Web Programming Step by Step

Chapter 5
PHP for Server-Side Programming

5.1: Server-Side Basics

URLs and web servers

`http://`*`server`*`/`*`path`*`/`*`file`*

- usually when you type a URL in your browser:
  - your computer looks up the server's IP address using DNS
  - your browser connects to that IP address and requests the given file
  - the web server software (e.g. Apache) grabs that file from the server's local file system, and sends back its contents to you

- some URLs actually specify *programs* that the web server should run, and then send their output back to you as the result:

  `https://webster.cs.washington.edu/quote2.php`

  - the above URL tells the server `webster.cs.washington.edu` to run the program `quote2.php` and send back its output

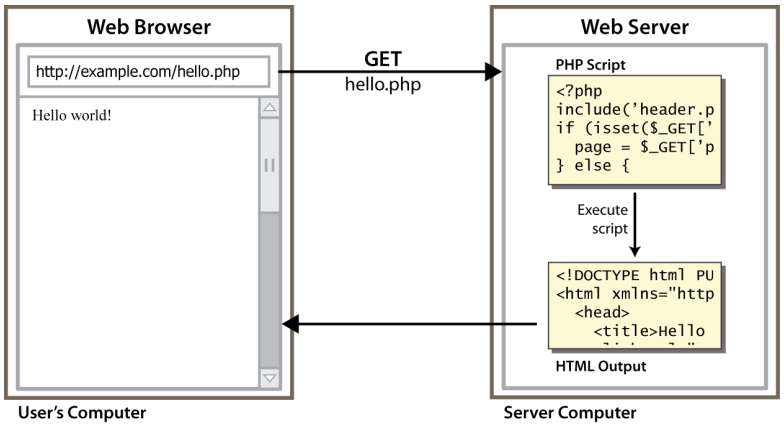
Server-Side web programming

- server-side pages are programs written using one of many web programming languages/frameworks
  - examples: PHP, Java/JSP, Ruby on Rails, ASP.NET, Python, Perl
- the web server contains software that allows it to run those programs and send back their output as responses to web requests
- each language/framework has its pros and cons
  - we use PHP for server-side programming in this textbook

What is PHP? (5.1.2)

- **PHP** stands for "PHP Hypertext Preprocessor"
- a server-side scripting language
- used to make web pages dynamic:
  - provide different content depending on context
  - interface with other services: database, e-mail, etc
  - authenticate users
  - process form information
- PHP code can be embedded in XHTML code

Lifecycle of a PHP web request (5.1.1)



- browser requests a `.html` file (**static content**): server just sends that file
- browser requests a `.php` file (**dynamic content**): server reads it, runs any script code inside it, then sends result across the network
  - script produces output that becomes the response sent back

Why PHP?

There are many other options for server-side languages: Ruby on Rails, JSP, ASP.NET, etc. Why choose PHP?

- free and open source: anyone can run a PHP-enabled server free of charge
- compatible: supported by most popular web servers
- simple: lots of built-in functionality; familiar syntax
- available: installed on UW's servers (Dante, Webster) and most commercial web hosts

Hello, World!

The following contents could go into a file `hello.php`:

```php
<?php
print "Hello, world!";
?>
```

