

MapleNet Administrator Guide

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Overview

About MapleNet

Use MapleNet™ to share your Maple documents, calculators, and technical applications.

Maple provides the most intuitive interface available for creating web applications that rely on mathematical computations. You simply drag buttons, sliders, math input regions, and other interactive components into your Maple document to create the interface, and add the functionality behind those components using Maple's high-level, mathematically sophisticated programming language. Once completed, you simply save the Maple document on the MapleNet server to make your application available online

MapleNet Resources

Resource	Description
MapleNet Installation Guide	System requirements and installation instructions for MapleNet. The MapleNet Installation Guide is available in the Install.html file located either on your MapleNet installation DVD or the folder where you installed MapleNet.
MapleNet Administrator Guide	Instructions for using environment variables to configure the MapleNet server. Security issues are also discussed.
MapleNet Services Guide	Outline of MapleNet services. Information on limitations of services provided as well as a summary of MapleNet API endpoints.
MapleNet API Programming Guide	A detailed description of the MapleNet API with examples.

For additional resources, visit http://www.maplesoft.com/site_resources.

Getting Help

To request customer support or technical support, visit <http://www.maplesoft.com/support>.

Customer Feedback

Maplesoft welcomes your feedback. For comments related to the MapleNet product documentation, contact doc@maplesoft.com.

1 Introduction

1.1 Overview

MapleNet provides online viewing and execution of Maple documents and access to a Maple compute programming interface. Maple worksheets and workbooks can be viewed in web browsers and embedded components in those documents are interactive. In addition, Maple help databases can be hosted to allow web-based navigation of Maple help content. The compute endpoint allows programmatic access to the Maple computation engine. Third party applications that require complex mathematical computations can send compute requests to MapleNet via standard `HTTP POST` request.

MapleNet 2019 is a new implementation of the MapleNet feature set. It is designed to be easier to maintain and deploy, more scalable and require less resources. It uses more current web and server technologies to provide a better experience both for users and administrators. However, as this is a completely new code base, you are encouraged to contact Maplesoft with any issues that are not covered by the documentation.

1.2 Docker Container for MapleNet

The MapleNet server is intended to be deployed in the Docker container generated by the MapleNet installer. Running it requires the Docker container engine. We recommend using the latest stable release of Docker. The Docker container contains all the dependencies of the MapleNet binary. The Docker container can also be deployed to various cloud hosting environments.

For more information on where to obtain the Docker engine for your platform, installing MapleNet and running the MapleNet server container see the **MapleNet Installation Guide**.

Note: Attempting to run MapleNet outside of the Docker container is not supported.

2 Basics of Running the MapleNet Server

2.1 Glossary of Variables Used in This Chapter

The following variables are used in this chapter, and should be replaced with the correct values:

LICENSEFILE: The location of the MapleNet license file (on the Docker host)

HOSTPORT: The port on the host machine on which MapleNet should accept connections

IMAGETAG: The tag of the Docker image created by the installer

CONTENTDIR: The directory containing Maple content for hosting by MapleNet (on the Docker host)

MAPLEONLINECDNURL: The URL of a Content Delivery Network hosting the MapleNet JavaScript libraries

MATHJAXCDNURL: The URL of a Content Delivery Network hosting the Math Jax JavaScript package

HOSTADDRESS: Is either the ip address or machine address of the machine running the MapleNet Docker container

CONTAINERID: The container id obtained from running `docker container ls`

Additional documentation for the configuration variables used in these examples is available in the Configuration section of the Administrators Guide

2.2 Loading the MapleNet Docker Image

After you have installed MapleNet, you must load the MapleNet image into Docker.

To load the MapleNet image:

1. Open a command prompt and navigate to the MapleNet installation folder, before running this command.
2. Run the following command:

```
docker load --input MapleNet-2019.1.tar
```

Note: This process could take several minutes.

Next, find the MapleNet server container image tag using the command:

```
docker images.
```

You are now ready to start MapleNet.

2.3 Starting the MapleNet Server

Starting MapleNet Using the docker run Command

To start MapleNet, run the following Docker command:

```
docker run --mount type=bind,source=$LICENSEFILE,target=/maple/license/license.dat,readonly --publish $HOSTPORT:8080 maplesoft/maplenet:$IMAGETAG
```

Note: If `$LICENSEFILE` contains spaces, then you must enclose the path in quotation marks. For example, `source="C:\Program Files\MapleNet\2019\license.dat"`.

To test if MapleNet is running properly navigate to `http://$HOSTADDRESS:8080` in your browser.

You should see a page displayed with a link to a Maple demo worksheet.

For more information on using the `docker run` command, see <https://docs.docker.com/engine/reference/command-line/run/>

Starting MapleNet Using a docker compose File

Alternatively, you can specify MapleNet options using a docker compose (YAML) file:

```
version: 3.7

services:
  maplenet:
    image: maplesoft/maplenet:$IMAGETAG
    ports:
      - "$HOSTPORT:8080"
    volumes:
      - type: "bind"
        source: "$LICENSEFILE"
        target: "/maple/license/license.dat"
        read_only: true
```

The command used to deploy MapleNet is

```
docker stack deploy maplenet --compose-file <path to above file>
```

To test if MapleNet is running properly navigate to `http://$HOSTADDRESS:8080` in your browser.

You should see a page displayed with a link to a Maple demo worksheet.

For more information on the `docker stack` command, see <https://docs.docker.com/engine/reference/command-line/stack/>.

