3

DOWNLOADING WEB PAGES

The most important thing a webbot does is move web pages from the Internet to your computer. Once the web page is on your computer, your webbot can parse and manipulate it.

This chapter will show you how to write simple PHP scripts that download web pages. More importantly, you'll learn PHP's limitations and how to overcome them with *PHP/CURL*, a special binding of the cURL library that facilitates many advanced network features. cURL is used widely by many computer languages as a means to access network files with a number of protocols and options.

NOTE *While web pages are the most common targets for webbots and spiders, the Web is not the only source of information for your webbots. Later chapters will explore methods for extracting data from newsgroups, email, and FTP servers, as well.*

Prior to discovering PHP, I wrote webbots in a variety of languages, including Visual Basic, Java, and Tcl/Tk. But due to its simple syntax, in-depth string parsing capabilities, networking functions, and portability, PHP proved ideal for webbot development. However, PHP is primarily a server language, and its chief purpose is to help webservers interpret incoming requests and send the appropriate web pages in response. Since webbots don't serve pages (they request them), this book supplements PHP built-in functions with PHP/CURL and a variety of libraries, developed specifically to help you learn to write webbots and spiders.

Think About Files, Not Web Pages

To most people, the Web appears as a collection of web pages. But in reality, the Web is collection of files that form those web pages. These files may exist on servers anywhere in the world, and they only create web pages when they are viewed together. Because browsers simplify the process of downloading and rendering the individual files that make up web pages, you need to know the nuts and bolts of how web pages are put together before you write your first webbot.

When your browser requests a file, as shown in Figure 3-1, the webserver that fields the request sends your browser a *default* or *index file*, which maps the location of all the files that the web page needs and tells how to render the text and images that comprise that web page.

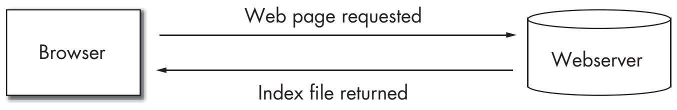


Figure 3-1: When a browser requests a web page, it first receives an index file.

As a rule, this index file also contains references to the other files required to render the complete web page,[1] as shown in Figure 3-2. These may include images, JavaScript, style sheets, or complex media files like Flash, QuickTime, or Windows Media files. The browser downloads each file separately, as it is referenced by the index file.

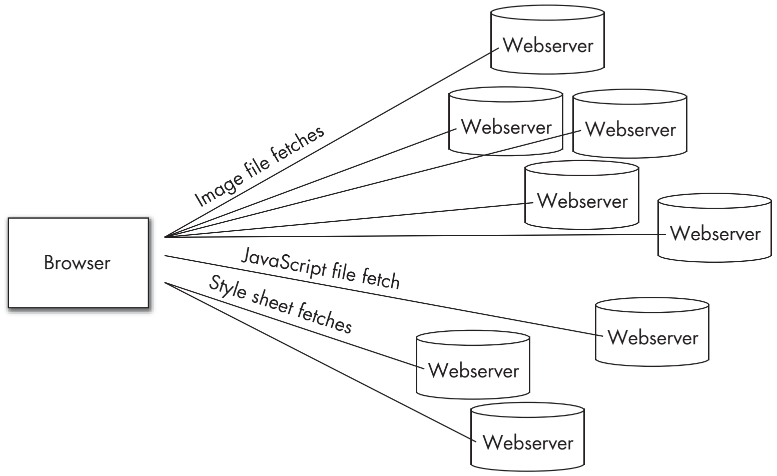


Figure 3-2: Downloading files, as they are referenced by the index file

[1] Some very simple websites consist of only one file.

For example, if you request a web page with references to eight items your single web page actually executes nine separate file downloads (one for the web page and one for each file referenced by the web page). Usually, each file resides on the same server, but they could just as easily exist on separate domains, as shown in Figure 3-2.

Downloading Files with PHP's Built-in Functions

Before you can appreciate PHP/CURL, you'll need to familiarize yourself with PHP's built-in functions for downloading files from the Internet.

Downloading Files with fopen() and fgets()

PHP includes two simple built-in functions for downloading files from a network—`fopen()` and `fgets()`. The `fopen()` function does two things. First, it creates a *network socket*, which represents the link between your webbot and the network resource you want to retrieve. Second, it implements the HTTP *protocol*, which defines how data is transferred. With those tasks completed, `fgets()` leverages the networking ability of your computer's operating system to pull the file from the Internet.

