An Introduction to Application Security in J2EE Environments

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Overview

- Background
- What is Application Security and Why is It Important?
- Specific Reference Examples
- J2EE Specific Examples
  - Access Controls
  - Input Validation
- Resources and Conclusions

Background

- Denim Group is a San Antonio based software development firm specializing in:
  - Custom software development
  - Business systems integration
  - Application-level security
  - J2EE and .NET environments
- Management team has breadth of experience working in and servicing:
  - Air Force information warfare
  - DoD software development
  - Big 4 consulting experience
  - Fortune 500 to SMB

What is Application Security?

- Ensuring that custom application code performs as expected under the entire range of possible inputs
- Software development focus
  - Traditional InfoSec focuses at the TCP/IP layer
  - Many traditional InfoSec practitioners are ill-equipped to work in the application security space

Cultural Differences

- Traditional InfoSec tends to have a “measure” culture
  - Determine what is in place
  - Audit configurations
- Application development tends to have a “build” culture
  - Create something that did not exist before
  - Project-based deadline environment
  - Certainly the case for custom software development; also largely the case for systems integration work

Why Does AppSec Matter?

- Business critical web apps are Internet-facing
- New laws and regulations govern how data is stored and made available
  - HIPAA
  - Sarbanes Oxley
  - GLB
- 70+% of applications have serious design or coding flaws
  - Studies performed by @Stake and Foundstone

Top 10 Critical Web App Vulnerabilities

- Unvalidated Parameters
- Broken Access Controls
- Broken Account and Session Management
- Cross-site Scripting Flaws
- Buffer Overflows
- Command Injection Flaws
- Error Handling Problems
- Insecure Use of Cryptography
- Remote Administration Flaws
- Web and Application Server Misconfiguration