For more information on docker compose files, see <https://docs.docker.com/compose/gettingstarted/>

Replacing the Landing Page

The MapleNet container, by default, includes a landing page, *index.html*. Located at the bottom of the MapleNet file directory. To replace this page, mount a directory from your host machine, with the replacement landing page (called *index.html*) onto your MapleNet Docker container, mapping it to the directory containing your current *index.html* file. For more information on mounting host machine directories into the MapleNet Docker container, see *Basic Document Hosting (page 19)*.

2.4 Stopping the MapleNet Server

To stop the MapleNet Server:

1. At the prompt, to list your running containers, enter:

```
docker container ls
```

Find the running MapleNet server container ID in the list.

2. Next, you must stop the MapleNet Docker container. To do this, enter:

```
docker container stop $CONTAINERID
```

Where \$CONTAINERID is the container id obtained from step 1.

For more information on the docker stop command see <https://docs.docker.com/engine/reference/commandline/stop/>

2.5 Removing a Docker Image

At some point, you may want to remove some docker images from your machine.

To remove a Docker image, enter:

```
docker image rm $IMAGETAG
```

For more information on the docker image command, see:

<https://docs.docker.com/engine/reference/commandline/image/>

2.6 Adding Maple Documents to MapleNet

MapleNet is capable of rendering both classic and standard worksheets, as well as Maple workbooks, for display in a web browser. This is the easiest way to create web content for use with MapleNet. Placing a worksheet in the correct location on a MapleNet server makes the worksheet's content available to users. Without an installed copy of Maple, users can interact with a posted worksheet using their web browser, and even perform new computations.

For instructions and examples on how to configure MapleNet to host Maple documents, see the *Basic Document Hosting* (page 19).

2.7 MapleNet Logging

MapleNet is a server process and as such it generates informative logs by default. It is important to understand how MapleNet logging working so its logs can be properly maintained and used.

docker log

MapleNet is deployed as a Docker container therefore its logs are captured by docker. You can access these logs by using the `docker logs` command. Docker has extensive logging configuration options for how it maintains its logs and for sending docker logs to other logging systems. You can also add command line arguments to the `docker run` command to configure how docker maintains MapleNet's logs. See *Logging Configuration* (page 21) for a basic log configuration example. For more information about docker's logging options, see

docker log: <https://docs.docker.com/engine/reference/commandline/logs/>

docker log driver configuration: <https://docs.docker.com/config/containers/logging/configure/>

MapleNet options

MapleNet has various options for configuring the generated logs. All these options are documented in the Configuration section. The most important option is the `MAPLENET_LOGGING_LEVEL` option. This option controls how verbose MapleNet's logging is. This options accepts the following values (from most verbose to quietest): trace, debug, info, warning, error, fatal. The default logging level is info. This level is chosen to provide a balance of informative logging without being excessive. Increase the logging to debug or trace will provide additional logging, however these addi-

tional log are intended for developers more than users. Decreasing the logging levels will reduce the amount of information which may seem desirable, however should something go wrong, the reduced logging means less information for determining what happened. The default level (info) is the suggested level for a normal MapleNet deployment. If log storage is a concern, it is better to configure the docker log driver with log rotation than to decrease the logging level of MapleNet.

3 Environment Variable Configuration

As MapleNet is deployed as a Docker container, configuration is handled by setting environment variables within the Docker container. On the Docker command line (`docker run`) you can set an environment variable by using the `-e` command line argument. They can also be specified in a Docker stack YAML file. Any variables that are used to specify files or directories are for locations **within** the container. See the *Adding Maple Documents to MapleNet* section of this guide for information on adding content to the Docker container.

The environment variables all start with the `MAPLENET_` prefix.

3.1 Licensing

Environment Variable	Parameter	Description
<code>MAPLENET_LICENSE</code>	file	This variable specifies which license file MapleNet uses. The license file must exist within the container at the time that MapleNet starts. It must be added to the container or mounted into the container.

3.2 Directory Setup

Environment Variable	Parameter	Description
<code>MAPLENET_WEBSERVER_DOCUMENTROOT</code>	directory	This variable specifies which directory MapleNet uses as its document root, the base directory of the content hosted by MapleNet. The default value of document root is <code>/webroot</code> . To make content available to users, mount a directory containing the content under the container's <code>/webroot</code> directory.
<code>MAPLENET_WEBSERVER_CACHEDIR</code>	directory	This variable specifies the directory where MapleNet stores cache files. The default value of this variable is <code>/webroot/maplenet/cache</code> . Cache directories contain temporary files required for rendering documents. As the remote clients need access to files in the cache directories, the cache directories must be located under document root.

3.3 Managing Connections

Environment Variable	Parameter	Description
<code>MAPLENET_WEBSERVER_REQUESTTIMEOUTMS</code>	timeout in milliseconds	This variable specifies how long, in milliseconds, MapleNet waits before timing out connections. The default value of this variable is 30000 (30 seconds). Documents that are opened by users will periodically connect to MapleNet to make sure those connections are kept open. This timeout is mostly for cases where clients disconnect without properly closing their connection.
<code>MAPLENET_WEBSERVER_NUMTHREADS</code>	integer	This variable specifies the maximum number of threads MapleNet can use for accepting connections. The default value is 1024. These threads are used to handle user connections. If all of these threads are used, MapleNet will not be able to accept new connections.

MAPLENET_WEBSERVER_NOTFOUNDFILE	file	This variable specifies a file to be sent to the user when a requested file cannot be found. The default is the <i>empty string</i> , which causes MapleNet to reply with a very simple 404 message.
MAPLENET_WEBSERVER_PORT	port number	This variable specifies the port MapleNet listens on for new connections. The default value of this variable is 8080. This is the port within the Docker container. You will still need to map this port to an external port on the host machine, thus changing this is generally not required.

