CS 455
Principles of Database Systems

Est. 1888
UNIVERSITY of PUGET SOUND

Department of Mathematics
and Computer Science

Supplemental Notes: PHP

Disclaimer: Materials adapted for use from various sources

Outline

- History of the Web
- Introduction to HTML
- Dynamic Web Programming with PHP
  - PHP Basics
  - Superglobals: Cookies and Form Handling
  - PDO Database Connectivity
- Conclusion

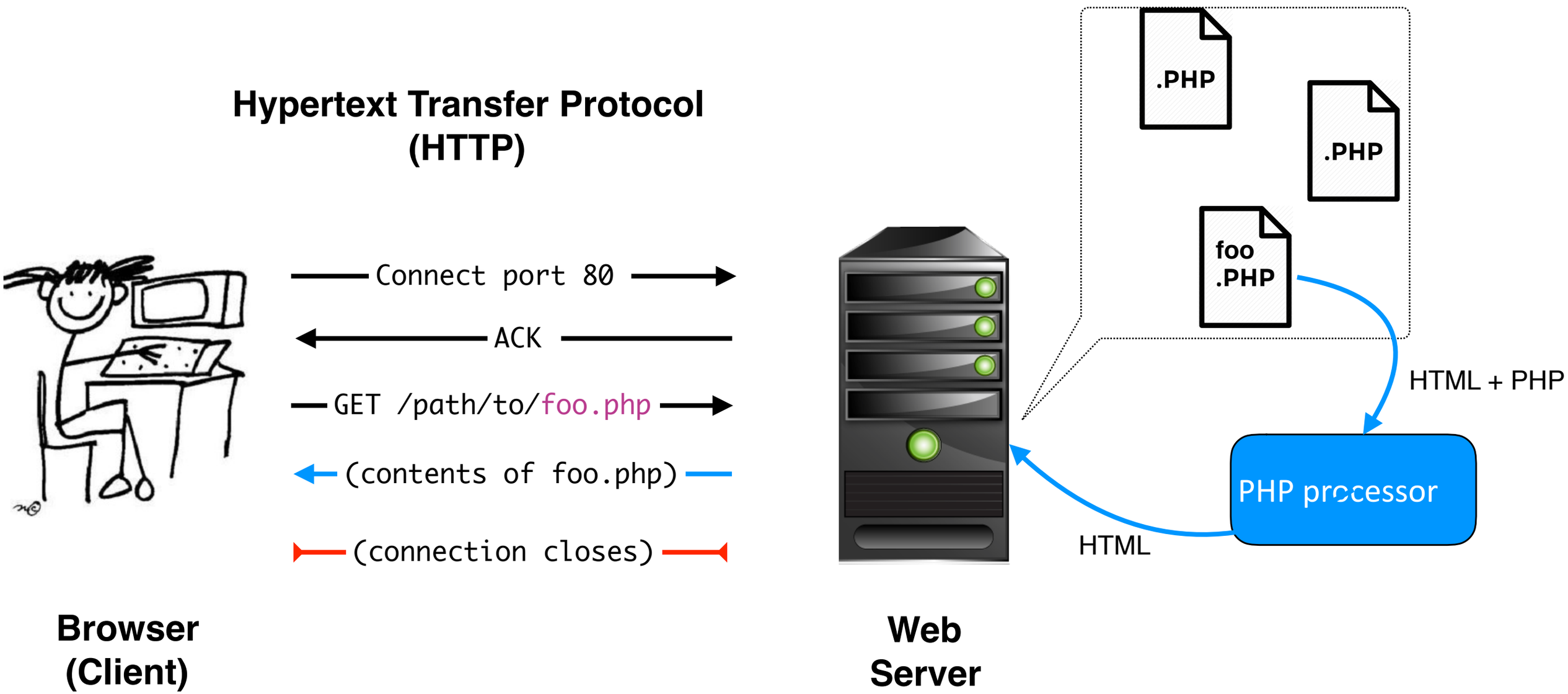
PHP Hypertext Preprocessor

- **P**HP **H**ypertext **P**reprocessor
  - Created by Rasmus Lerdorf in 1994
  - The first web-programming language
  - Formerly Personal Home Page Tools

- Today: Runs on > 75% of web servers
  - 8th most widely-used language (IEEE Spectrum, 2017)

Language Rank	Types
1. Python	
2. C	
3. Java	
4. C++	
5. C#	
6. R	
7. JavaScript	
8. PHP	
9. Go	
10. Swift	

How PHP Processing Works



Quick Guide

- Variable names start with $:

```
$var = expression;
```

- Getting info on variables:

```
var_dump($var);
```

- Printing:

```
echo expression;
```

Quick Guide (Cont.)

