CS 547

- Week 3 Day 2
  MySQL & Pattern Matching

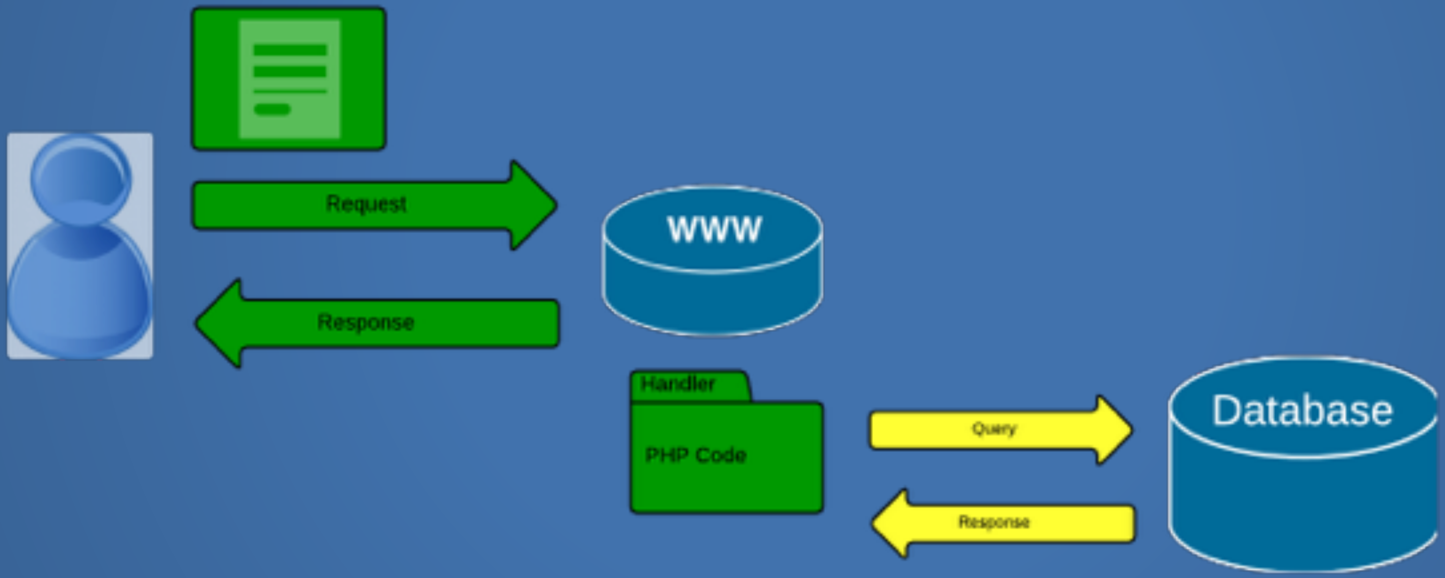
Agenda

- Prepared Statements
- PHP Session
- Cookies
- Pattern Matching

Announcement

- No Class on Feb 19, 2015

Review


Request
Response
WWW
Handler
PHP Code
Query
Response
Database

MySQLi Basics

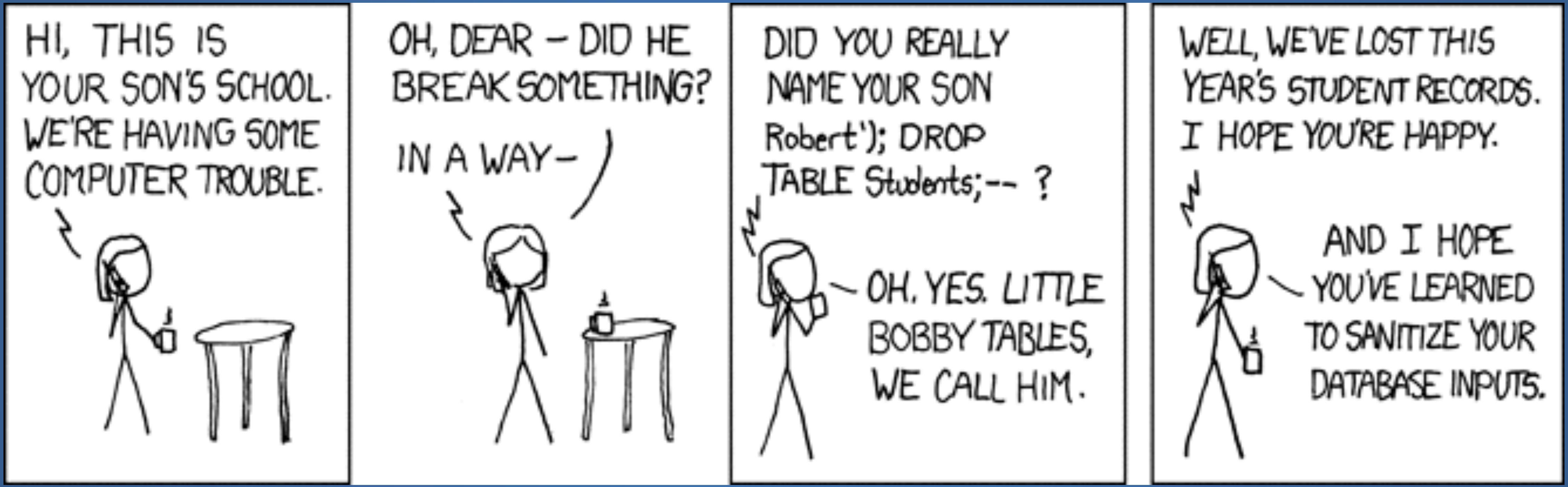
```
mysqli_conn();
mysqli_select();
mysqli_insert();
mysqli_update();
mysqli_delete();
```

MySQLi Prepared Statements

Why?
Used to mitigate against SQL injections.
Benefits
Reduce time and minimize bandwidth

- Prepared statements are very useful against SQL injections, because parameter values, which are transmitted later using a different protocol, need not be correctly escaped. ***If the original statement template is not derived from external input, SQL injection cannot occur.***

Prepared Statements: Little Bobby Tables


