MATLAB®
Web Server

The Language of Technical Computing

Computation

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Programming

The MATH WORKS Inc.

MATLAB Web Sever

Version 1

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MATLAB Web Server

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Preface

About this Book

This book describes the MATLAB® Web Server. The MATLAB Web Server lets you deploy MATLAB based applications over a network using standard Web technology.

Organization of the Document

Chapter	Description
Chapter 1	*"MATLAB on the Web"*. Provides basic information about how to develop MATLAB applications in a Web environment. Discusses how to install the MATLAB Web Server. Also describes how to obtain and install two related products: Virtual Network Computing (VNC) and Perl.
Chapter 2	*"Getting Started"*. Illustrates the creation of MATLAB Web applications with several demonstration programs, and provides templates to simplify the creation of user applications.
Chapter 3	*"Inside the MATLAB Web Server"*. Discusses the various components of the MATLAB Web Server and provides needed configuration information.
Chapter 4	*"Reference"*. Describes the functions used to create and manipulate MATLAB Web Server applications.
Appendix A	*"Directory Structure"*. Locations of installed files.
Appendix B	*"Troubleshooting Web Server"*. Solving problems and responding to error messages.
Appendix C	*"Selected Bibliography"*. Related documents available in print and on the Web.

Typographical Conventions

This manual uses some or all of these conventions.

Item	Convention to Use	Example
Example code	`Monospace font`	To assign the value 5 to `A`, enter `A = 5`
Function names/syntax	`Monospace font`	The `cos` function finds the cosine of each array element. Syntax line example is `MLGetVar ML_var_name`
Keys	**Boldface** with an initial capital letter	Press the **Return** key.
Literal string (in syntax descriptions in Reference chapters)	Use monospace bold for literals.	`f = freqspace(n,'whole')`
Mathematical expressions	Variables in *italics* Functions, operators, and constants in standard text.	This vector represents the polynomial $p = x^2 + 2x + 3$

MATLAB output	`Monospace font`	MATLAB responds with
		`A =`
		`5`

Menu names, menu items, and controls	**Boldface** with an initial capital letter	Choose the **File** menu.
New terms	*Italics*	An *array* is an ordered collection of information.
String variables (from a finite list)	*Monospace italics*	`sysc = d2c(sysd, 'method')`

Related Products

The MATLAB Web Server requires MATLAB Release 11 or later.

No other MathWorks-supplied software is required.

See “Product Requirements” on page 1-5 for additional requirements specific to Web-based software applications.

The MathWorks provides numerous products that can be used in conjunction with the MATLAB Web Server.

For more information about any of these products, see either:

- The online documentation for that product, if it is installed or if you are reading the documentation from the CD
- The MathWorks Web site, at `http://www.mathworks.com`; see the “products” section

Note The toolboxes listed below all include functions that extend MATLAB's capabilities.

Product	Description
Communications Toolbox	MATLAB functions for modeling the physical layer of communications systems
Control System Toolbox	Tool for modeling, analyzing, and designing control systems using classical and modern techniques
Data Acquisition Toolbox	MATLAB functions for direct access to live, measured data from MATLAB
Database Toolbox	Tool for connecting to, and interacting with, most ODBC/JDBC databases from within MATLAB

Product	Description
Datafeed Toolbox	MATLAB functions for integrating the numerical, computational, and graphical capabilities of MATLAB with financial data providers
Financial Derivatives Toolbox	Tool that extends the Financial Toolbox in the areas of fixed income derivatives and of securities contingent to interest rates, with functions for analyzing individual financial derivative instruments and portfolios composed of them
Financial Time Series Toolbox	Tool for analyzing time series data in the financial markets
Financial Toolbox	MATLAB functions for quantitative financial modeling and analytic prototyping
Image Processing Toolbox	Complete suite of digital image processing and analysis tools for MATLAB
LMI Control Toolbox	MATLAB functions for solving convex optimization problems in robust control design
Mapping Toolbox	Tool for analyzing and displaying geographically based information from within MATLAB
MATLAB	Integrated technical computing environment that combines numeric computation, advanced graphics and visualization, and a high-level programming language
MATLAB Compiler	Compiler for automatically converting MATLAB M-files to C and C++ code
MATLAB C/C++ Math Library	Library for automatically converting MATLAB applications that contain math and graphics to C and C++ code for stand-alone applications

Product	Description
MATLAB C/C++ Graphics Library	Library for automatically compiling MATLAB programs that contain graphics and graphical user interfaces (GUIs) into complete stand-alone applications
Optimization Toolbox	Tool for general and large-scale optimization of nonlinear problems, as well as for linear programming, quadratic programming, nonlinear least squares, and solving nonlinear equations
Robust Control Toolbox	Tool for advanced robust multivariable feedback control
Signal Processing Toolbox	Tool for algorithm development, signal and linear system analysis, and time-series data modeling
Stateflow Coder	Tool for generating highly readable, efficient C code from Stateflow diagrams
Statistics Toolbox	Tool for analyzing historical data, modeling systems, developing statistical algorithms, and learning and teaching statistics
Symbolic Math Toolbox	Tool for seamless integration of symbolic mathematics and variable precision arithmetic based on Maple V
System Identification Toolbox	Tool for building accurate, simplified models of complex systems from noisy time-series data
Wavelet Toolbox	Tool for signal and image analysis, compression, and de-noising

1

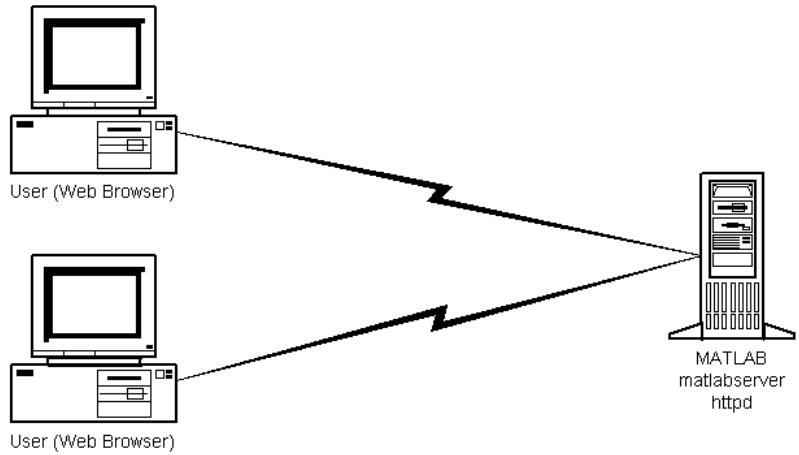
MATLAB on the Web

Introduction

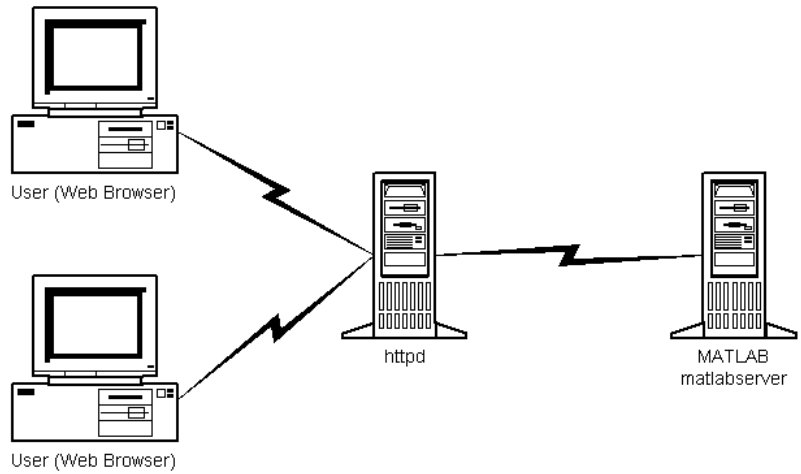
MATLAB Web Server Environment

The MATLAB® Web Server enables you to create MATLAB applications that use the capabilities of the World Wide Web to send data to MATLAB for computation and to display the results in a Web browser. The MATLAB Web Server depends upon TCP/IP networking for transmission of data between the client system and MATLAB. The required networking software and hardware must be installed on your system prior to using the MATLAB Web Server.

In the simplest configuration, a Web browser runs on your client workstation, while MATLAB, the MATLAB Web Server (`matlabserver`), and the Web server daemon (`httpd`) run on another machine.



In a more complex network, the Web server daemon can run on a machine apart from the others.



Building MATLAB Web Server Applications

MATLAB Web Server applications are a combination of M-files, Hypertext Markup Language (HTML), and graphics. Knowledge of MATLAB programming and basic HTML are the only requirements.

The application development process requires a small number of simple steps:

1. Create the HTML documents for collection of the input data from users and display of output. You can code the input documents using a text editor to input HTML directly, or you can use one of the commercially available HTML authoring systems, such as Front Page from Microsoft, PageMill from Adobe, or HoTMetaL from SoftQuad.

2. List the application name and associated configuration data in the configuration file `matweb.conf`. (See “matweb.conf” for a description of this file.)

3. Write a MATLAB M-file that:

a Receives the data entered in the HTML input form.

b Analyzes the data and generates any requested graphics.

c Places the output data into a MATLAB structure.

d Calls `htmlrep` to place the output data into an HTML output document template. (See `htmlrep` for a description of this process.) The maximum amount of HTML data you can receive from MATLAB is 256 KB.

Product Requirements

The MATLAB Web Server has the same supporting hardware and software requirements as MATLAB itself, except for memory required. MATLAB hardware and software requirements are documented in the *MATLAB Installation Guide* for your computer.

