

# OpenMath

version 06.01.03

**Andrew Solomon**

**Department of Computer Science**

**University of St. Andrews, North Haugh, St. Andrews, Fife KY16 9SS, Scotland**

This work is funded by the European Commission through ESPRIT grant EP 24969 “Accessing and Using Mathematical Information Electronically”

and

**Marco Costantini**

The compilation is non standard! See below.

This package has been developed to allow GAP users to import and export mathematical objects encoded in OpenMath, for the purpose of exchanging them with other applications which are OpenMath enabled.

### 1. Copyright

This package is distributed under the terms of the GAP copyright. Additionally, it contains code developed at INRIA (copyright INRIA), under the ESPRIT project number 24969 (OpenMath). The user may not use the library in commercial products without seeking permission from the GAP group (support@gap-system.org) and the CAFE team at INRIA SA (stephane.dalmas@sophia.inria.fr).

It may be redistributed “as is” together with this notice.

### 2. Technicalities and installation

This package uses an external binary and therefore works with full functionality only under UNIX systems.

To install this package (after extracting the packages archive file to the GAP pkg directory):

a) go to the directory `pkg/openmath/OMCv1.3c/src` and call

```
/bin/sh ./configure
```

and then call `make` to compile the INRIA library (producing `libOM.a`).

b) go to the directory `pkg/openmath` (the directory containing this README file) and call

```
/bin/sh ./configure path
```

where *path* is a path to the main GAP root directory (so normally you would call `/bin/sh ./configure ../..`).

afterwards call `make` to compile the binary. See file `examples` for usage examples.

c) you also need to modify the file `hasse/config.g` to make the Hasse diagram stuff work.

### 3. The INRIA library

The files in the directory `openmath/OMCv1.3c` are the OpenMath C library version 1.3c developed by the CAFE group at INRIA SA. For the latest version, contact: stephane.dalmas@sophia.inria.fr , or try

```
ftp://ftp-sop.inria.fr/safir/OM .
```

Andrew Solomon (andrew@illywhacker.net), Department of Computer Science, University of St. Andrews.

9 March 2000.

June 2004: I have done some modifications in this package, in order to make it usable again:

provided a `PackageInfo.g` file (this file is needed by GAP 4.4);

changed in several points “share package” into “package” as now the term “share” is obsolete;

slight modifications in the file `doc/make_doc`;

the warning “The compilation is non standard! See below.” above.

Marco Costantini

After agreement with Andrew Solomon, I will be the maintainer of this package. I have done the modifications listed below, which were necessary in order to extend the functionality and to fix the bugs, and because both OpenMath and the package mechanism of GAP have evolved in the meantime.

Marco Costantini

December 2005 and January 2006

This package performs the conversion from GAP to OpenMath, using only GAP code, and this part is expected to work on each machine on which GAP works. This package performs also the conversion from OpenMath to GAP, using an external program, which needs to be compiled, and which is called through pipes and FIFOs. This part is expected to work only on Unix machines.

The websites of this package are:

```
http://www-math.science.unitn.it/~costanti/#openmath    and
http://www.gap-system.org/Packages/openmath.html      .
```

For contacts, write to costanti@science.unitn.it .

The content of the subdirectories is:

```
openmath/
- OMCv1.3c    the OpenMath C library by the CAFE team at INRIA
- bin        the compiled gpipe program
- cds        some OpenMath content dictionaries
- doc        documentation in TeX, dvi, ps, pdf, html, txt
- gap        GAP code
- hasse      GAP code for Hasse diagrams
- include    file gap_tokens.h
- src        source of the gpipe program
- tst        test files and examples
```

List of main modifications (technical).

- o file pkg/openmath/gap/gap.g
  - o Updated function “OMnullarySymbolToGAP” according to the current OpenMath CDs.
- o file pkg/openmath/gap/omput.gi
  - o Updated and fixed functions “OMPut” and related, according to the current OpenMath CDs.
  - o Fixed OMPut method for cyclotomics. Now it is correct for GaussianRationals and infinity.
  - o Added a SetPrintFormattingStatus in OMWriteLine, to fix conversion of long objects.
  - o Fixed some typos.
- o added file pkg/openmath/gap/new.g that contains
  - o Update to function OMsymTable, according to the current OpenMath CDs (for converting from OpenMath to GAP).
  - o Added OMPut methods for infinity and a range (for converting from GAP to OpenMath).
- o file pkg/openmath/gap/omget.g
  - o Now OMGetObject doesn’t hang any more when OpenMath object is not retrieved.
  - o Now OMGetObject closes the files that is has opened.
  - o Modified also to avoid to use a new temporary directory for each call of OMGetObject.
- o file pkg/openmath/gap/pipeobj.g

