Sichere Software vom Java-Entwickler

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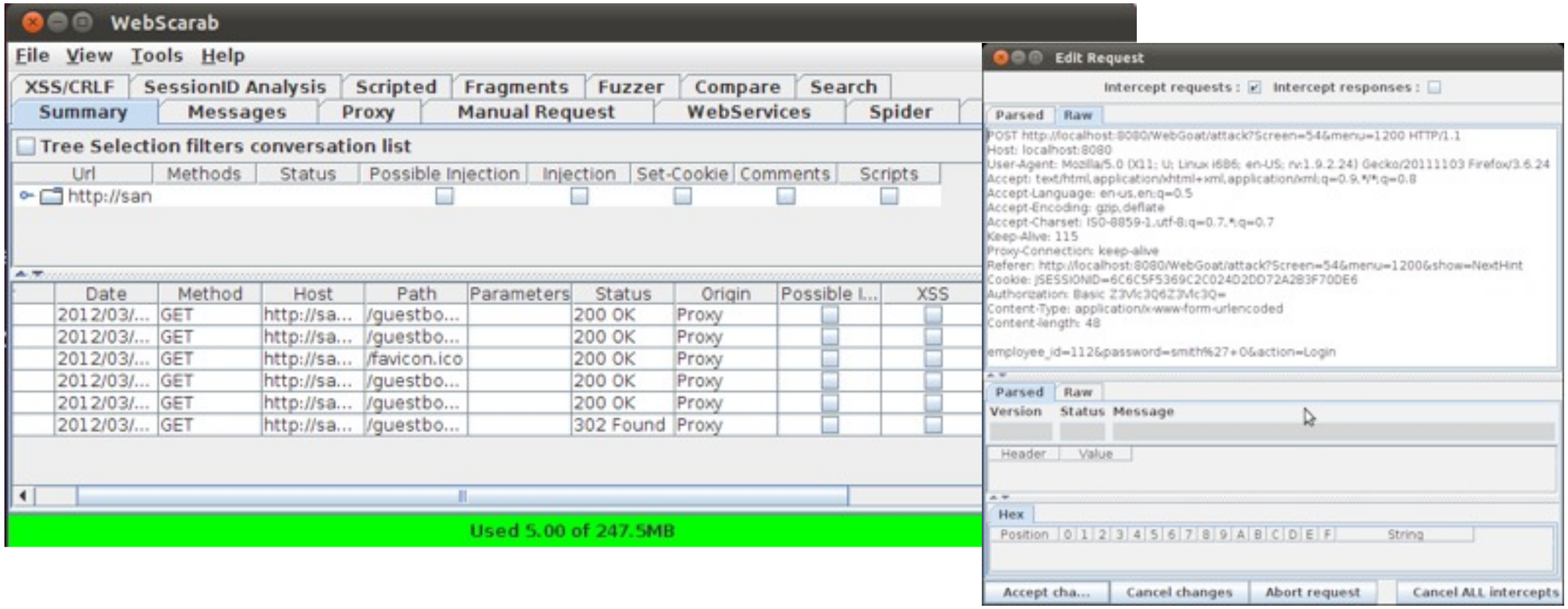
“We can no longer afford to tolerate relatively simple security problems like those presented in the OWASP Top 10.”

— OWASP

Secure software is not developed accidentally

- Applications must be protected from the beginning
  - Security fix does not bring back stolen data
  - Problem may be caused by the architecture
- 100% secure software will never exist
  - But we can stop making it that easy for attackers



