



PHP 8 Quick Scripting Reference

A Pocket Guide to PHP Web Scripting

—

Third Edition

—

Mikael Olsson

Apress®

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About the Author



Mikael Olsson is a professional web entrepreneur, programmer, and author. He works for an R&D company in Finland, where he specializes in software development.

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Introduction

PHP is a server-side programming language used for creating dynamic websites and interactive web applications. The acronym PHP originally stood for Personal Home Page, but as its functionality grew, this was changed to PHP: Hypertext Preprocessor. This recursive acronym comes from the fact that it takes PHP code as input and produces HTML as output. This means that users do not need to install any software to view PHP-generated web pages. All that is required is that the web server has PHP installed to interpret the script.

In contrast with HTML sites, PHP sites are dynamically generated. Instead of the site being made up of a large number of static HTML files, a PHP site may consist of only a handful of template files. The template files describe only the structure of the site using PHP code, while the web content is pulled from a database and the style formatting is from Cascading Style Sheets (CSS). This allows for site-wide changes from a single location, providing a flexible website that is easy to design, maintain, and update.

When creating websites with PHP, a content management system (CMS) is generally used. A CMS provides a fully integrated platform for website development consisting of a back end and a front end. The front end is what visitors see when they arrive at the site, whereas the back end is where the site is configured, updated, and managed by administrators. The back end also allows a web developer to change template files and modify plugins to more extensively customize the functionality and structure of the site. Examples of free PHP-based CMS solutions include WordPress, Joomla, MODX, and Drupal, with WordPress being the most popular and accounting for more than half of the CMS market.

INTRODUCTION

The first version of PHP was created by Rasmus Lerdorf and released in 1995. Since then, PHP has evolved greatly from a simple scripting language to a fully featured web programming language. The official implementation is now released by the PHP Group, with PHP 8 being the most recent version as of this writing. The language may be used free of charge and is open source, allowing developers to extend it for their own use or to contribute to its development.

PHP is by far the most popular server-side programming language in use today. It holds an 80% market share when compared with other server-side technologies, such as ASP.NET, Java, Ruby, and Python. One of the reasons for the widespread adoption of PHP is its platform independence. It can be installed on all major web servers and operating systems and used with any major database system. Another strong feature of PHP is its simple-to-use syntax based on C and Perl, which is easy for a newcomer to learn; however, PHP also offers many advanced features for the professional programmer.

CHAPTER 1

Using PHP

To start developing in PHP, create a plain text file with a `.php` file extension and open it in the editor of your choice—for example, Notepad, jEdit, Dreamweaver, NetBeans, or PHPEclipse. This PHP file can include any HTML, as well as PHP scripting code. Begin by first entering the following minimal markup for an HTML 5 web document.

```
<!doctype html>
<html>
  <head>
    <meta charset="UTF-8">
    <title>PHP Test</title>
  </head>
  <body></body>
</html>
```

Embedding PHP

PHP code can be embedded anywhere in a web document in several different ways. The standard notation is to delimit the code by `<?php` and `?>`. This is called a *PHP code block*, or just a *PHP block*.

```
<?php ... ?>
```

Within a PHP block, the PHP engine is said to be in *PHP mode*; outside of the block, the engine is in *HTML mode*. In PHP mode, everything is parsed (executed) by the PHP engine, whereas in HTML mode, everything is sent to the generated web page without any parsing.

The second notation for switching to PHP mode is a short version of the first where the `php` part is left out. Although this notation is shorter, the longer one is preferable if the PHP code needs to be portable. This is because support for the short delimiter can be disabled in the `php.ini` configuration file.¹

```
<? ... ?>
```

A third (now obsolete) alternative was to embed the PHP code within an HTML script element with the language attribute set to `php`. This alternative delimiter was seldom used; support for it was removed in PHP 7.

```
<script language="php">...</script>
```

Another obsolete notation that you may encounter in legacy code is when the script is embedded between ASP tags. This notation is disabled by default, but it can be enabled from the PHP configuration file. Use of this notation has long been discouraged. The ability to enable it was finally removed in PHP 7.

```
<% ... %>
```

The last closing tag in a script file may be omitted to make the file end while it is still in PHP mode.

```
<?php ... ?>
```

```
<?php ...
```

¹www.php.net/manual/en/configuration.file.php

Outputting Text

Printing text in PHP is done by either typing **echo** or **print** followed by the output. Each statement must end with a semicolon (;) in order to separate it from other statements. The semicolon for the last statement in a PHP block is optional, but it is a good practice to include it.

```
<?php
    echo "Hello World";
    print "Hello World";
?>
```

Output can also be generated using the `<?=>` open delimiter. As of PHP 5.4, this syntax is valid even if the short PHP delimiter is disabled.

```
<?= "Hello World" ?>
```

Keep in mind that text displayed on a web page should always be located within the HTML body element.

```
<body>
    <?php echo "Hello World"; ?>
</body>
```

Installing a Web Server

To view PHP code in a browser, the code first has to be parsed on a web server with the PHP module installed. An easy way to set up a PHP environment is to download and install a distribution of the popular Apache web server called XAMPP,² which comes preinstalled with PHP, Perl, and MariaDB. It is available for Windows, Linux, as well as OS X and allows you to experiment with PHP on your own computer.

²www.apachefriends.org

After installing the web server, point your browser to `http://localhost` to make sure that the server is online. It should display the `index.php` file, which by default is located under `C:\xampp\htdocs\` on Windows or `/opt/lampp/htdocs/` on Linux. `htdocs` is the folder that the Apache web server looks into for files to serve on your domain.

Hello World

Continuing from before, the simple Hello World PHP web document should look like this:

```
<!doctype html>
<html>
  <head>
    <meta charset="UTF-8">
    <title>PHP Test</title>
  </head>
  <body>
    <?php echo "Hello World"; ?>
  </body>
</html>
```

To view this PHP file parsed into HTML, save it to the web server's `htdocs` folder (the server's root directory) with a name such as `mypage.php`. Then point your browser to its path, which is `http://localhost/mypage.php` for a local web server.

When a request is made for the PHP web page, the script is parsed on the server and sent to the browser as only HTML. If the source code for the website is viewed, it will not show any of the server-side code that generated the page—only the HTML output.

Compile and Parse

PHP is an interpreted language, not a compiled language. Every time a visitor arrives at a PHP website, the PHP engine compiles the code and parses it into HTML, which is then sent to the visitor. The main advantage of this is that the code can be changed easily without having to recompile and redeploy the website. The main disadvantage is that compiling the code at run-time requires more server resources.

For a small website, a lack of server resources is seldom an issue. The time it takes to compile PHP code is also miniscule compared to other factors, such as the time required to execute database queries. However, for a large web application with lots of traffic, the server load from compiling PHP files is likely to be significant. For such a site, the script compilation overhead can be removed by precompiling the PHP code. This can be done using a PHP accelerator such as WinCache,³ which caches PHP scripts in their compiled state.

A website that only serves static content (same to all visitors) has another possibility, which is to cache the fully generated HTML pages. This provides all the maintenance benefits of having a dynamic site, with the speed of a static site. One such caching tool is the W3 Total Cache⁴ plugin for the WordPress CMS.

Each new version of PHP has improved not just the language but also the performance of the PHP engine. In particular, PHP 8 added a JIT (just in time) compiler. This compiler continuously looks for PHP code that is frequently re-executed. This code is then compiled into machine code and cached, allowing for the code to execute even faster than regular cached precompiled code.

³<https://sourceforge.net/projects/wincache/>

⁴<http://wordpress.org/extend/plugins/w3-total-cache>

Comments

Comments are used to insert notes into the code. They have no effect on the parsing of the script. PHP has the two standard C++ notations for single-line (//) and multiline (/* */) comments. The Perl comment notation (#) may also be used to make single-line comments.

```
<?php
    // single-line comment
    # single-line comment
    /* multi-line
       comment */
?>
```

As in HTML, whitespace characters—such as spaces, tabs, and comments—are ignored by the PHP engine. This allows you a lot of freedom in how to format your code.

CHAPTER 2

Variables

Variables are used for storing data, such as numbers or strings, so that they can be used multiple times in the code.

Defining Variables

A variable starts with a dollar sign (\$) followed by an *identifier*, which is the name of the variable. A common naming convention for variables is to have each word initially capitalized, except for the first one.

```
$myVar;
```

A value can be assigned to a variable by using the equals sign, or assignment operator (=). The variable then becomes *defined* or *initialized*.

```
$myVar = 10;
```

Once a variable has been defined, it can be used by referencing the variable's name. For example, the value of the variable can be printed to the web page by using `echo` followed by the variable's name.

```
echo $myVar; // "10"
```

Keep in mind that variable names are case sensitive. Names in PHP can include underscore characters and numbers, but they cannot start with a number. They also cannot contain spaces or special characters, and they must not be a reserved keyword.

Data Types

PHP is a loosely typed language. This means that the type of data that a variable can store is not specified. Instead, a variable's data type changes automatically to hold the value that it is assigned.

```
$myVar = 1; // int type
$myVar = 1.5; // float type
```

Furthermore, the value of a variable is evaluated differently, depending on the context in which it is used.

```
// Float type evaluated as string type
echo $myVar; // "1.5"
```

Because of these implicit type conversions, knowing the underlying type of a variable is not always necessary. Nevertheless, it is important to have an understanding of the data types that PHP works with in the background. These ten types are listed in Table 2-1.

Table 2-1. *PHP Data Types*

Data Type	Category	Description
int	Scalar	Integer.
float	Scalar	Floating-point number.
bool	Scalar	Boolean value.
string	Scalar	Series of characters.
array	Composite	Collection of values.
object	Composite	User-defined data type.
resource	Special	External resource.
callable	Special	Function or method.
mixed	Special	Any type.
null	Special	No value.

Integer Type

An integer is a whole number. They can be specified in decimal (base 10), hexadecimal (base 16), octal (base 8), or binary (base 2) notation.

Hexadecimal numbers are preceded with a 0x, octal with a 0, and binary numbers with a 0b.

```
$myInt = 1234; // decimal number
$myInt = 0b10; // binary number (2 in decimal)
$myInt = 0123; // octal number (83 in decimal)
$myInt = 0x1A; // hexadecimal number (26 in decimal)
```

Integers in PHP are always signed and can therefore store both positive and negative values. The size of an integer depends on the system word size, so on a 32-bit system, the largest storable value is 2^{32-1} . If PHP encounters a larger value, it is interpreted as a float instead.

Floating-Point Type

The float or floating-point type can store real numbers. These can be assigned using either decimal or exponential notation.

```
$myFloat = 1.234;
$myFloat = 3e2; // 3*10^2 = 300
```

The precision of a float is platform dependent. Commonly, the 64-bit IEEE format is used, which can hold approximately 14 decimal digits and a maximum decimal value of 1.8×10^{308} .

Bool Type

The bool type can store a Boolean value, which is a value that can only be either true or false. These values are specified with the true and false keywords.

```
$myBool = true;
```

Null Type

The case-insensitive constant null is used to represent a variable with no value. Such a variable is considered to be of the special null data type.

```
$myNull = null; // variable is set to null
```

Just as with other values, the null value evaluates differently, depending on the context in which the variable is used. If evaluated as a bool, it becomes false; as a number, it becomes zero (0); and as a string, it becomes an empty string ("").

```
$myInt = $myNull + 0;           // numeric context (0)
$myBool = $myNull == true;     // bool context (false)
echo $myNull;                  // string context ("")
```

Default Values

As of PHP 8, a variable must be defined before it can be used. Attempting to use an undefined variable will trigger an error exception, which halts execution of the script.

```
// PHP 8
$myDefined = null;
echo $myDefined; // ok
echo $myUndefined; // error exception
```

Prior to PHP 8, it was possible to use variables that had not been assigned a value. Such undefined variables would then automatically be created with a null value.

```
// Before PHP 8  
echo $myUndefined; // created and set to null
```

Although this behavior was allowed, it has always been a good coding practice to define variables before they are used, even if the variables are just set to null. As a reminder for this, PHP versions prior to PHP 8 issued an error notice when an undefined variable was used.

```
Notice: Undefined variable: myUndefined in C:\xampp\htdocs\  
mypage.php on line 10
```

CHAPTER 3

Operators

A numeric operator is a symbol that makes the script perform a specific mathematical or logical manipulation. The numeric operators can be grouped into five types: arithmetic, assignment, comparison, logical, and bitwise operators.

Arithmetic Operators

The arithmetic operators include the four basic arithmetic operations, as well as the modulus operator (%), which is used to obtain the division remainder.

```
$x = 4 + 2; // 6, addition
```

```
$x = 4 - 2; // 2, subtraction
```

```
$x = 4 * 2; // 8, multiplication
```

```
$x = 4 / 2; // 2, division
```

```
$x = 4 % 2; // 0, modulus (division remainder)
```

An exponentiation operator (**) was introduced in PHP 5.6. It raises the left-side operand to the power of the right-side operand.

```
$x = 4 ** 2; // 16, exponentiation
```

Assignment Operators

The second group is the assignment operators, most importantly, the assignment operator (=) itself, which assigns a value to a variable.

```
$x = 1; // assignment
```

Combined Assignment Operators

A common use of the assignment and arithmetic operators is to operate on a variable and then to save the result back into that same variable. These operations can be shortened with the combined assignment operators.

```
$x += 5; // $x = $x+5;
$x -= 5; // $x = $x-5;
$x *= 5; // $x = $x*5;
$x /= 5; // $x = $x/5;
$x %= 5; // $x = $x%5;
```

The exponentiation operator added in PHP 5.6 also received a shorthand assignment operator.

```
$x **= 5; // $x = $x**5;
```

Increment and Decrement Operators

Another common operation is to increment or decrement a variable by one. This can be simplified with the increment (++) and decrement (--) operators.

```
$x++; // $x += 1;
$x--; // $x -= 1;
```

Both of these operators can be used either before or after a variable.

```
$x++; // post-increment
$x--; // post-decrement
++$x; // pre-increment
--$x; // pre-decrement
```

The result on the variable is the same whichever is used. The difference is that the post-operator returns the original value before it changes the variable, whereas the pre-operator changes the variable first and then returns the value.

```
$x = 5; $y = $x++; // $x=6, $y=5
$x = 5; $y = ++$x; // $x=6, $y=6
```

Comparison Operators

The comparison operators compare two values and return either true or false. They are mainly used to specify conditions, which are expressions that evaluate to either true or false.

```
$x = (2 == 3); // equal to (false)
$x = (2 != 3); // not equal to (true)
$x = (2 <> 3); // not equal to (alternative)
$x = (2 === 3); // identical (false)
$x = (2 !== 3); // not identical (true)
$x = (2 > 3); // false, greater than (false)
$x = (2 < 3); // less than (true)
$x = (2 >= 3); // greater than or equal to (false)
$x = (2 <= 3); // less than or equal to (true)
```

The strict equality operators, `===` and `!==`, are used for comparing both type and value. These are necessary because the regular “equal to” (`==`) and “not equal to” (`!=`) operators automatically perform a type conversion before they compare the operands. It is considered good practice to use strict comparison when the type conversion feature of the “equal to” operation is not needed.

```
$x = (1 == "1"); // true (same value)
$x = (1 === "1"); // false (different types)
```

PHP 7 added a new comparison operator called the *spaceship operator* (`<=>`). It compares two values and returns 0 if both values are equal, 1 if the value on the left side is greater, and -1 if the value on the right side is greater.

```
$x = 1 <=> 1; // 0 (1 == 1)
$x = 3 <=> 2; // 1 (3 > 2)
$x = 1 <=> 2; // -1 (1 < 2)
```

Logical Operators

The logical operators are often used together with the comparison operators. Logical and (`&&`) evaluates to true if both the left and right side are true, and logical or (`||`) evaluates to true if either the left or right side is true. For inverting a Boolean result, there is the logical not (`!`) operator. Note that for both “logical and” and “logical or”, the right side of the operator is not evaluated if the result is already determined by the left side.

```
$x = (true && false); // logical and (false)
$x = (true || false); // logical or (true)
$x = !true;           // logical not (false)
```

Bitwise Operators

The bitwise operators can manipulate binary digits of numbers. For example, the xor operator (^) turns on the bits that are set on one side of the operator, but not on both sides.

```
$x = 5 & 4; // 101&100=100 (4) // and
$x = 5 | 4; // 101|100=101 (5) // or
$x = 5 ^ 4; // 101^100=001 (1) // xor (exclusive or)
$x = 4 << 1; // 100<<1=1000 (8) // left shift
$x = 4 >> 1; // 100>>1=10 (2) // right shift
$x = ~4; // ~00000100=11111011 (-5) // invert
```

These bitwise operators have shorthand assignment operators, just like the arithmetic operators.

```
$x=5; $x &= 4; // 101&100=100 (4) // and
$x=5; $x |= 4; // 101|100=101 (5) // or
$x=5; $x ^= 4; // 101^100=001 (1) // xor
$x=5; $x <<= 1; // 101<<1=1010 (10)// left shift
$x=5; $x >>= 1; // 101>>1=10 (2) // right shift
```

Note that decimal numbers used together with bitwise operators are automatically evaluated in binary. The binary notation may also be used to specify binary numbers for a bitwise operation.

```
$x = 0b101 & 0b100; // 0b100 (4)
```

Operator Precedence

When an expression contains multiple operators, the precedence of those operators decides the order in which they are evaluated. The order of precedence can be seen in Table 3-1.

