axiom™
The 30 Year Horizon
Information Sources

- Website: axiom-developer.org
What is Axiom?

Axiom has been in development since 1971. At that time, it was called Scratchpad. Scratchpad was a large, general purpose computer algebra system that was originally developed by IBM under the direction of Richard Jenks. The project started in 1971 and evolved slowly. Barry Trager was key to the technical direction of the project. Scratchpad developed over a 20 year stretch and was basically considered as a research platform for developing new ideas in computational mathematics. In the 1990s, as IBM's fortunes slid, the Scratchpad project was renamed to Axiom, sold to the Numerical Algorithms Group (NAG) in England and became a commercial system. As part of the Scratchpad project at IBM in Yorktown Tim Daly worked on all aspects of the system and eventually helped transfer the product to NAG. For a variety of reasons it never became a financial success and NAG withdrew it from the market in October, 2001.
Pre-compil ed binaries

Axiom has been compiled to run on various platforms.

This table contains links to various tar-gzipped version of files. In general you need to know the name of the file you download, usually something ending in .tgz (tar-gzip). You also need to know where the file gets untarred, this is referred to as (where) below. When you cd to the (where) location you should see the top level Makefile for Axiom, the changelog, etc.

Axiom builds on various platforms and uses the convention that the last name in the AXIOM shell variable denotes the type of system. This is referred to as the SYSNAME. You need to know which SYSNAME you downloaded.

To use one of these binaries just do:

download the binary and untar it.
  cd axiom
  export AXIOM=`pwd`/mnt/SYSNAME <= replace SYSNAME with actual name
  export PATH=$AXIOM/bin:$PATH
  axiom

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Combined Table of Contents
This is the table of contents from the existing volumes combined into one document for easy reference.

Volume 0: Axiom Jenks and Sutor
This is the reconstructed Jenks and Sutor volume.

Volume 1: Axiom Tutorial
This is the tutorial volume ISBN 1-411-66587-X. Hardcopy is available from Amazon.com or Lulu.com

Volume 2: Axiom Users Guide
This is a more detailed explanation with current information for Axiom users.

Volume 3: Axiom Programmers Guide
This is information about the language and algebra hierarchy for Spad language programmers.

Volume 4: Axiom Developers Guide
This is a collection of useful information for developers.

Volume 5: Axiom Interpreter
This is the source code and explanation for the interpreter.

Volume 6: Axiom Command
This covers the axiom commands, sman, and some other system related issues.

Volume 7: Axiom Hyperdoc
This is the source and explanation of the X11 hyperdoc subsystem.
  - Volume 7.1: Axiom Hyperdoc Pages
    This is the source and pages for Hyperdoc.

Volume 8: Axiom Graphics
This is the source and explanation of the X11 graphics subsystem.

Volume 9: Axiom Compiler
This is the source and explanation of the spad compiler.

Volume 10: Axiom Algebra Implementation
This is a multi-volume set covering the algebra. The first volume deals with implementation issues.
  - Volume 10.1: Axiom Algebra Theory
    This volume gives background theory for various algebra topics.
  - Volume 10.2: Axiom Algebra Categories
    This is the source code for all of the categories.
  - Volume 10.3: Axiom Algebra Domains
    This is the source code for all of the domains.
  - Volume 10.4: Axiom Algebra Packages
    This is the source code for all of the packages.

Volume 11: Axiom Browser
This is the source and explanation of the new Firefox browser front end.

Volume 12: Axiom Crystal
This is the design documents and internals for the crystal interface.
Information Sources

- Website: axiom-developer.org
- Jenks Book: ISBN 0–387-97855-0
The 30 Year Horizon

Manuel Bronstein
James Demong
Albrecht Fornascher
Jocelyn Cudry
Michael Managan
Jonathan Siewiorek
Stephen Watt

William Barse
Michael Donor
Parrita Closs
Richard Jenkins
Larry Lambe
William Ste
Barry Trager

Volume 0: Axiom Jenks and Sutor
Information Sources

- Website  axiom-developer.org
- Jenks Book  ISBN 0–387-97855-0
- Daly Tutorial  ISBN 1-4116-6597-X
The 30 Year Horizon

Volume 1: Axiom Tutorial
Information Sources

- Website: axiom-developer.org
- Jenks Book: ISBN 0–387-97855-0
- Source Code: github.com
Information Sources

- Website axiom-developer.org
- Jenks Book ISBN 0–387-97855-0
- Daly Tutorial ISBN 1-4116-6597-X
- Source Code github.com
- sourceforge.net
Axiom Computer Algebra System

Axiom is a computer algebra system. It consists of an interpreter, a compiler and a library of algorithms. Axiom is an excellent research platform as well as a useful tool for scientific programming.