Creating Your First Webbot Script

Let's use PHP's built-in functions to create your first webbot, which downloads a "Hello, world!" web page from this book's companion website. The short script is shown in Listing 3-1.

```
# Define the file you want to download
$target      = "http://www.schrenk.com/nostarch/webbots/hello_world.html";
$file_handle = fopen($target, "r");

# Fetch the file
while (!feof($file_handle))
    echo fgets($file_handle, 4096);
fclose($file_handle);
```

Listing 3-1: Downloading a file from the Web with `fopen()` and `fgets()`

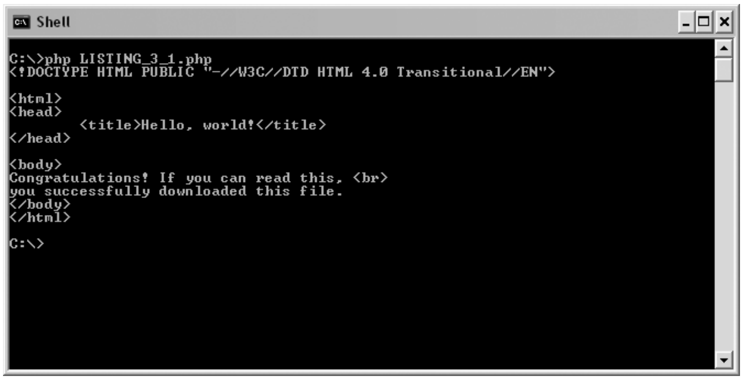
As shown in Listing 3-1, `fopen()` establishes a network connection to the *target*, or file you want to download. It references this connection with a *file handle*, or network link called `$file_handle`. The script then uses `fopen()` to fetch and echo the file in 4,096-byte chunks until it has downloaded and displayed the entire file. Finally, the script executes an `fclose()` to tell PHP that it's finished with the network handle.

Before we can execute the example in Listing 3-1, we need to examine the two ways to execute a webbot: You can run a webbot either in a browser or in a command shell.[2]

[2] See Chapter 23 for more information on executing webbots as scheduled events.

Executing Webbots in Command Shells

If you have a choice, it is usually better to execute webbots from a shell or command line. Webbots generally don't care about web page formatting, so they will display exactly what is returned from a webserver. Browsers, in contrast, will interpret HTML tags as instructions for rendering the web page. For example, Figure 3-3 shows what Listing 3-1 looks like when executed in a shell.



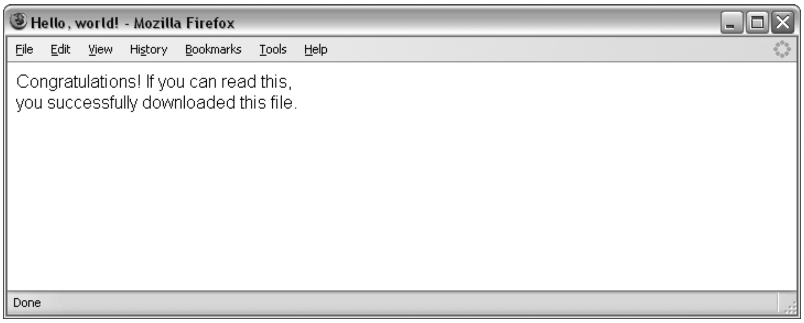
```
C:\>php LISTING_3_1.php
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.0 Transitional//EN">

<html>
<head>
        <title>Hello, world!</title>
</head>

<body>
Congratulations! If you can read this, <br>
you successfully downloaded this file.
</body>
</html>

C:\>
```

Figure 3-3: Running a webbot script in a shell

Executing Webbots in Browsers

To run a webbot script in a browser, simply load the script on a webserver and execute it by loading its URL into the browser's location bar as you would any other web page. Contrast Figure 3-3 with Figure 3-4, where the same script is run within a browser. The HTML tags are gone, as well as all of the structure of the returned file; the only things displayed are two lines of text. Running a webbot in a browser only shows a partial picture and often hides important information that a webbot needs.

NOTE *To display HTML tags within a browser, surround the output with* `<xmp>` *and* `</xmp>` *tags.*


Hello, world! - Mozilla Firefox
File Edit View History Bookmarks Tools Help
Done

Congratulations! If you can read this,
you successfully downloaded this file.