** The Open Web Application Security Project www.owasp.org

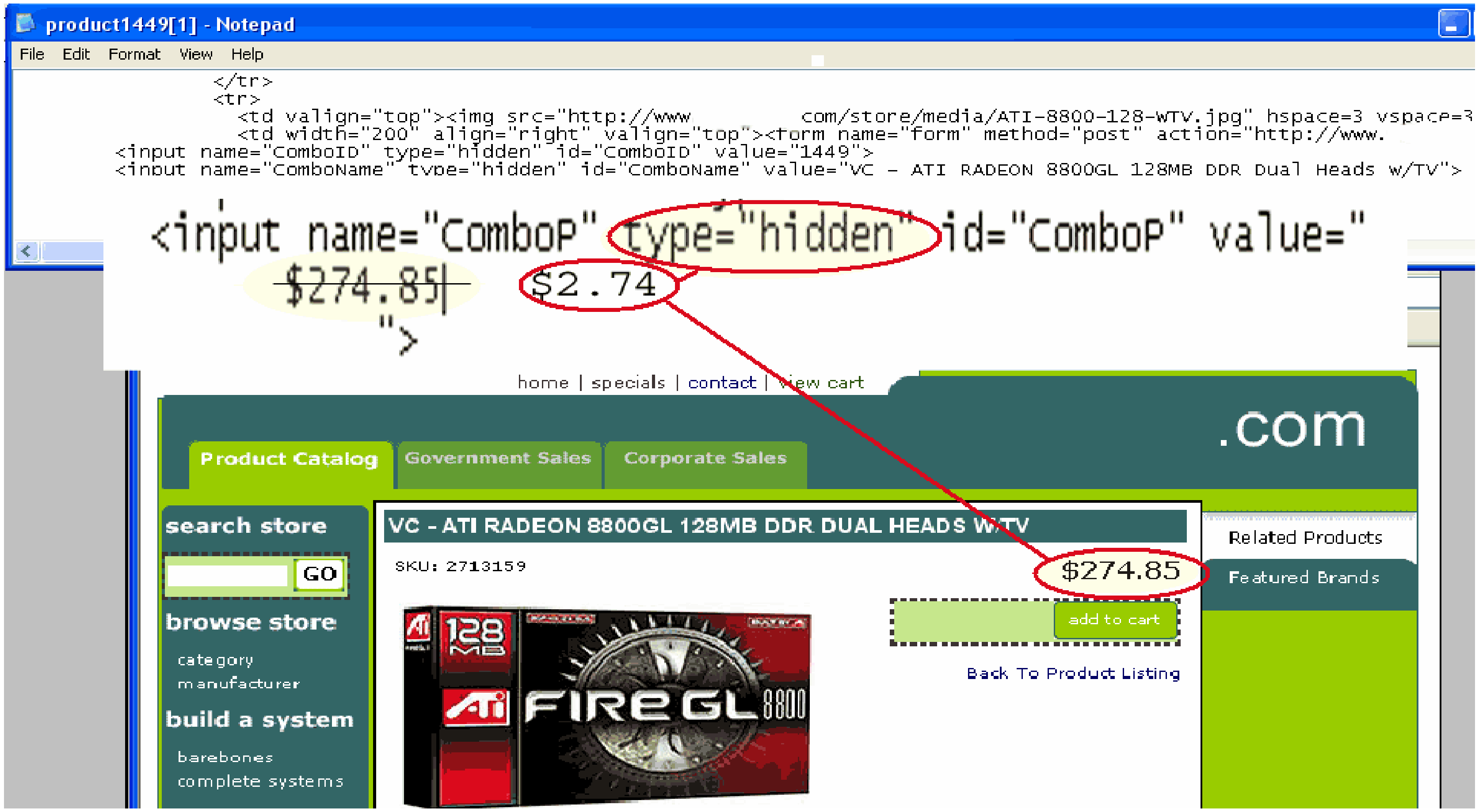
Example Vulnerabilities

- Hidden HTML Field Manipulation
- Cookie Poisoning
- SQL Injection

Hidden HTML Field Manipulation

- Price information is stored in hidden HTML field with assigned $ value
- Assumption: hidden field won’t be edited
- Attacker edits $ value of product in HTML
- Attacker submits altered web page with new “price”
- Still widespread in many web stores

Price Changes via Hidden HTML tags



```
product1449[1] - Notepad
File  Edit  Format  View  Help
                </tr>
                <tr>
                  <td valign="top"><img src="http://www        com/store/media/ATI-8800-128-wTV.jpg" hspace=3 vspace=3
                  <td width="200" align="right" valign="top"><form name="form" method="post" action="http://www.
        <input name="ComboID" type="hidden" id="ComboID" value="1449">
        <input name="ComboName" type="hidden" id="ComboName" value="VC - ATI RADEON 8800GL 128MB DDR Dual Heads w/TV">
```

```
<input name="ComboP" type="hidden" id="ComboP" value="
    ~~$274.85~~  $2.74
        ">
```

VC - ATI RADEON 8800GL 128MB DDR DUAL HEADS W/TV

SKU: 2713159

$274.85

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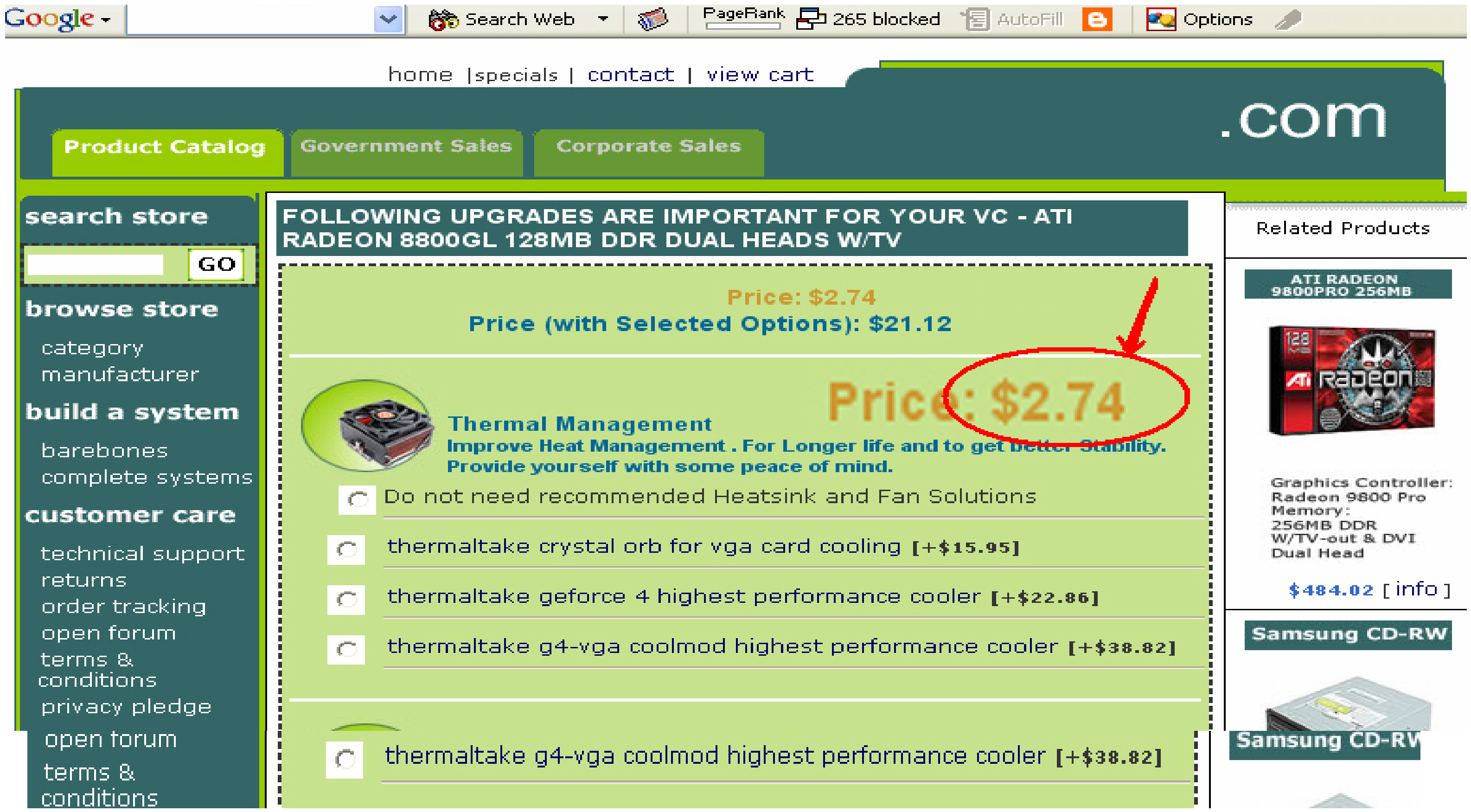
Price Changes via Hidden HTML tags