HI, THIS IS YOUR SON'S SCHOOL. WE'RE HAVING SOME COMPUTER TROUBLE.
OH, DEAR – DID HE BREAK SOMETHING?
IN A WAY–
DID YOU REALLY NAME YOUR SON Robert'); DROP TABLE Students;-- ?
OH. YES. LITTLE BOBBY TABLES, WE CALL HIM.
WELL, WE'VE LOST THIS YEAR'S STUDENT RECORDS. I HOPE YOU'RE HAPPY.
AND I HOPE YOU'VE LEARNED TO SANITIZE YOUR DATABASE INPUTS.

SQL Injection: The problem

```
//
if ($conn->connect_error) {
trigger_error('Database connection failed: '  . $conn->connect_error, E_USER_ERROR);
}
else {
$sql='SELECT * FROM mytable WHERE (pkid = "' . $_POST["name"]  . '") ; ';
$rs=$conn->query($sql);
if($rs === false) {
trigger_error('Wrong SQL: ' . $sql . ' Error: ' . $conn->error, E_USER_ERROR);
} else {
$rows_returned = $rs->num_rows;
echo ("Found " . $rows_returned . " rows.<hr>");
$rs->data_seek(0);
while($row = $rs->fetch_assoc()){
echo ("Name = " . $row['name'] . " age = " . $row['realAge'] . "<br>"   )
}
```