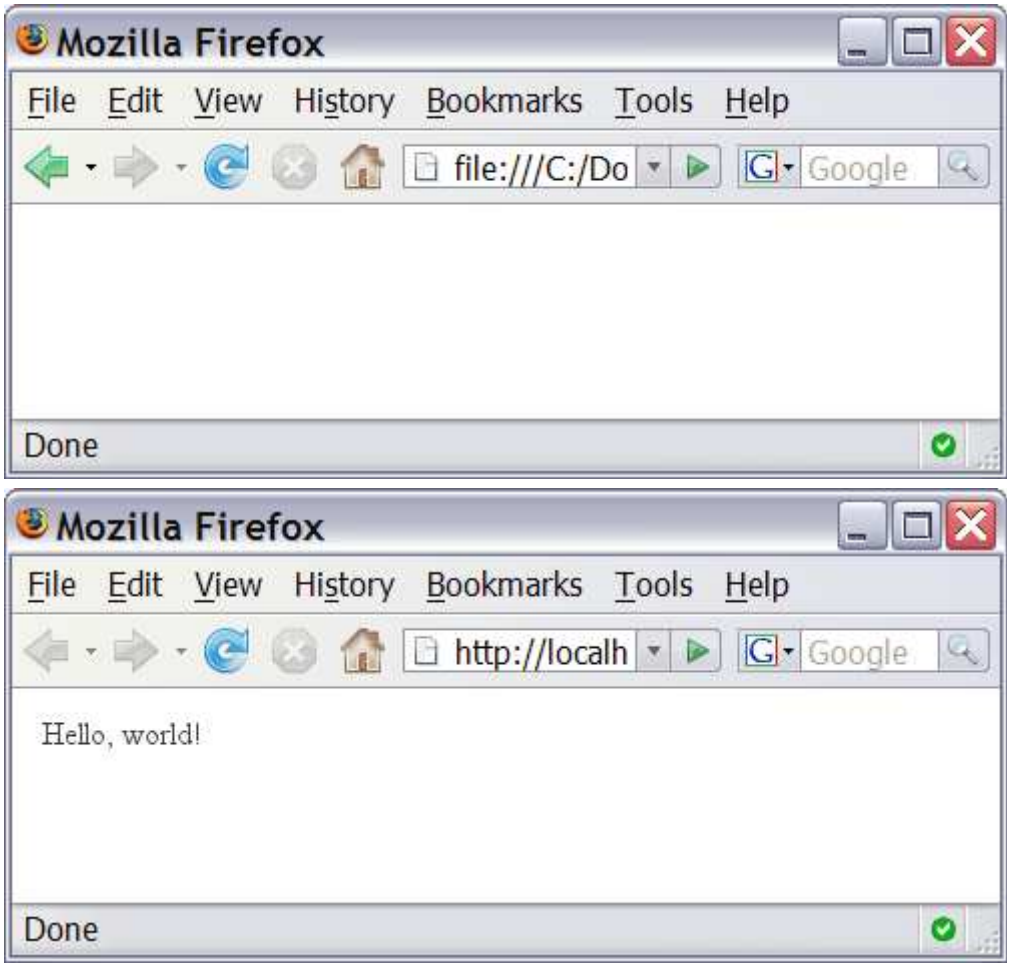
PHP

```
Hello, world!
```

output

- a block or file of PHP code begins with `<?php` and ends with `?>`
- PHP statements, function declarations, etc. appear between these endpoints

Viewing PHP output



- you can't view your `.php` page on your local hard drive; you'll either see nothing or see the PHP source code
- if you upload the file to a PHP-enabled web server, requesting the `.php` file will run the program and send you back its output

5.2: PHP Basic Syntax

Console output: `print` (5.2.2)

```php
print "text";

print "Hello, World!\n";
print "Escape \"chars\" are the SAME as in Java!\n";

print "You can have
line breaks in a string.";

print 'A string can use "single-quotes".  It\'s cool!';
```

```
Hello, World! Escape "chars" are the SAME as in Java! You can have line breaks in a string. A string can use "single-quotes". It's cool!
```

- some PHP programmers use the equivalent `echo` instead of `print`

Variables (5.2.5)

```php
$name = expression;

$user_name = "PinkHeartLuvr78";
$age = 16;
$drinking_age = $age + 5;
$this_class_rocks = TRUE;
```

- names are case sensitive; separate multiple words with _
- names always begin with $, on both declaration and usage
- always implicitly declared by assignment (type is not written)
- a loosely typed language (like JavaScript or Python)

Types (5.2.3)

- basic types: `int`, `float`, `boolean`, `string`, `array`, `object`, `NULL`
  - test what type a variable is with `is_`*`type`* functions, e.g. `is_string`
  - `gettype` function returns a variable's type as a string (not often needed)
- PHP converts between types automatically in many cases:
  - `string` → `int` auto-conversion on `+`
  - `int` → `float` auto-conversion on `/`
- type-cast with `(`*`type`*`)`:
  - `$age = (int) "21";`

Operators (5.2.4)

- `+ - * / % . ++ --`
  `= += -= *= /= %= .=`
  `== != === !== > < >= <=`
  `&& || !`
- `==` just checks value (`"5.0" == 5` is `TRUE`)
- `===` also checks type (`"5" === 5` is `FALSE`)
- many operators auto-convert types: `5 < "7"` is `TRUE`

