Code responsibly with generative AI in Java (CRWGAIJ)

ID CRWGAIJ **Prix** CHF 2 250,– (Hors Taxe) **Durée** 3 jours

A qui s'adresse cette formation

Java developers using Copilot or other GenAI tools

Pré-requis

OWASP, SEI CERT, CWE and Fortify Taxonomy

Objectifs

- Understanding the essentials of responsible AI
- Getting familiar with essential cyber security concepts
- Understanding how cryptography supports security
- Learning how to use cryptographic APIs correctly in Java
- Understanding Web application security issues
- Detailed analysis of the OWASP Top Ten elements
- Putting Web application security in the context of Java
- Going beyond the low hanging fruits
- Managing vulnerabilities in third party components
- All this put into the context of GitHub Copilot

Contenu

Day 1

Coding responsibly with GenAI

- What is responsible AI?
- What is security?
- Threat and risk
- Cyber security threat types – the CIA triad
- Consequences of insecure software
- Security and responsible AI in software development
- GenAI tools in coding: Copilot, Codeium and others
- The OWASP Top Ten from Copilot's perspective
    - The OWASP Top Ten 2021
        - A01 – Broken Access Control
            - Access control basics
            - Case study – Broken authn/authz in Apache OFBiz
            - Confused deputy
            - Insecure direct object reference (IDOR)
            - Path traversal
            - Lab – Insecure Direct Object Reference
            - Path traversal best practices
            - Lab – Experimenting with path traversal in Copilot
            - Authorization bypass through user-controlled keys
            - Case study – Remote takeover of Nexx garage doors and alarms
            - Lab – Horizontal authorization (exploring with Copilot)
            - File upload
                - Unrestricted file upload
                - Good practices
                - Lab – Unrestricted file upload (exploring with Copilot)
                - Case study – File upload vulnerability in Netflix Genie
        - A02 – Cryptographic Failures
            - Cryptography for developers
            - Cryptography basics
            - Java Cryptographic Architecture (JCA) in brief
            - Elementary algorithms
            - Hashing
                - Hashing basics
                - Hashing in Java
                - Lab – Hashing in JCA (exploring with Copilot)
            - Random number generation
                - Pseudo random number generators (PRNGs)
                - Cryptographically secure PRNGs
                - Weak and strong PRNGs in Java
                - Lab – Using random numbers in Java (exploring with Copilot)
                - Case study – Equifax credit account freeze
            - Confidentiality protection
                - Symmetric encryption
                    - Block ciphers
                    - Modes of operation
                    - Modes of operation and IV – best

practices
    - Symmetric encryption in Java
    - Symmetric encryption in Java with streams
    - Lab – Symmetric encryption in JCA (exploring with Copilot)
  - Asymmetric encryption
  - Combining symmetric and asymmetric algorithms
  - Key exchange and agreement
    - Key exchange
    - Diffie-Hellman key agreement algorithm
    - Key exchange pitfalls and best practices