Google Search Web PageRank 265 blocked AutoFill Options

home |specials | contact | view cart

.com

Product Catalog Government Sales Corporate Sales

search store GO

browse store
category
manufacturer

build a system
barebones
complete systems

customer care
technical support
returns
order tracking
open forum
terms & conditions
privacy pledge
open forum
terms & conditions

FOLLOWING UPGRADES ARE IMPORTANT FOR YOUR VC - ATI RADEON 8800GL 128MB DDR DUAL HEADS W/TV

Price: $2.74
Price (with Selected Options): $21.12

Price: $2.74

Thermal Management
Improve Heat Management . For Longer life and to get better Stability. Provide yourself with some peace of mind.

- ◯ Do not need recommended Heatsink and Fan Solutions
- ◯ thermaltake crystal orb for vga card cooling [+$15.95]
- ◯ thermaltake geforce 4 highest performance cooler [+$22.86]
- ◯ thermaltake g4-vga coolmod highest performance cooler [+$38.82]

- ◯ thermaltake g4-vga coolmod highest performance cooler [+$38.82]

Related Products

ATI RADEON 9800PRO 256MB

Graphics Controller: Radeon 9800 Pro
Memory: 256MB DDR
W/TV-out & DVI
Dual Head

$484.02 [info]

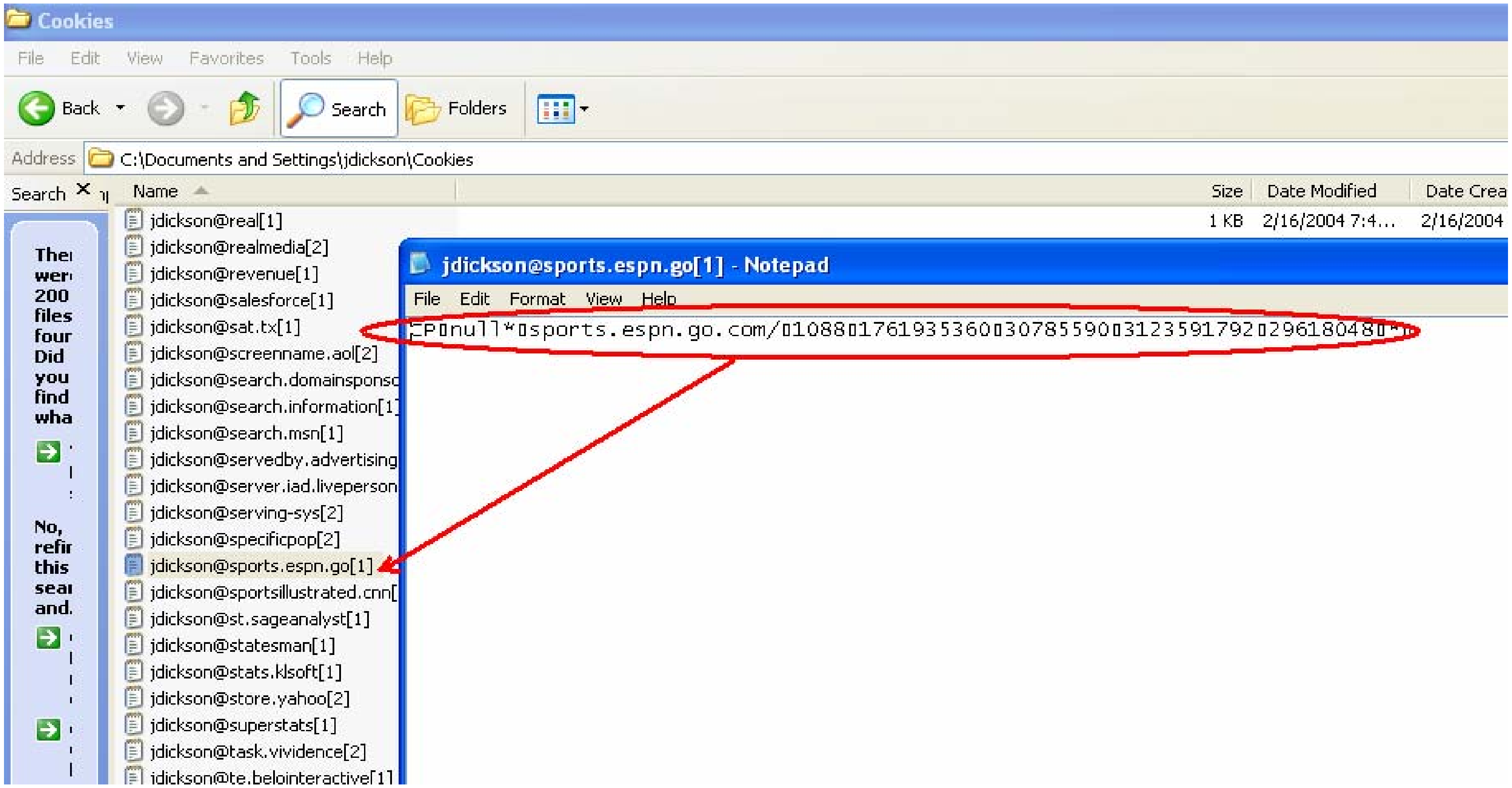
Samsung CD-RW

Samsung CD-RW

Cookie Poisoning

- Browser cookie is used to store user identity information
- Assumption: cookies are set by server side code and not manipulated by users
- Attacker changes cookie and impersonates another user