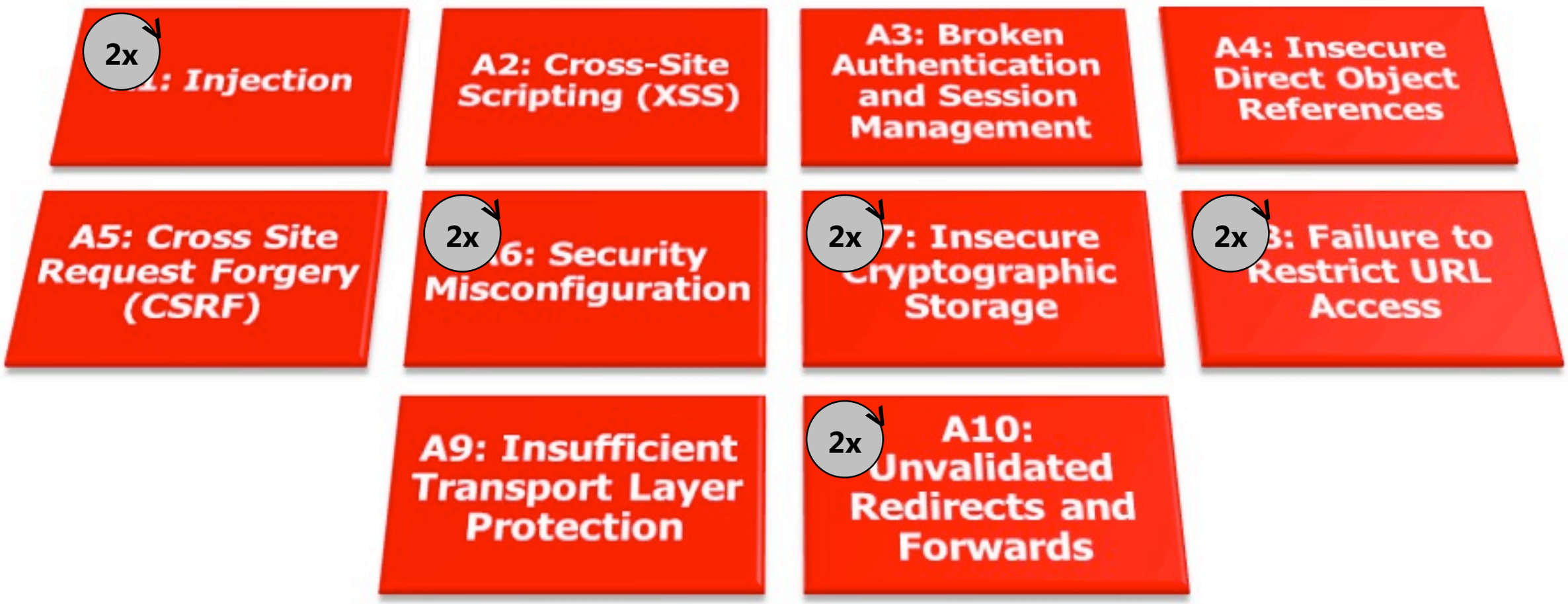
Open **W**eb **A**pplication **S**ecurity **P**roject (OWASP)

Improving the security of (web) application software

- Not-for-profit organization since 2001
- Raise interest in secure development

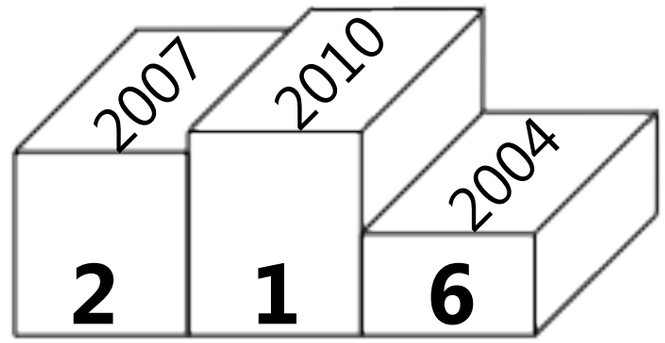
- Top 10
- Cheat Sheets
- Development Guides
- ...