Memory requirements while running the MATLAB Web Server vary with the number of MATLABs configured. Each MATLAB running under the MATLAB Web Server consumes 256 KB of memory.

The MATLAB Web Server requires that TCP/IP networking software must be installed on your computer.

Consult the *Release Notes* for any last minute changes to hardware or software requirements.

Web Requirements

Web Browsers

To submit input to and receive output from the MATLAB Web Server, you must install a Web browser suitable for your platform. Current versions of the MATLAB Web Server have been tested with Netscape Communicator Release 4.7 and Microsoft Internet Explorer 5.0. Earlier browser releases will probably also work but have not been tested.

The MathWorks does not redistribute these products. You can obtain them directly from the companies that developed them. You can find additional information at `http://www.netscape.com` or `http://www.microsoft.com`.

Web Server

You need to install Web server software (HTTPD or similar) on the system where MATLAB is running or on a machine that has network access to the machine where MATLAB is running. There are numerous sources for obtaining this software, including:

- Pre-installed Microsoft Peer Networking Services on your PC
- Netscape Enterprise Server, available by purchase from Netscape Communications, Inc.
- Free distribution over the Internet (Apache: `http://www.apache.org`)

The Web server software must be capable of running Common Gateway Interface (CGI) programs.

Installation

Availability

The MATLAB Web Server is available on UNIX (Solaris) workstations and IBM PC compatible computers running Microsoft Windows NT or Linux.

Installation Procedure

To install the MATLAB Web Server, follow the normal MATLAB installation procedure for your platform, as documented in the *MATLAB Installation Guide for PC* and the *MATLAB Installation Guide for UNIX*. The MATLAB Web Server appears as one of the installation choices you can select as you proceed through the installation screens.

General Post-Installation Procedures

After installing MATLAB and the MATLAB Web Server, you must perform a number of steps that regulate communication between MATLAB and your Web browser. Check the *Release Notes* for any last minute information concerning installation of this release.

Note Throughout this document the notation `<matlab>` represents the MATLAB root directory, the directory where MATLAB is installed on your system. For notational consistency in UNIX command syntax, the notation `$MATLAB` is used to represent the MATLAB root directory.

Note in particular:

1. To get the demonstration programs discussed in this chapter to work, you need to create a `matweb.conf` file in the `<matlab>/toolbox/webserver/wsdemos` directory. The `Readme` file shows the format for `matweb.conf`. Replace the notation `<matlab>` with the name of the root directory where you installed MATLAB. Use the `matlabroot` command to determine this directory. Also, replace `matlabserver_host_name` with the TCP/IP hostname for your machine.

2 The installation procedure creates the file `matlabserver.conf` in the `<matlab>/webserver` directory. The file contains the notation

```
-m 1
```

This number represents the number of MATLABs that can run concurrently. After testing that everything is working properly, you can change this number to something more convenient. On Windows NT edit `matlabserver.conf` directly with a text editor.

Note To see any changes made to `matlabserver.conf`, you need to stop and restart the MATLAB Web Server. See the section "Understanding matlabserver" for more information on `matlabserver.conf`.

On Solaris/Linux use the `webconf` script to initialzie the `matlabserver.conf` file. Then edit this file to change options further, particularly those that `webconf` cannot set on the command line.

3 Follow the directions provided by your Web server (`httpd`) to create the needed aliases:

- **a** The home or default directory
- **b** `/cgi-bin`
- **c** `/icons`

Point each of these aliases to `<matlab>/toolbox/webserver/wsdemos` to get the demonstration programs to work.

If your application creates graphic (`jpeg`) files, you need to provide a location where MATLAB can write these for `httpd` access, e.g, `/icons`. The `mldir` entry associated with each application in the `matweb.conf` file indicates the location to MATLAB.

If you do not have permission to set up or change these aliases, you must place copies of some files in locations where the `httpd` can find them.

- Copy `matweb` (`matweb.exe` on Windows NT), found in `<matlab>/webserver/bin/`*arch*, to the directory aliased by `/cgi-bin` or

equivalent. The supported architectures are Windows NT (`win32`), Solaris (`sol2`), and Linux (`glnx86`).

- Copy `matweb.conf` in `<matlab>/toolbox/webserver/wsdemos` to the directory aliased by `/cgi-bin` or equivalent.
- Copy all demo HTML files in `<matlab>/toolbox/webserver/wsdemos` to the directory where the `httpd` keeps all HTML files (often referred to as the *home* or *default* alias).

Note that when aliases are different from those provided in the demo HTML files, you will have to make the corresponding changes in those HTML files.

Solaris/Linux Post-Installation Procedures

The MATLAB Web Server installation procedure places five scripts into the `<matlab>/webserver` directory:

- `webconf`: Builds `matlabserver` configuration file (`matlabserver.conf`). See Chapter 2 for a discussion of `matlabserver` and the `matlabserver.conf` file. Use this script to specify the number of simultaneous MATLABs to run, the non-default TCP/IP port, and other variables.
- `webstart`: Stops and restarts `matlabserver` via calls to `webdown` and `webboot`. These three scripts must all reside in the same directory.
- `webdown`: Stops running `matlabserver`.
- `webboot`: Starts `matlabserver`.
- `webstat`: Displays `matlabserver` status information.

Enter the command

```
script_name -h
```

at the command prompt to see detailed information about a specific script.

After completing the MATLAB and MATLAB Web Server installation process, run the `webconf` script to generate the `matlabserver.conf` file. Then run `webstart` to start `matlabserver`. Run `webdown` at any time to stop `matlabserver` execution.

Automatic Startup at System Boot

1 To start `matlabserver` automatically at system boot, create the following links and file while logged in as `root` (superuser):

```
ln -s $MATLAB/webserver/webboot /etc/webboot$WEBSERVER_MARKER
ln -s $MATLAB/webserver/webdown /etc/webdown$WEBSERVER_MARKER
```

`$WEBSERVER_MARKER` is a marker string that uniquely identifies this release of the MATLAB Web Server. It is defined in the `matlabserver.conf` file. (See "matlabserver.conf" on page 3-5.) The default is `_TMW$RELEASE`, where `$RELEASE` is a string like `'R12'`, also set in `matlabserver.conf`.

Note Add the `-c` configuration file option to `webboot` and `webdown` if the `matlabserver.conf` file is not in `<matlab>/webserver` or in the directory where the script is located. For example: `webboot -c $CONFIGURATION_FILE` `$CONFIGURATION_FILE` is the path to the file `matlabserver.conf`.

---

2 In the directory `$MATLAB/webserver` are two initialization scripts:

- `rc.web.sol2` (Solaris)
- `rc.web.glnx86` (Linux)

Solaris users should copy the script as shown below.

```
cp $MATLAB/webserver/rc.web.sol2 /etc/init.d/webserver
```

Linux users should copy the appropriate script as shown below.

`cp $MATLAB/webserver/rc.web.glnx86 /etc/init.d/webserver` (Debian)
`cp $MATLAB/webserver/rc.web.glnx86 /etc/rc.d/init.d/webserver` (Red Hat)

3 Open the copied file in a text editor and follow the directions for modifying the file. Save and close the file when you are done.

4 *Solaris* users should create a link in the `rc` directory associated with run level 3.

```
cd /etc/rc3.d; ln -s ../init.d/webserver S20webserver
```

Linux users should look in `/etc/inittab` for the default run level. Create a link in the `rc` directory associated with that run level. For example, if it is 5:

```
cd /etc/rc5.d; ln -s ../init.d/webserver S95weberver (Debian)
cd /etc/rc.d/rc5.d; ln -s init.d/webserver S95webserver (Red Hat)
```

5. You can test the changes you have made without rebooting your system. To start the MATLAB Web Server on *Solaris* enter:

```
cd /etc/init.d
./webserver start
```

On *Linux* enter:

```
cd /etc/init.d (Debian)
cd /etc/rc.d/init.d (Red Hat)
./webserver start
```

6. To check that the MATLAB Web Server is operational on any system, enter:

```
cd $MATLAB/webserver
webstat -c $CONFIGURATION_FILE
```

`$CONFIGURATION_FILE` is the path to the file `matlabserver.conf`.

Windows NT Post-Installation Procedures

After installation, you must reboot your machine to start **MATLAB Server** as a Windows NT service. The service starts automatically at system boot.

Startup Sequence

If you install a new version of MATLAB and the MATLAB Web Server, start MATLAB before starting Web Server. MATLAB performs some system updates required for successful Web Server operation.

Deinstallation

To remove **MATLAB Server** from the Windows NT Registry, open a command prompt (MS-DOS) window. Enter the command sequence

```
cd <matlab>/webserver/bin/win32
matlabserver -remove
```

Graphics Display

We recommend that Solaris/Linux users use Virtual Network Computing (VNC) for their X display. VNC can be used even on systems where there is no hardware frame buffer. It is easy to use, can be easily started with the boot scripts, provides complete user control, and has good performance. For information about use of the VNC software with the MATLAB Web Server, see:

- "Downloading and Installing VNC" on page 1-13.
- "Starting and Stopping VNC" on page 1-14.
- "Using VNC with the MATLAB Web Server" on page 1-15.

The VNC software requires installation of Perl. Both VNC and Perl are available in binary form over the Web for free distribution

Linux users should find Perl already installed on their systems. Solaris users need to download the Perl distribution and decompress it with the `zcat` version of the `gunzip` utility. This utility is found in `$MATLAB/webserver/bin/sol2/zcat`. *Solaris* users should read "Downloading and Installing Perl" on page 1-14 for directions.

