OWASP Top 10 Risks

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Many thanks to Dave Wichers & OWASP

My Mom

- I got on the email and did a google on my boy
- My boy works in this Internet thing
- He makes cyber cafes a safe place for me
- He speaks a whole different language
  - It is called TCIP
- He is an Internet security teacher

Awwww! Mom, you got it all screwed up.

Goals

- High level overview of the Top 10 in 45 min.
  - Definition, Illustration, & Protection/Avoidance
- With abstraction comes loss of clarity
- Spend a whole life/week/day/hour
- Explain it to me like
  - You should be able to explain it to someone else
  - Your mom can get it
  - Your boss's boss will care

The Top 10 Web Risks

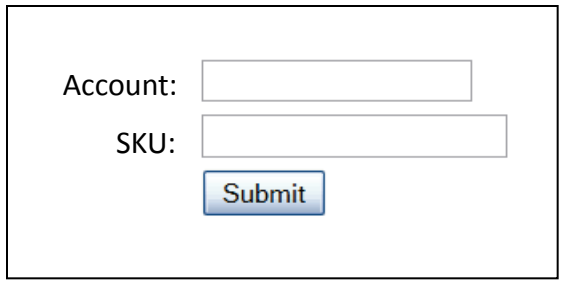
- A1: Injection
- A2: Cross-Site Scripting (XSS)
- A3: Broken Authentication and Session Management
- A4: Insecure Direct Object References
- A5: Cross-Site Request Forgery (CSRF)
- A6: Security Misconfiguration
- A7: Insecure Cryptographic Storage
- A8: Failure to Restrict URL Access
- A9: Insufficient Transport Layer Protection
- A10: Unvalidated Redirects and Forwards

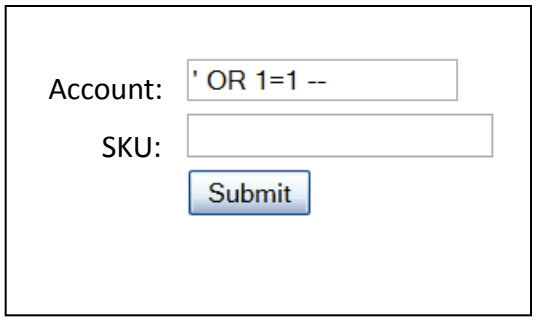
A1: Injection

A1 – Injection

Defined	• commands inserted in the data, interpreted by interpreter
Command Interpreters	• Perl, OS Shell, LDAP, Xpath…
SQL injection	• Web site are connected to Databases
Impact	• Impact Availability, Confidentiality, Integrity

SQL Injection – Illustrated






```
"SELECT * FROM
 accounts WHERE
acct='' OR 1=1--
        ''"
```

Account Summary

Acct:5424-6066-2134-4334
Acct:4128-7574-3921-0192
Acct:5424-9383-2039-4029
Acct:4128-0004-1234-0293

1. Application presents a form to the attacker
2. Attacker sends an attack in the form data
3. Application forwards attack to the database in a SQL query
4. Database runs query containing attack and sends results back to application
5. Application sends results to the user

A1 – Avoiding Injection

- Encode all user input before passing it to the interpreter
  - Everything that is data, only treat it as data
- Avoid using interpreter
- Reduce amount of data available
  - Least Privilege

A2: Cross-Site Scripting (XSS)

A2 – Cross-Site Scripting (XSS)

Defined

- Evil raw data from attacker is sent to an innocent user's browser

Raw data…

- Link retrieved from valid / trusted web site
- Link is a request for data sent directly to client

Web 2.0

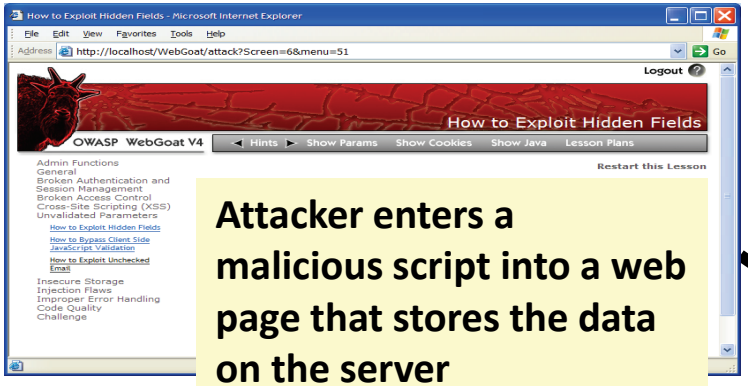
- Everyone posts to everyone else's site
- You can not get around it