Table 3-1. *Order of Operator Precedence*

Pre	Operator	Pre	Operator
1	**	10	&
2	++ --	11	^
3	~ - (unary)	12	
4	!	13	&&
5	* / %	14	
6	+ - (binary)	15	= op=
7	<< >>	16	and
8	< <= > >= <>	17	xor
9	== != === !== <=>	18	or

To give an example, multiplication has greater precedence than addition, and therefore it is evaluated first in the following line of code.

```
$x = 4 + 3 * 2; // 10
```

Parentheses can be used to force precedence. An expression placed within parentheses is evaluated before other expressions in that statement.

```
$x = (4 + 3) * 2; // 14
```

Additional Logical Operators

In the precedence table, make special note of the last three operators: and, or, and xor. The and and or operators work in the same way as the logical && and || operators. The only difference is their lower level of precedence.

```
// Same as: $x = (true && false);  
$x = true && false; // $x is false (0)  
  
// Same as: ($x = true) and false;  
$x = true and false; // $x is true (1)
```

The xor operator is a Boolean version of the bitwise ^ operator. It evaluates to true if only one of the operands is true.

```
$x = (true xor true); // false
```

CHAPTER 4

String

A string is a series of characters that can be stored in a variable. In PHP, strings are often delimited by single quotes.

```
$a = 'Hello';
```

String Concatenation

PHP has two string operators. The dot symbol is known as the *concatenation operator* (.). It combines two strings into one. It also has an accompanying assignment operator (.=), which appends the right-hand string to the left-hand string variable.

```
$b = $a . ' World'; // Hello World  
$a .= ' World';    // Hello World
```

Delimiting Strings

PHP strings can be delimited in four different ways. There are two common notations: double quote (" ") and single quote (' '). The difference between them is that variables are not parsed in single-quoted strings, whereas they are parsed in double-quoted strings.

```
$c = 'World';  
echo "Hello $c"; // "Hello World"  
echo 'Hello $c'; // "Hello $c"
```

Single-quoted strings tend to be preferred unless parsing is desired, which highlights that no parsing takes place. However, double-quoted strings are considered easier to read, which makes the choice more a matter of preference. The important thing is to be consistent.

In addition to single-quoted and double-quoted strings, there are two more notations: *heredoc* and *nowdoc*. These notations are mainly used to include larger blocks of text.

Heredoc Strings

The heredoc syntax consists of the `<<<` operator followed by an identifier and a new line. The string is then included followed by a new line containing the identifier to close the string.

```
$s = <<<LABEL
Heredoc string (with parsing)
Goodbye
LABEL;
```

Variables are parsed inside of a heredoc string, just as with double-quoted strings.

```
$name = 'John';
$s = <<<LABEL
Hello $name
LABEL;
echo $s; // "Hello John"
```

Nowdoc Strings

The syntax for the nowdoc string is the same as for the heredoc string, except that the initial identifier is enclosed in single quotes. Variables are not parsed inside a nowdoc string.

```
$s = <<<'LABEL '  
Nowdoc string (without parsing)  
LABEL;
```

Heredoc and nowdoc strings are useful for improving readability when defining long strings that stretch multiple lines. Any special characters, such as newline or quotation mark, that appear in these strings will be included without the need to use escape characters.

Escape Characters

Escape characters are used to write special characters, such as backslashes, newlines, and double quotes. These characters are always preceded by a backslash (`\`). Table 4-1 lists the escape characters available in PHP.

Table 4-1. *Escape Characters*

Character	Meaning	Character	Meaning
<code>\n</code>	Newline	<code>\f</code>	Form feed
<code>\t</code>	Horizontal tab	<code>\\$</code>	Dollar sign
<code>\v</code>	Vertical tab	<code>\'</code>	Single quote
<code>\e</code>	Escape	<code>\"</code>	Double quote
<code>\r</code>	Carriage return	<code>\\</code>	Backslash
<code>\u{}</code>	Unicode character		

For example, line breaks are represented with the escape character (`\n`) within strings.

```
$s = "Hello\nWorld";
```

Note that this character is different from the `
` HTML tag, which creates line breaks on web pages.

```
echo "Hello<br>World";
```

When using the single quote or nowdoc delimiter, the only escape characters that work are the backslash (`\\`) and single-quote (`\'`) characters. Escaping the backslash is only necessary before a single quote or at the end of the string.

```
$s = 'It\'s'; // "It's"
```

PHP 7 introduced the Unicode escape character, which provides the ability to embed UTF-8 encoded characters into strings. Such a character is specified as a hexadecimal number inside curly brackets. The number can be up to six digits long, with leading zeros being optional.

```
echo "\u{00C2A9}"; // © (copyright sign)
echo "\u{C2A9}"; // ©
```

Character Reference

Characters within strings can be referenced by specifying the index of the desired character in square brackets after the string variable, starting with zero. This can be used both for accessing and modifying single characters.

```
$s = 'Hello';
$s[0] = 'J';
echo $s; // "Jello"
```

The `strlen` function retrieves the length of the string argument. This can be used to change the last character of a string, for example.

```
$s[strlen($s)-1] = 'y';
echo $s; // "Jelly"
```

String Compare

The way to compare two strings is simply by using one of the equality operators. This does not compare the memory addresses, as in some other languages.

```
$a = 'test';
$b = 'test';
$c = ($a === $b); // true
```

String Functions

PHP has a number of built-in functions for handling and manipulating strings. Examples of some of the more commonly used string functions can be seen here.

```
$a = 'String';

// Search and replace characters in a string
$b = str_replace('i', 'o', $a); // Strong

// Insert text at specified position
$b = substr_replace($a, 'My ', 0, 0); // My String

// Get part of string specified by start and length
$b = substr($a, 0, 3); // Str

// Convert to uppercase
$b = strtoupper($a); // STRING

// Find position of the first occurrence of a substring
$i = strpos($a, 'i'); // 3 (starts at 0)

// Get string length
$i = strlen($a); // 6
```

CHAPTER 5

Arrays

An array is used to store a collection of values in a single variable. Arrays in PHP consist of key-value pairs. The key can either be an integer (numeric array), a string (associative array), or a combination of both (mixed array). The value can be any data type.

Numeric Arrays

Numeric arrays store each element in the array with a numeric index. An array is created using the array constructor. This constructor takes a list of values, which are assigned to elements of the array.

```
$a = array(1,2,3);
```

As of PHP 5.4, a shorter syntax is available, where the array constructor is replaced with square brackets.

```
$a = [1,2,3];
```

Once the array is created, its elements can be referenced by placing the index of the desired element in square brackets. Note that the index begins with zero.

```
$a[0] = 1;
```

```
$a[1] = 2;
```

```
$a[2] = 3;
```


The number of elements in the array is handled automatically. Adding a new element to the array is as easy as assigning a value to it.

```
$a[3] = 4;
```

The index can also be left out to add the value to the end of the array. This syntax also constructs a new array if the variable does not already contain one.

```
$a[] = 5; // $a[4]
```

To retrieve the value of an element in the array, the index of that element is specified inside the square brackets.

```
echo "$a[0] $a[1] $a[2] $a[3]"; // "1 2 3 4"
```

Associative Arrays

In associative arrays, the key is a string instead of a numeric index, which gives the element a name instead of a number. When creating the array, the double arrow operator (`=>`) is used to tell which key refers to what value.

```
$b = array('one' => 'a', 'two' => 'b', 'three' => 'c');
```

Elements in associative arrays are referenced using the element names. They cannot be referenced with a numeric index.

```
$b['one'] = 'a';
```

```
$b['two'] = 'b';
```

```
$b['three'] = 'c';
```

```
echo $b['one'] . $b['two'] . $b['three']; // "abc"
```

The double arrow operator can also be used with numeric arrays to decide in which element a value is placed.

```
$c = array(0 => 0, 1 => 1, 2 => 2);
```

Not all keys need to be specified. If a key is left unspecified, the value is assigned to the element following the largest previously used integer key.

```
$e = array(5 => 5, 6);
```

Mixed Arrays

PHP makes no distinction between associative and numerical arrays, and so elements of each can be combined in the same array.

```
$d = array(0 => 1, 'foo' => 'bar');
```

Just be sure to access the elements with the same keys.

```
echo $d[0] . $d['foo']; // "1bar"
```

Multi-dimensional Arrays

A multi-dimensional array is an array that contains other arrays. For example, a two-dimensional array can be constructed in the following way.

```
$a = array(array('00', '01'), array('10', '11'));
```

Once created, the elements can be modified using two sets of square brackets.

```
$a[0][0] = '00';
```

```
$a[0][1] = '01';
```

```
$a[1][0] = '10';
```

```
$a[1][1] = '11';
```

They are also accessed in the same way.

CHAPTER 5 ARRAYS

```
echo $a[0][0] . $a[0][1] . $a[1][0] . $a[1][1];
```

The key can be given a string name to make it into a multi-dimensional associative array, also called a *hash table*.

```
$b = array('one' => array('00', '01'));  
echo $b['one'][0] . $b['one'][1]; // "0001"
```

Multi-dimensional arrays can have more than two dimensions by adding additional sets of square brackets.

```
$c[][][][] = "0000"; // four dimensions
```

CHAPTER 6

Conditionals

Conditional statements are used to execute different code blocks based on different conditions.

If Statement

The `if` statement only executes if the condition inside the parentheses is evaluated to `true`. The condition can include any of the comparison and logical operators.

```
$x = 1;
// ...
if ($x == 1) {
    echo 'x is 1';
}
```

To test for other conditions, the `if` statement can be extended with any number of `elseif` clauses. Each additional condition is only tested if all previous conditions are false.

```
elseif ($x == 2) {
    echo 'x is 2';
}
```

For handling all other cases, there can be one `else` clause at the end, which executes if all previous conditions are false.

```
else {
    echo 'x is something else';
}
```

The curly brackets can be left out if only a single statement needs to be executed conditionally. However, it is considered good practice to include them since they improve code readability.

```
if ($x == 1)
    echo 'x is 1';
elseif ($x == 2)
    echo 'x is 2';
else
    echo 'x is something else';
```

Keep in mind that the scope of a variable in PHP is not limited by local code blocks, unlike in many other programming languages. Therefore, a variable created inside a conditional statement will remain accessible even after the end of the code block.

```
if ($x == 1) {
    $output = 'True';
}
else {
    $output = 'False';
}
echo $output; // ok
```

Any expression can be used as the condition for an if statement, not just Boolean values. As seen in the following, any zero-like expression will be evaluated as false. All other values are considered true.

```
if (0) {} // false
if (-0.0) {} // false
```

```
if ('') {} // false (empty string)
if (array()) {} // false (empty array)
if (null) {} // false (no value)
if (-1) {} // true (non-zero number)
```

Switch Statement

The switch statement checks for equality between an integer, float, or string and a series of case labels. It then passes execution to the matching case. The statement can contain any number of case clauses and may end with a default label for handling all other cases.

```
switch ($x)
{
    case 1: echo 'x is 1'; break;
    case 2: echo 'x is 2'; break;
    default: echo 'x is something else';
}
```

Note that the statements after each case label are not surrounded by curly brackets. Instead, the statements end with the `break` keyword to break out of the switch. Without the `break`, execution falls through to the next case. This is useful if several cases need to be evaluated in the same way.

Alternative Syntax

PHP has an alternative syntax for the conditional statements. In this syntax, the `if` statement's opening bracket is replaced with a colon, the closing bracket is removed, and the last closing bracket is replaced with the `endif` keyword.

```

if ($x == 1):    echo 'x is 1';
elseif ($x == 2): echo 'x is 2';
else:          echo 'x is something else';
endif;

```

Similarly, the switch statement also has an alternative syntax, which instead uses the `endswitch` keyword to terminate the statement.

```

switch ($x):
  case 1: echo 'x is 1'; break;
  case 2: echo 'x is 2'; break;
  default: echo 'x is something else';
endswitch;

```

The alternative syntax is often preferable for longer conditional statements since it then becomes easier to see where those statements end.

Mixed Modes

It is possible to switch back to HTML mode in the middle of a code block. This provides another way of writing conditional statements that output text to the web page.

```

<?php if ($x == 1) { ?>
  This will show if $x is 1.
<?php } else { ?>
  Otherwise this will show.
<?php } ?>

```

The alternative syntax may also be used in this way to make the code clearer.

```

<?php if ($x == 1): ?>
  This will show if $x is 1.

```

```
<?php else: ?>
    Otherwise this will show.
<?php endif; ?>
```

When outputting HTML and text, particularly larger blocks, this coding style is generally preferred because it makes it easier to distinguish between PHP code and the HTML content that appears on the web page.

Ternary Operator

In addition to the `if` and `switch` statements, there is the ternary operator (`?:`). This operator can replace a single `if/else` clause. The operator takes three expressions. If the first one is evaluated to `true`, then the second expression is returned, and if it is `false`, the third one is returned.

```
// Ternary operator expression
$y = ($x == 1) ? 1 : 2;
```

In PHP, this operator can be used as an expression and as a statement.

```
// Ternary operator statement
($x == 1) ? $y = 1 : $y = 2;
```

The programming term *expression* refers to code that evaluates to a value, whereas a *statement* is a code segment that ends with a semicolon or a closing curly bracket.

Match Expression

PHP 8 added a new conditional statement called the match expression. It offers some improvements to the `switch` statement, including a more concise syntax. Consider the following `switch` statement.

CHAPTER 6 CONDITIONALS

```
switch ($x)
{
  case 1: $output = 'True' break;
  case 2: $output = 'False'; break;
  default: $output = 'Unknown';
}
```

This statement can be rewritten into the match expression seen as follows. Note that the break keyword is not used and the expression ends with a semicolon.

```
$output = match($x) {
  1 => 'True',
  2 => 'False',
  default => 'Unknown'
};
echo $output;
```

Only a single expression is allowed per case. The returned value can be ignored so the previous example can alternatively be typed in the following way.

```
match($x) {
  1 => $output = 'True',
  2 => $output = 'False',
  default => $output = 'Unknown'
};
echo $output;
```

Whereas switch cases are matched using loose comparison (==), match expression cases are matched using strict comparison (===). This helps to avoid subtle conversion mistakes.

```

$x = '1'; // string type
switch ($x)
{
    case 1: $output = 'integer'; break;
    case '1': $output = 'string';
}
echo $output; // "integer"

$output = match($x) {
    1 => 'integer',
    '1' => 'string',
};
echo $output; // "string"

```

Conditions that are to be handled in the same way can be combined on the same line, separated by commas. Keep in mind that a match expression must have a matching condition or a default case. Otherwise an error occurs and the code stops executing.

```

$x = 4;
match($x) {
    1, 2, 3 => echo 'case 1, 2, or 3'
};
// Fatal error: Uncaught UnhandledMatchError

```

CHAPTER 7

Loops

There are four looping structures in PHP. These are used to execute a specific code block multiple times.

While Loop

The while loop runs through the code block only if its condition is true. It continues looping for as long as the condition remains true. Note that the condition is only checked at the beginning of each iteration (loop).

```
$i = 0;
while ($i < 10) { echo $i++; } // 0-9
```

Just as with the conditional if statement, the curly brackets for loops can be left out if there is only one statement in the code block.

```
$i = 0;
while ($i < 10) echo $i++; // 0-9
```

Do-while Loop

The do-while loop works in the same way as the while loop, except that it checks the condition after the code block. Therefore, it always runs through the code block at least once. Bear in mind that this loop ends with a semicolon.

```
$i = 0;
do { echo $i++; } while ($i < 10); // 0-9
```

For Loop

The for loop is used to go through a code block a specific number of times. It uses three parameters. The first parameter initializes a counter and is always executed once before the loop. The second parameter holds the condition for the loop and is checked before each iteration. The third parameter contains the increment of the counter and is executed at the end of each iteration.

```
for ($i = 0; $i < 10; $i++) { echo $i; } // 0-9
```

The for loop has several variations since either one of the parameters can be left out. For example, if the first and third parameters are left out, it behaves in the same way as the while loop.

```
$i = 0;
for (;$i < 10;) { echo $i++; }
```

The first and third parameters can also be split into several statements using the comma operator (,).

```
for ($i = 0, $x = 9; $i < 10; $i++, $x--) {
    echo $x; // 9-0
}
```

The `sizeof` function retrieves the number of elements in an array. Together with the for loop, it can be used to iterate through a numeric array.

```
$a = array(1,2,3);
for($i = 0; $i < sizeof($a); $i++) {
    echo $a[$i]; // "123"
}
```

If there is no need to keep track of iterations, the `foreach` loop provides a cleaner syntax. This loop is also necessary for traversing associative arrays.

