Exploiting and Defending: Common Web Application Vulnerabilities

CYPRESS
DATA DEFENSE

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Principal Security Consultant

SANS Instructor

Denver OWASP Chapter Lead

- Certifications
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Introduction: Aaron Cure

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Disclaimer

Using real attack tools

Illegal to attack targets without written contractual consent

Obey all state and federal laws

Cypress Data Defense assumes no liability

Agenda

Introduction

A6: Sensitive Data Exposure

A5: Security Misconfiguration

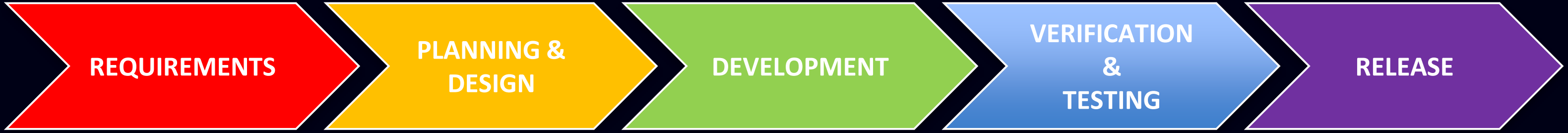
A1: Injection

A3: Cross-Site Scripting (XSS)

A8: Cross-Site Request Forgery (CSRF)

Secure Software Development LifeCycle (SSDLC)

Software Development LifeCycle (SDLC)



- Software Development Life Cycle
- Process for planning, creating, testing, and deploying an information system

What is a *Secure* SDLC?

Security considered at **<u>each phase</u>**

Initial and ongoing Security Training

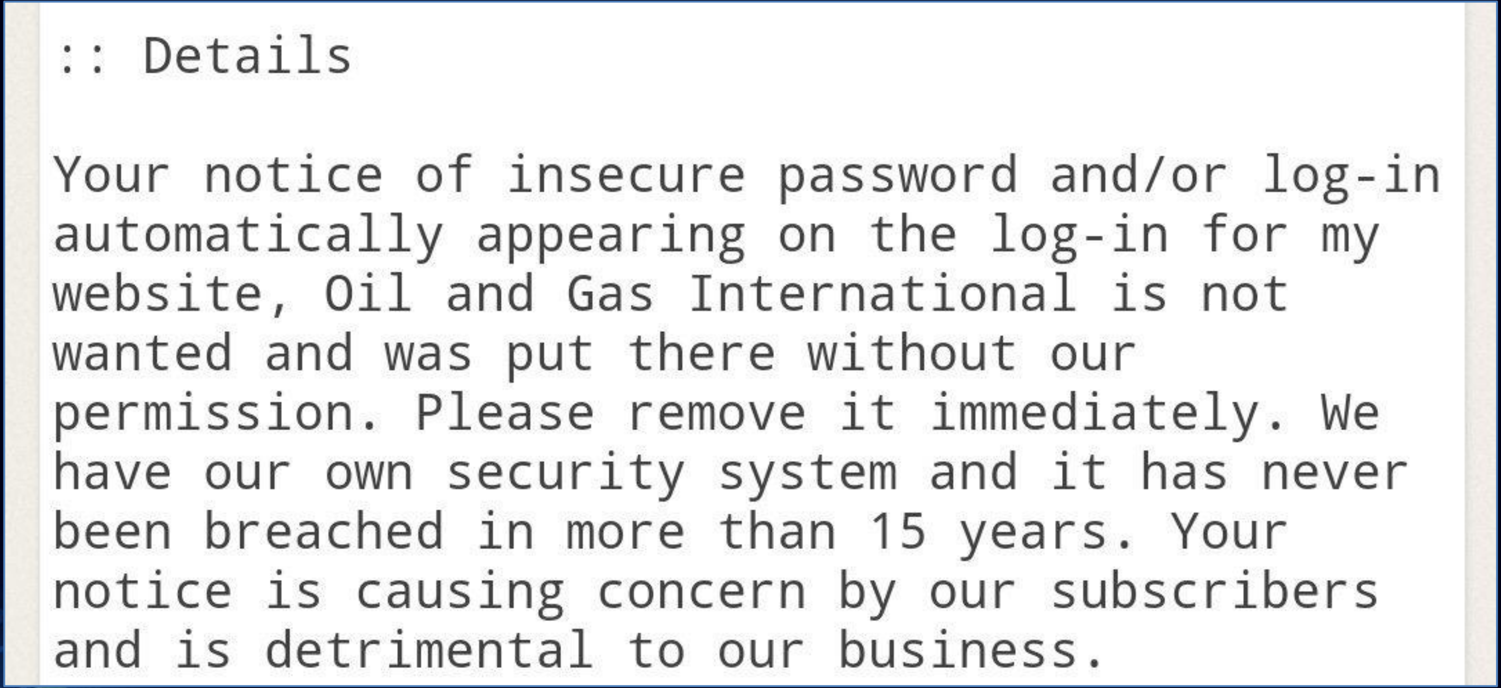
Overall security is the priority

Testing and evaluation of security throughout

Secure Software Development LifeCycle (SSDLC)