Figure 3-4: Browser "rendering" the output of a webbot

Browser buffering is another complication you might run into if you try to execute a webbot in a browser. Buffering is useful when you're viewing web pages because it allows a browser to wait until it has collected enough of a web page before it starts *rendering* or displaying the web page. However, browser buffering is troublesome for webbots because they frequently run for extended periods of time—much longer than it would take to download a typical web page. During prolonged webbot execution, status messages written by the webbot may not be displayed by the browser while it is buffering the display.

I have one webbot that runs continuously; in fact, it once ran for seven months before stopping during a power outage. This webbot could never run effectively in a browser because browsers are designed to render web pages with files of finite length. Browsers assume short download periods and may buffer an entire web page before displaying anything—therefore, never displaying the output of your webbot.

NOTE *Browsers can still be very useful for creating interfaces that set up or control the actions of a webbot. They can also be useful for displaying the results of a webbot's work.*

Downloading Files with file()

An alternative to `fopen()` and `fgets()` is the function `file()`, which downloads formatted files and places them into an array. This function differs from `fopen()` in two important ways: One way is that, unlike `fopen()`, it does not require you to create a file handle, because it creates all the network preparations for you. The other difference is that it returns the downloaded file as an array, with each line of the downloaded file in a separate array element. The script in Listing 3-2 downloads the same web page used in Listing 3-1, but it uses the `file()` command.

```
<?
// Download the target file
$target = "http://www.schrenk.com/nostarch/webbots/hello_world.html";
$downloaded_page_array = file($target);

// Echo contents of file
for($xx=0; $xx<count($downloaded_page_array); $xx++)
      echo $downloaded_page_array[$xx];
?>
```

Listing 3-2: Downloading files with `file()`

The `file()` function is particularly useful for downloading *comma-separated value (CSV) files*, in which each line of text represents a row of data with columnar formatting (as in an Excel spreadsheet). Loading files line-by-line into an array, however, is not particularly useful when downloading HTML files because the data in a web page is not defined by rows or columns; in a CSV file, however, rows and columns have specific meaning.

Introducing PHP/CURL

While PHP is capable when it comes to simple file downloads, most real-life applications require additional functionality to handle advanced issues such as form submission, authentication, redirection, and so on. These functions are difficult to facilitate with PHP's built-in functions alone. Therefore, most of this book's examples use PHP/CURL to download files.

The open source cURL project is the product of Swedish developer Daniel Stenberg and a team of developers. The cURL library is available for use with nearly any computer language you can think of. When cURL is used with PHP, it's known as PHP/CURL.

The name *cURL* is either a blend of the words *client* and *URL* or an acronym for the words *client URL Request Library*—you decide. cURL does everything that PHP's built-in networking functions do and a lot more. Appendix A expands on cURL's features, but here's a quick overview of the things PHP/CURL can do for you, a webbot developer.

Multiple Transfer Protocols

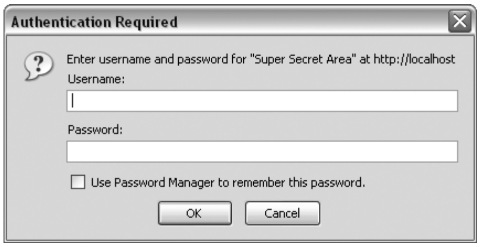
Unlike the built-in PHP network functions, cURL supports multiple transfer protocols, including FTP, FTPS, HTTP, HTTPS, Gopher, Telnet, and LDAP. Of these protocols, the most important is probably HTTPS, which allows webbots to download from encrypted websites that employ the Secure Sockets Layer (SSL) protocol.

Form Submission

cURL provides easy ways for a webbot to emulate browser form submission to a server. cURL supports all of the standard *methods*, or form submission protocols, as you'll learn in Chapter 5.

Basic Authentication

cURL allows webbots to enter password-protected websites that use basic authentication. You've encountered authentication if you've seen this familiar gray box, shown in Figure 3-5, asking for your username and password. PHP/CURL makes it easy to write webbots that enter and use password-protected websites.



