

# Package: R.matlab (via r-universe)

September 12, 2024

**Version** 3.7.0

**Depends** R (>= 2.14.0)

**Imports** methods, utils, R.methodsS3 (>= 1.7.1), R.oo (>= 1.23.0),  
R.utils (>= 2.5.0)

**Suggests** Matrix, SparseM

**Title** Read and Write MAT Files and Call MATLAB from Within R

**Author** Henrik Bengtsson [aut, cre, cph], Andy Jacobson [ctb] (Internal  
MAT v4 reader), Jason Riedy [ctb] (Support for reading  
compressed files, sparse matrices and UTF-encoded strings.)

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**Description** Methods readMat() and writeMat() for reading and writing  
MAT files. For user with MATLAB v6 or newer installed (either  
locally or on a remote host), the package also provides methods  
for controlling MATLAB (trademark) via R and sending and  
retrieving data between R and MATLAB.

**License** LGPL (>= 2.1)

**LazyLoad** TRUE

**ByteCompile** TRUE

**URL** <https://github.com/HenrikBengtsson/R.matlab>

**BugReports** <https://github.com/HenrikBengtsson/R.matlab/issues>

**Repository** <https://henrikbengtsson.r-universe.dev>

**RemoteUrl** <https://github.com/HenrikBengtsson/R.matlab>

**RemoteRef** master

**RemoteSha** 9c961a4bb4b051f055dcf9ee0ce73799a239542b

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R.matlab-package	Package R.matlab
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## Description

Methods `readMat()` and `writeMat()` for reading and writing MAT files. For user with MATLAB v6 or newer installed (either locally or on a remote host), the package also provides methods for controlling MATLAB (trademark) via R and sending and retrieving data between R and MATLAB.

In brief, this package provides a one-directional interface from R to MATLAB, with communication taking place via a TCP/IP connection and with data transferred either through another connection or via the file system. On the MATLAB side, the TCP/IP connection is handled by a small Java add-on.

The methods for reading and writing MAT files are stable. The R to MATLAB interface, that is the `Matlab` class, is less prioritized and should be considered a beta version.

For package history, see `showHistory(R.matlab)`.

## Requirements

This is a cross-platform package implemented in plain R. This package depends on the **R.00** package [1].

To use the `Matlab` class or requesting verbose output messages, the [R.utils](#) package is loaded when needed (and therefore required in those cases).

The `readMat()` and `writeMat()` methods do *not* require a MATLAB installation neither do they depend on the [Matlab](#) class.

To connect to MATLAB, MATLAB v6 or higher is required. It does *not* work with MATLAB v5 or before (because those versions do not support Java). For confirmed MATLAB versions, see the [Matlab](#) class.

## Installation

To install this package do

```
install.packages("R.matlab")
```

## To get started

To get started, see:

1. [readMat\(\)](#) and [writeMat\(\)](#) - For reading and writing MAT files (MATLAB is *not* needed).
2. [Matlab](#) - To start MATLAB and communicate with it from R.

## Miscellaneous

A related initiative is *RMatlab* by Duncan Temple Lang and Omegahat. It provides a bi-directional interface between the R and MATLAB languages. For more details, see <https://www.omegahat.net/RMatlab/>. To call R from MATLAB on Windows (only), see *MATLAB R-link* by Robert Henson available at the MATLAB Central File Exchange (<https://www.mathworks.com/matlabcentral/fileexchange/5051-matlab-r-link>).

## How to cite this package

Whenever using this package, please cite as

## Troubleshooting

### In general:

For trouble shooting in general, rerun erroneous function with verbose/debug messages turned on. For `readMat()` and `writeMat()` see their help. For communication with a MATLAB server, use

```
matlab <- Matlab()
setVerbose(matlab, threshold = -2)
```

The lower the threshold is the more information you will see.

### Cannot connect to MATLAB:

If R fails to connect to MATLAB, make sure to try the example in `help(Matlab)` first. Make sure that the MATLAB server is running before trying to connect to it from R first. If MATLAB is running but `open()` times out, make sure MATLAB is listening to the same port that R is trying to connect to. If that does not help, try to increase the time-out limit, see `help(open.Matlab)`.

### Expected an 'answer' from MATLAB, but kept receiving nothing.:

When launching a really long MATLAB process by `evaluate()`, you may get the above error message.

*Reason:* This happens because `evaluate()` expect a reply from MATLAB as soon as MATLAB is done. The waiting should be "blocked", i.e. it should wait until it receives something. For unknown reasons, this is not always happening. The workaround we have implemented is to try `readResult/maxTries` waiting `readResult/interval` seconds in-between.

*Solution:* Increase the total waiting time by setting the above options, e.g.

```
setOption(matlab, "readResult/interval", 10)      # Default is 1 second
setOption(matlab, "readResult/maxTries", 30 * (60 / 10)) # ~30 minutes
```

## Wishlist

Here is a list of features that would be useful, but which I have too little time to add myself. Contributions are appreciated.

- Add a function, say, `Matlab$createShortcut()` which creates a Windows shortcut to start the MATLAB server by double clicking it. It should be possible to create it in the current directory or to the Desktop. Maybe it is possible to do this upon installation and even to a Start -> All Programs -> R menu.
- To improve security, update the `MatlabServer.m` script to allow the user to specify a "password" to be send upon connection from R in order for MATLAB to accept the connection. This password should be possible to specify from the command line when starting MATLAB. If not given, no password is required.
- Add additional methods to the `Matlab` class. For instance, inline function in MATLAB could have its own method.
- Wrap up common MATLAB commands as methods of the `Matlab` class, e.g. `who(matlab)`, `clear(matlab)` etc. Can this be done automatically using "reflection", so that required arguments are automatically detected?
- Add access to MATLAB variables via "\$" and "\$<-", e.g. `matlab$A` and `matlab$A <- 1234`. Is this wanted? Maybe the same for functions, e.g. `matlab$dice(1000)`. Is it possible to return multiple return values?

If you consider implement some of the above, make sure it is not already implemented by downloading the latest "devel" version!

## Acknowledgments

Thanks to the following people who contributed with valuable feedback, suggestions, code and more:

- Patrick Drechsler, Biocenter, University of Wuerzburg.
- Spencer Graves.
- Andy Jacobson, Atmospheric and Oceanic Sciences Program, Princeton University.
- Jason Riedy, Computer Science Division, University of California, Berkeley.
- Chris Sims, Department of Economics, Princeton University.
- Frank Stephen, National Renewable Energy Laboratory.
- Yichun Wei, Department of Biological Sciences, University of Southern California.
- Wang Yu, ECE Department, Iowa State University.

