CHAPTER 10

Accessing MySQL Using PHP

If you worked through the previous chapters, you're proficient in using both MySQL and PHP. In this chapter, you will learn how to integrate the two by using PHP's built-in functions to access MySQL.

Querying a MySQL Database with PHP

The reason for using PHP as an interface to MySQL is to format the results of SQL queries in a form visible in a web page. As long as you can log into your MySQL installation using your username and password, you can also do so from PHP.

However, instead of using MySQL's command line to enter instructions and view output, you will create query strings that are passed to MySQL. When MySQL returns its response, it will come as a data structure that PHP can recognize instead of the formatted output you see when you work on the command line. Further PHP commands can retrieve the data and format it for the web page.

The Process

The process of using MySQL with PHP is as follows:

1. Connect to MySQL and select the database to use.
2. Prepare a query string.
3. Perform the query.
4. Retrieve the results and output them to a web page.
5. Repeat steps 2 to 4 until all desired data has been retrieved.
6. Disconnect from MySQL.

We'll work through these steps in turn, but first it's important to set up your login details in a secure manner so people snooping around on your system have trouble getting access to your database.

Creating a Login File

Most websites developed with PHP contain multiple program files that will require access to MySQL and will thus need the login and password details. Therefore, it's sensible to create a single file to store these and then include that file wherever it's needed. Example 10-1 shows such a file, which I've called *login.php*.

Example 10-1. The login.php file

```
<?php // login.php
  $hn = 'localhost';
  $db = 'publications';
  $un = 'username';
  $pw = 'password';
?>
```

Type the example, replacing `username` and `password` with the values you use for your MySQL database, and save it to the document root directory you set up in Chapter 2. We'll be making use of the file shortly.

The hostname `localhost` should work as long as you're using a MySQL database on your local system, and the database `publications` should work if you're typing the examples I've used so far.

The enclosing `<?php` and `?>` tags are especially important for the *login.php* file in Example 10-1, because they mean that the lines between can be interpreted *only* as PHP code. If you were to leave them out and someone were to call up the file directly from your website, it would display as text and reveal your secrets. But, with the tags in place, all that person will see is a blank page. The file will correctly include your other PHP files.

The `$hn` variable will tell PHP which computer to use when connecting to a database. This is required because you can access MySQL databases on any computer connected to your PHP installation, and that potentially includes any host anywhere on the web. However, the examples in this chapter will be working on the local server. So, in place of specifying a domain such as `mysql.myserver.com`, you can just use the word `localhost` (or the IP address `127.0.0.1`).

The database we'll be using, `$db`, is the one called *publications* that we created in Chapter 8 (if you're using a different database—one provided by your server administrator—you'll have to modify *login.php* accordingly).

Another benefit of keeping these login details in a single place is that you can change your password as frequently as you like and there will be only one file to update when you do, no matter how many PHP files access MySQL.

Connecting to a MySQL Database

Now that you have saved the *login.php* file, you can include it in any PHP files that will need to access the database by using the `require_once` statement. This is preferable to an `include` statement, as it will generate a fatal error if the file is not found—and believe me, not finding the file containing the login details to your database *is* a fatal error.

Also, using `require_once` instead of `require` means that the file will be read in only when it has not previously been included, which prevents wasteful duplicate disk accesses. Example 10-2 shows the code to use.

Example 10-2. Connecting to a MySQL server with mysqli

```
<?php
  require_once 'login.php';
  $conn = new mysqli($hn, $un, $pw, $db);
  if ($conn->connect_error) die("Fatal Error");
?>
```

This example creates a new object called `$conn` by calling a new instance of the `mysqli` method, passing all the values retrieved from the *login.php* file. We achieve error checking by referencing the `$conn->connect_error` property.

The `->` operator indicates that the item on the right is a property or method of the object on the left. In this case, if `connect_error` has a value, there was an error, so we call the `die` function to terminate the program.

The `$conn` object is used in the following examples to access the MySQL database.

The `die` function is great when you are developing PHP code, but of course you will want more user-friendly error messages on a production server. In this case, you won't abort your PHP program, but will format a message that will be displayed when the program exits normally—perhaps something like this:

```
function mysql_fatal_error()
{
    echo <<< _END
We are sorry, but it was not possible to complete
the requested task. The error message we got was:

    <p>Fatal Error</p>

Please click the back button on your browser
and try again. If you are still having problems,
please <a href="mailto:admin@server.com">email
our administrator</a>. Thank you.
_END;
}
```

You should also never be tempted to output the contents of any error message received from MySQL. Rather than helping your users, you could give away sensitive information to hackers such as login details. Instead, just guide the user with information on how to overcome their difficulty based on what the error message reports to your code.

Building and executing a query

Sending a query to MySQL from PHP is as simple as including the relevant SQL in the `query` method of a connection object. Example 10-3 shows you how to do this.

Example 10-3. Querying a database with mysqli

```
<?php
  $query  = "SELECT * FROM classics";
  $result = $conn->query($query);
  if (!$result) die("Fatal Error");
?>
```

As you can see, the MySQL query looks just like what you would type directly at the command line, except that there is no trailing semicolon, as none is needed when you are accessing MySQL from PHP.

Here the variable `$query` is assigned a string containing the query to be made, and then passed to the `query` method of the `$conn` object, which returns a result that we place in the object `$result`. If `$result` is `FALSE`, there was a problem and the `error` property of the connection object will contain the details, so the die function is called to display that error.

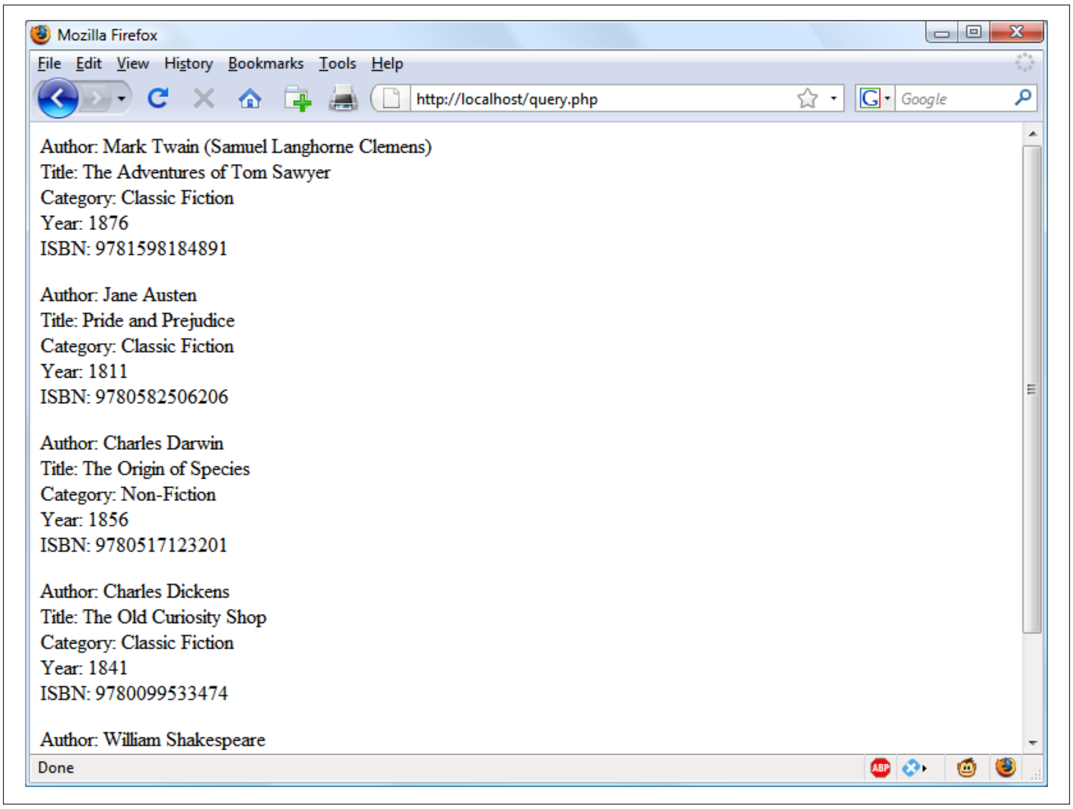
All the data returned by MySQL is now stored in an easily interrogable format in the $result object.