Downloading and Installing VNC

The VNC software is available at the Web site

```
http://www.uk.research.att.com/vnc/download.html
```

Select the latest distribution for either or both of the UNIX platforms

Linux 2.x for x86 (for glnx86)

Solaris 2.5 (SPARC) (for Solaris2; it should work on 2.6 and higher)

and download the software. To decompress run

```
zcat file | tar -xvf -
```

where *file* is either a `.tgz` file on glnx86 or a `.Z` file on Solaris.

The *file* directory created contains a `README` file that discusses how to install the sofware. The directory contains four files:

```
vncviewer
vncserver
vncpasswd
Xvnc
```

that should be copied to a standard directory on your UNIX path.

Downloading and Installing Perl

The Perl software is available at the Web site `http://www.activestate.com`.

Under **Products** select **ActivePerl**; then select **Download Now** next to the **ActivePerl** description on the **Products** page.

There are two formats for Solaris, one using Solaris packages and the other using the generic installer. Select **Solaris 2.6 - AS Package** to use the generic installer.

Download the distribution to a temporary directory, extract the files, change directory to the `ActivePerl` directory, and run the `install.sh` script.

```
$MATLAB/webserver/bin/sol2/zcat ActivePerlxxx.tar.gz | tar -xvf -
cd ActivePerlxxx
./install.sh
```

The installation script will ask for the installation directory.

Starting and Stopping VNC

Before starting VNC be sure the `vncserver` Perl script has the correct path to the Perl executable at the top of the script. Fix the path if it is incorrect. The default script makes reasonable assumptions about the geometry and color requirements of your virtual X display. If you need to change the assumptions, you can specify different geometry and color requirements on the command line or edit the `vncserver` script. See the `README` file with the VNC distribution for additional details or the online documentation at the Web site. Type

```
vncserver -help
```

for information about arguments to the script.

The first time you run the `vncserver`, you will be prompted for a password. This password controls access to the VNC viewer, which is not used with the Web Server.

You do not have to specify a display number when starting the VNC server, but it is best to specify one to prevent any potential conflict with the main X display, which is normally 0.

Starting VNC

To start the VNC server, enter

```
vncserver :number
```

where `number` is something other than 0. 1 is a good value. Set the `DISPLAY` variable to `:<number>` in your configuration file or use `'-display :<number>'` when starting the Web Server via the `webstart` or `webboot` script.

If your Web Server application requires MATLAB to render better color than the default, set the `depth` argument when you start the VNC server:

```
vncserver :<number> -depth <depth>
```

where <*depth*> is either 16 or 24.

Stopping VNC

To stop the VNC server, enter

```
vncserver -kill :number
```

where number is the same as that used to start the server.

After stopping the VNC server, it takes about 30 seconds for the socket to time out and clear, so wait a while after stopping the server before restarting it.

Using VNC with the MATLAB Web Server

Use the same value for `display` with the MATLAB Web Server that you used when starting the VNC server.

For example, suppose you want to start the Web Server by passing the display on the command line. Here is some sample output from such a command.

```
webstart -display :1
[webstart]:Calling webdown to take down MATLAB Web Server . . .
  No server to take down . . .
[webstart]:Calling webboot to start MATLAB Web Server . . .
  Waiting for MATLAB Web Server to come up . . .
     Type your interrupt character (usually CTRL-C) to quit.
```

```
Time = 10 secs : still waiting for 1 of 2 MATLAB sessions . . .
Time = 20 secs : still waiting for 1 of 2 MATLAB sessions . . .
Time = 30 secs : still waiting for 1 of 2 MATLAB sessions . . .
ALL MATLAB sessions started, but . . .
Time = 10 secs : Web Server startup still not complete . . .
Time = 20 secs : Web Server startup still not complete . . .
MATLAB Web Server is up . . .
```

The display can also be indicated in the `matlabserver.conf` file.

Getting Started

Introduction

The process of creating a MATLAB Web Server application involves the creation of:

- An HTML input document for data submission to MATLAB. See “Creating Input Documents” on page 2-4.
- An HTML output document for display of MATLAB's computations. See “Creating Output Documents” on page 2-10.
- A MATLAB M-file to process input data and compute results. See “Creating MATLAB Web Server M-Files” on page 2-7.
- A test file to validate code before distributing the application over the Web. See “Debugging Your Application” on page 2-13.

The process of creating a MATLAB Web Server application can be simplified through the use of a set of templates that has been provided. These are discussed in “Templates” on page 2-2.

Templates

Four templates found in the directory `<matlab>/toolbox/webserver/wsdemos` simplify the process of creating a MATLAB Web Server application:

- `input_template.html`
- `output_template.html`
- `mfile_template.m`
- `tmfile_template.m`

Each template provides actual code that you need to incorporate into your application plus instructions on how to modify the template where necessary. If you follow the directions in these templates, you should be able to create MATLAB Web Server applications with reasonable effort.

Additionally provided in `<matlab>/toolbox/webserver/wsdemos` is `webmagic`, a magic squares demonstration program. A magic square produces the same sum along any row, column, or either of the two main matrix diagonals. There are four files associated with `webmagic`:

- `webmagic1.html`: the `webmagic` input document

- `webmagic2.html`: the `webmagic` output document
- `webmagic.m`: the `webmagic` MATLAB M-file
- `twebmagic.m`: the `webmagic` stand-alone test file

To learn how the four templates were modified to create the `webmagic` application, we will examine templates and note the specific changes applied.

- If you want to look at some other applications created with these templates, see the section “Additional Application Examples”.

Creating Input Documents

Input Template

The file input_template.html provides the code needed to create a MATLAB Web Server input document. An abbreviated version looks like:

```
<!-- STEP 1
Choose either the NT version or the Unix version of the form
tag (depending on which platform the matweb client program
will be run):
-->
<!-- NT version: -->
<form action="/cgi-bin/matweb.exe" method="POST">
<!-- Unix version: -->
<form action="/cgi-bin/matweb" method="POST">

<!-- STEP 2
Create a hidden field naming your M-file. Replace MY_M_FILE
with the name of main MATLAB function of your application.(An
HTML input field of type "hidden" is commonly used to pass
variables to a web server. It is not displayed by the
browser.)
-->
<input type="hidden" name="mlmfile" value="my_m_file">

<!-- STEP 3
Add all your other HTML form tags here. Replace
MY_INPUT_VARIABLE_1 with the name of an input variable in
your application.
-->
<p>My input variable 1: <input type="text"
name="my_input_variable_1">
<!--
Create additional input variables here.
-->

<!-- STEP 4
Create a "submit" input tag for the user to click to send
the input to your program.
-->
```

```
<p><input type="submit" name="Submit" value="Submit"></p>

<!-- STEP 5
Add the name of your main application function to the file
matweb.conf. See the matweb.conf file in the wsdemos
directory and the documentation.)
-->
```

webmagic Input

Examine the significant part of the source for `webmagic1.html`:

```
<form action="/cgi-bin/matweb.exe" method="POST">
    <input type="hidden" name="mlmfile" value="webmagic">
    <p>Magic square size (minimum is 3, maximum is 20):
    <input type="text" size="2" maxlength="2"
name="msize"></p>
    <p><input type="submit" name="Submit" value="Submit"></
p>
</form>
```

The line

```
<form action="/cgi-bin/matweb.exe" method="POST">
```

calls `matweb`, the entry point to the MATLAB Web Server. `matweb.exe` is the Microsoft Windows NT name of the program used by the MATLAB Web Server to extract data from HTML forms. On Solaris/Linux this program is called just `matweb`. We refer to the program as `matweb` throughout this document except when the platform distinction is important. `matweb` is described more thoroughly in the next chapter.

The next line

```
<input type="hidden" name="mlmfile" value="webmagic">
```

provides the name of the MATLAB M-file (`mlmfile`) to run. In this application the M-file is named `webmagic`.

Lastly, the input

```
<input type="text" size="2" maxlength="2" name="msize"></p>
```

passes to `webmagic.m` a two-character field named `msize`, which contains the size of the magic square to compute.

To display the input document and run the magic squares demonstration locally on your computer, start your Web browser and set the URL to `http://<your_domain>/webmagic1.html`.

The magic squares input document, `webmagic1.html`, is displayed in your browser.

Enter the size of the magic square matrix you want to compute and press **Submit**.

