Secure By Design

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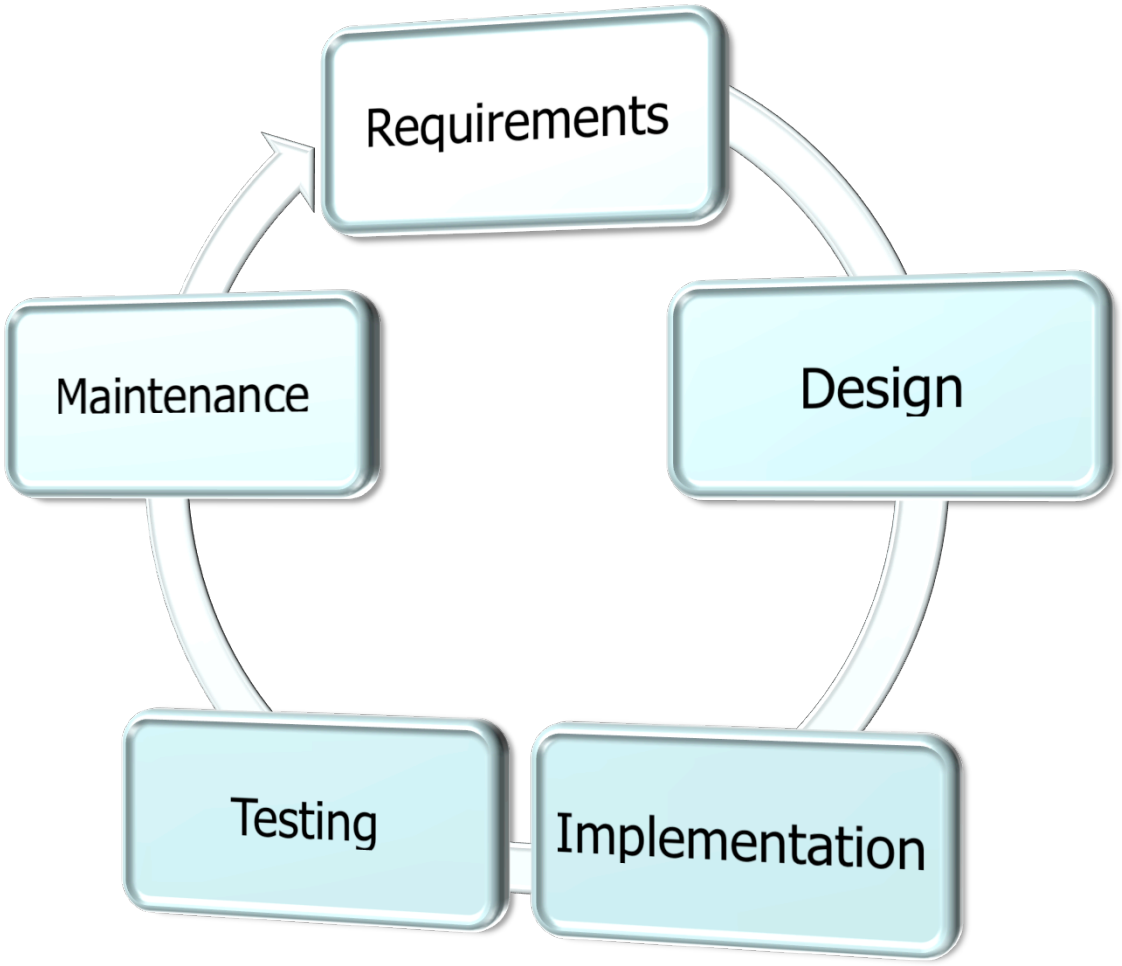
SDLC


Requirements
Design
Implementation
Testing
Maintenance

Security during Requirements

- Functional Requirements
- Security Requirements
- Compliance Requirements
- Privacy requirements

- Open Source frameworks to use
  - Log4j, log4net
- 3rd part software
  - CMS
  - Portal software
- Database or NoSql databases
- Java, .NET, ruby on rails, php,