SECURITY TRAINING	REQUIREMENTS	PLANNING & DESIGN	DEVELOPMENT	VERIFICATION & TESTING	RELEASE
Core Security Training	User Stories	Risk Analysis	Peer Review	Penetration Testing	Continuous Monitoring
Specialized Training	Security Stories	Attack Surface	Static Analysis	Attack Surface Review	Continuous Feedback
Ongoing Training	Abuse Stories	Threat Modeling			
	Risk Analysis				

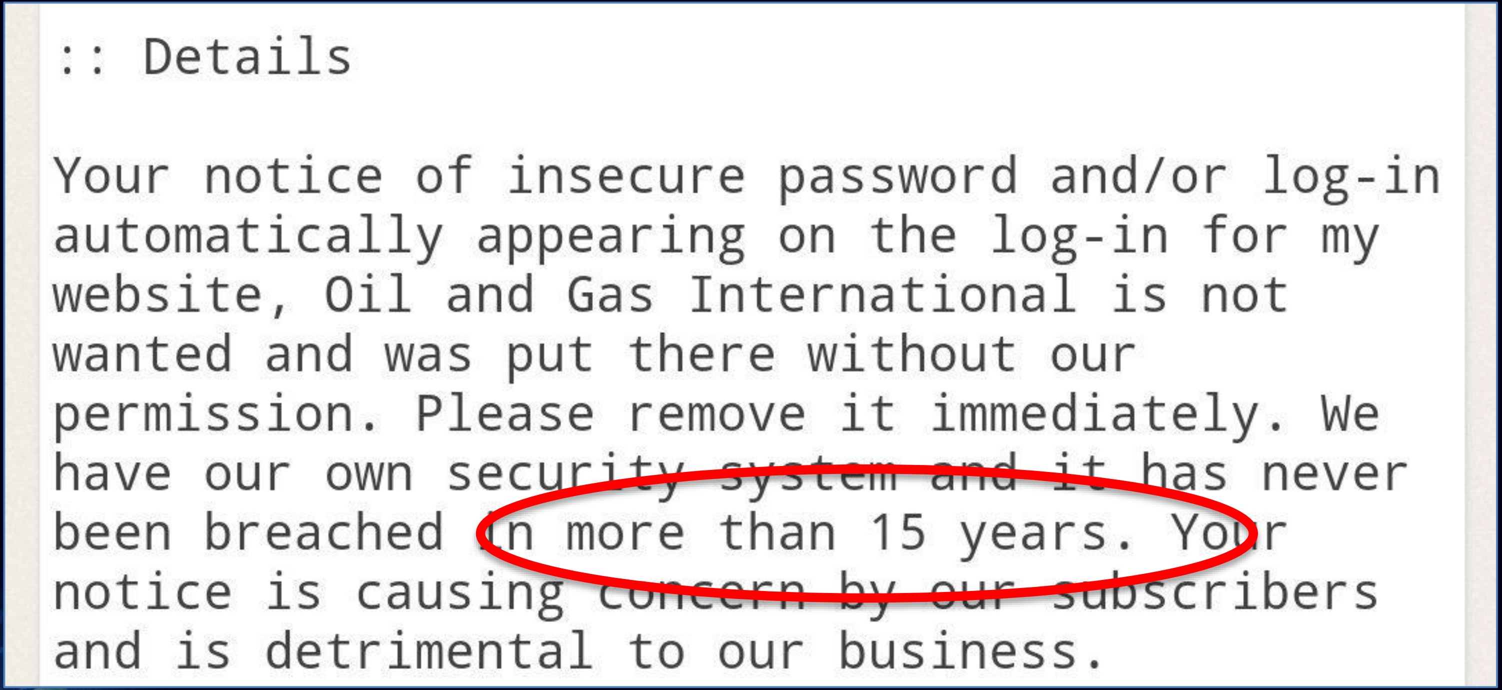
Meet George



:: Details

Your notice of insecure password and/or log-in automatically appearing on the log-in for my website, Oil and Gas International is not wanted and was put there without our permission. Please remove it immediately. We have our own security system and it has never been breached in more than 15 years. Your notice is causing concern by our subscribers and is detrimental to our business.

