in the first place, everyone is familiar with the RAND method of sentence structure determination because it has appeared in the literature. When we first took it to an outside audience, we took it to the National Bureau of Standards and I described the program that we had operating for sentence structure determination, said not a word about the relations of it to Mrs. Rhodes' method. Then she took me aside and described her method. It was very revealing to me because I felt that for the first time in the field of machine translation, outside of our own work, I was being shown a method in which certain general and abstract properties of language were being reflected in an algorithm or a decision procedure, and that the grammar of any concrete natural language could be attached as a table, or any kind of procedure that you care to choose as a side ap-pertinence to this basic program. That was what we felt was very im-portant about our own work, and I think it is the point of greatest substantive contention in this field. The Georgetown work and most of the work in the field, both in the United States and in the Soviet Union, is based on reflection of almost all the properties of a given language in a flow chart--all of the properties except the content of the lexicon which is stored separately. Even the contents of the lexicon is some-times built into the logical flow charts in some Russian work, but I have not seen it in the United States. Now, it appears to me that at the time we presented our system and saw Mrs. Rhodes' for the first time that she had, independently of us, and we independently of her, constructed virtually the same method relying on virtually the same general prop-erties of language. I would claim—now, this is one of your challenges, Mrs. Rhodes—that our method is the more general and that yours is a special case of it. The difficulty with understanding the RAND method is that it can be described in two sentences and those two sentences are very short. It takes about three minutes to say, but it isn't always obvious what those two sentences imply, and I have spent a lot of time understanding the implications myself.

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OETTINGER: This is indeed a challenge. We are currently in a high state of euphoria about this method, and so I think the audience will understand when I assert fairly confidently that, on the contrary, the RAND method is a very small subset of the predictive analysis. Now I think that there is simply not enough time here to go into the details of it. I think having followed Dr. Hays' exposition at Paris very closely and having read his papers, that we are dealing here with a method, the RAND method, that obviously has a strong isomorphism on structure to the Russian language, so has Mrs. Rhodes' method in the sense that they are both correct--there must be some relation between them.

ZARECHNAK: I will have a few questions pertaining to the syntactic analysis as presented by people from Harvard, though I note that the concept presented was not originated by Harvard but by Mrs. Rhodes. Therefore the questions which I will direct to Professor Oettinger and Mr. Sherry should be answered with this remark in the background but actually I would like Mrs. Rhodes to participate in answering the question as well. You have noticed that when syntactic analysis was presented, no difference was made between the syntagmatical level and the syntactic level. The sentence presented was СТОЛ КРАСНЫЙ СТОЛ ИМЕЕТ МНОГИ I imagine it was a doctored sentence not taken from the text. What is actually of importance is that all the words in that sentence have been treated as if they were functioning on the same level. All of them have been thrown into the prediction pool and handled equally. This is the first objection I have to the system, because when you translate the only purpose you pursue is to transfer the information encoded in the source language. Therefore if you consider the information encoded in the two words, КРАСНЫЙ СТОЛ it is the СТОЛ which is the Pivot word for the information transfer and not КРАСНЫЙ, and whatever will happen on a functional level between СТОЛ and anything else in that series of words will happen automatically to КРАСНЫЙ. Therefore you will be economically and formally much better off if you treat КРАСНЫЙ in relation to СТОЛ before you treat the relation of СТОЛ to some other nouns or verbs. The relation between КРАСНЫЙ and СТОЛ falls in the GAT syntactic analysis under the category of syntagmatic relations. By syntagmatic

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relation, we mean a relation between any subset of a class to that class. As soon as you go from one class to another class you are in syntactic level proper. To mix up those two levels means to add difficulties of not only a temporary but of a permanent nature to your analysis and to your forthcoming algorithm. Why have you decided not to differentiate those two levels? Usually when linguists speak about any level of analysis, they take care to define their basic unit. If they talk about the phonemic level they are very careful to define what is the basic unit on the phonemic level. You may be reminded that in Bloomfield's terms this would be a first abstraction as related to the acoustic data. When you move up to the morphemic level you will be reminded in his 4th chapter "Form Classes in Lexicon" that the morphemic basic unit is the second degree of abstraction in relation to the acoustic data. If you want to move to the syntactic level, we all should be careful to define what is the third degree of abstraction of acoustic data which will constitute the necessary information in defining the basic syntactic unit. My second question is, what is your definition of the basic syntactic unit before you move into that area? The subject and object certainly are not a basic syntactic unit. They are elements which enter the area of syntax analysis.