- PHP files should end in `.php`
  - HTML code *can co-exist* in a .php file

- Any PHP code must be enclosed in <?php ... ?> tags.
  - All other code will be interpreted as HTML!

```
<?php $title = "David's Page"; ?>
<head>
   <title> <?php echo $title; ?> </title>
</head>
```

PHP Primitives (Boolean)

- PHP variables are *dynamically typed* and do not need to be declared
  - A variable's type is determined at runtime!
- They could be.. `boolean`, `int`, `float`, `string`
- Boolean Example:

```
<html>
<p>
<?php
$largeFont = TruE;  //case-insensitive
if ($largeFont)
   echo '<font size="20">';
else
   echo '<font size="14">';
?>
Hello world!<br/>
</font>
</p>
</html>
```

PHP Primitives (numerics)

- Types: `boolean`, `int`, `float`, `string`
- Integers:

```
<?php
$a = 1234; // decimal number
$a = -123; // a negative number
$a = 0x1A; // hexadecimal number (equivalent to 26 decimal)
$a = 0b11111111; // binary number (equivalent to 255 decimal)
?>
```

- Floats (double-precision):

```
<?php
$a = 1.23456789;
$b = 1.23456780;
$epsilon = 0.00001;

// always use this instead of: if ($a == $b)
if (abs($a - $b) < $epsilon) {
    //do something useful
}
?>
```

PHP Primitives (strings)

- Types: `boolean`, `int`, `float`, `string`
- Single-quoted Strings: Behaves like Strings in Java

```
<?php
$var = "cool!";
echo 'I said, "$var"';  // I said, "$var"
?>
```

- Double-quoted Strings evaluates variables! NICE!

```
<?php
$var = "cool!"
echo "I said, \"$var\"";  // I said, "cool!"
?>
```

- Concatenation: `$str1 . $str2`
  - `Str1 .= $str2;  // works too!`

Arrays

- Arrays in PHP are basically *hash maps*

```php
<?php
$my_arr = array(
    "foo" => "bar",
    "bar" => "foo",
        0 => 9,
);

$my_arr[1] = 'moo!'

var_dump($my_arr);
?>
```

```
array(4) {
  ["foo"]=>
  string(3) "bar"
  ["bar"]=>
  string(3) "foo"
  [0]=>
  int(9)
  [1]=>
  string(4) "moo!"
}
```

This is the output from the above code

Type Juggling

- As mentioned before, PHP is dynamically typed
  - Known as *Type Juggling* in PHP lingo

```php
<?php

$number_of_toys = 10;
$toys_category = "123 Puzzles";
$toys_age_limit = "5.5";
$toys_price = "2e2";

$result1 = $number_of_toys + $toys_category;
$result2 = $number_of_toys + $toys_age_limit;
$result3 = $number_of_toys + $toys_price;

echo $result1."<br/>";
echo $result2."<br/>";
echo $result3."<br/>";

?>
```

From http://phppot.com/php/php-type-juggling/

PHP Comparison Operators

	Meaning
$a == $b	Equals after type juggling
$a === $b	Equals, and are of the same data type
$a != $b	Not equals after type juggling
$a !== $b	Not equals, or are of different types
$a < $b	Less than?
$a > $b	Greater than?
$a <= $b	Less than equals, after type juggling
$a >= $b	Greater than equals, after type juggling

Comparison Operators (Cont.)

```
$foo = 10;

var_dump($foo == 10);  //true

var_dump($foo == '10'); //true!

var_dump($foo === 10); //true

var_dump($foo === '10'); //false!

var_dump($foo <= '10'); //true!
```

Operations

	Meaning	Example
`+, -, *, **, /, %`	(Usual num ops)	`var_dump(2**3); //8`
`.`	String concatenation	`var_dump('foo' . 'bar ' . 88) //foobar 88`
`&&, ||, !`	(Usual boolean ops)	
`$a++, ++$a`	(Usual num ops)	
`$a--, --$a`	(Usual num ops)	
`+=, -=, *=, /=, **=`	(Usual num ops)	
`.=`	String concat	

Conditionals

- If-then-else

```
<?php

if (cond) {
    echo "That was <b>true</b>\n";
}
else {
    echo "That was <b>false</b>\n";
}

?>
```

- Integration with HTML (same result as above)

```
<?php if (cond) { ?>
 That was <b>true</b>
<?php } else { ?>
 That was <b>false</b>
<?php } ?>
```

Conditionals Else-If

- Else-Ifs

```
if (cond) {
    //statement
}
elseif (cond) {
    //statement
}
elseif (cond) {
    //statement
}
else {
    //statement
}
```

Loops (For & While)

- While and For loops also have familiar syntax

```
<?php

while (cond) {
    //loop statements
}

for (init; cond; progress) {
    //loop statements
}

?>
```

Loops (Cont.)