- Enterprise Security API (ESAPI)
- WebScarab
- WebGoat
- ...



http://owasptop10.googlecode.com/files/OWASP_Top_10_-_2010%20Presentation.pptx

Injection



- The famous (and least necessary) **SQL injection**
  - Simple to avoid with **prepared statements**
    - Use OR-Mapper like Hibernate or Spring JDBCTemplate
    - Use it correctly

```
String query = "Select * from users where user_id = '" + userId + "'";
PreparedStatement pstmt = con.prepareStatement(query);
ResultSet rs = pstmt.executeQuery();
```

  - Limit database user permissions
- **Other injections** (like LDAP injection, XPath injection)
  - **White list validation** for all user supplied input

Security Misconfiguration

Some other guys job

- Server/ database configuration, firewall, user rights
  - Disable unnecessary features, services, ports, …

Developer's job

- Configure logging/ exception handling
  - No technical errors in frontend
  - Never serve log over web application in production environment
- Framework security configuration
  - Security updates, new versions

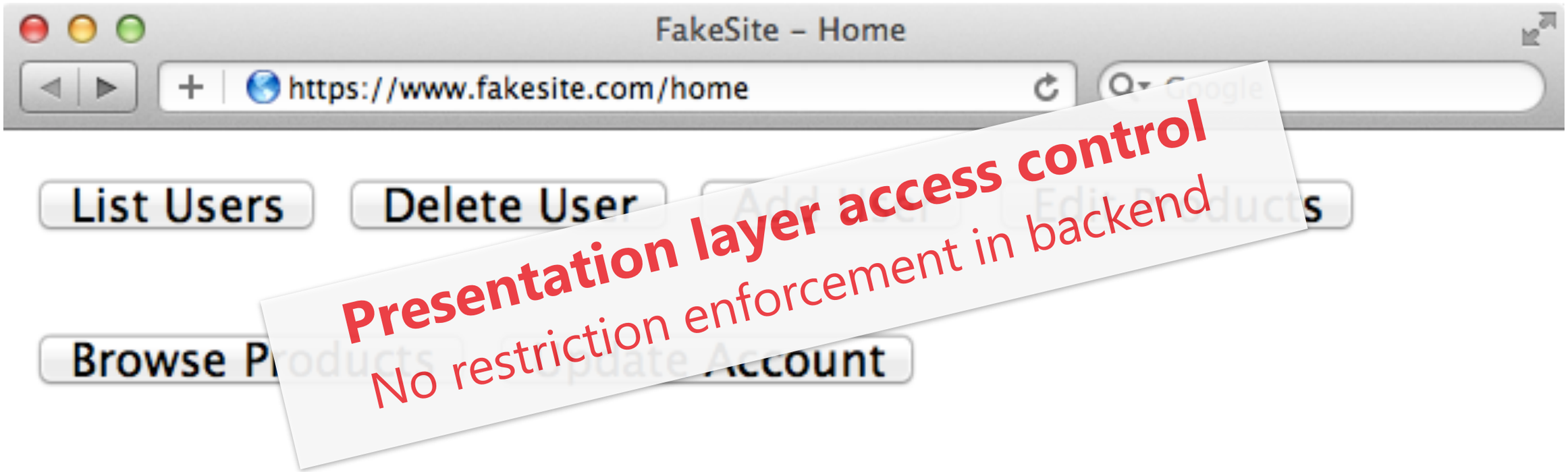
Insecure Cryptographic Storage

Most of the time, the problem is not the algorithm

- Data isn't protected at all
  - Identify and protect all sensitive data in all places
  - Never log any sensitive data (unencrypted)
- Real threats not identified
  - DB encryption protects data from DBA/ stolen disks, not SQL injection