Meet George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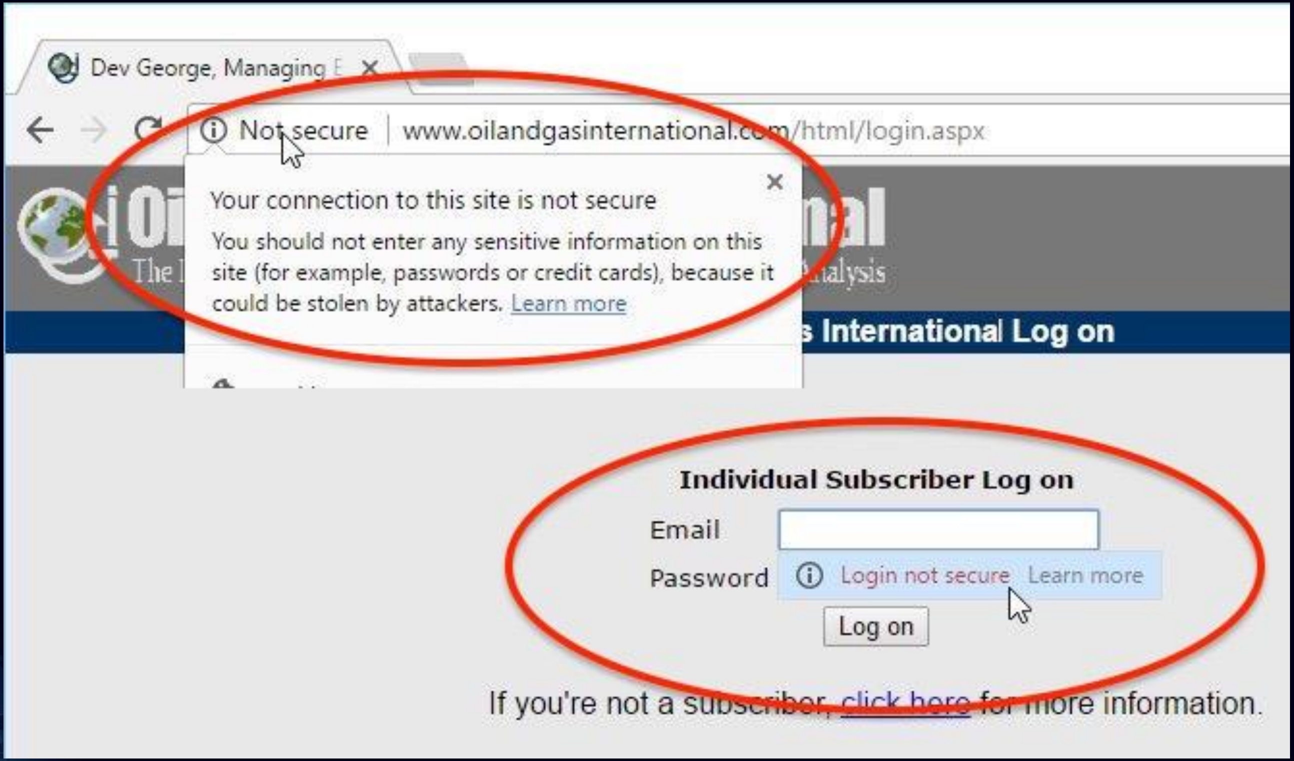
Oh, THAT notice…



Dev George, Managing E

Not secure | www.oilandgasinternational.com/html/login.aspx

Your connection to this site is not secure

You should not enter any sensitive information on this site (for example, passwords or credit cards), because it could be stolen by attackers. Learn more

