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Book Reviews

A Guide to ALGOL Programming, by DANIEL D. MCCRACKEN, 1962; 106 pages. (New York: *John Wiley and Sons Inc.* London: *John Wiley and Sons Ltd.*, 30s.)

This book is highly recommended for the person who wants to get a rapid grasp of the use of a computer in the solution of problems in science and engineering.

The first chapter is devoted to a general description of the fields in which computers may be used, and the necessary steps to be followed in solving a problem on a computer. The notation of flow charts is introduced, and finally an account of the origin and purpose of ALGOL 60 is given, together with a brief explanation of the necessity for translation of ALGOL programs into machine code. The chapter forms an excellent introduction to the subject of computing; there remains only the minor criticism that the use of flow charts is perhaps unnecessary in view of the elegance of the conditional statements and **for** statements of ALGOL. In fact, the later explanation of the relationship between flow charts and ALGOL conditionals tends to obscure the greater simplicity of the latter.

The description of the ALGOL language given in subsequent chapters is exceptionally clear and thorough; but the book offers far more than an account of the language. As each new facility is introduced, its purpose is explained, and practical advice is given on its proper use. This advice covers points of program efficiency and the validity of the numerical methods used. For example, the chapter on **for** statements mentions the danger of testing for absolute convergence, and suggests the proper method of testing for relative convergence; it also encourages the removal of unnecessary calculations from inner loops. Occasionally a warning is given that certain translators may not accept the notation described, but insufficient notice is given in cases where facilities have been widely rejected by implementors. In particular, the use of integer labels should have been discouraged from the start.

An excellent feature of the book is the large number of worked examples, each of which traces through all the stages in the construction of a well-designed program. These examples discuss and solve questions of problem analysis, design of input and output, and the use of computer storage. The exercises and their answers give further examples of the reasoning needed in the construction of good programs, not merely programs that work. After a study of this book, many scientists and engineers should be competent to use a computer for their own problems, with little or no assistance from an experienced programmer.

C. A. R. HOARE.

Input Language for Automatic Programming Systems, by A. P. YERSHOV, G. I. KOZHUKHIN, U. M. VOLOSHIN, 1963; 70 pages. (London: *Academic Press*, 35s.)

The spectre of ALGOL, which has haunted Europe since 1958, at last shows signs of being laid to rest. The third volume of the A.P.I.C. Studies in Data Processing contains a description of a source language designed in the Soviet Union for mathematical procedure description. Though ALGOL-like in some respects it departs sufficiently from the spirit of the original to be counted as a new venture in automatic programming.

The departure is away from pure sequential procedure description towards mathematically convenient forms. In an excellent introduction to the English edition, R. W. Hockney summarizes the most significant of these, which I will comment on here. First let it be said, however, that what might be called the body of the book, consisting of a sentence-by-sentence revision of the ALGOL 60 report, is only "readable" in the sense of a work of reference to the fine structure of the Input Language, so one could hardly call this a work of value for anyone but a specialist steeped in ALGOL lore.

The first modification is in the use and definition of arrays. Conventional matrix operations are permitted in expressions, and a meaning is given to the less conventional forms which can arise (though I think better use could have been made of these varieties). Multi-dimensional arrays can be declared in the usual way, but in addition the elements of an array can themselves be declared to have an array form. New arrays, moreover, can be formed by adding old ones "in parallel" (increasing the dimensionality) or "in series" (increasing the length in one dimension). Elaborate notations are developed for referring to elements or sub-arrays. All this seems very attractive for mathematical work, but there is one unaccountable drawback, that an array must at all times keep the shape of a hyper-rectangle. My experience in using a scheme of this type is that its greatest use is in representing a complete system of programs and data in an array form, which is certainly much less regular than that demanded by the Input Language. Using codeword techniques (Iliffe and Jodeit, *The Computer Journal* Vol. 5, p. 200) this facility is easily gained, and it has obvious applications in both mathematical and data-processing work.

One other significant departure is towards what might be called initialized declarations, in which a value may be assigned to a variable at the same time as it is declared. A special case, a function-expression declaration, is included

[*Continued on p.* 168

10. Acknowledgement

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Appendix

The minimum on a line

A simple algorithm is given for estimating the parameter α^i. A point $|y^i\rangle$ is chosen on $|x^i\rangle + \lambda|s^i\rangle$ with $\lambda > 0$. Let f_x, $|g_x\rangle$, f_y and $|g_y\rangle$ denote the values of the function and gradient at the points $|x^i\rangle$ and $|y^i\rangle$. Then an estimate of α^i can be formed by interpolating cubically, using the function values f_x and f_y and the components of the gradients along $|s^i\rangle$.

This is given by

$$\frac{\alpha^i}{\lambda} = 1 - \frac{\langle g_y|s^i\rangle + w - z}{\langle g_y|s^i\rangle - \langle g_x|s^i\rangle + 2w}$$

where $w = (z^2 - \langle g_x|s^i\rangle \langle g_y|s^i\rangle)^{\frac{1}{2}}$

and $z = \frac{3}{\lambda}(f_x - f_y) + \langle g_x|s^i\rangle + \langle g_y|s^i\rangle$.

A suitable choice of the point $|y^i\rangle$ is given by $|y^i\rangle = |x^i\rangle + \eta|s^i\rangle$ where

$$\eta = \text{MINIMUM OF} \left\{1, \frac{-2(f_x - f_0)}{\langle g_x|s^i\rangle}\right\}.$$

f_0 is the predicted lower bound of $f(|x\rangle)$, for example zero in least-squares calculations. This value of η ensures that the choice of $|y^i\rangle$ is reasonable.

It is necessary to check that $f(|x^i\rangle + \alpha^i|s^i\rangle)$ is less than both f_x and f_y. If it is not, the interpolation must be repeated over a smaller range. Davidon suggests one should ensure that the minimum is located between $|x^i\rangle$ and $|y^i\rangle$ by testing the sign of $\langle g_y|s^i\rangle$ and comparing f_x and f_y before interpolating. The reader is referred to Davidon's report for more extensive details of this stage.

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here. It seems entirely wrong that modern source languages should be dominated by the sequential regimes of early machine codes, and any move towards conventional mathematical forms is to be welcomed. Again, the approach here seems rather tentative and some major benefits are lost. I think it is preferable to make sequential coding subordinate to definitions rather than the other way round: here lies the key to the very important problem of integrating the translator with a realistic operating system.

Amongst the other problems tackled are the handling of complex variables, recurrence relations, and direct transfer of control to parts of the program not similarly accessible in ALGOL. It may be regarded as a tribute to ALGOL that an attempt has been made to graft such a system onto the same tree. At the same time it must accept a measure of responsibility for the fact that the above ideas were not more fully developed and in use three years ago.

J. K. ILIFFE.