Foreach Loop

The `foreach` loop provides an easy way to iterate through arrays. At each iteration, the next element in the array is assigned to the specified variable (the iterator) and the loop continues to execute until it has gone through the entire array.

```
$a = array(1,2,3);
foreach ($a as $v) {
    echo $v; // "123"
}
```

There is an extension of the `foreach` loop to also obtain the key's name or index by adding a key variable followed by the double arrow operator (`=>`) before the iterator.

```
$a = array('one' => 1, 'two' => 2);
foreach ($a as $k => $v) {
    echo "$k = $v "; // "one = 1 two = 2 "
}
```

Alternative Syntax

As with conditional statements, the brackets in the loops can be rewritten into the alternative syntax with a colon and one of the `endwhile`, `endfor`, or `endforeach` keywords.

```
$i = 0;
while ($i < 10): echo $i++; endwhile;

for ($i = 0; $i < 10; $i++): echo $i; endfor;

$a = array(1,2,3);
foreach ($a as $v): echo $v; endforeach;
```

The main benefit of this is improved readability, especially for longer loops.

Break

There are two special keywords that can be used inside loops—`break` and `continue`. The `break` keyword ends the execution of a loop structure.

```
for ($i = 0; $i < 5; $i++)
{
    if ($i == 3) break; // end loop
    echo $i; // "012"
}
```

It can be given a numeric argument that specifies how many nested looping structures to break out of.

```
$i = 0;
while ($i++ < 10)
{
    for (;;) { break 2; } // end for and while
}
```

Continue

The `continue` keyword can be used within any looping statement to skip the rest of the current loop and continue at the beginning of the next iteration.

```
for ($i = 0; $i < 5; $i++)
{
    if ($i == 2) continue; // start next iteration
    echo $i; // "0134"
}
```

This keyword can accept an argument for how many enclosing loops it should skip to the end of.

```
$i = 0;
while ($i++ < 10)
{
    for (;;) { continue 2; } // start next while iteration
}
```

In contrast to many other languages, the `continue` statement also applies to switches, where it behaves the same as `break`. Therefore, to skip an iteration from inside a switch, `continue 2` needs to be used.

```
$i = 0;
while ($i++ < 10)
{
    switch ($i)
    {
        case 1: continue 2; // start next while iteration
    }
}
```

Goto

A third jump statement introduced in PHP 5.3 is `goto`, which performs a jump to a specified label. A label is a name followed by a colon (:).

```
goto myLabel; // jump to label
myLabel: // label declaration
```

The target label must be within the same script file and scope. Therefore, `goto` cannot be used to jump into looping structures, only out of them.

```
loop:
while (!$finished)
{
    // ...
    if ($try_again) goto loop; // restart loop
}
```

In general, the `goto` statement is often best avoided since it tends to make the flow of execution difficult to follow.

CHAPTER 8

Functions

Functions are reusable code blocks that only execute when called. They allow the code to be divided into smaller parts that are easier to understand and reuse.

Defining Functions

To create a function, the `function` keyword is used, followed by a name, a set of parentheses, and a code block. The naming convention¹ for functions is the same as for variables—to use a descriptive name with each word initially capitalized, except for the first one.

```
function myFunc()  
{  
    echo 'Hello World';  
}
```

A function code block can contain any valid PHP code, including other function definitions.

¹www.php-fig.org/psr/psr-12/

Calling Functions

Once defined, a function can be called (invoked) from anywhere on the page by typing its name followed by a set of parenthesis.

```
myFunc(); // "Hello World"
```

Function names are case insensitive, but it is good practice to use the same casing that they have in their definition.

```
myfunc(); // "Hello World"
MYFUNC(); // "Hello World"
```

A function can be called even if the function definition appears further down in the script file.

```
foo(); // allowed
function foo() {}
```

An exception to this is where the function is only defined when a certain condition is met. That conditional code must then be executed prior to calling the function.

```
bar(); // error
if (true) { function bar() {} }
bar(); // ok
```

Function Parameters

The parentheses that follow the function name are used to pass arguments to the function. To do this, the corresponding parameters must first be specified in the function definition in the form of a comma-separated list of variables. The parameters can then be used in the function.

```
function myFunc($x, $y)
{
    echo $x . $y;
}
```

With the parameters specified, the function can be called with the same number of arguments.

```
myFunc('Hello', ' World'); // "Hello World"
```

To be precise, *parameters* appear in function definitions, whereas *arguments* appear in function calls. However, the two terms are sometimes mistakenly used interchangeably.

Optional Parameters

It is possible to specify default values for parameters by assigning them a value inside the parameter list. Then, if that argument is unspecified when the function is called, the default value is used instead. For this to work as expected, it is important that the parameters with default values are declared to the right of those without default values.

```
function myFunc($x, $y = ' Earth')
{
    echo $x . $y;
}

myFunc('Hello'); // "Hello Earth"
```

Named Arguments

PHP 8 introduced *named arguments*, which allow an argument to be passed in any order by specifying the name of its corresponding parameter. This feature complements optional parameters by allowing default values to be skipped.

```
function myNamed($a, $b = 2, $c = 4)
{
    echo "$a $b $c";
}
```

```
myNamed(c: 3, a: 1); // "1 2 3"
```

Both optional and required parameters can be named, but any named arguments must be placed after the unnamed ones.

```
myNamed(1, c: 3); // "1 2 3"
```

Variable Parameter Lists

A function cannot be called with fewer arguments than is specified in its declaration, but it may be called with more arguments. This allows for the passing of a variable number of arguments, which can then be accessed using a couple of built-in functions. For getting one argument at a time, there is the `func_get_arg` function. This function takes a single argument, which is the parameter to be returned, starting with zero.

```
function myArgs()
{
    $x = func_get_arg(0);
    $y = func_get_arg(1);
}
```

```

    $z = func_get_arg(2);
    echo $x . $y . $z;
}

myArgs('Fee', 'Fi', 'Fo'); // "FeeFiFo"

```

There are two more functions related to the argument list. The `func_num_args` function gets the number of arguments passed and `func_get_args` returns an array containing all of those arguments. Together they can be used to allow a function to handle a variable number of arguments.

```

function myArgs2()
{
    $num = func_num_args();
    $args = func_get_args();
    for ($i = 0; $i < $num; $i++)
        echo $args[$i];
}

myArgs2('Fee', 'Fi', 'Fo'); // "FeeFiFo"

```

The use of variable parameter lists was simplified in PHP 5.6. As of this version, parameter lists may include a variadic parameter, indicated by an ellipsis (`...`) token, which accepts a variable number of arguments. The variadic parameter behaves as an array and must always be the last parameter in the list.

```

function myArgs3(...$args)
{
    foreach($args as $v) {
        echo $v;
    }
}

myArgs3(1, 2, 3); // "123"

```

As a complementary feature, the ellipsis token can also be used to unpack a collection of values into an argument list.

```
$a = [1, 2, 3];
myArgs3(...$a); // "123"
```

Return Statement

`return` is a jump statement that causes the function to end its execution and return to the location where it was called.

```
function myFunc()
{
    return; // exit function
    echo 'Hi'; // never executes
}
```

It can optionally be given a value to return, in which case it makes the function call evaluate to that value.

```
function myFunc()
{
    // Exit function and return value
    return 'Hello';
}

echo myFunc(); // "Hello"
```

A function without a return value automatically returns `null`.

```
function myNull() {}

if (myNull() === null)
    echo 'true'; // "true"
```

Scope and Lifetime

Normally, a PHP variable's scope starts where it is declared and lasts until the end of the page. However, a local function scope is introduced within functions. By default, any variable used inside a function is limited to this local scope. Once the scope of the function ends, the local variable is destroyed.

```
$x = 'Hello'; // global variable

function myFunc()
{
    $y = ' World'; // local variable
}
```

In PHP, trying to access a global variable from a function does not work and instead creates a new local variable. In order to make a global variable accessible, the scope of that variable must be extended to the function by declaring it with the `global` keyword.

```
$x = 'Hello'; // global $x

function myFunc()
{
    global $x; // use global $x
    $x .= ' World'; // change global $x
}

myFunc();
echo $x; // "Hello World"
```

An alternative way to access variables from the global scope is by using the predefined `$GLOBALS` array. The variable is referenced by its name, specified as a string without the dollar sign.

```
function myFunc()
{
    $GLOBALS['x'] .= ' World'; // change global $x
}
```

In contrast to many other languages, control structures—such as loop and conditional statements—do not have their own variable scope. Therefore, a variable defined in such a code block is not destroyed when the code block ends.

```
if(true)
{
    $x = 10; // global $x
}

echo $x; // "10"
```

In addition to global and local variables, PHP also has property variables; these are looked at in the next chapter.

Anonymous Functions

PHP 5.3 introduced *anonymous functions*, which allow functions to be passed as arguments and assigned to variables. An anonymous function is defined like a regular function, except that it has no specified name. The function can be assigned to a variable using the normal assignment syntax, including the semicolon. That variable can then be called as a function.

```
$say = function($name)
{
    echo "Hello " . $name;
};

$say("World"); // "Hello World"
```


Anonymous functions are mainly used as *callback functions*. This is a function passed as an argument to another function, which is expected to call it as part of its execution.

```
function myCaller($myCallback)
{
    echo $myCallback();
}

// "Hello"
myCaller( function() { echo "Hello"; } );
```

In this way, functionality can be injected into an existing function, increasing its versatility. For instance, the built-in `array_map` function applies its callback to each element of its given array.

```
$a = [1, 2, 3];

$squared = array_map(function($val)
{
    return $val * $val;
}, $a);

foreach ($squared as $v)
    echo $v; // "149"
```

A benefit of using anonymous functions is that they allow for a concise way to define functions that are only used once in the location where they are used. This also prevents such throwaway functions from cluttering up the global scope.

Closures

A closure is an anonymous function that can capture variables local to the scope it was created in. In PHP, all anonymous functions are closures and they are implemented using the Closure class. They can specify variables to be captured with a use clause in the function header.

```
$x = 1, $y = 2;

$myClosure = function($z) use ($x, $y)
{
    return $x + $y + $z;
};

echo $myClosure(3); // "6"
```

Arrow Functions

A more concise syntax for anonymous functions, called arrow functions, was introduced in PHP 7.4. Like anonymous functions, the arrow function is implemented using the Closure class and supports the same features, with the difference that arrow function automatically captures variables from the parent scope by value. The previous example can therefore be shortened as follows.

```
$x = 1, $y = 2;

$myClosure = fn($z) => $x + $y + $z;

echo $myClosure(3); // "6"
```

The main advantage of arrow functions is their brevity, so they use the reserved keyword `fn` instead of `function` when specifying the anonymous function's parameters. They also only allow a single, implicitly returned expression and so they do not use the `return` keyword.

Generators

A *generator* is a function used to generate a series of values. Each value is returned with a `yield` statement. Unlike `return`, the `yield` statement saves the state of the function, allowing it to continue from where it left off when it is called again.

```
function getNum()
{
    for ($i = 0; $i < 5; $i++) {
        yield $i;
    }
}
```

The generator function behaves as an iterator; therefore, it can be used with a `foreach` loop. The loop continues until the generator has no more values to yield.

```
foreach(getNum() as $v)
    echo $v; // "01234"
```

Generators were introduced in PHP 5.5. Their use was expanded in PHP 7 with the `yield from` statement, which allows a generator to yield values from another generator, iterator, or array.

```
function countToFive()
{
    yield 1;
    yield from [2, 3, 4];
    yield 5;
}

foreach (countToFive() as $v)
    echo $v; // "12345"
```

Since generators only yield values one at a time on demand, they do not require the whole sequence to be computed all at once and stored in memory. This can have significant performance benefits when it comes to generating large amounts of data.

Built-in Functions

PHP comes with a large number of built-in functions that are always available, such as string and array handling functions. Other functions depend on what extensions PHP is compiled with, for example, the MySQLi extension for communicating with MySQL databases. For a complete reference of the built-in PHP functions, see the PHP Function Reference.²

²www.php.net/manual/en/funcref.php

CHAPTER 9

Class

A *class* is a template used to create objects. To define one, the `class` keyword is followed by a name and a code block. The naming convention for classes is to use mixed case, meaning that each word should be initially capitalized.

```
class MyRectangle {}
```

The class body can contain properties and methods. *Properties* are variables that hold the state of the object, whereas *methods* are functions that define what the object can do. Properties are also known as *fields* or *attributes* in other languages. In PHP, they need to have an explicit access level specified. In the following example, the `public` access level is used, which gives unrestricted access to the property.

```
class MyRectangle
{
    public $x, $y;
    function newArea($a, $b) { return $a * $b; }
}
```

To access members from inside the class, the `$this` pseudo variable is used along with the single arrow operator (`->`). The `$this` variable is a reference to the current instance of the class and can only be used within an object context. Without it, `$x` and `$y` would just be seen as local variables.

```
class MyRectangle
{
    public $x, $y;

    function newArea($a, $b) {
        return $a * $b;
    }

    function getArea() {
        return $this->newArea($this->x, $this->y);
    }
}
```

Instantiating an Object

To use a class's members from outside the enclosing class, an object of the class must first be created. This is done using the `new` keyword, which creates a new object or instance.

```
$r = new MyRectangle(); // object instantiated
```

The object contains its own set of properties, which can hold values that are different from those of other instances of the class. As with functions, objects of a class may be created even if the class definition appears further down in the script file.

```
$r = new MyDummy(); // allowed
class MyDummy {};
```

Accessing Object Members

To access members that belong to an object, the single arrow operator (`->`) is needed. It can be used to call methods or to assign values to properties.

```
$r->x = 5;
$r->y = 10;
$r->getArea(); // 50
```

Another way to initialize properties is to use initial property values.

Initial Property Values

If a property needs to have an initial value, a concise way is to assign the property at the same time that it is declared. This initial value is then set when the object is created. Assignments of this kind must be a constant expression. It cannot, for example, be a variable or a mathematical expression.

```
class MyRectangle
{
    public $x = 5, $y = 10;
}
```

Constructor

A class can have a constructor, which is a special method used to initialize (construct) the object. This method provides a way to initialize properties, which is not limited to constant expressions. In PHP, the constructor starts with two underscores followed by the word `construct`. Methods like these are known as *magic methods*.

```
class MyRectangle
{
    public $x, $y;

    function __construct()
```

CHAPTER 9 CLASS

```
{
    $this->x = 5;
    $this->y = 10;
    echo "Constructed";
}
}
```

When a new instance of this class is created, the constructor is called, which in this example sets the properties to the specified values. Note that any initial property values are set before the constructor is run.

```
$r = new MyRectangle(); // "Constructed"
```

Since this constructor takes no arguments, the parentheses may optionally be left out.

```
$r = new MyRectangle; // "Constructed"
```

Just as any other method, the constructor can have a parameter list. It can be used to set the property values to the arguments passed when the object is created.

```
class MyRectangle
{
    public $x, $y;

    function __construct($x, $y)
    {
        $this->x = $x;
        $this->y = $y;
    }
}

$r = new MyRectangle(5,10);
```


PHP 8 introduced constructor property promotion, allowing properties to be declared in the constructor parameter list. Any constructor parameter prefixed with an access level, such as `public`, will be promoted to a new property. This allows the previous class to be rewritten in the following less verbose way.

```
class MyRectangle
{
    function __construct(public $x, public $y)
    {
        $this->x = $x;
        $this->y = $y;
    }
}
```

Default parameters may be used with the constructor in the same way as with other functions and methods. Both promoted and non-promoted parameters can have default values. Keep in mind that the default value is assigned to the parameter and not to the promoted property. The promoted property needs to be assigned inside the constructor as is done here.

```
class MyRectangle
{
    public $x;
    function __construct($x = 5, public $y = 10)
    {
        $this->x = $x;
        $this->y = $y;
    }
}
$r = new MyRectangle;
echo $r->x + $r->y; // "15"
```

Destructor

In addition to the constructor, classes can also have a destructor. This magic method starts with two underscores followed by the word `destruct`. It is called as soon as there are no more references to the object, before the object is destroyed by the PHP garbage collector.

```
class MyRectangle
{
    // ...
    function __destruct() { echo "Destructed"; }
}
```

To test the destructor, the `unset` function can be used which manually removes all references to the object.

```
$r = new MyRectangle;
unset($r); // "Destructed"
```

Bear in mind that the object model was completely rewritten in PHP 5. Therefore, many features of classes, such as destructors, do not work in earlier versions of the language.