Fetching a result

Once you have an object returned in $result, you can use it to extract the data you want, one item at a time, using the fetch_assoc method of the object. Example 10-4 combines and extends the previous examples into a program that you can run yourself to retrieve the results (as depicted in Figure 10-1). Type this script in and save it using the filename *query-mysqli.php*, or download it from the companion website.

Example 10-4. Fetching results one cell at a time

```
<?php // query-mysqli.php
  require_once 'login.php';
  $connection = new mysqli($hn, $un, $pw, $db);

  if ($connection->connect_error) die("Fatal Error");

  $query  = "SELECT * FROM classics";
  $result = $connection->query($query);

  if (!$result) die("Fatal Error");

  $rows = $result->num_rows;

  for ($j = 0 ; $j < $rows ; ++$j)
  {
    $result->data_seek($j);
    echo 'Author: '  .htmlspecialchars($result->fetch_assoc()['author'])  .'<br>';
    $result->data_seek($j);
    echo 'Title: '   .htmlspecialchars($result->fetch_assoc()['title'])   .'<br>';
    $result->data_seek($j);
    echo 'Category: '.htmlspecialchars($result->fetch_assoc()['category']).'<br>';
    $result->data_seek($j);
    echo 'Year: '    .htmlspecialchars($result->fetch_assoc()['year'])    .'<br>';
    $result->data_seek($j);
    echo 'ISBN: '    .htmlspecialchars($result->fetch_assoc()['isbn'])    .'<br><br>';
  }

  $result->close();
  $connection->close();
?>
```



```
Author: Mark Twain (Samuel Langhorne Clemens)
Title: The Adventures of Tom Sawyer
Category: Classic Fiction
Year: 1876
ISBN: 9781598184891

Author: Jane Austen
Title: Pride and Prejudice
Category: Classic Fiction
Year: 1811
ISBN: 9780582506206

Author: Charles Darwin
Title: The Origin of Species
Category: Non-Fiction
Year: 1856
ISBN: 9780517123201

Author: Charles Dickens
Title: The Old Curiosity Shop
Category: Classic Fiction
Year: 1841
ISBN: 9780099533474

Author: William Shakespeare
```

Figure 10-1. The output from the query-mysqli.php program in Example 10-4

Here, each time around the loop, we call the `fetch_assoc` method to retrieve the value stored in each cell, and output the result using `echo` statements.

> When displaying data in a browser the source of which was (or may have been) user input, there's always a risk of sneaky HTML characters being embedded within it—even if you believe it to have been previously sanitized—which could potentially be used for a cross-site scripting (XSS) attack. The simple way to prevent this possibility is to embed all such output within a call to the function `htmlspecialchars`, which replaces all such characters with harmless HTML entities. This technique was implemented in the preceding example and will be used in many of the following examples.

You will probably agree that all this multiple seeking and so forth is rather cumbersome, and that there ought to be a more efficient method of achieving the same result. And, indeed, there is a better method, which is to extract a row at a time.

In Chapter 9, I talked about First, Second, and Third Normal Form. You may have noticed that the *classics* table doesn't satisfy these, because both author and book details are included within the same table. That's because we created this table before encountering normalization. However, for the purposes of illustrating access to MySQL from PHP, reusing this table avoids the hassle of typing in a new set of test data, so we'll stick with it for the time being.

Fetching a row

To fetch one row at a time, replace the `for` loop from Example 10-4 with the one highlighted in bold in Example 10-5, and you will find that you get exactly the same result that was displayed in Figure 10-1. You may wish to save this revised file using the name *fetchrow.php*.

Example 10-5. Fetching results one row at a time

```
<?php // fetchrow.php
  require_once 'login.php';
  $conn = new mysqli($hn, $un, $pw, $db);
  if ($conn->connect_error) die("Fatal Error");

  $query  = "SELECT * FROM classics";
  $result = $conn->query($query);
  if (!$result) die("Fatal Error");

  $rows = $result->num_rows;

  for ($j = 0 ; $j < $rows ; ++$j)
  {
    $row = $result->fetch_array(MYSQLI_ASSOC);

    echo 'Author: '   . htmlspecialchars($row['author'])   . '<br>';
    echo 'Title: '    . htmlspecialchars($row['title'])    . '<br>';
    echo 'Category: ' . htmlspecialchars($row['category']) . '<br>';
    echo 'Year: '     . htmlspecialchars($row['year'])     . '<br>';
    echo 'ISBN: '     . htmlspecialchars($row['isbn'])     . '<br><br>';
  }

  $result->close();
  $conn->close();
?>
```

In this modified code, only one-fifth of the interrogations of the `$result` object are made (compared to the previous example), and only one seek into the object is made in each iteration of the loop, because each row is fetched in its entirety via the `fetch_array` method. This returns a single row of data as an array, which is then assigned to the array `$row`.

The `fetch_array` method can return three types of array according to the value passed to it:

`MYSQLI_NUM`
: Numeric array. Each column appears in the array in the order in which you defined it when you created (or altered) the table. In our case, the zeroth element of the array contains the *author* column, element 1 contains the *title* column, and so on.

`MYSQLI_ASSOC`
: Associative array. Each key is the name of a column. Because items of data are referenced by column name (rather than index number), use this option where possible in your code to make debugging easier and help other programmers better manage your code.

`MYSQLI_BOTH`
: Associative and numeric array.

Associative arrays are usually more useful than numeric ones because you can refer to each column by name, such as `$row['author']`, instead of trying to remember where it is in the column order. This script uses an associative array, leading us to pass `MYSQLI_ASSOC`.

Closing a connection

PHP will eventually return the memory it has allocated for objects after you have finished with the script, so in small scripts, you don't usually need to worry about releasing memory yourself. However, if you're allocating a lot of result objects or fetching large amounts of data, it can be a good idea to free the memory you have been using to prevent problems later in your script.

This becomes particularly important on higher-traffic pages, because the amount of memory consumed in a session can rapidly grow. Therefore, note the calls to the `close` methods of the objects `$result` and `$conn` in the preceding scripts, as soon as each object is no longer needed, like this:

```
$result->close();
$conn->close();
```

> Ideally, you should close each result object when you have finished using it, and then close the connection object when your script will not be accessing MySQL anymore. This best practice ensures that resources are returned to the system as quickly as possible to keep MySQL running optimally, and alleviates doubt over whether PHP will return unused memory in time for when you next need it.