SHERRY: As to our definition of what we use on these various levels, we don't have levels. We use the words; the words are the input. The words are what we look up in the dictionary, and as far as we are concerned this is what we are dealing with. Now, as far as any comments about whether an adjective should be associated with a noun, should a noun be associated with an adjective, or any other combination you might wish, I challenge anybody to point out where we have any difficulties. We claim that this is the most trivial part of the whole work. That is, we save our real efforts for the hard problems for various types of inverted structures, for clauses, and so on. As a matter of fact, by our means we don't have to look for these nouns to which we are going to attach the adjectives to which we are going to attach the prepositions, and so on. They just fall right out. What is the difference whether you call the adjective the subject and call the noun following the master; or call the noun the subject and call the adjective preceding a modifier? You obviously know in both cases

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you have a noun phrase and the noun phrase is the subject. So I do not see where it makes any difference, and we claim we have the advantage whereby we do not have to scan constantly through the sentence. Another advantage being that our programming difficulties just do not exist either. We now have a more complicated system than you saw. We have 45 subroutines which fall into two distinct categories. One type of subroutine is that which makes predictions, and is called in by a word after we have found out how this word functions in the sentence. The second set of subroutines tests these predictions. The subroutines are independent and, as a matter of fact, generally consist of about 30 lines of coding apiece. There is a skeleton program which was programmed once (and we expect for all) which moves the subroutines around and brings them into proper order depending upon the words in the sentence. As an example of this simplicity, we decided in December that we were going to enter more subroutines into our system. This was only our second time around. The first time we had only what I showed. We decided to reprogram from the beginning since we had one very good programmer who decided upon a format and four other programmers (two of which were just beginners, two of whom had a little experience). Inside of two days they had finished the programming and inside of two weeks they had finished debugging. I further state that any other additions we want to make to our system we can do in the same manner. A couple of days to do the programming and a couple of weeks to do the debugging. I challenge anybody else to make changes in the system with this same rate of speed. Putting all these things together I do not see what objection there can be to our method.

SEBEOK: Are there any questions addressed to Professor Reifler?

RHODES: May I ask something? This is not a trick question. I hope no-one takes this as being a trick question. I really mean this seriously and I mean it not only for Professor Reifler, I mean it also for my friend Professor Oettinger. I can go into a store and I can buy for \$3.50 a pretty good second-hand dictionary, a lot better one than these people are making and why do I have to pay \$300,000 dollars for theirs?

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REIFLER: This is a very good question. I have had much to do with dictionaries. As a matter of fact I was once an editor of a German-Chinese dictionary, a co-editor in China, and thus I ought to know what the difference is. I want to point out that the dictionaries destined for human beings who are not interested in machine translation contain a lot of information we simply do not need. On the other hand, they lack a lot of information we do need for our purposes. In our traditional dictionaries we have mostly only some members of the paradigms of semantic units. Mostly we have, for instance, a nominative singular of nouns or the infinitive of verbs, and in all these dictionaries you have the complete free forms. Now in our approach we found it necessary or advisable to enter not only one of the many members of the paradigm but all relevant members of the paradigm. Whereas in another approach people think it is not necessary to enter the complete form but only to enter the stems and the endings as you have heard from previous papers. There are some other differences. I do not know whether this satisfies you but the question was also addressed to Professor Oettinger.

OETTINGER: This is a point that has been the frequent subject of discussion. It is a point at which Mrs. Rhodes and I obviously disagree. I think her point of view, and I hope I am stating it fairly, is that it is silly, if not criminal, to make a dictionary before one has a perfected syntactic scheme. In abstracto I must agree with this and I think to a certain extent it is a tribute to Mrs. Rhodes' rare intelligence that she has been able to see through as much of the structure of the Russian language and avoid so thoroughly being confused by wishful thinking about what she sees in the sentence and what a machine can see in the sentence. In spite of not having a crutch in the form of a dictionary she has been able to develop to a very high degree of perfection this rather beautiful method. I must confess that we could not have done this in the same way, and that if we have to do it over again we probably could not again. Working with a group that includes graduate students that changes its constitution fairly frequently, it is not possible for us to keep as much in our heads, even if they were capable of it, as Mrs. Rhodes does. The crutch of a dictionary which contains just what each word is, what

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its description is--whether it is a noun or can serve as one, what kind of verb, what it can govern in terms of prepositions, it is transitive and so forth and so on--has lent our work a sort of stable base and a way in which we could test our results which would not otherwise be possible. As a result, we are able here to present our case in the full knowledge that with the dictionary that we have prepared the syntactic analysis scheme works to a degree that makes it seem very promising, and if this be a crutch I simply hope that I am making the most of it.

SEBEOK: I would like to call for a discussion of Dr. Lamb's paper.

EDMUNDSON: Dr. Lamb, I would like to ask how you stand on the question of whether a cyclical approach is advisable and, if you have decided on another course, why specifically? I somehow got the impression from your remarks that you felt that the final perfect program would somehow spring forth from someone's brow without iterations. Is this correct?

LAMB: The program is something that should not be constructed until after you have the information on which it must be based. But since nobody has that information our present job is to get it. Once you have the information then you will know what kind of a program to write and then you write it.

EDMUNDSON: What do you do next, after you have tried the program on a new batch of text?

LAMB: That will be sometime in the future.

EDMUNDSON; I repeat the question.

LAMB: Well, I think that will depend on what happens.

EDMUNDSON: This is precisely why I am concerned.