s International Log on

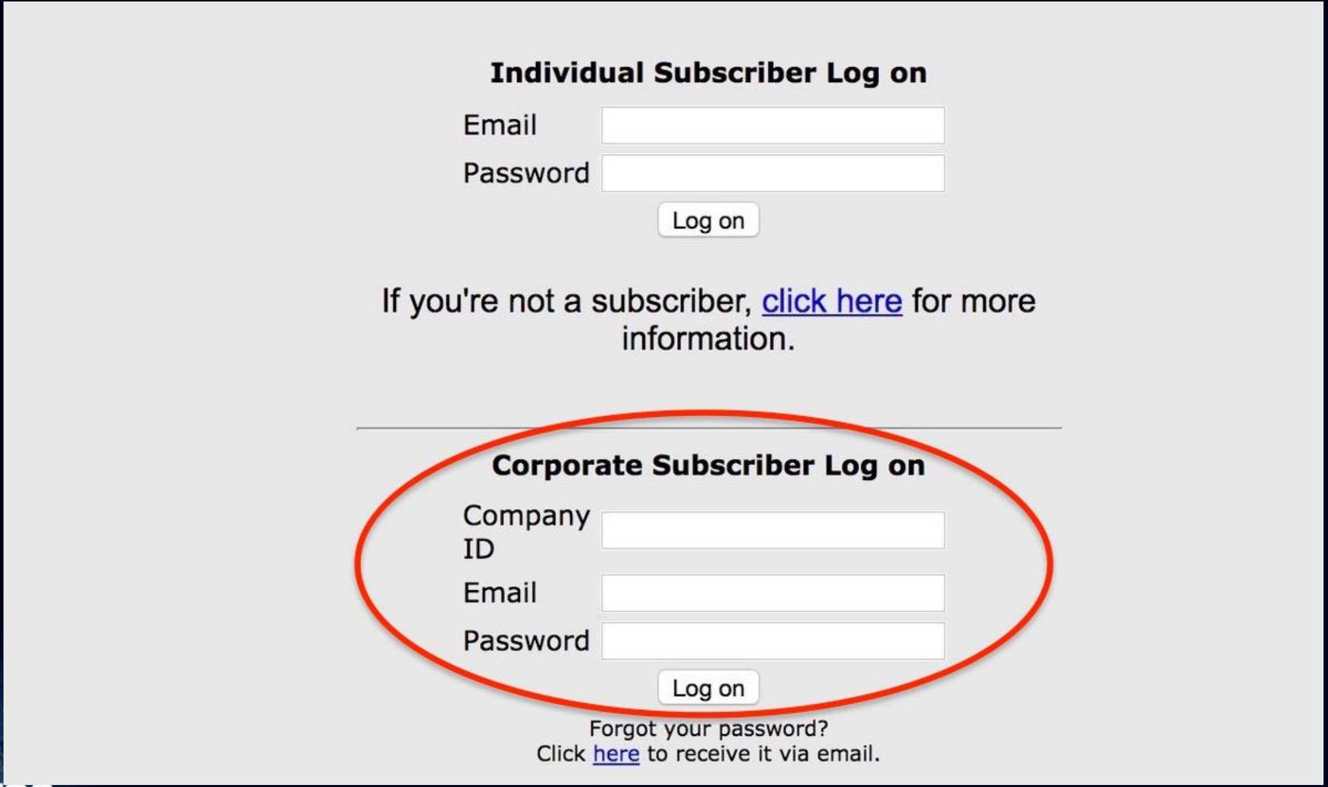
Individual Subscriber Log on

Email	
Password	Login not secure Learn more

Log on

If you're not a subscriber, click here for more information.

It Just Gets Worse…



Individual Subscriber Log on

Email	
Password	

Log on

If you're not a subscriber, click here for more information.

Corporate Subscriber Log on

Company ID	
Email	
Password	

Log on

Forgot your password?
Click here to receive it via email.

A6: Sensitive Data Exposure

Sensitive Data Exposure occurs when an application does not adequately protect sensitive information. The data can vary and anything from passwords, session tokens, credit card data to private health data and more can be exposed.

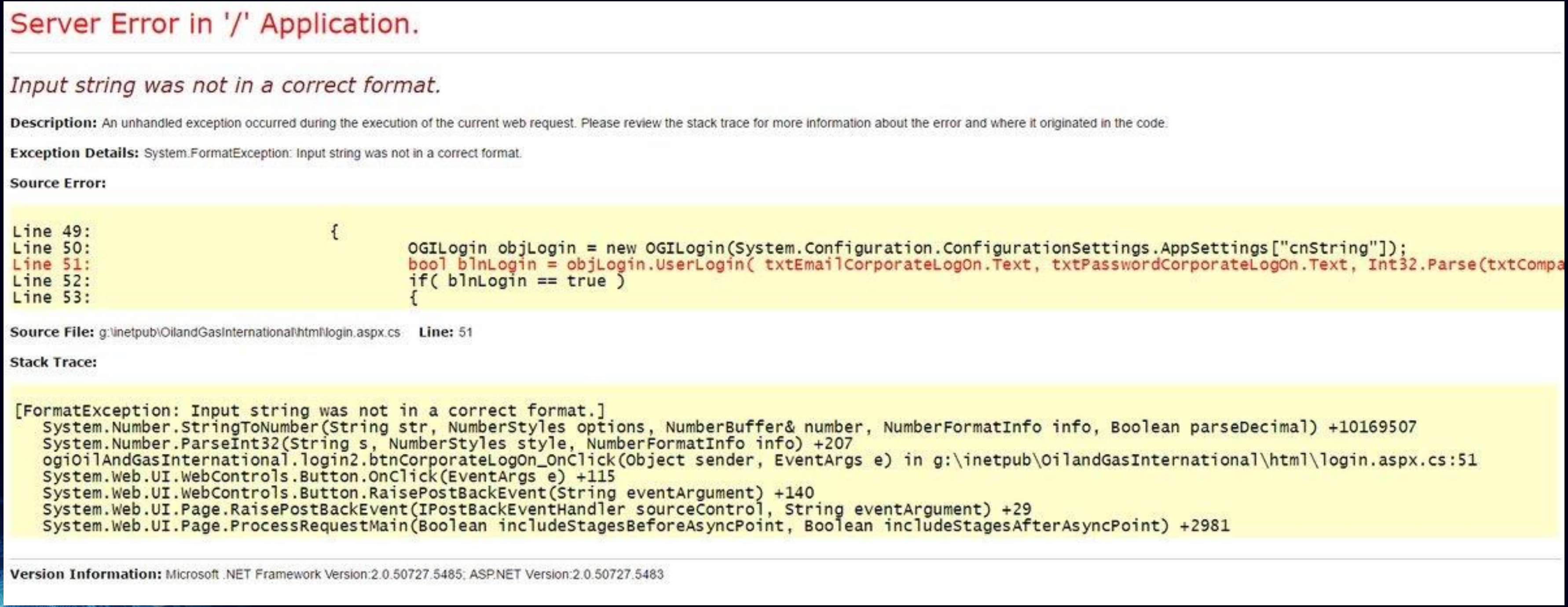
A6: Mitigation

HTTPS (TLS Cert)

HTTP Security Headers

- HSTS (HTTP Strict Transport Security)

Stack Trace Anyone?



Server Error in '/' Application.

Input string was not in a correct format.

Description: An unhandled exception occurred during the execution of the current web request. Please review the stack trace for more information about the error and where it originated in the code.

Exception Details: System.FormatException: Input string was not in a correct format.