3.4 Directory Listings

Environment Variable	Parameter	Description
MAPLENET_WEBSERVER_ENABLEDIRECTORYLISTING	boolean	This variable specifies whether MapleNet permits directory listings. The default value of this variable is <i>false</i> . Directory listings allow the user to navigate document root like a file system.

3.5 Sendfile Usage

Environment Variable	Parameter	Description
MAPLENET_WEBSERVER_ENABLESENDFILE	boolean	This variable specifies whether MapleNet uses the sendfile command to optimize file transfers. <i>By default this option is enabled.</i> In some host configurations (certain networked or virtualized file systems) using sendfile can lead to data corruption in the transferred file.

3.6 Content Delivery Network

Environment Variable	Parameter	Description
MAPLENET_WEBSERVER_MAPLECLLOUDCDN	URL	This variable specifies the base URL to use for fetching the MapleNet JavaScript library. The default value for this variable is <i>"/mapleonline"</i> , meaning the library will be loaded from the mapleonline sub-directory of MapleNet's document root. This can be used to place the library (mapleonline.nocache.js) on to a Content Delivery Network (CDN). mapleonline.nocache.js will be appended to the given URL.

3.7 Worksheet Template Location

Environment Variable	Parameter	Description
MAPLENET_WEBSERVER_MAPLEWORKSHEET	filename	This variable specifies the file to use as the Worksheet HTML template page. By default, this file is <i>/maple/data/MapleWorksheet.html</i> .

		Some users may want to use a custom version of this file.
--	--	---

3.8 Web Server Endpoints

Environment Variable	Parameter	Description
MAPLENET_WEBSERVER_ENDPOINTS_COMPUTE	boolean	This variable specifies whether MapleNet enables its compute endpoint. The default value of this variable is <code>true</code> . The compute endpoint allows for a user to submit a Maple computation request to the server and receive the result as a reply.
MAPLENET_WEBSERVER_ENDPOINTS_DOCUMENT	boolean	This variable specifies whether MapleNet enables its document endpoint. The default value of this variable is <code>true</code> . The document endpoint allows for users to open Maple worksheets hosted by MapleNet in a browser.
MAPLENET_WEBSERVER_ENDPOINTS_DOWNLOAD	boolean	This variable specifies whether MapleNet permits users to download the Maple documents hosted by MapleNet. The default value of this variable is <code>false</code> . If set to <code>true</code> , adding the <code>download url</code> parameter to the url of a Maple document causes it to be downloaded instead of displayed.
MAPLENET_WEBSERVER_ENDPOINTS_HELP	boolean	This variable specifies whether MapleNet enables its help endpoints. The default value of this variable is <code>true</code> . The help endpoints allow users to display worksheets taken from a Maple help database.
MAPLENET_WEBSERVER_ENDPOINTS_UPLOAD	boolean	This variable specifies whether MapleNet enables the upload endpoint. The default value is <code>false</code> . Enabling the upload endpoint allow users to upload content to MapleNet using the <code>upload.html</code> page.

3.9 CORS

Environment Variable	Parameter	Description
MAPLENET_WEBSERVER_CORS_ALLOWORIGIN	string	This variable specifies the value MapleNet sets for the cross-origin resource sharing (CORS) allow origin header. The default value for this value is the <i>empty string</i> . CORS allows sites hosted on different domains to access resources from MapleNet.
MAPLENET_WEBSERVER_CORS_ALLOWMETHODS	string	This variable specifies the value MapleNet sets for the cross-origin resource sharing (CORS) allow methods header. The default value for this value is the <i>empty string</i> . CORS allows sites hosted on different domains to access resources from MapleNet.
MAPLENET_WEBSERVER_CORS_ALLOWHEADERS	string	This variable specifies the value MapleNet sets for the cross-origin resource sharing (CORS) allow headers header. The default value for this value is the <i>empty string</i> . CORS allows sites hosted on different domains to access resources from MapleNet.

3.10 SSL

Environment Variable	Parameter	Description
MAPLENET_WEBSERVER_SSL_VERIFYPEER	boolean	This variable specifies that MapleNet will require that connecting clients have a valid certificate. The default value of this variable is <code>false</code> . This allows the server to verify that any connecting client has a certificate that is signed by certificate authority from the server's trusted certificate authorities.
MAPLENET_WEBSERVER_SSL_CAPATH	directory	This variable specifies a directory MapleNet will use as its certificate authority (CA) path. The default value of this variable is the <i>empty string</i> , meaning no CA path will be added. This directory will be searched for CA certificates in PEM format.
MAPLENET_WEBSERVER_SSL_CAFILE	file	This variable specifies a file MapleNet will use as its certificate authority (CA) file. The default value for this variable is the <i>empty string</i> , meaning no CA file will be added. A CA file is a file containing CA certificates in PEM format.
MAPLENET_WEBSERVER_SSL_VERIFYDEPTH	integer	This variable specifies the maximum depth of a certificate authority chain that MapleNet will accept. The default value for this variable is 9.
MAPLENET_WEBSERVER_SSL_DEFAULTVERIFYPATHS	boolean	This variable specifies whether MapleNet uses default values for CAFILE and CAPATH. The default is true. With this set MapleNet server will use default, OS supplied, certificates.
MAPLENET_WEBSERVER_SSL_CIPHERLIST	comma separated list or ALL	This variable specifies which ciphers MapleNet should present to clients for use with SSL. The default value for this variable is ALL, meaning all available ciphers should be presented.
MAPLENET_WEBSERVER_SSL_PROTOCOLVERSION	integer	This variable specifies the minimal version of SSL/TLS MapleNet will accept for connections. The default value for this variable is 0.
MAPLENET_WEBSERVER_SSL_SHORTTRUST	boolean	This variable specifies whether MapleNet checks for new certificates while it is running. The default value for this variable is <code>false</code> . When set to true MapleNet will check for new certificates added to the CAFILE or CAPATH.