Cookie Poisoning


Cookies
File Edit View Favorites Tools Help
Back
Search
Folders
Address
Search
Name
Size
Date Modified
Date Crea
jdickson@sports.espn.go[1] - Notepad
File Edit Format View Help

C:\Documents and Settings\jdickson\Cookies

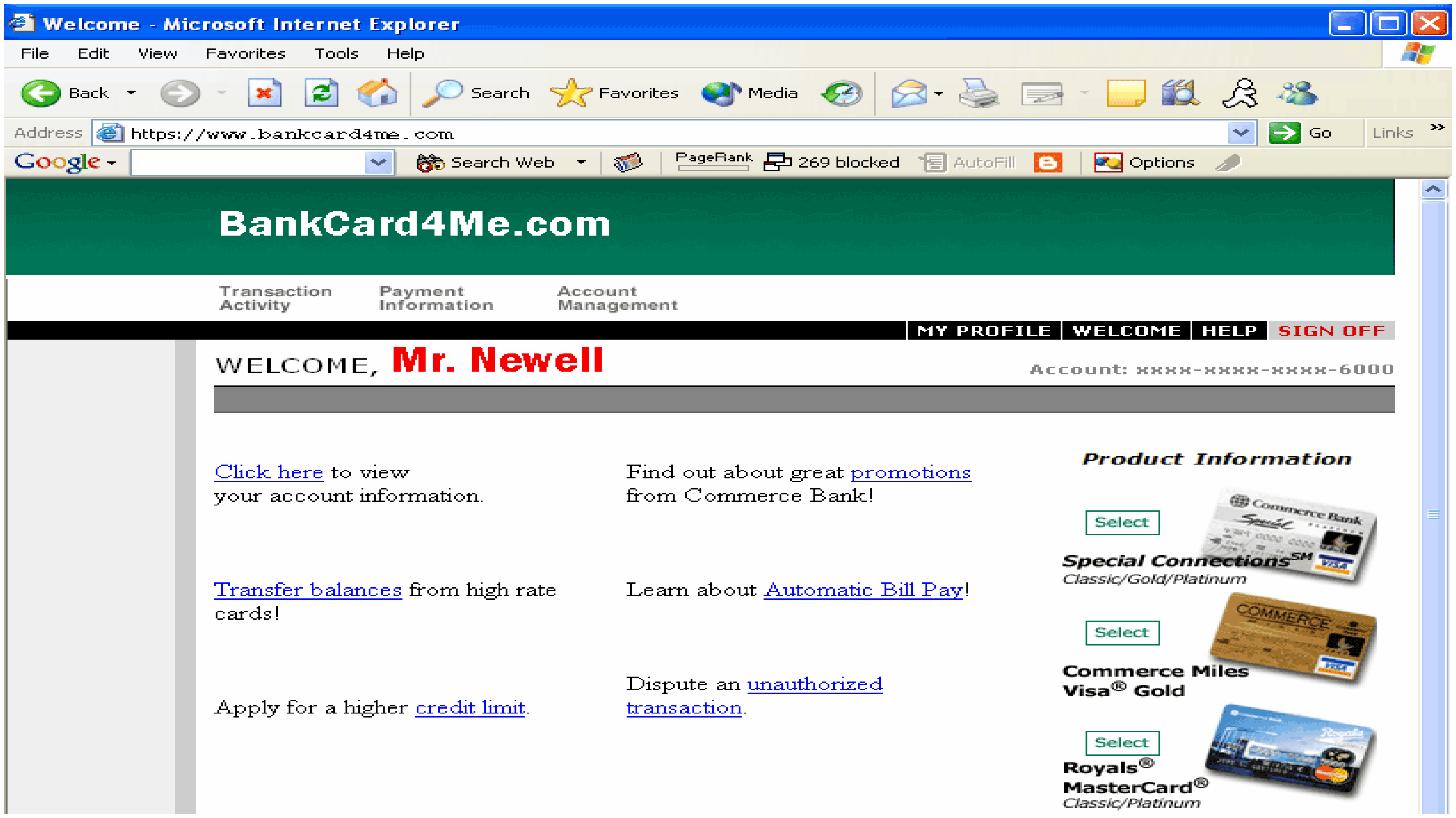
Name	Size	Date Modified	Date Crea
jdickson@real[1]	1 KB	2/16/2004 7:4...	2/16/2004
jdickson@realmedia[2]			
jdickson@revenue[1]			
jdickson@salesforce[1]			
jdickson@sat.tx[1]			
jdickson@screenname.aol[2]			
jdickson@search.domainsponsc			
jdickson@search.information[1]			
jdickson@search.msn[1]			
jdickson@servedby.advertising			
jdickson@server.iad.liveperson			
jdickson@serving-sys[2]			
jdickson@specificpop[2]			
jdickson@sports.espn.go[1]			
jdickson@sportsillustrated.cnn[			
jdickson@st.sageanalyst[1]			
jdickson@statesman[1]			
jdickson@stats.klsoft[1]			
jdickson@store.yahoo[2]			
jdickson@superstats[1]			
jdickson@task.vividence[2]			
jdickson@te.belointeractive[1]			

```
CP▯null*▯sports.espn.go.com/▯1088▯1761935360▯30785590▯3123591792▯29618048▯*▯
```

