

of mode, of which there are an infinite variety and which include structured values and names (pointers, here called "references"). Subscripting is generalized to include slices. There is a more general conditional statement. (Statements are called "clauses" in ALGOL 68.) The language has facilities for formatted input-output (called "transput") and for environment inquiries.

The opinion has been expressed (cf. Minority Report, ALGOL Bulletin 31, p. 7) that ALGOL 68 is not sufficiently advanced to facilitate the reliable creation of today's more sophisticated programs. Since no implementation of the language has been completed (although several efforts are well advanced), experience is not available to confirm or deny this view.

The offprint from *Numerische Mathematik* has exactly the same material as the Mathematisch Centrum edition but is much easier on the eye because of better choices of type and better spacing.

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12[13.35].—ARTO SALOMAA, *Theory of Automata*, International Series of Monographs in Pure and Applied Mathematics, Vol. 100, Pergamon Press Ltd., Oxford, 1969, xii + 263 pp., 22 cm. Price \$12.00.

This is a well organized introduction to finite automata theory. It deals with the mathematical foundations, and not with the practical applications to sequential switching circuits or nerve networks. The construction and programming of actual computers is not treated. Instead, the "machines" considered are certain theoretical models which have been intensively investigated during the last fifteen years. These include the finite deterministic automaton, the finite nondeterministic and probabilistic automata, and the pushdown and linear bounded automata.

Attention centers on the languages which are representable in the various machines. Regular languages (those representable in finite deterministic automata) and stochastic languages (those representable in probabilistic automata) are studied in the first two chapters. The third chapter is devoted to the algebra of regular expressions; here the author presents some of his own results concerning axiomatizations of this algebra.

The fourth and last chapter, entitled "Formal languages and generalized automata," introduces the notion of generation of languages by grammars. It includes proofs that the context-free languages are those which are representable in nondeterministic pushdown automata and that the context-sensitive languages are those which are representable in nondeterministic linear bounded automata. Recursively enumerable sets and Turing machines are mentioned in this chapter; however, the full study of recursive function theory is outside the scope of the book. This chapter also includes a section on the abstract pushdown automata of Letichevskii. The author has prepared the reader for this section by including earlier sections on the analysis of finite automata by means of characteristic equations and on the solution

of equation systems in which the unknowns are languages. There are many other items of special interest which cannot be mentioned in a brief review.

Algebraic structure theories, such as those developed by Krohn and Rhodes, by Hartmanis and Stearns, and by Eilenberg and Wright, are not considered in this book. The author has, however, provided a collection of historical and bibliographical remarks, which, together with an extensive list of references, make the book a useful guide to the literature on automata theory, in both the English and Russian languages. Many exercises which explain and extend the theory are listed, and some statements of unsolved problems are given as well, so that the book can be conveniently used as a text in a seminar or in a beginning graduate course.

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