3.11 Client Configuration

Environment Variable	Parameter	Description
MAPLENET_WEBCLIENT_CONFIGURATION	key=value	This variable is used to set client configuration values in MapleNet. The default value for this variable is the <i>empty string</i> (no values set). These key,value pairs are placed into a JavaScript map in the MapleWorksheet.html template. These values can then be accessed by JavaScript running in that page. The default MapleNet JavaScript currently recognizes the MathJaxCDN key. The corresponding value is the base URL to use for locating the MathJax library. When MathJaxCDN is not set, the MathJax library is loaded from the MathJax sub-directory of MapleNet's document root. This can be used to place the MathJax library on to a Content Delivery Network (CDN). <i>MathJax.js</i> will be appended to the given URL.
MAPLENET_WEBCLIENT_ADDITIONALJAVASCRIPTURL	string	This variable specifies a string that will be injected into the HTML page sent to the client when opening a document. The default value for this variable is the <i>empty string</i> , which mean that nothing will be added to the page. This can be used to add custom JavaScript to the page as viewed by the client.
MAPLENET_WEBCLIENT_HELPURL	URL	This variable sets a URL that that is used to map help links in worksheets to web pages. The default value for this variable is <i>/help/display</i> . The help topic from the help link is appended to this value to form the URL for the link. The default value maps the help links to the help endpoint of the server hosting the worksheet. Assuming the help page exists in the help databases and the help endpoints are enabled, then the help page should display.

3.12 Managing Maple Engines

Environment Variable	Parameter	Description
MAPLENET_POOL_MAXENGINES	integer	This variable sets the maximum number of Maple engines that MapleNet will start. The default value for this variable is 0, meaning no limit. This value is

		different than <code>MAPLENET_POOL_MAXRUNNINGENGINES</code> , as this limits the total number of engines that can be opened, not the number of running engines.
<code>MAPLENET_POOL_MAXFALLBACKENGINES</code>	integer	This variable sets the maximum number of Maple engines that MapleNet will start for image plot generation. The default value for this variable is 0, meaning no limit. The pool of engines for image plot generation is separate from the pool for normal computation/document engines.
<code>MAPLENET_POOL_COMPUTATIONTIMELIMIT</code>	seconds	This variable sets the timelimit for compute requests (as opposed to document computations). The default value is 360 seconds. Compute requests that run for longer than this will be stopped by MapleNet and an error will be returned.
<code>MAPLENET_POOL_DOCUMENTCOMPUTATIONTIMELIMIT</code>	seconds	This variable sets the timelimit for computations related to an open document (worksheet/workbook). The default value is 1200 seconds. Computations that last longer than this will be stopped by MapleNet and an error will be returned.
<code>MAPLENET_POOL_QUEUETIMELIMIT</code>	seconds	This variable sets the timelimit for requests (computation or document) that are not able to run because MapleNet is not allowed to start a running engine. The default value for this variable is 60 seconds. An engine may not be available to run because of limits on the number of running engines. For example license restrictions or <code>MAPLENET_POOL_MAXRUNNINGENGINES</code> . If a request waits longer than this limit, the request will be cancelled and an error will be returned.
<code>MAPLENET_POOL_MAXRUNNINGENGINES</code>	integer	This variable sets the maximum number of running engines that MapleNet will allow. It defaults to 0, which means the maximum allowed by the license. It is an error to set this value greater than the license allows.

3.13 Maple Configuration

Environment Variable	Parameter	Description
<code>MAPLENET_MAPLE_LIBRARY</code>	path	This variable specifies a value to set for the Maple libname variable. The default is the <i>empty string</i> , which uses the default value for Maple's libname. When specifying more than one path, use a comma (,) as a separator. When setting this parameter, only the directories listed will be used. If Maple's library (maple.mla) is not present in the list, MapleNet will not function properly.

MAPLENET_MAPLE_MSERVER	filename	This variable specifies the file to be executed when starting a Maple engine. The default value for this variable is the <i>empty string</i> . The default value uses the normal Maple engine binary.
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3.14 Configuring Logging

Environment Variable	Parameter	Description
MAPLENET_LOGGING_DISABLE	boolean	This variable specifies if logging is disabled in MapleNet. The default value is <i>false</i> , meaning log messages will be generated.
MAPLENET_LOGGING_FILENAME	filename	This variable specifies a file that MapleNet's logs should be written to. The default value is the <i>empty string</i> . This default causes MapleNet to log to the console. Setting this value will capture the logs in a file within the Docker container. This is probably not what you want. Instead capture the output of Docker or use the <code>docker logs</code> command.
MAPLENET_LOGGING_FLUSH	boolean	This variable specifies if MapleNet should flush its logs whenever a logging message is produced. The default is <i>false</i> . Flushing causes log messages to not get buffered. This can reduce performance of MapleNet, but reduces the likelihood of a log message being lost if MapleNet should exit unexpectedly.
MAPLENET_LOGGING_LEVEL	log level	This variable specifies the logging level that MapleNet uses. There are 6 logging levels, from least to most output: <i>fatal</i> , <i>error</i> , <i>warning</i> , <i>info</i> , <i>debug</i> and <i>trace</i> . The default value is <i>info</i> , which generates sufficient logging for normal operations, without being excessive. Levels below <i>info</i> (<i>debug</i> and <i>trace</i>) are intended for debugging and generate too much output for normal use.
MAPLENET_LOGGING_SYNCHRONOUS	boolean	This variable whether MapleNet uses synchronous logging. The default is <i>false</i> . Synchronous logging forces the log messages to be generated directly by the caller, not send to another thread for output. This means the message is output more directly, reducing the likelihood the message will be lost if MapleNet exits unexpectedly.