Enter username and password for "Super Secret Area" at http://localhost

Figure 3-5: A basic authentication prompt

Cookies

Without cURL, it is difficult for webbots to read and write *cookies*, those small bits of data that websites use to create session variables that track your movement. Websites also use cookies to manage shopping carts and authenticate users. cURL makes it easy for your webbot to interpret the cookies that webservers send it; it also simplifies the process of showing webservers all the cookies your webbot has written. Chapters 21 and 22 have much more to say on the subject of webbots and cookies.

Redirection

Redirection occurs when a web browser looks for a file in one place, but the server tells it that the file has moved and that it should download it from another location. For example, the website www.company.com may use redirection to force browsers to go to www.company.com/spring_sale when a seasonal promotion is in place. Browsers handle redirections automatically, and cURL allows webbots to have the same functionality.

Agent Name Spoofing

Every time a webserver receives a file request, it stores the requesting agent's name in a log file called an *access log file*. This log file stores the time of access, the IP address of the requester, and the *agent name*, which identifies the type of program that requested the file. Generally, agent names identify the browser that the web surfer was using to view the website.

Some agent names that a server log file may record are shown in Listing 3-3. The first four names are browsers; the last is the Google spider.

```
Mozilla/5.0 (Windows; U; Windows NT 5.1; rv:1.7.6) Gecko/20050225 Firefox/1.0.1
Mozilla/4.0 (compatible; MSIE 5.0; Windows 2000) Opera 6.03 [en]
Mozilla/5.0 (compatible; Konqueror/3.1-rc3; i686 Linux; 20020515)
Mozilla/4.0 (compatible; MSIE 7.0b; Windows NT 5.1)
Googlebot/2.1 (+http://www.google.com/bot.html)
```

Listing 3-3: Agent names as seen in a file access log

A webbot using cURL can assume any appropriate (or inappropriate) agent name. For example, sometimes it is advantageous to identify your webbots, as Google does. Other times, it is better to make your webbot look like a browser. If you write webbots that use the `LIB_http` library (described later), your webbot's agent name will be *Test Webbot*. If you download a file from a webserver with PHP's `fopen()` or `file()` functions, your agent name will be the version of PHP installed on your computer.

Referer Management

cURL allows webbot developers to change the *referer*, which is the reference that servers use to detect which link the web surfer clicked. Sometimes webservers use the referer to verify that file requests are coming from the correct place. For example, a website might enforce a rule that prevents downloading of images unless the referring web page is also on the same webserver. This prohibits people from *bandwidth stealing*, or writing web pages using images on someone else's server. cURL allows a webbot to set the referer to an arbitrary value.

Socket Management

cURL also gives webbots the ability to recognize when a webserver isn't going to respond to a file request. This ability is vital because, without it, your webbot might hang (forever) waiting for a server response that will never happen. With cURL, you can specify how long a webbot will wait for a response from a server before it gives up and moves on.

Installing PHP/CURL

Since PHP/CURL is tightly integrated with PHP, installation should be unnecessary, or at worst, easy. You probably already have PHP/CURL on your computer; you just need to enable it in php.ini, the PHP configuration file. If you're using Linux, FreeBSD, OS X, or another Unix-based operating system, you may have to recompile your copy of Apache/PHP to enjoy the benefits of PHP/CURL. Installing PHP/CURL is similar to installing any other PHP library. If you need help, you should reference the PHP website (http://www.php.net) for the instructions for your particular operating system and PHP version.

LIB_http

Since PHP/CURL is very flexible and has many configurations, it is often handy to use it within a *wrapper function*, which simplifies the complexities of a code library into something easier to understand. For your convenience, this book uses a library called `LIB_http`, which provides wrapper functions to the PHP/CURL features you'll use most. The remainder of this chapter describes the basic functions of the `LIB_http` library.

`LIB_http` is a collection of PHP/CURL routines that simplify downloading files. It contains defaults and abstractions that facilitate downloading files, managing cookies, and completing online forms. The name of the library refers to the HTTP protocol used by the library. Some of the reasons for using this library will not be evident until we cover its more advanced features. Even simple file downloads, however, are made easier and more robust with `LIB_http` because of PHP/CURL. The most recent version of `LIB_http` is available at this book's website.