- Loops can also integrate with HTML

```
<?php $n = 5; ?>
<ul>
<?php
    for ($i = 0; $i < $n; $i++) {
        echo "<li>List item: $i</li>\n";
    }
?>
</ul>
```

- Output:

```
<ul>
 <li>List item: 0</li>
 <li>List item: 1</li>
 <li>List item: 2</li>
 <li>List item: 3</li>
 <li>List item: 4</li>
</ul>
```

Arrays

- Recall: all PHP arrays are actually associative arrays (or HashMaps)
  - Created with the array(...) function

```
$list = array(
    "foo" => "bar",
    "bar" => true,
        9 => 4,
        0 => "bla",
);
```

- Accessed as expected...

```
var_dump($list["foo"]); // string(3) "bar"

var_dump($list[9]);   // int(4)

var_dump($list[8]);   // NULL
```

Arrays (Cont.)

- Single command to print out all contents of array: `print_r($list)`
  - Good for debugging, but not much else
  - Output:

```
Array
(
    [foo] => bar
    [bar] => foo
    [9] => 4
    [0] => bla
)
```

Array Access (Foreach loop)

- How to access elements in an associative array?
  - No standard index... so how do we know how to loop?

- If you don't care about the array index:

```
foreach (array_expression as $value) {
    //statement
}
```

- If you want the array index:

```
foreach (array_expression as $key => $value) {
    //statement
}
```

Foreach Loops

```php
<?php
$list = array(
    "foo" => "bar",
    "bar" => true,
        9 => 4,
        0 => "bla",
);

foreach ($list as $k => $v) {
    echo "$k holds $v\n";
}
?>
```

- Output:

```
foo holds bar
bar holds true
9 holds 4
0 holds bla
```

Functions

- Functions in PHP are defined as follows:
  - Notice: no return type; just return when needed

```
<?php
 function functionName(paramList) {
     //body
 }
?>
```

- Example:

```
<?php
function max($a, $b) {
    if ($a < $b)
        return $b;
    return $a;
}

echo "The larger of 4 and 5 is: ". max(4,5); // call the function
?>
```

Good Practice

- Put related functions in their own file, then include as needed.

myfuncs.php

```php
<?php
function func0(params) {
    //body
}
//...
?>
```

otherFile.php

```php
<?php
  include "myfuncs.php";

   func0(...);
?>
```

myDBFuncs.php

```php
<?php
function dbConnect(params) {
    //body
}
function dbQuery(params) {
    //body
}
?>
```

otherFile2.php

```php
<?php
  include "myfuncs.php";
  include "myDBfuncs.php";

   dbQuery(...);
?>
```

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  - Superglobals
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Variable Scope in PHP

- Different PHP blocks *within* file:

```
<?php
   $x = 100;
?>

<!-- some HTML -->

<?php
   echo $x;  // This works
?>
```

- Across file:

```
<?php
   $x = 100;
?>
```

File1.php

```
<?php
   echo $x;  // $x is not defined
?>
```

File2.php

Variable Scope in PHP

- Across file (using include):

File1.php

```
<?php
   $x = 100;
?>
```

File2.php

```
<?php
   include "File1.php";

   echo $x;  // This works again
?>
```

PHP Superglobals

- *Superglobals* are variables that are accessible in all scopes.
  - They are all associative arrays (hashmaps)

- Here are a few important ones:
  - $_GLOBALS[...]: user-defined (think public static variables in Java)
  - $_COOKIE[...]: cookies (variables) we set on the client (browser)
  - $_GET[...]: variables passed from URLs
  - $_POST[...]: variables passed from HTML forms
  - $_SERVER[...]: information about the web server

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  - $_GLOBALS[...]: user-defined (think public static variables in Java)
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  - $_GET[...]: variables passed from URLs
  - $_POST[...]: variables passed from HTML forms
  - $_SERVER[...]: information about the web server

Cookies

- If HTTP is stateless, how do sites like Amazon and Facebook remember that I'm logged in?

- *Cookies* are data that websites can store on your browser so that it can remember you in a later HTTP session.

- PHP has built-in cookie handling mechanisms

Setting Cookies

- Setting a cookie (browser has to accept them)
  - Caveat: Cookies are a part of the HTTP header, and *must be set before* any other content is sent to the browser

Cookie name and cookie value

```
<?php
   setcookie("userID", "dchiu", time() + (86400 * 30)); // 86400 = 1 day
?>
<!DOCTYPE html>
<html>
   <!-- blah blah blah -->
</html>
```

Expiration (duration): Time from now in seconds.
Value of 0 means end of session (when browser closes)

Reading Cookies

- Later, a user browses back to your web page... to remember who they are, we need to see if the userID cookie is set!
- Enter the `$_COOKIE[...]` superglobal

```
<!DOCTYPE html>
<html>
   <body>
    <?php
        // do we know this user?
        if (isset($_COOKIE["userID"])) {
            $firstName = getName($_COOKIE["userID"]);
            echo "Welcome back $firstName!";
        }
        else {
            // don't know this person (or cookie expired)
            printLoginForm();  // make them login again
        }
    ?>
  </body>
</html>
```