## License

The releases of this package is licensed under LGPL version 2.1 or newer.

The development code of the packages is under a private license (where applicable) and patches sent to the author fall under the latter license, but will be, if incorporated, released under the "release" license above.

## References

[1] H. Bengtsson, *The R.oo package - Object-Oriented Programming with References Using Standard R Code*, In Kurt Hornik, Friedrich Leisch and Achim Zeileis, editors, Proceedings of the 3rd International Workshop on Distributed Statistical Computing (DSC 2003), March 20-22, Vienna, Austria. <https://www.r-project.org/conferences/DSC-2003/Proceedings/>

## Author(s)

Henrik Bengtsson

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1. The MATLAB server running in MATLAB

*1. The MATLAB server running in MATLAB*

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## Description

This section gives addition details on the MATLAB server. At the end, the MatlabServer.m script and the InputStreamByteWrapper.java code is shown.

## Starting the MATLAB server on Windows

Note that you "cannot prevent MATLAB from creating a window when starting on Windows systems, but you can force the window to be hidden, by using " the option -minimize. See <https://www.mathworks.com/matlabcentral/answers/102082> for more information.

## MatlabServer.m script

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% MatlabServer
%
% This scripts starts a minimalistic MATLAB "server".
%
% When started, the server listens for connections at port 9999 or the
% port number specified by the environment variable 'MATLABSERVER_PORT'.
%
% Troubleshooting: If not working out of the box, add this will to the
% MATLAB path. Make sure InputStreamByteWrapper.class is in the same
% directory as this file!
%
% Requirements:
% This requires MATLAB with Java support, i.e. MATLAB v6 or higher.
%
% Author: Henrik Bengtsson, 2002-2016
%
% References:
```

```

% [1] http://www.mathworks.com/access/helpdesk/help/techdoc/
%                               matlab_external/ch_jav34.shtml#49439
% [2] http://staff.science.uva.nl/~horus/dox/horus2.0/user/
%                               html/n_installUnix.html
% [3] http://www.mathworks.com/access/helpdesk/help/toolbox/
%                               modelsim/a1057689278b4.html
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(2, 'Running MatlabServer v3.5.9-9000\n');

% addpath R/R_LIBS/linux/library/R.matlab/misc/

% - - - - -
% MATLAB version-dependent setup
% - - - - -
% Identify major version of Matlab
MatlabServer_tmp_hasMajor = eval('length(regexp(version, ''^[0-9]'')) ~= 0', '0');
if (MatlabServer_tmp_hasMajor)
    MatlabServer_tmp_verParts = sscanf(version, '%d. ');
    MatlabServer_tmp_verMajor = MatlabServer_tmp_verParts(1);
    clear MatlabServer_tmp_verParts;
else
    MatlabServer_tmp_verMajor = -1;
end
clear MatlabServer_tmp_hasMajor;

if (MatlabServer_tmp_verMajor < 6)
    % Java is not available/supported
    error('MATLAB v5.x and below is not supported. ');
elseif (MatlabServer_tmp_verMajor == 6)
    fprintf(2, 'MATLAB v6.x detected.\n');
    % Default save option
    MatlabServer_saveOption = '';
    % In MATLAB v6 only the static Java CLASSPATH is supported. It is
    % specified by a 'classpath.txt' file. The default one can be found
    % by which('classpath.txt'). If a 'classpath.txt' exists in the
    % current(!) directory (that MATLAB is started from), it *replaces*
    % the global one. Thus, it is not possible to add additional paths;
    % the global ones has to be copied to the local 'classpath.txt' file.
    %
    % To do the above automatically from R, does not seem to be an option.
else
    fprintf(2, 'MATLAB v7.x or higher detected.\n');
    % MATLAB v7 and above saves compressed files, which is not recognized
    % by R.matlab's readMat(); force saving in old format.
    MatlabServer_saveOption = '-V6';
    fprintf(2, 'Saving with option -V6.\n');

    % In MATLAB v7 and above both static and dynamic Java CLASSPATH:s exist.

```

```

    % Using dynamic ones, it is possible to add the file
    % InputStreamByteWrapper.class to CLASSPATH, given it is
    % in the same directory as this script.
    javaaddpath({fileparts(which('MatlabServer'))});
    fprintf(2, 'Added InputStreamByteWrapper to dynamic Java CLASSPATH.\n');
end
clear MatlabServer_tmp_verMajor;

% - - - - -
% Import Java classes
% - - - - -
import java.io.*;
import java.net.*;

% - - - - -
% If an old MATLAB server is running, close it
% - - - - -
% If a server object exists from a previous run, close it.
if (exist('MatlabServer_server'))
    close(MatlabServer_server);
    clear MatlabServer_server;
end

% If an input stream exists from a previous run, close it.
if (exist('MatlabServer_is'))
    close(MatlabServer_is);
    clear MatlabServer_is;
end

% If an output stream exists from a previous run, close it.
if (exist('MatlabServer_os'))
    close(MatlabServer_os);
    clear MatlabServer_os;
end

fprintf(2, '-----\n');
fprintf(2, 'MATLAB server started!\n');
fprintf(2, '-----\n');

fprintf(2, 'MATLAB working directory: %s\n', pwd);

% - - - - -
% Initiate server socket to which clients may connect
% - - - - -
MatlabServer_port = getenv('MATLABSERVER_PORT');
```

```

if (length(MatlabServer_port) > 0)
    MatlabServer_port = str2num(MatlabServer_port);
else
    % Try to open a server socket on port 9999
    MatlabServer_port = 9999;
end

% Ports 1-1023 are reserved for the Internet Assigned Numbers Authority.
% Ports 49152-65535 are dynamic ports for the OS. [3]
if (MatlabServer_port < 1023 | MatlabServer_port > 65535)
    error('Cannot not open connection. Port ('MATLABSERVER_PORT') is out of range [1023,65535]: %d', MatlabServer_port);
end

fprintf(2, 'Trying to open server socket (port %d)...', MatlabServer_port);
MatlabServer_server = java.net.ServerSocket(MatlabServer_port);
fprintf(2, 'done.\n');

% -----
% Wait for client to connect
% -----
% Create a socket object from the ServerSocket to listen and accept
% connections.
% Open input and output streams