`int` and `float` types

```php
$a = 7 / 2;                # float: 3.5
$b = (int) $a;             # int: 3
$c = round($a);            # float: 4.0
$d = "123";                # string: "123"
$e = (int) $d;             # int: 123
```

- `int` for integers and `float` for reals
- division between two `int` values can produce a `float`

Math operations

```php
$a = 3;
$b = 4;
$c = sqrt(pow($a, 2) + pow($b, 2));
```

abs	ceil	cos	floor	log	log10	max
min	pow	rand	round	sin	sqrt	tan

math functions

M_PI	M_E	M_LN2

math constants

- the syntax for method calls, parameters, returns is the same as Java

Comments (5.2.7)

```php
#  single-line comment

//  single-line comment

/*
multi-line comment
*/
```

- like Java, but # is also allowed
  - a lot of PHP code uses # comments instead of / /
  - we recommend # and will use it in our examples

`String` type (5.2.6)

```php
$favorite_food = "Ethiopian";
print $favorite_food[2];            # h
```

- zero-based indexing using bracket notation
- string concatenation operator is `.` (period), not +
  - `5 + "2 turtle doves" === 7`
  - `5 . "2 turtle doves" === "52 turtle doves"`
- can be specified with `""` or `''`

`String` functions

```php
$name = "Kenneth Kuan";
$length = strlen($name);              # 12
$cmp = strcmp($name, "Jeff Prouty");  # > 0
$index = strpos($name, "e");          # 1
$first = substr($name, 8, 4);         # "Kuan"
$name = strtoupper($name);            # "KENNETH KUAN"
```

Name	Java Equivalent
explode, implode	split, join
strlen	length
strcmp	compareTo
strpos	indexOf
substr	substring
strtolower, strtoupper	toLowerCase, toUpperCase
trim	trim

Interpreted strings

```php
$age = 16;
print "You are " . $age . " years old.\n";
print "You are $age years old.\n";    # You are 16 years old.
```

- strings inside " " are **interpreted**
  - variables that appear inside them will have their values inserted into the string
- strings inside ' ' are *not* interpreted:

```php
print 'You are $age years old.\n';    # You are $age years old.\n
```

- if necessary to avoid ambiguity, can enclose variable in { }:

```php
print "Today is your $ageth birthday.\n";     # $ageth not found
print "Today is your {$age}th birthday.\n";
```

for loop (same as Java) (5.2.9)

```
for (initialization; condition; update) {
  statements;
}
```
PHP

```
for ($i = 0; $i < 10; $i++) {
  print "$i squared is " . $i * $i . ".\n";
}
```
PHP

bool (Boolean) type (5.2.8)

```
$feels_like_summer = FALSE;
$php_is_rad = TRUE;

$student_count = 217;
$nonzero = (bool) $student_count;      # TRUE
```
PHP

- the following values are considered to be FALSE (all others are TRUE):
  - 0 and 0.0 (but NOT 0.00 or 0.000)
  - "", "0", and NULL (includes unset variables)
  - arrays with 0 elements
- can cast to boolean using (bool)
- FALSE prints as an empty string (no output); TRUE prints as a 1

- TRUE and FALSE keywords are case insensitive

`if/else` statement

```php
if (condition) {
  statements;
} elseif (condition) {
  statements;
} else {
  statements;
}
```

- NOTE: although `elseif` keyword is much more common, `else if` is also supported

`while` loop (same as Java)

```php
while (condition) {
  statements;
}
```

```php
do {
  statements;
} while (condition);
```

- `break` and `continue` keywords also behave as in Java

NULL

```php
$name = "Victoria";
$name = NULL;
if (isset($name)) {
  print "This line isn't going to be reached.\n";
}
```