Impact

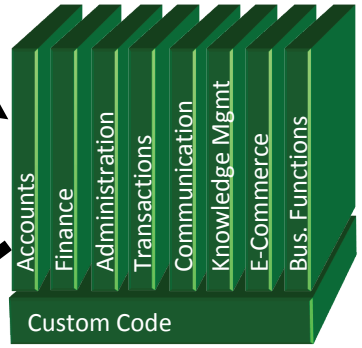
- Confidentiality, Integrity
- Attacker may observe and direct all user's behavior

Cross-Site Scripting Illustrated

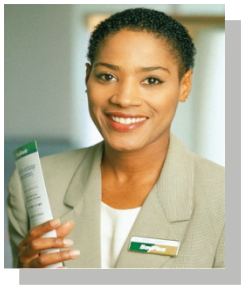
1 **Attacker sets the trap – update my profile**

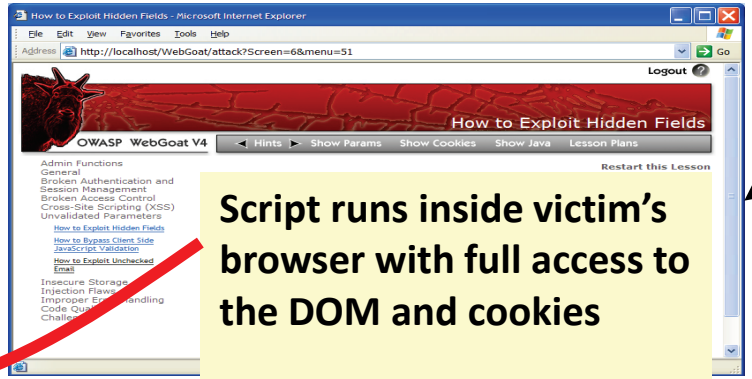


Application with stored XSS vulnerability



2 **Victim views page – sees attacker profile**





3 **Script silently sends attacker Victim's session cookie**

A2 – Avoiding XSS Flaws

- Don’t include user-supplied input in the output page
- Convert all user-supplied input to data only
- Whitelist input validation on all user input
- Use OWASP’s AntiSamy to sanitize this HTML

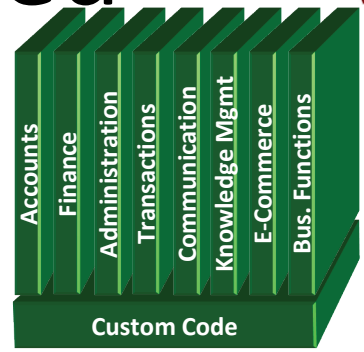
A3: Broken Authentication and Session Management

A3 – Broken Authentication and Session Management

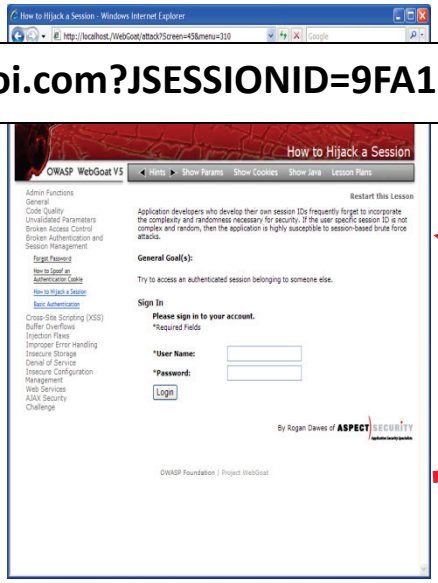
Defined	• Convert user name & password to Session ID • If attacker can predict Session ID, they can steal it
Session management flaws	• Credentials must be appended with every request • SESSION ID is used to track state since HTTP doesn't • SESSION ID is typically exposed
Other session entry points	• Change my password, remember my password, forgot my password, logout, email address, etc…
Impact	• Confidentiality, Integrity • Accounts compromised or sessions hijacked

Broken Authentication Illustrated

1 User sends credentials

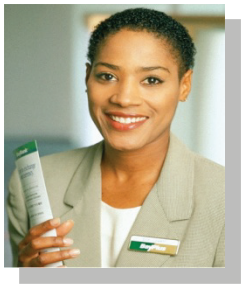


www.boi.com?JSESSIONID=9FA1DB9EA...



