

Uni App Security Notes

Notes for the Anwendungssicherheit (app security) course at HdM Stuttgart

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Introduction

Contributing

These study materials are heavily based on professor Heuzeroth's "Anwendungssicherheit" lecture at HdM Stuttgart.

Found an error or have a suggestion? Please open an issue on GitHub (github.com/poijntfx/uni-appsecurity-notes):



Figure 1: QR code to source repository

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Organization

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- 60 Minutes of test at the end
- Will have practical examples
- Threat detection plays a fundamental role in tests

Overview

Elements of a Secure Development Process

Primary purpose: Analysis of the data flow; data is both protected by the GDPR and represents value of the corporation

- **Requirements**

- Security-Requirements
- Anti-Requirements
- Abuse cases
- Protection poker
- → **Security analysis/architecture analysis**

- **Draft**

- AuthN/AuthZ
- Drafting concepts
- **Risk modelling**

- **Implementation**

- Secure implementation guidelines
- **Code review, dynamic analysis**

- **Tests**

Support Hierarchy

- **Level 1:** Direct support with customers; call center, non-technical
- **Level 2:** People who know about typical problems with the software
- **Level 3:** Developers of the software

Basics

What is Secure Software?

- Software which is protected against intentional attacks
- Every participant in the software development process should be interested in this objective
- Software must be hardened against all known attacks (and future, unknown attacks)

What is Security?

- $Risk = \frac{Cost\ of\ breach}{Probability\ of\ breach}$
- A system is protected against threats compromising valuable data using measures which lead to a reduced, accepted risk.
- Accepted risk is defined by context of use (i.e. nuclear power: very low accepted risks)
- **Safety:** Protection of the environment from the functional effects a system
- **Security:** Protection of the system from threats from the environment
- Concrete definitions: uni-itsec-notes#security-objectives; most importantly (“CIA objectives”):
 - Confidentiality
 - Integrity
 - Availability
- If there are contractions between the security objectives (anonymity vs. accountability): The context defines which

- **Security Engineering:** Engineering and Management of Security
- **Security Assessment and Testing:** Designing, Performing and Analyzing Security Testing
- **Security Operations:** Foundational Concepts, Investigations, Incident Management and Disaster Recovery
- **Software Development Security:** Understanding, Applying and Enforcing Software Security
- → This course strives for 80% of TPSSE compliance

Why Security?

- Security is context dependent: On localhost and unprotected UNIX socket isn't an issue, but forward it with socat and it becomes a massive security vulnerability!
- With every change every test needs to be run again (regression testing)
- Typically ~30 errors in every 1000 lines of code
- Growing application complexity
- Devices are more and more connected which reduces the need for physical access
- Extensible architectures

Common Terms

- Exploit/Proof of Concept
 - Attack
 - Vulnerability
 - Threat
 - Error
-
1. Threat agent gives rise to threat
 2. Threat exploits vulnerability
 3. Vulnerability leads to risk
 4. Risk can damage asset and causes exposure
 5. Exposure can be countermeasured by a safeguard
 6. Safeguard directly affects threat agent

Threat Agents

- Virus (i.e. infection)
- Hacker (i.e. unauthorized access)
- User (i.e. wrong config, data loss)
- Fire (i.e. damage to computers)
- Worker (i.e. leaking)
- Other corporations (i.e. industrial espionage)
- Black hats (i.e. buffer overflows, DoS)
- Intruders (i.e. physically stealing drives)

Researching Vulnerabilities

- Classifying vulnerabilities by severity (low, middle, high)
- Classifying vulnerabilities by exploit range (local or remote)
- Intents to find trends and attacks
- Intents to find vulnerabilities before they can be exploited
- Intents to find countermeasures

CVSS Metrics

Results in a number which can be used to classify the vulnerability.

- **Base Score Metrics**

- **Exploitability Metrics**

- **AV: Attack Vector:** Network, Adjacent Network, Local, Physical
 - **AC: Attack Complexity:** Low, High
 - **PR: Privileges Required:** None, Low, High
 - **UI: User Interaction:** None, Required
 - **S: Scope:** Unchanged, Change

- **Impact Metrics (CIA Metrics)**

- **C: Confidentiality Impact:** None, Low, High
 - **I: Integrity Impact:** None, Low, High
 - **A: Availability Impact:** None, Low, High

- **Temporal Score Metrics**

- **E: Exploit Code Maturity:** Not defined, unproven that exploit exists, proof of concept code, functional exploit exists, high

- Security is always a balance between functionality and usability
- Security often means to have restrictions in terms of features

- Many sections
 - Secure development practices
 - Secure development process (supply chain security)
 - Security reviews
 - Pentesting
- Time and money should be invested into all sections according to individual risk, not only into a singular section

Finishing Thoughts

- Systems are only secure if all elements of the system are secure
- Perimeter and infrastructure security can not make the entire system secure
- Applications are always connected
- Development of secure systems is not a choice, but a must!

Web Application Security

- Unauthorized breach of security systems is illegal
- Unauthorized eavesdropping is illegal
- Distribution or usage of “hacking tools” is illegal (which has however been relativized by judges)

Components of Web Environments

- Web server (no business logic, static content)
- App server (business logic, Tomcat etc.)
- Databases
- Middleware
- LDAP
- Reverse Proxies
- Web Application Firewalls
- Load Balancers
- Firewalls

Targets

- Browser
- Transport
- Web server
- Web application
- Backend
- Network components
- Partner connections (i.e. Sentry, Monitoring etc.)

Risks in the Layered Architecture

- Client presentation layer: Validation
- Browser: Browser sandboxing etc.
- Encryption in transport
- Server presentation layer: Input & output validation
- Logging: Auditing
- Error handling: Secure error escalation
- All layers: Authorization & authentication checks
- Encryption to database
- Data protection in database

Methods to find Vulnerabilities

- **Security audit**

- Checks if previously established security guidelines have been implemented
- Assessment of configuration

- **Vulnerability assessment**

- Scans for known vulnerabilities
- Can point in directions, but not show concrete exploits

- **Pentesting**

- Security audit and vulnerability assessment is included
- Shows how vulnerabilities can be exploited

Pentesting Process

1. **Pre-Attack Phase**

- 1.1 Rules of engagement must be noted in a contract
- 1.2 Customer's requirements need to be queried
- 1.3 Enumeration
 - 1.3.1 Passive: Enumerating without having access to client's network
 - 1.3.2 Active: Scanning

2. **Attack Phase:**

- 2.1 Perimeter breach
- 2.2 Access
- 2.3 Exploit/privilege escalation
- 2.4 Keeping access
- 2.5 Removing all traces

3. **Post-Attack Phase:**

- 3.1 Restoring the pre-attack state
- 3.2 Writing the report
- 3.3 Posting recommendations on how to continue (i.e. fixing the