

The final paper in Part 1, entitled "Remote Display Terminals," deals with the various types of display terminals suitable for use in a remote on-line interactive environment. The so-called low-speed terminals (e.g., teletype, incremental plotters, and alphanumeric CRT's) receive the bulk of the attention, while CRT's providing the full range of graphics receive very sketchy treatment.

Part 2 contains nine papers, eight of which describe graphic applications. The graphical discussions contained in these eight papers are, for the most part, not of a general nature and hence would be of little interest to anyone not familiar with the rather specialized applications covered. The final papers in this section consist of a collection of remarks and observations which were recorded during a discussion session at the Symposium.

There is only one paper in Part 3. This paper, "Present Day Computer Graphics Research," gives a good coverage of research efforts in low-cost terminals and in graphic software.

The reference section of the book, Part 4, consists of a series of advertisements for hardware manufacturers of graphics equipment, a glossary of computer graphics terms, and a consolidated bibliography for all of the papers appearing in the book. The glossary provides a comprehensive coverage of graphics-related terms, and is perhaps the most useful portion of the book.

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11[12].—A. VAN WIJNGAARDEN, Editor, B. J. MAILLOUX, J. E. L. PECK & C. H. A. KOSTER, *Report on the Algorithmic Language ALGOL 68*, Second Printing MR 101, Mathematisch Centrum, Amsterdam, 1969, v + 134 pp., 24 cm. Price \$4.50. Also available as offprint from *Numerische Mathematik*, v. 14, 1969, pp. 79–218, Springer-Verlag, New York.

The report is the culmination of a five-year effort by Working Group 2.1 of the International Federation for Information Processing (IFIP) to design a successor to ALGOL 60. Section 0 of the report describes the aims and principles of design, the first of which is "completeness and clarity of description." By Section 1, the clarity has disappeared. Embedded among the specifications of syntax and semantics are comments, called pragmatics, intended "to help the reader understand the implications of the definitions." However, they are often little more than verbalization of the syntax rules. The reader well-versed in the language may find the report useful as an authoritative reference manual (provided he has learned all the new terminology), but even the reader experienced in programming languages is advised to seek other expositions to learn the language. (Such documents are beginning to be available in computer science literature.)

As for the language, although it is not strictly an extension of ALGOL 60, it is in the same tradition. (A brief comparison of ALGOL 60 and ALGOL 68 is given in Section 0 of the report.) The ALGOL 60 notion of type is generalized to the concept

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