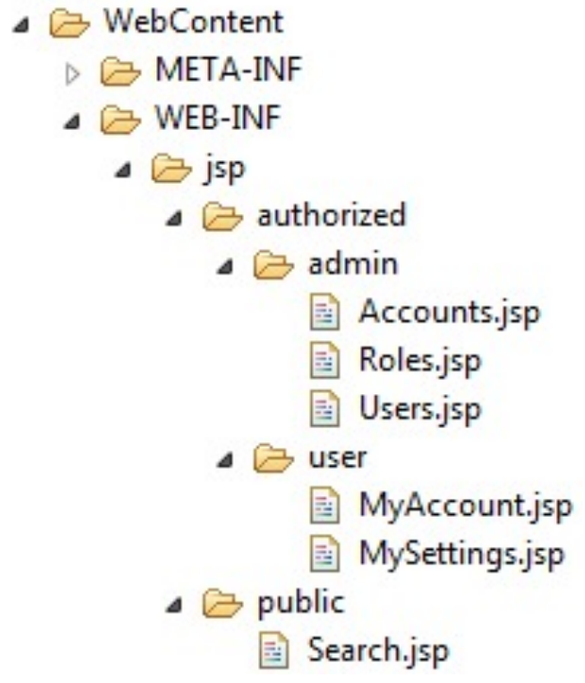
- Use standards, never invent your own *‚algorithm'*
- Prepare key exchange and revocation
  - Change keys periodically

Failure to Restrict URL Access



Think about roles from the beginning

- Store view files (JSP, JSF, …) in different folders based on roles
- Makes filter configuration much easier



Unvalidated Redirects and Forwards

Redirects send request to new external page

- **Target:** Phishing, pharming, malware installation

Forwards send request to new page in same application

- **Target:** Bypass authentication/ authorization checks

Avoid redirects and forwards wherever possible

Don’t allow user parameters in target URL

User parameters in target URL required

↓

Validate final URL

↓

Call access controller

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

http://owasptop10.googlecode.com/files/OWASP_Top_10_-_2010%20Presentation.pptx

Cross-Site Scripting (XSS)

- Execute code in victim's browser
  - Steal user session, sensitive user data, ...
  - Redirect to phishing sites, malware installation, ...
- Different XSS types
  - Stored
  - Reflected
  - DOM based

Often because of missing input validation

```
<img src="javascript:alert('XSS');">

                    <input type="image" src="javascript:alert('XSS');">

<body onload=alert('XSS')>          <b onmouseover=alert('XSS')>click me!</b>
```

Input validation and output escaping for every input

- Input **validate** with a white list
- Output **escape**
  - JSF implicitly escapes output

```
<h:outputText value="#{user.firstname" escape="false" />
```

  - ESAPI.encoder() provides different encoding methods

```
private void escapeOutput() {
    String input = "<script>alert(12345)</script>";

    String safeOutput = ESAPI.encoder().encodeForHTML(input);
    // &lt;script&gt;alert&#x28;12345&#x29;&lt;&#x2f;script&gt;

    safeOutput = ESAPI.encoder().encodeForJavaScript(input);
    // \x3Cscript\x3Ealert\x2812345\x29\x3C\x2Fscript\x3E
}
```

Prevent scripts from accessing cookie with http-only

```
<cookie-config>
    <!-- block script access to cookie -->
    <http-only>true</http-only>
    <!-- protect cookie transport -->
    <secure>true</secure>
</cookie-config>
```

Broken Authentication and Session Management

One of the most complicated parts to develop

Simply: Don't invent it again, use existing frameworks

- Spring Security http://www.springsource.org/spring-security
- Apache Shiro http://shiro.apache.org

Centralize: One library, one place

- Independent of authentication system (LDAP, AD, DB, ...)
- Know exactly how to use it

But: HTTP is a stateless protocol →
credentials (session id) are included in every request

Protect all connections with authentication data with SSL/TLS

- Session id and credentials must be protected at all times
  - As valuable as username and password
  - Unprotected connection exposes session id

- Don’t include session information (like session id) in URLs

@

web.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<web-app xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns="http://java.sun.com/xml/ns/javaee" xmlns:web="http://java.sun.com/xm
    xsi:schemaLocation="http://java.sun.com/xml/ns/javaee http://java.sun.com/x
    id="WebXMLParameters" version="3.0">
    <display-name>WebXMLParameters</display-name>

    <session-config>
        <!-- soft session timeout -->
        <session-timeout>30</session-timeout>

        <cookie-config>
            <!-- block script access to cookie -->
            <http-only>true</http-only>
            <!-- protect cookie transport -->
            <secure>true</secure>
        </cookie-config>

