A Syntactical Chart of ALGOL 60

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The definitive description of the syntax of ALGOL 60 is to be found in the "Report on the Algorithmic Language ALGOL 60" published in the May, 1960 ACM Communications. In the early stages of writing the ALGOL compiler for the Burroughs B 5000, it became evident that although this report admirably fulfills its purpose as the authoritative definition of ALGOL, it leaves much to be desired as a working reference document.

The need for repeated reference to all 16 pages of the ALGOL report (the reprints of which soon became tattered and dog-eared) convinced us that a more condensed version was needed. In considering the design of such a document, the following characteristics of ALGOL 60 stood out from the rest:

1. Every possible ALGOL 60 construct is precisely defined by means of metalinguistic formulas.
2. The formulas are composed of metalinguistic variables and basic symbols.
3. Each metalinguistic variable has a fixed number of alternative definitions, many of which are recursive.
4. Through substitution every metalinguistic variable can be defined in terms of basic symbols.

These features suggested representing the language as a flow, and we decided to construct a syntactical flow chart. The effort proved fruitful, and the accompanying chart is the final result. Although this is not an ordinary flow chart. The shapes of enclosures—circles, ellipses, and rectangles—have special meanings which are quite different from those employed in a conventional flow chart. In this chart for example, meaning is given to the direction of arrows. The chart contains every basic symbol of ALGOL 60; they are enclosed in circles.1

Every metalinguistic formula used in describing the syntax of ALGOL 60 can be found on the chart. For example:

(block) ::= (unlabelled block) | (label) ; (block)

is to be found at grid points A25 as follows:

This formula states that a block may be either an unlabelled block, or a label followed by a colon followed by a block. Therefore, there are two distinct syntactical definitions of the metalinguistic variable Block. A vertical arrow is used to point to the first element in each of these definitions. In the first case there is only one element—Unlabelled Block—with which that definition is terminated. The second definition has three elements; horizontal arrows are used to connect these elements and to indicate their sequence. Vertical arrows, then, indicate multiple definitions of a single metalinguistic variable, while horizontal arrows connect multiple elements of a single definition. Arrows are categorized horizontal or vertical by their direction at points of exit from any entry to connected enclosures.

While a single metalinguistic variable may appear many times on the chart, the formula for this variable is given only once. For instance, the formula describing the syntax of a block is recursive and the variable Block occurs twice. One appearance is enclosed in an ellipse, the other in a rectangle. An ellipse is used to indicate that the formula defining this metalinguistic variable is given at that point on the chart. A rectangle, on the other hand, indicates that the metalinguistic formula for the enclosed variable is to be found elsewhere on the chart. As a consequence, vertical arrows flow only from ellipses because that is where variables are defined.

The right-hand end of each rectangle contains grid coordinates, which direct the reader to the location of the metalinguistic formula for the variable enclosed in the rectangle. Thus the K29 appearing in the Identifier rectangle at C26 indicates that the ellipse defining Identifier is to be found at coordinates K29.

Some ellipses include a number in the left-hand end, which specifies the number of appearances of this variable on the chart in addition to the one enclosed in the ellipse. If there is no number, the metalinguistic variable appears only once. For instance, the ellipse enclosing the variable Block contains a 2, which means that Block appears in the definition of two variables. One appearance is in the definition of itself, the other can be found in the formula for Unconditional Statement (both of these rectangles, of course, refer the reader back to A25).

This chart has proved to be a valuable reference aid. It has significantly helped us in writing the ALGOL 60 compiler for the Burroughs B 5000. We recommend its use to anyone who is checking the syntax of programs written in ALGOL 60, and as a training aid for anyone who is learning to use the language for the first time.

1 A few circles are divided so that the ALGOL 60 basic symbol is contained in the upper half, and the B 5000 line printer transliteration appears in the lower half.
Diagram techniques as a means of concretely describing ALGOL 60. The form of every possible construct in ALGOL 60 is shown (the extensions to ALGOL 60 included in this text are not shown). All ALGOL formulations are composed of graphic variables.

Presentation differs from the published ALGOL reference in that the B.M.D. symbol appears in the diagram and is used to designate the beginning of a new definition. All other symbols are used to denote the beginning of a new construct.

Horizontal arrows are used to connect the basic symbols and metalinguistic variables which form a definition.

Metalinguistic variables appear in ellipses and parallelograms: the ellipse indicates that the enclosed variable is defined at that place on the chart.

If a metalinguistic variable occurs more than once on the chart, the number of such occurrences appears at the left and right of the ellipse.

The rectangle indicates that the enclosed variable is defined elsewhere on the chart and contains the grid coordinates for locating the definition.