- o Added support for conversion of OpenMath objects with binary encoding, from OpenMath to GAP.
- o Added support for the new OpenMath 2.0 objects that contain information inside the OMOBJ tag.
- o Added support for comment along the streams, between OpenMath objects.
- o file pkg/openmath/gap/lex.g
  - o Added support for XML escaped characters.
- o file pkg/openmath/PackageInfo.g
  - o Provided an up-to-date, informative, complete and working PackageInfo.g file
- o added files pkg/openmath/tst/test\_new, pkg/openmath/tst/test\_new.src, pkg/openmath/tst/test\_new.omt
  - o Provided a test file.
- o file pkg/openmath/read.g
  - o Reads the file pkg/openmath/gap/new.g above.
  - o Converted ReadPkg to ReadPackage
  - o Removed banner (moved to PackageInfo.g file)
- o files pkg/openmath/examples and pkg/openmath/hasse/example
  - o Converted RequirePackage to LoadPackage
  - o Added some notes
- o file pkg/openmath/hasse/config.g
  - o INSTALLATION\_PATH made automatic
  - o Warning about SERVLET
- o file pkg/openmath/init.g
  - o Commented out, and added: “This file is obsolete with Gap 4.4, and its content can be removed.”
- o file pkg/openmath/README (this file)
  - o Updated, added the list of modifications.
- o in various files
  - o Added commands to close all the streams.
  - o various minor changes.
- o Now the package loads, and provides conversion from GAP to OpenMath, even if the external binary has not been compiled. In this case, if the conversion from OpenMath to GAP is attempted, an informative error message is issued.

Marco Costantini

December 2005 and January 2006

# Contents

	A short introduction to OpenMath	5
1	OpenMath functionality in GAP	6



# A short introduction to OpenMath

*From the official OpenMath society website:*

OpenMath is an emerging standard for representing mathematical objects with their semantics, allowing them to be exchanged between computer programs, stored in databases, or published on the worldwide web. While the original designers were mainly developers of computer algebra systems, it is now attracting interest from other areas of scientific computation and from many publishers of electronic documents with a significant mathematical content. There is a strong relationship to the MathML recommendation from the Worldwide Web Consortium, and a large overlap between the two developer communities. MathML deals principally with the presentation of mathematical objects, while OpenMath is solely concerned with their semantic meaning or content. While MathML does have some limited facilities for dealing with content, it also allows semantic information encoded in OpenMath to be embedded inside a MathML structure. Thus the two technologies may be seen as highly complementary.

Mathematical objects encoded in OpenMath can be:

- displayed in a browser
- exchanged between software systems
- cut and pasted for use in different contexts
- verified as being mathematically sound (or not!)
- used to make interactive documents really interactive.

OpenMath is highly relevant for persons working with mathematics on computers, for those working with large documents (e.g. databases, manuals) containing mathematical expressions, and for technical and mathematical publishing.

The worldwide OpenMath activities are coordinated within the OpenMath Society, based in Helsinki, Finland. It is coordinated by an executive committee, elected by its members. It organizes workshops and holds an annual meeting. The Society brings together tool builders, software suppliers, publishers and authors.

*OpenMath and GAP*

This package has been developed to allow GAP users to import and export mathematical objects encoded in in OpenMath, for the purpose of exchanging them with other applications which are OpenMath enabled.

*Further Information*

Visit the OpenMath Society webpage at

<http://www.openmath.org> , or the ESPRIT project webpage at

<http://www.nag.co.uk/projects/OpenMath.html> (you may try

<http://web.archive.org/web/20040416013945/http://www.nag.co.uk/projects/OpenMath.html> ). ■

# 1

# OpenMath functionality in GAP

After loading the package the following operations are available.

## 1 ► `OMPrint( obj )`

F

`OMPrint` writes the XML OpenMath encoding of GAP object *obj* to the standard output.

```
gap> g := Group((1,2,3));;
gap> OMPrint(g);
<OMOBJ>
<OMA>
<OMS cd="group1" name="Group"/>
<OMA>
<OMS cd="permut1" name="Permutation"/>
<OMI> 2</OMI>
<OMI> 3</OMI>
<OMI> 1</OMI>
</OMA>
</OMA>
</OMOBJ>
```

## 2 ► `OMGetObject( stream )`

F

*stream* is an input stream with an OpenMath object on it. `OMGetObject` takes precisely one object off *stream* and returns it as a GAP object. Both XML and binary OpenMath encoding are supported, autodetection is used. This function requires that the external program `gpipe`, included in this package, has been compiled.

This may be used to retrieve objects from a file, for example:

```
gap> stream := InputTextFile("test3.omt");;
gap> OMGetObject(stream);
912873912381273891
gap> CloseStream(s);
```

or it can be used to retrieve them from standard input - one may paste an OpenMath object directly into standard input after issuing GAP with the following commands:

```
gap> stream := InputTextUser();;
gap> g := OMGetObject(stream);CloseStream(s);
```

## 3 ► `OMPutObject( stream, obj )`

F

`OMPutObject` writes the XML OpenMath encoding of the GAP object *obj* to output stream *stream*.

```

gap> g := [[1,2],[1,0]];
gap> t := "";
""
gap> s := OutputTextString(t, true);
gap> OMPutObject(s, g);
gap> CloseStream(s);
gap> Print(t);
<OMOBJ>
<OMA>
<OMS cd="linalg2" name="matrix"/>
<OMA>
<OMS cd="linalg2" name="matrixrow"/>
<OMI> 1</OMI>
<OMI> 2</OMI>
</OMA>
<OMA>
<OMS cd="linalg2" name="matrixrow"/>
<OMI> 1</OMI>
<OMI> 0</OMI>
</OMA>
</OMA>
</OMOBJ>

```

#### 4 ► OMTTest( *obj* )

F

Converts *obj* to OpenMath and back. Returns true iff *obj* is unchanged (as a GAP object) by this operation. The OpenMath standard does not stipulate that converting to and from OpenMath should be the identity function so this is a useful diagnostic tool.