Case Sensitivity

Whereas variable names are case sensitive, class names in PHP are case insensitive—as are function names, keywords, and built-in constructs such as `echo`. This means that a class named `MyClass` can also be referenced as `myclass` or `MYCLASS`.

```
class MyClass {}
$o1 = new myclass(); // ok
$o2 = new MYCLASS(); // ok
```

Object Comparison

When using the equal to operator (==) on objects, these objects are considered equal if the objects are instances of the same class and their properties have the same values and types. In contrast, the strict equal to operator (===) returns true only if the variables refer to the same instance of the same class.

```
class Flag
{
    public $flag = true;
}

$a = new Flag();
$b = new Flag();

$c = ($a == $b); // true (same values)
$d = ($a === $b); // false (different instances)
```

Anonymous Classes

Support for anonymous classes was introduced in PHP 7. Such a class is useful in place of a named class when only a single, throwaway object is needed.

```
$obj = new class {};
```

The implementation of the anonymous class, and the object created from it, is no different from a named class. For instance, they can use constructors in the same way as any named class.

```
$o = new class('Hi')
{
    public $x;
```

```

public function __construct($a)
{
    $this->x = $a;
}
};

echo $o->x; // "Hi";

```

Closure Object

Anonymous functions in PHP are also closures, as they have the ability to capture a context from outside of the function's scope. In addition to variables, this context can also be an object's scope. This creates a so-called *closure object*, which has access to the properties of that object. An object closure is made using the `bindTo` method. This method accepts two arguments: the object to which the closure is bound and the class scope that it is associated with. To access non-public members (private or protected), the name of the class or object must be specified as the second argument.

```

class C { private $x = 'Hi'; }

$getC = function() { return $this->x; };
$getX = $getC->bindTo(new C, 'C');
echo $getX(); // "Hi"

```

This example uses two closures. The first closure, `$getC`, defines the method for retrieving the property. The second closure, `$getX`, is a duplicate of `$getC`, to which the object and class scope has been bound. PHP 7 simplified this by providing a more concise and better performing way of temporarily binding and then calling a closure in the same operation.

```

// PHP 7
$getX = function() { return $this->x; };
echo $getX->call(new C); // "Hi"

```

CHAPTER 10

Inheritance

Inheritance allows a class to acquire the members of another class. In the following example, the Square class inherits from Rectangle, specified by the extends keyword. Rectangle then becomes the parent class of Square, which in turn becomes a child class of Rectangle. In addition to its own members, Square gains all accessible (non-private) members in Rectangle, including any constructor.

```
// Parent class (base class)
class Rectangle
{
    public $x, $y;
    function __construct($a, $b)
    {
        $this->x = $a;
        $this->y = $b;
    }
}

// Child class (derived class)
class Square extends Rectangle {}
```

When creating an instance of Square, two arguments must now be specified because Square has inherited Rectangle's constructor.

```
$s = new Square(5,10);
```

The properties inherited from `Rectangle` can also be accessed from the `Square` object.

```
$s->x = 5;
$s->y = 10;
```

A class in PHP may only inherit from one parent class, and the parent must be defined before the child class in the script file.

Overriding Members

A member in a child class can redefine a member in its parent class to give it a new implementation. To override an inherited member, it just needs to be redeclared with the same name. As shown in the following, the `Square` constructor overrides the constructor in `Rectangle`.

```
class Square extends Rectangle
{
    function __construct($a)
    {
        $this->x = $a;
        $this->y = $a;
    }
}
```

With this new constructor, only a single argument is used to create the `Square`.

```
$s = new Square(5);
```

Because the inherited constructor of `Rectangle` is overridden, `Rectangle`'s constructor is no longer called when the `Square` object is created. It is up to the developer to call the parent constructor, if necessary. This is done by prepending the call with the `parent` keyword and a double colon. The double colon is known as the *scope resolution operator* (`::`).

```
class Square extends Rectangle
{
    function __construct($a)
    {
        parent::__construct($a,$a);
    }
}
```

The `parent` keyword is an alias for the parent's class name, which may alternatively be used. In PHP, it is possible to access overridden members that are any number of levels deep in the inheritance hierarchy using this notation.

```
class Square extends Rectangle
{
    function __construct($a)
    {
        Rectangle::__construct($a,$a);
    }
}
```

Like constructors, the parent destructor is not called implicitly if it is overridden. It, too, would have to be explicitly called with `parent::__destruct()` from the child destructor.

Final Keyword

To stop a child class from overriding a method, it can be defined as `final`. A class itself can also be defined as `final` to prevent any class from extending it.

```
final class NotExtendable
{
    final function notOverridable() {}
}
```

Instanceof Operator

As a safety precaution, you can test to see whether an object can be cast to a specific class by using the `instanceof` operator. This operator returns `true` if the left-side object can be cast into the right-side type without causing an error. This is true when the object is an instance of, or inherits from, the right-side class.

```
$s = new Square(5);
$s instanceof Square; // true
$s instanceof Rectangle; // true
```


CHAPTER 11

Access Levels

Every class member has an accessibility level that determines where the member is visible. There are three of them available in PHP: `public`, `protected`, and `private`.

```
class MyClass
{
    public    $myPublic;    // unrestricted access
    protected $myProtected; // enclosing or child class
    private  $myPrivate;   // enclosing class only
}
```

Private Access

All members, regardless of access level, are accessible in the class in which they are declared—the enclosing class. This is the only place where a private member can be accessed.

```
class MyClass
{
    public    $myPublic    = 'public';
    protected $myProtected = 'protected';
    private  $myPrivate   = 'private';

    function test()
```

```

{
    echo $this->myPublic;    // allowed
    echo $this->myProtected; // allowed
    echo $this->myPrivate;  // allowed
}
}

```

Unlike properties, methods do not have to have an explicit access level specified. They default to public access unless set to another level.

Protected Access

A protected member can be accessed from inside the class where they are declared, as well as from any class that extends them.

```

class MyChild extends MyClass
{
    function test()
    {
        echo $this->myPublic;    // allowed
        echo $this->myProtected; // allowed
        echo $this->myPrivate;  // inaccessible
    }
}

```

Public Access

Public members have unrestricted access. In addition to anywhere a protected member can be accessed, a public member can also be reached through an object variable.

```

$m = new MyClass();
echo $m->myPublic;    // allowed
echo $m->myProtected; // inaccessible
echo $m->myPrivate;   // inaccessible

```

Var Keyword

Before PHP 5, the `var` keyword was used to declare properties. To maintain backward compatibility, this keyword is still usable and gives public access, just like the `public` modifier.

```

class MyVars
{
    var $x, $y; // deprecated property declaration
}

```

Object Access

In PHP, objects of the same class have access to each other's private and protected members. This behavior is different from many other programming languages where such access is not allowed.

```

class MyClass
{
    private $myPrivate;

    function setPrivate($obj, $val) {
        $obj->myPrivate = $val; // set private property
    }
}
$a = new MyClass();
$b = new MyClass();
$a->setPrivate($b, 10);

```

Access Level Guideline

As a guideline, when choosing an access level, it is generally best to use the most restrictive level possible. This is because the more places a member can be accessed, the more places it can be accessed incorrectly, which makes the code harder to debug. Using restrictive access levels also makes it easier to modify the class without breaking the code for any other developers using that class.

Accessors

Use of public properties should be avoided, because it exposes the internals of a class which makes future changes to that class more difficult. A better way is to provide access to such properties through get and set accessor methods. The get accessor retrieves the property and is typically named with a “get” prefix. Likewise, the set accessor sets the value of the property and is commonly named with a “set” prefix.

```
class Time
{
    private $minutes;

    function getMinutes() {
        return $this->minutes;
    }

    function setMinutes($val) {
        $this->minutes = $val;
    }
}
```

By not exposing the property directly, the class is more flexible. For instance, the underlying property representing time in this class can be changed from minutes to seconds without breaking the code for anyone using this class. The set accessor can also validate the input to verify it is a valid value for the property, making the class safer to use.

```
class Time
{
    private $seconds;

    function getMinutes() {
        return $this->seconds / 60;
    }

    function setMinutes($val) {
        if ($val > 0) { $this->seconds = $val * 60; }
        else { $this->seconds = 0; }
    }
}
```

Another advantage to accessors is that a property's read and write access can be restricted. A property can be made read-only by leaving out the set accessor or write-only by leaving out the get accessor.

CHAPTER 12

Static

The `static` keyword can be used to declare properties and methods that can be accessed without having to create an instance of the class. Static (class) members only exist in one copy, which belongs to the class itself, whereas instance (non-static) members are created as new copies for each new object.

```
class MyCircle
{
    // Instance members (one per object)
    public $r = 10;
    function getArea() {}

    // Static/class members (only one copy)
    static $pi = 3.14;
    static function newArea($a) {}
}
```

Static methods cannot use instance members since these methods are not part of an instance. They can use other static members, however.

Referencing Static Members

Unlike instance members, static members are not accessed using the single arrow operator (->). Instead, to reference static members inside a class, the member must be prefixed with the `self` keyword followed by the scope resolution operator (`::`). The `self` keyword is an alias for the class name, so alternatively, the actual name of the class can be used.

```
static function newArea($a)
{
    return self::$pi * $a * $a; // ok
    return MyCircle::$pi * $a * $a; // alternative
}
```

This same syntax is used to access static members from an instance method. Note that in contrast to static methods, instance methods can use both static and instance members.

```
function getArea()
{
    return self::newArea($this->r);
}
```

To access static members from outside the class, the name of the class needs to be used, followed by the scope resolution operator (`::`).

```
class MyCircle
{
    static $pi = 3.14;

    static function newArea($a)
    {
        return self::$pi * $a * $a;
    }
}
```

```
echo MyCircle::$pi; // "3.14"  
echo MyCircle::newArea(10); // "314"
```

The advantage of static members can be seen here; they can be used without having to create an instance of the class. Therefore, methods should be declared static if they perform a generic function independently of instance variables. Likewise, properties should be declared static if there is only need for a single instance of the variable.

Static Variables

Local variables can be declared static to make the function remember its value. Such a static variable only exists in the local function's scope, but it does not lose its value when the function ends. This can be used to count the number of times a function is called, for example.

```
function add()  
{  
    static $val = 0;  
    echo $val++;  
}  
  
add(); // "0"  
add(); // "1"  
add(); // "2"
```

The initial value that a static variable is given is only set once. Keep in mind that static properties and static variables may only be initialized with a constant, but not with an expression, such as another variable or a function return value.

Late Static Bindings

As mentioned before, the `self` keyword is an alias for the class name of the enclosing class. This means that the keyword refers to its enclosing class even when it is called from the context of a child class.

```
class MyParent
{
    protected static $val = 'parent';

    public static function getVal()
    {
        return self::$val;
    }
}

class MyChild extends MyParent
{
    protected static $val = 'child';
}

echo MyChild::getVal(); // "parent"
```

To get the class reference to evaluate to the class from which the method is actually called on, the `static` keyword needs to be used instead of the `self` keyword. This feature is called *late static bindings* and it was added in PHP 5.3.

```
class MyParent
{
    protected static $val = 'parent';

    public static function getLateBindingVal()
```

```
{
    return static::$val;
}
}

class MyChild extends MyParent
{
    protected static $val = 'child';
}

echo MyChild::getLateBindingVal(); // "child"
```

CHAPTER 13

Constants

A *constant* is a variable with a value that cannot be changed by the script. Therefore, such a value must be assigned at the same time that the constant is created. PHP provides two methods for creating constants: the `const` modifier and the `define` function.

Const

The `const` modifier is used to create class constants. Unlike regular properties, class constants do not have an access level specified because they are always publicly visible. They also do not use the dollar sign parser token (`$`). The naming convention for constants is all uppercase, with underscores separating each word.

```
class MyCircle
{
    const PI = 3.14;
}
```

Constants must be assigned a value when they are created. Like static properties, a constant may only be initialized with a constant value and not with an expression or variable. Class constants are referenced in the same way as static properties, except that they do not use the dollar sign.

```
echo MyCircle::PI; // "3.14"
```

The `const` modifier may not be applied to local variables or parameters. However, as of PHP 5.3, `const` can be used to create global constants. Such a constant is defined in the global scope and can be accessed anywhere in the script after where it has been defined.

```
const PI = 3.14;
echo PI; // "3.14"
```

Define

The `define` function can create both global and local constants, but not class constants. The first argument to this function is the constant's name and the second is its value.

```
define('DEBUG', 1);
```

Just like constants created with `const`, `define` constants are used without the dollar sign and their value cannot be modified.

```
echo DEBUG; // "1"
```

Like constants made with `const`, the value for `define` may be any scalar data type: integer, float, string, or `bool`. Unlike `const`, however, the `define` function allows an expression to be used in the assignment, such as a variable or the result of a mathematical expression.

```
define('ONE', 1);        // 1
define('TWO', ONE+1); // 2
```

Constants are case sensitive by default. However, the `define` function takes a third optional argument that may be set to `true` to create a case-insensitive constant.

```
define('DEBUG', 1, true);
echo debug; // "1"
```

To check whether a constant already exists, the `defined` function can be used. This function works for constants created with `const` or `define`.

```
if (!defined('PI'))
    define('PI', 3.14);
```

PHP 7 made it possible to create constant arrays using the `define` function. Support for constant arrays created with `const` has existed since PHP 5.6.

```
const CA = [1, 2, 3];    // PHP 5.6 or later
define('DA', [1, 2, 3]); // PHP 7 or later
```

Const and define

The `const` modifier creates a compile-time constant, so the compiler replaces all usage of the constant with its value. In contrast, `define` creates a run-time constant that is not set until run-time. This is the reason why `define` constants may be assigned with expressional values, whereas `const` requires constant values that are known at compile-time.

```
const PI = 3.14;    // compile-time constant
define('E', 2.72); // run-time constant
```

Only `const` may be used for class constants and only `define` for local constants. However, when creating global constants, both `const` and `define` are allowed. In these circumstances, using `const` is generally preferable, as compile-time constants are slightly faster than run-time constants. The main exception is when the constant is conditionally defined, or an expressional value is required, in which case `define` must be used.

Constant Guideline

In general, it is a good idea to create constants instead of variables if their values do not need to be changed. This ensures that the variables are not changed anywhere in the script by mistake, which in turn helps to prevent bugs.

Magic Constants

PHP provides eight predefined constants, as shown in Table 13-1. These are called *magic constants* because their values change, depending on where they are used.

Table 13-1. Magic Constants

Name	Description
<code>__LINE__</code>	Current line number of the file.
<code>__FILE__</code>	Full path and file name of the file.
<code>__DIR__</code>	Directory of the file.
<code>__FUNCTION__</code>	Function name.
<code>__CLASS__</code>	Class name including namespace.
<code>__TRAIT__</code>	Trait name including namespace.
<code>__METHOD__</code>	Class method name.
<code>__NAMESPACE__</code>	Current namespace.