Creating MATLAB Web Server M-Files

M-File Template

You use the M-file template to code your MATLAB application as you normally do. The template provides the additional code you need to accept input from your HTML input document and to return results to your HTML output document. An abbreviated version looks like:

```
function retstr = mfile_template(instruct, outfile)
% STEP 1
% Initialize the return string.
retstr = char('');

% STEP 2
% Set working directory.
% The variables INSTRUCT.MLDIR and INSTRUCT.MLID are
provided
% automatically to all MATLAB Web Server applications that
use
% the matweb program.
cd(instruct.mldir);

% STEP 3
% Get the HTML form input variables
my_input_variable_1 = instruct.my_input_variable_1;

% STEP 4
% Perform your MATLAB computations, graphics file creations,
% etc. here:

% STEP 5
% Put variables that you want to put into your HTML output
document in an output structure.  You create an HTML output
document from OUTPUT_TEMPLATE.HTML.
outstruct.my_output_variable_1 = More MATLAB computations
creating ...
   scalars, matrices, cell arrays, graphics files, etc.;

% STEP 6
% Call the function HTMLREP with the output structure you
just
```

```
% created and the filename you created from
OUTPUT_TEMPLATE.HTML.
% Replace <OUTPUT_TEMPLATE.HTML> with the name of the HTML
output
% file you created using OUTPUT_TEMPLATE.HTML.
% This call fills the string RETSTR to return and optionally
% writes the output as a file if a valid filename is given
as the
% second argument to the present function.
templatefile = which('<OUTPUT_TEMPLATE.HTML>');
if (nargin == 1)
   retstr = htmlrep(outstruct, templatefile);
elseif (nargin == 2)
   retstr = htmlrep(outstruct, templatefile, outfile);
end
```

webmagic M-File

The data entered on the `webmagic1.html` input document is automatically passed to MATLAB, which then runs the `webmagic` function. Notations in **boldface** refer to steps in the M-file template.

```
% Initialize the return string. (Step 1)
retstr = char('');
```

(Step 2. *Not needed. No generated graphics.***)**

```
% Get the msize (string) variable. Convert to a number. (Step
3)
% Check the range.
if(~length(instruct.msize))
   msize = 3; % Default empty field.
else
   msize = str2double(instruct.msize);
   if (msize > 20), msize = 20; end % Max size.
   if (msize < 3), msize = 3; end % Min square.
end
```

```
% Save size as a char string in structure OUTSTRUCT. (Step
4, 5)
outstruct.msize = msize;
```

```
% Create magic square in output structure OUTSTRUCT.
outstruct.msquare = magic(msize);

% Get column, row, and diagonal sum.  Put in OUTSTRUCT.
d = sum(outstruct.msquare,1);
outstruct.msum = d(1,1);

% Output the results and optionally write as a file if the
% filename was given as the second argument to WEBMAGIC.
```
(Step 6)
```
templatefile = which('webmagic2.html');
if (nargin == 1)
   retstr = htmlrep(outstruct, templatefile);
elseif (nargin == 2)
   retstr = htmlrep(outstruct, templatefile, outfile);
end
```

Creating Output Documents

Output Template

The file output_template.html provides the code needed to create a MATLAB Web Server output document. An abbreviated version looks like:

```
<!--
Modify this file to create your own HTML output document
and save it as <MY_OUTPUT>.html, where <MY_OUTPUT> is
replaced
by a name that has meaning within the context of your
application.
-->

<!-- STEP 1
Display a MATLAB scalar or character string. Replace
<MY_OUTPUT_VARIABLE_1> in the following line with the name
of the MATLAB variable you want to display. Change the other
text to something meaningful within the context of your
application.
-->
My output variable 1 has been computed to be:
$<my_output_variable_1>$

<!-- STEP 2
Put all your other HTML tags here.
-->
```

webmagic Output

The webmagic output document contains three variables:

$msquare$ -- the completed magic square

$msize$ -- the size of the magic square

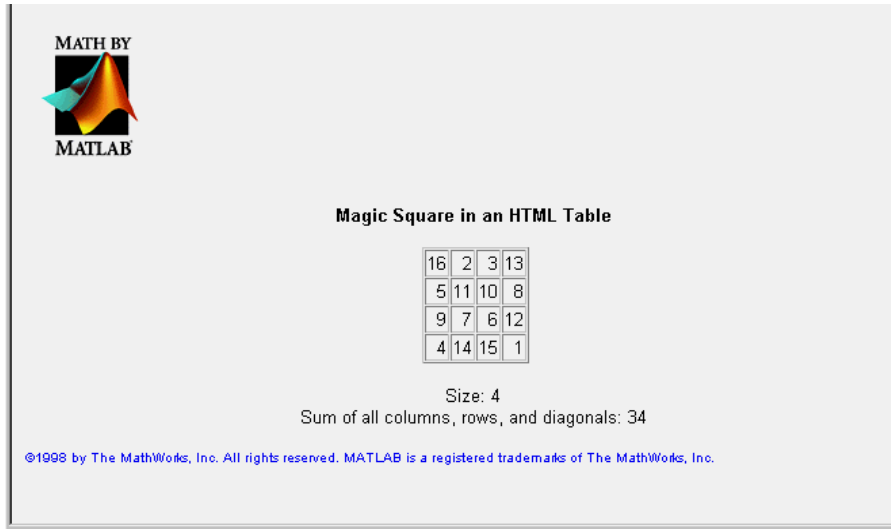
$msum$ -- the magic square sum along its rows, columns, or diagonals

Using htmlrep the webmagic function replaces these variables with actual values, using the input obtained from webmagic1.html.

The source for the webmagic2.html template document looks like:

```
<!--
HTML output template used by webmagic.m in call to the
function HTMLREP. (HTMLREP replaces variable names delinated
by dollar signs, e.g. $msquare$, with their values. It also
generates HTML tables and select lists dynamically from
matrics,
cell arrays, and vectors.)
-->

<html>
<head>
<title>Magic Square in an HTML Table</title>
</head>
<div align="center">
<strong>Magic Square in an HTML Table</strong></p>

<!--
Use the MATLAB "AUTOGENERATE" HTML attribute to generate a
table dynamically from the variable "msquare" which is a
matrix (in program webmagic.m).
-->

<table border="1" cellspacing="1" autogenerate="$msquare$">
    <tr>
        <td align="right">
   </td>
    </tr>
</table>

<!--
Replace $msize$ and $msum$ with the contents of MATLAB
variables
named "msize" and "msum" respectively as computed in
webmagic.m.
-->

<p>
Size: $msize$<br>
Sum of all columns, rows, and diagonals: $msum$
</div>
```

When displayed in a browser, `webmagic2.html` looks like



Debugging Your Application

Debugging Procedure

You can use the MATLAB debugging facility plus your Web browser to debug your application before making it available to all users.

An effective method of debugging is to write your application M-file to accept two arguments, as in

```
retstr = webmagic(structure, testfile)
```

You can use the second argument to create an HTML file that displays test output.

As a first debugging step, create a driver program that sets up the input variables and calls the main function. You can use the MATLAB debugging facilities to check the logic of your test program. The file `twebmagic.m` located in `<matlab>/toolbox/webserver/wsdemos` is an example of such a driver program. (Note the use of the `wssetfield` function to create the test input variables. This is optional. Elements of the structure `s` could be created directly, e.g., `s.msize = '5'`.)

```
function twebmagic()
%TWEBMAGIC Example standalone test of webmagic function.
%TWEBMAGIC Does setup and calls webmagic. Creates the output
file, %twebmagic.html.

% Set up input variables.
s = {};
s = wssetfield(s, 'mlmfile', 'webmagic');
s = wssetfield(s, 'msize', '5');
s = wssetfield(s, 'mldir', '.');

% Create an output test file.
str = webmagic(s, 'twebmagic.html');
```

Because the driver program calls `webmagic` with two arguments, `webmagic` writes its output to the file `twebmagic.html`. The call to `htmlrep` within the `webmagic` function handles this.

```
retstr = htmlrep(outstruct,'webmagic2.html', outfile)
```

outfile in this case is twebmagic.html, the second argument passed to webmagic.

The second step in debugging is to use your Web browser to examine your test file (outfile) and make appropriate changes until the output is displayed as you intend.

Debugging Template

To assist you in debugging, we have provided the template tmfile_template.m, shown below in abbreviated form:

```
function tmfile_template()

% STEP 1
% Set up input variables as they would come in from
% the HTML input form created from INPUT_TEMPLATE.HTML.
outstruct.my_input_variable_1 = some appropriate test value;

% STEP 2
% Call your application function that was created from
% <MFILE_TEMPLATE.M>. Replace <MFILE_TEMPLATE> with the
% name of your application M-file. Provide a test output
% file name for the optional argument by replacing
% <TEST_OUTPUT.HTML> with your test output HTML file name.
retstr = <MFILE_TEMPLATE>(outstruct, '<TEST_OUTPUT.HTML>');

% STEP 3
% Examine the file you supplied for <TEST_OUTPUT.HTML> in
your
% web browser.
```

Additional Application Examples

The easiest way to learn how to create MATLAB applications that send and receive data over the Web is to analyze the sample programs included with your MATLAB Web Server distribution. To access these sample programs, open the file `<matlab>/toolbox/webserver/wsdemos/index.html` in your browser. By analyzing the code used to create these examples, you can expand upon them to create more complex MATLAB Web Server applications.

Data Display

The `players` demonstration function illustrates a basic use of the MATLAB Web Server to display data over the Web. The file `players.txt` contains a data base with information about The MathWorks' softball team:

PLAYER	POSITION	AVERAGE	AT BATS
Ron Berg	First Base	.337	30
John Theytaz	Second Base	.294	22
Charles Carmody	Third Base	.261	34
Debby Oldman	Shortstop	.287	29
Jack Pirrotta	Right Field	.256	27
Josh Tillson	Center Field	.301	31
Eugene Goldbrick	Left Field	.281	31
Donna Navillus	Pitcher	.222	32
Anna Alman	Catcher	.290	30

`players` uses a few MATLAB commands to read the tab-delimited file, convert the data to an HTML file, and display the output in a Web browser. No input form is needed for this application, only a URL. The URL can be entered directly in your browser or as a live link in another page. The URL for the `players` example is

`http://<your_domain>/cgi-bin/matweb.exe?mlmfile=players&`
on Windows NT. (On Solaris/Linux use `matweb` instead of `matweb.exe`.)