News

Axiom February 2005 release 2005-01-31
Axiom 3.0 Beta (January 2005) 2005-01-05
View all news...

Related Articles
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Information Sources

- Website: axiom-developer.org
- Jenks Book: ISBN 0–387-97855-0
- Source Code: github.com, sourceforge.net, savannah.nongnu.org
This project is not part of the GNU Project.

Axiom is a general purpose Computer Algebra system. It is useful for doing mathematics by computer and for research and development of mathematical algorithms. It defines a strongly typed, mathematically correct type hierarchy. It has a programming language and a built-in compiler.

Axiom has been in development since 1973 and was sold as a commercial product. It has been released as free software.

Efforts are underway to extend this software to (a) develop a better user interface (b) make it useful as a teaching tool (c) develop an algebra server protocol (d) integrate additional mathematics (e) rebuild the algebra in a literate programming style (f) integrate logic programming (g) develop an Axiom Journal with refereed submissions.

Axiom is sponsored by CAISS, the Center for Algorithms and Interactive Scientific Software, at The City College of New York.

Registration Date: Thu 12 Sep 2002 12:39:40 AM UTC
License: Modified BSD License
Development Status: 5 - Production/Stable
Information Sources

- Website  axiom-developer.org
- Jenks Book  ISBN 0–387-97855-0
- Daly Tutorial  ISBN 1-4116-6597-X
- Source Code  github.com,
-  sourceforge.net
-  savannah.nongnu.org
- Mailing List  axiom-developer@nongnu.org
axiom-developer Archives

Archives are generally refreshed every 2 hours (in the presence of new messages) - for details, please visit the main index.
You can also download the archives in mbox format.

Search String:  
Search!  [How to search]

Display: 20  
Description: normal  
Sort: by score

[All Lists]

- 2008-11: [Date] [Thread]
- 2008-10: [Date] [Thread]
- 2008-09: [Date] [Thread]
- 2008-08: [Date] [Thread]
- 2008-07: [Date] [Thread]
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Information Sources

- Hyperdoc
What would you like to do?

- **Basic Commands**: Solve problems by filling in templates.
- **Reference**: Scan on-line documentation for Axiom.
- **Topics**: Learn how to use Axiom, by topic.
- **Browse**: Browse through the Axiom library.
- **Examples**: See examples of use of the library.
- **Settings**: Display and change the system environment.
- **About Axiom**: See some basic information about Axiom.
- **What’s New**: Enhancements in this version of Axiom.
Information Sources

- Hyperdoc
- Axiom Firefox
What would you like to do?

**Any Command**
Try command line input

**Basic Commands**
Solve problems by filling in templates

**Axiom Textbook**
Read Volume 0 -- The Jenks/Sutor Book

**Axiom Tutorial**
Read Volume 1 -- The Tutorial

**Reference**
Scan on-line documentation for AXIOM

**Topics**
Learn how to use Axiom, by topic

**Browser**
Browse through the AXIOM library

**Examples**
See examples of use of the library

**Settings**
Display and change the system environment

**What's New**
Enhancements in this version of Axiom

**Fonts**
Test Axiom Fonts in your Browser
Information Sources

- Hyperdoc
- Axiom Firefox
- )help
(1) → )help

A.12. )help

User Level Required: interpreter

Command Syntax:
- )help
- )help commandName
- )help syntax

Command Description:
This command displays help information about system commands. If you issue
)help
then this very text will be shown. You can also give the name or abbreviation
of a system command to display information about it. For example,
)help clear
will display the description of the )clear system command.
The command
)help syntax
will give further information about the Axiom language syntax.