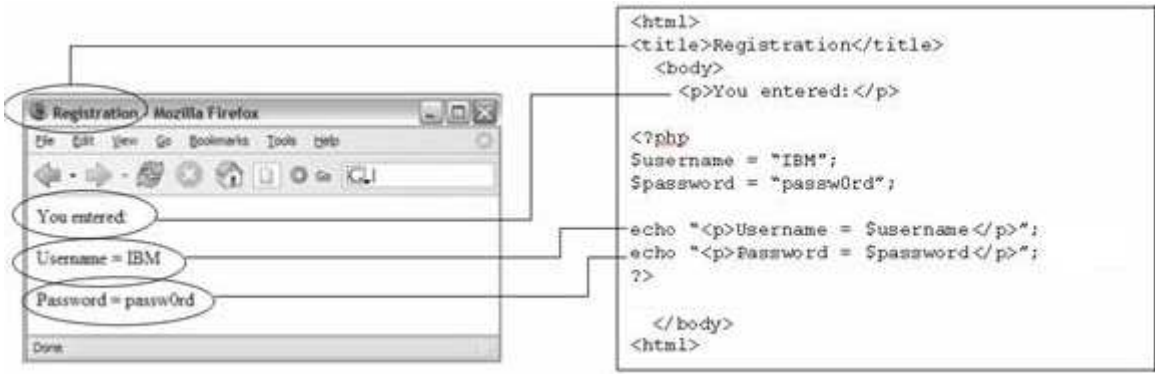
- a variable is NULL if
  - it has not been set to any value (undefined variables)
  - it has been assigned the constant NULL
  - it has been deleted using the `unset` function
- can test if a variable is NULL using the `isset` function
- NULL prints as an empty string (no output)

5.3: Embedded PHP

- 5.1: Server-Side Basics
- 5.2: PHP Basic Syntax
- **5.3: Embedded PHP**
- 5.4: Advanced PHP Syntax

Embedding code in web pages

- most PHP programs actually produce HTML as their output
  - dynamic pages; responses to HTML form submissions; etc.
- an **embedded PHP** program is a file that contains a mixture of HTML and PHP code



A bad way to produce HTML in PHP

```
<?php
print "<!DOCTYPE html PUBLIC \"-//W3C//DTD XHTML 1.1//EN\"\n";
print " \"http://www.w3.org/TR/xhtml11/DTD/xhtml11.dtd\">\n";
print "<html xmlns=\"http://www.w3.org/1999/xhtml\">\n";
print "  <head>\n";
print "    <title>My web page</title>\n";
...
?>
```

- printing HTML code with `print` statements is ugly and error-prone:
  - must quote the HTML and escape special characters, e.g. `\"`
  - must insert manual `\n` line breaks after each line
- don't `print` HTML; it's bad style!

Syntax for embedded PHP (5.3.1)

```
HTML content

<?php
PHP code
?>

HTML content
```
PHP

- any contents of a `.php` file that are not between `<?php` and `?>` are output as pure HTML
- can switch back and forth between HTML and PHP "modes"

Embedded PHP example

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.1//EN"
 "http://www.w3.org/TR/xhtml11/DTD/xhtml11.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
  <head><title>CSE 190 M: Embedded PHP</title></head>
  <body>
    <h1>Geneva's Counting Page</h1>
    <p>Watch how high I can count:
      <?php
      for ($i = 1; $i <= 10; $i++) {
        print "$i\n";
      }
      ?>
    </p>
  </body>
</html>
```
PHP

- the above code would be saved into a file such as `count.php`
- How many lines of numbers will appear? (View Source!)

Embedded PHP + `print` = bad

```
...
    <h1>Geneva's Counting Page</h1>
    <p>Watch how high I can count:
      <?php
      for ($i = 1; $i <= 10; $i++) {
        print "$i\n";
      }
      ?>
    </p>
```
PHP

- best PHP style is to use as few `print`/`echo` statements as possible in embedded PHP code
- but without `print`, how do we insert dynamic content into the page?

PHP expression blocks (5.3.2)

```
<?= expression ?>
```
PHP

```
<h2>The answer is <?= 6 * 7 ?></h2>
```
PHP

The answer is 42

output

- **PHP expression block**: a small piece of PHP that evaluates and embeds an expression's value into HTML
  - `<?=` *expression* `?>` is equivalent to:

    ```
    <?php print expression; ?>
    ```
    PHP

  - useful for embedding a small amount of PHP (a variable's or expression's value) in a large block of HTML without having to switch to "PHP-mode"

Expression block example

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.1//EN"
 "http://www.w3.org/TR/xhtml11/DTD/xhtml11.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
  <head><title>CSE 190 M: Embedded PHP</title></head>
  <body>
    <?php
    for ($i = 99; $i >= 1; $i--) {
      ?>
      <p><?= $i ?> bottles of beer on the wall, <br />
         <?= $i ?> bottles of beer. <br />
         Take one down, pass it around, <br />
         <?= $i - 1 ?> bottles of beer on the wall.</p>
      <?php
    }
    ?>
  </body>
</html>
```
PHP