Magic constants are especially useful for debugging purposes. For example, the value of `__LINE__` depends on the line in which it appears in the script.

```
if(!isset($var))
{
    echo '$var not set on line ' . __LINE__;
}
```

CHAPTER 14

Interface

An interface specifies methods that classes using the interface must implement. They are defined with the `interface` keyword, followed by a name and a code block. A common naming convention is to name interfaces starting with a small “i” and then to have each word initially capitalized.

```
interface iMyInterface {}
```

Interface Signatures

The code block for an interface can contain signatures for instance methods. These methods cannot have any implementations. Instead, their bodies are replaced by semicolons. Interface methods must always be public.

```
interface iMyInterface
{
    public function myMethod();
}
```

Additionally, interfaces may define constants. These interface constants behave just as class constants, except that they cannot be overridden.


```
interface iMyInterface
{
    const PI = 3.14;
}
```

An interface may not inherit from a class, but it may inherit from another interface, which effectively combines the two interfaces into one.

```
interface i1 {}
interface i2 extends i1 {}
```

Interface Example

The following example shows an interface called `iComparable`, which has a single method named `Compare`. Note that this method makes use of type hinting to make sure that the method is called with the correct type. This functionality is covered in a later chapter.

```
interface iComparable
{
    public function compare(iComparable $o);
}
```

The `Circle` class implements this interface by using the `implements` keyword after the class name, followed by the interface name. If the class also has an `extends` clause, the `implements` clause needs to be placed after it. Bear in mind that although a class can only inherit from one parent class, it may implement any number of interfaces by specifying them in a comma-separated list.

```
class Circle implements iComparable
{
    public $r;
}
```

Because `Circle` implements `iComparable`, it must define the `compare()` method. For this class, the method returns the difference between the circle radiuses. The implemented method must be public, in addition to having the same signature as the method defined in the interface. It may also have more parameters, as long as they are optional.

```
class Circle implements iComparable
{
    public $r;

    public function compare(iComparable $o)
    {
        return $this->r - $o->r;
    }
}
```

Interface Usages

Interfaces allow for multiple inheritance of class design without the complications associated with allowing multiple inheritance of functionality. The main benefit of requiring a specific class design can be seen with the `iComparable` interface, which defines a specific functionality that classes can share. It allows developers to use interface members without having to know the actual type of a class. To illustrate, the following example shows a simple method that takes two `iComparable` objects and returns the largest one.

```
function largest(iComparable $a, iComparable $b)
{
    return ($a->compare($b) > 0) ? $a : $b;
}
```

This method works for any two objects of the same type that implement the `Comparable` interface. It works regardless of what type the objects are since the method only uses the functionality exposed through that interface.

Interface Guideline

An interface provides a design for a class without any implementation. It is a contract by which classes that implement it agree to provide certain functionality. This has two benefits. First, it provides a way to make sure that developers implement certain methods. Second, because these classes are guaranteed to have certain methods, they can be used even without knowing the class's actual type, which allows the code to be more flexible.

CHAPTER 15

Abstract

An abstract class provides a partial implementation that other classes can build upon. When a class is declared as abstract, it means that the class can contain incomplete methods that must be implemented in child classes, in addition to normal class members.

Abstract Methods

In an abstract class, any method can be declared abstract. These methods are then left unimplemented and only their signatures are specified, while their code blocks are replaced by semicolons.

```
abstract class Shape
{
    abstract public function myAbstract();
}
```

Abstract Example

To give an example, the following class has two properties and an abstract method.

CHAPTER 15 ABSTRACT

```
abstract class Shape
{
    private $x = 100, $y = 100;
    abstract public function getArea();
}
```

If a class inherits from this abstract class, it is then forced to override the abstract method. The method signature must match, except for the access level, which can be made less restricted.

```
class Rectangle extends Shape
{
    public function getArea()
    {
        return $this->x * $this->y;
    }
}
```

It is not possible to instantiate an abstract class. They serve only as parents for other classes, partly dictating their implementation.

```
$s = new Shape(); // compile-time error
```

However, an abstract class may inherit from a non-abstract (concrete) class.

```
class NonAbstract {}
abstract class MyAbstract extends NonAbstract {}
```

Abstract Classes and Interfaces

Abstract classes are in many ways similar to interfaces. They can both define member signatures that the deriving classes must implement, and neither one of them can be instantiated. The key differences are, first, that the abstract class can contain non-abstract members, while the interface cannot. Second, a class can implement any number of interfaces but only inherit from one class, abstract or not.

```
// Defines default functionality and definitions
abstract class Shape
{
    public $x = 100, $y = 100;
    abstract public function getArea();
}
// Class is a Shape
class Rectangle extends Shape { /*...*/ }

// Defines a specific functionality
interface iComparable
{
    function compare(iComparable $o);
}
// Class can be compared
class MyClass implements iComparable { /*...*/ }
```

Abstract Guideline

An abstract class provides a partially implemented base class that dictates how child classes must behave. They are most useful when child classes share some similarities, but differ in other implementations that child classes are required to define. Just like interfaces, abstract classes are useful constructs in object-oriented programming that help developers follow good coding standards.

CHAPTER 16

Traits

A *trait* is a group of methods that can be inserted into classes. They were added in PHP 5.4 to enable greater code reuse without the added complexity that comes from allowing multiple inheritance. Traits are defined with the `trait` keyword, followed by a name and a code block. The naming convention is commonly the same as for classes, with each word initially capitalized. The code block may only contain static and instance methods.

```
trait PrintFunctionality
{
    public function myPrint() { echo 'Hello'; }
}
```

Classes that need the functionality that a trait provides can include it with the `use` keyword, followed by the trait's name. The trait's methods then behave as if they were directly defined in that class.

```
class MyClass
{
    // Insert trait methods
    use PrintFunctionality;
}

$o = new MyClass();
$o->myPrint(); // "Hello"
```


A class may use multiple traits by placing them in a comma-separated list. Similarly, a trait may be composed of one or more other traits.

Inheritance and Traits

Trait methods override inherited methods. Likewise, methods defined in the class override methods inserted by a trait.

```
class MyParent
{
    public function myPrint() { echo 'Base'; }
}

class MyChild extends MyParent
{
    // Overrides inherited method
    use PrintFunctionality;
    // Overrides trait inserted method
    public function myPrint() { echo 'Child'; }
}

$o = new MyChild();
$o->myPrint(); // "Child"
```

Trait Guidelines

Single inheritance sometimes forces the developer to make a choice between code reuse and a conceptually clean class hierarchy. To achieve greater code reuse, methods can be moved near the root of the class hierarchy, but then classes start to have methods that they do not need, which reduces the understandability and maintainability of the code.

On the other hand, enforcing conceptual cleanliness in the class hierarchy often leads to code duplication, which may cause inconsistencies. Traits provide a way to avoid this shortcoming with single inheritance by enabling code reuse that is independent of the class hierarchy.

CHAPTER 17

Importing Files

The same code often needs to be called on multiple pages. This can be done by first placing the code inside a separate file and then including that file using the `include` statement. This statement takes all the text in the specified file and includes it in the script, as if the code had been copied to that location. Just like `echo`, `include` is a special language construct and not a function, so parentheses should not be used.

```
<?php
include 'myfile.php';
?>
```

When a file is included, parsing changes to HTML mode at the beginning of the target file and resumes PHP mode again at the end. For this reason, any code inside the included file that needs to be executed as PHP code must be enclosed within PHP tags.

```
<?php
// myfile.php
?>
```

Include Path

An `include` file can either be specified with a relative path, an absolute path, or without a path. A *relative file path* is relative to the importing file's directory. An *absolute file path* includes the full file path.

```
// Relative path
include 'myfolder/myfile.php';

// Absolute path
include 'C:/xampp/htdocs/myfile.php';
```

Note that a forward slash “/” works as the directory separator under both Windows and Linux. As for casing, file paths are by default case insensitive on Windows and case sensitive on Linux.

When a relative path or no path is specified, `include` first searches for the file in the current working directory, which defaults to the directory of the importing script. If the file is not found there, `include` checks the folders specified by the `include_path`¹ directive defined in `php.ini` before failing.

```
// No path
include 'myfile.php';
```

In addition to `include`, there are three other language constructs available for importing the content of one file into another: `require`, `include_once`, and `require_once`.

Require

The `require` construct includes and evaluates the specified file. It is identical to `include`, except in how it handles failure. When a file import fails, `require` halts the script with an error, whereas `include` only issues a warning. An import may fail either because the file is not found or because the user running the web server does not have read access to it.

```
require 'myfile.php'; // halt on error
```

¹www.php.net/manual/en/ini.core.php#ini.include-path

Generally, it is best to use `require` for any complex PHP application or CMS site. That way, the application does not attempt to run when a key file is missing. For less critical code segments and simple PHP websites, `include` may suffice, in which case PHP shows the output, even if the included file is missing.

Include_once

The `include_once` statement behaves like `include`, except that if the specified file has already been included, it is not included again.

```
include_once 'myfile.php'; // include only once
```

Require_once

The `require_once` statement works like `require`, but it does not import a file if it has already been imported.

```
require_once 'myfile.php'; // require only once
```

In cases where a file might be imported more than once during a particular execution of a script, it is preferable to use the `include_once` or `require_once` statements. This avoids errors caused by function and class redefinitions, for example.

Return

It is possible to execute a return statement inside an imported file. This stops the execution and returns to the script that called the file import.

```
<?php
// myimport.php
return 'OK';
?>
```

If a return value is specified, the import statement evaluates to that value, just like a normal function.

```
<?php
// myfile.php
if ((include 'myimport.php') == 'OK')
    echo 'OK';
?>
```

__Autoload

For large web applications, the number of includes required in every script may be substantial. This can be avoided by defining an `__autoload` function. This function is automatically invoked when an undefined class or interface is used to try to load that definition. It takes one parameter, which is the name of the class or interface that PHP is looking for.

```
function __autoload($class_name)
{
    include $class_name . '.php';
}

// Attempt to auto include MyClass.php
$obj = new MyClass();
```

A good coding practice to follow when writing object-oriented applications is to have one source file for every class definition and to name the file according to the class name. Following this convention, the `__autoload` function is able to load the class—provided that it is in the same folder as the script file that needed it.

```
<?php
// MyClass.php
class MyClass {}
?>
```

If the file is located in a subfolder, the class name can include underscore characters to symbolize this. The underscore characters then need to be converted into directory separators in the `__autoload` function.

CHAPTER 18

Type Declarations

Type declarations allow the type to be specified for properties, function parameters, and function return types. This permits the PHP engine to enforce that the specified types are used.

Argument Type Declarations

Early versions of PHP relied exclusively on proper documentation of functions for developers to know what arguments a function accepts. To allow for functions that are more robust, PHP 5 began to introduce *argument type declarations*, permitting the type of a function parameter to be specified. Valid types for type declarations are shown in Table 18-1, along with the PHP version in which these types were added.

Table 18-1. *Type Declarations*

Name	Description	Version
class name	Argument must be an object or a child of this class.	PHP 5.0
interface name	Value must be an object implementing this interface.	PHP 5.0
Self	Value must be an instance of the class that defines the method, or one of its child classes. Only usable on class and instance methods.	PHP 5.0
parent	Value must be an instance of the parent to the class defining the method, or one of its child classes. Only usable on class and instance methods.	PHP 5.0
array	Value must be an array.	PHP 5.1
iterable	Value must be an array or an object implementing the Traversable interface. It can be used with the foreach loop.	PHP 5.1
callable	Value must be callable as a function.	PHP 5.4
Bool	Value must be true or false.	PHP 7.0
Float	Value must be a floating-point number.	PHP 7.0
Int	Value must be an integer.	PHP 7.0
string	Value must be a string.	PHP 7.0
mixed	Any value allowed.	PHP 8.0

A type declaration is set by prefixing the parameter with the type in the function signature. The following is an example using the array pseudo type introduced in PHP 5.1.

```
function myPrint(array $a)
{
    foreach ($a as $v) { echo $v; }
}

myPrint( array(1,2,3) ); // "123"
```

Failing to satisfy the type hint results in a fatal error. This gives a quick way for the developer to detect when an invalid argument is used.

```
myPrint('Test'); // error
```

The callable pseudo type was added in PHP 5.4. With this type hint in place, the argument must be a callable function, method, or object. Language constructs such as `echo` are not allowed, but anonymous functions may be used, as in the following example.

```
function myCall(callable $callback, $data)
{
    $callback($data);
}

$say = function($s) { echo $s; };
myCall( $say, 'Hi' ); // "Hi";
```

To pass a method as a callback function, both the object and the method name need to be grouped together as an array.

```
class MyClass {
    function myCallback($s) {
        echo $s;
    }
}
```

```
$o = new MyClass();
myCall( array($o, 'myCallback'), 'Hi' ); // "Hi"
```

Type declarations for scalar types—including bool, int, float, and string—were added in PHP 7. The following is a simple example using the bool type.

```
function isTrue(bool $b)
{
    return ($b === true);
}

echo isTrue(true); // "1"
echo isTrue(false); // ""
```

It is a good idea to use type declarations for functions that rely on an argument being of a specific type. That way, if this function is mistakenly passed an argument of the incorrect type, it immediately triggers an error. Without a type declaration, the function may fail silently, making the error much more difficult to detect.

Return Type Declarations

Support for return type declarations was added in PHP 7 as a way to prevent unintended return values. The return type is declared after the parameter list, prefixed by a colon (:). The same types are allowed as for argument type declarations.

```
function f(): array {
    return [];
}
```

When used with an interface, type declarations force implementing classes to match the same type declarations.

```
interface I {
    static function myArray(array $a): array;
}

class C implements I {
    static function myArray(array $a): array {
        return $a;
    }
}
```

Starting with PHP 7.1, the `void` type may be used as a return type declaration, specifying that the function does not return a value. Such a function may leave out the return statement altogether, or use an empty return statement to exit the function.

```
function myFunc(): void {
    return; // empty return statement
}
```

PHP 8 added `static` to the list of allowed return types for methods. Such a method must return an object of the class that defines the method.

```
class MyTest
{
    public function getNewObject(): static
    {
        return new MyTest();
    }
}
```

Strict Typing

The default behavior in PHP is to attempt to convert scalar values of incorrect type into the expected type. For instance, a function expecting a string can still be called with an integer argument, because an integer can be converted into a string.

```
function showString(string $s) {
    echo $s;
}

showString(5); // "5"
```

Strong type checking can be enabled in a specific source file by placing the following declaration as the first statement in that file.

```
declare(strict_types=1);
```

This affects both argument and return type declarations of scalar type, which must then be of the exact type declared in the function.

```
showString(5); // Fatal error: Uncaught TypeError
```

Nullable Types

As of PHP 7.1, a type declaration can be marked as nullable by prefixing the type with a question mark. A nullable type is allowed to hold null in addition to any regular value of its designated type.

```
function nullOrInt(?int $i)
{
    echo $i === null ? 'null' : 'int';
}

echo nullOrInt(3); // "int"
echo nullOrInt(null); // "null"
```

Union Types

PHP 8 introduced union types allowing a type declaration to include more than one type. When declaring a union type, each permitted type is separated by a vertical bar (|).

```
function squared(int|float $i): int|float
{
    return $i ** 2;
}
```

```
echo squared(2); // "4"
echo squared(1.5); // "2.25"
```

Pseudo types such as `null` and subtypes like `true` or `false` may also be used to form union types.

```
function trueOrNull(true|null $j): true|null
{
    return $j === null ? true : null;
}
```

Property Type Declarations

Typed properties were added in PHP 7.4, allowing a property to specify what type of values it may hold. Any type (except for `callable` and `void`) may be used when declaring such a property.

```
class MyClass
{
    public int $a = 3;
}
```

As shown here, the PHP engine will prevent other types from being assigned to the typed property.

```
$o = new MyClass;
$o->a = 5; // allowed
$o->a = 'string'; // fatal error: TypeError
```

A regular untyped property that is left unassigned will be null. In contrast, a typed property will be uninitialized, which is a new kind of variable state that is different from null.

```
class MyType
{
    public int $a; // uninitialized
    public $b; // null
}
```

Uninitialized was added since it would otherwise not be possible to distinguish between a nullable property which was set to null and one which was left unassigned by mistake. Trying to read from an uninitialized typed property results in a fatal error as of PHP 8.

```
$t1 = new MyType;
$o->t1 = 5;
$i = $o->t1; // ok

$t2 = new MyType;
$i = $o->t2; // error
```

CHAPTER 19

Type Conversions

PHP automatically converts a variable's data type as necessary, given the context in which it is used. For this reason, explicit type conversions are seldom required. Nonetheless, the type of a variable or expression may be changed by performing an explicit type cast.

Explicit Casts

An explicit cast is performed by placing the desired data type in parentheses before the variable or value that is to be evaluated. In the following example, the explicit cast forces the bool variable to be evaluated as an int.

```
$myBool = false;  
$myInt = (int)$myBool; // 0
```

One use for explicit casts can be seen when the bool variable is sent as output to the page. Due to automatic type conversions, the false value becomes an empty string; therefore, it is not displayed. By first converting it to an integer, the false value shows up as 0 instead.

```
echo $myBool; // ""  
echo (int)$myBool; // "0"
```

Allowed casts are listed in Table [19-1](#).

Table 19-1. *Allowed Type Casts*

Name	Description
(int), (integer)	Cast to int.
(bool), (boolean)	Cast to bool.
(float), (double), (real)	Cast to float.
(string)	Cast to string.
(array)	Cast to array.
(object)	Cast to object.
(unset)	Cast to null.