% Wait for the client to connect
fprintf(2, 'Waiting for client to connect (port %d)...', MatlabServer_port);
MatlabServer_clientSocket = accept(MatlabServer_server);
fprintf(2, 'connected.\n');

% ...client connected.
MatlabServer_is = java.io.DataInputStream(getInputStream(MatlabServer_clientSocket));
MatlabServer_os = java.io.DataOutputStream(getOutputStream(MatlabServer_clientSocket));

% -----
% The MATLAB server state machine
% -----
% Commands
MatlabServer_commands = {'eval', 'send', 'receive', 'send-remote', 'receive-remote', 'echo', 'evalc'};

MatlabServer_lasterr = [];
MatlabServer_variables = [];

% As long as we receive data, echo that data back to the client.
MatlabServer_state = 0;
while (MatlabServer_state >= 0),

```

```

if (MatlabServer_state == 0)
    MatlabServer_tmp_cmd = readByte(MatlabServer_is);
    fprintf(2, 'Received cmd: %d\n', MatlabServer_tmp_cmd);
    if (MatlabServer_tmp_cmd < -1 | MatlabServer_tmp_cmd > length(MatlabServer_commands))
        fprintf(2, 'Unknown command code: %d\n', MatlabServer_tmp_cmd);
    else
        MatlabServer_state = MatlabServer_tmp_cmd;
    end
    clear MatlabServer_tmp_cmd;

%-----
% 'evalc'
%-----
elseif (MatlabServer_state == strmatch('evalc', MatlabServer_commands, 'exact'))
    MatlabServer_tmp_bfr = char(readUTF(MatlabServer_is));
    fprintf(2, '"evalc" string: "%s"\n', MatlabServer_tmp_bfr);
    try
        MatlabServer_tmp_bfr = sprintf(MatlabServer_tmp_bfr);
        MatlabServer_tmp_result = evalc(MatlabServer_tmp_bfr);
        writeByte(MatlabServer_os, 0);
        fprintf(2, 'Sent byte: %d\n', 0);
        writeUTF(MatlabServer_os, MatlabServer_tmp_result);
        fprintf(2, 'Sent UTF: %s\n', MatlabServer_tmp_result);
        flush(MatlabServer_os);
        clear MatlabServer_tmp_result;
    catch
        MatlabServer_lasterr = sprintf('Failed to evaluate expression '%s''.', MatlabServer_tmp_bfr);
        fprintf(2, 'EvaluationException: %s\n', MatlabServer_lasterr);
        writeByte(MatlabServer_os, -1);
        fprintf(2, 'Sent byte: %d\n', -1);
        writeUTF(MatlabServer_os, MatlabServer_lasterr);
        fprintf(2, 'Sent UTF: %s\n', MatlabServer_lasterr);
        flush(MatlabServer_os);
    end
    flush(MatlabServer_os);
    MatlabServer_state = 0;
    clear MatlabServer_tmp_bfr;

%-----
% 'eval'
%-----
elseif (MatlabServer_state == strmatch('eval', MatlabServer_commands, 'exact'))
    MatlabServer_tmp_bfr = char(readUTF(MatlabServer_is));
    fprintf(2, '"eval" string: "%s"\n', MatlabServer_tmp_bfr);
    try
        eval(MatlabServer_tmp_bfr);
        writeByte(MatlabServer_os, 0);
        fprintf(2, 'Sent byte: %d\n', 0);
    catch
    end
end

```

```

        flush(MatlabServer_os);
    catch
    MatlabServer_lasterr = sprintf('Failed to evaluate expression '%s''.', MatlabServer_tmp_bfr);
        fprintf(2, 'EvaluationException: %s\n', MatlabServer_lasterr);
        writeByte(MatlabServer_os, -1);
        fprintf(2, 'Sent byte: %d\n', -1);
        writeUTF(MatlabServer_os, MatlabServer_lasterr);
        fprintf(2, 'Sent UTF: %s\n', MatlabServer_lasterr);
        flush(MatlabServer_os);
    end
    flush(MatlabServer_os);
    MatlabServer_state = 0;
    clear MatlabServer_tmp_bfr;

%-----
% 'send'
%-----
elseif (MatlabServer_state == strcmp('send', MatlabServer_commands, 'exact'))
    MatlabServer_tmp_tmpname = sprintf('%s%d.mat', tempname, MatlabServer_port);
    MatlabServer_tmp_expr = sprintf('save(MatlabServer_tmp_tmpname, '%s'', MatlabServer_saveOption);
    MatlabServer_tmp_ok = 1;
    for MatlabServer_tmp_k=1:length(MatlabServer_variables),
        MatlabServer_tmp_variable = MatlabServer_variables{MatlabServer_tmp_k};
        if (exist(MatlabServer_tmp_variable) ~= 1)
            MatlabServer_lasterr = sprintf('Variable '%s'' not found.', MatlabServer_tmp_variable);
            fprintf(2, '%s\n', MatlabServer_lasterr);
            MatlabServer_tmp_ok = 0;
            break;
        end;
    MatlabServer_tmp_expr = sprintf('%s, '%s'', MatlabServer_tmp_expr, MatlabServer_tmp_variable);
    end;

    MatlabServer_tmp_expr = sprintf('%s)', MatlabServer_tmp_expr);
    if (~MatlabServer_tmp_ok)
        writeInt(MatlabServer_os, -1);
        writeUTF(MatlabServer_os, MatlabServer_lasterr);
    else
        fprintf(2, '%s\n', MatlabServer_tmp_expr);
        eval(MatlabServer_tmp_expr);
        writeInt(MatlabServer_os, 0); % Here anything but -1 means "success"
        writeUTF(MatlabServer_os, MatlabServer_tmp_tmpname);
    end

    MatlabServer_tmp_answer = readByte(MatlabServer_is);
    fprintf(2, 'answer=%d\n', MatlabServer_tmp_answer);

    MatlabServer_state = 0;
    clear MatlabServer_tmp_name MatlabServer_tmp_expr MatlabServer_tmp_ok MatlabServer_tmp_answer;

```