- this code could go into a file named `beer.php`

Common error: unclosed braces

```
...
  <body>
    <p>Watch how high I can count:
      <?php
      for ($i = 1; $i <= 10; $i++) {
        ?>
        <?= $i ?>
    </p>
  </body>
</html>
```
PHP

- if you open a { brace, you must have a matching } brace later
  - `</body>` and `</html>` above are inside the `for` loop, which is never closed
- if you forget to close your braces, you'll see an error about 'unexpected `$end`'

Common error fixed

```
...
  <body>
    <p>Watch how high I can count:
      <?php
      for ($i = 1; $i <= 10; $i++) {      # PHP mode
        ?>
        <?= $i ?>                       <!-- HTML mode -->
        <?php
      }                                    # PHP mode
      ?>
    </p>
  </body>
</html>                                                    PHP
```

Common error: Missing = sign

```
...
  <body>
    <p>Watch how high I can count:
      <?php
      for ($i = 1; $i <= 10; $i++) {
        ?>
        <? $i ?>
        <?php
      }
      ?>
    </p>
  </body>
</html>                                                    PHP
```

- a block between `<? ... ?>` is often interpreted the same as one between `<?php ... ?>`
- PHP evaluates the code, but `$i` does not produce any output

Complex expression blocks

```
...
  <body>
    <?php
    for ($i = 1; $i <= 3; $i++) {
      ?>
      <h<?= $i ?>>This is a level <?= $i ?> heading.</h<?= $i ?>>
      <?php
    }
    ?>
  </body>
```

PHP

This is a level 1 heading.

This is a level 2 heading.

This is a level 3 heading.

output

- expression blocks can even go inside HTML tags and attributes

5.4: Advanced PHP Syntax

- 5.1: Server-Side Basics
- 5.2: PHP Basic Syntax
- 5.3: Embedded PHP
- **5.4: Advanced PHP Syntax**

Functions (5.4.1)

```
function name(parameterName, ..., parameterName) {
  statements;
}
```
PHP

```
function quadratic($a, $b, $c) {
  return -$b + sqrt($b * $b - 4 * $a * $c) / (2 * $a);
}
```
PHP

- parameter types and return types are not written

Calling functions

```
name(parameterValue, ..., parameterValue);
```
PHP

```
$x = -2;
$a = 3;
$root = quadratic(1, $x, $a - 2);
```
PHP

- if the wrong number of parameters are passed, it's an error

Default parameter values

```
function name(parameterName, ..., parameterName) {
  statements;
}
```
PHP

```
function print_separated($str, $separator = ", ") {
  if (strlen($str) > 0) {
    print $str[0];
    for ($i = 1; $i < strlen($str); $i++) {
      print $sep . $str[$i];
    }
  }
}
```
PHP

```
print_separated("hello");         # h, e, l, l, o
print_separated("hello", "-");    # h-e-l-l-o
```
PHP

- if no value is passed, the default will be used (defaults must come last)

Variable scope: global and local vars

```
$school = "UW";                   # global
...

function downgrade() {
  global $school;
  $suffix = "Tacoma";             # local

  $school = "$school $suffix";
  print "$school\n";
}
```
PHP

- variables declared in a function are **local** to that function
- variables not declared in a function are **global**
- if a function wants to use a global variable, it must have a `global` statement

Including files: `include()` (5.4.2)

```php
include("filename");
```

```php
include("header.php");
```

- inserts the entire contents of the given file into the PHP script's output page
- encourages modularity
- useful for defining reused functions like form-checking

Arrays (5.4.3)

```php
$name = array();                              # create
$name = array(value0, value1, ..., valueN);

$name[index]                                  # get element value
$name[index] = value;                         # set element value
$name[] = value;                              # append
```

```php
$a = array();      # empty array (length 0)
$a[0] = 23;        # stores 23 at index 0 (length 1)
$a2 = array("some", "strings", "in", "an", "array");
$a2[] = "Ooh!";    # add string to end (at index 5)
```

- to append, use bracket notation without specifying an index
- element type is not specified; can mix types