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- Here are a few important ones:
  - $_GLOBALS[...]: user-defined (think public static variables in Java)
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  - $_GET[...]: variables passed from URLs
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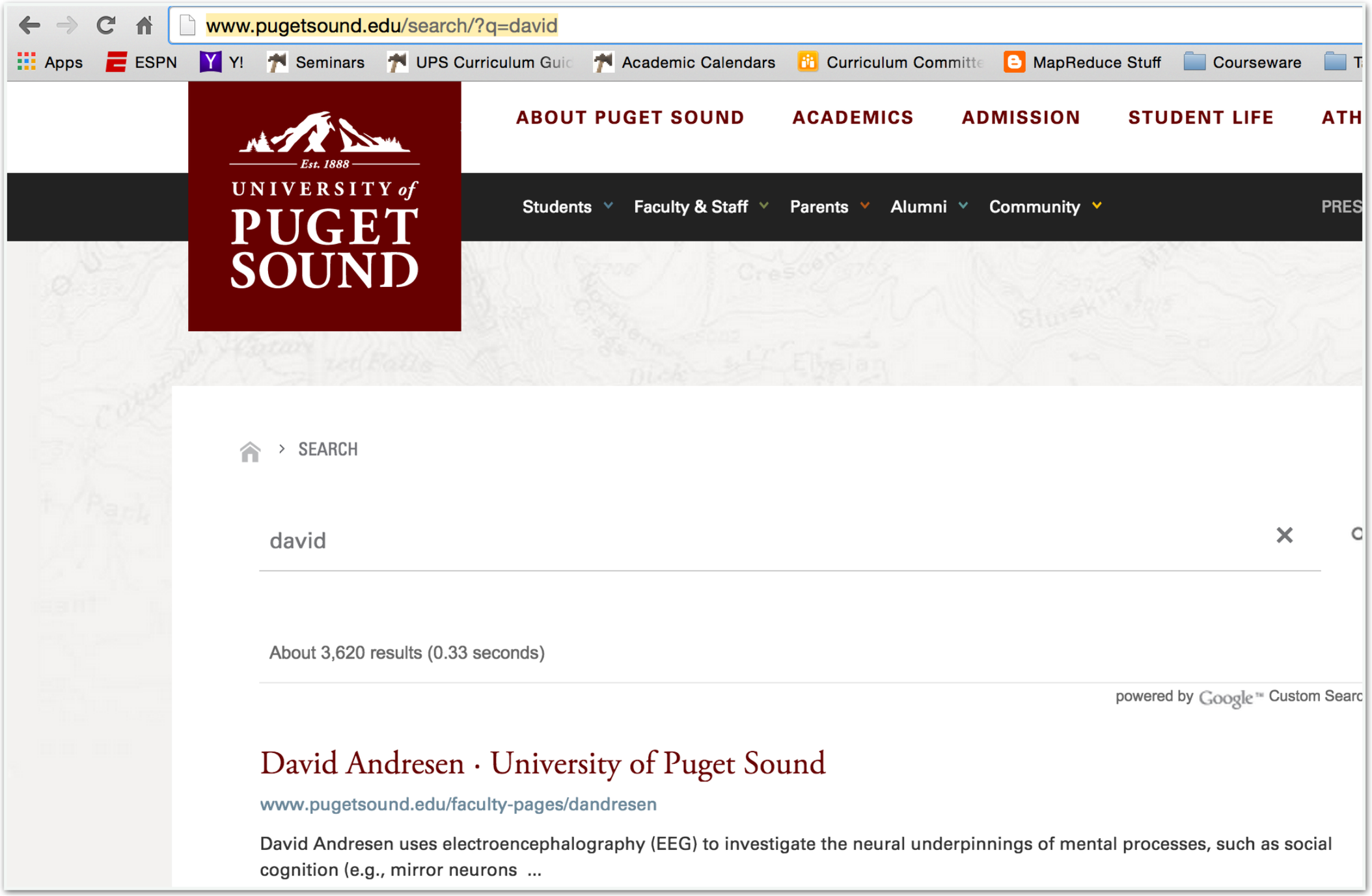
You Can Pass Variables via a URL

- Ever wonder what ?, = and & mean in a URL?



What's in a URL?

- URL Syntax

```
protocol:[//[user:password@]host[:port]][/]path[?query][#fragment]
```

- Examples:
  - Locates a file on my local machine

```
file://localhost/Users/David/Documents/foo.txt
```

  - Locates a directory on another machine using FTP

```
ftp://ftp.at.debian.org/debian-cd/8.2.0/i386/iso-dvd
```

What's in a URL? (Cont.)