Site uses URL rewriting
(i.e., put session in URL)

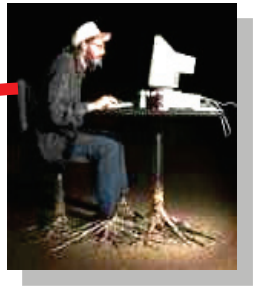
2



3 User clicks on a link to http://www.hacker.com in a forum

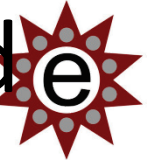
Hacker checks referer logs on www.hacker.com
and finds user's JSESSIONID

4



5 Hacker uses JSESSIONID and takes over victim's account

A3 – Avoiding Broken Authentication and Session Management



- Architecture
  - Authentication = simple, centralized, and standardized
  - SSL from cradle to grave
- Implementation
  - Check your SSL certificate
  - Examine all the authentication-related functions
  - Verify that logoff actually destroys the session
  - WebScarab to test
  - No automated analysis

A4: Insecure Direct Object References

A4 – Insecure Direct Object References

Defined

- Internal files and executables lead to other internal sensitive functions
- Attacker tampers with parameter value

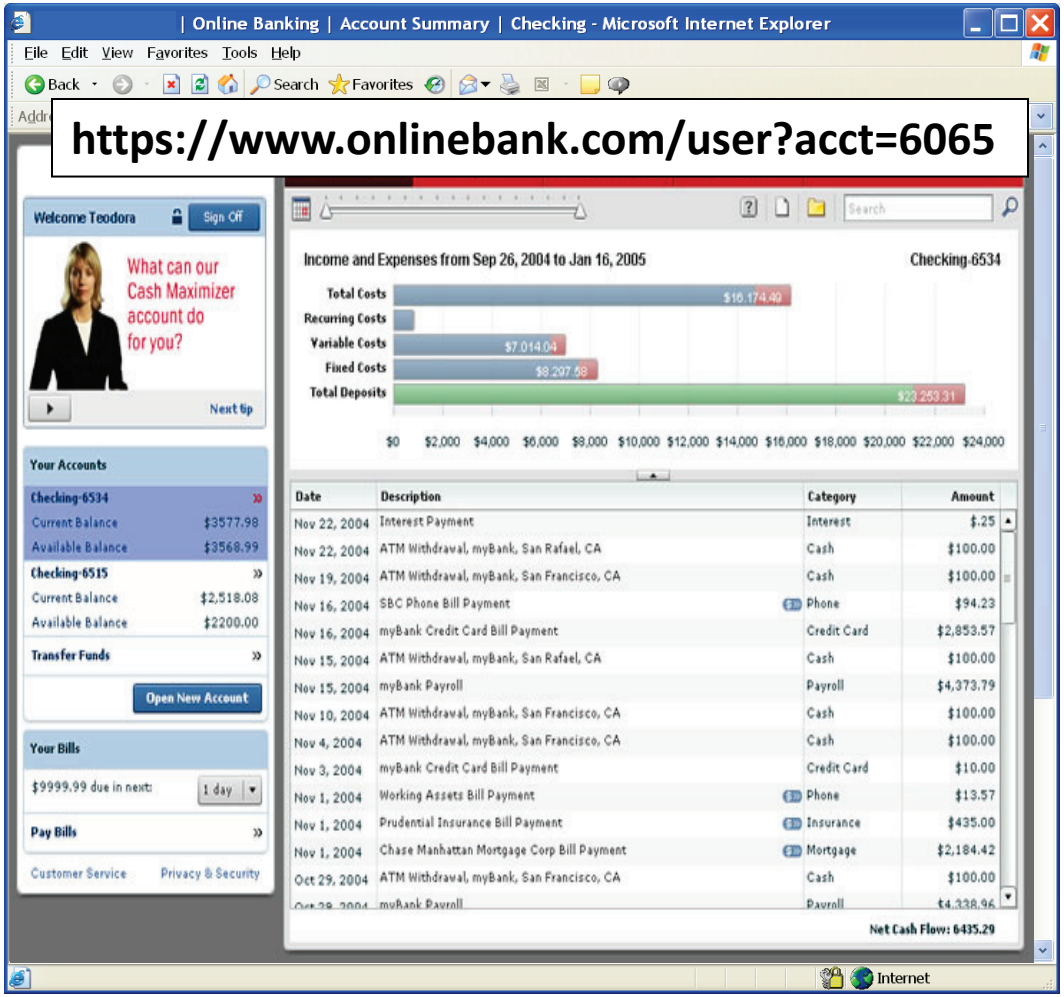
Flaws

- Listing the ‘authorized’ objects
- Hiding the object references

Impact

- Confidentiality
- Attackers are able to access unauthorized files or data

Insecure Direct Object References Illustrated