```

%-----
% 'send-remote'
%-----
elseif (MatlabServer_state == strcmp('send-remote', MatlabServer_commands, 'exact'))
    MatlabServer_tmp_tmpname = sprintf('%s_%d.mat', tempname, MatlabServer_port);
    MatlabServer_tmp_expr = sprintf('save(MatlabServer_tmp_tmpname, '%s'', MatlabServer_saveOption);
    MatlabServer_tmp_ok = 1;
    for MatlabServer_tmp_k=1:length(MatlabServer_variables),
        MatlabServer_tmp_variable = MatlabServer_variables{MatlabServer_tmp_k};
        if (exist(MatlabServer_tmp_variable) ~= 1)
            MatlabServer_lasterr = sprintf('Variable '%s'' not found.', MatlabServer_tmp_variable);
            fprintf(2, '%s\n', MatlabServer_lasterr);
            MatlabServer_tmp_ok = 0;
            break;
        end;
    MatlabServer_tmp_expr = sprintf('%s, '%s'', MatlabServer_tmp_expr, MatlabServer_tmp_variable);
end;
clear MatlabServer_tmp_k MatlabServer_tmp_variable;

MatlabServer_tmp_expr = sprintf('%s)', MatlabServer_tmp_expr);
if (~MatlabServer_tmp_ok)
    writeInt(MatlabServer_os, -1);
    writeUTF(MatlabServer_os, MatlabServer_lasterr);
else
    fprintf(2, '%s\n', MatlabServer_tmp_expr);
    eval(MatlabServer_tmp_expr);
    MatlabServer_tmp_file = java.io.File(MatlabServer_tmp_tmpname);
    MatlabServer_tmp_maxLength = length(MatlabServer_tmp_file);
    clear MatlabServer_tmp_file;
writeInt(MatlabServer_os, MatlabServer_tmp_maxLength); % Here anything but -1 means "success"
    fprintf(2, 'Send int: %d (maxLength)\n', MatlabServer_tmp_maxLength);
    MatlabServer_tmp_fid = fopen(MatlabServer_tmp_tmpname, 'r');
    MatlabServer_tmp_count = 1;
    while (MatlabServer_tmp_count ~= 0)
        [MatlabServer_tmp_bfr, MatlabServer_tmp_count] = fread(MatlabServer_tmp_fid, 65536, 'int8');
        if (MatlabServer_tmp_count > 0)
            write(MatlabServer_os, MatlabServer_tmp_bfr);
        end;
    end;
    fclose(MatlabServer_tmp_fid);
    fprintf(2, 'Send buffer: %d bytes.\n', MatlabServer_tmp_maxLength);
    delete(MatlabServer_tmp_tmpname);
clear MatlabServer_tmp_bfr MatlabServer_tmp_count MatlabServer_tmp_maxLength MatlabServer_tmp_fid;
end
flush(MatlabServer_os);

MatlabServer_tmp_answer = readByte(MatlabServer_is);

```

```

    fprintf(2, 'answer=%d\n', MatlabServer_tmp_answer);

    MatlabServer_state = 0;
    clear MatlabServer_tmp_name MatlabServer_tmp_expr MatlabServer_tmp_ok MatlabServer_tmp_answer;

    %-----
    % 'receive-remote'
    %-----
elseif (MatlabServer_state == strcmp('receive-remote', MatlabServer_commands, 'exact'))
    MatlabServer_tmp_len = readInt(MatlabServer_is);
    fprintf(2, 'Will read MAT file structure of length: %d bytes.\n', MatlabServer_tmp_len);

    MatlabServer_tmp_reader = InputStreamByteWrapper(4096);
    MatlabServer_tmp_bfr = [];
    MatlabServer_tmp_count = 1;
    while (MatlabServer_tmp_len > 0 & MatlabServer_tmp_count > 0)
        MatlabServer_tmp_count = MatlabServer_tmp_reader.read(MatlabServer_is, min(4096, MatlabServer_tmp_len));
        if (MatlabServer_tmp_count > 0)
            MatlabServer_tmp_bfr = [MatlabServer_tmp_bfr; MatlabServer_tmp_reader.bfr(1:MatlabServer_tmp_count)];
            MatlabServer_tmp_len = MatlabServer_tmp_len - MatlabServer_tmp_count;
        end;
    end;

    clear MatlabServer_tmp_reader MatlabServer_tmp_count MatlabServer_tmp_len;

    MatlabServer_tmp_tmpfile = sprintf('%s%d.mat', tempname, MatlabServer_port);
    MatlabServer_tmp_fh = fopen(MatlabServer_tmp_tmpfile, 'wb');
    fwrite(MatlabServer_tmp_fh, MatlabServer_tmp_bfr, 'int8');
    fclose(MatlabServer_tmp_fh);

    clear MatlabServer_tmp_fh MatlabServer_tmp_bfr;

    load(MatlabServer_tmp_tmpfile);

    delete(MatlabServer_tmp_tmpfile);
    clear MatlabServer_tmp_tmpfile;
    writeByte(MatlabServer_os, 0);

    MatlabServer_state = 0;

    %-----
    % 'receive'
    %-----
elseif (MatlabServer_state == strcmp('receive', MatlabServer_commands, 'exact'))
    MatlabServer_tmp_filename = char(readUTF(MatlabServer_is));
    fprintf(2, 'Will read MAT file: "%s"\n', MatlabServer_tmp_filename);
    load(MatlabServer_tmp_filename);
    clear MatlabServer_tmp_filename;

```

```

        writeByte(MatlabServer_os, 0);
        MatlabServer_state = 0;
        clear MatlabServer_tmp_filename;
    end
end

% - - - - -
% Shutting down the MATLAB server
% - - - - -

fprintf(2, '-----\n');
fprintf(2, 'MATLAB server shutdown!\n');
fprintf(2, '-----\n');
writeByte(MatlabServer_os, 0);
close(MatlabServer_os);
close(MatlabServer_is);
close(MatlabServer_server);
quit;

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% HISTORY:
% 2016-04-05 [v3.6.0]
% o All verbose/debug messages are outputted to stream #2 ("stderr").
% 2015-09-11 [v3.3.0]
% o Now temporary files use format <tempname>_<port>.mat.
% o Add 'MatlabServer_' prefix to all variables.
% o Add 'evalc' command. Thanks to Rohan Shah for this.
% 2015-01-08 [v3.1.2]
% o BUG FIX: Matlab$getVariable() for a non-existing variable would
%   crash the R-to-Matlab communication if remote=FALSE.
% 2014-06-23 [v3.0.2]
% o ROBUSTNESS: Variables 'lasterr' and 'variables' are now always
%   defined. Potential bug spotted by Steven Jaffe at Morgan Stanley.
% o Added more progress/verbose output, e.g. current working directory.
% 2014-01-21 [v2.2.0]
% o BUG FIX: The MatlabServer.m script would incorrectly consider
%   Matlab v8 and above as Matlab v6. Thanks to Frank Stephen at NREL
%   for reporting on this and providing a patch.
% 2013-07-11 [v1.3.5]
% o Updated messages to use 'MATLAB' instead of 'Matlab'.
% 2010-10-25 [v1.3.4]
% o BUG FIX: The MatlabServer.m script incorrectly referred to the
%   InputStreamByteWrapper class as java.io.InputStreamByteWrapper.
%   Thanks Kenvor Cothey at GMO LCC for reporting on this.
% 2010-08-28
% o Now the MatlabServer script reports its version when started.
% 2010-08-27

```

[illegible]

/\*\*\*\*\*