The
wer
200
files
four
Did
you
find
wha

No,
refir
this
sear
and.

Cookie Poisoning


Welcome - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address https://www.bankcard4me.com Go Links
Google Search Web PageRank 269 blocked AutoFill Options
Transaction Activity
Payment Information
Account Management
MY PROFILE WELCOME HELP SIGN OFF
Select
Select
Select

BankCard4Me.com

WELCOME, **Mr. Newell**

Account: xxxx-xxxx-xxxx-6000

Click here to view your account information.

Transfer balances from high rate cards!

Apply for a higher credit limit.

Find out about great promotions from Commerce Bank!

Learn about Automatic Bill Pay!

Dispute an unauthorized transaction.

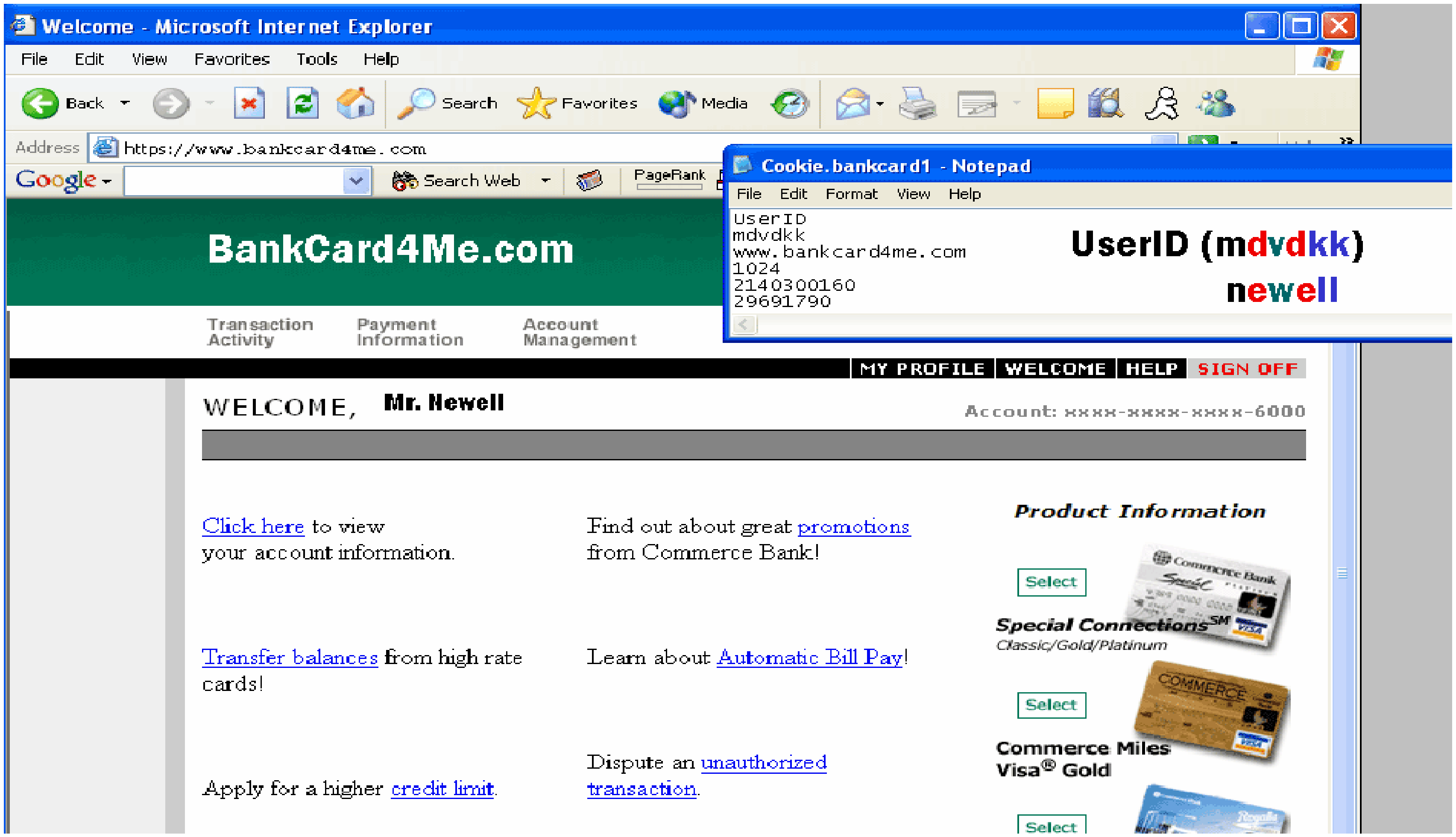
Product Information

Special ConnectionsSM
Classic/Gold/Platinum

Commerce Miles Visa® Gold

Royals® MasterCard®
Classic/Platinum

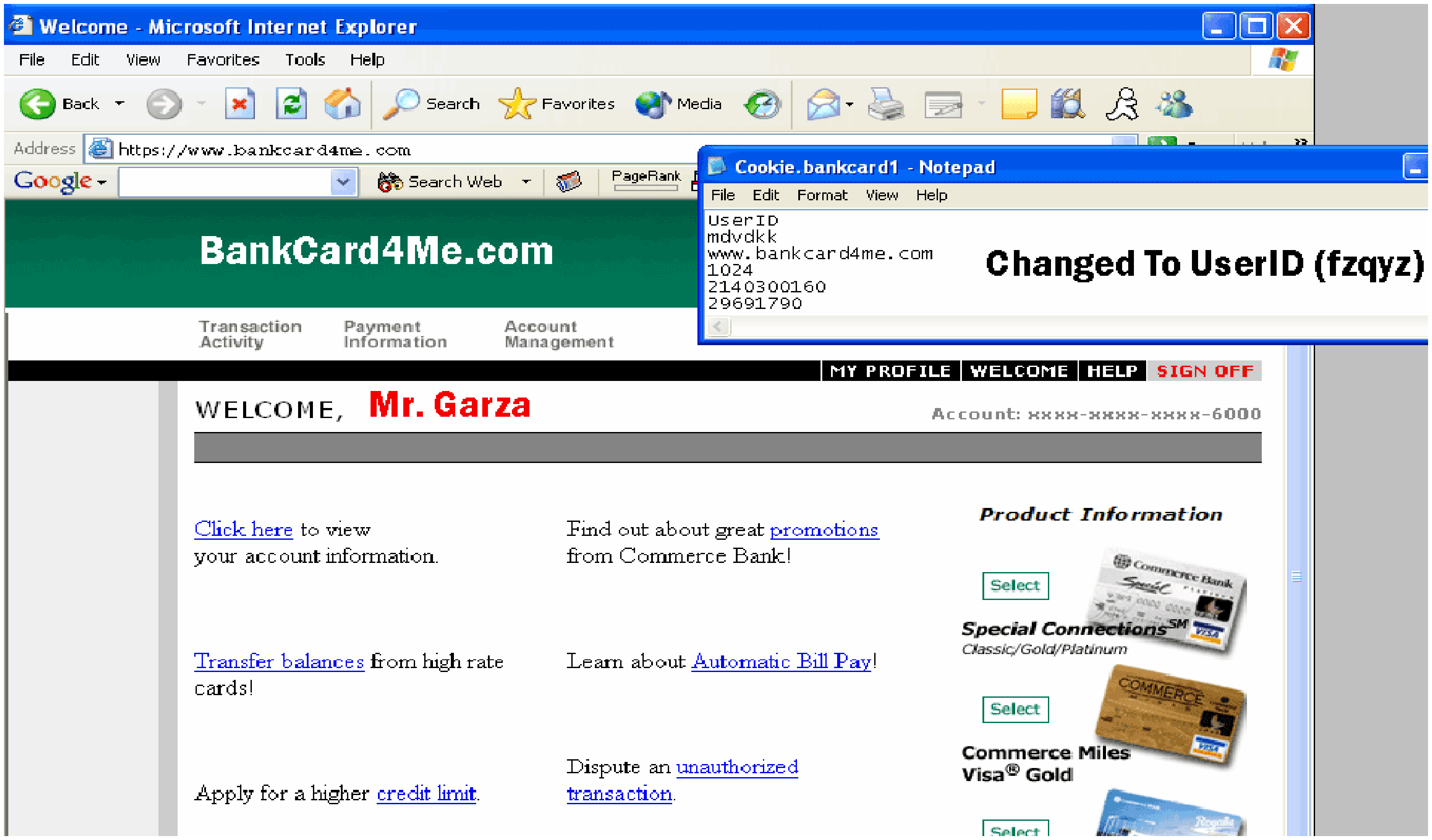
Cookie Poisoning



```
UserID
mdvdkk
www.bankcard4me.com
1024
2140300160
29691790
```

Welcome - Microsoft Internet Explorer
Address https://www.bankcard4me.com
Cookie.bankcard1 - Notepad
UserID (mdvdkk)
newell
BankCard4Me.com
Transaction Activity
Payment Information
Account Management
MY PROFILE
WELCOME
HELP
SIGN OFF
WELCOME, Mr. Newell
Account: xxxx-xxxx-xxxx-6000
Click here to view your account information.
Find out about great promotions from Commerce Bank!
Product Information
Transfer balances from high rate cards!
Learn about Automatic Bill Pay!
Apply for a higher credit limit.
Dispute an unauthorized transaction.
Special Connections Classic/Gold/Platinum
Commerce Miles Visa® Gold
Select

Cookie Poisoning


Welcome - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address https://www.bankcard4me.com
Google Search Web PageRank
BankCard4Me.com
Transaction Activity
Payment Information
Account Management
MY PROFILE WELCOME HELP SIGN OFF
WELCOME, Mr. Garza
Account: xxxx-xxxx-xxxx-6000
Product Information
Select
Special Connections℠
Classic/Gold/Platinum
Select
Commerce Miles Visa® Gold
Select
Cookie.bankcard1 - Notepad
File Edit Format View Help
Changed To UserID (fzqyz)

```
UserID
mdvdkk
www.bankcard4me.com
1024
2140300160
29691790
```

Click here to view your account information.

