FH JOANNEUM
Elektronik und
Computer Engineering

Security and Testing

Introduction

FH JOANNEUM

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Introduction

Outline

- Information Security
- Secure Software Development Lifecycle

Information Security

Introduction

Information = functionality + data

Information security is defined as protecting information and information systems from unauthorized access, use, disclosure, disruption, modification, or destruction.

We want to **protect our data and systems** from those who seek to misuse them, intentionally or unintentionally, or those who should not have access to them.

No single activity or action will make you secure in every situation.

But the cost of the security you put in place should never outstrip the value of what it's protecting.

Information Security

Introduction

Three of the primary concepts in information security are:

- **Confidentiality** refers to our ability to protect our data from those who are not authorized to view it.
- **Integrity** is the ability to prevent people from changing your data in an unauthorized or undesirable manner.
- **Availability** refers to the ability to access our data when we need it.

Information Security

Attacks

We can place attacks into one of four categories:

- **Interception** attacks allow unauthorized users to access your data, applications, or environments, and they are primarily attacks against confidentiality. When they're properly executed, interception attacks can be difficult to detect.

- **Interruption** attacks make your assets unusable or unavailable to you on a temporary or permanent basis. These attacks often affect availability but can affect integrity.

Attacks

We can place attacks into one of four categories: (continued)

- **Modification** attacks involve tampering with an asset. Such attacks might primarily be considered attacks on integrity but could also represent attacks on availability.
- **Fabrication** attacks involve generating data, processes, communications, or other similar material with a system. Fabrication attacks primarily affect integrity but could affect availability.

Information Security

Attacks

In the context of attacks, we distinguish between:

- A **threat** is something that has the potential to cause harm.
- **Vulnerabilities** are weaknesses, or holes, that threats can exploit to cause you harm.
- **Risk** is the likelihood that something bad will happen.

The best strategy is to spend your time **mitigating the most likely attacks** (the ones with the highest risks).

Information Security

FAQs

- Explain the term **information security**.
- Explain the three concepts of information security: **confidentiality**, **integrity**, and **availability**.
- Explain the four **categories of attacks**.
- Describe the **differences** between **threats**, **vulnerabilities**, and **risks**.

References

- *Jason Andress*
  Foundations of Information Security
  No Starch Press, 2019

Secure Software Development Lifecycle

Introduction

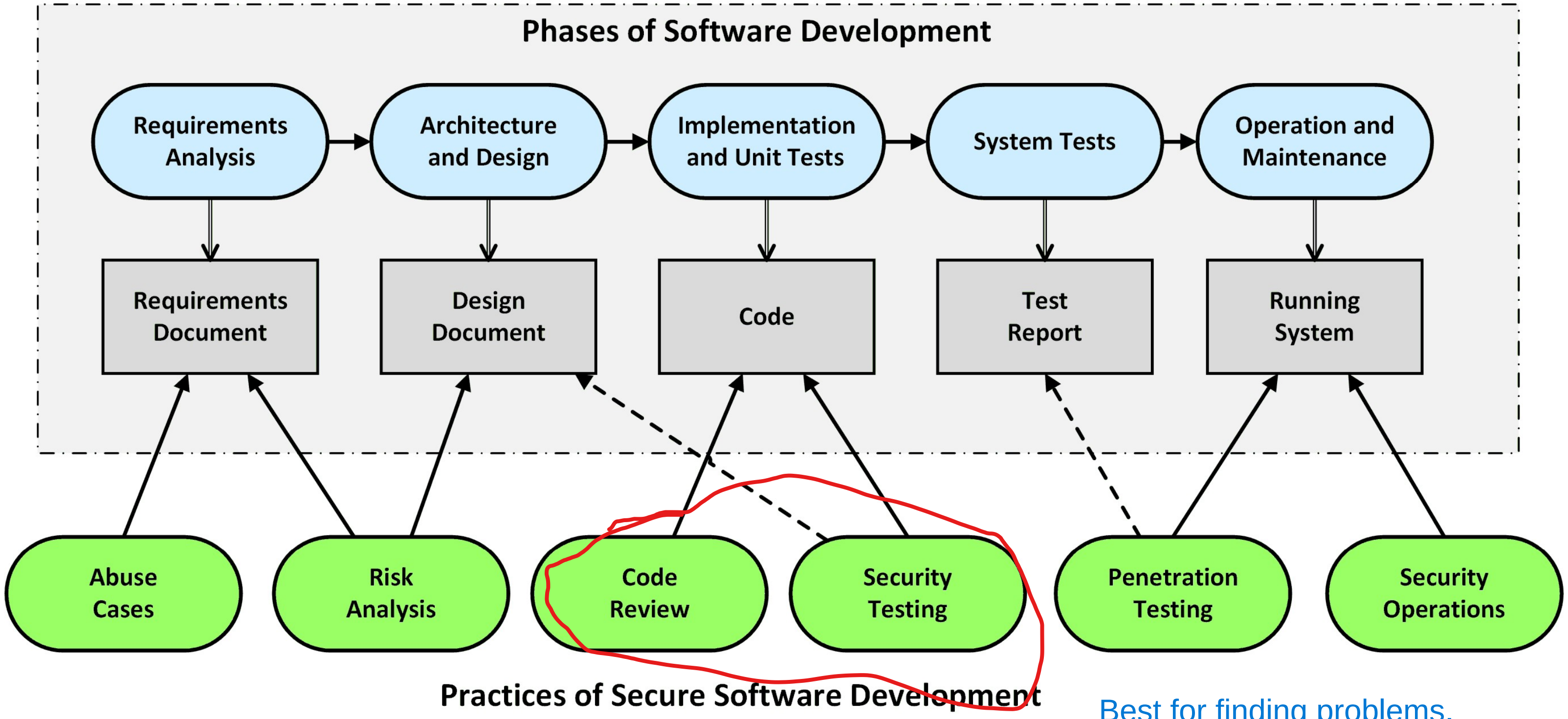
In order to develop a secure software system, several **security-related activities** must be carried out in **different phases** of software development.