A Practical Example

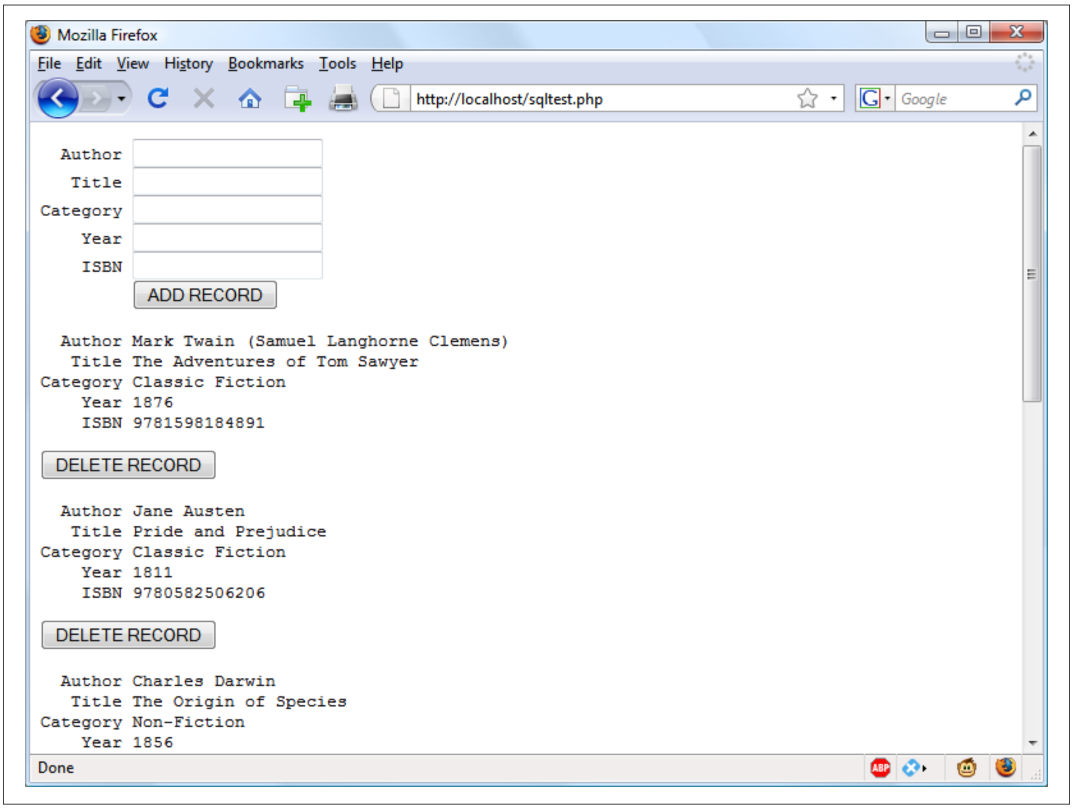
It's time to write our first example of inserting data in and deleting it from a MySQL table using PHP. I recommend that you type Example 10-6 and save it to your web development directory using the filename *sqltest.php*. You can see an example of the program's output in Figure 10-2.

Example 10-6 creates a standard HTML form. Chapter 11 explains forms in detail, but in this chapter I take form handling for granted and just deal with database interaction.

Example 10-6. Inserting and deleting using sqltest.php

```
<?php // sqltest.php
  require_once 'login.php';
  $conn = new mysqli($hn, $un, $pw, $db);
  if ($conn->connect_error) die("Fatal Error");

  if (isset($_POST['delete']) && isset($_POST['isbn']))
  {
    $isbn   = get_post($conn, 'isbn');
    $query  = "DELETE FROM classics WHERE isbn='$isbn'";
    $result = $conn->query($query);
    if (!$result) echo "DELETE failed<br><br>";
  }

  if (isset($_POST['author'])   &&
      isset($_POST['title'])    &&
      isset($_POST['category']) &&
      isset($_POST['year'])     &&
      isset($_POST['isbn']))
  {
    $author   = get_post($conn, 'author');
    $title    = get_post($conn, 'title');
    $category = get_post($conn, 'category');
    $year     = get_post($conn, 'year');
    $isbn     = get_post($conn, 'isbn');
    $query    = "INSERT INTO classics VALUES" .
      "('$author', '$title', '$category', '$year', '$isbn')";
    $result   = $conn->query($query);
    if (!$result) echo "INSERT failed<br><br>";
  }

  echo <<<_END
  <form action="sqltest.php" method="post"><pre>
    Author <input type="text" name="author">
     Title <input type="text" name="title">
  Category <input type="text" name="category">
```

```
      Year <input type="text" name="year">
      ISBN <input type="text" name="isbn">
           <input type="submit" value="ADD RECORD">
  </pre></form>
_END;

  $query  = "SELECT * FROM classics";
  $result = $conn->query($query);
  if (!$result) die ("Database access failed");

  $rows = $result->num_rows;

  for ($j = 0 ; $j < $rows ; ++$j)
  {
    $row = $result->fetch_array(MYSQLI_NUM);

    $r0 = htmlspecialchars($row[0]);
    $r1 = htmlspecialchars($row[1]);
    $r2 = htmlspecialchars($row[2]);
    $r3 = htmlspecialchars($row[3]);
    $r4 = htmlspecialchars($row[4]);

    echo <<<_END
  <pre>
    Author $r0
     Title $r1
  Category $r2
      Year $r3
      ISBN $r4
  </pre>
  <form action='sqltest.php' method='post'>
  <input type='hidden' name='delete' value='yes'>
  <input type='hidden' name='isbn' value='$r4'>
  <input type='submit' value='DELETE RECORD'></form>
_END;
  }

  $result->close();
  $conn->close();

  function get_post($conn, $var)
  {
    return $conn->real_escape_string($_POST[$var]);
  }
?>
```


Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://localhost/sqltest.php
Google
ADD RECORD
DELETE RECORD
DELETE RECORD
Done

```
  Author
   Title
Category
    Year
    ISBN

  Author Mark Twain (Samuel Langhorne Clemens)
   Title The Adventures of Tom Sawyer
Category Classic Fiction
    Year 1876
    ISBN 9781598184891

  Author Jane Austen
   Title Pride and Prejudice
Category Classic Fiction
    Year 1811
    ISBN 9780582506206

  Author Charles Darwin
   Title The Origin of Species
Category Non-Fiction
    Year 1856
```

Figure 10-2. The output from Example 10-6, sqltest.php

At over 80 lines of code, this program may appear daunting, but don't worry—you've already covered many of those lines in Example 10-5, and what the code does is actually quite simple.

It first checks for any inputs that may have been made and then either inserts new data into the table *classics* of the *publications* database or deletes a row from it, according to the input supplied. Regardless of whether there was input, the program then outputs all rows in the table to the browser. So, let's see how it works.

The first section of new code starts by using the `isset` function to check whether values for all the fields have been posted to the program. Upon confirmation, each line within the `if` statement calls the function `get_post`, which appears at the end of the program. This function has one small but critical job: fetching input from the browser.