Source Error:

```
Line 49:                        {
Line 50:                                OGILogin objLogin = new OGILogin(System.Configuration.ConfigurationSettings.AppSettings["cnString"]);
Line 51:                                bool blnLogin = objLogin.UserLogin( txtEmailCorporateLogOn.Text, txtPasswordCorporateLogOn.Text, Int32.Parse(txtCompa
Line 52:                                if( blnLogin == true )
Line 53:                                {
```

Source File: g:\inetpub\OilandGasInternational\html\login.aspx.cs **Line:** 51

Stack Trace:

```
[FormatException: Input string was not in a correct format.]
   System.Number.StringToNumber(String str, NumberStyles options, NumberBuffer& number, NumberFormatInfo info, Boolean parseDecimal) +10169507
   System.Number.ParseInt32(String s, NumberStyles style, NumberFormatInfo info) +207
   ogiOilAndGasInternational.login2.btnCorporateLogOn_OnClick(Object sender, EventArgs e) in g:\inetpub\OilandGasInternational\html\login.aspx.cs:51
   System.Web.UI.WebControls.Button.OnClick(EventArgs e) +115
   System.Web.UI.WebControls.Button.RaisePostBackEvent(String eventArgument) +140
   System.Web.UI.Page.RaisePostBackEvent(IPostBackEventHandler sourceControl, String eventArgument) +29
   System.Web.UI.Page.ProcessRequestMain(Boolean includeStagesBeforeAsyncPoint, Boolean includeStagesAfterAsyncPoint) +2981
```

Version Information: Microsoft .NET Framework Version:2.0.50727.5485; ASP.NET Version:2.0.50727.5483

A5: Security Misconfiguration

Good security requires having a secure configuration defined and deployed for the application, frameworks, application server, web server, database server, and platform. Secure settings should be defined, implemented, and maintained, as defaults are often insecure. Additionally, software should be kept up to date.

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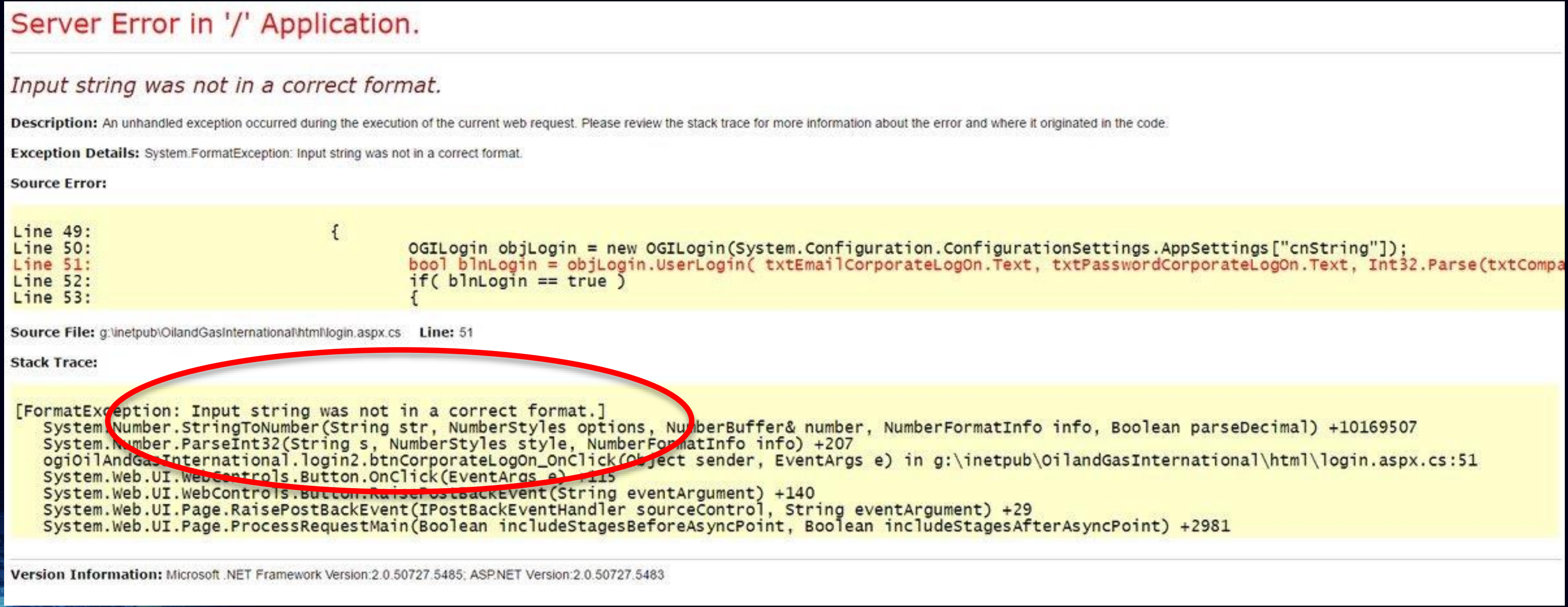
A5: Mitigation

- Custom Error Handler
  - Single Error Message/Page
  - No Error Information – Including Return Code
- Internal Error Logging

What Threw the Stack Trace?



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A1: Injection

Text-based attacks that exploit the syntax of the targeted interpreter.

Almost any source of data can be an injection vector, including internal sources.

Injection flaws occur when an application sends untrusted data to an interpreter.