All this material is available in the AXIOM User Guide and in HyperDoc. In
HyperDoc, choose the Commands item from the Reference menu.

A.1. Introduction
Information Sources

- Hyperdoc
- Axiom Firefox
- )help
- )display operation
(1) -> Display operation concat

There are 10 exposed functions called concat:

[1] (Result, Result) -> Result from ExpertSystemToolsPackage
[3] List D -> D from D if D has LNAGG D2 and D2 has TYPE
[4] (D, D) -> D from D if D has LNAGG D1 and D1 has TYPE
[5] (D1, D) -> D from D if D has LNAGG D1 and D1 has TYPE
[6] (D, D1) -> D from D if D has LNAGG D1 and D1 has TYPE
[7] (RoutinesTable, RoutinesTable) -> RoutinesTable from RoutinesTable
[8] Stream Stream D3 -> Stream D3 from StreamFunctions1 D3 if D3 has TYPE
[9] (D1, D) -> D from D if D has URAGG D1 and D1 has TYPE
[10] (D, D) -> D from D if D has URAGG D1 and D1 has TYPE

Examples of concat from ExpertSystemToolsPackage

Examples of concat from LinearAggregate

Examples of concat from RoutinesTable

Examples of concat from StreamFunctions1

m:=[i for i in 1..]
n:=[j for j in 1.. | prime? j]
p:=[m, n]::Stream(Stream(PositiveInteger))
concat(p)

Examples of concat from UnaryRecursiveAggregate

(1) ->
Information Sources

- Hyperdoc
- Axiom Firefox
- )help
- )display operation
- )show domain
DenavitHartenbergMatrix  R: Join(Field,TranscendentalFunctionCategory) is a domain constructor

Abbreviation for DenavitHartenbergMatrix is DHMATRIX

This constructor is exposed in this frame.

Issue )edit bookvol10,3.spad,pamphlet to see algebra source code for DHMATRIX

--- Operations ---

?**? : (%,Point R) -> Point R
?**? : (%,Vector R) -> Vector R
?**? : (%,R) -> %
?**? : (%,%) -> %
-?: : % -> %
antisymmetric? : % -> Boolean
column : (%,Integer) -> Vector R
diagonal? : % -> Boolean
diagonalMatrix : List % -> %
etl : (%,Integer,Integer,Integer,R) -> R
elt : (%,Integer) -> R
empty? : % -> Boolean
fill! : (%,R) -> %
identity : () -> %
map : (((R,R) -> R),%,%) -> %
listOfLists : % -> List List R
map! : ((R -> R),%) -> %
maxColIndex : % -> Integer
minColIndex : % -> Integer
maxRowIndex : % -> Integer
minRowIndex : % -> Integer
nrows : % -> NonNegativeInteger
parts : % -> List NonNegativeInteger
rotate : (%,Integer,Integer) -> %
rotate : (%,R) -> %
row : (%,Integer) -> Vector R
scale : (R,R,R) -> %
square? : % -> Boolean
squareTop : % -> %
symmetric? : % -> Boolean
transpose : (%,R) -> %
transpose : Vector R -> %
vertConcat : (%,%) -> %

#? : % -> NonNegativeInteger if $ has finiteAggregate

???: (%,Integer) -> % if R has FIELD

???: (%,NonNegativeInteger) -> %

???: (%,R) -> % if R has FIELDS
Information Sources

- Hyperdoc
- Axiom Firefox
- )help
- )display operation
- )show domain
- **Algebra source code**
Abbrev package EF ElementaryFunction

++ Author: Manuel Bronstein
++ Date Created: 1987
++ Date Last Updated: 10 April 1995
++ Keywords: elementary, function, logarithm, exponential.
++ Examples: )r EF INPUT
++ Description: Provides elementary functions over an integral domain.