- URL Syntax

```
protocol:[//[user:password@]host[:port]][/]path[?query][#fragment]
```

- Examples:
  - Get Lecture 1 from my course page (login automatically)

```
http://CS455:p4ssword@cs.pugetsound.edu/~dchiu/CS455/notes/CS455_1-intro.pdf
```

  - Sends a "query" (i.e., variables) to the server

```
http://cs.pugetsound.edu/~dchiu/CS455/webstuff/showGetvars.php?foo=1&bar=test
```

http://cs.pugetsound.edu/~dchiu/CS455/webstuff/showGetvars.php?foo=1&bar=test

Inside showGetvars.php

- Just use the $_GET[...] superglobal to access any variable and its value that was passed via URL!

- showGetvars.php:

```
<!DOCTYPE html>
<html>
<body>
  <?php
      if ($_GET["foo"] == 10)
          echo "Foo!";
      if ($_GET["bar"] == 20)
          echo "Bar!";
  ?>
</body>
</html>
```

PHP Superglobals

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  - $_GET[...]: variables passed from URLs
  - $_POST[...]: variables passed from HTML forms
  - $_SERVER[...]: information about the web server

HTML Forms

- You can make forms with HTML:

Where does it take you when you click the *submit* button?

Which HTTP method to use to send data? Possible values: *post or get* *(USE POST ALWAYS)*

```
<form action="formHandler.php" method="post">

  Name: <input type="text" name="name"/><br/>

  E-mail: <input type="text" name="email"/><br/>

  <input type="submit"/>
</form>
```

The *submit* button

HTML Forms (Cont.)

- You can make forms with HTML:

Name:
E-mail:
Submit

```
<form action="formHandler.php" method="post">

  Name: <input type="text" name="name"/><br/>

  E-mail: <input type="text" name="email"/><br/>

  <input type="submit"/>
</form>
```

Draw a *textbox*

Name of the variable

HTML Forms (Cont.)

- Password Field

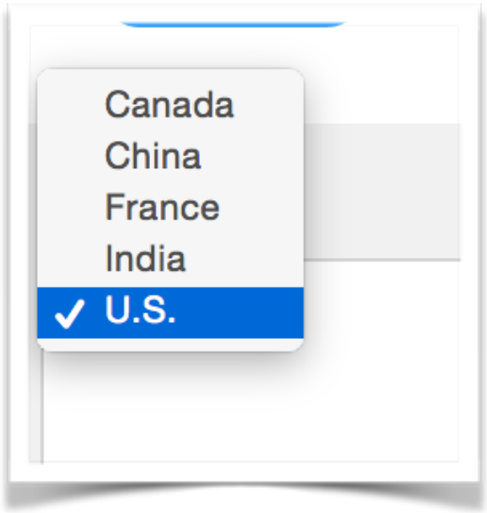
```
Enter your password: <input type="password" name="pwd"/>
```

- Checkbox

```
Today I am:<br/>
<input type="checkbox" name="happy"/> Happy<br/>
<input type="checkbox" name="angry"/> Angry<br/>
<input type="checkbox" name="sad"/> Sad<br/>
```

- Dropdown List

```
<select name="country">
  <option value="ca">Canada</option>
  <option value="zn">China</option>
  <option value="fr">France</option>
  <option value="in">India</option>
  <option selected="selected" value="us">U.S.</option>
</select>
```



HTML Forms (Cont.)

- File

```
Upload a file:<br/>
<input type="file" name="filename"/>
```

Upload a file:
Choose File No file chosen Submit

- Hidden

```
<input type="hidden" name="var" value="val" />
```

- Radio Options

```
Your pet is a:<br/>
<input type="radio" name="species" value="cat"/> Cat<br/>
<input type="radio" name="species" value="dog"/> Dog<br/>
<input type="radio" name="species" value="fish"/> Fish<br/>
<input type="radio" name="species" value="lizard"/> Lizard<br/>
```

Your pet is a:
- Cat
- Dog
- Fish
- Lizard

Where Does the Form Take Us?

- We need a (PHP) script to process the form data!
  - The superglobal $_POST[...] hold all those variables from the form
    - Assuming you used the "post" method in your form

```
<?php

var_dump($_POST[name]);
var_dump($_POST[email]);

?>
```

  - Typically, this PHP script would insert the collected data into a database...

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PHP Database Connectivity

- There are many free PHP database libraries...
  - We focus on PHP Data Objects (PDO)
  - Need to be installed as an add-on library to PHP
- From your (Ubuntu) Linux shell:

```
$ sudo apt-get install php-pdo
```

  - or (if on CentOS)

```
$ sudo yum install php-pdo
```

- PDO is not the only way... other libraries exist

Assumptions

- Caveat: This tutorial written for SQLite3

- Assumptions:
  - SQLite3 database already exists on filesystem (*i.e.*, you used `.save` or `.backup` to create the file)
  - Apache web server needs write access to both the database file and the directory where it's located

- The PDO library is object-oriented. Pro-tip:

```
$obj = new Class(..);  //instantiation
$obj->method(..);      //method call
```