Day 2

The OWASP Top Ten from Copilot's perspective

- A03 – Injection
  - Injection principles
  - Injection attacks
    - SQL injection
      - SQL injection basics
      - Lab – SQL injection
      - Attack techniques
        - Content-based blind SQL injection
        - Time-based blind SQL injection
      - SQL injection best practices
      - Input validation
      - Parameterized queries
      - Lab – Using prepared statements
      - Lab – Experimenting with SQL injection in Copilot
      - Database defense in depth
      - Case study – SQL injection in Fortra FileCatalyst
    - Code injection
      - OS command injection
      - OS command injection best practices
      - Using Runtime.exec()
      - Case study – Shellshock
      - Lab – Shellshock
      - Case study – Command injection in VMware Aria
    - HTML injection – Cross-site scripting (XSS)
      - Cross-site scripting basics
      - Cross-site scripting types
        - Persistent cross-site scripting
        - Reflected cross-site scripting
        - Client-side (DOM-based) cross-site scripting
      - Lab – Stored XSS
      - Lab – Reflected XSS
      - XSS protection best practices
      - Protection principles – escaping
      - XSS protection APIs in Java
      - Lab – XSS fix / stored (exploring with Copilot)
      - Lab – XSS fix / reflected (exploring with Copilot)
      - Additional protection layers – defense in depth
      - Case study – XSS vulnerabilities in DrayTek Vigor routers
  - A04 – Insecure Design
    - The STRIDE model of threats
    - Secure design principles of Saltzer and Schroeder
      - Economy of mechanism
      - Fail-safe defaults
      - Complete mediation
      - Open design
      - Separation of privilege
      - Least privilege
      - Least common mechanism
      - Psychological acceptability
    - Client-side security
    - Frame sandboxing
    - Cross-Frame Scripting (XFS) attacks
    - Lab – Clickjacking
    - Clickjacking beyond hijacking a click
    - Clickjacking protection best practices
    - Lab – Using CSP to prevent clickjacking (exploring with Copilot)
  - A05 – Security Misconfiguration
    - Configuration principles
    - XML entities
      - DTD and the entities
      - Entity expansion
      - External Entity Attack (XXE)
      - File inclusion with external entities
      - Server-Side Request Forgery with external entities
      - Lab – External entity attack
      - Preventing XXE
      - Lab – Prohibiting DTD
      - Case study – XXE vulnerability in Ivanti products
      - Lab – Experimenting with XXE in

Copilot

Day 3

The OWASP Top Ten from Copilot's perspective

- A06 – Vulnerable and Outdated Components
  - Using vulnerable components
  - Untrusted functionality import
  - Case study – The Polyfill.io supply chain attack
  - Vulnerability management
  - Lab – Finding vulnerabilities in third-party components
  - Security of AI generated code
  - Practical attacks against code generation tools
  - Dependency hallucination via generative AI
  - Case study – A history of GitHub Copilot weaknesses (up to mid 2024)
- A07 – Identification and Authentication Failures
  - Authentication
    - Authentication basics
    - Multi-factor authentication (MFA)
    - Case study – The InfinityGauntlet attack
  - Password management
    - Inbound password management
    - Storing account passwords
    - Lab – Is just hashing passwords enough?
    - Dictionary attacks and brute forcing
    - Salting
    - Adaptive hash functions for password storage
    - Lab – Using adaptive hash functions in JCA
    - Lab – Using adaptive hash functions in Copilot
    - Password policy
    - NIST authenticator requirements for memorized secrets
- A08 – Software and Data Integrity Failures
  - Integrity protection
    - Message Authentication Code (MAC)
    - Calculating MAC in Java
    - Lab – Calculating MAC in JCA
  - Digital signature
    - Elliptic Curve Cryptography
    - ECC basics
    - Digital signature with ECC
    - Digital signature in Java
    - Lab – Digital signature with ECDSA in JCA
  - Subresource integrity
    - Importing JavaScript
    - Lab – Importing JavaScript (exploring with Copilot)
    - Case study – The British Airways data breach
  - Insecure deserialization
    - Serialization and deserialization challenges
    - Integrity – deserializing untrusted streams
    - Integrity – deserialization best practices
    - Look ahead deserialization
    - Property Oriented Programming (POP)
    - Creating a POP payload
    - Lab – Creating a POP payload
    - Lab – Using the POP payload
    - Case study – Deserialization RCEs in NextGen Mirth Connect
- A09 – Security Logging and Monitoring Failures
  - Logging and monitoring principles
  - Log forging
  - Log forging – best practices
  - Case study – Log interpolation in log4j
  - Case study – The Log4Shell vulnerability (CVE-2021-44228)
  - Case study – Log4Shell follow-ups (CVE-2021-45046, CVE-2021-45105)
  - Lab – Log4Shell
- A10 – Server-side Request Forgery (SSRF)
  - Server-side Request Forgery (SSRF)
  - Case study – SSRF in Ivanti Connect Secure
- Wrap up
  - Secure coding principles