A1: SQL Injection

In The News (Target)

110 million customer records

Email, Mailing addresses, other Personally Identifiable Information (PII)

In The News (Living Social)

50 million customer records

Email, DOB, Password Hashes, Challenge Questions & Answers

A1: Example (1)

Command Injection

```
Runtime.getRuntime().exec(String.format("myTestProcess.exe %s",
request.getParameter(”employeeId")))
```

Inline SQL

```
rs = statement.executeQuery(
"Select EmployeeId, LastName, FirstName, PhoneNumber " +
"From Employees " +
"Where EmployeeId = " + request.getParameter(”employeeId”))
```

Exploitation DEMO

sqlmap DEMO

http://sqlmap.org/

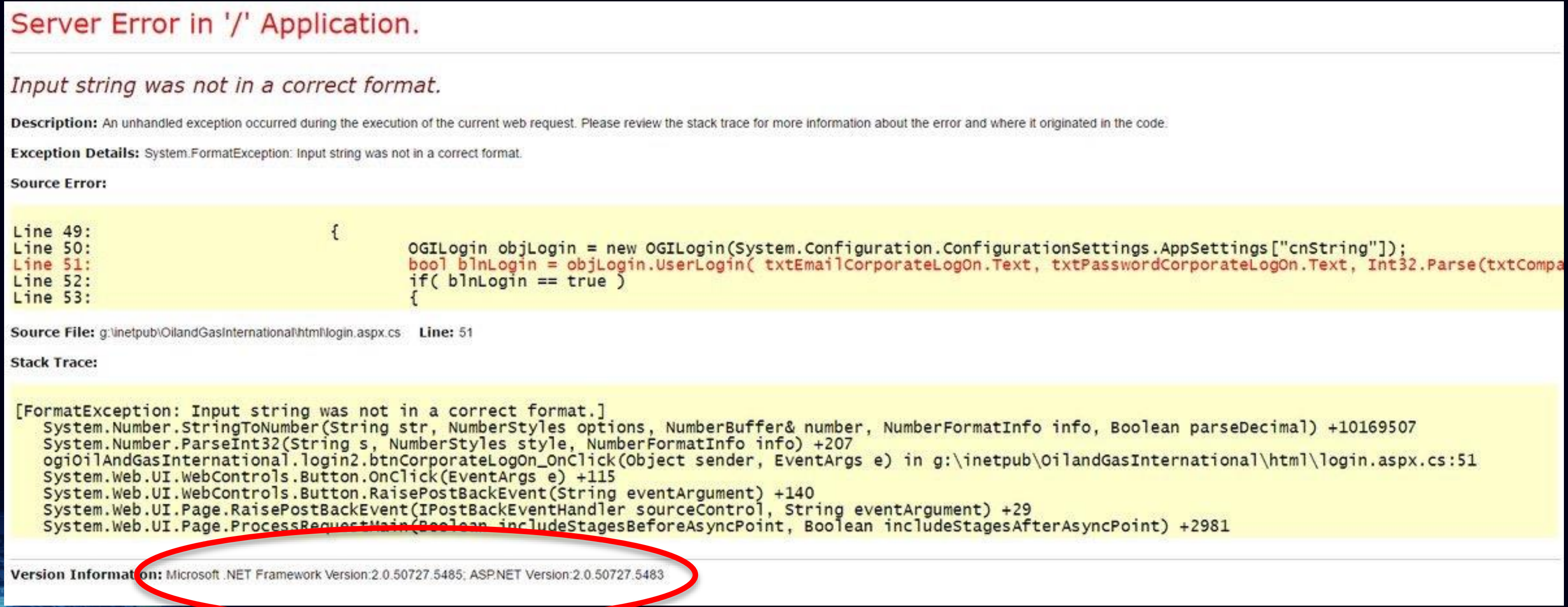
Written in Python

A1: Mitigation

Parameterized Queries

Object Relation Mappers (ORM)

Remember Me?



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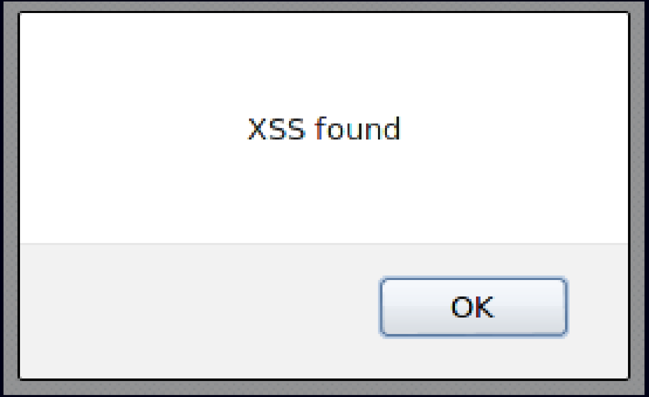
XSS