(Dis)Connecting to/from the Database

- PDO Object Instantiation: `new PDO(string $pathToDBFile)`

```php
<?php
    try
    {
        //open the sqlite database file
        //assumes airport.db is in the myDB directory and has read/write permissions
        $db = new PDO('sqlite:./myDB/airport.db');

        // Set errormode to exceptions
        $db->setAttribute(PDO::ATTR_ERRMODE, PDO::ERRMODE_EXCEPTION);

        // >>> queries and stuff right here <<<

        //disconnect from database
        $db = null;
    }
    catch(PDOException $e)
    {
        die('Exception : '.$e->getMessage());  //die will quit the script immediate
    }
?>
```

Important: Set Permissions on DB

- Say you're in the document root directory...

```
$ sudo chown -R apache myDB/
$ sudo chmod -R 755 myDB
$ sudo chmod -R 700 myDB/airport.db
$ ls -l
total 88
-rw-r--r-- 1 dchiu          10000  285 Feb 27  2015 cookieread.php
-rw-r--r-- 1 dchiu          10000   70 Feb 27  2015 formHandler.php
-rw-r--r-- 1 dchiu          10000  519 Feb 27  2015 form.php
-rw-r--r-- 1 dchiu  ctweb03-access 2048 Jul 26 15:53 hi.db
-rw-r--r-- 1 dchiu  ctweb03-access  417 Oct 11 21:31 insert.html
-rw-r--r-- 1 dchiu  ctweb03-access  698 Oct 11 21:55 insertPassenger.php
drwxr-xr-x 2 apache ctweb03-access 4096 Oct 11 21:58 myDB
-rw-r--r-- 1 dchiu          10000  332 Oct 10 14:56 setcookie.php
-rw-r--r-- 1 dchiu  ctweb03-access  165 Oct 10 16:17 showGetvars.php
-rw-r--r-- 1 dchiu  ctweb03-access  321 Oct 14  2015 showPassengers.html
-rw-r--r-- 1 dchiu  ctweb03-access  752 Oct 11 21:56 showPassengers.php

$ ls -l myDB/
total 64
-rwx------ 1 apache ctweb03-access 28672 Oct 11 21:58 airport.db
```

"Read" Queries: Select

- With select, we don't care about number of rows affected, we want the result set that was returned!
- Syntax: `public PDOStatement query(string $statement)`
- Return Value: An array of tuples
  - Each tuple is an associative array of *attribute => value* pairs

```
//select all passengers
$result = $db->query('SELECT * FROM passengers;');

foreach($result as $tuple) {
   echo "$tuple[ssn] $tuple[f_name] $tuple[l_name] <br/>";
}
```

ShowPassengers_insecure.php (code on site)

```
<!DOCTYPE html>
<html>
<body>
<h2>List of all passengers</h2>
<?php
     try
     {
         //open the sqlite database file
         $db = new PDO('sqlite:./myDB/airport.db');
         $db->setAttribute(PDO::ATTR_ERRMODE, PDO::ERRMODE_EXCEPTION);

         //select all passengers
         $query = "SELECT * FROM passengers";
         $result = $db->query($query);

         //loop through each tuple in result set
         foreach($result as $tuple) {
             echo "<font color='blue'>$tuple[ssn]</font> $tuple[f_name]
                   $tuple[m_name] $tuple[l_name]<br/>\n";
         }
         $db = null;   //disconnect from db
     }
     catch(PDOException $e)
     {
         die('Exception : '.$e->getMessage());
     }
?>
</body>
</html>
```

Results of ShowPassengers_insecure.php

List of all passengers

111-11-1111 Homer J Simpson
444-44-4444 Bart H Simpson
222-22-2222 Lisa G Simpson
555-55-5555 Frank Lovejoy
666-66-6666 Robert N Quimby
777-77-7777 Ned T Flanders
333-33-3333 Frank Ryerson
000-00-0000 Test t Testing
000-00-1234 Test t Testing

"Write Queries" (Insert, Delete, Update)

- Use this: `public int exec(string $statement)`
  - Executes given SQL statements and returns number of affected rows

```php
<?php
try {
    $db = new PDO('sqlite:./myDB/airport.db');
    $db->setAttribute(PDO::ATTR_ERRMODE, PDO::ERRMODE_EXCEPTION);

    //insert some new tuples into the passenger relation
    $db->exec("insert into passengers values ('David', NULL, 'Chiu', '888-88-8888');");
    $db->exec("insert into passengers values ('Brad', NULL, 'Richards', '999-99-9999');");

    //now put Brad and David on the same flight
    $db->exec("insert into onboard values ('888-88-8888',4,'32B')");
    $db->exec("insert into onboard values ('999-99-9999',4,'32C')");

    //disconnect from database
    $db = null;
}
catch(PDOException $e) {
    die('Exception : '.$e->getMessage());
}
?>
```