- Attacker notices his acct parameter is 6065

  ?acct=6065

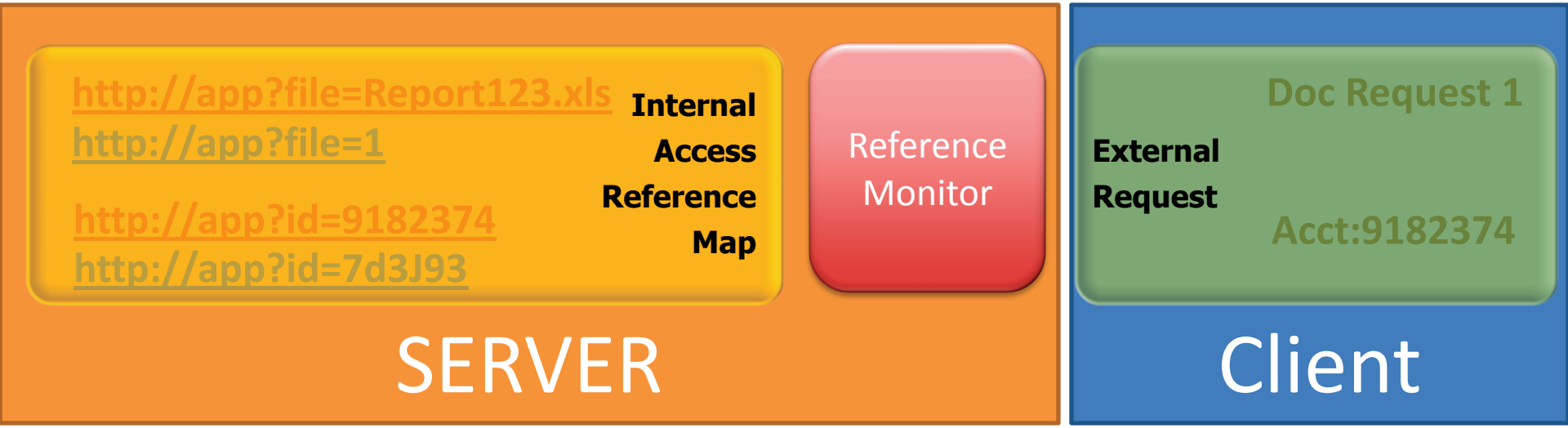
- He modifies it to a nearby number

  ?acct=6066

- Attacker views the victim's account information

A4 – Avoiding Insecure Direct Object References

- Eliminate the direct object reference
  - temporary mapping value (e.g. 1, 2, 3)
- Validate the direct object reference



A5: Cross-Site Request Forgery (CSRF)

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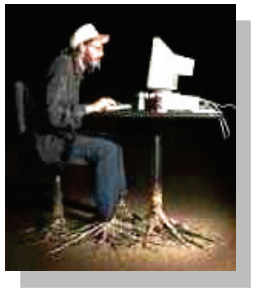
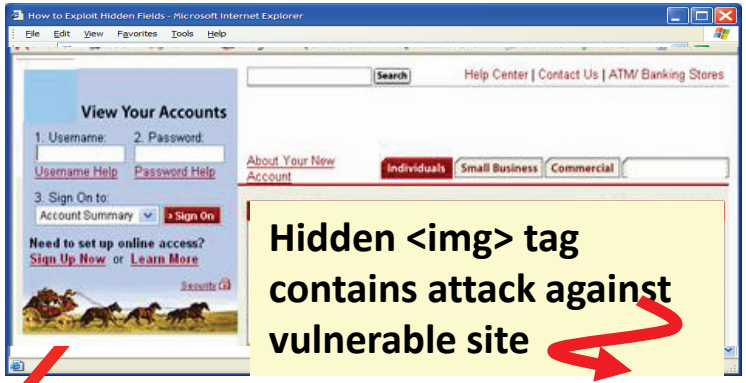
Defined	• Victim's browser is tricked into issuing a command to a vulnerable web application under attacker's control
Cause	• Browsers automatically including user authentication data with each request
Automatically Provided Credentials	• Session cookie, Basic authentication header, IP address • Client side SSL certificates • Windows domain authentication
Impact	• Confidentiality, Integrity • Initiate transactions • Access sensitive data

CSRF Illustrated

1

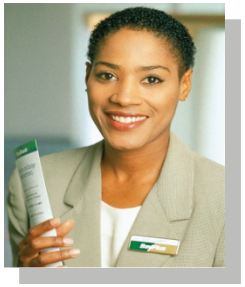
Attacker sets the trap on some website on the internet (or simply via an e-mail)