The output looks like

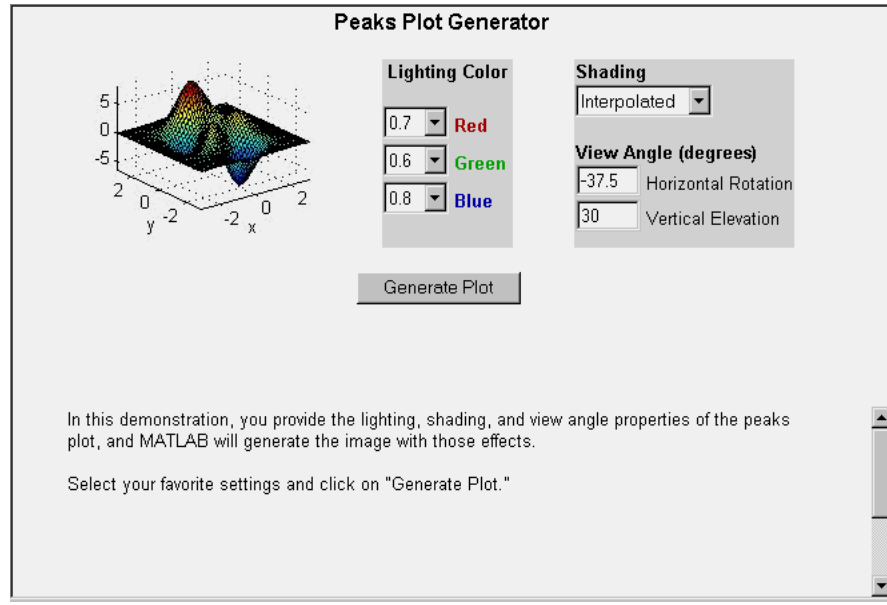
Ron Berg	First Base	.337	30
John Theytaz	Second Base	.294	22
Anna Alman	Catcher	.290	30
Debby Oldman	Shortstop	.287	29
Eugene Goldbrick	Left Field	.281	31
Charles Carmody	Third Base	.261	34
Jack Pirrotta	Right Field	.256	27
Donna Navillus	Pitcher	.242	32
Josh Tillson	Center Field	.221	31

If you would like to experiment on your own with a similar simple application, use `players` as a model to create an M-file that reads your own text file, e.g., `myfile.txt`, and places data into a MATLAB structure. To display the result in your Web browser, use the above URL, changing the value of the `mlmfile` argument to the name of your new M-file. Also, copy the entry for `players` in `matweb.conf` and change the name of the application within the brackets `[]` to the one you have chosen.

MATLAB Graphics

The `webpeaks` function, included as a demonstration program, creates a `peaks` plot and returns the output to your Web browser. In examining portions of the `webpeaks` code, you will see how to include MATLAB graphics as part of a MATLAB Web Server application.

To start the `webpeaks` demonstration, set the URL in your browser to `http://<your_domain>/webpeaks1.html`, the `webpeaks` input document.



This input document allows you to set the characteristics of the peaks plot you want to generate. This is a more complex input document than the one we used with `webmagic`, as it makes use of HTML frames. The code in the source file

```
<form action="/cgi-bin/matweb.exe" method="POST"
target="outputwindow">
   <input type="hidden" name="mlmfile" value="webpeaks">
```

calls the `webpeaks` function and targets the output to a frame on the lower portion of the input document itself.

In addition to the code necessary to compute and display the peaks function, the file `webpeaks.m` contains additional code specific to the transmission of graphics data across the Web. In `webpeaks.m` the code

```
   mlid = getfield(h,'mlid')
```

extracts `mlid` from the structure `h`.

`mlid` is a unique identifier that `matlabserver` provides. Using the value of `mlid` to construct filenames ensures that filenames are unique. It can

also be used to maintain contexts among the different connections in an application.You can see this in the code

```
s.GraphFileName = sprintf('%speaks.jpeg',mlid)
```

which creates a name for a `jpeg` file. If `mlid` has the value `ml00277`, for example, the `jpeg` file will be named `ml00277peaks.jpeg`.

The function `htmlrep` replaces MATLAB variable names it finds in the HTML output template file `webpeaks2.html` with the values in the input structure `s`:

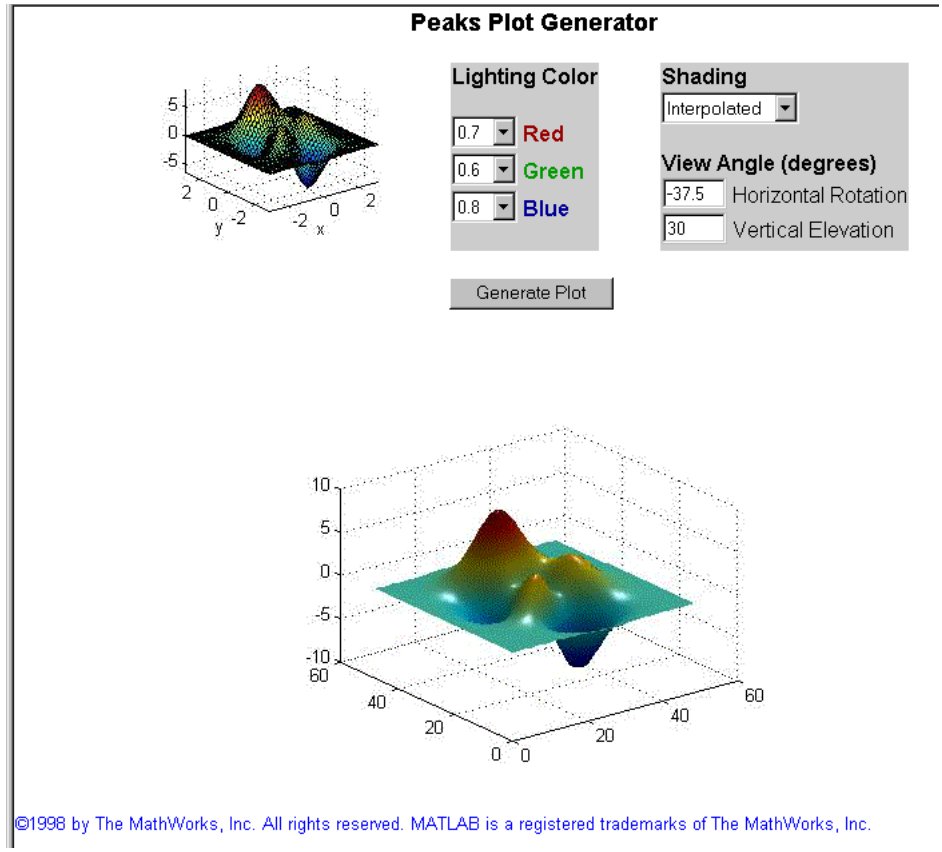
```
rs = htmlrep(s,'webpeaks2.html')
```

`$GraphFileName$`, the variable that represents the graphic output, is found in the line

```
<img border=0 src="$GraphFileName$">
```

in `webpeaks2.html`.

The final output document shows both the input and output frames.



Note: When the input form contains a "clickable" image created by an `<input>` tag of the form `<type = "image" name = "mymap">`, the variable names for the `x` and `y` coordinates are normally passed to the program as `mymap.x` and `mymap.y`. The MATLAB Web Server converts these to `mymap_x` and `mymap_y`. For example, the input `<input type = image src = "mymap.jpeg" name = "mymap">` results in storing the `x` and `y` coordinates `mymap_x` and `mymap_y` in the structure passed to your program.

Stock Price Simulation

Now that you are familiar with the use and operation of the MATLAB Web Server, look at `webstock`, a program that uses MATLAB to simulate possible stock price scenarios based on user assumptions about estimated return and price volatility.

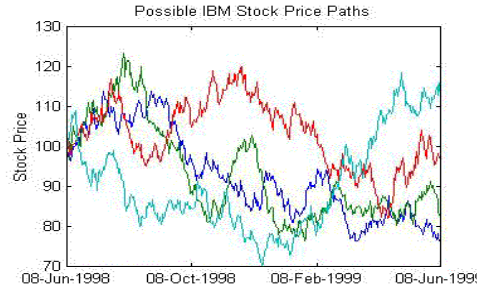
Simulation of Future Stock Prices

This is a Monte-Carlo simulation of the price of a stock over the next year. Input today's price, the expected rate of return, and the volatility of the stock. You can plot a number of possible price scenarios at once.

The prices are generated by sampling a lognormal stock price process. See, for example, N. Chriss "Black-Scholes and Beyond", Irwin, 1997. The lognormal stock price model is used in finance to value stock options.

Stock symbol: IBM
Current Stock Price: 100
Annualized Expected Return (percent): 10
Annualized Volatility (percent): 30
Number of Simulated Paths: 4

Submit



Set your browser to `http://<your_domain>/webstock1.html` to begin the simulation. When you are finished, examine the source of the input (`webstock1.html`) and output (`webstock2.html`) documents, the MATLAB M-file (`webstockrnd.m`), and the stand-alone test M-file `twebstockrnd.m`.

3

Inside the MATLAB Web Server

MATLAB Web Server Components

The MATLAB Web Server consists of a set of programs that enable MATLAB programmers to create MATLAB applications and access them on the Web:

- `matlabserver`: Manages the communication between the Web application and MATLAB.

  `matlabserver` is a multithreaded TCP/IP server. It runs the MATLAB program (M-file) specified in a hidden field named `mlmfile` contained in the HTML document. `matlabserver` invokes `matweb.m` , which in turn runs the M-file.

  `matlabserver` can be configured to listen on any legal TCP/IP port by editing the `matlabserver.conf` file on Windows NT or running `webconf` on Solaris/ Linux. The number of simultaneous MATLABs is specified here.
- `matweb`: A TCP/IP client of `matlabserver`. This program uses the Common Gateway Interface (CGI) to extract data from HTML documents and transfer it to `matlabserver`.
- `matweb.m`: Calls the M-file that you want the Web application to run.