```

% Compile from within MATLAB with:
% !javac InputStreamByteWrapper.java

% MATLAB example that reads a file using Java code and writes it
% back to a temporary file using MATLAB code. Finally the contents
% of the new file is displayed.

reader = InputStreamByteWrapper; % Default buffer size is 4096 bytes.

in = java.io.FileInputStream('InputStreamByteWrapper.java');

bfr = [];
len = 1;
while (len > 0)
    len = reader.read(in, 16); % Read 16 bytes at the time (offset=0).
    if (len > 0)
        bfr = [bfr; reader.bfr(1:len)]; % Add bytes to my MATLAB buffer.
    end
end

close(in);
clear in, reader;

disp(bfr');

tmpfile = tempname;
fh = fopen(tmpfile, 'wb');
fwrite(fh, bfr, 'char');
fclose(fh);

type(tmpfile);
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%/
public class InputStreamByteWrapper {
    public static byte[] bfr = null;

    public InputStreamByteWrapper(int capacity) {
        bfr = new byte[capacity];
    }

    public InputStreamByteWrapper() {
        this(4096);
    }

    public int read(InputStream in, int offset, int length) throws IOException {
        return in.read(bfr, offset, length);
    }

    public int read(InputStream in, int length) throws IOException {

```

```

        return read(in, 0, length);
    }

    public int read(InputStream in) throws IOException {
        return in.read(bfr);
    }
}

/*****
HISTORY:
2013-07-11
    o Updated comments to use 'MATLAB' instead of 'Matlab'.
2002-09-02 [or maybe a little bit earlier]
    o Created.
*****/

```

---

Matlab

---

*MATLAB client for remote or local MATLAB access*


---

## Description

Package: R.matlab

**Class Matlab**

[Object](#)

~~|

~~+--Matlab

**Directly known subclasses:**

public static class **Matlab**

extends [Object](#)

## Usage

```
Matlab(host="localhost", port=9999, remote=! (host %in% c("localhost", "127.0.0.1")))
```

## Arguments

host	Name of host to connect to.
port	Port number on host to connect to.

`remote` If `TRUE`, all data to and from the MATLAB server will be transferred through the socket `connection`, otherwise the data will be transferred via a temporary file.

## Fields and Methods

### Methods:

<code>as.character</code>	Gets a string describing the current MATLAB connection.
<code>close</code>	Closes connection to MATLAB server.
<code>evaluate</code>	Evaluates a MATLAB expression.
<code>finalize</code>	(internal) Finalizes the object if deleted.
<code>getOption</code>	Gets the value of an option.
<code>getVariable</code>	Gets one or several MATLAB variables.
<code>isOpen</code>	Checks if connection to the MATLAB server is open.
<code>open</code>	Tries to open a connection to the MATLAB server.
<code>readResult</code>	(internal) Reads results from the MATLAB server.
<code>setFunction</code>	Defines a MATLAB function.
<code>setOption</code>	Sets the value of an option.
<code>setVariable</code>	Sets one or several MATLAB variables.
<code>setVerbose</code>	Sets the verbose level to get more details about the MATLAB access.
<code>startServer</code>	Static method which starts a MATLAB server.
<code>writeCommand</code>	(internal) Writes (sends) an R-to-MATLAB command to the MATLAB server.

### Methods inherited from Object:

`$`, `$<-`, `[]`, `[[<-`, `as.character`, `attach`, `attachLocally`, `clearCache`, `clearLookupCache`, `clone`, `detach`, `equals`, `extend`, `finalize`, `getEnvironment`, `getFieldModifier`, `getFieldModifiers`, `getFields`, `getInstantiationTime`, `getStaticInstance`, `hasField`, `hashCode`, `ll`, `load`, `names`, `objectSize`, `print`, `save`

## Requirements

In order for R to communicate with MATLAB, MATLAB v6 or higher is needed. It will *not* work with previous versions, because they do not support Java.

We use the term *server* to say that MATLAB acts like a server with regard to R. Note that it is a standard MATLAB session that runs.

Also, the starting of the `MatlabServer` is simpler from MATLAB v7, although it is pretty straightforward for MATLAB v6 too. It is easier in MATLAB v7 and above, because the Java class required for remote-data-transfer can be automatically/dynamically added to the MATLAB Java classpath, whereas for MATLAB v6 it has to be added manually (see below).

## Remote and non-remote connections

When a remote connection (argument `remote = TRUE`) is used, data is sent to and from MATLAB via a data stream. This is needed when R is running on a host with a separated file system than the one MATLAB is running on.

If not connection "remotely" (`remote = FALSE`), data is communicated via the file system, that is, by saving and reading it to temporary MAT files.

Troubleshooting: If "remote" transfers are used, the `InputStreamByteWrapper` Java class must be found by MATLAB, otherwise an error will occur in MATLAB as soon as data is send from R to MATLAB. In all other cases, the above Java class is *not* needed.

### Starting the MATLAB server from within R

The MATLAB server may be started from within R by calling `Matlab$startServer()`. By default 'matlab' is called if named differently set options(`matlab = "matlab6.5"`), say. *The method is experimental and may not work on your system.* By default the MATLAB server listens for connections on port 9999. For other ports, set argument `port`, e.g. `Matlab$startServer(port = 9998)`.

Note that the code will *not* halt and wait for MATLAB to get started. Thus, you have to make sure you will wait long enough for the server to get up and running before the R client try to connect. By default, the client will try once a second for 30 seconds before giving up. Moreover, on non-Windows systems, the above command will start MATLAB in the background making all MATLAB messages be sent to the R output screen. In addition, the method will copy the `MatlabServer.m` and `InputStreamByteWrapper.class` files to the current directory and start MATLAB from there.

### Starting the MATLAB server without R

If the above does not work, the MATLAB server may be started manually from MATLAB itself. Please follow the below instructions carefully.

#### To be done once:

In MATLAB, add the path to the directory where `MatlabServer.m` sits. See `help pathtool` in MATLAB on how to do this. In R you can type `system.file("externals", package = "R.matlab")` to find out the path to `MatlabServer.m`.

**For MATLAB v6 only:** Contrary to MATLAB v7 and above, MATLAB v6 cannot find the `InputStreamByteWrapper` class automatically. Instead, the so called Java classpath has to be set manually. In MATLAB, type `which('classpath.txt')` to find where the default MATLAB `classpath.txt` file is located. Copy this file to the *current directory*, and append the *path* (the directory) of `InputStreamByteWrapper.class` to the end of `classpath.txt`. The path of `InputStreamByteWrapper.class` can be identified by `system.file("java", package = "R.matlab")` in R.

**Lazy alternative:** Instead of setting path and classpaths, you may try to copy the `MatlabServer.m` and `InputStreamByteWrapper.class` to the current directory from which MATLAB is then started.

#### To start the server:

In order to start the MATLAB server, type