Find out about great promotions from Commerce Bank!

Transfer balances from high rate cards!

Learn about Automatic Bill Pay!

Apply for a higher credit limit.

Dispute an unauthorized transaction.

SQL Injection

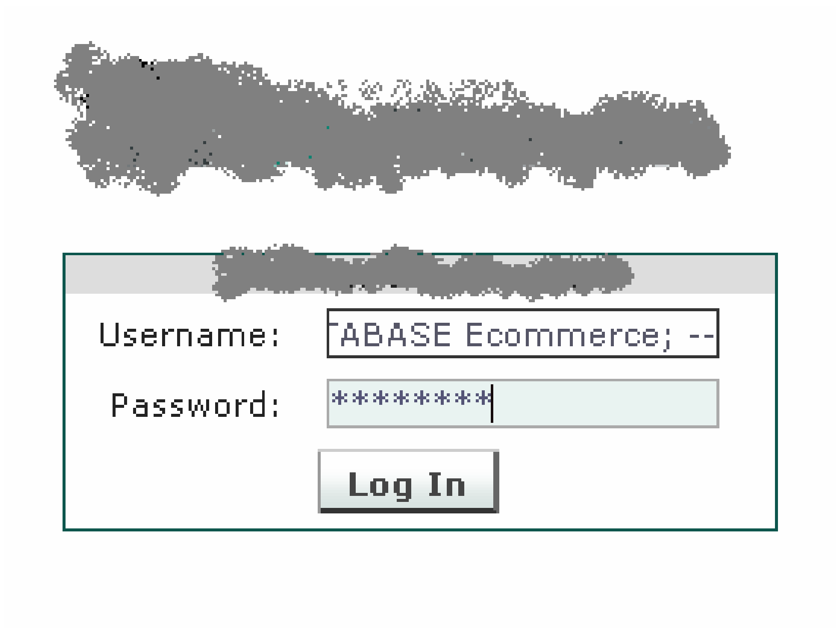
- SQL statements are created from a combination of static text and user inputs
- Assumption: users will enter well-formed inputs
- Attacker crafts a custom input to hijack control of the SQL interpreter and execute arbitrary code

An Example: Insecure Design/Code

```
try {
   string username = request.getParameter(“username”);
   string password = request.getParameter(“password”);
   string sSql = “SELECT * FROM User WHERE username = ‘” +
   username + “’ AND password = ‘” + password + “’”;
   Statement stmt = con.createStatement();
   ResultSet rs = stmt.ExecuteQuery(sSql);
   …
} catch(Exception ex) {}
```

Possible Exploit

- Specially crafted input contains SQL control characters



[redacted]

[redacted]

Username: ABASE Ecommerce; --

Password: ********

Possible Exploit

- Malicious user sends in a username parameter of:

Dcornell'; DROP DATABASE Ecommerce; --

SQL Executed is:

```
SELECT * FROM User WHERE username = 'Dcornell'; DROP
  DATABASE Ecommerce; -- AND password = 'whocares'
```

- Cracker breaks into database and has cleartext access to usernames and passwords, which may be reused on other sites
- Malicious user finds a way to cause an error condition and exploits the unexpected behavior in some manner

An Example: More Secure Design/Code

```
try {
   string username = request.getParameter(“username”);
   string password = request.getParameter(“password”);
   string passwordHash = MD5.hash(password);
   PreparedStatement stmt = con.prepareStatement(“SELECT *
   FROM User WHERE username = ? AND passwordHash = ?);
   stmt.setString(1, username);
   stmt.setString(2, passwordHash);
   ResultSet rs = stmt.ExecuteQuery();
   …
} catch(SQLException sqlEx) {
   //  Actually handle error condition…
]
```

J2EE Specific Examples

- Access Control
  - Authentication
  - Authorization
- Input Validation
  - Stinger framework
  - SQL Injection
  - Cross-Site Scripting (XSS)
  - Buffer Overflows
  - Command Injection

Access Control

- This is where security begins
- Responsible for 3 or 4 of the OWASP Top 10
  - Broken Access Controls
  - Broken Account and Session Management
  - Remote Administration Flaws
  - Web and Application Server Misconfiguration (kind of)
- Don’t rely on security through obscurity
- See the application server documentation