To give some examples, the array cast converts a scalar type to an array with a single element. It performs the same function as using the array constructor.

```
$myInt = 10;
$myArr = (array)$myInt;
$myArr = array($myInt); // same as above
echo $myArr[0]; // "10"
```

If a scalar type such as int is cast to object, it becomes an instance of the built-in `stdClass` class. The value of the variable is stored in a property of this class, called `scalar`.

```
$myObj = (object)$myInt;
echo $myObj->scalar; // "10"
```

The `unset` cast makes the variable evaluate to null. Despite its name, it does not actually unset the variable. The cast merely exists for the sake of completeness, because null is considered a data type. It was deprecated in PHP 7.2 and should no longer be used.

```
$myNull = (unset)$myInt;  
$myNull = null; // same as above
```

Settype

An explicit cast does not change the type of the variable it precedes, only how it is evaluated in that expression. To change the type of a variable, the `settype` function can be used, which takes two arguments. The first is the variable to be converted, and the second is the data type given as a string.

```
$myVar = 1.2; // float variable  
settype($myVar, 'int'); // convert variable to int
```

Alternatively, a type conversion can be performed by storing the result of an explicit cast back into the same variable.

```
$myVar = 1.2;  
$myVar = (int)$myVar; // 1
```

Gettype

Related to `settype` is the `gettype` function, which returns the type of the supplied argument as a human-readable string.

```
$myBool = true;  
echo gettype($myBool); // "boolean"
```

CHAPTER 20

Variable Testing

As a web-focused language, it is common in PHP to process user-supplied data. Such data needs to be tested before it is used to confirm that it exists and has a valid value. PHP provides a number of built-in constructs that can be used for this purpose.

isset

The `isset` language construct returns `true` if the variable exists and has been assigned a value other than `null`.

```
isset($a); // false

$a = 10;
isset($a); // true

$a = null;
isset($a); // false
```

Empty

The `empty` construct checks whether the specified variable has an empty value—such as `null`, `0`, `false`, or an empty string—and returns `true` if that is the case. It also returns `true` if the variable does not exist.

```
empty($b); // true

$b = false;
empty($b); // true
```

is_null

The `is_null` construct can be used to test whether a variable is set to null.

```
$c = null;
is_null($c); // true

$c = 10;
is_null($c); // false
```

As of PHP 8, the `is_null` construct emits an error if the variable does not exist, because it is not supposed to be used with uninitialized variables. Prior to PHP 8, `is_null` returned true along with a non-fatal error notice.

```
// Prior to PHP 8
is_null($d); // true (undefined variable notice)

// As of PHP 8
is_null($d); // error (TypeError)
```

A strict equality check against null is functionally equivalent to using the `is_null` construct. Using this operator instead is often preferred because it is more readable and marginally faster, as it does not involve a function call overhead.

```
$c = null;
$c === null; // true
```

Unset

Another language construct that is useful to know about is `unset`, which deletes a variable from the current scope.

```
$e = 10;
unset($e); // delete $e
```

When a global variable is made accessible in a function by using the `global` keyword, this code actually creates a local reference to the global variable in the `$GLOBALS` array. For this reason, attempting to `unset` a global variable in a function only deletes the local reference. To delete the global variable from a function's scope, the `unset` has to be made directly on the `$GLOBALS` array.

```
$o = 5; // global variable

function myUnset()
{
    // Make $o a reference to $GLOBALS['o']
    global $o;

    // Remove the local reference variable
    unset($o);

    // Remove the global variable
    unset($GLOBALS['o']);
}
```

Unsetting a variable is slightly different from setting the variable to null. When a variable is set to null, the variable still exists, but the content it held is immediately freed. In contrast, unsetting a variable deletes the variable, but the memory is still considered to be in use until the garbage collector clears it. Performance issues aside, using `unset` is recommended because it makes the code's intent clearer.

```
$var = null; // free memory
unset($var); // delete variable
```

Keep in mind that, most of the time, it is not necessary to manually unset variables, because the PHP garbage collector automatically deletes variables when they go out of scope. However, if a server performs memory-intensive tasks, then unsetting those variables manually allows the server to handle a greater number of simultaneous requests before running out of memory.

Null Coalescing Operator

The null coalescing operator (??) was added in PHP 7 as a shortcut for the common case of using a ternary with `isset`. It returns its first operand if it exists and is not null; otherwise, it returns its second operand.

```
$x = null;
$name = $x ?? 'unknown'; // "unknown"
```

This statement is equivalent to the following ternary operation, which uses the `isset` construct.

```
$name = isset($x) ? $x : 'unknown';
```

PHP 7.4 added the null coalescing assignment operator (??=). This operator provides a concise method of assigning a value to a variable only if the variable is unassigned (`null`). It can also be used with undefined variables.

```
// Assign value if $name is unassigned
$name ??= 'unknown';

// Same as above
if(!isset($name)) { $name = 'unknown'; }
```

```
// Functionally same as above
$name = $name ?? 'unknown';
```

Nullsafe Operator

Before a method is called, it can be necessary to first check to make sure its object exists. This can be done for instance using the ternary operator.

```
$result = $obj ? $obj->myMethod() : null;
```

PHP 8 introduced the nullsafe operator (`?->`) as a more concise way to achieve this functionality. The operator returns `null` if the object does not exist.

```
$result = $obj?->myMethod();
```

The operator can be used either when calling a method or fetching a property, but not when writing to a property.

Determining Types

PHP has several useful functions for determining the type of a variable. These functions can be seen in [Table 20-1](#).

Table 20-1. *Type Functions*

Name	Description
<code>is_array()</code>	True if variable is an array.
<code>is_bool()</code>	True if variable is a bool.
<code>is_callable()</code>	True if variable can be called as a function.
<code>is_float()</code> , <code>is_double()</code> , <code>is_real()</code>	True if variable is a float.
<code>is_int()</code> , <code>is_integer()</code> , <code>is_long()</code>	True if variable is an integer.
<code>is_null()</code>	True if variable is set to null.
<code>is_numeric()</code>	True if variable is a number or numeric string.
<code>is_scalar()</code>	True if variable is an int, float, string, or bool.
<code>is_object()</code>	True if variable is an object.
<code>is_resource()</code>	True if variable is a resource.
<code>is_string()</code>	True if variable is a string.

To give an example, the `is_numeric` function returns true if the argument contains either a number or a string that can be evaluated to a number.

```
is_numeric(10.5); // true (float)
is_numeric('33'); // true (numeric string)
is_numeric('text'); // false (non-numeric string)
```


Variable Information

PHP has three built-in functions for retrieving information about variables: `print_r`, `var_dump`, and `var_export`. The `print_r` function displays the value of a variable in a human-readable way. It is useful for debugging purposes.

```
$a = array('one', 'two', 'three');
print_r($a);
```

The preceding code produces the following output.

```
Array ( [0] => one [1] => two [2] => three )
```

Similar to `print_r` is `var_dump`, which, in addition to values, also displays data types and sizes. Calling `var_dump($a)` shows this output.

```
array(3) {
  [0]=> string(3) "one"
  [1]=> string(3) "two"
  [2]=> string(5) "three"
}
```

Finally, there is the `var_export` function, which prints variable information in a style that can be used as PHP code. The following shows the output for `var_export($a)`. Note the trailing comma after the last element, which is allowed.

```
array ( 0 => 'one', 1 => 'two', 2 => 'three', )
```

The `var_export` function, along with `print_r`, accepts an optional Boolean second argument. When set to `true`, the function returns the output instead of printing it. This gives `var_export` further uses, such as being combined with the `eval` language construct. This construct takes a string argument and evaluates it as PHP code.

```
eval('$b = ' . var_export($a, true) . ');');
```

The ability to execute arbitrary code with `eval` is a powerful feature that should be used with care. It should not be used to execute any user-provided data, at least not without proper validation, as this represents a security risk. Another reason why the use of `eval` is discouraged is because similar to `goto`, it makes the execution of code more difficult to follow, which complicates debugging.

CHAPTER 21

Overloading

Overloading in PHP provides the ability to add object members at run-time. This is done by having the class implement the overloading methods `__get`, `__set`, `__call`, and `__callStatic`. Bear in mind that the meaning of overloading in PHP is different from many other languages.

Property Overloading

The `__get` and `__set` methods provide a convenient way to implement getter and setter methods, which are methods that are often used to safely read and write to properties. These overloading methods are invoked when using properties that are inaccessible, either because they are not defined in the class or because they are unavailable from the current scope. In the following example, the `__set` method adds any inaccessible properties to the `$data` array, and `__get` safely retrieves the elements from this array.

```
class MyProperties
{
    private $data = array();

    public function __set($name, $value)
    {
        $this->data[$name] = $value;
    }

    public function __get($name)
```

```

{
    if (array_key_exists($name, $this->data))
        return $this->data[$name];
}
}

```

When setting the value of an inaccessible property, `__set` is called with the name of the property and the value as its arguments. Similarly, when accessing an inaccessible property, `__get` is called with the property name as its argument.

```

$obj = new MyProperties();

$obj->a = 1; // __set called
echo $obj->a; // __get called

```

Method Overloading

There are two methods for handling calls to inaccessible methods of a class: `__call` and `__callStatic`. The `__call` method is invoked for instance method calls.

```

class MyClass
{
    public function __call($name, $args)
    {
        echo "Calling $name $args[0]";
    }
}

// "Calling myTest in object context"
(new MyClass()->myTest('in object context'));

```

The first argument to `__call` is the name of the method being called and the second is a numeric array containing the parameters passed to the method. These arguments are the same for the `__callStatic` method, which handles calls to inaccessible static methods.

```
class MyClass
{
    public static function __callStatic($name, $args)
    {
        echo "Calling $name $args[0]";
    }
}

// "Calling myTest in static context"
MyClass::myTest('in static context');
```

Isset and unset Overloading

The built-in constructs `isset`, `empty`, and `unset` only work on explicitly defined properties, not overloaded ones. This functionality can be added to a class by overloading the `__isset` and `__unset` methods.

```
class MyClass
{
    private $data = array();

    public function __set($name, $value) {
        $this->data[$name] = $value;
    }

    public function __get($name) {
        if (array_key_exists($name, $this->data))
            return $this->data[$name];
    }
}
```

```

public function __isset($name) {
    return isset($this->data[$name]);
}

public function __unset($name) {
    unset( $this->data[$name] );
}
}

```

The `__isset` method is invoked when `isset` is called on an inaccessible property.

```

$obj = new MyClass();
$obj->name = "Joe";

isset($obj->name); // true
isset($obj->age); // false

```

When `unset` is called on an inaccessible property, the `__unset` method handles that call.

```

unset($obj->name); // delete property
isset($obj->name); // false

```

The `empty` construct only works on overloaded properties if both `__isset` and `__get` are implemented. If the result from `__isset` is false, the `empty` construct returns true. If, on the other hand, `__isset` returns true, then `empty` retrieves the property with `__get` and evaluates if it has a value considered to be empty.

```

empty($obj->name); // false
empty($obj->age); // true

```

CHAPTER 22

Magic Methods

There are a number of methods that can be implemented in a class for the purpose of being called internally by the PHP engine. These are known as *magic methods*, and they are easy to recognize because they all start with two underscores. Table 22-1 lists the magic methods that have been discussed so far.

Table 22-1. *Magic Methods*

Name	Description
<code>__construct(...)</code>	Called when creating a new instance.
<code>__destruct()</code>	Called when object has no references left.
<code>__call(\$name, \$array)</code>	Called when invoking inaccessible methods in an object context.
<code>__callStatic(\$name, \$array)</code>	Called when invoking inaccessible methods in a static context.
<code>__get(\$name)</code>	Called when reading data from inaccessible properties.
<code>__set(\$name, \$value)</code>	Called when writing data to inaccessible properties.
<code>__isset(\$string)</code>	Called when <code>isset</code> or <code>empty</code> is used on inaccessible properties.
<code>__unset(\$string)</code>	Called when <code>unset</code> is used on inaccessible properties.

In addition to these, there are six more magic methods that, like the others, can be implemented in classes to provide certain functionalities.

Table 22-2. *More Magic Methods*

Name	Description
<code>__toString()</code>	Called for object to string conversions.
<code>__invoke(...)</code>	Called for object to function conversions.
<code>__sleep()</code>	Called by <code>serialize</code> . Performs cleanup tasks and returns an array of variables to be serialized.
<code>__wakeup()</code>	Called by <code>unserialize</code> to reconstruct the object.
<code>__set_state(\$array)</code>	Called by <code>var_export</code> . The method must be static and its argument contains the exported properties.
<code>__clone()</code>	Called after object has been cloned.

`__toString`

When an object is used in a context where a string is expected, the PHP engine searches for a method named `__toString` to retrieve a string representation of the object.

```
class MyClass
{
    public function __toString()
    {
        return 'Instance of ' . __CLASS__;
    }
}

$obj = new MyClass();
echo $obj; // "Instance of MyClass"
```


It is not possible to define how an object will behave when evaluated as types other than string.

`__invoke`

The `__invoke` method allows an object to be treated as a function. Arguments provided when the object is called are used as the `__invoke` function's arguments.

```
class MyClass
{
    public function __invoke($arg)
    {
        echo $arg;
    }
}

$obj = new MyClass();
$obj('Test'); // "Test"
```

Object Serialization

Serialization is the process of converting data into a string format. This is useful for storing objects in databases or files. In PHP, the built-in `serialize` function performs this object-to-string conversion and `unserialize` converts the string back into the original object. The `serialize` function handles all types, except for the resource type, which is used to hold database connections and file handlers, for example. Consider the following simple database class.

```

class MyConnection
{
    public $link, $server, $user, $pass;

    public function connect()
    {
        $this->link = mysql_connect($this->server,
                                   $this->user,
                                   $this->pass);
    }
}

```

When this class is serialized, the database connection is lost and the `$link` resource type variable holding the connection is stored as null.

```

$obj = new MyConnection();
// ...

$bin = serialize($obj); // serialize object
$obj = unserialize($bin); // restore object

```

To get greater control over how object data is serialized and unserialized, the `__sleep` and `__wakeup` methods may be implemented by this class.

`__sleep`

The `__sleep` method is called by `serialize` and needs to return an array containing the properties that will be serialized. This array must not include private or protected properties because `serialize` is not able to access them. The method may also perform cleanup tasks before the serialization occurs, such as committing any pending data to storage mediums.

```
public function __sleep()
{
    return array('server', 'user', 'pass');
}
```

Note that the properties are returned to serialize in string form. The `$link` resource type pointer is not included in the array because it cannot be serialized. To reestablish the database connection, the `__wakeup` method can be used.

`__wakeup`

Calling `unserialize` on the serialized object invokes the `__wakeup` method in order to restore the object. It accepts no arguments and does not need to return any value. It is used for reestablishing resource type variables and for performing other initializing tasks that may need to be done after an object has been unserialized. In this example, it reestablishes the MySQL database connection.

```
public function __wakeup()
{
    if(isset($this->server, $this->user, $this->$pass))
        $this->connect();
}
```

Note that the `isset` construct is called here with multiple arguments, in which case it only returns `true` if all parameters are set.

Set State

The `var_export` function retrieves variable information that is usable as valid PHP code. In the following example, this function is used on an object.

```
class Fruit
{
    public $name = 'Lemon';
}

$export = var_export(new Fruit(), true);
```

Since an object is a complex type, there is no generic syntax for constructing it along with its members. Instead, `var_export` creates the following string.

```
Fruit::__set_state(array( 'name' => 'Lemon', ))
```

In order to construct the object, this string relies on a static `__set_state` method being defined for the object. As shown, the `__set_state` method takes an associative array containing key-value pairs of each of the object's properties, including private and protected members.

```
static function __set_state(array $array)
{
    $tmp = new Fruit();
    $tmp->name = $array['name'];
    return $tmp;
}
```

With this method defined in the `Fruit` class, the exported string can now be parsed with the `eval` construct to create an identical object.

```
eval('$MyFruit = ' . $export . ');');
```

Object Cloning

Assigning an object to a variable only creates a new reference to the same object. To copy an object, the `clone` operator can be used.

```
class Fruit {}

$f1 = new Fruit();
$f2 = $f1;          // copy object reference
$f3 = clone $f1;   // copy object
```

When an object is cloned, its properties are copied over to the new object. However, any child objects it may contain are not cloned, so they are shared between the copies. This is where the `__clone` method comes in. It is called on the cloned copy after the cloning is done, and it can be used to clone any child objects.

```
class Apple {}

class FruitBasket
{
    public $apple;

    function __construct() { $apple = new Apple(); }

    function __clone()
    {
        $this->apple = clone $this->apple;
    }
}
```

CHAPTER 23

User Input

When an HTML form is submitted to a PHP page, the data becomes available to that script.

HTML Form

An HTML form has two required attributes: `action` and `method`. The `action` attribute specifies the script file to which the form data is passed when the form is submitted. For example, the following form submits one input property called `myString` to the `mypage.php` script file.

```
<?php // myform.php ?>
<!doctype html>
<html>
<body>
  <form action="mypage.php" method="post">
    <input type="text" name="myString">
    <input type="submit">
  </form>
</body>
</html>
```

The second required attribute of the form element specifies the sending method, which may be either GET or POST.

