

F. L. Bauer · F. L. De Remer · A. P. Ershov · D. Gries
M. Griffiths · U. Hill · J. J. Horning · C. H. A. Koster
W. M. McKeeman · P. C. Poole · W. M. Waite

Compiler Construction

An Advanced Course

Edited by F. L. Bauer and J. Eickel

Second Edition



Springer-Verlag New York · Heidelberg · Berlin

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CHAPTER 1.A
COMPILER CONSTRUCTION

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"If PL/I is the Fatal Disease,
then perhaps Algol-68 is
Capital Punishment".

An Anonymous Compiler Writer

1. DEFINITIONS

1.1. SOURCE AND TARGET LANGUAGES

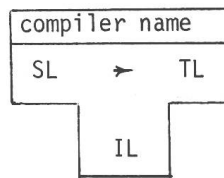
A compiler is a program, written in an implementation language, accepting text in a source language and producing text in a target language. Language description languages are used to define all of these languages and themselves as well. The source language is an algorithmic language to be used by programmers. The target language is suitable for execution by some particular computer.

If the source and target languages are reasonably simple, and well matched to each other, the compiler can be short and easy to implement (See Section 1.A.2 of these notes). The more complex the requirements become, the more elaborate the compiler must be and, the more elaborate the compiler, the higher the payoff in applying the techniques of structured programming.

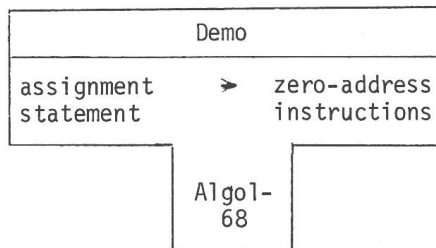
1.2. IMPLEMENTATION LANGUAGES

Compilers can, and have, been written in almost every programming language, but the use of structured programming techniques is dependent upon the implementation language being able to express structure. There are some existing languages which were explicitly designed for the task of compiler writing (FSL [Feldman 66], XPL [McKeeman 70], CDL [Koster 71b], and some for structuring (Pascal [Wirth 71], Algol 68 [van Wijngaarden 68]). The criterion for choosing an implementation language is quite straight forward: it should minimize the implementation effort and maximize the quality of the compiler. Lacking explicit knowledge of this kind, the compiler writer is advised to seek a language as close as possible to the ones mentioned above. The number, quality and availability of such languages is generally on the increase. It may be advantageous to write a compiler to run on a different machine than the target text will run on if better tools can thus be used (especially common for very small target machines). In any case, we shall simply assume an appropriate implementation language is available.

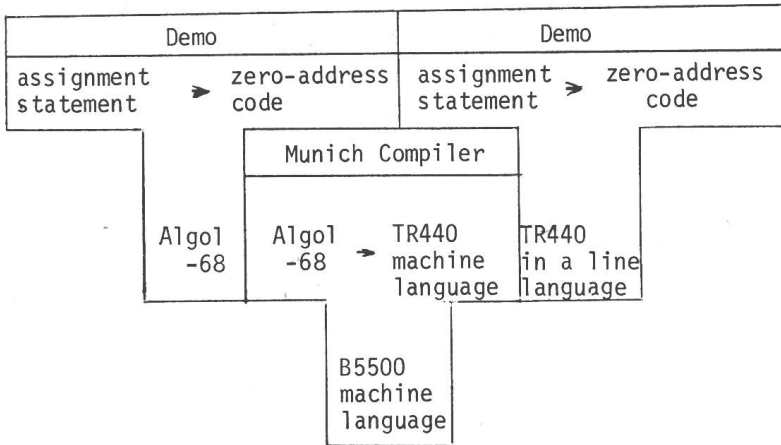
Since there are so many languages involved, and thus so many translations, we need a notation to keep the interactions straight. A given translator has three main languages (SL, TL, IL above) which are objects of the prepositions from, to and in respectively. A T diagram of the form



gives all three [Bratman 61]. If the compiler in Section 1.A.2 (below) is called Demo, then it can be described by the diagram



Now a compiler written in Algol-68 is of no use unless there is also a running compiler for Algol-68 available. Suppose it is on the Burroughs B5500. Then if we apply it to the T above, we will get a new T as follows:



where the arms of the middle T must match the tails of the Ts to the left and right. Complicated, multistage, multilanguage, multimachine translation processes can be described by appropriate cascades of such T diagrams [McKeeman 70 pp. 16-18].

1.3 Language Defining Languages

Language defining languages are almost always based on grammars (see Chapter 2 of these notes) but frequently have additional features designed to define the target text (i.e., translation defining languages). Thus the distinction between language definition and implementation language has not always been very clear. There was a tradition at one point of time to define a programming language as "what the compiler would translate" but this turned out to be of no value to the user who was not prepared to explore the idiosyncracies of a compiler to be able to write programs. The problem then has been to define languages without leaning on the compiler itself.