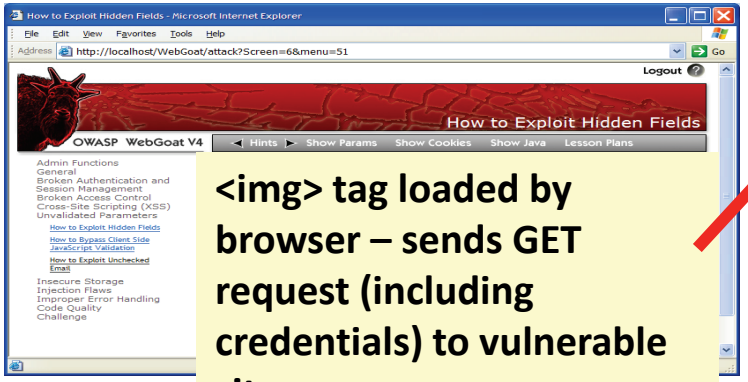




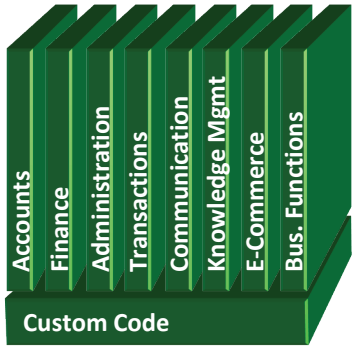
2

While logged into vulnerable site, victim views attacker site





Application with CSRF vulnerability



3

Vulnerable site sees legitimate request from victim and performs the action requested

A5 – Avoiding CSRF Flaws

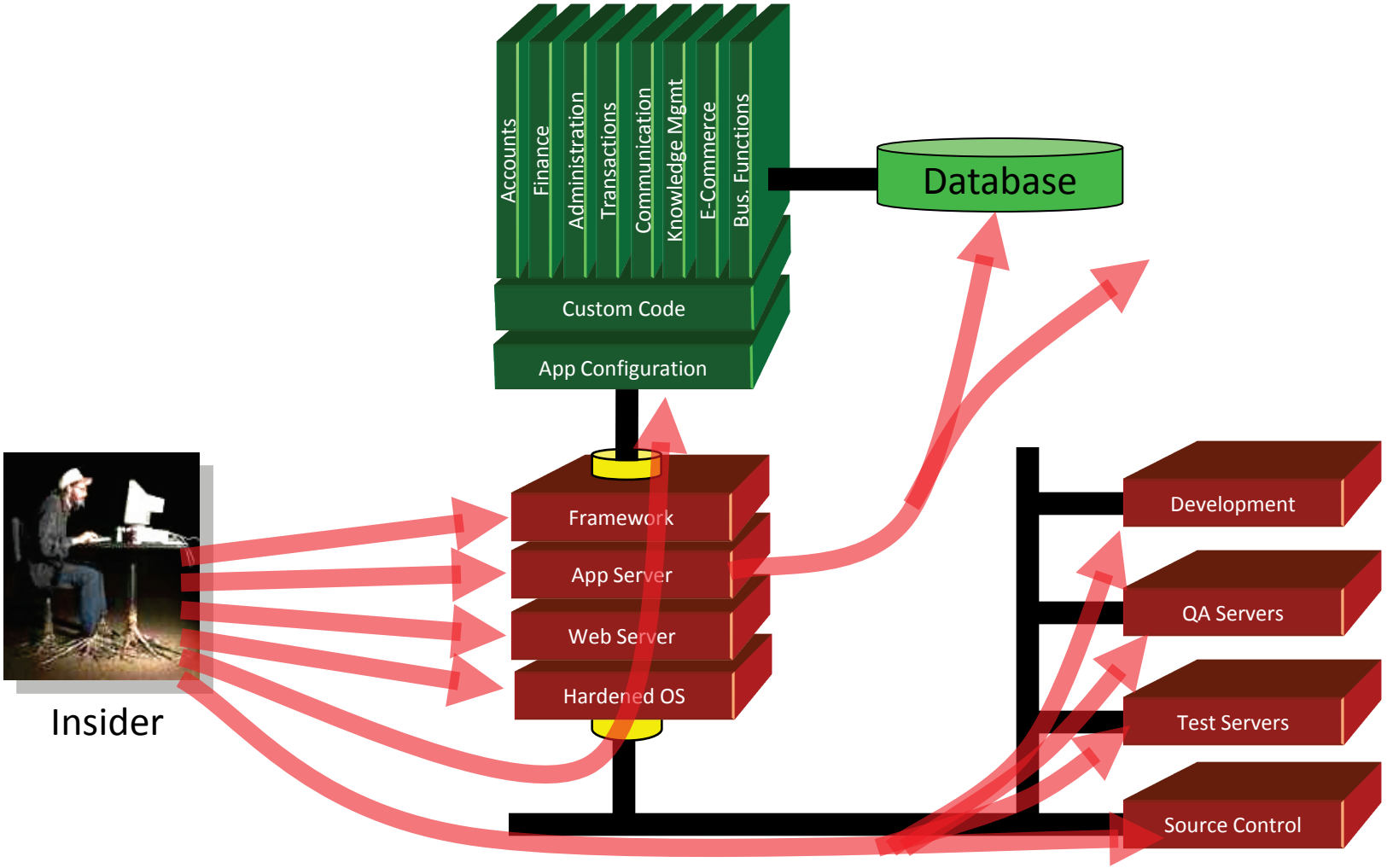
- Add a secret, not automatically submitted
- Tokenize to ALL sensitive requests
  - Cryptographically strong or random
- Don’t allow attackers to store attacks on your site
  - Properly encode all input on the way out
  - This renders all links/requests inert in most interpreters