For reasons of clarity and brevity, and to explain things as simply as possible, many of the following examples omit certain very sensible security precautions that would have made them longer and possibly detract from explaining their function in the clearest manner. Therefore, it is important that you don't skip past the section later in this chapter on preventing your database from being hacked ("Preventing Hacking Attempts" on page 258), in which you will learn about additional actions you can take with your code to secure it.

The $_POST Array

I mentioned in an earlier chapter that a browser sends user input through either a GET request or a POST request. The POST request is usually preferred (because it avoids placing unsightly data in the browser's address bar), and so we use it here. The web server bundles up all of the user input (even if the form was filled out with a hundred fields) and puts in into an array named `$_POST`.

`$_POST` is an associative array, which you encountered in Chapter 6. Depending on whether a form has been set to use the POST or the GET method, either the `$_POST` or the `$_GET` associative array will be populated with the form data. They can both be read in exactly the same way.

Each field has an element in the array named after that field. So, if a form contains a field named `isbn`, the `$_POST` array contains an element keyed by the word `isbn`. The PHP program can read that field by referring to either `$_POST['isbn']` or `$_POST["isbn"]` (single and double quotes have the same effect in this case).

If the `$_POST` syntax still seems complex to you, rest assured that you can just use the convention I've shown in Example 10-6, copy the user's input to other variables, and forget about `$_POST` after that. This is normal in PHP programs: they retrieve all the fields from `$_POST` at the beginning of the program and then ignore it.

There is no reason to write to an element in the `$_POST` array. Its only purpose is to communicate information from the browser to the program, and you're better off copying data to your own variables before altering it.

So, back to the `get_post` function, which passes each item it retrieves through the `real_escape_string` method of the connection object to escape any quotes that a hacker may have inserted in order to break into or alter your database, like this:

```
function get_post($conn, $var)
{
  return $conn->real_escape_string($_POST[$var]);
}
```

Deleting a Record

Prior to checking whether new data has been posted, the program checks whether the variable $_POST['delete'] has a value. If so, the user has clicked the DELETE RECORD button to erase a record. In this case, the value of $isbn will also have been posted.

As you'll recall, the ISBN uniquely identifies each record. The HTML form appends the ISBN to the DELETE FROM query string created in the variable $query, which is then passed to the query method of the $conn object to issue it to MySQL.

If $_POST['delete'] is not set (and so there is no record to be deleted), $_POST['author'] and other posted values are checked. If they have all been given values, $query is set to an INSERT INTO command, followed by the five values to be inserted. The string is then passed to the query method, which upon completion returns either TRUE or FALSE. If FALSE is returned an error message is displayed, like this:

```
if (!$result) echo "INSERT failed<br><br>";
```

Displaying the Form

Before displaying the little form (as shown in Figure 10-2), the program sanitizes copies of the elements we will be outputting from the $row array into the variables $r0 through $r4 by passing them to the htmlspecialchars function, to replace any potentially dangerous HTML characters with harmless HTML entities.

Then the part of code that displays the output follows, using an echo <<<_END..._END structure as seen in previous chapters, which outputs everything between the _END tags.

Instead of using the echo command, the program could drop out of PHP using ?>, issue the HTML, and then reenter PHP processing with <?php. Which style is used is a matter of programmer preference, but I always recommend staying within PHP code, for these reasons:

- It makes it very clear when you're debugging (and also for other users) that everything within a *.php* file is PHP code. Therefore, there is no need to go hunting for dropouts to HTML.
- When you wish to include a PHP variable directly within HTML, you can just type it. If you had dropped back to HTML, you would have had to temporarily reenter PHP processing, access the variable, and then drop back out again.

The HTML form section simply sets the form's action to *sqltest.php*. This means that when the form is submitted, the contents of the form fields will be sent to the file *sqltest.php*, which is the program itself. The form is also set up to send the fields as a POST rather than a GET request. This is because GET requests are appended to the URL being submitted and can look messy in your browser. They also allow users to easily modify submissions and try to hack your server (although that can also be achieved with in-browser developer tools). Additionally, avoiding GET requests prevents too much information appearing in server log files. Therefore, whenever possible, you should use POST submissions, which also have the benefit of revealing less posted data.

Having output the form fields, the HTML displays a submit button with the name ADD RECORD and closes the form. Note the <pre> and </pre> tags here, which have been used to force a monospaced font that lines up all the inputs neatly. The carriage returns at the end of each line are also output when inside <pre> tags.

Querying the Database

Next, the code returns to the familiar territory of Example 10-5, where a query is sent to MySQL asking to see all the records in the *classics* table, like this:

```
$query  = "SELECT * FROM classics";
$result = $conn->query($query);
```

After that, $rows is set to a value representing the number of rows in the table:

```
$rows = $result->num_rows;
```

Using the value in $rows, a for loop is then entered to display the contents of each row. Then the program populates the array $row with a row of results by calling the fetch_array method of $result, passing it the constant value MYSQLI_NUM, which forces the return of a numeric (rather than associative) array, like this:

```
$row = $result->fetch_array(MYSQLI_NUM);
```

With the data in $row, it's now a simple matter to display it within the heredoc echo statement that follows, in which I have chosen to use a <pre> tag to line up the display of each record in a pleasing manner.

After the display of each record, there is a second form that also posts to *sqltest.php* (the program itself) but this time contains two hidden fields: delete and isbn. The delete field is set to yes and isbn to the value held in $row[4], which contains the ISBN for the record.

Then a submit button with the name DELETE RECORD is displayed, and the form is closed. A curly brace then completes the for loop, which will continue until all records have been displayed, at which time the $result and $conn object's close methods are closed to release resources back to PHP:

```
$result->close();
$conn->close();
```

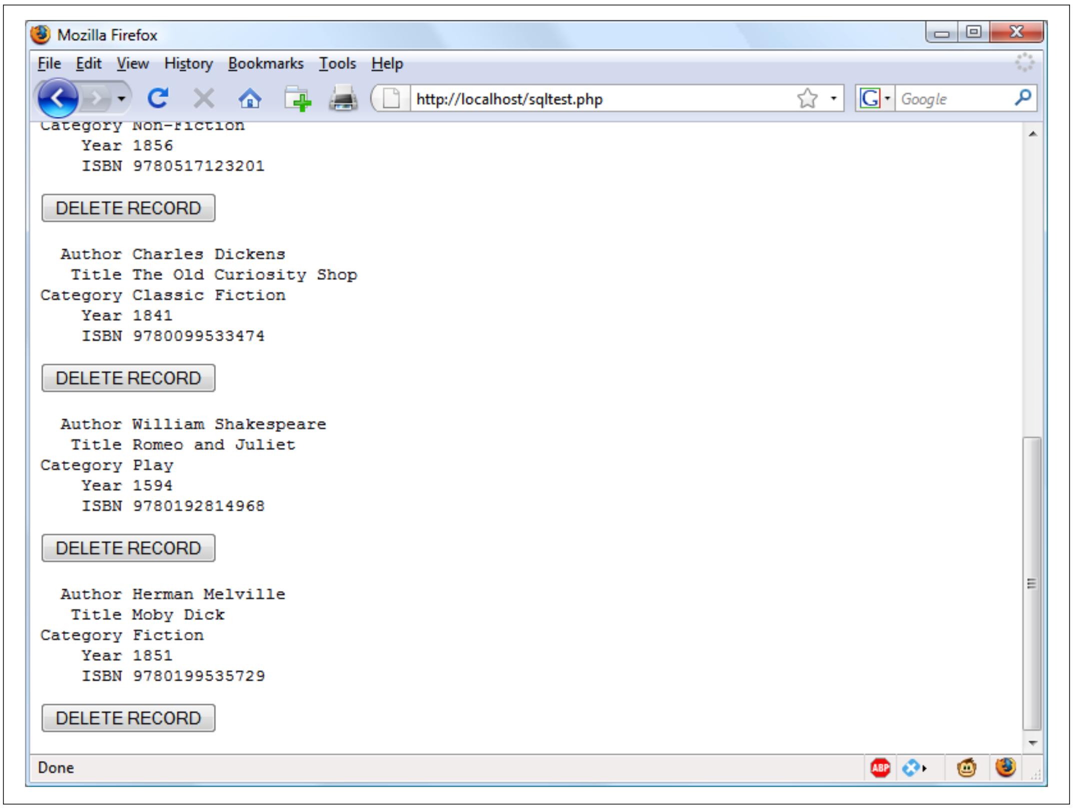
Finally, you see the definition for the function get_post, which we've already looked at. And that's it—our first PHP program to manipulate a MySQL database. So, let's check out what it can do.