Existing process models of software development have therefore been expanded to include specific security activities that take security into account in every development phase.

The best-known representatives of these extended process models are:

- The **Security Development Lifecycle (SDL)** from Microsoft
- The **Touchpoints for Software Security** from Gary McGraw

Secure Software Development Lifecycle



Best for finding problems.

(McGraw, 2006)

Secure Software Development Lifecycle

Practices of Secure Software Development

1. Abuse Cases

To bring software security into the development process as early as possible, you should consider **any requirement** for **how it could be misused** by a hacker. Such scenarios are called Abuse Cases. The advantage of explicit abuse cases is that they can already be considered in the architecture and design phase - evaluated and prioritized.

To bring in this hacker perspective, you can put **security experts** into the team.

For smaller projects, we can use known **attack patterns** (OWASP Top 10) and integrate them into the requirements analysis.

Secure Software Development Lifecycle

Practices of Secure Software Development

2. Architectural Risk Analysis

In addition to implementation-level bugs, architectural and **design flaws** cause the most security holes in software systems.

A variant of the risk analysis is the **threat modeling**: The system is analyzed from the perspective of a hacker to find possible **entry points**, which then can be used to accessed the desired **assets**. Such attack goals are then called **threats**. If there are no sufficient safeguards for a given threat, we have found a **vulnerability**.

The results of a risk analysis should have a direct impact on the architecture and design phase of software development.

Secure Software Development Lifecycle

Practices of Secure Software Development

3. Code Review

The entire structure and functionalities of a software system can be read in the source code.
The focus of the code review lies on those **implementation errors** that can be exploited as a security vulnerability.

- **Manual reviews** are very time consuming and error prone, so they are only suitable for **small code fragments** and training purposes.
- **Automated reviews** are performed using static analysis tools. These tools create a model from the given code and then look for **error patterns** using **predefined rules**. The results of analysis tools must always be manually reviewed and prioritized to separate relevant bugs from less important warnings.

Secure Software Development Lifecycle

Practices of Secure Software Development

4. Risk-Based Security Testing

Based on the results of the risk analysis, automated tests can check whether these vulnerabilities can be successfully attacked.

We can also use automated testing to verify built-in security mechanisms, for example: the validation of input data.

Technically, **unit-**, **integration-**, and **system tests** are used.
While unit, component and integration tests can be automated very well with **regular xUnit test frameworks**, security system tests usually rely on tools that use known attack patterns - **active scanner**.

Secure Software Development Lifecycle

Practices of Secure Software Development

5. Penetration Testing

After a software system has been installed in its **final runtime environment**, hacker attacks can be simulated.

It is a **blackbox test** based on tools and techniques used by hackers.

When penetration testing is used as part of the development process, it focuses on the **scanning and exploitation** activities because it is primarily about detecting and identifying security holes.

Alternatively, penetration tests are used to get an **initial overview of the vulnerabilities** of an existing application.

Secure Software Development Lifecycle

Practices of Secure Software Development

6. Secure Operations

When a software system has been fully developed, it will be installed in the final runtime environment - **deployment**.

From the point of view of software security, it is fundamentally important that the **configurations** for operating system, network, application server and web server etc. are carried out correctly and the latest **updates** and **patches** are installed.

In addition, administrators often have great expertise in hacker attacks. They oversee and monitor **intrusion detection systems**, **event logs**, and **deal with vulnerabilities** in many applications over the years.

Secure Software Development Lifecycle

Practices of Secure Software Development

The time at which a security analysis takes place has a significant influence on the **order of the practices used**:

- If a software system is **developed from scratch**, security problems must be removed as early as possible during development.
  The practices of secure software development are applied along the phases of software development.

- If an **existing software system** is analyzed, often a penetration test is used first. The additional use of code review and architectural risk analysis is recommended in order to fully discover security issues.

Secure Software Development Lifecycle

FAQs

- Describe the **practices of secure software development**: Abuse Cases, Architectural Risk Analysis, Code Review, Risk-Based Security Testing, Penetration Testing, and Secure Operations.

References

- *Gary McGraw*
  Software Security – Building Security In
  Addison-Wesley, 2006

- *Matt Bishop*
  Computer Security
  Addison-Wesley, 2003