A6: Security Misconfiguration

A6 – Security Misconfiguration

Defined	• Unpatched operating systems and applications are an attack vector
Other code	• Anything you install is an attack vector
Impact	• Availability, Confidentiality, Integrity

Security Misconfiguration Illustrated



A6 – Avoiding Security Misconfiguration

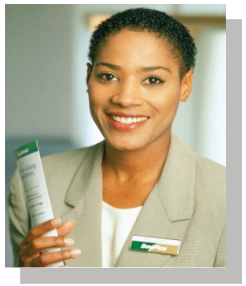
- Hardening
  - Operating System
  - Utilities
  - Applications
  - Agents
- Patch
- Change Control

A7: Insecure Cryptographic Storage

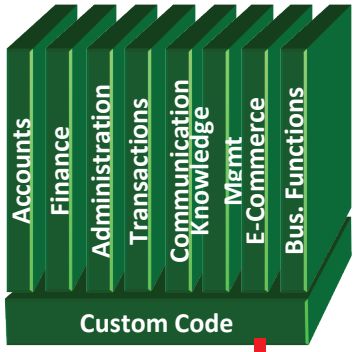
A7 – Insecure Cryptographic Storage

Defined	• Unidentified sensitive data at rest
Data	• Databases, files, directories, log files, backups…
Impact	• Confidentiality, Integrity • Expense of cleaning up the incident • Sued and/or fined

Insecure Cryptographic Storage Illustrated

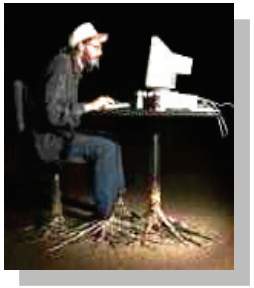


1 Victim enters credit card number in form



2 Error handler logs CC details because merchant gateway is unavailable

3 Logs are accessible to all members of IT staff for debugging purposes



4 Malicious insider steals 4 million credit card numbers

A7 – Avoiding Insecure Cryptographic Storage

- Identify all sensitive data and locations
- Encryption as much as you can afford
- Use the mechanisms correctly
  - Use standard strong algorithms
  - Generate, distribute, and protect keys properly
  - Be prepared for key change
- Verify and test

A8: Failure to Restrict URL Access

A8 – Failure to Restrict URL Access

Defined

- If authentication is used on any part of the site and not on all parts of the site