The Design Process

- Set of blueprints for the system
- Class diagrams and ORM
- UML Models and Data Flow Diagrams
- Deployment Diagrams
- Application Layers and Tiers
- …

- Misuse Cases
- Threat Modeling
- Security Design Patterns

Misuse Cases

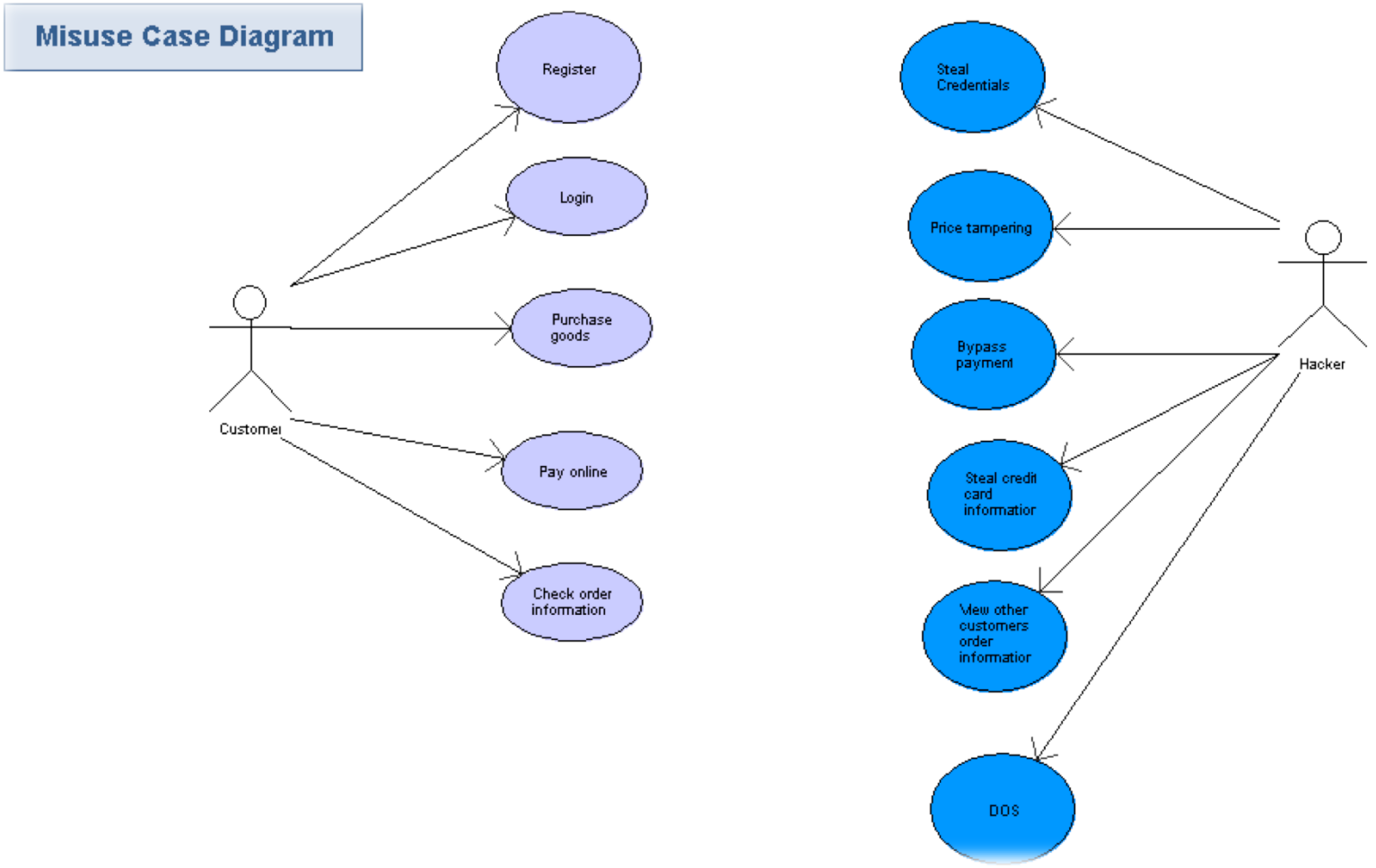
Use Case vs Misuse Case

- Use Case is a sequence of steps by which a **actor** can obtain **value** from a system
- Misuse case is a sequence of steps by which an actor(**attacker)** can **abuse/attack** a system