        <!-- store JSESSIONID in cookie -->
        <tracking-mode>COOKIE</tracking-mode>
    </session-config>
</web-app>
```

Design Source

Insecure Direct Object References

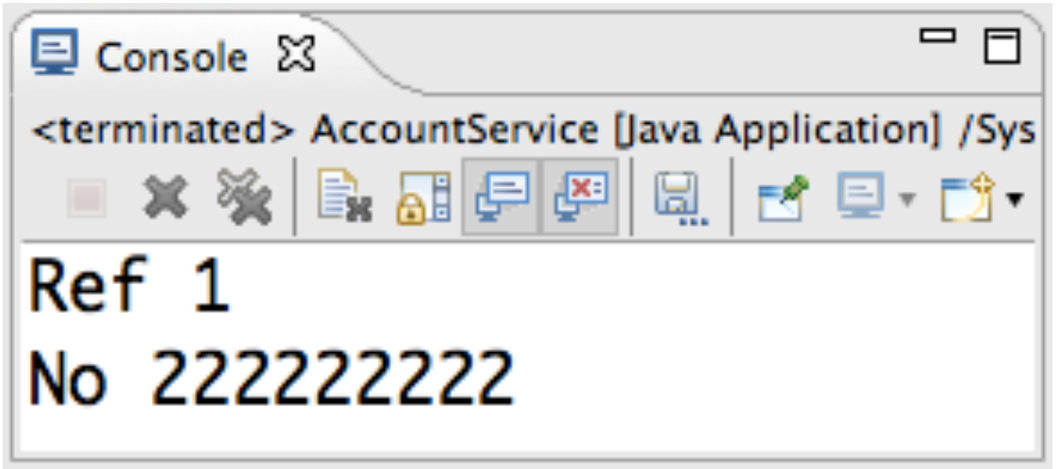
Presentation layer access control

No restriction enforcement in backend

1. User logs in with username/ password
   URL is https://www.fakesite.com/account?**no=123456789**
2. User experiments with URL *no* parameter
   URL is https://www.fakesite.com/account?**no=987654321**
3. User can view/ change other accounts

```java
private Set<Object> accounts;
private Account accountA = new Account(111111111);
private Account accountB = new Account(222222222);
private Account accountC = new Account(333333333);
private Account accountD = new Account(444444444);

public AccountService() {
  accounts = new HashSet<Object>();
  accounts.add(accountA);
  // add all accounts
}
```




```java
public void accessMap() throws AccessControlException {
  IntegerAccessReferenceMap map = new IntegerAccessReferenceMap(accounts);
  String indRef = map.getIndirectReference(accountB);
  System.out.println("Ref " + indRef);

  String mapRef = indRef; // e.g. accessed via request parameter
  Account account = (Account) map.getDirectReference(mapRef);
  System.out.println("No " + account.getNo());
}
```

```java
private Set<Object> accounts;
private Account accountA = new Account(111111111);
private Account accountB = new Account(222222222);
private Account accountC = new Account(333333333);
private Account accountD = new Account(444444444);

public AccountService() {
  accounts = new HashSet<Object>();
  accounts.add(accountA);
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```