Once you have typed the program (and corrected any typing errors), try entering the following data into the various input fields to add a new record for the book *Moby Dick* to the database:

```
Herman Melville
Moby Dick
Fiction
1851
9780199535729
```

Running the Program

When you have submitted this data using the ADD RECORD button, scroll down to the bottom of the web page to see the new addition. It should look like Figure 10-3.


Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://localhost/sqltest.php
Google

```
Category Non-Fiction
    Year 1856
    ISBN 9780517123201
```

```
  Author Charles Dickens
   Title The Old Curiosity Shop
Category Classic Fiction
    Year 1841
    ISBN 9780099533474
```

```
  Author William Shakespeare
   Title Romeo and Juliet
Category Play
    Year 1594
    ISBN 9780192814968
```

```
  Author Herman Melville
   Title Moby Dick
Category Fiction
    Year 1851
    ISBN 9780199535729
```

Figure 10-3. The result of adding Moby Dick to the database

Now let's look at how deleting a record works by creating a dummy record. Try entering just the number 1 in each of the five fields and clicking the ADD RECORD button. If you now scroll down, you'll see a new record consisting just of 1s. Obviously, this record isn't useful in this table, so now click the DELETE RECORD button and scroll down again to confirm that the record has been deleted.

Assuming that everything worked, you are now able to add and delete records at will. Try doing this a few times, but leave the main records in place (including the new one for *Moby Dick*), as we'll be using them later. You could also try adding the record with all 1s again a couple of times and note the error message that you receive the second time, indicating that there is already an ISBN with the number 1.

Practical MySQL

You are now ready to look at some practical techniques that you can use in PHP to access the MySQL database, including tasks such as creating and dropping tables; inserting, updating, and deleting data; and protecting your database and website from malicious users. Note that the following examples assume that you've already created the *login.php* program discussed earlier in this chapter.

Creating a Table

Let's assume that you are working for a wildlife park and need to create a database to hold details about all the types of cats it houses. You are told that there are nine *families* of cats—Lion, Tiger, Jaguar, Leopard, Cougar, Cheetah, Lynx, Caracal, and Domestic—so you'll need a column for that. Then each cat has been given a *name*, so that's another column, and you also want to keep track of their *ages*, which is another. Of course, you will probably need more columns later, perhaps to hold dietary requirements, inoculations, and other details, but for now that's enough to get going. A unique identifier is also needed for each animal, so you also decide to create a column for that called *id*.

Example 10-7 shows the code you might use to create a MySQL table to hold this data, with the main query assignment in bold text.

Example 10-7. Creating a table called cats

```
<?php
  require_once 'login.php';
  $conn = new mysqli($hn, $un, $pw, $db);
  if ($conn->connect_error) die("Fatal Error");

  $query = "CREATE TABLE cats (
    id SMALLINT NOT NULL AUTO_INCREMENT,
    family VARCHAR(32) NOT NULL,
    name VARCHAR(32) NOT NULL,
    age TINYINT NOT NULL,
    PRIMARY KEY (id)
  )";

  $result = $conn->query($query);
  if (!$result) die ("Database access failed");
?>
```

As you can see, the MySQL query looks just like what you would type directly at the command line, except without the trailing semicolon.

Describing a Table

When you aren't logged into the MySQL command line, here's a handy piece of code that you can use to verify that a table has been correctly created from inside a browser. It simply issues the query `DESCRIBE cats` and then outputs an HTML table with four headings—*Column*, *Type*, *Null*, and *Key*—underneath which all columns within the table are shown. To use it with other tables, simply replace the name `cats` in the query with that of the new table (see Example 10-8).

Example 10-8. Describing the cats table

```
<?php
  require_once 'login.php';
  $conn = new mysqli($hn, $un, $pw, $db);
  if ($conn->connect_error) die("Fatal Error");

  $query  = "DESCRIBE cats";
  $result = $conn->query($query);
  if (!$result) die ("Database access failed");

  $rows = $result->num_rows;

  echo "<table><tr><th>Column</th><th>Type</th><th>Null</th><th>Key</th></tr>";

  for ($j = 0 ; $j < $rows ; ++$j)
  {
    $row = $result->fetch_array(MYSQLI_NUM);

    echo "<tr>";
    for ($k = 0 ; $k < 4 ; ++$k)
      echo "<td>" . htmlspecialchars($row[$k]) . "</td>";
    echo "</tr>";
  }

  echo "</table>";
?>
```

The output from the program should look like this:

```
Column Type        Null Key
id     smallint(6) NO   PRI
family varchar(32) NO
name   varchar(32) NO
age    tinyint(4)  NO
```

Dropping a Table

Dropping a table is very easy to do and is therefore very dangerous, so be careful. Example 10-9 shows the code that you need. However, I don't recommend that you try it until you have been through the other examples (up to "Performing Additional Queries" on page 257), as it will drop the table *cats* and you'll have to re-create it using Example 10-7.

Example 10-9. Dropping the cats table

```
<?php
  require_once 'login.php';
  $conn = new mysqli($hn, $un, $pw, $db);
  if ($conn->connect_error) die("Fatal Error");

  $query  = "DROP TABLE cats";
  $result = $conn->query($query);
  if (!$result) die ("Database access failed");
?>
```

Adding Data

Let's add some data to the table now, using the code in Example 10-10.

Example 10-10. Adding data to the cats table

```
<?php
  require_once 'login.php';
  $conn = new mysqli($hn, $un, $pw, $db);
  if ($conn->connect_error) die("Fatal Error");

  $query  = "INSERT INTO cats VALUES(NULL, 'Lion', 'Leo', 4)";
  $result = $conn->query($query);
  if (!$result) die ("Database access failed");
?>
```

You may wish to add a couple more items of data by modifying `$query` as follows and calling up the program in your browser again:

```
$query = "INSERT INTO cats VALUES(NULL, 'Cougar', 'Growler', 2)";
$query = "INSERT INTO cats VALUES(NULL, 'Cheetah', 'Charly', 3)";
```

By the way, notice the `NULL` value passed as the first parameter? This is because the *id* column is of type `AUTO_INCREMENT`, and MySQL will decide what value to assign according to the next available number in sequence. So, we simply pass a `NULL` value, which will be ignored.