Value of misuse cases

- Most people are familiar with use cases already
- Can use the same tools used to create misuse cases
- The output can be used by designers/developers
- Can be used to communicate potential risks to stakeholders
- Can go from high level misuse cases to detailed misuse cases
- Defense mechanisms can be enumerated and documented

Misuse Case – Online Shopping

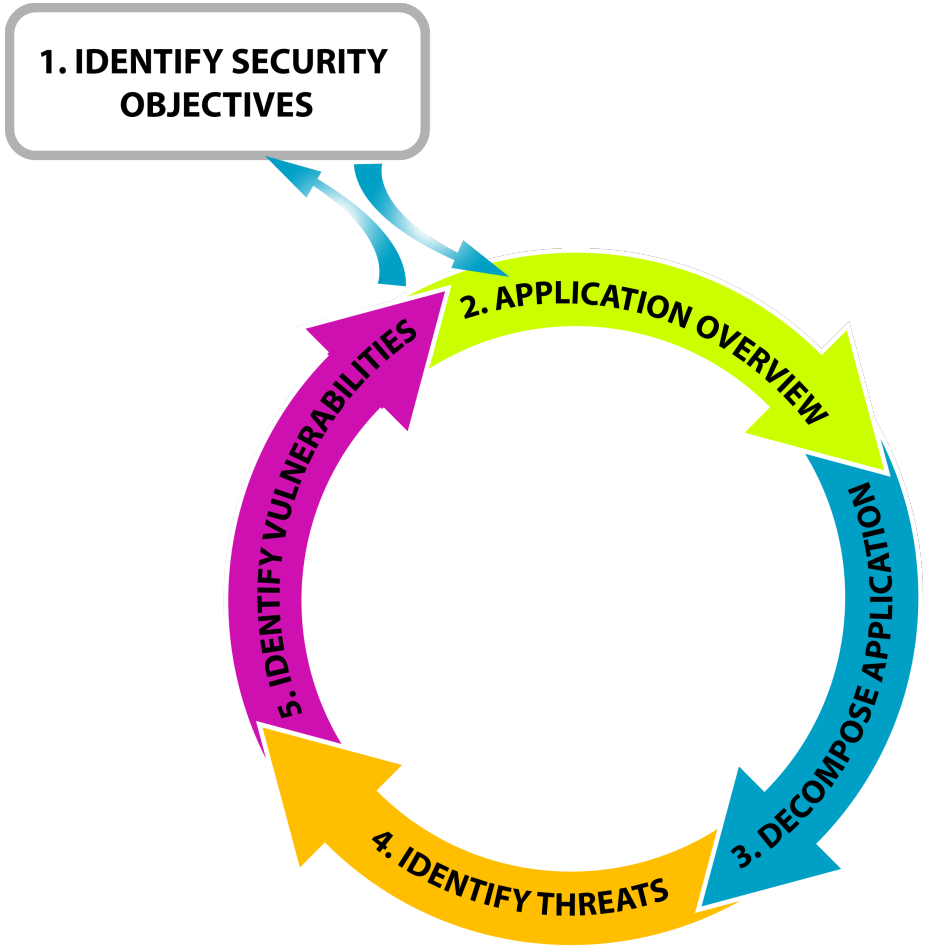


Threat Modeling

Threat Modeling

- Technique to help identify threats, attacks, vulnerabilities, and countermeasures in the context of an application scenario.
- The threat modeling activity helps to:
  - Identify your security objectives.
  - Identify relevant threats.
  - Identify relevant vulnerabilities and countermeasures.

Threat Modeling



Step 1: Identify Security Objectives

- What can we prevent?
- What do we care most about?
- What is the worst thing that can happen?
- What regulations do we need to be aware of?

