

FROM THE EDITOR

The third newsletter was delayed by commitment of the editor to other activities at the University of Colorado. Similarly, the response time to correspondence and orders for Pascal has also been slow, at times as long as two months. Meanwhile, the following significant events regarding Pascal have transpired in the last eight months since newsletter number 2.

The Pascal User Manual and Report has been published by Springer-Verlag.

A questionnaire was mailed in September 1974 to all known Pascal users. The summary of the responses is reported here.

The editor presented a paper at the VIM (CDC Users Group) Conference in October 1974 in Denver, Colorado on Pascal. Parts of that paper appear in this newsletter.

The new portable version of Pascal was released in November of 1974.

Recipients of PASCAL2 should receive UPDATE7 soon.

As always, items of interest for the newsletter can be sent to the editor for inclusion in the next issue. Write:

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PASCAL USER MANUAL AND REPORT

The "Pascal User Manual and Report" by Kathleen Jensen and Niklaus Wirth has been published by Springer-Verlag. This report is Number 18 in the series "Lecture Notes in Computer Science". The price is \$8.20 or DM 20,-. Springer-Verlag has offices at 175 Fifth Avenue, New York, NY 10010, USA; D-6900 Heidelberg 1, Neuenheimer Landstrasse 28-30, Germany; and D-1000 Berlin 33, Heidelberger Platz 3, Germany.

K. Jensen and N. Wirth  
Lecture Notes in Computer Science No. 18

Pascal - User Manual and Report

Errata

December 1974

Preface, line 24: minmum

minimum

page/line (negative line numbers imply counting from the bottom)

3/-10	is	are
3/-9	is	are
6/23	procedrue	procedure
12/-10	negetion	negation
14/14	subtrcct	subtract
17/1	(delete the quote " )	
20/5	assignement	assignment
31/23	label	labels
31/25	ccse	case
35/15	in not	is not
35/19	scclar	scalar
41/7	<, <=	<, >, <=
43/-11	small pox	smallpox
49	Replace last 3 lines ("Furthermore ...") by "Within the qualified statement S in	

with b do S

	the identifiers a and b now denote the components b.a and b.b respectively."	
57/24	procedure) or	procedure), or
62/-13	(delete the extra quote " )	
63/8	first := nil	first := nil
67/1	PROCEDURUS	PROCEDURES
67/-3	j1..jn	j1 ... jn
71/-17	parcmeter	parameter
81/10	(move line left by 20 positions)	
84/26	(delete the extra quote " )	
92/18	(delete the comma after "12")	
97/13	procedrues	procedures
98/10	debby	debby ;
101/-18	discriptors	descriptors
101/-5	(delete the extra period)	
102/23	B4	B1
106/16	either intege or	either integer or
109/-1	data	date
134/15	charccter	character
138/28	constrat	contrast
139/21	know	known
144/-8	skde2	side2
161/8	if no next	If no next
168/-1	world symbols	word symbols

PASCAL QUESTIONNAIRE

A questionnaire was mailed in September 1974 to people on the newsletter mailing list. Its purpose was twofold. First, it was an attempt to reduce the number of names on the list. About 70 people failed to respond and were dropped. The other purpose was to survey the Pascal community and report its profile.

A summary follows of the questionnaire. Individual responses cannot be given due to the large number of replies and specific requests by several individuals (mainly those associated with the computer industry) to keep their replies confidential.

Of 269 questionnaires mailed, 190 were returned. This is a response of 70.6 percent. No attempt was made to account for the effect of several people responding from the same site. Most replies were received in the period September through December 1974.

Do you have access to a Pascal compiler?

73.7 %	137/186	YES
26.3 %	49/186	NO

Which version of Pascal are you using?

41.6 %	47/113	Wirth, PASCAL2
25.7 %	29/113	Wirth, PASCAL1
9.7 %	11/113	Hartman, IBM 370
8.0 %	9/113	Nagel, DEC 10
6.2 %	7/113	Wirth, PASCAL0
5.3 %	6/113	Welsh, ICL 1900
4.4 %	5/113	Thibault, CII IRIS
3.5 %	4/113	Amble, Univac 1100
3.5 %	4/113	Burger, CDC 6000

How many Pascal jobs are run in a month?