3.15 Data Limit

Environment Variable	Parameter	Description
MAPLENET_ENGINE_JAVADATALIMIT	mebibytes	This variable specifies a data limit for Java operations used by MapleNet. The default is 2048 MiB. The Maple engine can utilize a Java virtual machine (JVM) for certain operations. This variable limits the maximum amount of memory the JVM is allowed to use.

3.16 Compute Engine

Environment Variable	Parameter	Description
MAPLENET_COMPUTEENGINE_COMMANDLINE	string	This variable specifies extra command line arguments to use when starting a Maple engine for the compute endpoint. The default value for this variable is the <i>empty string</i> .
MAPLENET_COMPUTEENGINE_DISABLESECURITY	boolean	This variable specifies whether MapleNet disables the security setting when starting a Maple engine for the compute endpoint.

		The default value for this variable is false. The Maple engine has security settings that restrict access to the operating system. Disabling the security setting will disable these restrictions, allowing Maple access to the entire system.
MAPLENET_COMPUTEENGINE_CPULIMIT	integer	This variable specifies whether MapleNet starts the Maple engines for the compute endpoint with a CPU limit. The default value for this variable is 0, which means no limit is given. Passing a CPU limit to the Maple engine halts the Maple engine after a the given number of CPU seconds. When setting a CPU limit, it is important to remember that compute engines are re-used a limited number of times and the CPU limit applies to the lifetime of the compute engine.
MAPLENET_COMPUTEENGINE_DATALIMIT	integer	This variable specifies whether MapleNet starts the Maple engines for the compute endpoint with a data limit. The default value for this variable is 0, which means no limit is given. Passing a data limit to the Maple engine limits the maximum amount of memory a Maple engine can access. If this limit is exceeded the Maple engine will shutdown. Compute engines are restarted between each computation, so each computation should start with a minimal amount of memory.

3.17 Document Engine

Environment Variable	Parameter	Description
MAPLENET_DOCUMENTENGINE_COMMANDLINE	string	This variable specifies extra command line arguments to use when starting a Maple engine for a document. The default value for this variable is the <i>empty string</i> .
MAPLENET_DOCUMENTENGINE_DISABLESECURITY	boolean	This variable specifies whether the MapleNet security setting is disabled when starting a Maple engine for a document. The default value for this variable is <code>false</code> . The Maple engine has security settings that restrict access to the operating system. Disabling the security setting will disable these restrictions, allowing Maple access to the entire system.
MAPLENET_DOCUMENTENGINE_CPULIMIT	integer	This variable specifies whether MapleNet starts the Maple engines for documents with a CPU limit. The default value for this variable is 0, which means no limit is given. Passing a CPU limit to the Maple

		engine halts the Maple engine after a certain number of CPU seconds. Document engines persist for the lifetime of the document, are not re-used. Thus this variable limits the total amount of CPU time a document session can consume.
MAPLENET_DOCUMENTENGINE_DATALIMIT	integer	This variable specifies whether MapleNet starts the Maple engines for the compute endpoint with a data limit. The default value for this variable is 0, which means no limit is given. Passing a data limit to the Maple engine limits the maximum amount of memory a Maple engine can access. If this limit is exceeded the Maple engine will shutdown. Document engines persist for the lifetime of the document, are not re-used. Thus this variable limits the total amount of memory a document session can consume.

4 Security Issues

MapleNet permits remote users to execute Maple code on a server. Maple is a full featured programming language, including tools for accessing the file system, networking and external calling to other programming language, such as Java, Python and C. It is difficult to restrict what users can access. Deploying MapleNet securely requires understanding the environment in which it is intended to be used. Do you trust your users, or is there a risk of malicious access? Are there users whose content should be kept private from others? This section will describe the security risks of deploying MapleNet server and best practices for limited harm.

4.1 Untrusted Users

The risk of allowing untrusted users to access MapleNet is that someone malicious might attempt to cause harm or exploit the system for their own purposes. It is difficult to secure MapleNet against malicious users so we advise against allowing untrusted users to access a MapleNet installation. The biggest risk is allowing an untrusted user to execute their own code. If you intend to deploy MapleNet where it would be accessible to untrusted users, we suggest the following procedures.

1. Configure MapleNet behind a load balancer with SSL offload.
2. Disable the compute endpoint. The compute endpoint explicitly allows users to run arbitrary Maple code on the server.
3. Disable the help endpoints. The help pages may contain examples that could be exploited.
4. Disable uploading. Another route to executing malicious code would be to embed it in a worksheet and upload it.
5. Disable directory listing. This makes it harder for malicious users to find content on the site.
6. Double-check your content. Maple worksheets can contain embedded components. These components can accept user input and cause Maple code to be evaluated. It is possible to create worksheets that execute Maple code entered into a component (a text area or math container, for example). Do not allow such worksheets to be hosted.
7. Make sure you have limited the CPU and data limits for your document engines. This makes denial of service attacks via Maple code more difficult.
8. Assume the content that users view is available to other users. With all the steps above implemented, it is very hard for one user to "snoop" on another user's content, however we suggest that you do not use MapleNet to display content that you would consider private when untrusted users have access to MapleNet.

4.2 Trusted Users

In an environment when you trust your users to not be malicious, MapleNet features can be enabled as you see fit. However there are still some issues to consider. Turning off unnecessary features is still a good idea. A curious user might experiment with the compute features of MapleNet without realizing it could negatively effect the performance of documents. With directory listings enabled, it is possible to locate temporary files created by on going computations and open documents (the contents of the cache directory). These locations can also be determined by viewing the HTTP requests made by a open document. These requests are encrypted when using SSL, but are sent in the clear when SSL is not enabled. This may be a concern as it allows one user to see some of the content generated by another user's document. If this is a concern, using SSL and disabling directory listings makes it significantly harder to discover those files. If you need to be certain that no data leakage can occur between groups of users, we suggest running multiple instances of MapleNet that are only accessible by users of the particular security levels.