Of course, the most efficient way to populate MySQL with data is to create an array and insert the data with a single query.

At this point in the book I am concentrating on showing you how to directly insert data into MySQL (and providing some security precautions to keep the process safe). However, later in this book we'll move on to a better method you can employ that involves placeholders (see "Using Placeholders" on page 260), which make it virtually impossible for users to inject malicious hacks into your database. So, as you read this section, do understand that this is the basics of how MySQL insertion works, and remember that we will improve upon it later.

Retrieving Data

Now that some data has been entered into the *cats* table, Example 10-11 shows how you can check that it was correctly inserted.

Example 10-11. Retrieving rows from the cats table

```
<?php
  require_once 'login.php';
  $conn = new mysqli($hn, $un, $pw, $db);
  if ($conn->connect_error) die("Fatal Error");

  $query  = "SELECT * FROM cats";
  $result = $conn->query($query);
  if (!$result) die ("Database access failed");

  $rows = $result->num_rows;
  echo "<table><tr> <th>Id</th> <th>Family</th><th>Name</th><th>Age</th></tr>";

  for ($j = 0 ; $j < $rows ; ++$j)
  {
    $row = $result->fetch_array(MYSQLI_NUM);

    echo "<tr>";
    for ($k = 0 ; $k < 4 ; ++$k)
      echo "<td>" . htmlspecialchars($row[$k]) . "</td>";
    echo "</tr>";
  }

  echo "</table>";
?>
```

This code simply issues the MySQL query `SELECT * FROM cats` and then displays all the rows returned. Its output is as follows:

```
Id Family  Name    Age
1  Lion    Leo     4
2  Cougar  Growler 2
3  Cheetah Charly  3
```

Here you can see that the *id* column has correctly auto-incremented.

Updating Data

Changing data that you have already inserted is also quite simple. Did you notice the spelling of *Charly* for the cheetah's name? Let's correct that to *Charlie*, as in Example 10-12.

Example 10-12. Renaming Charly the cheetah to Charlie

```
<?php
  require_once 'login.php';
  $conn = new mysqli($hn, $un, $pw, $db);
  if ($conn->connect_error) die("Fatal Error");

  $query  = "UPDATE cats SET name='Charlie' WHERE name='Charly'";
  $result = $conn->query($query);
  if (!$result) die ("Database access failed");
?>
```

If you run Example 10-11 again, you'll see that it now outputs the following:

```
    Id Family  Name    Age
    1  Lion    Leo     4
    2  Cougar  Growler 2
    3  Cheetah Charlie 3
```

Deleting Data

Growler the cougar has been transferred to another zoo, so it's time to remove him from the database; see Example 10-13.

Example 10-13. Removing Growler the cougar from the cats table

```
<?php
  require_once 'login.php';
  $conn = new mysqli($hn, $un, $pw, $db);
  if ($conn->connect_error) die("Fatal Error");

  $query  = "DELETE FROM cats WHERE name='Growler'";
  $result = $conn->query($query);
  if (!$result) die ("Database access failed");
?>
```

This uses a standard `DELETE FROM` query, and when you run Example 10-11, you can see that the row has been removed in the following output:

```
Id Family  Name    Age
1  Lion    Leo     4
3  Cheetah Charlie 3
```

Using AUTO_INCREMENT

When using `AUTO_INCREMENT`, you cannot know what value has been given to a column before a row is inserted. Instead, if you need to know it, you must ask MySQL afterward using the `mysql_insert_id` function. This need is common: for instance, when you process a purchase, you might insert a new customer into a *Customers* table and then refer to the newly created *CustId* when inserting a purchase into the *Purchases* table.

> Using `AUTO_INCREMENT` is recommended instead of selecting the highest ID in the *id* column and incrementing it by one, because concurrent queries could change the values in that column after the highest value has been fetched and before the calculated value is stored.

Example 10-10 can be rewritten as Example 10-14 to display this value after each insert.

Example 10-14. Adding data to the cats table and reporting the insert ID

```
<?php
  require_once 'login.php';
  $conn = new mysqli($hn, $un, $pw, $db);
  if ($conn->connect_error) die("Fatal Error");

  $query  = "INSERT INTO cats VALUES(NULL, 'Lynx', 'Stumpy', 5)";
  $result = $conn->query($query);
  if (!$result) die ("Database access failed");

  echo "The Insert ID was: " . $conn->insert_id;
?>
```

The contents of the table should now look like the following (note how the previous *id* value of 2 is *not* reused, as this could cause complications in some instances):

```
Id Family  Name    Age
1  Lion    Leo     4
3  Cheetah Charlie 3
4  Lynx    Stumpy  5
```

Using insert IDs

It's very common to insert data in multiple tables: a book followed by its author, a customer followed by their purchase, and so on. When doing this with an auto-increment column, you will need to retain the insert ID returned for storing in the related table.

For example, let's assume that these cats can be "adopted" by the public as a means of raising funds, and that when a new cat is stored in the *cats* table, we also want to create a key to tie it to the animal's adoptive owner. The code to do this is similar to that in Example 10-14, except that the returned insert ID is stored in the variable `$insertID` and is then used as part of the subsequent query:

```
$query    = "INSERT INTO cats VALUES(NULL, 'Lynx', 'Stumpy', 5)";
$result   = $conn->query($query);
$insertID = $conn->insert_id;

$query    = "INSERT INTO owners VALUES($insertID, 'Ann', 'Smith')";
$result   = $conn->query($query);
```

Now the cat is connected to its "owner" through the cat's unique ID, which was created automatically by `AUTO_INCREMENT`.

Performing Additional Queries

Okay, that's enough feline fun. To explore some slightly more complex queries, we need to revert to using the *customers* and *classics* tables that you created in Chapter 8. There will be two customers in the *customers* table; the *classics* table holds the details of a few books. They also share a common column of ISBNs, called *isbn*, that you can use to perform additional queries.

For example, to display all of the customers along with the titles and authors of the books they have bought, you can use the code in Example 10-15.