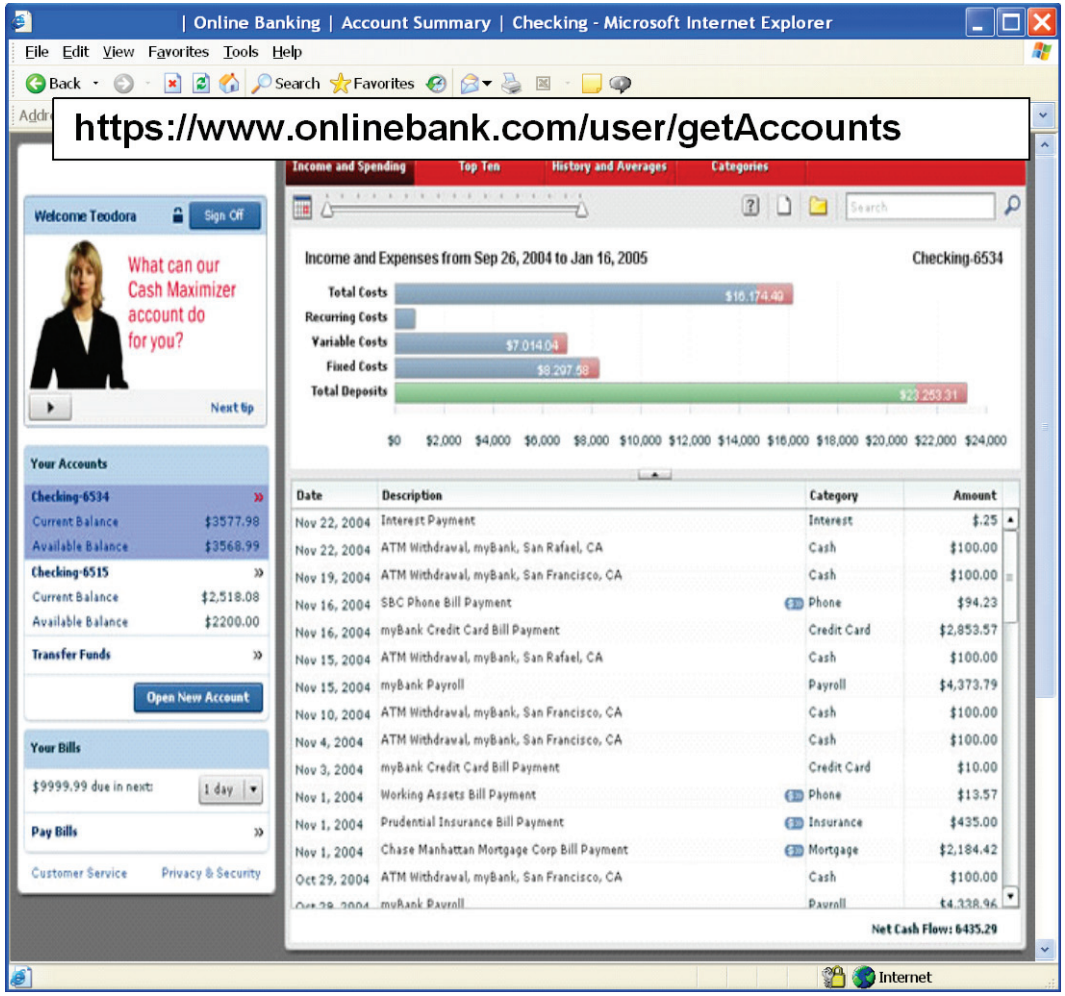
A common mistake …

- Displaying only authorized links and menu choices
- Attacker types the URL directly

Impact

- Confidentiality
- Access other user's accounts and data
- Perform privileged actions

Failure to Restrict URL Access Illustrated



- Attacker notices the URL indicates his role

  /user/getAccounts

- He modifies it to another directory (role)

  /admin/getAccounts, or

  /manager/getAccounts

- Attacker views more accounts than just their own

A8 – Avoiding URL Access Control Flaws

- For each URL, a site needs to do 3 things:
  - Restrict access to authenticated users (if not public)
  - Enforce any user or role-based permissions (if private)
  - Completely disallow requests to unauthorized page types
- Verify the server configuration disallows requests to unauthorized file types
- Use WebScarab to forge unauthorized requests

A9: Insufficient Transport Layer Protection

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Define

- Sensitive data is transmitted in clear

SSL & TLS

- Server side certificate normal
- Client side certificates are rare
- Server to server is possible

Impact

- Confidentiality
- Attackers use data as launching point for further attack

Insufficient Transport Layer Protection Illustrated

External Victim

Custom Code

Backend Systems

Business Partners

Employees

1

External attacker steals credentials and data off network

External Attacker

2

Internal attacker steals credentials and data from internal network

Internal Attacker

A9 – Avoiding Insufficient Transport Layer Protection

- Use SSL/TLS on all connections with sensitive data
- Use certificates correctly
  - Use current standard strong algorithms
  - Manage keys/certificates properly
- Client side
  - Verify SSL certificates before using them

A10: Unvalidated Redirects and Forwards

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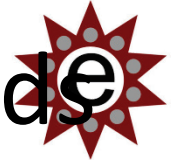


Defined

- User-supplied parameters (Controlled by the Attacker) in the destination URL request data from unauthorized sites
- Attacker can send victim to a site of their choice

Forwards (Transfer in .NET)

- Internally send the request to a new page in the same application
- Sometimes parameters define the target page

