REDUCE Information Package

REDUCE is an interactive program designed for general algebraic computations of interest to mathematicians, scientists and engineers. Its capabilities include:

- expansion and ordering of polynomials and rational functions;
- substitutions and pattern matching in a wide variety of forms;
- automatic and user controlled simplification of expressions;
- calculations with symbolic matrices;
- arbitrary precision integer and real arithmetic;
- facilities for defining new functions and extending program syntax;
- analytic differentiation and integration;
- factorization of polynomials;
- facilities for the solution of a variety of algebraic equations;
- facilities for the output of expressions in a variety of formats;
- facilities for generating optimized numerical programs from symbolic input;
- Dirac matrix calculations of interest to high energy physicists.

It is often used as an algebraic calculator for problems that are possible to do by hand. However, the main aim of REDUCE is to support calculations that are not feasible by hand. Many such calculations take a significant time to set up and can run for minutes, hours or even days on the most powerful computers. In support of this goal, REDUCE has the following characteristics:

1. Code stability. Various versions of REDUCE have been in use for over twenty years. There has been a steady stream of improvements and refinements since then, with the source being subject to wide review by the user community. REDUCE has thus evolved into a powerful system whose critical components are highly reliable, stable and efficient.
2. Wide user base. A particular algebra system is often chosen for a given calculation because of its widespread use in a particular application area, with existing packages and templates being used to speed up problem solving. As evidenced by more than 800 reports listed in the current bibliography, REDUCE has a large and dedicated user community working in just about every branch of computational science and engineering. A large number of special purpose packages are available in support of this, with many contributed by users.
3. Full source code availability. From the beginning, it has been possible to obtain the complete REDUCE source code, including the “kernel”. Consequently, REDUCE is a valuable educational resource and a good foundation for experiments in the discipline of computer algebra. Many users do in fact effectively modify the source code for their own purposes.

4. Flexible updating. One advantage of making all code accessible to the user is that it is relatively easy to incorporate patches to correct small problems or extend the applicability of existing code to new problem areas. An electronic mail service and gopher and World Wide Web servers allow users to get such updates and complete new packages as they become available, without having to wait for a formal system release.

5. State-of-the-art algorithms. Another advantage of an "open" system is that there is a shared development effort involving both distributors and users. As a result, it is easier to keep the code up-to-date, with the best current algorithms being used soon after their development. At the present time, we believe REDUCE has the best available code for solving nonlinear polynomial equations using Groebner bases, real and complex root finding to any precision, exterior calculus calculations and optimized numerical code generation among others. Its simplification strategy, using a combination of efficient polynomial manipulation and flexible pattern matching is focussed on giving users as natural a result as possible without excessive programming.

6. Algebraic focus. REDUCE aims at being part of a complete scientific environment rather than being the complete environment itself. As a result, users can take advantage of other state-of-the-art systems specializing in numerical and graphical calculations, rather than depend on just one system to provide everything. To this end, REDUCE provides facilities for writing results in a form compatible with common programming numerical languages (such as Fortran) or document processors such as TeX.

7. Portability. Careful design for portability means REDUCE is often available on new or uncommon machines soon after their release. This has led to significant user communities throughout the world. At the present time, REDUCE is readily available on essentially all workstations and high-end microprocessor-based machines in the market.

8. Uniformity. Even though REDUCE is supported with different Lisps on many different platforms, much attention has been paid to making all versions perform in the same manner regardless of implementation. As a result, users can have confidence that their calculations will not behave differently if they move them to a different machine.

9. Flexible Offerings. To support the differing needs of the user community, REDUCE is available in a number of different configurations:

   (a) personal system, ready to run, available for a selection of common personal computers, shipped without source and hence with less easy updatability between major releases, but at lowest cost for a single user site;
   (b) professional system, which comes with source, and is licensed for use on one CPU or fileserver and so can be especially attractive for laboratories or work-groups;
   (c) site licenses, which extend the professional system to cover all similar machines at a single postal address.