Sending with POST

When this form is submitted, the browser loads `mypage.php` and passes the form data along. If the form is sent using the POST method, the data becomes available to the receiving script through the `$_POST` array. The names of the form input properties become keys in that associative array.

```
<?php // mypage.php ?>
<!doctype html>
<html>
<body>
  <?php echo $_POST['myString']; ?>
</body>
</html>
```

Data sent with the POST method is not visible on the URL of the page, but this also means that the state of the page cannot be saved by, for example, bookmarking the page.

Sending with GET

The alternative to POST is to send the form data with the GET method and to retrieve it using the `$_GET` array. The variables are then displayed in the address bar, which effectively maintains the state of the page if it is bookmarked and revisited.

```
// mypage.php
echo $_GET['myString'];
```

Because the data is contained in the address bar, variables cannot only be passed through HTML forms but also through HTML links. The `$_GET` array can then be used to change the state of the page accordingly. This provides one way of passing variables from one page to another, as seen in the following example.

```
<?php // sender.php ?>
<!doctype html>
<html>
<body>
  <a href="receiver.php?myString=Foo+Bar">link</a>
</body>
</html>
```

When the link on this web page is clicked, the receiver.php file can access the data that has been passed to it. The following example displays the data on the page.

```
<?php // receiver.php ?>
<!doctype html>
<html>
<body>
  <?php echo $_GET['myString']; // "Foo Bar" ?>
</body>
</html>
```

Request Array

If it does not matter whether the POST or GET method was used to send the data, the `$_REQUEST` array can be used. This array typically contains the `$_GET` and `$_POST` arrays, but may also contain the `$_COOKIE` array.

```
echo $_REQUEST['myString']; // "Foo Bar"
```

The content of the `$_REQUEST` array can be set in the PHP configuration file¹ and varies between PHP distributions. Due to security concerns, the `$_COOKIE` array is usually not included.

¹www.php.net/manual/en/ini.core.php#ini.request-order

Security Concerns

Any user-provided data can be manipulated; therefore, it should be validated and sanitized before being used. *Validation* means that you make sure that the data is in the form you expect, in terms of data type, range, and content. For example, the following code validates an email address.

```
if(!filter_var($_POST['email'], FILTER_VALIDATE_EMAIL))
    echo "Invalid email address";
```

Sanitizing is when you disable potentially malicious code in the user input. This is done by escaping the code according to the rules of the language where the input is to be used. For example, if the data is sent to a database, it needs to be sanitized with the `mysql_real_escape_string` function to disable any embedded SQL code.

```
// Sanitize for database use
$name = mysql_real_escape_string($_POST['name']);

// Execute SQL command
$sql = "SELECT * FROM users WHERE user='" . $name . "'";
$result = mysql_query($sql);
```

When user-supplied data is output to the web page as text, the `htmlspecialchars` function should be used. It disables any HTML markup, so that the user input is displayed but not interpreted.

```
// Sanitize for web page use
echo htmlspecialchars($_POST['comment']);
```

Submitting Arrays

Form data can be grouped into arrays by including array square brackets after the variable names in the form. This works for all form input elements, including `<input>`, `<select>`, and `<textarea>`.

```
<input type="text" name="myArr[]">
<input type="text" name="myArr[]">
```

The elements may also be assigned their own array keys.

```
<input type="text" name="myArr[name]">
```

Once submitted, the array is available for use in the script.

```
$val1 = $_POST['myArr'][0];
$val2 = $_POST['myArr'][1];
$name = $_POST['myArr']['name'];
```

The form `<select>` element has an attribute for allowing multiple items to be selected from the list.

```
<select name="myArr[]" size="3" multiple="true">
  <option value="apple">Apple</option>
  <option value="orange">Orange</option>
  <option value="pear">Pear</option>
</select>
```

When this multi-select element is included in a form, the array brackets become necessary for retrieving the selected values in the script.

```
foreach ($_POST['myArr'] as $item)
  echo $item . ' '; // ex "apple orange pear"
```

File Uploading

The HTML form provides a file input type that allows files to be uploaded to the server. For file uploading to work, the form's optional `enctype` attribute must be set to `"multipart/form-data"`, as shown in the following example.

```
<form action="mypage.php" method="post"
      enctype="multipart/form-data">
  <input name="myfile" type="file">
  <input type="submit" value="Upload">
</form>
```

Information about the uploaded file is stored in the `$_FILES` array. The keys of this associative array are seen in Table 23-1.

Table 23-1. Keys of the `$_FILES` Array

Name	Description
<code>name</code>	Original name of uploaded file.
<code>tmp_name</code>	Path to temporary server copy.
<code>type</code>	Mime type of the file.
<code>size</code>	File size in bytes.
<code>error</code>	Error code.

A received file is only temporarily stored on the server. If it is not saved by the script, it will be deleted. The following shows a simple example of how to save the file. The example checks the error code to make sure that the file was successfully received and, if so, moves the file out of the temporary folder to save it. In practice, you would also want to examine the file size and type to determine whether the file is to be kept.

```
$dest = 'upload/' . basename($_FILES['myfile']['name']);  
$file = $_FILES['myfile']['tmp_name'];  
$err = $_FILES['myfile']['error'];  
  
if($err == 0 && move_uploaded_file($file, $dest))  
    echo 'File successfully uploaded';
```

Two new functions are seen in this example. The `move_uploaded_file` function checks to ensure that the first argument contains a valid upload file, and if so, it moves it to the path and renames it to the file name specified by the second argument. The specified folder must already exist, and if the function succeeds in moving the file, it returns `true`. The other new function is `basename`. It returns the file name component of a path, including the file extension.

Superglobals

As seen in this chapter, there are a number of built-in associative arrays that make external data available to PHP scripts. These arrays are known as *superglobals*, because they are automatically available in every scope. There are nine superglobals in PHP, each of which is described briefly in Table 23-2.

Table 23-2. *Superglobals*

Name	Description
<code>\$GLOBALS</code>	Contains all global variables, including other superglobals.
<code>\$_GET</code>	Contains variables sent via an HTTP GET request.
<code>\$_POST</code>	Contains variables sent via an HTTP POST request.
<code>\$_FILES</code>	Contains variables sent via an HTTP POST file upload.
<code>\$_COOKIE</code>	Contains variables sent via HTTP cookies.
<code>\$_SESSION</code>	Contains variables stored in a user's session.
<code>\$_REQUEST</code>	Contains <code>\$_GET</code> , <code>\$_POST</code> , and possibly <code>\$_COOKIE</code> variables.
<code>\$_SERVER</code>	Contains information about the web server and the request made to it.
<code>\$_ENV</code>	Contains all environment variables set by the web server.

The content of the variables `$_GET`, `$_POST`, `$_COOKIE`, `$_SERVER`, and `$_ENV` is included in the output generated by the `phpinfo` function. This function also displays the general settings of the PHP configuration file, `php.ini`, along with other information regarding PHP.

```
phpinfo(); // display PHP information
```

CHAPTER 24

Cookies

A *cookie* is a small file kept on the client's computer that can be used to store data relating to that user.

Creating Cookies

To create a cookie, the `setcookie` function is used. This function must be called before any output is sent to the browser. It is typically called with three parameters that contain the name, value, and expiration date of the cookie.

```
setcookie("lastvisit", date("H:i:s"), time() + 60*60);
```

The value here is set with the `date` function, which returns a string formatted according to the specified format string. The expiration date is measured in seconds and is usually set relative to the current time in seconds retrieved through the `time` function. In this example, the cookie expires after one hour.

Two more optional arguments can be provided: `path` and `domain`. These are used to restrict from what pages the cookie can be accessed. For instance, the following cookie will only be sent along when visiting a page within the “foo” directory on the “fr.example.com” subdomain, such as when visiting “fr.example.com/foo/example.php”.

```
setcookie("lastvisit",  
         date("H:i:s"),  
         time() + 60*60,  
         '/foo/',  
         'fr.example.com');
```

Cookie Array

Once the cookie has been set for a user, this cookie is sent along the next time that user views a page on the same domain. It can then be accessed through the `$_COOKIE` array.

```
if (isset($_COOKIE['lastvisit']))  
    echo "Last visit: " . $_COOKIE['lastvisit'];
```

Deleting Cookies

A cookie can be deleted manually by re-creating that same cookie with an old expiration date. It is then removed when the browser is closed.

```
setcookie("lastvisit", 0, 0);
```

CHAPTER 25

Sessions

A *session* provides a way to make variables accessible across multiple web pages. Unlike cookies, session data is stored on the server.

Starting a Session

To begin a session, the `session_start` function is used. This function must appear before any output is sent to the web page.

```
<?php session_start(); ?>
```

The `session_start` function sets a cookie on the client's computer, containing an id used to associate the client with the session. If the client already has an ongoing session, the function resumes that session instead of starting a new one.

Session Array

With the session started, the `$_SESSION` array is used to store session data as well as retrieve it. As an example, the page view count is stored with the following code. The first time the page is viewed, the session element is initialized to one.


```

if(isset($_SESSION['views']))
    $_SESSION['views'] += 1;
else
    $_SESSION['views'] = 1;

```

This element can now be retrieved from any page on the domain as long as `session_start` is called on the top of that page.

```
echo 'Views: ' . $_SESSION['views'];
```

Deleting a Session

A session is guaranteed to last until the user leaves the website. After that, the garbage collector is free to delete that session. To manually remove a session variable, the `unset` function can be used. For removing all session variables, there is the `session_destroy` function.

```

unset($_SESSION['views']); // destroy session variable
session_destroy(); // destroy session

```

Sessions and Cookies

Both sessions and cookies are used for storing data across pages of a site. Typically, sessions are used to temporarily store user data for the duration of a single visit. Cookies on the other hand are used to store data for longer durations, for instance, to preserve the logged in state of a user. Keep in mind that cookies are stored on the client side, whereas session data is stored on the server side. Cookie data therefore can be tampered with by a malicious user, and so no passwords or other sensitive data should ever be stored in a cookie.

CHAPTER 26

Namespaces

Namespaces provide a way to avoid naming conflicts and to group namespace members into a hierarchy. Any code may be contained within a namespace, but only four code constructs are affected: classes, interfaces, functions, and constants.

Creating Namespaces

A construct that is not included in a namespace belongs to the global namespace.

```
// Global code/namespace  
class MyClass {}
```

To assign the construct to another namespace, a namespace directive is defined. Any code constructs below the namespace directive belong to that namespace. A common naming convention for namespaces is to use all lowercase letters.

```
namespace my;  
  
// Belongs to my namespace  
class MyClass {}
```

A script file containing namespaced code must declare the namespace at the top of the file before any other code, markup, or whitespace. Declare statements are an exception to this because they must be placed before namespace declarations.

```
<?php
namespace my;
class MyClass {}
?>
<html><body></body></html>
```

Nested Namespaces

Namespaces can be nested any number of levels deep to further define the namespace hierarchy. Like directories and files in Windows, namespaces and their members are separated with a backslash character.

```
namespace my\sub;
class MyClass {} // my\sub\MyClass
```

Alternative Syntax

Alternatively, namespaces may be defined with the bracketed syntax commonly used in other programming languages. Just as with the regular syntax, no text or code may exist outside of the namespace.

```
<?php
namespace my
{
    class MyClass {}
?>
<html><body></body></html>
<?php }?>
```

Multiple namespaces can be declared in the same file, although this is not considered good coding practice. If global code is to be combined with namespaced code, then the bracketed syntax must be used. The global code is then enclosed in an unnamed namespace block.

```
// Namespaced code
namespace my
{
    const PI = 3.14;
}

// Global code
namespace
{
    echo my\PI; // "3.14"
}
```

Unlike other PHP constructs, the same namespace may be defined in more than one file. This allows namespace members to be split up across multiple files.

Referencing Namespaces

A namespace member can be referred to in three ways: fully qualified, qualified, and unqualified. The fully qualified name can always be used. It consists of the global prefix operator (`\`), followed by the namespace path and the member. The global prefix operator indicates that the path is relative to the global namespace.

```
namespace my
{
    class MyClass {}
}
```

```
namespace other
{
    // Fully qualified name
    $obj = new \my\MyClass();
}
```

The qualified name includes the namespace path, but not the global prefix operator. Therefore, it can only be used if the wanted member is defined in a namespace below the current namespace in the hierarchy.

```
namespace my
{
    class MyClass {}
}

namespace
{
    // Qualified name
    $obj = new my\MyClass();
}
```

The member name alone, or unqualified name, may only be used within the namespace that defines the member.

```
namespace my
{
    class MyClass {}

    // Unqualified name
    $obj = new MyClass();
}
```

Unqualified class and interface names only resolve to the current namespace. In contrast, if an unqualified function or constant does not exist in the current namespace, they will try to resolve to any global function or constant by the same name.

```
namespace
{
    function myPrint() { echo 'global'; }
}

namespace my
{
    // Falls back to global namespace
    myPrint(); // "global"
}
```

Alternatively, the global prefix operator can be used to explicitly refer to the global member. This would be necessary if the current namespace contained a function with the same name.

```
namespace my
{
    function myPrint() { echo 'local'; }
    \myPrint(); // "global"
    myPrint(); // "local"
}
```

Namespace Aliases

Aliases shorten qualified names to improve readability of the source code. The names for classes, interfaces, and namespaces can be shortened. An alias is defined with a use directive, which must be placed after the namespace name in the topmost scope of the file.

```
namespace my;
class MyClass {}

namespace foo;
use my\MyClass as MyAlias;
$obj = new MyAlias();
```

With the bracketed syntax, any use directives are placed after the opening curly bracket in the topmost scope.

```
namespace foo;
{
    use my\MyClass as MyAlias;
    $obj = new MyAlias();
}
```

The `as` clause may optionally be left out to import the member under its current name.

```
namespace foo;
use \my\MyClass;
$obj = new MyClass();
```

It is not possible to mass-import the members of another namespace. However, there is a syntactical shortcut for importing multiple members in the same use statement.

```
namespace foo;
use my\Class1 as C1, my\Class2 as C2;
```

PHP 7 further simplified this syntax by allowing use declarations to be grouped within curly brackets.

```
namespace foo;
use my\{ Class1 as C1, Class2 as C2 };
```

In addition to classes, interfaces, and namespaces, PHP 5.6 extended the use construct to support function and constant aliases. These are imported with the use function and use const constructs, respectively.

```
namespace my\space {
    const C = 5;
    function f() {}
}

namespace {
    use const my\space\C;
    use function my\space\f;
}
```

Keep in mind that aliases only apply to the script file that defines them. Therefore, an imported file does not inherit the parent file's aliases.

Namespace Keyword

The namespace keyword can be used as a constant that evaluates to the current namespace or an empty string in global code. It may be used to explicitly refer to the current namespace.

```
namespace my\name
{
    function myPrint() { echo 'Hi'; }
}

namespace my
{
    namespace\name\myPrint(); // "Hi"
    name\myPrint(); // "Hi"
}
```


Namespace Guideline

As the number of components involved in a web application grows, so too increases the potential for name clashes. One solution for this is to prefix names with the name of the component. However, this creates long names, which reduces readability of the source code. For this reason, PHP 5.3 introduced namespaces, to allow developers to group code for each component into separately named containers.

CHAPTER 27

References

A *reference* is an alias that allows two different variables to write to the same value. There are three operations that can be performed with references: assign by reference, pass by reference, and return by reference.