How to Get Form Data from Users

- See insert.html on course page:

```
<!DOCTYPE html>
<html>
<head>
    <title>Insert Passengers</title>
</head>
<body>
    <p>
    <form action="insertPassenger_insecure.php" method="post">
    SSN: <input type="text" name="form_ssn" /><br/>
    First Name: <input type="text" name="form_fname" /><br/>
    Middle Name: <input type="text" name="form_mname" /><br/>
    Last Name: <input type="text" name="form_lname" /><br/>
    <input type="submit"/>
    </form>
    </p>
</body>
</html>
```

- Demo: http://cs.pugetsound.edu/~dchiu/cs455/webstuff/insert.html

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</head>
<body>
    <p>
    <form action="insertPassenger_insecure.php" method="post">
    SSN: <input type="text" name="form_ssn" /><br/>
    First Name: <input type="text" name="form_fname" /><br/>
    Middle Name: <input type="text" name="form_mname" /><br/>
    Last Name: <input type="text" name="form_lname" /><br/>
    <input type="submit"/>
    </form>
    </p>
</body>
</html>
```

Clicking on "submit" will go here

- Demo: http://cs.pugetsound.edu/~dchiu/cs455/webstuff/insert.html

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```
<!DOCTYPE html>
<html>
<head>
    <title>Insert Passengers</title>
</head>
<body>
    <p>
    <form action="insertPassenger_insecure.php" method="post">
    SSN: <input type="text" name="form_ssn" /><br/>
    First Name: <input type="text" name="form_fname" /><br/>
    Middle Name: <input type="text" name="form_mname" /><br/>
    Last Name: <input type="text" name="form_lname" /><br/>
    <input type="submit"/>
    </form>
    </p>
</body>
</html>
```

Uses the HTTP POST command to send values to apache

- Demo: http://cs.pugetsound.edu/~dchiu/cs455/webstuff/insert.html

How to Get Form Data from Users

- See insert.html on course page:

```
<!DOCTYPE html>
<html>
<head>
    <title>Insert Passengers</title>
</head>
<body>
    <p>
    <form action="insertPassenger_insecure.php" method="post">
    SSN: <input type="text" name="form_ssn" /><br/>
    First Name: <input type="text" name="form_fname" /><br/>
    Middle Name: <input type="text" name="form_mname" /><br/>
    Last Name: <input type="text" name="form_lname" /><br/>
    <input type="submit"/>
    </form>
    </p>
</body>
</html>
```

Form input can be accessed with PHP's $_POST[name] superglobals
e.g., $_POST[form_ssn]

- Demo: http://cs.pugetsound.edu/~dchiu/cs455/webstuff/insert.html

InsertPassenger_insecure.php (on site)

```php
<?php
    try {
        //open the sqlite database file
        $db = new PDO('sqlite:./myDB/airport.db');
        $db->setAttribute(PDO::ATTR_ERRMODE, PDO::ERRMODE_EXCEPTION);

        //insert the passenger (UNSAFE!)
        //order matters (look at your schema) -- fname, mname, lname, ssn
        $stmt = "INSERT INTO passengers VALUES
                 ('$_POST[form_fname]', '$_POST[form_mname]', '$_POST[form_lname]', '$_POST[form_ssn]');";
        $db->exec($stmt);

        //disconnect from database
        $db = null;
    }
    catch(PDOException $e)
    {
        die('Exception : '.$e->getMessage());
    }

    //redirect user to another page
    header("Location: showPassengers_secure.php");
?>
```

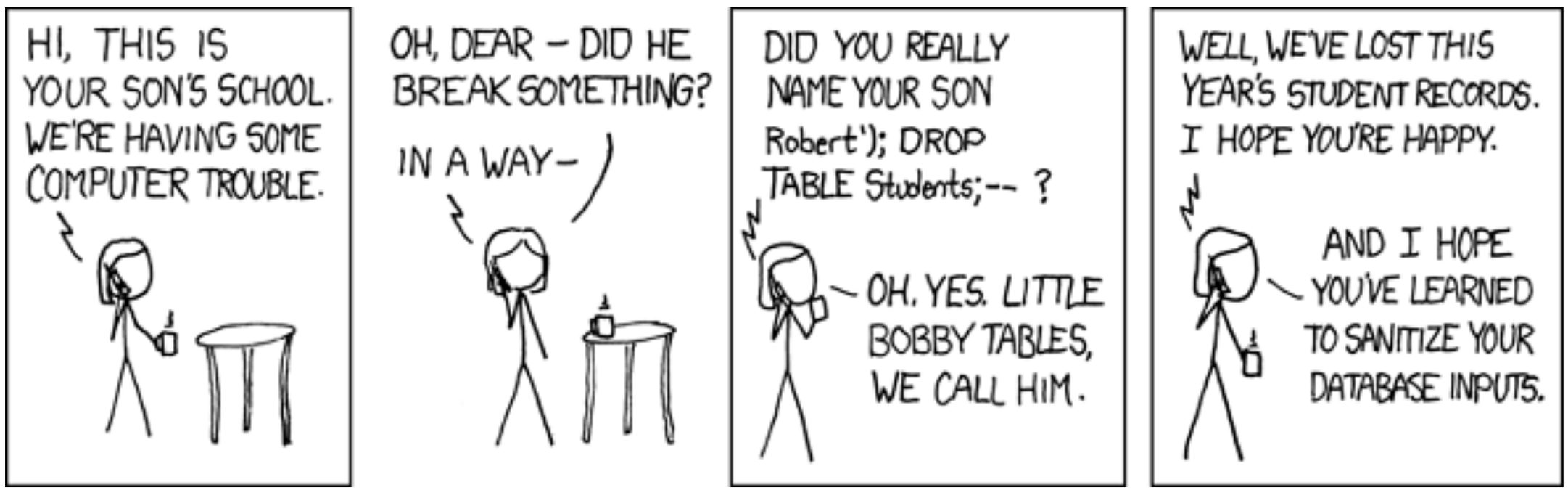
These superglobals are now populated with form data!