Two configuration files are used in conjunction with the MATLAB Web Server programs:

- `matweb.conf`: A configuration file that `matweb` needs for connecting to `matlabserver`. Applications must be listed in `matweb.conf`.
- `hosts.conf`: An optional file providing additional security. If `hosts.conf` is present, only listed machines can connect to the MATLAB Web Server. Machines are listed by name in a single column, e.g.,

  ```
  parrot.mathworks.com
  bluebird.mathworks.com
  ```

  Machines must be listed by name, not by IP number. The operating system resolves the name into a valid IP address.

Figure 3-1, MATLAB on the Web, is diagram showing how MATLAB operates over the Web.

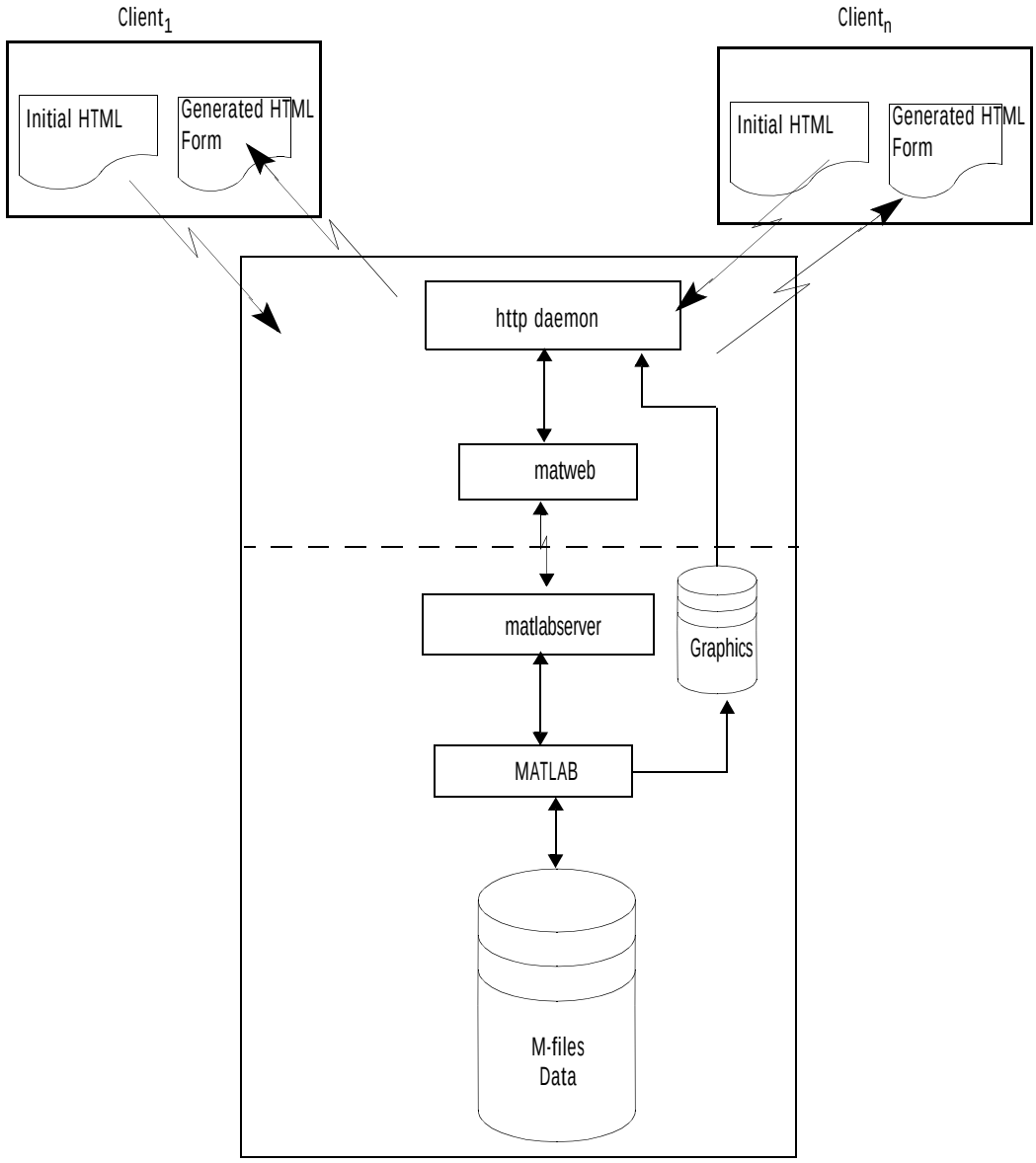


Figure 3-1: MATLAB on the Web

File Locations

Any M-files used in conjunction with a Web application, including `matweb.m`, must appear on the MATLAB path. The `matweb` and `matweb.conf` files must appear under a `/cgi-bin` alias. Any generated graphics must be located where the Web Server can find them and programs can write them.

Understanding matlabserver

`matlabserver` is designed to run continuously in the background as a Windows NT service or as a background process on other systems. (Administrator privileges are normally required to install `matlabserver`.) For testing you can turn on terminal logging by entering the command `matlabserver -t` at a Windows NT command prompt (`webstart -t` on Solaris and Linux) when starting `matlabserver`. (See "General Troubleshooting" on page B-2.)

- To learn about how the `matlabserver.conf` file controls `matlabserver`, see "matlabserver.conf" on page 3-5.
- To learn about the `matweb` program and additional files and programs that run in conjunction with `matlabserver`, see "Using matlabserver" on page 3-6.
- To learn how the MATLAB Web Server returns output, see "Returning Results via the Web" on page 3-9.

matlabserver.conf

When `matlabserver` starts up, it looks in the file `matlabserver.conf` for its initial setting data. On Windows NT the installation procedure creates this file in the `<matlab>/webserver` directory while installing the MATLAB Web Server. On other systems you must first run the `webconf` script to establish values for some of the arguments in the file before starting the MATLAB Web Server.

Configuration settings must appear on the first line of the `matlabserver.conf` file. The basic options set by the data in `matlabserver.conf` are:

- Port number
- Threads (maximum number of simultaneous MATLABs)
- Display: Specifies the display. (Solaris)
- Release: Specifies the release number. (Solaris/Linux)

The default version of `matlabserver.conf` file is simply

```
-m 1
```

meaning that you want to run one copy of MATLAB with the `matlabserver` port defaulted to `8888`.

Changing Initial Data

Edit `matlabserver.conf` on Windows NT. On Solaris/Linux run the `webconf` script to initialize the `matlabserver.conf` file. Edit this file if you want to change options further, particularly those that `webconf` cannot set on the command line. To see any changes you have made to `matlabserver.conf`, you need to stop and restart the MATLAB Web Server.

Table 3-1: matlabserver Basic Options

Option	Meaning
`-p [n]`	Port that `matlabserver` listens on. `8888` is the default.
`-m [n]`	MATLABs to run. Default is `1`.
`DISPLAY =`	Specifies where the output is displayed. (Solaris/Linux) Use `-nodisplay` if there is no graphical output.
`WEBSERVER_MARKER`	Extension for file naming. (Solaris/Linux). Default is: `WEBSERVER_MARKER = _TMW$RELEASE` `RELEASE` is determined from the `$MATLAB/.VERSION` file. For example, for Release 12, `RELEASE` is `R12`.

Type `matlabserver -h` on Windows NT (`webconf -h` on Solaris/Linux) for a list of additional editable `matlabserver.conf` options.

If `matlabserver` cannot locate a `matlabserver.conf file`, it uses the defaults.

Using matlabserver

When we viewed the source of the `webmagic1.html` file, we observed the line of HTML code

```
<FORM ACTION="/cgi-bin/matweb.exe" METHOD="POST">
```

and we noted that this line establishes communication with MATLAB. `matweb` is a program that resides on the HTTP server and communicates with

matlabserver. matweb requires information found in matweb.conf to locate matlabserver (which could be running on a different machine).

matweb Program

matweb is a client of matlabserver that uses Common Gateway Interface (CGI) to get data from HTML forms. It transfers the information to matlabserver, which then runs applications written in M-files to produce responses.

When the MATLAB Web Server is installed, matweb is placed in <matlab>/webserver/bin/*arch* for all architectures. This placement allows you to run matweb on a machine having the HTTPD but not having MATLAB installed and being of a different architecture from the server.

For HTTP server access you must also place a copy of matweb in the directory denoted by the /cgi-bin alias. The installation process places a copy in <matlab>/toolbox/webserver/wsdemos to run the sample applications.

matweb.conf

To connect with matlabserver, matweb requires information stored in the configuration file matweb.conf. Create this file inside the directory denoted by /cgi-bin, along with the matweb program. Use the copy in <matlab>/toolbox/webserver/wsdemos as a guide.

An instance of matweb.conf looks like:

```
[webmagic]
mlserver=parrot

[webpeaks]
mlserver=parrot
mldir=/matlab/toolbox/websever/wsdemos
```

Multiple application configurations must appear in the same file. Each variable appears on a separate line followed by an equal sign =, which is then followed by a value, e.g., mlserver=parrot. Applications are delineated by the main application entry point name (M-file) in square brackets []. For example, [webpeaks] is on one line followed by all its variables and corresponding values. Note that webmagic does not require an mldir entry because it does not generate any graphics or save any files. Use the % or # character at the beginning of any line to comment it out.

All the fields that can be contained in `matweb.conf` are described in Table 3-2.