Cross-Site Scripting

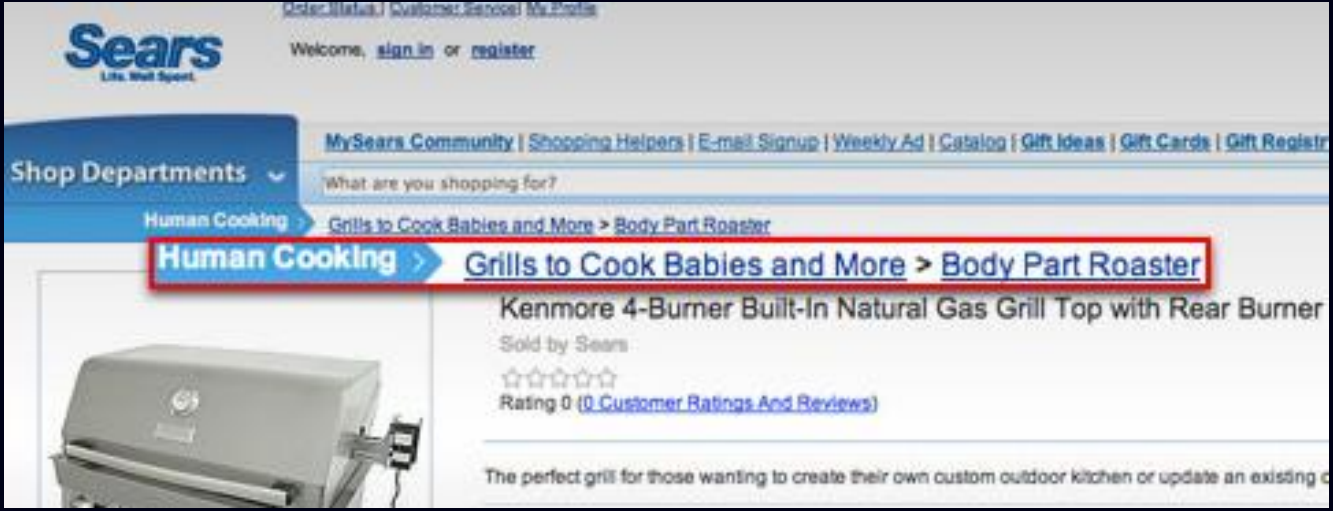
A3: Cross-Site Scripting (XSS)

XSS flaws occur whenever an application takes untrusted data and sends it to a web browser without proper encoding.

- Execute scripts in the victim's browser
- Hijack user sessions
- Deface web sites
- Redirect the user to malicious sites.


XSS found

In The News (Sears)



Order Status | Customer Service | My Profile

Welcome, sign in or register

MySears Community | Shopping Helpers | E-mail Signup | Weekly Ad | Catalog | Gift Ideas | Gift Cards | Gift Registr

Shop Departments

What are you shopping for?

Human Cooking > Grills to Cook Babies and More > Body Part Roaster

Human Cooking > Grills to Cook Babies and More > Body Part Roaster

Kenmore 4-Burner Built-In Natural Gas Grill Top with Rear Burner

Sold by Sears

Rating 0 (0 Customer Ratings And Reviews)

The perfect grill for those wanting to create their own custom outdoor kitchen or update an existing

In The News (EF)

Site defaced to contain flashing images designed to cause seizures

Some victims required hospital care

Reflected Example

HTML Context

```
<td><%= request.getParameter("Name") %></td>
```

URL Context

```
<a href='<%= String.format("details.aspx?id=%s",
request.getParameter("Name")) %>'></a>
```

JavaScript Context

```
<a href='<%= String.format("javascript:redirect
('{%s}')", request.getParameter("Name"))
%>'>View</a>
```

Exploitation DEMO

Browser Exploitation Framework (BeEF)

http://beefproject.com/

Written in Ruby

Mitigations

- Encoding, encoding, encoding
  - **Validation is not the solution**
- Contexts to consider
  - Html, Url, JavaScript
  - HtmlAttribute, Css, Xml, XmlAttribute

Mitigations (2)

- Language Specific Encoding Libraries
- HTTP Security Headers
  - X-XSS-Protection
  - Content-Security-Policy (CSP)

CSRF

Cross Site Request Forgery

In The News (GoDaddy)

Admin console vulnerable to CSRF allowing attackers to perform the following:

- Modify automatic renewals
- Edit zone files
- Name server management

In The News (TP-Link)