Familiarizing Yourself with the Default Values

To simplify its use, `LIB_http` sets a series of default conditions for you, as described below:

- Your webbot's agent name is *Test Webbot*.
- Your webbot will time out if a file transfer doesn't complete within 25 seconds.
- Your webbot will store cookies in the file c:\cookie.txt.
- Your webbot will automatically follow a maximum of four redirections, as directed by servers in HTTP headers.
- Your webbot will, if asked, tell the remote server that you do not have a local authentication certificate. (This is only important if you access a website employing SSL encryption, which is used to protect confidential information on e-commerce websites.)

These defaults are set at the beginning of the file. Feel free to change any of these settings to meet your specific needs.

Using LIB_http

The `LIB_http` library provides a set of wrapper functions that simplify complicated PHP/CURL interfaces. Each of these interfaces calls a common routine, `http()`, which performs the specified task, using the values passed to it by the wrapper interfaces. All functions in `LIB_http` share a similar format: A target and referring URL are passed, and an array is returned, containing the contents of the requested file, transfer status, and error conditions.

While `LIB_http` has many functions, we'll restrict our discussion to simply fetching files from the Internet using HTTP. The remaining features are described as needed throughout the book.

http_get()

The function `http_get()` downloads files with the `GET` method; it has many advantages over PHP's built-in functions for downloading files from the Internet. Not only is the interface simple, but this function offers all the previously described advantages of using PHP/CURL. The script in Listing 3-4 shows how files are downloaded with `http_get()`.

```
# Usage: http_get()
array http_get (string target_url, string referring_url)
```

Listing 3-4: Using `http_get()`

These are the inputs for the script in Listing 3-4:

target_url is the fully formed URL of the desired file

referring_url is the fully formed URL of the referer

These are the outputs for the script in Listing 3-4:

$array['FILE'] contains the contents of the requested file

$array['STATUS'] contains status information regarding the file transfer

$array['ERROR'] contains a textual description of any errors

http_get_withheader()

When a web agent requests a file from the Web, the server returns the file contents, as discussed in the previous section, along with the *HTTP header*, which describes various properties related to a web page. Browsers and webbots rely on the HTTP header to determine what to do with the contents of the downloaded file.

The data that is included in the HTTP header varies from application to application, but it may define cookies, the size of the downloaded file, redirections, encryption details, or authentication directives. Since the information in the HTTP header is critical to properly using a network file, `LIB_http` configures cURL to automatically handle the more common header directives. Listing 3-5 shows how this function is used.

```
# Usage: http_get_withheader()
array http_get_withheader (string target_url, string referring_url)
```

Listing 3-5: Using `http_get()`

These are the inputs for the script in Listing 3-5:

target_url is the fully formed URL of the desired file

referring_url is the fully formed URL of the referer

These are the outputs for the script in Listing 3-5:

$array['FILE'] contains the contents of the requested file, including the HTTP header

$array['STATUS'] contains status information about the file transfer

$array['ERROR'] contains a textual description of any errors

The example in Listing 3-6 uses the `http_get_withheader()` function to download a file and display the contents of the returned array.

```
# Include http library
include("LIB_http.php");
```

```
# Define the target and referer web pages
$target = "http://www.schrenk.com/publications.php";
$ref    = "http://www.schrenk.com";

# Request the header
$return_array = http_get_withheader($target, $ref);

# Display the header
echo "FILE CONTENTS \n";
var_dump($return_array['FILE']);

echo "ERRORS \n";
var_dump($return_array['ERROR']);

echo "STATUS \n";
var_dump($return_array['STATUS']);
```

Listing 3-6: Using `http_get_withheader()`

The script in Listing 3-6 downloads the page and displays the requested page, any errors, and a variety of status information related to the fetch and download.

Listing 3-7 shows what is produced when the script in Listing 3-6 is executed, with the array that includes the page header, error conditions, and status. Notice that the contents of the returned file are limited to only the HTTP header, because we requested only the header and not the entire page. Also, notice that the first line in a HTTP header is the *HTTP code*, which indicates the status of the request. An HTTP code of 200 tells us that the request was successful. The HTTP code also appears in the status array element.[3]

```
FILE CONTENTS
string(215) "HTTP/1.1 200 OK
Date: Sat, 08 Oct 2008 16:38:51 GMT
Server: Apache/2.0.53 (FreeBSD) mod_ssl/2.0.53 OpenSSL/0.9.7g PHP/4.4.0
X-Powered-By: PHP/4.4.0
Content-Type: text/html; charset=ISO-8859-1

"
ERRORS
string(0) ""

STATUS
array(20) {
  ["url"]=>
  string(39) "http://www.schrenk.com/publications.php"
  ["content_type"]=>
  string(29) "text/html; charset=ISO-8859-1"
  ["http_code"]=>
  int(200)
```