Array functions

function name(s)	description
count	number of elements in the array
print_r	print array's contents
array_pop, array_push, array_shift, array_unshift	using array as a stack/queue
in_array, array_search, array_reverse, sort, rsort, shuffle	searching and reordering
array_fill, array_merge, array_intersect, array_diff, array_slice, range	creating, filling, filtering
array_sum, array_product, array_unique, array_filter, array_reduce	processing elements

Array function example

```php
$tas = array("MD", "BH", "KK", "HM", "JP");
for ($i = 0; $i < count($tas); $i++) {
  $tas[$i] = strtolower($tas[$i]);
}                                  # ("md", "bh", "kk", "hm", "jp")
$morgan = array_shift($tas);       # ("bh", "kk", "hm", "jp")
array_pop($tas);                   # ("bh", "kk", "hm")
array_push($tas, "ms");            # ("bh", "kk", "hm", "ms")
array_reverse($tas);               # ("ms", "hm", "kk", "bh")
sort($tas);                        # ("bh", "hm", "kk", "ms")
$best = array_slice($tas, 1, 2);   # ("hm", "kk")
```

PHP

- the array in PHP replaces many other collections in Java
  - list, stack, queue, set, map, ...

The `foreach` loop (5.4.4)

```
foreach ($array as $variableName) {
  ...
}
```
PHP

```
$stooges = array("Larry", "Moe", "Curly", "Shemp");
for ($i = 0; $i < count($stooges); $i++) {
  print "Moe slaps {$stooges[$i]}\n";
}
foreach ($stooges as $stooge) {
  print "Moe slaps $stooge\n";  # even himself!
}
```
PHP

- a convenient way to loop over each element of an array without indexes

Splitting/joining strings

```
$array = explode(delimiter, string);
$string = implode(delimiter, array);
```
PHP

```
$s  = "CSE 190 M";
$a  = explode(" ", $s);     # ("CSE", "190", "M")
$s2 = implode("...", $a);   # "CSE...190...M"
```
PHP

- `explode` and `implode` convert between strings and arrays
- for more complex string splitting, we'll use **regular expressions** (later)

Unpacking an array: `list`

```php
list($var1, ..., $varN) = array;
```

```php
$line = "stepp:17:m:94";
list($username, $age, $gender, $iq) = explode(":", $line);
```

- the `list` function accepts a comma-separated list of variable names as parameters
- assign an array (or the result of a function that returns an array) to store that array's contents into the variables

Non-consecutive arrays

```php
$autobots = array("Optimus", "Bumblebee", "Grimlock");
$autobots[100] = "Hotrod";
```

- the indexes in an array do not need to be consecutive
- the above array has a `count` of 4, with 97 blank elements between `"Grimlock"` and `"Hotrod"`

PHP file I/O functions (5.4.5)

- reading/writing entire files: `file_get_contents`, `file_put_contents`
- asking for information: `file_exists`, `filesize`, `fileperms`, `filemtime`, `is_dir`, `is_readable`, `is_writable`, `disk_free_space`
- manipulating files and directories: `copy`, `rename`, `unlink`, `chmod`, `chgrp`, `chown`, `mkdir`, `rmdir`
- reading directories: `scandir`, `glob`

Reading/writing files

```php
$text = file_get_contents("schedule.txt");
$lines = explode("\n", $text);
$lines = array_reverse($lines);
$text = implode("\n", $lines);
file_put_contents("schedule.txt", $text);
```

- `file_get_contents` returns entire contents of a file as a string
  - if the file doesn't exist, you'll get a warning
- `file_put_contents` writes a string into a file, replacing any prior contents

Reading files example

```php
# Returns how many lines in this file are empty or just spaces.
function count_blank_lines($file_name) {
  $text = file_get_contents($file_name);
  $lines = explode("\n", $text);
  $count = 0;
  foreach ($lines as $line) {
    if (strlen(trim($line)) == 0) {
      $count++;
    }
  }
  return $count;
}
...
print count_blank_lines("ch05-php.html");
```

PHP

Reading directories

```php
$folder = "images";
$files = scandir($folder);
foreach ($files as $file) {
  if ($file != "." && $file != "..") {
    print "I found an image: $folder/$file\n";
  }
}
```

PHP

- `scandir` returns an array of all files in a given directory
- annoyingly, the current directory (`"."`) and parent directory (`".."`) are included in the array; you probably want to skip them