LINGUISTICS

Machine Translation Seen

Russian is being analyzed by "predictive analysis," a method that may provide automatic translation and an approach to design of automatic programming for computers.

EXPERIMENTS in automatic translation at Harvard University have shown that the structure of the Russian language—its grammar or syntax—is much simpler than had previously been thought.

Russian syntactic structures have "a hitherto unsuspected degree of simplicity, regularity and universality," Prof. Anthony G. Oettinger of the Harvard Computation Laboratory, Cambridge, Mass., reported to the National Symposium on Machine Translation at the University of California, Los Angeles.

Sentences in Russian are now being analyzed for their structure on the Harvard UNIVAC computer using a simple, yet powerful, method known as "predictive analysis."

The predictive analysis of language at Harvard, Prof. Oettinger explained, is based on "brilliant fundamental work" by Mrs. Ida Rhodes of the applied mathematics division of the National Bureau of Standards, Washington, D. C.

Predictive analysis can be described as a series of educated guesses, in which each word in the sentence predicts the most likely grammatical form of the following words. Alternative guesses are stored in a special hindsight section of the machine's memory and are investigated only if later words in the sentence show that the first guess was wrong.

Predictive analysis methods are used in conjunction with the Harvard automatic Russian-English dictionary on magnetic computer tape, which now contains entries for about 15,000 words occurring in mathematical and electronic texts.

Russian sentences are fed directly into the computing machine without preliminary editing. The output of the machine is a printed analysis of the grammatical role of each word in the sentence, supplied by the predictive analysis computer program.

The Russian-English dictionary also provides a list of the English equivalents of each Russian word and of all the possible grammatical roles that the particular form of this word may take.

This is not yet automatic translation, Prof. Oettinger emphasized, but it is a long step toward the goal. Right now, predictive analysis is a most powerful tool for learning more about the structure of languages.

The problem of the analysis of syntax is just the same as the "parsing" exercises for diagramming sentences that are familiar to most persons from their school days. Syntactic analysis is not concerned with the meaning of the words in the sentence, but with the questions: Is this a complete sentence? Which word is the subject of the sentence? Which is the verb? What grammatical roles do the rest of the words play?

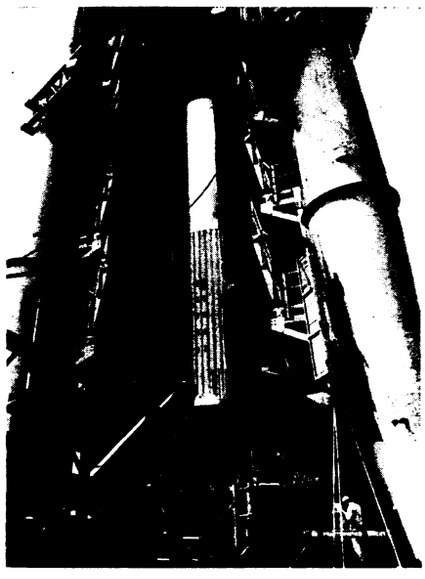
The problem is further complicated by the fact that many word forms can play different grammatical roles in different sentences. This is true even in a highly inflected language like Russian.

Any method of analyzing a sentence, whether in Russian or English or any other language, results in a diagram that looks like a tree, with clauses, phrases and modifying words branching off the main stem of the sentence, Prof. Oettinger said. When a computing machine analyzes a sentence, this tree structure must be expressed as a string of symbols lying in a straight line.

He noted, however, that a human also receives a sentence as a straight-line string of words.

The predictive analysis technique chooses the correct tree diagram for each sentence by working through the sentence from beginning to end—just as the human reader does.

Subsidiary phrases and clauses are treated as structures "nested" within the main sentence, and several levels of nests-within-nests are permitted. By predicting the form of each word on the basis of the word immediately preceding, predictive analysis is able to set forth the grammatical rules of the langauge with extraordinary simplicity and clarity, the scientist said.



BLUE STREAK—Britain's ballistic missile, Blue Streak, being tested at Hatfield, Hertfordshire, England, is 70 feet long and 10 feet in diameter. It is designed to carry thermonuclear warheads to surface targets from underground launching sites.

The ability of predictive analysis to handle "nested" structure within a sentence means that when a sentence contains a construction that is not provided for in the machine program, the machine will analyze all of the sentence that it can, and then make a note of which part of the sentence cannot be analyzed.

To the experimenter, this is a red flag. Either the input sentence is in error, or its grammatical form is not adequately described in the rules of the machine program. Thus the machine can be made to indicate automatically the places where the grammatical rules of analysis are not complete.

Prof. Oettinger said linguists are already showing much interest in the new machine technique as a convenient way of discovering the rules governing rare grammatical constructions that have gone unnoticed in conventional linguistic analysis.

The Harvard project for the predictive analysis of Russian is not yet complete, Prof. Oettinger said, and not all of the resources of the technique have been fully exploited. Theoretical work seems to show that predictive analysis can work for English and for any other natural language. Prof. Oettinger also suggested that predictive analysis may provide an approach to the design of systems of automatic programming for computing machines.

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BIOLOGY

Turtle Immune to Man-of-War's Stinger

WHY THE POISONOUS stingers of the Portuguese man-of-war, so injurious to man and fish, do not affect the loggerhead turtle is still an unsolved mystery.

The Portuguese man-of-war, a brilliantly colored animal, or group of animals, that floats by means of an air sac in the warm waters of the Gulf of Mexico, possesses masses of fine hanging tentacles. These tantacles, sometimes 30 to 40 feet long, are equipped with stingers that can penetrate a rubber glove and presumably even the hard shell of a crab's leg.

Wherever a tentacle touches human flesh, a painful red welt is raised like that left by the lash of a whip.

The loggerhead turtle is reported to eat the man-of-war and seems to be peculiarly immune to the latter's potent toxin. The man-of-war's tentacles, which cling tightly to skin, gloves, glass containers, and even the polished surface of steel scissors, are easily swallowed and digested by the loggerhead.

Because the adult turtle can eat the man-of-war, researchers have thought there might be protective antibodies in the turtle's blood acquired by contact with the man-of-war early in life.

However, experiments designed to test this hypothesis and reported by Dr. Charles E. Lane and Eleanor Dodge Wangersky of the University of Miami's Marine Laboratory in *Nature* (**185,** 330, Jan. 20, 1960), suggest that the loggerhead turtle lacks the blood immune bodies that might explain its apparent insensitivity to the toxin.

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