Multiple manufacturers

4.5 Million Routers Compromised in Brazil

Cross-Site Request Forgery

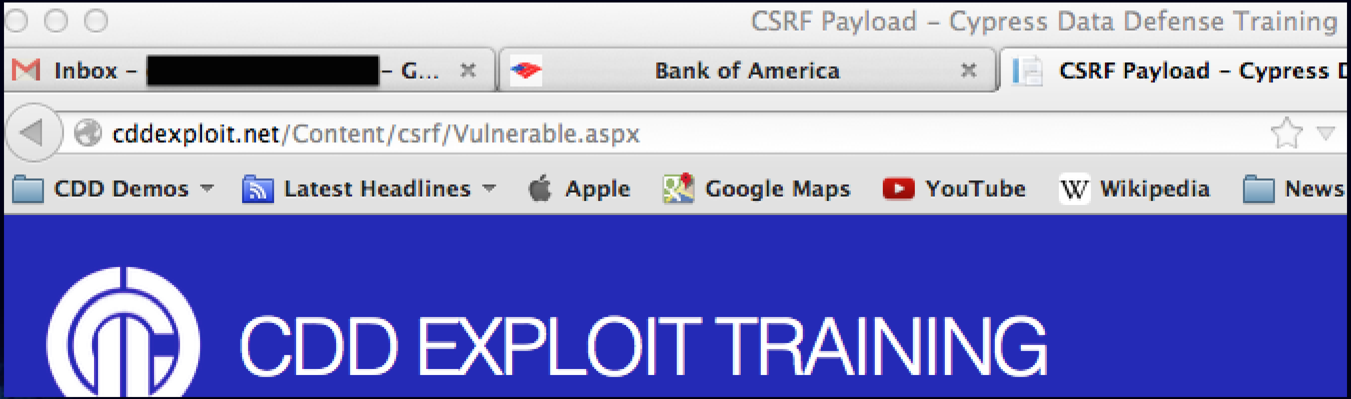
A CSRF attack forces a logged-on victim’s browser to send a forged HTTP request, including the victim’s session cookie and any other automatically included authentication information.

- Audit logs will show the user made the transaction
- User has no knowledge of the transaction

Cross-Site Request Forgery (CSRF) Example

Multiple Tabs

Authenticated Session


CSRF Payload – Cypress Data Defense Training

Inbox – [redacted] – G... | Bank of America | CSRF Payload – Cypress D

cddexploit.net/Content/csrf/Vulnerable.aspx

Cross-Site Request Forgery (CSRF) Example (2)

Payload on attack page

```
<form id="csrfForm"
action="http://localhost:8080/csrf/content/vulnerable/changepa
ssword" method="POST" >
    <input type="hidden" name="newPassword"
        value="StorageRoomB" />
    <input type="hidden" name="confirmPassword"
        value="StorageRoomB" />
</form>
```

Cross-Site Request Forgery (CSRF) Example (3)

Request triggered from authenticated session

```
POST /csrf/content/vulnerable/changepassword HTTP/1.1
Host: localhost:8080
Cookie: JSESSIONID=2E7F523BE6E086F5EEB593B2B69842D2
Content-Type: application/x-www-form-urlencoded
Content-Length: 53

newPassword=StorageRoomB&confirmPassword=StorageRoomB
```

Cross-Site Request Forgery (CSRF) Example (4)

200 Response from web site

```
HTTP/1.1 200 OK


<div class="alert alert-dismissable alert-success">
     <span>Your password was successfully changed.</span>
</div>
```

Exploitation DEMO

Simple Javascript Post

Mitigations

CSRF Mitigations

- Random nonce for each request
- Anti-Forgery Tokens
- CSRF Guard (OWASP Project)
- Browsers looking at headers (e.g., Origin)

Cross-Site Request Forgery (CSRF) Mitigation (1)

Payload with incorrect csrf token

```
<form id="csrfForm"
action="http://localhost:8080/csrf/content/vulnerable/changepa
ssword" method="POST" >
    <input type="hidden" name="newPassword"
        value="StorageRoomB" />
    <input type="hidden" name="confirmPassword"
        value="StorageRoomB" />
    <input type="hidden" name="&#95;csrf"
        value="103ae2a3&#45;d4d6&#45;46e9&#45;8ba6&#45;
        92188ff998c2" />

</form>
```

Cross-Site Request Forgery (CSRF) Mitigation (2)

Request with invalid token submitted

```
POST /csrf/content/vulnerable/changepassword HTTP/1.1
Host: localhost:8080
Cookie: JSESSIONID=2E7F523BE6E086F5EEB593B2B69842D2
Content-Type: application/x-www-form-urlencoded
Content-Length: 53

newPassword=StorageRoomB&confirmPassword=StorageRoomB&_csrf=10
3ae2a3-d4d6-46e9-8ba6-92188ff998c2
```

Cross-Site Request Forgery (CSRF) Example (3)

403 response from web site

```
HTTP/1.1 403 Forbidden


<div class="alert alert-dismissable alert-danger">
    <span>java.lang.NullPointerException</span>
</div>
```

Secure Software Development LifeCycle (SSDLC)

SECURITY TRAINING	REQUIREMENTS	PLANNING & DESIGN	DEVELOPMENT	VERIFICATION & TESTING	RELEASE
Core Security Training	User Stories	Risk Analysis	Peer Review	Penetration Testing	Continuous Monitoring
Specialized Training	Security Stories	Attack Surface	Static Analysis	Attack Surface Review	Continuous Feedback
Ongoing Training	Abuse Stories	Threat Modeling			
	Risk Analysis				

Secure Lifecycle

Involve security through lifecycle

- Security Training
- Requirements
- Design
- Automated testing during implementation
- Manual testing of critical security components during implementation
- Secure Code Review and Penetration Testing

What Can I Do TODAY?

Security Headers

Parameterized Queries/ORM

Treat Untrusted Data Appropriately

Thanks for attending!

Questions?

Aaron

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Email: aaron.cure@cypressdefense.com

Steve

Twitter: @skosten

Email: steve.kosten@cypressdefense.com

Thanks for attending!

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CYPRESS DATA DEFENSE

SANS

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