SEBEOK: Any further comments on Dr. Lamb's paper?

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SILVERN: Dr. Lamb introduced a great many new words in his presentation and other speakers introduced other words and other words appeared in the papers published so far. I just wondered how much agreement there was. I believe that several different words are used to represent the same thing and the same word is used to represent different things. Has any attempt been made to standardize the terminology in the field of MT and, if not, then would not it be a worthwhile purpose of this symposium to have some kind of glossary of terms perhaps similar to what the Institute of Radio Engineers did in the computer field? This might include the abbreviations that Professor Josselson suggested that we ought to list.

SEBEEK: Professor Josselson and Professor Oettinger will answer in turn.

JOSSELSON: Without wishing to appear facetious, I would say that the fact that we have an abundance of terms and differences in viewpoint is simply a sign that the discipline has grown up and reached full maturity. On the other hand, this question is going to be tackled very, very seriously. There will be a meeting held fairly soon of workers in the field, and one of the items on the agenda is precisely this matter of terminology. In some cases, the terminology does apply to things which are essentially the same but, in other cases, there is a difference in approach, and those should be outlined. This is a very worthwhile suggestion and I think some compilation should be forthcoming. Every discipline suffers from that.

OETTINGER: Do not do it while it is too early. Words have a very dangerous property. When a word exists there is a natural tendency to believe that something exists that the word refers to. There is nothing more fossilizing for a discipline than the early coinage, the early adoption of a terminology, that is standardized because then everyone assumes that it means something; for example, "mechanical translation". The word is there, therefore it exists and, of all people, we should know that it does not and is not likely to for quite a while and this is so for many other terms. Now, an insistence that every author or speaker carefully define his terms so that people know what

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he is talking about, I will say amen to, but a compendium of meaningless false hypothetizations I think would be a horror.

GLEICHMAN: I would like to ask Mr. Sherry a question. I wonder if it would be possible to describe how his system works when you do have some kind of nested clause.

SHERRY: I am afraid I cannot make this brief; it will take about 1/2 hour. We do have some more slides which we could show. We have more difficult sentences; one that we consider to be a fairly difficult sentence which we can analyze very nicely which indicates precisely these properties.

MERSEL: Mr. Sherry, I would like to thank you. I am basically a very cautious person, and I have been hearing challenges in this field since I first went to visit Mrs. Rhodes in November. If you are talking about making changes to our system, I think you said two days for programming and two weeks for debugging, we feel safe in making this. Furthermore, if you will change it slightly to four days for programming, I think we can make it two days for debugging.

SHERRY: I can answer that without too much trepidation. Our Univac unfortunately, is not our own. As a matter of fact, student courses get first priority on it, and since we are such good and faithful users of it we get last priority on it because they know we are not going to go anywhere else. So when you say two weeks debugging this means getting in a little time here and a little time there. I can not say how many minutes.

MERSEL: We are allowed to get on the computer only once a day, and that is for one checkout. So somehow or other I feel one mistake on the computer is all that you really should be allowed.

SEBEOK: Please feel free to discuss any or all of the papers. Are there any further comments of any sort?

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MATHEWS: This question is for Professor Oettinger. You made reference to phrase structure grammars, and I got the impression that you felt that these methods made use of the fact that a language has a phrase structure. It was not clear from the discussion of the sample sentence, however, how phrase structure actually enters into this. For instance, one of the predictions for something following a noun might be a genitive modifier, but the relationship between a genitive modifier and the noun are different in different sentences; for instance, a "cup of coffee" and the "color of coffee" are quite different genitives. I would expect a program of this sort to make this difference.

OETTINGER: That is a good point. I think that on any syntactic basis, there is very little that one has for distinguishing between these two instances of an "of" or a genitive. Now, the question of the relation of this method to phrase structure is not something that I can explain in two minutes. I will just try to sketch it. It should be more obvious on Thursday in the theoretical paper. My statements about theory are only to be taken as approximate as far as natural languages are concerned. There is an intrinsic relationship and that relates to the topology of trees. A phrase structure language, as anyone who has read any of Chomsky's works knows, amounts essentially to diagramming a sentence in the form of a tree. The sentence on top, noun phrase, verb phrase, and branches coming down below this. Now, it turns out that in a very real, natural, and ideal sense, the Lukasiewicz parenthesis-free notation is the most economical notation for representing the structure of a tree in a linear sequence. There are other representational devices used; for example, parentheses, commas, prepositions, post-modifiers, and so forth. These account for variations in the technique depending on what kind of thing you are working with. But the essential phrase structure-ness, treeness, of the thing, is reflected in the behavior of the prediction pool which, as shown in our talk, is approximately a pushdown store, but not exactly. I hope to show on Thursday that the essence of the phrase-structure predictive technique lies in that in the ideal limiting case where one is dealing with a prediction pool analog which is a precise pushdown store; where the right thing is always at the top of store when you want it; and where when you have finished an inner nest corresponding to a low hanging

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branch on the tree, all the history of this is removed from the prediction pool pushdown store.