J2EE Artifacts

- Setup of users and roles
- Deployment descriptors
  - web.xml
    - Controls access to servlets and JSP pages
  - ejb-jar.xml
    - Controls access to EJBs and EJB methods
    - Very powerful
    - Lots of XML

web.xml for HTTP Basic Auth

```
<security-constraint>
    <web-resource-collection>
            <web-resource-name>Name</web-resource-name>
            <url-pattern>/admin/*</url-pattern>
            <http-method>GET</http-method>
            <http-method>POST</http-method>
    </web-resource-collection>
    <auth-constraint>
            <role-name>Administrator</role-name>
    </auth-constraint>
</security-constraint>
…
<login-config>
    <auth-method>BASIC</auth-method>
</login-config>
…
<security-role>
    <role-name>Administrator</role-name>
</security-role>
…
Rest of web.xml
```

web.xml for Form Auth

```
<security-constraint>
     <web-resource-collection>
            <web-resource-name>Name</web-resource-name>
            <url-pattern>/admin/*</url-pattern>
            <http-method>GET</http-method>
            <http-method>POST</http-method>
     </web-resource-collection>
     <auth-constraint>
            <role-name>Administrator</role-name>
     </auth-constraint>
</security-constraint>
…
<login-config>
     <auth-method>FORM</auth-method>
     <form-login-config>
            <form-login-page>login.jsp</form-login-page>
            <form-error-page>login_error.jsp</form-error-page>
     </form-login-config>
</login-config>
…
<security-role>
     <role-name>Administrator</role-name>
</security-role>
…
Rest of web.xml
```

More on Form Auth

- Login form:
  - Username: j_username
  - Password: j_password
- See the application server documentation

JAAS

- java.sun.com/products/jaas/
- Java Authentication and Authorization Services
- Standardized API for leveraging or building access controls
  - Most application servers have implementations for JDBC, LDAP
  - Can create your own
- Can be used to secure access to servlets, JSPs, EJB methods, etc

More JAAS

- 3 steps
  - Create a LoginModule
    - Implement javax.security.auth.spi.LoginModule
    - initialize, login, commit, abort, logout methods
  - Create a configuration file
    - $JAVA_HOME/jre/lib/security/java.security
  - Make application JAAS aware
    - Servlets, etc

Input Validation

- "Root of all evil" in application security
- Responsible for 4 of the OWASP Top 10
  - Unvalidated Parameters
  - Cross-site Scripting Flaws
  - Buffer Overflows
  - Command Injection Flaws

J2EE Validation Framework: Stinger

- http://www.owasp.org/software/validation/stinger.html

```
// get the stinger instance so it knows where to find the rules
// validate this request against the rules

Stinger stinger = Stinger.getInstance( this.getServletConfig() );

ErrorList errors = null;
try
{
      errors = stinger.validate( request );
}
      catch ( FatalValidationException e )
{
      request.getSession().invalidate();
      out.println( "Invalid HTTP Request" );
      out.close();
      return;
}
```

J2EE Cross Site Scripting Defense

- Escape key HTML characters like < > &
- http://www-106.ibm.com/developerworks/security/library/s-csscript/

```
StringBuffer sbuf = new StringBuffer();

char[] chars = myText.toCharArray();

for (int i = 0; i < chars.length; i++) {
  sbuf.append("&#" + (int) chars[i]);
}
```

J2EE SQL Injection Countermeasures

- Use stored procedures:

```
CallableStatement cs = con.prepareCall("{call SHOW_SUPPLIERS}");
cs.setInt(1, 75);
cs.setString(2, "Colombian");
ResultSet rs = cs.executeQuery();
```

J2EE SQL Injection Countermeasures

- Use parameterized queries:

```
PreparedStatement updateSales = con.prepareStatement(
"UPDATE COFFEES SET SALES = ? WHERE COF_NAME LIKE ?");

updateSales.setInt(1, 75);
updateSales.setString(2, "Colombian");
updateSales.executeUpdate();
```

Buffer Overflows

- Thankfully not typically a big deal in J2EE environments
- JNI code should be wrapped
  - Treat it as if you are crossing a trust boundary

Command Injection

- Watch out for System.execute() calls
- Strip out potentially harmful shell control characters: `, ;, &, |, etc
- Command separators:
  - Windows - &
  - UNIX - ;
- If users are passing in filenames, disallow '.' Characters so that ../ cannot be used to "escape" the base directory
- Less of a need to escape these special characters as you might have to do for SQL Injection or XSS situations
  - Not many applications actually accept those characters as legitimate inputs
  - Instead strip them out or disallow sending tainted inputs to the command

Resources

- OWASP www.owasp.org
  - WebGoat training tool
  - WebScarab penetration testing tool (proxy)
  - Discussion lists
- @Stake (now Symantec) www.atstake.com
  - netcat TCP/IP tool
  - Whitepapers

Questions

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Responses to Questions

- There were two unanswered questions at the end of the presentation
  - WebScarab and SSL
  - Netegrity and application security

WebScarab and SSL

- As it turns out, WebScarab *does* support SSL
- http://www.owasp.org/software/webscarab.html
- "Proxy - observes traffic between the browser and the web server. The WebScarab proxy is able to observe both HTTP and encrypted HTTPS traffic, by negotiating an SSL connection between WebScarab and the browser instead of simply connecting the browser to the server and allowing an encrypted stream to pass through it."

Netegrity

- www.netegrity.com
- Purchased by Computer Associates in 2004
- Works with JAAS for authentication and authorization in Java/J2EE environments