15.0 %	12/80	Less than 10
31.3 %	25/80	To 100
28.8 %	23/80	To 500
11.3 %	9/80	To 1000
13.8 %	11/80	Over 1000

What is the nature of your installation?

73.7 %	112/152	Educational institution
11.8 %	18/152	Computer industry
9.9 %	15/152	Governmental facility
4.6 %	7/152	Business firm

What applications do you use Pascal for?

70.5 %	122/173	Educational
69.4 %	120/173	Software development
37.0 %	64/173	Scientific
6.9 %	12/173	Business

Several people reported having implemented their own version of Pascal. These implementations have not yet been distributed. Mr. Pierre Desjardins of the Université de Montréal is working on a Xerox Sigma 6 Pascal compiler. Monsieur Marcel Dupras of the Institut de Programmation of the Université Pierre et Marie Curie in Paris, France has a CDC 3600 version of Pascal. There is also a CDC 3300 version of Pascal from Bratislava, Yugoslavia on which there is little information. Professor Donald B. Gillies at the University of Illinois (Urbana) has a PDP-11/20 Pascal compiler. Professor Doctor G. Goos at the Universität Karlsruhe in Germany has a B6700 version of Pascal. Monsieur Gerard Henneron of IREP in Grenoble, France has an IBM 370 Pascal compiler. Dr. J. Larmouth at Cambridge in England has a IBM 370 Pascal interpreter. Dr. Jan Madey of the Leibniz-Rechenzentrum der BAW in Munich, Germany has a Telefunken TR440 version of Pascal. Mr. David L. Russell and Mr. Jeffrey Y. Sue of the Digital Systems Laboratory of Stanford University have an IBM 370 Pascal compiler. And Mr. H. C. de Ruyter van Steveninck of Philips Research Laboratories in Eindhoven, The Netherlands has a version of Pascal for the Philips P1400.

#### HISTORY OF PASCAL, REVISED - G. Richmond

The Pascal Newsletter No. 2 contained a section on the history of Pascal. Since then, omissions were brought to the editor's attention and more information about the development of Pascal was discovered. The editor presented the revised history at the VIM 21 Conference in Denver last October and it is repeated here for the benefit of those who have not seen it before. Note in particular, the use of the terms PASCAL0, PASCAL1, PASCAL2, PASCAL-P1, and PASCAL-P2 to denote various versions of Pascal that have been released. A bibliography of material about Pascal is also included.

Pascal is an outgrowth of the early efforts of Dr. Niklaus Wirth to define a successor to Algol 60 by extension into the area of data definition facilities. In 1965, a proposal for such a successor was presented to an IFIP Working Group. It was deemed not to be a sufficient advance over Algol 60 and was released for wider publication and appeared in the Communications of the Association for Computing Machinery [Wir66]. Some of the aims of this proposal were to define a language that could be compiled quickly by a reliable translator, extend the utility of the language beyond strictly algebraic and numeric applications into areas such as information retrieval and symbol manipulation, and to oblige the programmer to express himself clearly without subverting the language to accomplish his task.

These goals reappear in the original definition of the language Pascal [Wir71a]. There was a desire to provide a language well suited to teaching programming as a systematic discipline based on fundamental concepts that were visibly reflected in the language. And Dr. Wirth wanted to demonstrate through an actual implementation that a significant and useful language can be realized in a reliable fast compiler.

The first work on Pascal began in 1968 at Eidgenössische Technische Hochschule (ETH) in Zürich, Switzerland on a CDC 6000 system with the construction of a Pascal compiler written in Fortran [Wir71b]. Although the compiler was completed, the result was an internal data structure and program contorted to fit the rules of Fortran. This compiler was unsuitable for translating at the source level into Pascal and a new compiler was started. It was entirely written in Pascal.