10. Cost. The cost of the complete REDUCE system to the end-user is moderate, and does not vary substantially from platform to platform. In addition, the personal system and site licenses are offered on very generous terms. Moreover, since all systems are derived from the same source base, they are very compatible from platform to platform (from a

PC to a Cray supercomputer). This makes it possible to have compatible versions at home and work.

The most recent release of REDUCE (Version 3.6) is dated 15 July 1995. It is available for most common computing systems, in some cases in more than one version for the same machine, through a variety of distributors listed in this memo. REDUCE is based on a dialect of Lisp called *Standard Lisp*, and the differences between versions are the result of different implementations of this Lisp; in each case the source code for REDUCE itself remains the same. The complete source code for REDUCE is available. On-line versions of the manual and other support documents and tutorials are also normally included with the distribution.

In order to help users choose the best version of REDUCE for their purposes, we shall describe the general characteristics of the available Lisps. Following this will be a table showing the particular versions supported on each machine, and finally the full names and addresses of the REDUCE distributors.

Since Standard Lisp includes a limited number of functions, it is possible to run REDUCE on most modern Lisps, since they contain these functions as a subset. However, the distributed versions of REDUCE are based on two easily available Lisps, namely:

- Portable Standard Lisp (PSL). This is currently the Lisp used most widely for running REDUCE. It evolved from the original Standard Lisp definition, but now contains many more facilities. It is quite efficient in its use of both space and time, and has been optimized for algebraic computation. All PSL versions of REDUCE are distributed with sufficient PSL support to run on the given computing system. PSL is supported on many architectures and is an ideal system for those wanting to run REDUCE as a standalone system. The current principal developer of PSL is the Konrad Zuse Center, Berlin (ZIB).
- Codemist Standard Lisp (CSL). This is a Lisp system written completely in ANSI C, which makes it very easy to port to a new machine. Like PSL, it is a faithful implementation of Standard Lisp and has been optimized for running REDUCE. It requires a very small memory partition for its Lisp support. Furthermore, most of the REDUCE facilities are supported as machine independent pseudocode, which is quite compact. In the worst case, the performance of this system is about a factor of two slower than PSL, though in many cases it matches PSL performance. However, the memory use is smaller. All CSL versions are distributed with sufficient CSL support to run on the given computing system. This is an ideal system for those wishing to embed algebraic calculations in a C-based programming environment. The developer of CSL is Codemist Ltd. A version with Japanese language support is also available from Forbs Ltd.

Demonstration Versions

Demonstration versions of the CSL-based REDUCE for the IBM PC and Macintosh described below are available by anonymous ftp from ftp.bath.ac.uk in the directory pub/jpff/REDUCE .

Demonstration versions of the PSL-based REDUCE for the IBM PC described below are available by anonymous ftp from ftp.zib-berlin.de as follows:

pub/reduce/demo/msdos: MS-DOS and Windows 3.1
pub/reduce/demo/linux: LINUX

Obtaining Further Information about REDUCE

You can obtain a current copy of this information form at any time by including the line "send info-package" (or "send info-package.tex" for a LaTeX version) in a message to one of the REDUCE network library servers, namely reduce-netlib@rand.org, reduce-netlib@can.nl or reduce-netlib@pi.cc.u-tokyo.ac.jp. This message is answered by an automated server. The library includes packages made available since the release of REDUCE 3.6 and patches to correct any bugs that have been discovered. Further information on this library, as well as instructions on how to join a REDUCE electronic forum, can be obtained by including "help" on a separate line in the message. Finally, a set of introductory examples in LaTeX format can be obtained by including "send intro.tex" on a line in your message.

The same information is available from an Internet gopher server with the address info.rand.org. The network library files are in a "REDUCE Library" directory under the directory "Publicly Available Software". The relevant URL is gopher://info.rand.org/11/software/reduce .

A World Wide Web REDUCE server with URL http://www.rrz.uni-koeln.de/REDUCE/ is also supported. In addition to general information about REDUCE, this server has pointers to the network library, the demonstration versions, examples of REDUCE programming, a set of manuals, and the REDUCE online help system.