Step 2: Identify Trust Boundaries

- Any place where the level of trust changes
- Where are the entry points?
  - Search page
  - Registration page
  - Login
  - Shopping Cart
- Can you trust the data?
- Can you trust the caller?
- Where are the exit points where data is being written back?

- Trust boundary between
  - Application and database
    - Give the user accessing the database minimal privileges
  - Application and web services
    - Validate
  - 3rd party systems
    - More validation

Step 3: Identify Threats

- Brute force attacks against the dictionary store
- Network eavesdropping between browser and Web server to capture client credentials
- Attacker captures authentication cookie to spoof identity
- SQL injection
- Cross-site scripting (XSS) where an attacker injects script code
- Cookie replay or capture, enabling an attacker to spoof identity and access the application as another user
- Information disclosure with sensitive exception details propagating to the client
- Unauthorized access to the database if an attacker manages to take control of the Web server and run commands against the database
- Discovery of encryption keys used to encrypt sensitive data (including client credit card numbers) in the database
- Unauthorized access to Web server resources and static files

Step 4: Identify and Document Vulnerabilities and Counter-Measures

- Armed with a list of threats consider how the application handles these threats.
- Rate the threats
- Sample questions to consider:
  - How, specifically, will input validation be performed in this application?
  - Are we validating all input? How are cookie values validated?
  - What level of logging will be in place? How will this be handled?
  - How will we protect user sessions?

Step 4 contd - Vulnerabilities in components

- Top 10 2013-A9-Using Components with Known Vulnerabilities
  - Remote code vulnerability in Spring Framework for Java
  - .NET padding oracle (now fixed)
  - Apache Struts 2 vulnerability
    - https://cwiki.apache.org/confluence/display/WW/S2-015

Step 5 : Rate the threat

- **Risk = Probability * Damage Potential**
- 1-10 rating
- High, Medium, Low
- CVSS – Common Vulnerability Scoring System

DREAD

- **D**amage potential: How great is the damage if the vulnerability is exploited?
- **R**eproducibility: How easy is it to reproduce the attack?
- **E**xploitability: How easy is it to launch an attack?
- **A**ffected users: As a rough percentage, how many users are affected?
- **D**iscoverability: How easy is it to find the vulnerability?

The STRIDE threat system:

- **S**poofing
- **T**ampering
- **R**epudiation
- **I**nformation Disclosure
- **D**enial of Service
- **E**levation of Privilege

Security Design Patterns

Design Patterns

- A pattern can be characterized as *"a solution to a problem that arises within a specific context"*.
- A proven solution to a problem.
- Idea comes from architecture of buildings (C. Alexander)
- Security Design Patterns are a subset

Value of Patterns

- Reusable solutions, but maybe not directly, usually require tailoring
- Encapsulate experience and knowledge of designers (best practices)
- Free of errors after a while
- Need to be catalogued to be useful
- Used as guidelines for design
- Good to evaluate systems and standards

Value of Security Patterns

- Can guide the design and implementation of the security mechanism itself
- Can guide the use of security mechanisms in an application (stop specific threats)
- Extensive catalogues of security patterns have been developed
- Care must be taken in their use

Security Design Patterns examples

- Secure Logger
  - Remote logging for decentralized systems
- Input Validator
  - Validate input against acceptable criteria
- Clear Sensitive Information
- Exception Manager
  - Wrap and sanitize exceptions

Questions?

- Microsoft Threat Modeling: http://msdn.microsoft.com/en-us/library/ff648644.aspx
- OWASP: https://www.owasp.org/index.php/Application_Threat_Modeling
- Fernandez, E.B.; Ajaj, O.; Buckley, I.; Delessy-Gassant, N.;Hashizume, K.; Larrondo-Petrie, M.M. A Survey of Patternsfor Web Services Security and Reliability Standards. Future Internet 2012, 4, 430-450. http://www.mdpi.com/1999-5903/4/2/430/

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- https://www.owasp.org/index.php/OWASP_Secure_Application_Design_Project