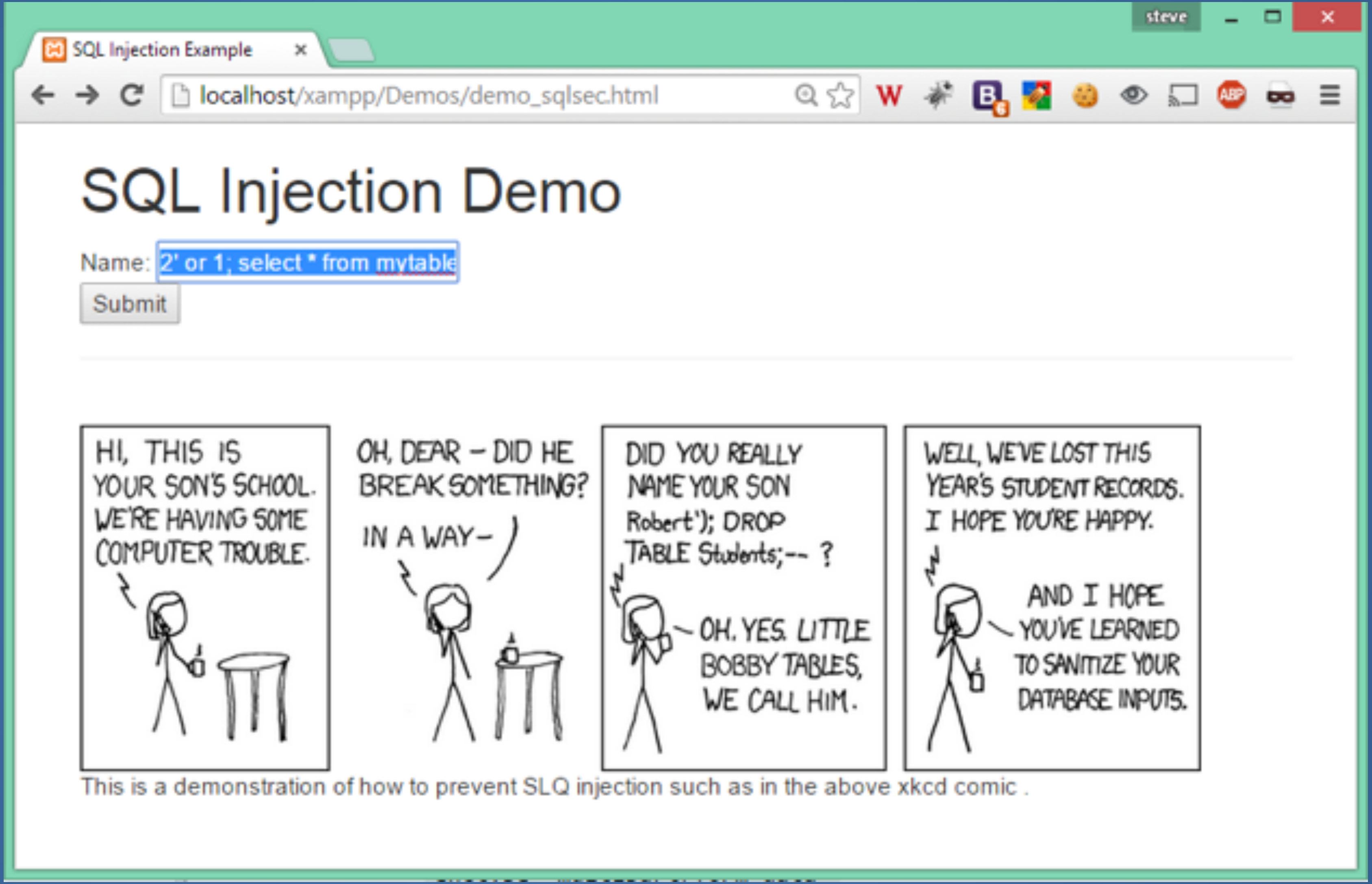
SQL Injection: The problem

- With malformed strings like

  2' or 1; select * from mytable ;