Assign by Reference

A reference is assigned by placing an ampersand (&) before the variable that is to be bound.

```
$x = 5;  
$r = &$x; // r is a reference to x  
$s =& $x; // alternative syntax
```

The reference then becomes an alias for that variable and can be used exactly as if it was the original variable.

```
$r = 10; // assign value to $r/$x  
echo $x; // "10"
```

Pass by Reference

In PHP, function arguments are passed by value by default. This means that a local copy of the variable is passed; so if the copy is changed, it will not affect the original variable.

```
function myFunc($x) { $x .= ' World'; }

$x = 'Hello';
myFunc($x); // value of x is passed
echo $x; // "Hello"
```

To allow a function to modify an argument, it must be passed by reference. This is done by adding an ampersand before the parameter's name in the function definition.

```
function myFunc(&$x) { $x .= ' World'; }

$x = 'Hello';
myFunc($x); // reference to x is passed
echo $x; // "Hello World"
```

Object variables are also passed by value by default. However, what is actually passed is a pointer to the object data, not the data itself. Therefore, changes to the object's members affect the original object, but replacing the object variable with the assignment operator only creates a local variable.

```
class MyClass { public $x = 1; }

function modifyVal($o)
{
    $o->x = 5;
    $o = new MyClass(); // new local object
}

$o = new MyClass();
modifyVal($o); // pointer to object is passed
echo $o->x; // "5"
```

In contrast, when an object variable is passed by reference, it is not only possible to change its properties but also to replace the entire object and have the change propagate back to the original object variable.

```
class MyClass { public $x = 1; }

function modifyRef(&$o)
{
    $o->x = 5;
    $o = new MyClass(); // new object
}

$o = new MyClass();
modifyRef($o); // reference to object is passed
echo $o->x; // "1"
```

Return by Reference

A variable can be assigned a reference from a function by having that function return by reference. The syntax for returning a reference is to place the ampersand before the function name. In contrast to pass by reference, the ampersand is also used when calling the function to bind the reference.

```
class MyClass
{
    public $val = 10;

    function &getVal()
    {
        return $this->val;
    }
}
```

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```
$obj = new MyClass();  
$myVal = &$obj->getVal();
```

Bear in mind that references should not be used merely for performance reasons, because the PHP engine takes care of such optimizations on its own. Only use references when you have a need for reference-type behavior.

CHAPTER 28

Advanced Variables

In addition to being a container for data, PHP variables have other features that are examined in this chapter. These are features that are not commonly used but are good to know about.

Curly Syntax

A variable name can be explicitly specified by enclosing it in curly brackets. This is known as *curly* or *complex syntax*. To illustrate, the following code outputs the variable even though it appears in the middle of a word.

```
$fruit = 'Apple';  
echo "Two {$fruit}s"; // "Two Apples"
```

More importantly, the curly syntax is useful for forming variable names out of expressions. Consider the following code, which uses the curly syntax to construct names for three variables.

```
for ($i = 1; $i <= 3; $i++)  
    ${'x' . $i} = $i;  
  
echo "$x1 $x2 $x3"; // "1 2 3"
```

The curly syntax is required here because the expression needs to be evaluated in order to form a valid variable name. If the expression has only a single variable, the curly brackets are not needed.

```
for ($i = 'a'; $i <= 'c'; $i++)
    $$i = $i;

echo "$a $b $c"; // "a b c"
```

This syntax is known as a *variable variable* in PHP.

Variable Variable Names

A variable variable is a variable whose name can be changed through code. As an example, consider the following regular variable.

```
$a = 'foo';
```

This variable's value can be used as a variable name by placing an additional dollar sign before it.

```
$$a = 'bar';
```

The value of \$a, which is foo, now becomes an alternative name for the \$\$a variable.

```
echo $foo; // "bar"
echo $$a; // "bar"
```

An example usage for this would be to generate variables from an array.

```
$arr = array('a' => 'Foo', 'b' => 'Bar');

foreach ($arr as $key => $value)
{
    $$key = $value;
}

echo "$a $b"; // "Foo Bar"
```

Variable Function Names

By placing parentheses after a variable, its value is evaluated as the name for a function.

```
function myPrint($s) { echo $s; }
$func = 'myPrint';
$func('Hello'); // "Hello"
```

This behavior does not work with built-in language constructs, such as `echo`.

```
echo('Hello'); // "Hello"
$myecho = 'echo';
$myecho('Hello'); // error
```

Variable Class Names

Similar to variable function names, classes can be referenced using string variables. This functionality was introduced in PHP 5.3.

```
class MyClass {}
$classname = 'MyClass';
$obj = new $classname();
```

The mechanism of accessing code entities via strings and string variables also works for members of a class or an instance.

```
class MyClass
{
    public $myProperty = 10;
}

$obj = new MyClass();
echo $obj->{'myProperty'}; // "10"
```


CHAPTER 29

Error Handling

An error is a mistake in the code that the developer needs to fix. When an error occurs in PHP, the default behavior is to display the error message in the browser. This message includes the file name, line number, and error description in order to help the developer correct the problem.

While compile and parse errors are typically easy to detect and fix, run-time errors can be harder to find because they may only occur in certain situations and for reasons beyond the developer's control. Consider the following code that attempts to open a file for reading using the `fopen` function.

```
$handle = fopen('myfile.txt', 'r');
```

It relies on the assumption that the requested file will always be there. If, for any reason, the file is not there or is otherwise inaccessible, the function will generate an error.

```
Warning: fopen(myfile.txt):  
failed to open stream: No such file or directory in  
C:\xampp\htdocs\mypage.php on line 2
```

Once an error has been detected, it should be corrected, even if it only occurs in exceptional situations.

Correcting Errors

There are two ways to correct this error. The first way is to check to make sure that the file can be read before attempting to open it. PHP conveniently provides the `is_readable` function for this task, which returns true if the specified file exists and is readable.

```
if (is_readable('myfile.txt'))
    $handle = fopen('myfile.txt', 'r');
```

The second way is to use the error control operator (`@`). When prepended to an expression, this operator suppresses error messages that might be generated by that expression. PHP 8 changed the behavior of this operator so that only non-fatal error messages are silenced.

```
$handle = @fopen('myfile.txt', 'r');
```

To determine if the file was opened successfully, the return value needs to be examined. Looking at the documentation,¹ you can find that `fopen` returns false on error.

```
if ($handle === false)
{
    echo 'File not found.';
}
```

If this is not the case, then the content of the file can be read with the `fread` function. This function reads the number of bytes specified in the second argument from the file handler given in the first argument.

```
else
{
    // Read the content of the whole file
```

¹www.php.net/manual/en/function.fopen.php

```

$content = fread($handle, filesize('myfile.txt'));

// Close the file handler
fclose($handle);
}

```

Once the file handler is no longer needed, it is good practice to close it with `fclose`; although, PHP automatically closes the file after the script has finished.

Error Levels

PHP provides several built-in constants for describing different error levels. Table 29-1 includes some of the more important ones.

Table 29-1. *Error Levels*

Name	Description
<code>E_ERROR</code>	Fatal run-time error. Execution is halted.
<code>E_WARNING</code>	Non-fatal run-time error.
<code>E_NOTICE</code>	Run-time notice about possible error.
<code>E_USER_ERROR</code>	Fatal user-generated error.
<code>E_USER_WARNING</code>	Non-fatal user-generated warning.
<code>E_USER_NOTICE</code>	User-generated notice.
<code>E_COMPILE_ERROR</code>	Fatal compile-time error.
<code>E_PARSE</code>	Compile-time parsing error.
<code>E_STRICT</code>	Suggested change to ensure forward compatibility.
<code>E_ALL</code>	All errors, except <code>E_STRICT</code> prior to PHP 5.4.

The first three of these levels represent run-time errors generated by the PHP engine. The following are some examples of operations that trigger these errors.

```
// E_NOTICE (<PHP8) - Use of undefined variable
$a = $x;

// E_WARNING - Missing file
$b = fopen('missing.txt', 'r');

// E_ERROR - Missing function
$c = missing();
```

PHP 8 reclassified several warnings and notices into more severe Error exceptions, which are looked at in the next chapter. For instance, using undefined variables results in an exception of the Error type as of PHP 8.

Error-Handling Environment

PHP provides a few configuration directives for setting up the error-handling environment. The `error_reporting` function sets which errors PHP reports through the internal error handler. The error level constants have bitmask values. This allows them to be combined and subtracted using bitwise operators, as shown here.

```
error_reporting(E_ALL | ~E_NOTICE); // all but E_NOTICE
```

The error reporting level can also be changed permanently in `php.ini`. The default value found in `php.ini` is `E_ALL` as of PHP 8, and so all error messages are displayed. This is a good setting to have during development, and it can be set programmatically by placing the following line of code at the start of the script. Note that `E_STRICT` can be added for backward compatibility, because this error level was not included in `E_ALL` until PHP 5.4.

```
// During development
error_reporting(E_ALL | E_STRICT);
```

When the web app goes live, raw error messages should be hidden away from users. This is done with the `display_errors` directive. It determines whether errors are printed to the web page by the internal error handler. The default value is to print them, but when the website is live, it is preferable to hide any potential raw error messages.

```
// During production
ini_set('display_errors', '0');
```

Another directive related to the error-handling environment is the `log_errors` directive. It sets whether error messages are recorded in the server's error log. This directive is disabled by default, but it is a good idea to enable it during development to keep track of errors.

```
// During development
ini_set('log_errors', '1');
```

The `ini_set` function sets the value of a configuration option. Alternatively, these options can all be permanently set in the `php.ini` configuration file instead of in the script files.

Custom Error Handlers

The internal error handler can be overridden with a custom error handler. This is the preferred method for handling errors because it allows you to abstract the raw errors with friendly, custom error messages to the end users.

A custom error handler is defined using the `set_error_handler` function. This function accepts two arguments: a callback function that is called when the error is raised and, optionally, the error levels that the function handles.

```
set_error_handler('myError', E_ALL | E_STRICT);
```

If no error levels are specified, the error handler is set to handle all errors, including `E_STRICT`. However, a user-defined error handler is only actually able to handle run-time errors, and only run-time errors other than `E_ERROR`. Keep in mind that changes to the `error_reporting` setting do not affect the custom error handler, only the internal one.

The callback function requires two parameters: the error level and error description. Optional parameters include the file name, line number, and error context, which is an array containing every variable in the scope that the error was triggered in.

```
function myError($errlvl, $errdesc, $errfile, $errline)
{
    switch($errlvl)
    {
        case E_USER_ERROR:
            error_log("Error: $errdesc", 1, 'me@example.com');
            require_once('my_error_page.php');
            return true;
        }
    return false;
}
```

This example function handles errors of level `E_USER_ERROR`. When such an error occurs, an email is sent to the specified address and a custom error page is displayed. By returning `false` from the function for other errors, they are handled by the internal error handler instead.

Raising Errors

PHP provides the `trigger_error` function for raising errors. It has one required argument, the error message, and a second optional argument specifying the error level. The error level must be one of the three `E_USER` levels, with `E_USER_NOTICE` being the default level.

```
if( !isset($myVar) )  
    trigger_error('$myVar not set'); // E_USER_NOTICE
```

Triggering errors is useful when you have a custom error handler in place, allowing you to combine the handling of both custom errors and errors raised by the PHP engine.

CHAPTER 30

Exception Handling

PHP 5 introduced *exceptions*, a built-in mechanism for handling program failures within the context in which they occur. Unlike errors, which generally need to be fixed by the developer, exceptions are handled by the script. They represent an irregular run-time situation that should have been expected as a possibility and which the script should be able to handle on its own.

Try-catch Statement

To handle an exception, it must be caught using a try-catch statement. This statement consists of a try block containing the code that may cause the exception, and one or more catch clauses.

```
try
{
    $div = invert(0);
}
catch (LogicException $e) {}
```

If the try block successfully executes, the program then continues running after the try-catch statement. However, if an exception occurs, the execution is then passed to the first catch block able to handle that exception type.

Throwing Exceptions

When a situation occurs that a function cannot recover from, it can generate an exception to signal to the caller that the function has failed. This is done using the `throw` keyword, followed by a new instance of the `Throwable` class or one of its child classes. In the following example, the `LogicException` type is thrown. It inherits from the `Exception` class which in turn inherits from `Throwable`.¹

```
function invert($x)
{
    if ($x == 0) {
        throw new LogicException('Division by zero');
    }
    return 1 / $x;
}
```

Catch Block

In the previous example, the catch block is set to handle the built-in `LogicException` type. If the code in the try block could throw more kinds of exceptions, multiple catch blocks can be used, allowing different exceptions to be handled in different ways.

```
catch (LogicException $e) {}
catch (RuntimeException $e) {}
// ...
```

To catch a more specific exception, the catch block needs to be placed before exceptions that are more general. For example, `LogicException` inherits from `Exception`, so it needs to be caught first.

¹www.php.net/manual/en/spl.exceptions.php

```
catch (LogicException $e) {}  
catch (Exception $e) {}
```

The catch clause can define an exception object. This object is used to obtain more information about the exception, such as a description of the exception using the `getMessage` method.

```
catch (LogicException $e)  
{  
    echo $e->getMessage(); // "Division by zero"  
}
```

As of PHP 8, the exception object may optionally be left out if there is no need to use that object.

```
catch (LogicException) {}
```

Finally Block

PHP 5.5 introduced the finally block, which can be added as the last clause in a try-catch statement. This block is used to clean up resources allocated in the try block. It always executes whether or not there is an exception.

```
$resource = myopen();  
try { myuse($resource); }  
catch(Exception $e) {}  
finally { myfree($resource); }
```

Rethrowing Exceptions

Sometimes an exception cannot be handled where it is first caught. It can then be rethrown using the `throw` keyword followed by the exception object.

```
try { $div = invert(0); }  
catch (LogicException $e) { throw $e; }
```

The exception then propagates up the caller stack until it is caught by another `try-catch` statement. If the exception is never caught, it becomes an error of level `E_ERROR`, which halts the script, unless an uncaught exception handler has been defined.

PHP 8 changed `throw` from being a statement to being an expression. This makes it possible to throw exceptions anywhere an expression is allowed, such as inside the following statement.

```
$name = $_GET['name'] ?? throw new Exception('name missing');
```

Uncaught Exception Handler

The `set_exception_handler` function allows any uncaught exceptions to be caught. It takes a single argument, which is the callback function that is raised for such an event.

```
set_exception_handler('myException');
```

The callback function only needs one parameter, the exception object that was thrown.

```
function myException($e)  
{  
    $file = 'exceptionlog.txt';
```

```

file_put_contents($file, $e->getMessage(), FILE_APPEND);
require_once('my_error_page.php');
exit;
}

```

Because this exception handler is called outside the context where the exception occurred, recovering from the exception would be difficult. Instead, this example handler writes the exception to a log file and displays an error page. To stop further execution of the script, the built-in `exit` construct is used. It is synonymous with the `die` construct and optionally takes a string argument that is printed before the script is halted.

Errors and Exceptions

Whereas exceptions are thrown with the intention of being handled by the script, errors are generated to inform the developer that there is a mistake in the code. When it comes to problems that occur at run-time, the exception mechanism is generally considered superior. However, since it was not introduced until PHP 5, all internal functions continued to use the error mechanism until PHP 8. As of PHP 8, many errors have been reclassified as Error exceptions. For example, a division by zero throws a `DivisionByZeroError` exception in PHP 8, whereas it triggered a warning in previous PHP versions.

```

try {
    echo 1/0; // throws exception in PHP 8
}
catch(DivisionByZeroError $e){
    echo $e->getMessage();
}

```

Throwable has two built-in child classes, Exception and Error. As of PHP 8, most internal functions throw exceptions of the Error type, such as TypeError, ValueError, or DivisionByZeroError.

For user-defined functions, the developer is free to choose either the exception or error-handling mechanism, but the more modern exception mechanism is preferred. Keep in mind that errors cannot be caught by try-catch statements. Likewise, exceptions do not trigger error handlers.

CHAPTER 31

Assertions

Assert is a debugging feature that can be used during development to ensure that a condition is always true. Any expression can be asserted, as long as it evaluates to either true or false.

```
// Make sure $myVar is set
assert(isset($myVar));
```

Code assertions like this help validate that there are no execution paths that break the specified assumption. If this occurs, an error (or warning prior to PHP 8) that shows the file and line number of the assertion is displayed, which makes it easy to locate and fix the mistake in the code.

```
Fatal error: Assertion failed in C:\xampp\htdocs\mypage.php on
line 3
```

A description of the assertion may be included, which is displayed if the assertion fails. Support for this second parameter was added in PHP 5.4.8.

```
assert(isset($myVar), '$myVar not set');
```

As of PHP 7, the second parameter can also be an exception object to be thrown if the assertion fails. By default, an `AssertionError` is thrown when an assertion fails.

```
assert(false, new AssertionError('Assert failed'));
```

Assert Performance

Assertions can be turned off using the `assert_options` function by setting the `ASSERT_ACTIVE` option to zero. This means that assertions do not need to be removed from the code after debugging is finished and the development code becomes production code.

```
// Disable assertions
assert_options(ASSERT_ACTIVE, 0);
```

Prior to PHP 7, a condition passed to an assertion was always evaluated, even if assertions were turned off. To avoid this extra overhead in production code, the condition could be passed as a string instead, which was then evaluated by `assert`.

```
assert('isset($myVar)');
```

In PHP 7, `assert` became a language construct, as opposed to a function, allowing for zero performance loss from including assertions in production code. The way to skip assertions completely in PHP 7 is to set the `zend.assertions` configuration directive to `-1` in the `php.ini` configuration file. Use of `assert` with string arguments was deprecated in PHP 8 and should no longer be used.

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