[3] A complete list of HTTP codes can be found in Appendix B.

```
  ["header_size"]=>
  int(215)
  ["request_size"]=>
  int(200)
  ["filetime"]=>
  int(-1)
  ["ssl_verify_result"]=>
  int(0)
  ["redirect_count"]=>
  int(0)
  ["total_time"]=>
  float(0.683)
  ["namelookup_time"]=>
  float(0.005)
  ["connect_time"]=>
  float(0.101)
  ["pretransfer_time"]=>
  float(0.101)
  ["size_upload"]=>
  float(0)
  ["size_download"]=>
  float(0)
  ["speed_download"]=>
  float(0)
  ["speed_upload"]=>
  float(0)
  ["download_content_length"]=>
  float(0)
  ["upload_content_length"]=>
  float(0)
  ["starttransfer_time"]=>
  float(0.683)
  ["redirect_time"]=>
  float(0)
}
```

Listing 3-7: File contents, errors, and the download status array returned by `LIB_http`

The information returned in `$array['STATUS']` is extraordinarily useful for learning how the fetch was conducted. Included in this array are values for download speed, access times, and file sizes—all valuable when writing diagnostic webbots that monitor the performance of a website.

Learning More About HTTP Headers

When a Content-Type line appears in an HTTP header, it defines the *MIME*, or the media type of file sent from the server. The MIME type tells the web agent what to do with the file. For example, the Content-Type in the previous example was *text/html*, which indicates that the file is a web page. Knowing if the file they just downloaded was an image or an HTML file helps browsers know if they should display the file as text or render an image. For example, the HTTP header information for a JPEG image is shown in Listing 3-8.

```
HTTP/1.1 200 OK
Date: Mon, 23 Mar 2009 00:06:13 GMT
Server: Apache/1.3.12 (Unix) mod_throttle/3.1.2 tomcat/1.0 PHP/4.0.3pl1
Last-Modified: Wed, 23 Jul 2008 18:03:29 GMT
ETag: "74db-9063-3d3eebf1"
Accept-Ranges: bytes
Content-Length: 36963
Content-Type: image/jpeg
```

Listing 3-8: An HTTP header for an image file request

Examining LIB_http's Source Code

Most webbots in this book will use the library `LIB_http` to download pages from the Internet. If you plan to explore any of the webbot examples that appear later in this book, you should obtain a copy of this library; the latest version is available for download at this book's website. We'll explore some of the defaults and functions of `LIB_http` here.

LIB_http Defaults

At the very beginning of the library is a set of defaults, as shown in Listing 3-9.

```
define("WEBBOT_NAME", "Test Webbot");        # How your webbot will appear in server logs
define("CURL_TIMEOUT", 25);                  # Time (seconds) to wait for network response
define("COOKIE_FILE", "c:\cookie.txt");      # Location of cookie file
```

Listing 3-9: `LIB_http` defaults

LIB_http Functions

The functions shown in Listing 3-10 are available within `LIB_http`. All of these functions return the array defined earlier, containing downloaded files, error messages, and the status of the file transfer.

```
http_get($target, $ref)                               # Simple get request (w/o header)
http_get_withheader($target, $ref)                    # Simple get request (w/ header)
http_get_form($target, $ref, $data_array)             # Form (method ="GET", w/o header)
http_get_form_withheader($target, $ref, $data_array) # Form (method ="GET", w/ header)
http_post_form($target, $ref, $data_array)            # Form (method ="POST", w/o header)
http_post_withheader($target, $ref, $data_array)      # Form (method ="POST", w/ header)
http_header($target, $ref)                            # Only returns header
```

Listing 3-10: `LIB_http` functions

Final Thoughts

Some of these functions use an additional input parameter, `$data_array`, when form data is passed from the webbot to the webserver. These functions are listed below:

- `http_get_form()`
- `http_get_form_withheader()`
- `http_post_form()`
- `http_post_form_withheader()`

If you don't understand what all these functions do now, don't worry. Their use will become familiar to you as you go through the examples that appear later in this book. Now might be a good time to thumb through Appendix A, which details the features of cURL that webbot developers are most apt to need.