Table 3-2: matweb.conf Fields

Variable	Description	Sample Value
`[application]` (required)	Name of the MATLAB application to run	`webmagic`
`mldir` (optional)	Working directory for reading or writing files. If specified, this directory is automatically added to the MATLAB path.	`<matlab>/toolbox/webserver/wsdemos`
`mllog` (optional)	Produces an application-specific log file that records all exchanges between the application and MATLAB. Turn off logging when the program is running because logging has a negative impact on performance.	`<matlab>/toolbox/webserver/wsdemos/webmagic.log`
`mlserver` (required)	Name of host running `matlabserver`	`parrot`
`mlport` (optional)	Port that `matlabserver` listens on. This value must correspond to the port number set in the `matlabserver.conf` file or on the command line (the `p` argument).	`8888` (default)
`mltimeout` (optional)	Seconds to wait for `matlabserver` before timing out	`180` (default)
`my_var`	User-created configuration variable	*value*

After you create a new MATLAB Web Server application and enter its configuration data into `matweb.conf`, you need to restart `matlabserver` before you can use the application.

matweb M-File

Looking again at the source from the `webmagic1.html` file (see “webmagic Input” on page 2-5), observe that the line

```
<input type="hidden" name="mlmfile" value="webmagic">
```

sets argument `mlmfile` to the value `webmagic`. The `mlmfile` argument contains the name of the MATLAB M-file to run.

`matlabserver` uses the value of `mlmfile` obtained from the `matweb` M-file, `matweb.m`, (`webmagic` in this example) to run the MATLAB application. `webmagic` takes the input data from `webmagic1.html`, computes the magic square of the requested dimensions, and outputs the results using `webmagic2.html` as a template.

Returning Results via the Web

The MATLAB Web Server distribution kit contains the file `webmagic2.html`, which serves as an example of an HTML output document template. The `webmagic` function uses the `htmlrep` command to place the computed values into the `webmagic2.html` output template using the code:

```
str = htmlrep(s,'webmagic2.html');
```

In this example `s` is a MATLAB structure containing the results of the `webmagic` magic squares computation. `htmlrep` extracts data from `s` and replaces variable fields in `webmagic2.html` with the results of MATLAB computation. The completed `webmagic2.html` form is transmitted to the user's browser.

4

Reference

Function Summary

This chapter provides detailed descriptions of the functions in the MATLAB Web Server.

Function	Purpose
`htmlrep`	Replace variable names with values in HTML document.
`matweb`	MATLAB Web Server main entry point.
`wscleanup`	Purge stale files from directory.
`wsprintjpeg`	Create JPEG file.
`wssetfield`	Add new field or append to existing field.

Alphabetical List of Functions

htmlrep

Purpose

Substitute values for variable names in HTML document

Syntax

```
outstring = htmlrep(instruct,infile)
outstring = htmlrep(instruct,infile,outfile)
outstring = htmlrep(instruct,infile,outfile,attributes)
```

Description

`htmlrep(instruct,infile)` replaces all MATLAB variables in `infile`, an HTML document, with corresponding values of variables of the same name in `instruct`. Variables can be character strings, matrices, or cell arrays containing strings and scalars. String and scalar variables are replaced by straight substitution. Output is returned in `outstring`. Variable names in `infile` must be enclosed in dollar signs, e.g., `$varname$`.

`outstring = htmlrep(instruct,infile,outfile)` additionally writes output to the HTML document `outfile` (for stand-alone testing).

`instruct` is a MATLAB structure containing variable names (field names) and corresponding values.

`infile` is an HTML template file with MATLAB variable names enclosed in dollar signs.

`outfile` is the name of an output file for optional standalone testing.

`outstring = htmlrep(instruct,infile,outfile,attributes)` provides additional directives to `htmlrep`. The third argument in this form of the command must be present for the *attributes* argument to be recognized. Use an empty string `''` for the third argument if you do not want to direct output to a file. The *attributes* argument is a MATLAB string (enclosed in `''`) with the listed attributes separated by spaces.

Two attributes are allowed:

`noheader` Suppresses the output of the HTML header `'Content-type: text/html\n\n'` to `outfile` and `outstring`.

`extendmemory` Enables dynamic memory extension beyond 256KB.

Note The extendmemory attribute is designed only for use with htmlrep independently of the MATLAB Web Server. Using it with the MATLAB Web Server will cause unpredictable results with output larger than 256KB.

HTML tables and select lists can be generated dynamically from matrices or cell arrays containing strings and scalars.

1. Tables can be generated using the special MATLAB AUTOGENERATE HTML table attribute with the matrix or cell array name as the value. For example, the following code automatically generates all the HTML needed to display the the entire matrix, msquare, in an HTML table.

```
<TABLE BORDER="1" CELLSPACING="1" AUTOGENERATE="$msquare$">
   <TR>
       <TD ALIGN="RIGHT">
       </TD>
   </TR>
</TABLE>
```

At least one of each of the tags listed above is required.

htmlrep uses the HTML code from the <TABLE> tag to the </TABLE> tag as a template for generating the entire table. If different column attributes are required, additional pairs of cell tags (<TD> and </TD>) can be included up to the number of columns in the matrix or cell array. For example, adding these tags

```
<TD ALIGN="CENTER">
</TD>
```

after the </TD> tag above causes the second column to be center-justified.

If there are more columns in the matrix or cell array than <TD> </TD> pairs, the last pair is used for all subsequent columns.

2. SELECT lists are generated using the special MATLAB AUTOGENERATE HTML SELECT attribute with the vector, matrix or cell array name as the value. For example, the following code automatically generates all the HTML needed to display the the entire vector, mylist, in an HTML SELECT list. (SELECT lists must appear inside HTML <FORM> and </FORM> tags.)

```
<SELECT NAME="NAMELIST" SIZE=10 AUTOGENERATE=$mylist$ MULTIPLE>
<OPTION SIZE=6>
</SELECT>
```

`htmlrep` uses the HTML code from the `<SELECT>` tag to the `</SELECT>` tag as a template for generating the entire `SELECT` list. One of each of the tags shown above is required.

If `mylist` is a matrix or cell array, `htmlrep` uses only the the first column vector to construct the select list.

Purpose

MATLAB Web Server main entry point

Syntax

```
matweb(instruct)
```

Description

`matweb` is an M-file that in turn calls a MATLAB application M-file stored in the `mlmfile` field of MATLAB structure `instruct`. It also passes `instruct` to the application. The `matweb` function (M-file) is invoked by `matlabserver`. `instruct` contains the fields:

- All the data from the HTML input document
- `mlmfile`, which stores the name of the M-file to call
- `mldir`, the working directory specified in `matweb.conf`
- `mlid`, the unique identifier for creating filenames and maintaining contexts

If a MATLAB warning or error is encountered, the text is captured and returned to the user's browser. You can disable error and warning notification if you want.

See Also

`eval`, `lasterr`, `lastwarn`, `warning`

wscleanup

Purpose

Purge stale files from directory

Syntax

```
deletecount = wscleanup(filespec,timewindow,direc)
deletecount = wscleanup(filespec,timewindow)
```

Description

`deletecount = wscleanup(filespec,timewindow,direc)` deletes all files matching `filespec` in the directory `direc` that are older than the number of hours specified in `timewindow`. `deletecount` is the number of files actually deleted.

`deletecount = wscleanup(filespec,timewindow)` deletes all files matching `filespec` in the current default directory that are older than the number of hours specified in `timewindow`. `deletecount` is the number of files actually deleted.

Purpose

Create JPEG file

Syntax

```
status = wsprintjpeg(fig, jpegfilename)
```

Description

`status = wsprintjpeg(fig, jpegfilename)` creates a JPEG file called `jpegfilename`. `wsprintjpeg` attempts to create the JPEG file using the MATLAB `print` command with the `-djpeg` argument. If this fails, it creates a temporary PCX file and then calls `imread` and `imwrite` to create the JPEG output.

See Also

`imread`, `imwrite`, `print`

wssetfield

Purpose

Add new field or append to existing field

Syntax

```
s = wssetfield(s,name1,value1,...)
```

Description

`s = wssetfield(s,name1,value1,...)` sets the contents of the field `name1` to `value1` and returns the result in the changed structure `s`. A single value is stored as a character array. Items with multiple values have the values stored in a cell array of strings. Multiple calls serve to add values to an existing field.

Either use the MATLAB `getfield` function to retrieve the values or reference the structure fields directly.

See Also

`getfield`

A

Directory Structure

MATLAB is distributed in compressed format on CD. The installation procedure moves the files to your hard disk, decompresses them, and installs them into your MATLAB root directory. The installation provides a version of the CGI client program `matweb` for all platforms, regardless of which platform `matlabserver` is licensed for. This allows your `matweb` client to run on a different machine and platform from your copy of `matlabserver`. The supported platforms are:

- PC running Windows NT (`win32`)
- Sun workstation running Solaris (`sol2`)
- PC running Linux (`glnx86`)

In the directory structure shown below, replace the pathname component *arch* with the appropriate identifier for your platform.

After installation of the MATLAB Web Server, your MATLAB directory should include these additional files and subdirectories.

Table A-1: <matlab>/webserver

File	Purpose
`matlabsever.conf`	`matlabserver` options
`webboot`	Start `matlabserver` script
`webconf`	`matlabserver` configuration file script
`webdown`	Stop `matlabserver` script
`webstart`	`matlabserver` restart script
`webstat`	Report `matlabserver` status

Note If you create a `hosts.conf` file to control which machines can access the MATLAB Web Server, you must place that file in this directory.

Table A-2: <matlab>/webserver/bin/*arch*

File	Purpose
`matlabserver`	The MATLAB Web Server binary
`matlabserver.exe`	The MATLAB Web Server binary (Windows NT)
`matweb`	MATLAB TCP/IP client of `matlabserver` (Solaris and Linux)
`matweb.exe`	MATLAB TCP/IP client of `matlabserver` (Windows NT)

You must also place a copy of the appropriate `matweb` executable and `matweb.conf` into the `/cgi-bin` aliased subdirectory of the HTTP server root directory.