To register for the electronic mail forum, or for further information, please contact:

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1700 Main Street
P.O. Box 2138
Santa Monica CA 90407-2138
Telephone: +1-310-393-0411 Ext. 6615
Facsimile: +1-310-393-4818
Electronic Mail: reduce@rand.org

Versions Available

The following table describes the versions of REDUCE supported by the various distributors. Contact them for detailed price and availability information. For some machines REDUCE 3.6 may not be available, but 3.5 still distributed.

The generic ANSI C version requires some experience with the embedding language for installation; the machine-specific versions have more straightforward installation procedures.

System Description	Distributors (Lisp Used)
Generic ANSI C version	Codemist (CSL)
Acorn Archimedes	Codemist (CSL)
Apple Macintosh	Codemist (CSL)
Atari 1040ST and Mega	Codemist (CSL)
CDC Cyber 910	ZIB (PSL)
CDC 4000 series	ZIB (PSL)
Convex C100, C200 and C300 series	ZIB (PSL)
Cray X-MP, Y-MP and C90	ZIB (PSL)
Data General AViiON series	ZIB (PSL)
DEC Alpha PC running MS Windows NT	ZIB (PSL)
DEC Alpha series running OSF-1 or Open VMS	ZIB (PSL)
DEC DECStation series 2000, 3000 and 5000	ZIB (PSL)
DEC VAX running VAX/VMS or Ultrix	ZIB (PSL)
Fujitsu M Mainframe Unix series	Forbs (CSL)
Fujitsu 2400 series running UXP/M	ZIB (PSL)
HP 9000/300 and 400 series	Forbs (CSL); ZIB (PSL)
HP 9000/700 and 800 series	Forbs (CSL); ZIB (PSL)
IBM-compatible PCs based on Intel 80286 with extended memory, 80386 and 80486 running MS-DOS	Codemist (CSL); Forbs (CSL)
IBM-compatible PCs based on Intel 80386 and 80486 running MS-DOS, MS-Windows 3, OS/2 or Windows NT	ZIB (PSL)
IBM-compatible PCs based on Intel 80386 and 80486 running UNIX (SCO-Unix, Interactive, Solaris or LINUX)	ZIB (PSL)
IBM-compatible PCs based on Intel 80386 and 80486 running Next Step	ZIB (PSL)
IBM RISC System/6000	ZIB (PSL)
ICL mainframes running VME	Codemist (CSL)
ICL DRS6000	Codemist (CSL)
NEC EWS 4800 series	Forbs (CSL)
NEC PC-9800 series	Forbs (CSL)
NeXTstation	ZIB (PSL)
Siemens S400/40 series running UXP/M	ZIB (PSL)
Silicon Graphics IRIS or INDIGO	ZIB (PSL)
Sony NEWS	Forbs (CSL)
Sun 3	Forbs (CSL); ZIB (PSL)
Sun 4, SPARCStation series and compatibles	Forbs (CSL); ZIB (PSL)
Thinking Machines CM5	ZIB (PSL)

REDUCE Distributors

Codemist: Codemist Limited
"Alta", Horsecombe Vale
Combe Down
Bath BA2 5QR, UNITED KINGDOM
Telephone: +44-1225-837430
Facsimile: +44-1225-837430
Electronic Mail: jpff@maths.bath.ac.uk

Forbs: Forbs System Co. Ltd
Kannai JS Building
207 Yamasitachou
Naka-ku
Yokohama 231, JAPAN
Telephone: +81-45-212-5020
Facsimile: +81-45-212-5023

ZIB: Herbert Melenk
Konrad-Zuse-Zentrum fuer Informationstechnik Berlin (ZIB)
Heilbronner Str. 10
D10711 Berlin, GERMANY Telephone: +49-30-89604-195
Facsimile: +49-30-89604-125
Electronic Mail: melenk@sc.zib-berlin.de

Ordering information for the ZIB versions is available from the URL http://www.zib-berlin.de/Symbolik/reduce/dist/ or by anonymous ftp from ftp.zib-berlin.de in pub/reduce/distribution.

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