```
matlab -nodesktop -nosplash -r MatlabServer
```

If using MATLAB v6, make sure your `classpath.txt` is the current directory!

This will start MATLAB and immediately call the `MatlabServer(m)` script. Here is how it should look like when the server starts:

< M A T L A B (R) >  
Copyright 1984–2012 The MathWorks, Inc.  
R2012a (7.14.0.739) 64-bit (glnxa64)  
February 9, 2012

To get started, type one of these: helpwin, helpdesk, or demo.  
For product information, visit [www.mathworks.com](http://www.mathworks.com).

```
Running MatlabServer v3.0.2
MATLAB v7.x or higher detected.
Saving with option -V6.
Added InputStreamByteWrapper to dynamic Java CLASSPATH.
-----
MATLAB server started!
-----
MATLAB working directory: /home/AwesomeUser/FabulousProject/
Trying to open server socket (port 9999)...done.
```

Alternatively you can start MATLAB and type MatlabServer at the prompt.

By default the MATLAB server listens for connections on port 9999. For other ports, set environment variable MATLABSERVER\_PORT.

### Confirmed MATLAB versions

This package has been confirmed to work *successfully* out of the box together with the following MATLAB versions: MATLAB v6.1.0.450 (R12.1) [Jun 2001], MATLAB v6.5.0.180913a (R13) [Jul 2002], MATLAB v7.0.0.19901 (R14) [Jun 2004], MATLAB v7.0.1.24704 (R14SP1) [Oct 2004], MATLAB v7.0.4.365 (R14SP2) [Mar 2005], MATLAB v7.2.0.232 (R2006a) [Mar 2006], MATLAB v7.4.0 (R2007a) [Mar 2007], MATLAB v7.7.0.471 (R2008b) [Oct 2008], MATLAB v7.10.0.499 (R2010a) [Mar 2010], MATLAB v7.11.0.584 (R2010b) [Sep 2010], MATLAB v7.14.0.739 (R2012a) [Mar 2012], MATLAB v8.2.0.701 (R2013b) [Sep 2013], and MATLAB v8.4.0 (R2014b) [Oct 2014]. If you successfully use a different/higher MATLAB version, please tell us, so we can share it here.

It does *not* work with MATLAB v5 or before.

### Security

There is *no* security in the communication with the MATLAB server. This means that if you start the MATLAB server, it will wait for requests via the connection at the specified port. As long as your R session has not connected to this port, others may be able to steal the connection and send malicious commands (if they know the R.matlab protocol). The MATLAB server only allows one connection. In other words, if you are connected it is not possible for others to connect to the MATLAB server.

### MATLAB server is timing out

It might be that an `*evaluate()` call to the MATLAB server takes a long time for the server to finish resulting in a time-out exception. By default this happens after 30 seconds, but it can be changed by modifying options, cf. `setOption()`.

### Multiple parallel MATLAB instances

You can launch multiple parallel MATLAB instance using this interface. This can be done in separate R sessions or in a single one. As long as each MATLAB server/session is communicating on a separate port, there is no limitation in the number of parallel MATLAB instances that can be used. Example:

```
> library('R.matlab')
## Start two separate MATLAB servers
> Matlab$startServer(port = 9997)
> Matlab$startServer(port = 9999)

## Connect to each of them
> matlab1 <- Matlab(port = 9997); open(matlab1)
> matlab2 <- Matlab(port = 9999); open(matlab2)

## Evaluate expression in each of them
> evaluate(matlab1, "x = 1+2; x")
> evaluate(matlab2, "y = 1+2; y")
```

Note that the two MATLAB instance neither communicate nor share variables.

### Author(s)

Henrik Bengtsson

### See Also

Stand-alone methods `readMat()` and `writeMat()` for reading and writing MAT file structures.

### Examples

```
## Not run:
# - - - - -
# This example will try to start the MATLAB server on the local machine,
# and then setup a Matlab object in R for communicating data between R
# and MATLAB and for sending commands from R to MATLAB.
# - - - - -

# - - - - -
# 1. Load R.matlab
# - - - - -
library(R.matlab)
```

```

# -----
# 2. Start MATLAB
# -----
# 2.1. Start MATLAB from R?
# Start MATLAB server on the local machine (if this fails,
# see help(Matlab) for alternatives).
Matlab$startServer()

# 2.2. OR start MATLAB externally,
#      THEN add 'externals' subdirectory to the MATLAB path

# (Where is the 'externals' subdirectory?)
print(system.file("externals", package = "R.matlab"))

#      THEN from within MATLAB,
#      issue MATLAB command "MatlabServer"
# Note: If issued from a MATLAB command line, this last command
#      prevents further MATLAB 'command line' input
#      until something like close(matlab) at the end of this script

# 2.3. If both these options fail, see help(Matlab) for alternatives.

# -----
# 3. Create a MATLAB client object used to communicate with MATLAB
# -----
matlab <- Matlab()

# 3.1 Check status of MATLAB connection (not yet connected)
print(matlab)

# 3.2 If you experience any problems, ask for detailed outputs
#      by uncommenting the next line
# setVerbose(matlab, -2)

# 3.3 Connect to the MATLAB server.
isOpen <- open(matlab)

# 3.4 Confirm that the MATLAB server is open, and running
if (!isOpen)
  throw("MATLAB server is not running: waited 30 seconds.")