Outline

- History of the Web
- Introduction to HTML
- Dynamic Web Programming with PHP
  - PHP Basics
  - Superglobals: Cookies and Form Handling
  - PDO Database Connectivity
    - Dealing with the SQL Injection Vulnerability
- Conclusion

Why Insecure? (SQL Injection)

- One of the classic XKCD comics (Exploits of a Mom)
  - Oct 10, 2007
  - https://www.explainxkcd.com/wiki/index.php/327:_Exploits_of_a_Mom



- Demo:
  - http://cs.pugetsound.edu/~dchiu/cs455/webstuff/injection_demo.html

What Happened?

- Attacker guesses (correctly) that the form will take users to a page that does an INSERT.

```
123-45-6789'); delete from Passengers; --
```

Injection

```
//from insertPassenger_insecure.php
$stmt = "INSERT INTO passengers VALUES
         ('$_POST[form_fname]', '$_POST[form_mname]', '$_POST[form_lname]', '$_POST[form_ssn]');";
$db->exec($stmt);
```

- After POST variables are evaluated. Now:

```
$stmt = "INSERT INTO passengers VALUES
         ('David', 'Blah', 'Chiu', '123-45-6789'); delete from Passengers; -- ');";
$db->exec($stmt);
```

- Essentially running two statements:

```
INSERT INTO passengers VALUES ('David', 'Blah', 'Chiu', '123-45-6789');
delete from Passengers; --');
```

How to Combat SQL Injection?

- David isn't going to tell you
  - The preferred way:
    - Use PDO's *prepared statements*
  - Another way (not recommended in real-world)
    - "Sanitizing" inputs. Check every POST variable for suspicious stuff like: --, ',), DROP TABLE, DELETE FROM, ...
    - Why not recommended? Limits what users can/can't enter. Some DB fields might want to accept any input (like a review)

- Project 2 must handle inputs securely
  - David will try to access/destroy your database as part of grading

Outline

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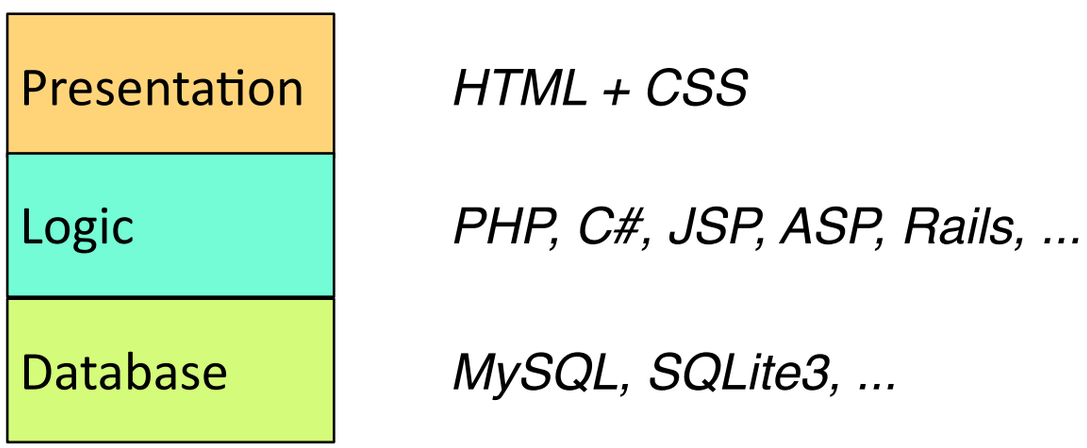
Conclusion

- Dynamic web programming boot camp
  - PHP is a huge language... highly recommend that you learn more on your own
- Many of today's websites follow the 3-tier architecture:



- Further topics for exploration for the Web-curious:
  - JavaScript, NodeJS, Ajax, MongoDB, XML (DTD, XPath, XQuery)