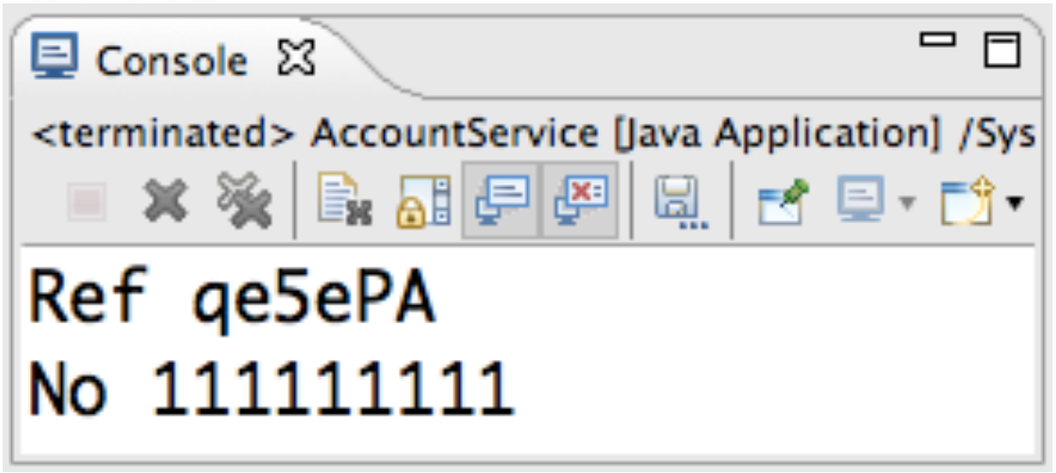


```java
public void accessRandomMap() throws AccessControlException {
  RandomAccessReferenceMap map = new RandomAccessReferenceMap(accounts);
  String indRef = map.getIndirectReference(accountA);
  System.out.println("Ref " + indRef);

  String mapRef = indRef; // e.g. accessed via request parameter
  Account account = (Account) map.getDirectReference(mapRef);
  System.out.println("No " + account.getNo());
}
```

Cross Site Request Forgery (CSRF)

- Browser **with authenticated user** must send credentials
  - Attacker causes request from his site to vulnerable application
    - e.g. with an invisible <img> or <iframe>
    - User's credentials are used to execute attacker's request
- Often a vulnerable (standard) intranet application
  - Not accessible externally
  - Victim's browser inside corporate network is tricked into issuing commands

?

<SCRIPT>

Calculate a random secret token

- **Calculate** a **random secret token** at beginning of session
  - Calculate per request for higher security needs
  - Value not automatically submitted like session cookie
- **Add** this token as hidden field to **all** (critical) **forms**

```
<input type="hidden" name="csrfToken"
value="928ce83948da9389eb9384019c38de8c"/>
```

- **Check** token before executing selected action

Create your own secure form

- Create own form like ***SecureForm***
  - Adds token automatically
  - Easy (re)usable by developers
- Standard unprotected form still available

Configure session timeout in web.xml

```
<session-config>
  <session-timeout>60</session-timeout>
</session-config>
```

Insufficient Transport Layer Protection

Correct SSL/TLS configuration is difficult

- Web-/application server administrator

- Identify all routes where sensitive data is broadcasted
- Protect all ~~*(or nothing)*~~
- Don't mix protected with unprotected content
- Secure the input form for log-in credentials
- Secure the session cookie

less vulnerable for Man-in-the-Middle attacks

HTTP Strict Transport Security (HSTS) is currently an IETF draft

```
HttpServletResponse response ...;
response.setHeader("Strict-Transport-Security",
 "max-age=8640000; includeSubdomains");
```

- Application forces browser to only use HTTPS when visiting
  - For specified time, renewed with every response
- Access blocked if communication is insecure
  - Invalid certificate --> error page (not strange warning dialog)
- Browser support required 
  - No backwards compatibility issues

Security is every developer‘s job

Developing with security awareness is a good start

- Every developer must know at least security basics
- One (senior) developer per team with deep security knowledge

Design security in from the beginning

- Think about security requirements before starting to code
- Much harder/ more expensive to secure an existing application

Security must be a natural part of your development process

Resources

- OWASP www.owasp.org
- OWASP WebScarab https://www.owasp.org/index.php/Category:OWASP_WebScarab_Project with Firefox QuickProxy https://addons.mozilla.org/de/firefox/addon/quickproxy
- ESAPI http://esapi.org
- Java Secure Coding Guidelines http://www.oracle.com/technetwork/java/seccodeguide-139067.html
- Qualys SSL Labs https://www.ssllabs.com
- Preventing CSRF with JSF 2.0 http://blog.eisele.net/2011/02/preventing-csrf-with-jsf-20.html
- HTTP Strict Transport Security Header http://tools.ietf.org/html/draft-ietf-websec-strict-transport-sec

Secure coding…

Visit us at our booth for more (security) questions…

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