ElementaryFunction(R, F): Exports == Implementation where
R: Join(OrderedSet, IntegralDomain)
F: Join(FunctionSpace R, RadicalCategory)

B ==> Boolean
L ==> List
Z ==> Integer
OP ==> BasicOperator
K ==> Kernel F
INV ==> error "Invalid argument"

Exports == with
exp : F -> F
  ++ exp(x) applies the exponential operator to x
log : F -> F
  ++ log(x) applies the logarithm operator to x
sin : F -> F
  ++ sin(x) applies the sine operator to x
cos : F -> F
  ++ cos(x) applies the cosine operator to x	
tan : F -> F
  ++ tan(x) applies the tangent operator to x
cot : F -> F
  ++ cot(x) applies the cotangent operator to x
sec : F -> F
  ++ sec(x) applies the secant operator to x
csc : F -> F
  ++ csc(x) applies the cosecant operator to x
asin : F -> F
  ++ asin(x) applies the inverse sine operator to x
Information Sources

- Hyperdoc
- Axiom Firefox
- )help
- )display operation
- )show domain
- Algebra source code
- Input files
section{The Pauli basis Biquaternions}

The quaternion package in axiom is based upon the Hamiltonian basis, \( i, j, k \), in contrast to the Pauli basis used in the Morgan papers which make certain operations correspond more closely (in the sense of visualization as ordering of components is more natural so that classical operations can be easily identified) to vector calculus functions and connect with more directly with various spinor QM formulations. To both follow these papers and obtain these visualization benefits, we will define and use the Pauli basis also.

The Pauli basis in terms of the Hamiltonian quaternion basis

\( \langle \langle \ast \rangle \rangle = \)

```plaintext
--S 7 of 43
sig0:=quatern(1,0,0,0)::Q
--R
--R
--R (7) 1
--R
--E 7

--S 8 of 43
sig1:=%i*quatern(0,0,0,1)::Q
--R
--R
--R (8) %i k
--R
--E 8

--S 9 of 43
sig2:=%i*quatern(0,0,1,0)::Q
--R
--R
--R (9) %i j
--R
--E 9
```

Type: Quaternion Complex Expression Integer
axiom™

The 30 Year Horizon
This short video will introduce you to the many sources of Axiom information.

There are two groups of information, external and internal.

The first group, the external information, is available without running Axiom.

The second group, the internal information, is available from a running Axiom.
The axiom-developer.org website contains information about the latest release of Axiom.

Axiom is released every two months and the website is updated with each release.
The Axiom home page has links to all of the other pages.

The most likely reason to visit the website is to download binary versions of the code, found under the download link.

The documentation link provides access to the various Axiom literate volumes.

Additional videos will be available at the website.
Axiom binaries are built at every release for a variety of systems.

This page also has instructions for downloading source code.

There are notes for some systems that might require special handling if you build Axiom from source.
All of the Axiom source code is being assembled into book form.

This style of maintaining source code is called Literate Programming.

The goal is to combine the readability of a textbook with the maintainability of well documented source code.

The code in these books is the actual source code used to build Axiom.
Information Sources

- Website  axiom-developer.org
- Jenks Book  ISBN 0–387-97855-0

A comprehensive source of information is the Axiom textbook by Jenks and Sutor.

The textbook is available from Amazon.com

The textbook is also available for free on the Axiom website as a link from the home page.
The Jenks textbook covers many of the common areas of Axiom's user-level abilities.

For serious users of Axiom, this book is essential.

The book is built from source and is included in every binary download.
Information Sources

- Website  axiom-developer.org
- Jenks Book  ISBN 0–387-97855-0
- Daly Tutorial  ISBN 1-4116-6597-X

A tutorial for Axiom by Daly is available from Amazon.com

The tutorial is also available for free on the Axiom website as a link on the home page.
The Daly tutorial covers many of the first time uses of Axiom.

This tutorial is useful for classroom material.

The book is built from source and is included in every binary download.
Information Sources

- Website  axiom-developer.org
- Jenks Book  ISBN 0–387-97855-0
- Daly Tutorial  ISBN 1-4116-6597-X
- Source Code github.com

Axiom source code is available from a variety of websites.

Axiom is maintained under git, CVS, SVN, and arch software repositories located on axiom-developer, github, sourceforge, and savannah.