# 3.5 Check status of MATLAB connection (now connected)
print(matlab)

# -----
# 4. Sample uses of the MATLAB server
# -----
# 4.1 Run MATLAB expressions on the MATLAB server
evaluate(matlab, "A = 1+2;", "B = ones(2, 20);")

```

```

# 4.2 Ask MATLAB to display a value (without transferring it to R)
evaluate(matlab, "A")

# 4.3 Get MATLAB variables
data <- getVariable(matlab, c("A", "B"))
cat("Received variables:\n")
str(data)

# 4.4 Set variables in MATLAB
ABCD <- matrix(rnorm(10000), ncol = 100)
str(ABCD)
setVariable(matlab, ABCD = ABCD)

# 4.5 Retrieve what we just set
data <- getVariable(matlab, "ABCD")
cat("Received variables:\n")
str(data)

# 4.6 Create a function (M-file) on the MATLAB server
setFunction(matlab, "
    \
    function [win, aver] = dice(B) \
    %Play the dice game B times \
    gains = [-1, 2, -3, 4, -5, 6]; \
    plays = unidrnd(6, B, 1); \
    win = sum(gains(plays)); \
    aver = win/B; \
")

# 4.7 Use the MATLAB function just created
evaluate(matlab, "[w, a] = dice(1000);")
res <- getVariable(matlab, c("w", "a"))
print(res)

# - - - - -
# 5. Exception handling
# - - - - -
# 5.1 Try to get non-existing MATLAB variable
# (will result in an informative error)
tryCatch({
  data <- getVariable(matlab, "unknown")
  cat("Received variables:\n")
  str(data)
}, error = function(ex) {
  print(ex)
})
# Confirm that things still work
data <- getVariable(matlab, "A")
cat("Received variables:\n")
str(data)

# 5.2 Try to evaluate a MATLAB expression that fails

```

```

# (will result in an informative error)
tryCatch({
  res <- evaluate(matlab, "C = 1+unknown;")
  res
}, error = function(ex) {
  print(ex)
})
# Confirm that things still work
res <- evaluate(matlab, "C = 1+2;")
print(res)
data <- getVariable(matlab, "C")
cat("Received variables:\n")
str(data)

# - - - - -
# 6. Done: close the MATLAB client
# - - - - -
# When done, close the MATLAB client, which will also shutdown
# the MATLAB server and the connection to it.
close(matlab)

# 6.1 Check status of MATLAB connection (now disconnected)
print(matlab)

## End(Not run)

```

readMat

*Reads a MAT file structure from a connection or a file***Description**

Reads a MAT file structure from a connection or a file. Both the MAT version 4 and MAT version 5 file formats are supported. The implementation is based on [1-5]. Note: Do not mix up version numbers for the MATLAB software and the MATLAB file formats.

**Usage**

```

## Default S3 method:
readMat(con, maxLength=NULL, fixNames=TRUE, drop=c("singletonLists"),
  sparseMatrixClass=c("Matrix", "SparseM", "matrix"), verbose=FALSE, ...)

```

**Arguments**

con	Binary <a href="#">connection</a> from which the MAT file structure should be read. If a <a href="#">character</a> string, it is interpreted as filename, which then will be opened (and closed afterwards). If a <a href="#">raw vector</a> , it will be read via as a raw binary <a href="#">connection</a> .
maxLength	The maximum number of bytes to be read from the input stream, which should be equal to the length of the MAT file structure. If NULL, data will be read until End Of File has been reached.

fixNames	If <b>TRUE</b> , underscores within names of MATLAB variables and fields are converted to periods.
drop	A <b>character vector</b> specifying cases when one or more dimensions of elements should be dropped in order to decrease the amount of "nestedness" of the returned data structure. This only applies to the MAT v5 file format.
sparseMatrixClass	If "matrix", a sparse matrix is expanded to a regular <b>matrix</b> . If either "Matrix" (default) or "SparseM", the sparse matrix representation by the package of the same name will be used. These packages are only loaded if the a sparse matrix is read.
verbose	Either a <b>logical</b> , a <b>numeric</b> , or a <b>Verbose</b> object specifying how much verbose/debug information is written to standard output. If a Verbose object, how detailed the information is is specified by the threshold level of the object. If a numeric, the value is used to set the threshold of a new Verbose object. If <b>TRUE</b> , the threshold is set to -1 (minimal). If <b>FALSE</b> , no output is written.
...	Not used.

### Value

Returns a named **list** structure containing all variables in the MAT file structure.

### Speed performance

This function uses a MAT file parser implemented completely using pure R. For MAT files containing large vectorized objects, for instance long vectors and large matrices, the R implementation is indeed fast enough because it can read and parse each such objects in one go.

On the other hand, for MAT files containing a large number of small objects, e.g. a large number of cell structures, there will be a significant slowdown, because each of the small objects has to be parsed individually. In such cases, if possible, try to (re)save the data in MATLAB using larger ("more vectorized") objects.

### MAT cell structures

For the MAT v5 format, *cell* structures are read into R as a **list** structure.

### Unicode strings

Recent versions of MATLAB store some strings using Unicode encodings. If the R installation supports **iconv**, these strings will be read correctly. Otherwise non-ASCII codes are converted to NA. Saving to an earlier file format version may avoid this problem as well.

### Reading compressed MAT files

From MATLAB v7, *compressed* MAT version 5 files are used by default [3-5], which is supported by this function.

If for some reason it fails, use `save -v6` in MATLAB to write non-compressed MAT v5 files (sic!).

### About MAT files saved in MATLAB using '-v7.3'

MAT v7.3 files, saved using for instance `save('foo.mat', '-v7.3')`, stores the data in the Hierarchical Data Format (HDF5) [6, 7], which is a format not supported by this function/package. However, there exist other R packages that can parse HDF5, e.g. CRAN package **h5** and Bioconductor package **rhdf5**.

### Reading MAT file structures input streams

Reads a MAT file structure from an input stream, either until End of File is detected or until `maxLength` bytes has been read. Using `maxLength` it is possible to read MAT file structure over socket connections and other non-terminating input streams. In such cases the `maxLength` has to be communicated before sending the actual MAT file structure.

### Author(s)

Henrik Bengtsson. The internal MAT v4 reader was written by Andy Jacobson (Princeton University). Support for reading sparse matrices, UTF-encoded strings and compressed files, was contributed by Jason Riedy (UC Berkeley).

### References

- [1] The MathWorks Inc., *MATLAB - MAT-File Format, version 5*, June 1999.
- [2] The MathWorks Inc., *MATLAB - Application Program Interface Guide, version 5*, 1998.
- [3] The MathWorks Inc., *MATLAB - MAT-File Format, version 7*, September 2009.
- [4] The MathWorks Inc., *MATLAB - MAT-File Format, version R2012a*, September 2012.
- [5] The MathWorks Inc., *MATLAB - MAT-File Format, version R2015b*, September 2015.
- [6] The MathWorks Inc., *MATLAB - MAT-File Versions*, December 2015. [https://www.mathworks.com/help/matlab/import\\_export/mat-file-versions.html](https://www.mathworks.com/help/matlab/import_export/mat-file-versions.html)
- [7] Undocumented Matlab, *Improving save performance*, May 2013. <https://undocumentedmatlab.com/articles/improving-save-performance/>
- [8] J. Gilbert et al., Sparse Matrices in MATLAB: Design and Implementation, SIAM J. Matrix Anal. Appl., 1992. [https://www.mathworks.com/help/pdf\\_doc/otherdocs/simax.pdf](https://www.mathworks.com/help/pdf_doc/otherdocs/simax.pdf)
- [9] J. Burkardt, *HB Files: Harwell Boeing Sparse Matrix File Format*, Apr 2010. <https://people.sc.fsu.edu/~jburkardt/data/hb/hb.html>

### See Also

[writeMat\(\)](#).

### Examples