Impact

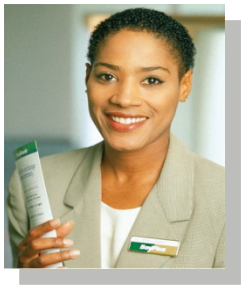
- Integrity
- Redirect victim to phishing or malware site

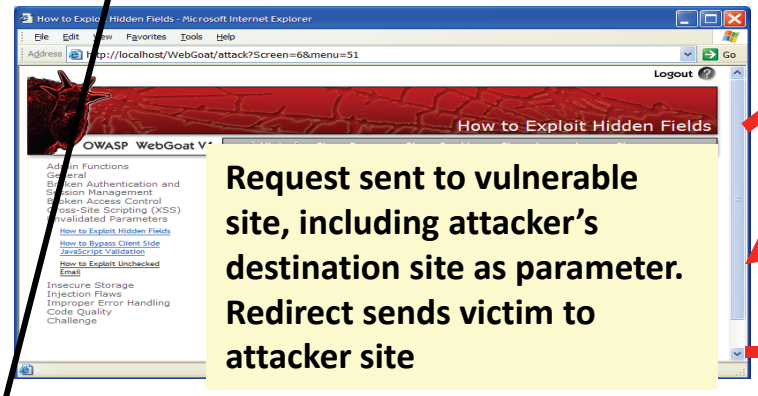
Unvalidated Redirect Illustrated

1 **Attacker sends attack to victim via email or webpage**

From: Internal Revenue Service
Subject: Your Unclaimed Tax Refund
Our records show you have an unclaimed federal tax refund. Please click here to initiate your claim.

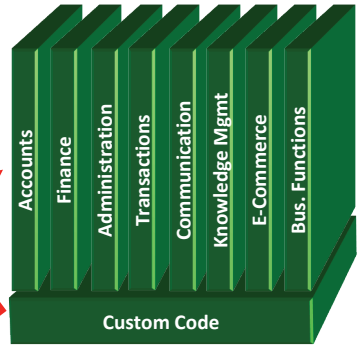
2 **Victim clicks link containing unvalidated parameter**





Request sent to vulnerable site, including attacker's destination site as parameter. Redirect sends victim to attacker site

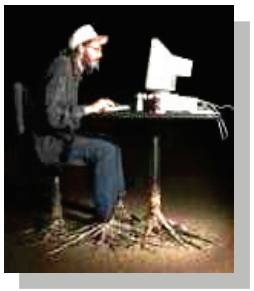
3 **Application redirects victim to attacker's site**



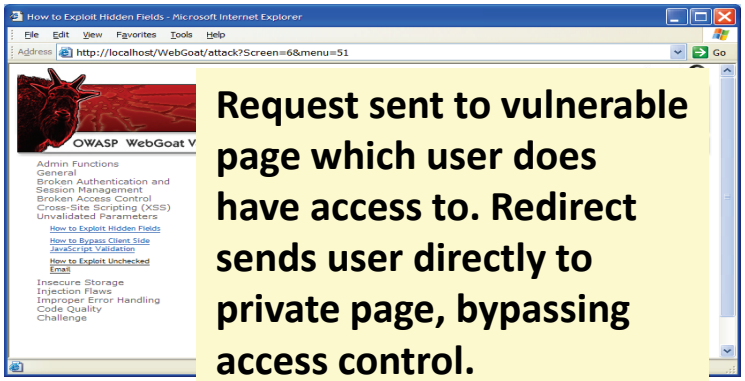
4 **Evil site installs malware on victim, or phish's for private information**

http://www.irs.gov/taxrefund/claim.jsp?year=2006 & … &dest=www.evilsite.com

Unvalidated Forward Illustrated



1 **Attacker sends attack to vulnerable page they have access to**



Request sent to vulnerable page which user does have access to. Redirect sends user directly to private page, bypassing access control.

2 **Application authorizes request, which continues to vulnerable page**

Filter

```
public void doPost( HttpServletRequest request,
HttpServletResponse response) {
    try {
        String target = request.getParameter( "dest" ) );
        ...
        request.getRequestDispatcher( target
        ).forward(request, response);
    }
    catch ( ...
```

```
public void sensitiveMethod(
HttpServletRequest request,
HttpServletResponse response) {
    try {
          // Do sensitive stuff here.
          ...
    }
    catch ( ...
```

3 **Forwarding page fails to validate parameter, sending attacker to unauthorized page, bypassing access control**

A10 – Avoiding Unvalidated Redirects and Forwards

- Avoid using redirects and forwards
- Do not involve user parameters in defining the target URL
- If you ‘must’ involve user parameters
  - Validate each parameter
  - Server side mapping

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