5 Example Configurations

This section contains example configurations for typical MapleNet deployments

The following variables are used in this document, and should be replaced with the correct values:

LICENSEFILE: The location of the MapleNet license file (on the Docker host)

HOSTPORT: The port on the host machine on which MapleNet should accept connections

IMAGETAG: The tag of the Docker image created by the installer

CONTENTDIR: The directory containing Maple content for hosting by MapleNet (on the Docker host)

MAPLEONLINECDNURL: The URL of a Content Delivery Network hosting the MapleNet JavaScript libraries

MATHJAXCDNURL: The URL of a Content Delivery Network hosting the Math Jax JavaScript package

Additional documentation for the configuration variables used in these examples is available in the Configuration section of the Administrators Guide. These examples are shown as separate commands, however arguments from one example can, in general, be combined with arguments from other examples.

Note: In the following examples long commands are broken across multiple lines. The \ character is used to indicate the continuation of the command on the next line. This is supported in many terminals so copying and pasting the entire command should work. If that does not work, duplicating the command as a single line by omitting these characters and joining the argument should also work.

5.1 Basic Document Hosting

These configurations are for customers who want to host Maple documents located within a directory on the Docker host machine.

Mounting as a sub-directory of /webroot

The easiest way to add user content to the container is to simply mount the directory containing the content as a sub-directory of /webroot.

```
docker run --mount type=bind,source=$LICENSEFILE,target=/maple/license/license.dat,readonly \
  --mount type=bind,source=$CONTENTDIR,target=/webroot/content \
  --publish $HOSTPORT:8080 \
  --rm \
  maplesoft/maplenet:$IMAGETAG
```

With this configuration, the files in the \$CONTENTDIR directory are available under

`http://localhost:$HOSTPORT/content`

If you want to be able to navigate the directory structure via the web browser you can enable directory listings using the `MAPLENET_WEBSERVER_ENABLEDIRECTORYLISTING` variable.

With this configuration the default locations of MapleNet's libraries are unaffected by the mount. However this does leave the MapleNet landing page and example document on the server. If you want to replace the entire `/webroot` directory, the following configuration will do that.

Mounting on top of /webroot

Replacing `/webroot` completely will hide the JavaScript libraries required for document rendering in MapleNet. Therefore you will need to either use a Content Delivery Network (see next configuration) or copy those libraries into your content directory so they continue to be available when `/webroot` is hidden. To copy the libraries from the Docker image, we first need to start the image. This is only to access the files, so a simple `docker run` command is sufficient.

```
docker run --mount type=bind,source=$LICENSEFILE,target=/maple/license/license.dat,readonly \
  --name copy_container \
  --rm \
  maplesoft/maplenet:$IMAGETAG
```

We use the `--name` option to give the container a easy to remember name. We can now copy the directory containing the MapleNet libraries to the directory of content we want to mount on top of `/webroot`.

```
docker cp -a copy_container:/webroot/mapleonline $CONTENTDIR
docker cp -a copy_container:/webroot/MathJax $CONTENTDIR
```

Now stop this container

```
docker stop copy_container
```

There should now be directories named `mapleonline` and `MathJax` within `$CONTENTDIR` containing the JavaScript libraries from the Docker container.

Now we can start the Docker container with `$CONTENTDIR` replacing `/webroot`

```
docker run --mount type=bind,source=$LICENSEFILE,target=/maple/license/license.dat,readonly \
  --mount type=bind,source=$CONTENTDIR,target=/webroot \
  --publish $HOSTPORT:8080 \
  --rm \
  maplesoft/maplenet:$IMAGETAG
```

With this configuration, the `$CONTENTDIR` directory is the root of the files served by MapleNet.

Using a Content Delivery Network for JavaScript libraries

If you are able to use a Content Delivery Network [CDN] to host MapleNet's JavaScript libraries this can simplify the process of replacing `/webroot` as the MapleNet content is no longer require to exist within the Docker container. However to place the content on a CDN, it still needs to be extracted from the Docker image as described above. To use a CDN, the following command should be used

```
docker run --env MAPLENET_WEBSERVER_MAPLECLLOUDCDN=$MAPLEONLINECDNURL \
  --env MAPLENET_WEBCLIENT_CONFIGURATION="MathJaxCDN=$MATHJAXCDNRURL" \
```

```
--publish $HOSTPORT:8080 \
--mount type=bind,source=$LICENSEFILE,target=/maple/license/license.dat,readonly \
--mount type=bind,source=$CONTENTDIR,target=/webroot \
--rm \
maplesoft/maplenet:$IMAGETAG
```

Logging Configuration

The following example configures the json-file logger (the docker default) to perform log rotation with three log files each with a maximum size of 10 Mb. Thus if the current log file reaches 10 Mb and there are already three log files, the oldest is deleted and a new log file is created.

```
docker run --log-opt max-size=10m \
--log-opt max-file=3 \
--mount type=bind,source=$LICENSEFILE,target=/maple/license/license.dat,readonly \
--mount type=bind,source=$CONTENTDIR,target=/webroot \
--publish $HOSTPORT:8080 \
--rm \
maplesoft/maplenet:$IMAGETAG
```