Table A-3: <matlab>/toolbox/webserver/webserver

File	Purpose
`htmlrep.mexsol` (Solaris) `htmlrep.mexglx` (Linux) `htmlrep.dll` (Windows NT)	Replace variable names with values in HTML document
`matweb.m`	Web Server main entry point
`wscleanup.m`	Purge stale files from directory
`wsprintjpeg`	Create JPEG file
`wssetfield.m`	Add new field or append to existing field

Table A-4: <matlab>/toolbox/webserver/wsdemos

File	Purpose
dummy.html	Temporary HTML document in bottom frame of webpeaks1.html
index.html	List of demos
input_template.html	HTML input template
matweb.conf	Sample matweb.conf file
mfile_template.m	M-file creation template
output_template.html	HTML output template
peaksplot.html	HTML document (input form) in top frame of webpeaks1.html
players.html	Softball players HTML output form
players.m	Softball statistics file
players.txt	Softball text data file
tplayers.m	Stand-alone test driver for players
tmfile_template.m	Test file template
thtmlrep.m	Test of htmlrep function
thtmlrep1.html	HTML input form
webmagic.m	Convert magic square into HTML table
webmagic1.html	Magic square input form
webmagic2.html	Magic square output template
twebmagic.m	Example stand-alone test of webmagic function
webpeaks.m	Web peaks plot

Table A-4: <matlab>/toolbox/webserver/wsdemos (Continued)

File	Purpose
webpeaks1.html	HTML frame
webpeaks2.html	peaks plot output form
webstock.html	Stock price simulation input form
webstock1.html	Stock price simulation main frame
webstock2.html	Stock price simulation output template
webstockrnd.m	Stock future price path simulation
webstocktemp.html	HTML output place holder
twebstockrnd.m	Stand-alone test driver for webstockrnd
wstextread.m	Place a delimited file into a cell array of strings

B

Troubleshooting Web Server

This section provides three categories of troubleshooting information:

- General Troubleshooting
- Additional Troubleshooting for Windows NT
- Additional Troubleshooting for Solaris and Linux

General Troubleshooting

This information is relevant to all operating systems that support the MATLAB Web Server.

Event and Error Logging

The MATLAB Web Server provides a logging facility that may be useful in diagnosing operational problems. This facility supplements capabilities such as the Windows NT Event Viewer provided by the operating system. Logs may record all events or error events only.

Logging can be controlled using various logging options. Logging options may be set in the `matlabserver.conf` file or specified on the command line. Any option you specify on the command line overrides the value found in `matlabserver.conf`.

Use the `matlabserver` command on Windows NT and the `webconf` and `webstart` scripts on Solaris and Linux to set these options.

Table B-1: matlabserver Logging Options

Option	Purpose
`-f [`*`log_filename`*`]`	Event log file. Required when logging to a file. File content determined by –v setting. (File logging is inefficient. Use when debugging only.)
`-l [`*`errorlog_filename`*`]`	(Solaris and Linux only). Error log file. Default is `matlabserver_error.log` in current directory. On Windows NT use the Event Viewer to see a list of error events.

Table B-1: matlabserver Logging Options (Continued)

`-t`	Terminal logging. The logging level is set to `2` (transaction and buffer logging). (If you use this option with the `matlabserver` command on Windows NT, it must precede all other options on the command line.)
`-v [n]`	Verbosity. Controls file logging. Default is `0` (no logging). Additional values are `1` (transaction logging) and `2` (transaction and buffer logging).

Application-Specific Log File Not Produced

If present, the `mllog` variable in `matweb.conf` (see "matweb.conf" on page 3-7) creates an application-specific log file. This file is not a MATLAB file; it is controlled by the operating system. If this file is not produced, check that the slashes in the pathname of your file are in the correct orientation for the operating system you are using.

Network bind Error (Port in Use)

If `matlabserver` fails to start because of a `bind` error, as noted in `matlabserver_error.log` or in the **Event Viewer** on Windows NT, the port you are attempting to run `matlabserver` on is busy. To fix this problem, you need to change the port number that matlabserver listens on. See the section "matlabserver.conf" on page 3-5 for a discussion on how to change the port number. You may need to ask your system administrator to provide you with a valid unused port number.

M-File Programming Considerations

Make certain that each line of your M-file application is terminated with a `;` character. Otherwise, the HTML output will be corrupted.

Connect() failure Error

There are two probable reasons why you may receive a `Error: connect() failure` message:

1 `matlabserver` is not running.

   On Solaris or Linux run the `webstat` script. On Windows NT click the **Start** button, open the **Control Panel**, and choose **Services**. The status of `MATLAB Server` should be `Started`.

2 Port mismatch between `matlabserver.conf` and `matweb.conf`.

   The default TCP/IP port that `matlabserver` listens on is set at `8888`. You may change this setting in the `matlabserver.conf` file with the `-p` option. The port setting for each application configuration in the `matweb.conf` file must agree with the port setting in `matlabserver.conf`. (See "Table 3-2: matweb.conf Fields".) If you have changed the port setting in `matlabserver.conf`, you must similarly change the port setting in `matweb.conf` using the `mlport` option. If `mlport` is not explicitly set, the default of `8888` is assumed.

Locating matweb.conf

In some network configurations it is not possible to give programmers access to the `/cgi-bin` directory of the HTTP server. In such cases a `matweb.conf` file should be created with only one entry, containing the actual location of a configuration file that programmers can edit. This entry must appear inside angle brackets `< >`. An example of this type of `matweb.conf` file is:

```
</apps/projects/strategy/matweb.conf>
```

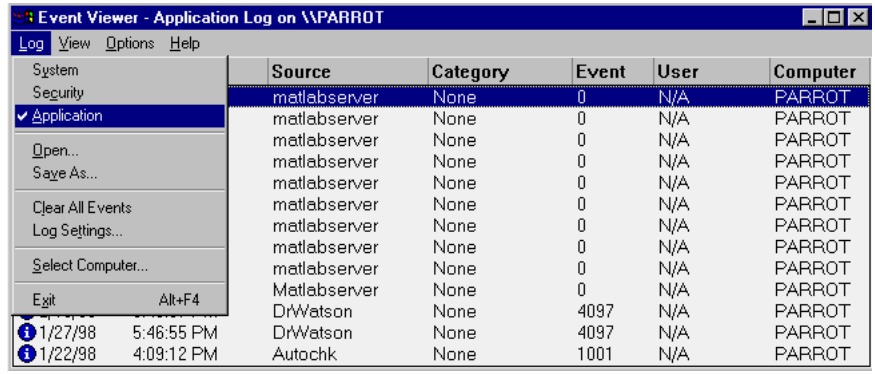
where `/apps/projects/strategy/matweb.conf` is a valid accessible file.

Additional Troubleshooting for Windows NT

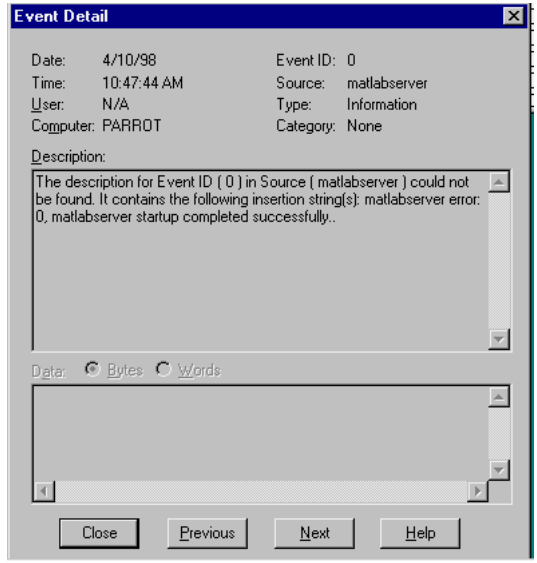
Using the Windows NT Event Viewer

The Windows NT Event Viewer captures data that can be useful for debugging `matlabserver` operations even if you have not requested `matlabserver` logging through the command options. To access the Event Viewer, choose **Start ->Programs ->Administrative Tools ->Event Viewer**. When the Event

Viewer appears, click on **Log** on the menu bar and choose **Application** from the pulldown menu.



Double-click on a `matlabserver` entry to receive additional detail that may be useful in determining the cause of a `matlabserver` problem.



Startup Sequence

If you install a new version of MATLAB and the MATLAB Web Server, you need to start MATLAB before starting Web Server. MATLAB performs some system updates required for successful Web Server operation.

Additional Troubleshooting for Solaris and Linux

Error Logging

For error logging information, look in `matlabserver_error.log` in `<matlab>/webserver` or in the file specified with the `-l` option in the `matlabserver.conf` file.

Creating New Applications

After you create a new MATLAB Web Server application and enter its configuration data into `matweb.conf`, you will need to restart `matlabserver` before you can use the application.

C

Selected Bibliography

Numerous books have been published about HTML programming and the World Wide Web. Two that we have found both useful and readable are:

Gundavaram, Shishir, *CGI Programing on the World Wide Web*, Sebastopol, CA, O'Reilly & Associates, Inc., 1996.

Musciano, Chuck and Bill Kennedy, *HTML The Definitive Guide*, Sebastopol, CA, O'Reilly & Associates, Inc., 1996.

On the Web, the World Wide Web Consortium (W3C) publishes comprehensive information about current and future directions of the Web and the HTML language. You will find their home page at `http://www.w3.org`. Look at `http://www.w3.org/MarkUp` for a comprehensive discussion of HTML.

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