- Principles of robust programming by Matt Bishop
- And now what?
- Software security sources and further reading
- Java resources
- Responsible AI principles in software development
- Generative AI – Resources and additional guidance

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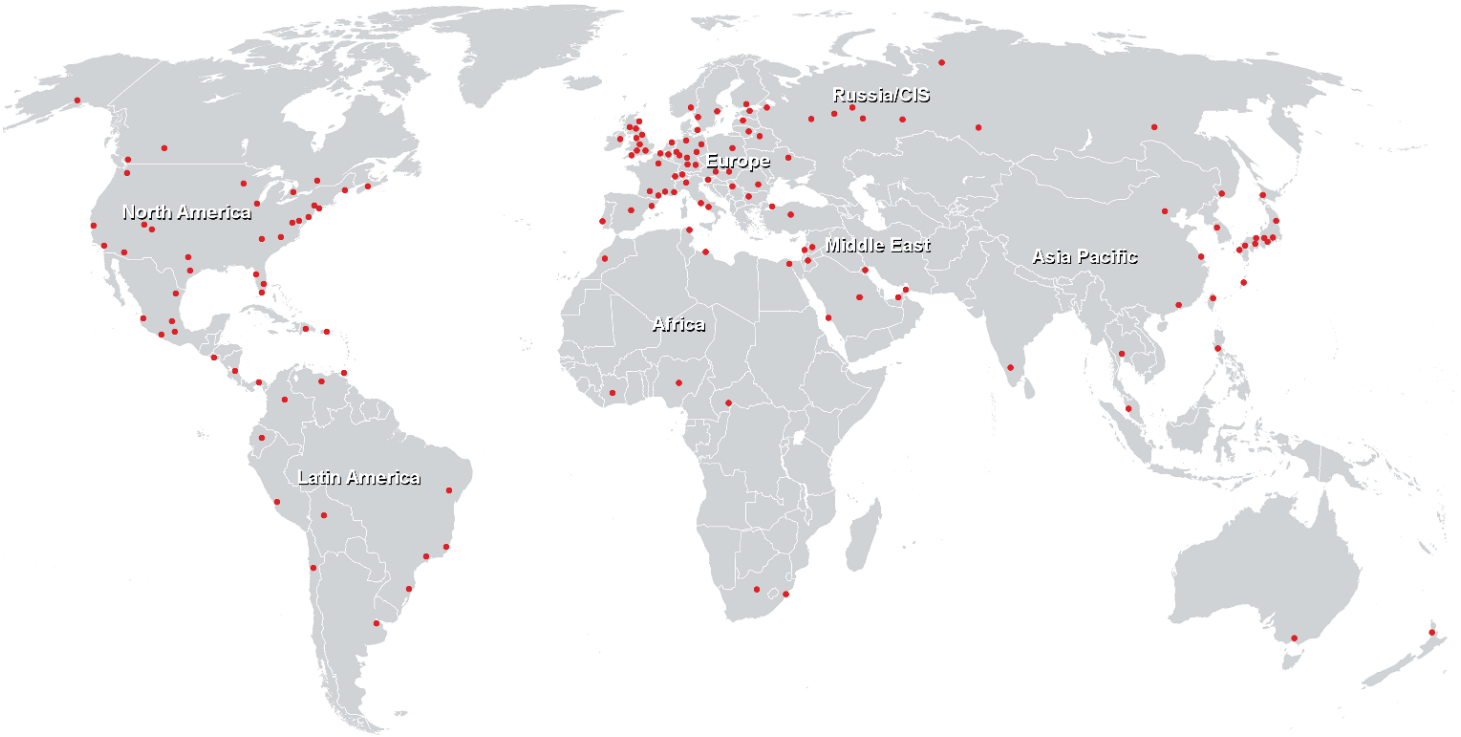

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