Once the project had progressed to the point that the paper compiler could theoretically translate itself, the compiler was translated by hand into a low level language and an executable compiler was produced. This hand translation only took one man-month of effort. Admittedly, only enough of the language facilities to allow self-compilation had been implemented, but 60 percent of the final version was already there. Almost 3000 lines of code were produced before testing could begin. The full compiler was available in 1970 and this version is called PASCAL0.

Further validation of the design of the language Pascal and of its implementation was provided one year later when Drs. J. Welsh and C. Quinn at Queen's University in Belfast, North Ireland transported Pascal from the CDC 6000 series computer to the ICL 1900 series computer [Wel72]. This project required six man-months of preparatory design and coding without access to an operational compiler. The major work involved the design and writing of expression recognizers to generate code for a radically different machine architecture. An additional man-month was devoted to writing an ICL machine code interpreter to run on the CDC machine. This tool would allow testing of the ICL compiler on the CDC machine. In a single trip to Zurich of eight working days, the ICL compiler was run for the first time and debugged. The binary of the ICL compiler was taken back to Belfast where it ran successfully.

The original report on Pascal provided a rigorous definition of the syntax of the language but only a verbal description of the semantics. The semantics were provided in 1972 by the publication of an axiomatic definition of Pascal [Hoa73]. As part of this project, the syntax of the language was revised slightly and the revised report on Pascal was issued [Wir72a]. To bring the existing compiler up to date, the necessary cosmetic changes, except for class variables which were retained from the previous version, were made and a new compiler was released. This version is referred to as PASCAL1 and was first available in late 1972. It is also known as PASCAL 6000-3.2.

However, the decision was made to rewrite the compiler completely. The changes included replacement of class variables with pointer variables to conform with the revised report, relocatable binary object code compatible with the standard CDC loader instead of a special absolute loader, introduction of a facility for separately compiled procedures and external Fortran subroutines, and new transport procedures for eliminating the need for a line control character and to accommodate CDC disk file structures. The new Pascal compiler was released in June 1974 and is called PASCAL2. It is also known as PASCAL 6000-3.4.

During the past two years, another method for implementing Pascal on computers other than the CDC 6000 series has been available from ETH. A portable Pascal compiler was released in early 1973 for this purpose. This first version is called PASCAL-P1. It was written to generate in an abstract language called P-code. By compiling the compiler, a P-code Pascal compiler is obtained. Thus, one only need provide an interpreter for P-code in order to obtain a Pascal compiler. However, the PASCAL-P1 compiler followed the original definition of Pascal (PASCAL0 compiler) and did not implement all the features available in the CDC 6000 version.

To remedy this problem, the portable Pascal compiler was rewritten and released in November 1974. It is called PASCAL-P2. The new compiler can be tailored to the target machine by specifying several parameters. Further details on this compiler can be found elsewhere in this newsletter.

With two methods of implementation possible, Pascal has been transferred to several different machines. The original bootstrap of the CDC version was done by Welsh and Quinn to an ICL 1900 machine [Wel72]. Since then, Mr. D. Thibault and Mr. P. Mancel in Paris, France bootstrapped Pascal to the CII Iris 80 [Thi73]. This machine has an instruction set equivalent to the Xerox Sigma 7. Another bootstrap is being attempted by Mr. P. Desjardins in Montreal, Quebec for the Xerox Sigma 6 [Des73]. Implementations via PASCAL-P1 were done by Dr. H. H. Nagel in Hamburg, Germany for the DEC System 10 [Gro74], by Mr. A. Hartmann at Caltech for the IBM 360 [Ric74b], and Dr. T. Amble in Trondheim, Norway for the Univac 1108 [Mol74]. Other IBM 360 Pascal projects are underway at the University of Manitoba by Dr. J. M. Wells using PL360 as the implementation language [Ric74b] and at Stanford University by Mr. D. Russell and Mr. J. Sue using the bootstrap technique [Rus74]. In a recent survey reported elsewhere in this newsletter, responses indicated that projects were underway for the following machines: TI ASC, Data General 840, Raytheon 704, Univac AN/VYK-20, Honeywell G635, Burroughs 4700 and 6700, and PDP-11/45.