Example 10-15. Performing a secondary query

```
<?php
  require_once 'login.php';
  $conn = new mysqli($hn, $un, $pw, $db);
  if ($conn->connect_error) die("Fatal Error");

  $query  = "SELECT * FROM customers";
  $result = $conn->query($query);
  if (!$result) die ("Database access failed");

  $rows = $result->num_rows;

  for ($j = 0 ; $j < $rows ; ++$j)
  {
    $row = $result->fetch_array(MYSQLI_NUM);
    echo htmlspecialchars($row[0]) . " purchased ISBN " .
         htmlspecialchars($row[1]) . ":<br>";

    $subquery  = "SELECT * FROM classics WHERE isbn='$row[1]'";
    $subresult = $conn->query($subquery);
    if (!$subresult) die ("Database access failed");

    $subrow = $subresult->fetch_array(MYSQLI_NUM);
    echo "&nbsp;&nbsp;" . htmlspecialchars("'$subrow[1]'") . " by " .
                          htmlspecialchars(  $subrow[0])   . "<br><br>";
  }
?>
```

This program uses an initial query to the *customers* table to look up all the customers and then, given the ISBNs of the books each customer purchased, makes a new query to the *classics* table to find out the title and author for each. The output from this code should be similar to the following:

```
Joe Bloggs purchased ISBN 9780099533474:
  'The Old Curiosity Shop' by Charles Dickens

Jack Wilson purchased ISBN 9780517123201:
  'The Origin of Species' by Charles Darwin

Mary Smith purchased ISBN 9780582506206:
  'Pride and Prejudice' by Jane Austen
```

Of course, although it wouldn't illustrate performing additional queries, in this particular case you could also return the same information using a NATURAL JOIN query (see Chapter 8), like this:

```
SELECT name,isbn,title,author FROM customers
 NATURAL JOIN classics;
```

Preventing Hacking Attempts

If you haven't looked into it, you may find it hard to appreciate just how dangerous it is to pass user input unchecked to MySQL. For example, suppose you have a simple piece of code to verify a user, and it looks like this:

```
$user  = $_POST['user'];
$pass  = $_POST['pass'];
$query = "SELECT * FROM users WHERE user='$user' AND pass='$pass'";
```

At first glance, you might think this code is perfectly fine. If the user enters values of `fredsmith` and `mypass` for `$user` and `$pass`, respectively, then the query string, as passed to MySQL, will be as follows:

```
SELECT * FROM users WHERE user='fredsmith' AND pass='mypass'
```

This is all well and good, but what if someone enters the following for `$user` (and doesn't even enter anything for `$pass`)?

```
admin' #
```

Let's look at the string that would be sent to MySQL:

```
SELECT * FROM users WHERE user='admin' #' AND pass=''
```

Do you see the problem there? An *SQL injection* attack has occurred. In MySQL, the `#` symbol represents the start of a comment. Therefore, the user will be logged in as *admin* (assuming there is a user *admin*), without having to enter a password. In the following, the part of the query that will be executed is shown in bold; the rest will be ignored.

```
SELECT * FROM users WHERE user='admin' #' AND pass=''
```

But you should count yourself very lucky if that's all a malicious user does to you. At least you might still be able to go into your application and undo any changes the user makes as *admin*. But what about the case in which your application code removes a user from the database? The code might look something like this:

```
$user  = $_POST['user'];
$pass  = $_POST['pass'];
$query = "DELETE FROM users WHERE user='$user' AND pass='$pass'";
```

Again, this looks quite normal at first glance, but what if someone entered the following for `$user`?

```
anything' OR 1=1 #
```

This would be interpreted by MySQL as follows:

```
DELETE FROM users WHERE user='anything' OR 1=1 #' AND pass=''
```

Ouch—that SQL query will always be `TRUE`, and therefore you've lost your whole *users* database! So what can you do about this kind of attack?

Steps You Can Take

The first thing is not to rely on PHP's built-in *magic quotes*, which automatically escape any characters such as single and double quotes by prefacing them with a backslash (\). Why? Because this feature can be turned off. Many programmers do so in order to put their own security code in place, and there is no guarantee that this hasn't happened on the server you are working on. In fact, the feature was deprecated as of PHP 5.3.0 and removed in PHP 5.4.0.

Instead, you should always use the `real_escape_string` method for all calls to MySQL. Example 10-16 is a function you can use that will remove any magic quotes added to a user-inputted string and then properly sanitize it for you.

Example 10-16. How to properly sanitize user input for MySQL

```
<?php
  function mysql_fix_string($conn, $string)
  {
    if (get_magic_quotes_gpc()) $string = stripslashes($string);
    return $conn->real_escape_string($string);
  }
?>
```

The `get_magic_quotes_gpc` function returns `TRUE` if magic quotes are active. In that case, any slashes that have been added to a string have to be removed, or the `real_escape_string` method could end up double-escaping some characters, creating corrupted strings. Example 10-17 illustrates how you would incorporate `mysql_fix_string` within your own code.

Example 10-17. How to safely access MySQL with user input

```
<?php
  require_once 'login.php';
  $conn = new mysqli($hn, $un, $pw, $db);
  if ($conn->connect_error) die("Fatal Error");

  $user  = mysql_fix_string($conn, $_POST['user']);
  $pass  = mysql_fix_string($conn, $_POST['pass']);
  $query = "SELECT * FROM users WHERE user='$user' AND pass='$pass'";

  // Etc.

  function mysql_fix_string($conn, $string)
  {
    if (get_magic_quotes_gpc()) $string = stripslashes($string);
    return $conn->real_escape_string($string);
  }
?>
```

These precautions are becoming less important, however, because there's a much easier and safer way to access MySQL, which obviates the need for these types of functions—the use of placeholders, explained next.

Using Placeholders

All the methods you have seen so far work with MySQL but had security implications, with strings constantly requiring escaping to prevent security risks. So, now that you know the basics, let me introduce the best and recommended way to interact with MySQL, which is pretty much bulletproof in terms of security. Once you have read this section, you should no longer use direct inserting of data into MySQL (though it was important to show you how to do this), but should always use placeholders instead.

So what are placeholders? They are positions within prepared statements in which data is transferred directly to the database, without the possibility of user-submitted (or other) data being interpreted as MySQL statements (and the potential for hacking that could then result).

The technology works by requiring you to first prepare the statement you wish to be executed in MySQL, but leave all the parts of the statement that refer to data as simple question marks.

In plain MySQL, prepared statements look like Example 10-18.

Example 10-18. MySQL placeholders

```
PREPARE statement FROM "INSERT INTO classics VALUES(?,?,?,?,?)";

SET @author   = "Emily Brontë",
    @title    = "Wuthering Heights",
    @category = "Classic Fiction",
    @year     = "1847",
    @isbn     = "9780553212587";

EXECUTE statement USING @author,@title,@category,@year,@isbn;
DEALLOCATE PREPARE statement;
```

This can be cumbersome to submit to MySQL, so the `mysqli` extension makes handling placeholders easier for you with a ready-made method called `prepare`, which you call like this:

```
$stmt = $conn->prepare('INSERT INTO classics VALUES(?,?,?,?,?)');
```

The object `$stmt` (which is shorthand for *statement*) returned by this method is then used for sending the data to the server in place of the question marks. Its first use is to bind some PHP variables to each of the question marks (the placeholder parameters) in turn, like this:

```
$stmt->bind_param('sssss', $author, $title, $category, $year, $isbn);
```

The first argument to `bind_param` is a string representing the type of each of the arguments in turn. In this case, it comprises five `s` characters, representing strings, but any combination of types can be specified here, out of the following:

- `i`: The data is an integer.
- `d`: The data is a double.
- `s`: The data is a string.

- b: The data is a BLOB (and will be sent in packets).