```
path <- system.file("mat-files", package = "R.matlab")
pathname <- file.path(path, "ABC.mat")
data <- readMat(pathname)
print(data)
```

---

writeMat	<i>Writes a MAT file structure</i>
----------	------------------------------------

---

## Description

This function takes the given variables (...) and places them in a MAT file structure, which is then written to a binary connection.

## Usage

```
## Default S3 method:
writeMat(con, ..., fixNames=TRUE, matVersion="5", onWrite=NULL, verbose=FALSE)
```

## Arguments

con	Binary <a href="#">connection</a> to which the MAT file structure should be written to. A string is interpreted as filename, which then will be opened (and closed afterwards).
...	<i>Named</i> variables to be written where the names must be unique.
fixNames	If <a href="#">TRUE</a> , periods within names of R variables and fields are converted to underscores.
matVersion	A <a href="#">character</a> string specifying what MAT file format version to be written to the connection. If "5", a MAT v5 file structure is written. No other formats are currently supported.
onWrite	Function to be called just before starting to write to connection. Since the MAT file structure does not contain information about the total size of the structure this argument makes it possible to first write the structure size (in bytes) to the connection.
verbose	Either a <a href="#">logical</a> , a <a href="#">numeric</a> , or a <a href="#">Verbose</a> object specifying how much verbose/debug information is written to standard output. If a Verbose object, how detailed the information is is specified by the threshold level of the object. If a numeric, the value is used to set the threshold of a new Verbose object. If <a href="#">TRUE</a> , the threshold is set to -1 (minimal). If <a href="#">FALSE</a> , no output is written (and neither is the <a href="#">R.utils</a> package required).

Note that ... must *not* contain variables with names equal to the arguments matVersion and onWrite, which were chosen because we believe they are quite unique to this write method.

## Value

Returns (invisibly) the number of bytes written. Any bytes written by any onWrite function are *not* included in this count.

## Limitations

Currently only the uncompressed MAT version 5 file format [6] is supported, that is, compressed MAT files cannot be written (only read).

Moreover, the maximum variable size supported by the MAT version 5 file format is  $2^{31}$  bytes [6]. In R, this limitation translates to  $2^{31}-1$  bytes, which corresponds to for instance an integer object with 536870912 elements or double object with 268435456 elements.

## Details on onWrite()

If specified, the `onWrite()` function is called before the data is written to the connection. This function must take a `list` argument as the first argument. This will hold the element `con` which is the opened `connection` to be written to. It will also hold the element `length`, which specified the number of bytes to be written. See example for an illustration.

*Note*, in order to provide the number of bytes before actually writing the data, a two-pass procedure has to be taken, where the first pass is imitating a complete writing without writing anything to the connection but only counting the total number of bytes. Then in the second pass, after calling `onWrite()`, the data is written.

## Author(s)

Henrik Bengtsson

## References

- [1] The MathWorks Inc., *MATLAB - MAT-File Format, version 5*, June 1999.
- [2] The MathWorks Inc., *MATLAB - Application Program Interface Guide, version 5*, 1998.
- [3] The MathWorks Inc., *MATLAB - MAT-File Format, version 7*, September 2009.
- [4] The MathWorks Inc., *MATLAB - MAT-File Format, version R2012a*, September 2012.
- [5] The MathWorks Inc., *MATLAB - MAT-File Format, version R2015b*, September 2015.
- [6] The MathWorks Inc., *MATLAB - MAT-File Versions*, December 2015. [https://www.mathworks.com/help/matlab/import\\_export/mat-file-versions.html](https://www.mathworks.com/help/matlab/import_export/mat-file-versions.html)

## See Also

`readMat()`.

## Examples

```
A <- matrix(1:27, ncol = 3)
B <- as.matrix(1:10)
C <- array(1:18, dim = c(2, 3, 3))

filename <- paste(tempfile(), ".mat", sep = "")

writeMat(filename, A = A, B = B, C = C)
data <- readMat(filename)
str(data)
```

```

X <- list(A = A, B = B, C = C)
stopifnot(all.equal(X, data[names(X)]))

unlink(filename)

# - - - - -
# All objects written must be named uniquely
# - - - - -
tryCatch({
  # Named
  writeMat(filename, A = A)
  # Not named
  writeMat(filename, A)
}, error = function(ex) {
  cat("ERROR:", ex$message, "\n")
})

tryCatch({
  # Uniquely named
  writeMat(filename, A = A, B = B, C = C)
  # Not uniquely named
  writeMat(filename, A = A, B = B, A = C)
}, error = function(ex) {
  cat("ERROR:", ex$message, "\n")
})

## Not run:
# When writing to a stream connection the receiver needs to know on
# beforehand how many bytes are available. This can be done by using
# the 'onWrite' argument.
onWrite <- function(x)
  writeBin(x$length, con = x$con, size = 4, endian = "little")
  writeMat(con, A = A, B = B, onWrite = onWrite)

## End(Not run)

```

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