Several people have gone beyond just implementing Pascal on their computer. The best documented example is that of Dr. W. Burger [Bur73] who made extensive modifications to the compiler and supporting routines, particularly in the area of partial compilation. Control Data Corporation has modified Pascal to make it a cross-compiler. This version runs on the CDC 6000 series computer and produces binary code for their front-end processor.

After the development of Pascal in 1970 at ETH Zürich, Pascal spread through publication in journals, such as Acta Informatica [Wir71a] and Software-Practice and Experience [Wir71b]. Dr. Wirth spent the 1971-1972 academic year at Stanford University and gave several talks throughout the United States about Pascal. In 1972, Dr. Lyle Smith at the University of Colorado agreed to help Dr. Wirth distribute Pascal in the United States. In 1973, the editor took over this function after Dr. Smith left the University of Colorado. Other people with their own versions of Pascal have begun their own distribution mechanisms. Growth

of the Pascal community can be seen through the number of new CDC sites installing Pascal within the United States over the past several years.

1972	14
1973	22
1974	46

To this point in time, Pascal has been entirely supported by a small group at ETH in Zurich. Dr. Niklaus Wirth, Ms. Kathleen Jensen, Mr. Urs Ammann, Mr. H. H. Nägeli, and Mr. Helmut Sandmayr are the current members. In the past, Mr. E. Marmier, Mr. W. Bächli, and Mr. Rudy Schild have been associated with the project. The PASCAL0 and PASCAL1 compilers are extremely stable with only 9 cards of corrective code (about 0.1 % of the system) issued for them. The recently released PASCAL2 compiler (June 1974) has a poor initial history with 742 lines of corrective code (9.7 %) already released.

The mechanism for reporting problems is extremely informal. Evidence is mailed to Zürich and corrective code is later mailed out to all known Pascal sites. Unfortunately, none of the beneficial mechanisms of a formal reporting system like the CDC PSR Summaries exist. And no indications have been given as to what problems have been repaired by each corrective code release.

Since Pascal can be modified easily, many users have made extensive changes, particularly because of the spartan compilation listing produced by the compiler. Coordination of these individual efforts has not been attempted.

Documentation for Pascal is sparse, particularly concerning the internal construction of the compiler. The only published internal documentation on the compiler are the original papers on the design of the compiler [Wir71b] and on code generation [Wir72b].

Manuals for users of Pascal were at first limited to only the formal definition of the language [Wir71a, Wir72a]. In 1973, Dr. W. Burger wrote a Pascal Manual [Bur73] for his version of Pascal. This manual was revised to reflect PASCAL1 by the editor and distributed as part of the Pascal package. Just recently, a Pascal User Manual and Report by Ms. Jensen and Dr. Wirth [Jen74] was published and fulfills the need for a user document on Pascal (and PASCAL2).

Pascal is a good language for teaching programming [Lec74a] and the development of software [Wir71c, Wir73]. For CDC 6000 computer users in particular, Pascal is a much more readable and versatile language than Algol or Fortran. It provides the control and data structures that are desirable for structured programming. With the PASCAL2 compiler supporting separate compilation, relocatable binary decks, and interfacing to Fortran subroutines, Pascal is now a viable language for programming on CDC computers. Its portability to other computers gives it the potential to be as widely used a language as Fortran.

However, there are some problems with Pascal. First, the language has a number of minor deficiencies which were stated in a paper by Dr. Habermann [Hab73] and rebutted by Prof. Lecarme [Lec74b]. Although these are not serious problems, any further refinements to the language to solve them would just place another dialect of Pascal in the field. The problem of incompatible dialects is further compounded by the number of people willing to make significant changes to the compiler.

The second problem is a lack of support from any major computer manufacturer. Most implementation efforts have been in a university environment. However, manufacturer support may be undesirable as computer manufacturers have never been known as promoters of portable software. There is a need for a strong Pascal Users Group to carry on the task of developing, distributing, and supporting Pascal for all brands of computers. As the number of Pascal sites continues to grow, the present mechanism for distribution and support will become more inadequate.

However, the willingness of hundreds of sites to install Pascal and use it is proof of the merit of the language.

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