  We get results we didn’t expect

Demo



SQL Injection Example
localhost/xampp/Demos/demo_sqlsec.html

SQL Injection Demo

Name: 2' or 1; select * from mytable

Submit

HI, THIS IS YOUR SON'S SCHOOL. WE'RE HAVING SOME COMPUTER TROUBLE.
OH, DEAR – DID HE BREAK SOMETHING?
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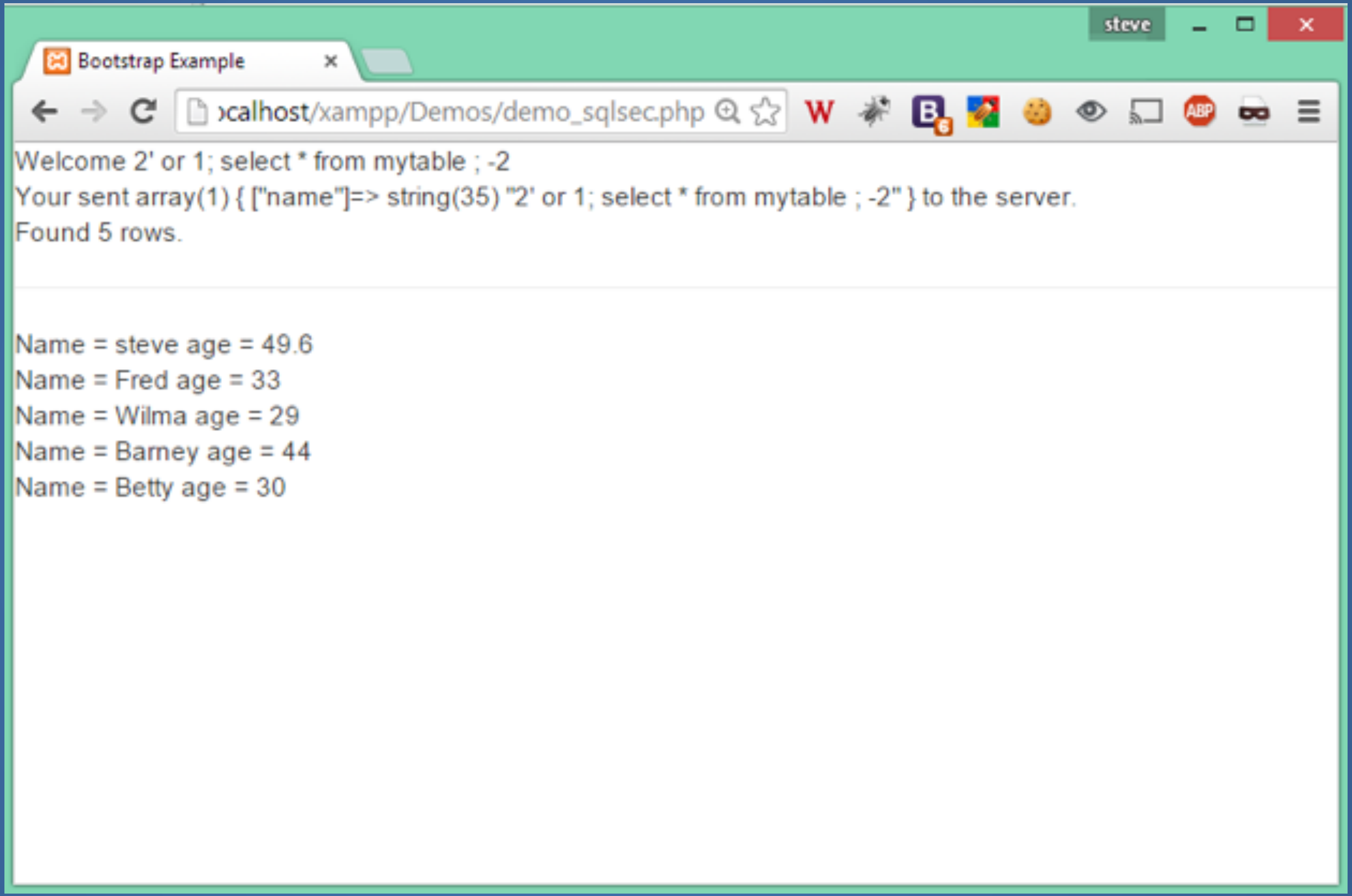
This is a demonstration of how to prevent SLQ injection such as in the above xkcd comic .

Demo

Not what you want.



```
Welcome 2' or 1; select * from mytable ; -2
Your sent array(1) { ["name"]=> string(35) "2' or 1; select * from mytable ; -2" } to the server.
Found 5 rows.

Name = steve age = 49.6
Name = Fred age = 33
Name = Wilma age = 29
Name = Barney age = 44
Name = Betty age = 30
```

SQL Injection Mitigation

The solution to SQL injection types of attacks is complicated and requires vigilance and understanding on the part of the programmer.

One can not blindly rely on a one size fits all solution.

You must understand what your code is doing and design your code appropriately.