Axiom source code is also available in gzipped tarball format on the axiom website at axiom-developer.org
Axiom golden source code is maintained on [github.com](https://github.com).

It is possible to clone the github Axiom repository. This will give you a complete local copy of the sources.
Information Sources

- Website         axiom-developer.org
- Jenks Book     ISBN 0–387-97855-0
- Daly Tutorial   ISBN 1-4116-6597-X
- Source Code    github.com
- sourceforge.net

Axiom source code is available on sourceforge.net under sourceforge.net/projects/axiom
There are two Axiom repositories on sourceforge.

The CVS repository contains the golden sources from the latest release.

The SVN repository contains the silver sources which is the ongoing development branch. Unless you are doing development you should not use the SVN version. If you are doing development, the master version of the development sources is at axiom-developer.org as a git repository.
Information Sources

- Website axiom-developer.org
- Jenks Book ISBN 0–387-97855-0
- Daly Tutorial ISBN 1-4116-6597-X
- Source Code github.com,
  sourceforge.net
- savannah.nongnu.org

Axiom golden sources are available from savannah under the savannah.nongnu.org/projects/axiom
The savannah site is a CVS repository which contains the golden sources.

These sources are updated with every release.
All activity on the Axiom project is reflected on the axiom-developer@nongnu.org mailing list.

All bugs, comments, and questions should be posted to this list.

All patches and announcements go to this list.
The axiom-developer mailing list is available online at lists.gnu.org on the savannah website.

The entire archive of the Axiom project mail is available online.
Information Sources

- Hyperdoc

There are also internal information sources available only when running Axiom.

Work is in progress to significantly enhance these sources to make the system easier to use.

Hyperdoc is the classic Axiom browser.
By default, Hyperdoc starts when Axiom starts.

Hyperdoc contains hundreds of pages of documentation, some of which are dynamically generated.

Hyperdoc integrates the command line functions for basic commands like integration, showing what you need to type.

Hyperdoc integrates the graphics subsystem, showing you how to create graphics.
The Hyperdoc browser was written years before any internet browser existed. While it has held up well and serves its information purposes it needs to be updated.
Axiom Firefox is a rewrite of Hyperdoc to use the Firefox browser as a standard help mechanism. This front end is still being built but there are newly written pages that are not in Hyperdoc.

Since this is standard browser code, the user can add additional web pages with little effort, possibly to customize the system for classroom use.

Axiom Firefox is the future direction of the Hyperdoc help system.
There are many pieces of information available from the Axiom command line.

Axiom system commands all start with the close-paren symbol to distinguish the command from any other user input.
The paren-help command gives access to help pages for particular domains. These static help pages give many examples of how to use Axiom for specific tasks.

Typing just paren-help at the Axiom command line will give further information.
The paren-display command will give you detailed information of what arguments are needed for a given function.
These argument lists are called modemaps.

Here we ask what concat operations are available.

Axiom functions are heavily overloaded. For instance, there are many concat operations in Axiom all having the same name but taking different arguments.

Axiom not only shows you the argument lists. It also gives examples of code you can write to use a particular version of the function.
Axiom arranges operations by domains. A domain is something like Integers or Complex Numbers or Expressions.

When using a domain it is sometimes necessary to ask what operations it supports.
The `paren-show` command will show you all of the operations that can be performed on elements of this domain.

It also shows what file contains the source code as well as other useful information such as the abbreviation of the domain.
Axiom is free and open source software and includes all of the source code for the algebra.

This source code is gradually being collected into books that are available on the axiom-developer.org website under the documentation link.

The algebra sources are included in the source distribution and are available in literate form in the binary distribution.
The Axiom algebra sources contain exact information about how an operation is implemented.

You can write your own algebra or modify the existing algebra, compile it, and use it in your own local copy of the system.
Axiom users can put a sequence of statements into text files, called input files.

Input files can be read into a running Axiom session.

This allows users to develop algebra examples, possibly for classroom use.
Axiom comes with hundreds of input files in literate format. These provide test cases for Axiom but they are also useful as documentation
Axiom has the long term goal of producing fully literate, readable, and useful documentation of the entire system.

See the other videos available on the axiom-developer.org website for more information.