With the variables bound to the prepared statement, it is now necessary to populate these variables with the data to be passed to MySQL, like this:

```
$author   = 'Emily Brontë';
$title    = 'Wuthering Heights';
$category = 'Classic Fiction';
$year     = '1847';
$isbn     = '9780553212587';
```

At this point, PHP has everything it needs in order to execute the prepared statement, so you can issue the following command, which calls the execute method of the $stmt object created earlier:

```
$stmt->execute();
```

Before going any further, it makes sense to verify whether the command was executed successfully. Here's how you can do that by checking the affected_rows property of $stmt:

```
printf("%d Row inserted.\n", $stmt->affected_rows);
```

In this case, the output should indicate that one row was inserted.

Once you are happy that the statement executed successfully (or you have dealt with any errors), you can close the $stmt object, like this:

```
$stmt->close();
```

and finally close the $conn object (assuming you have finished with it too), like this:

```
$conn->close();
```

When you put all this together, the result is Example 10-19.

Example 10-19. Issuing prepared statements

```
<?php
  require_once 'login.php';
  $conn = new mysqli($hn, $un, $pw, $db);
  if ($conn->connect_error) die("Fatal Error");

  $stmt = $conn->prepare('INSERT INTO classics VALUES(?,?,?,?,?)');
  $stmt->bind_param('sssss', $author, $title, $category, $year, $isbn);

  $author   = 'Emily Brontë';
  $title    = 'Wuthering Heights';
  $category = 'Classic Fiction';
  $year     = '1847';
  $isbn     = '9780553212587';

  $stmt->execute();
  printf("%d Row inserted.\n", $stmt->affected_rows);
  $stmt->close();
  $conn->close();
?>
```

Every time you are able to use prepared statements in place of nonprepared ones, you will be closing a potential security hole, so it's worth spending some time getting to know how to use them.

Preventing HTML Injection

There's another type of injection you need to concern yourself about—not for the safety of your own websites, but for your users' privacy and protection. That's *cross-site scripting*, also referred to as an *XSS attack*.

This occurs when you allow HTML or, more often, JavaScript code to be input by a user and then displayed by your website. One place this is common is in a comment form. What happens most often is that a malicious user will try to write code that steals cookies from your site's users, which sometimes even allows them to discover username and password pairs if those are poorly handled, or other information that could enable session hijacking (in which a user's login is taken over by a hacker, who could then take over that person's account!). Or the malicious user might launch an attack to download a Trojan onto a user's computer.

But preventing this is as simple as calling the `htmlentities` function, which strips out all HTML markup and replaces it with a form that displays the characters, but does not allow a browser to act on them. For example, consider this HTML:

```
<script src='http://x.com/hack.js'>
</script><script>hack();</script>
```

This code loads in a JavaScript program and then executes malicious functions. But if it is first passed through `htmlentities`, it will be turned into the following totally harmless string:

```
&lt;script src='http://x.com/hack.js'&gt; &lt;/script&gt;
&lt;script&gt;hack();&lt;/script&gt;
```

Therefore, if you are ever going to display anything that your users enter, either immediately or after storing it in a database, you need to first sanitize it using the `htmlentities` function. To do this, I recommend that you create a new function, like the first one in Example 10-20, which can sanitize for both SQL and XSS injections.

Example 10-20. Functions for preventing both SQL and XSS injection attacks

```
<?php
  function mysql_entities_fix_string($conn, $string)
  {
    return htmlentities(mysql_fix_string($conn, $string));
  }

  function mysql_fix_string($conn, $string)
  {
    if (get_magic_quotes_gpc()) $string = stripslashes($string);
    return $conn->real_escape_string($string);
  }
?>
```

The `mysql_entities_fix_string` function first calls `mysql_fix_string` and then passes the result through `htmlentities` before returning the fully sanitized string. To use either of these functions, you must already have an active connection object open to a MySQL database.

Example 10-21 shows the new "higher protection" version of Example 10-17.

Example 10-21. How to safely access MySQL and prevent XSS attacks

```
<?php
  require_once 'login.php';
  $conn = new mysqli($hn, $un, $pw, $db);
  if ($conn->connect_error) die("Fatal Error");

  $user  = mysql_entities_fix_string($conn, $_POST['user']);
  $pass  = mysql_entities_fix_string($conn, $_POST['pass']);
  $query = "SELECT * FROM users WHERE user='$user' AND pass='$pass'";

  // Etc.

  function mysql_entities_fix_string($conn, $string)
  {
    return htmlentities(mysql_fix_string($conn, $string));
  }

  function mysql_fix_string($conn, $string)
  {
    if (get_magic_quotes_gpc()) $string = stripslashes($string);
    return $conn->real_escape_string($string);
  }
?>
```

Using mysqli Procedurally

If you prefer, there is an alternative set of functions you can use to access `mysqli` in a procedural (rather than object-oriented) manner.

So, instead of creating a `$conn` object like this:

```
$conn = new mysqli($hn, $un, $pw, $db);
```

You can use the following:

```
$link = mysqli_connect($hn, $un, $pw, $db);
```

To check that the connection has been made and handle it, you could use code such as this:

```
if (mysqli_connect_errno()) die("Fatal Error");
```

And to make a MySQL query, you would use code such as the following:

```
$result = mysqli_query($link, "SELECT * FROM classics");
```

Upon return, `$result` will contain the data. You can find out the number of rows returned as follows:

```
$rows = mysqli_num_rows($result);
```

An integer is returned in `$rows`. You can fetch the actual data one row at a time in the following way, which returns a numeric array:

```
$row = mysqli_fetch_array($result, MYSQLI_NUM);
```

In this instance, `$row[0]` will contain the first column of data, `$row[1]` the second, and so on. As described in "Fetching a row" on page 241, rows can also be returned as associative arrays or as both types, depending on the value passed in the second argument.

When you need to know the insert ID of an insert operation, you can always call the `mysqli_insert_id` function, like this:

```
$insertID = mysqli_insert_id($result);
```

Escaping strings procedurally with `mysqli` is as easy as using the following:

```
$escaped = mysqli_real_escape_string($link, $val);
```

And preparing a statement with `mysqli` is as simple as this:

```
$stmt = mysqli_prepare($link, 'INSERT INTO classics VALUES(?,?,?,?,?)');
```

To bind variables to the prepared statement, you would then use the following:

```
mysqli_stmt_bind_param($stmt, 'sssss', $author, $title, $category, $year, $isbn);
```

And to execute the prepared statement after assigning the variables with the required values, you would issue this call:

```
mysqli_stmt_execute($stmt);
```

To close a statement, issue the following command:

```
mysqli_stmt_close($stmt);
```

And to close the connection to MySQL, enter this command:

```
mysqli_close($link);
```

Check out for the documentation in the PHP Manual for complete details on using prepared statements, procedurally or otherwise, and for more advice on all aspects of `mysqli`.

Now that you have learned how to integrate PHP with MySQL in several different ways, the next chapter moves on to creating user-friendly forms and dealing with the data submitted from them.

Questions

1. How do you connect to a MySQL database using `mysqli`?
2. How do you submit a query to MySQL using `mysqli`?
3. How can you retrieve a string containing an error message when a `mysqli` error occurs?
4. How can you determine the number of rows returned by a `mysqli` query?
5. How can you retrieve a particular row of data from a set of `mysqli` results?
6. Which `mysqli` method can be used to properly escape user input to prevent code injection?
7. What negative effects can happen if you do not close the objects created by `mysqli` methods?

See "Chapter 10 Answers" on page 720 in Appendix A for the answers to these questions.