The MapleNet container can also be configured to pass its logs to standard logging facilities, for example

```
docker run --log-driver syslog \
--mount type=bind,source=$LICENSEFILE,target=/maple/license/license.dat,readonly \
--mount type=bind,source=$CONTENTDIR,target=/webroot \
--publish $HOSTPORT:8080 \
--rm \
maplesoft/maplenet:$IMAGETAG
```

For a complete list of supported logging facilities, see the docker log driver documentation:

<https://docs.docker.com/config/containers/logging/configure/>

5.2 Basic Compute Hosting

This example configuration is for MapleNet's compute API. The primary concern for the compute API is usually resource limits. The following command starts MapleNet with restricted compute limits of 5 seconds of compute time and 500 MiB of memory.

```
docker run --env MAPLENET_POOL_COMPUTATIONTIMELIMIT=5 \
--env MAPLENET_COMPUTEENGINE_DATA LIMIT=500 \
--mount type=bind,source=$LICENSEFILE,target=/maple/license/license.dat,readonly \
--publish $HOSTPORT:8080 \
--rm \
maplesoft/maplenet:$IMAGETAG
```

Cross-Origin Resource Sharing (CORS)

Cross-Origin Resource Sharing is a mechanism for allowing web applications running on one domain to access web services running on another. Normally web browsers do not allow applications to access services running on different

domain. CORS allows the service to state if a domain is allowed to make requests to the server. This may be important for the compute service if users have written web applications hosted on other domains and want access the compute service. By default MapleNet is configured to not allow requests from different domains.

The following configuration allow requests from any domain

```
docker run --env MAPLENET_WEBSERVER_CORS_ALLOWORIGIN="*" \
  --mount type=bind,source=$LICENSEFILE,target=/maple/license/license.dat,readonly \
  --mount type=bind,source=$CONTENTDIR,target=/webroot \
  --publish $HOSTPORT:8080 \
  --rm \
  maplesoft/maplenet:$IMAGETAG
```

If you have a list of domains you are willing to accept requests from you can use a comma separated list of domain names

```
docker run --env MAPLENET_WEBSERVER_CORS_ALLOWORIGIN="domain1.com,domain2.com,domain3.com" \
  --mount type=bind,source=$LICENSEFILE,target=/maple/license/license.dat,readonly \
  --mount type=bind,source=$CONTENTDIR,target=/webroot \
  --publish $HOSTPORT:8080 \
  --rm \
  maplesoft/maplenet:$IMAGETAG
```

5.3 Adding Maple Libraries and Help Databases

Users can add Maple libraries and help databases to MapleNet. Adding Maple libraries allows hosted documents and compute requests to access the Maple functionality in those libraries. Adding help databases allows MapleNet to host Maple help pages for display in browsers. In this example we will simply add the user libraries and help databases to the Maple library directory. For this example, we'll use \$MAPLELIBRARYDIR to represent the path to a Maple library (.mla) \$MAPLELIBRARY and \$MAPLEHELPPDIR to represent a the path to a Maple help database (.help) \$MAPLEHELP.

```
docker run --mount type=bind,source=$LICENSEFILE,target=/maple/license/license.dat,readonly \
  --mount type=bind,source=$CONTENTDIR,target=/webroot \
  --mount type=bind,source=$MAPLELIBRARYDIR/$MAPLELIBRARY,target=/maple/lib/$MAPLELIBRARY \
  --mount type=bind,source=$MAPLEHELPPDIR/$MAPLEHELP,target=/maple/lib/$MAPLEHELP \
  --publish $HOSTPORT:8080 \
  --rm \
  maplesoft/maplenet:$IMAGETAG
```

Multiple libraries and help database can be added by having multiple mount commands.

Care must be taken to not override the default Maple libraries (maple.mla, update.mla,MathematicalFunctions.mla or MTM.mla) as this would remove Maple (and MapleNet) functionality. If the name of your library conflicts with an existing Maple library, you can simply mount it with a different name.

```
docker run --mount type=bind,source=$LICENSEFILE,target=/maple/license/license.dat,readonly \
  --mount type=bind,source=$CONTENTDIR,target=/webroot \
  --mount type=bind,source=$MAPLELIBRARYDIR/maple.mla,target=/maple/lib/mymaple.mla \
  --publish $HOSTPORT:8080 \
  --rm \
  maplesoft/maplenet:$IMAGETAG
```

5.4 Enabling the Upload Page

MapleNet includes an upload page that allows users to upload Maple documents to MapleNet from their web browsers. To enable this feature the `MAPLENET_WEBSERVER_ENDPOINTS_UPLOAD` variable must be set. In addition, the upload page displays the contents of the upload directory if `MAPLENET_WEBSERVER_ENABLEDIRECTORYLISTING` is set.

```
docker run --env MAPLENET_WEBSERVER_ENDPOINTS_UPLOAD=true \
  --env MAPLENET_WEBSERVER_ENABLEDIRECTORYLISTING=true \
  --mount type=bind,source=$LICENSEFILE,target=/maple/license/license.dat,readonly \
  --mount type=bind,source=$CONTENTDIR,target=/webroot/content \
  --publish $HOSTPORT:8080 \
  --rm \
  maplesoft/maplenet:$IMAGETAG
```

With these variables set, the upload page

```
http://$HOSTNAME/mapleonline/upload/upload.html
```

will be fully functional.