SQL Injection Mitigation

Techniques:

Prepared Statements

Sanitizing Input

Prepared Statements and Bound Parameters

Lifecycle

- Prepare: An SQL statement template is created and sent to the database. Certain values are left unspecified, called parameters (labeled "?"). Example: **INSERT INTO mytable VALUES(?, ?, ?)**
- Parse: The database parses, compiles, and performs query optimization on the SQL statement template, and stores the result **without executing it**
- Execute: At a later time, the application **binds the values to the parameters,** and the database executes the statement. The application may execute the statement as many times as it wants with different values

SQL Injection Solution

```
•       if ($stmt = $conn->prepare("SELECT pkID, name, age, realAge, phone, email FROM mytable WHERE name=?")) {
•
•               $stmt->bind_param("s", $_POST["name"]);// Bind a variable to the parameter as a string.
•
•               $stmt->execute();  // Execute the statement.

•               $stmt->bind_result($pkID, $name, $age, $realAge, $phone, $email);
•
•               $stmt->store_result();  /* Store the result (to get properties) */
•               $num_of_rows = $stmt->num_rows;

•               /* Bind the result to variables */
•               $stmt->bind_result($pkID, $name, $age, $realAge, $phone, $email);
•
•               $stmt->fetch(); // Fetch the data.

•               // Display the data.
•               printf("ID %s is %s. They are %s, but really they are %s", $name, $pkID, $age, $realAge);

•       }
```

Caution about User Input

- Never trust user Input.
- All user input shoud be sanitized.
- Use mysqli_real_escape_string();
- or PDO::quote();

Sanitizing User input

mysqli_real_escape_string -- Escapes special characters in a string for use in an SQL statement, taking into account the current charset of the connection

Parameters

link

Procedural style only: A link identifier returned by mysqli_connect() or mysqli_init()

escapestr

The string to be escaped.Characters encoded are NUL (ASCII 0), \n, \r, \, ', ", and Control-Z.

Returns: the escaped string;

What if you want to validate input?

To validate user input you must match the input to a pattern. PHP uses Regular Expressions (called RegEx) to do this. A regex is a a sequence of characters that forms a search pattern, mainly for use in pattern matching with strings, or string matching, i.e. "find and replace"-like operations

PHP Regular Expressions

preg_match() — Perform a regular expression match

int preg_match (string $pattern , string $);

int preg_match (string $pattern , string $subject [, array &$matches [, int $flags = 0 [, int $offset = 0]]]);

Regular Expressions

Validate Name

```
$name = test_input($_POST["name"]);
if (preg_match("/^[a-zA-Z ]*$/",$name)) {
        echo (“Found a name”);
```

RegEx Patterns

```
if (preg_match(" /^[a-zA-Z ]*$/",  $name))
```

the yellow text is the important part.

RegEx Patterns

- Operator list (the pattern to match) is contained in the / /

  Simple characters match

  /a/ -> a

  /b/ -> b

  /cd/ -> cd

RegEx

- Square brackets denote a class of characters

  /[ab]/ -> a , ab , b, and ba   but not A

RegEx

- A dash (-) inside square brackets denote a range of characters

  /[a-z]/ -> all lower case characters but not A-Z

Reg Ex

The ^, $ * and . have special meanings

^ = Line start

$ =Line end

* = 0 or more time

. = any character except a new line

Reg Ex: Character Classes

Character classes	
.	any character except newline
\w \d \s	word, digit, whitespace
\W \D \S	not word, digit, whitespace
[abc]	any of a, b, or c
[^abc]	not a, b, or c
[a-g]	character between a & g

Reg Ex Boundaries

^abc$	start / end of the string
\b	word boundary

RegEx: Escaped Characters

\. * \\	escaped special characters
\t \n \r	tab, linefeed, carriage return
\u00A9	unicode escaped ©

RegEx: Quantifiers

a* a+ a?	0 or more, 1 or more, 0 or 1
a{5} a{2,}	exactly five, two or more
a{1,3}	between one & three
a+? a{2,}?	match as few as possible
ablcd	match ab or cd

Regular Expressions

- Take some time to learn by example.
- visit the site http://www.regexr.com/

Regular Expressions

- Rich amount of regular expression functions in the php library. Check out the PCRE pages on php.net. Of interest may be
- preg_match(); and preg_match_all()
- preg_filter(); and preg_replace();
- and
- preg_split();

PHP Sessions

Sessions are used to preserve data across page visits. Sessions can either be stored with the URL or in a cookie on the client.

Sessions are created with the session_start (); function and are accessible through the super global $_SESSION variable;

Session Code Demo

PHP Cookie

- Cookies store information on the client.

PHP Cookie Demo