By default the upload directory lives within the docker container, thus when the container is restarted any uploads are lost. To have the uploaded content persist between MapleNet restarts, mount a host directory on top of the upload directory. With this, the uploads are saved to the host directory. If `/webroot` is replaced with a host directory (as described above), uploads will be stored into the host directory. If that is not the case, the following command mounts the `$UPLOADDIR` from the host machine on top of the MapleNet upload directory.

```
docker run --env MAPLENET_WEBSERVER_ENDPOINTS_UPLOAD=true \
  --env MAPLENET_WEBSERVER_ENABLEDIRECTORYLISTING=true \
  --mount type=bind,source=$LICENSEFILE,target=/maple/license/license.dat,readonly \
  --mount type=bind,source=$CONTENTDIR,target=/webroot/content \
  --mount type=bind,source=$UPLOADDIR,target=/webroot/worksheet/upload \
  --publish $HOSTPORT:8080 \
  --rm \
  maplesoft/maplenet:$IMAGETAG
```

5.5 Security Options

The following options implement the suggested configuration in the Security section of the Administrators Guide. It also mounts `$CONTENTDIR` on top of `/webroot` as described above.

```
docker run --env MAPLENET_ENDPOINTS_COMPUTE=false \
  --env MAPLENET_ENDPOINTS_HELP=false \
  --env MAPLENET_DOCUMENTENGINE_CPULIMIT=120 \
  --env MAPLENET_DOCUMENTENGINE_DATA_LIMIT=2048 \
  --mount type=bind,source=$LICENSEFILE,target=/maple/license/license.dat,readonly \
  --mount type=bind,source=$CONTENTDIR,target=/webroot \
  --publish $HOSTPORT:8080 \
  --rm \
  maplesoft/maplenet:$IMAGETAG
```

5.6 Troubleshooting

Docker not starting

Error: Bind for \$HOSTPORT failed: port is already allocated

The port you specified for MapleNet to listen on is already in use. This could be caused by an existing MapleNet instance using the same port. Running

```
docker ps
```

will show all the running Docker containers as well as the port they are using. You can use `docker stop` to stop a running container or select a different port for MapleNet.

MapleNet is not starting

Error: The license file, /maple/license/license.dat, does not exist

This indicates that MapleNet was unable to locate a valid license. Make sure you completed the installation step to obtain a valid license and that it was correctly mounted into the Docker container.

Error: Unable to create compute cache directory

If you are mounting on top of `/webroot`, MapleNet needs to be able to create directories in the mounted directory. The permissions on the `$CONTENTDIR` may be preventing MapleNet from doing so.

Performances Issues

Error: Users seeing "Time out" errors when accessing MapleNet

When users see time out errors when connecting to MapleNet, this usually indicates that MapleNet is overloaded. There are a few configuration options that may be able to solve these issues.

MAPLENET_WEBSERVER_NUMTHREADS: The MapleNet web server has a limited number of threads to handle incoming connections. If you are handling a large number of incoming connections you may need to increase this

value. Be aware that increasing the number of web server threads also increases the amount of memory MapleNet will use.

MAPLENET_POOL_MAXENGINES: MapleNet maintains a pool of Maple engines. If there are a large number of open documents, it is possible to reach this limit. Increasing this limit will allow more users to have open documents on MapleNet. Each running Maple engine requires memory, so this will also lead to higher memory usage. This variable does not effect the maximum number of **running** engines, simply the maximum number of open engines.

MAPLENET_POOL_QUEUELIMIT: MapleNet has a limit on the number of engines that can run at the same time (limited by the MapleNet license). When MapleNet runs a command it may need to wait if the maximum number of engines are already running. This variable determines how long MapleNet should wait for an available engine before aborting.

MAPLENET_WEBSERVER_REQUESTTIMEOUTMS: This variable limits how long MapleNet keeps a connection open when it stops receiving messages from a client. The MapleNet client sends regular messages to keep the connection alive and these are normally sufficient. However if users have low speed or unreliable connections, this timeout may be exceeded, and the connection closed.

MapleNet memory usage

MapleNet allows multiple users to run commands in Maple on a single server. This can use a lot of memory, potentially making the host machine unstable. If you have problems with excessive memory usage, you can try adjusting the following variables.

MAPLENET_POOL_MAXENGINES: Reduce the maximum number of open Maple engines, with the trade off of allowing fewer users to access MapleNet.

MAPLENET_COMPUTEENGINE_DATALIMIT and **MAPLENET_DOCUMENTENGINE_DATALIMIT:** These variables limit the amount of memory a single compute or document engine can use. Setting these limits will stop individual connections from using a large amount of memory, with the trade off that large computations may not be able to finish.

MAPLENET_ENGINE_JAVADATALIMIT: If you see mjava processes consuming large amounts of memory, adjusting this variable may help. In some circumstances (machines with a large amount of memory) the java virtual machine may use a large amount of memory instead of collection more quickly. This variable forces java to work within a smaller memory footprint.

Increase the number of allowed running engines

If the none of the suggestions above help, and you are seeing high load on the machine, then you may need to increase the number of licensed running engines. Before doing this, verify that during peak load times, you are seeing one running engine for each allowed running engine in your license. The easiest way to do this is to look at the MapleNet monitoring page. In the limiter section you should see three values, `maxRunningEngines`, `runningEngines` and `waitingEngines`. If `waitingEngines` is greater than 0, then MapleNet is running at or beyond its optimal capacity. You may need to increase your number of licensed engines to allow more engines to run in parallel. This only makes sense if you also have available CPU resources. MapleNet is designed to run with one core per running engine. Running MapleNet with more allowed running engines than CPU cores is not suggested, and will not increase performance.

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6.1 Client Side Software Copyright Statements

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- CLAPACK

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- CoolProp

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Bell, Ian H.; Wronski, Jorrit; Quoilin, Sylvain; and Lemort, Vincent. **Pure and Pseudo-pure Fluid Thermophysical Property Evaluation and the Open-Source Thermophysical Property Library CoolProp**. Industrial & Engineering Chemistry Research, Vol. **53** No. 6 (2014), pp. 2498--2508; <http://www.coolprop.org/>.

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- Cuba

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