Code responsibly with generative AI in Python (CRWGAIP)

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

A qui s'adresse cette formation

Python developers using Copilot or other GenAI tools

Pré-requis

General Python and Web development

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 Python
- Understanding Web application security issues
- Detailed analysis of the OWASP Top Ten elements
- Putting Web application security in the context of Python
- 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
            - Failure to restrict URL access
            - 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)
        - A02 – Cryptographic Failures
            - Cryptography for developers
            - Cryptography basics
            - Cryptography in Python
            - Elementary algorithms
            - Hashing
                - Hashing basics
                - Hashing in Python
                - Lab – Hashing in Python (exploring with Copilot)
            - Random number generation
                - Pseudo random number generators (PRNGs)
                - Cryptographically secure PRNGs
                - Weak PRNGs
                - Using random numbers
                - Lab – Using random numbers in Python (exploring with Copilot)
                - Lab – Secure PRNG use in Copilot
            - Confidentiality protection
                - Symmetric encryption
                - Block ciphers
                - Modes of operation
                - Modes of operation and IV – best practices
                - Symmetric encryption in Python
                - Lab – Symmetric

encryption in Python (exploring with Copilot)
- Asymmetric encryption
- Combining symmetric and asymmetric algorithms

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 against US airport security
    - Code injection
      - Code injection via input()
      - OS command injection
      - Lab – Command injection
      - OS command injection best practices
      - Avoiding command injection with the right APIs
      - Lab – Command injection best practices
      - Lab – Experimenting with command injection in Copilot
      - Case study – Shellshock
      - Lab – Shellshock
      - Case study – Command injection in Ivanti security appliances
    - 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
      - Case study – XSS to RCE in Teltonika routers
      - XSS protection best practices
      - Protection principles – escaping
      - XSS protection APIs in Python
      - XSS protection in Jinja2
      - Lab – XSS fix / stored (exploring with Copilot)
      - Lab – XSS fix / reflected (exploring with Copilot)
      - 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
      - Same Origin Policy
      - Simple request
      - Preflight request
      - Cross-Origin Resource Sharing (CORS)
      - Lab – Same-origin policy demo
      - 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)

Day 3

The OWASP Top Ten from Copilot's perspective

- A05 – Security Misconfiguration
  - Configuration principles
  - Server misconfiguration
  - Python configuration best practices
  - Configuring Flask
  - Cookie security
    - Cookie attributes
  - 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

- A06 – Vulnerable and Outdated Components
  - Using vulnerable components
  - Untrusted functionality import
  - Malicious packages in Python
  - 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
    - Time-based One Time Passwords (TOTP)
  - Password management
    - Inbound password management
    - Storing account passwords
    - Password in transit
    - Lab – Is just hashing passwords enough?
    - Dictionary attacks and brute forcing
    - Salting
    - Adaptive hash functions for password storage
    - Lab – Using adaptive hash functions in Python
    - Lab – Using adaptive hash functions in Copilot
    - Password policy
    - NIST authenticator requirements for memorized secrets
    - Password database migration
- A08 – Software and Data Integrity Failures
  - Integrity protection
    - Message Authentication Code (MAC)
    - Calculating HMAC in Python
    - Lab – Calculating MAC in Python
  - Digital signature
    - Digital signature in Python
  - Subresource integrity
    - Importing JavaScript
    - Lab – Importing JavaScript (exploring with Copilot)
    - Case study – The British Airways data breach
- 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
  - Python resources
  - Responsible AI principles in software development
  - Generative AI – Resources and additional guidance

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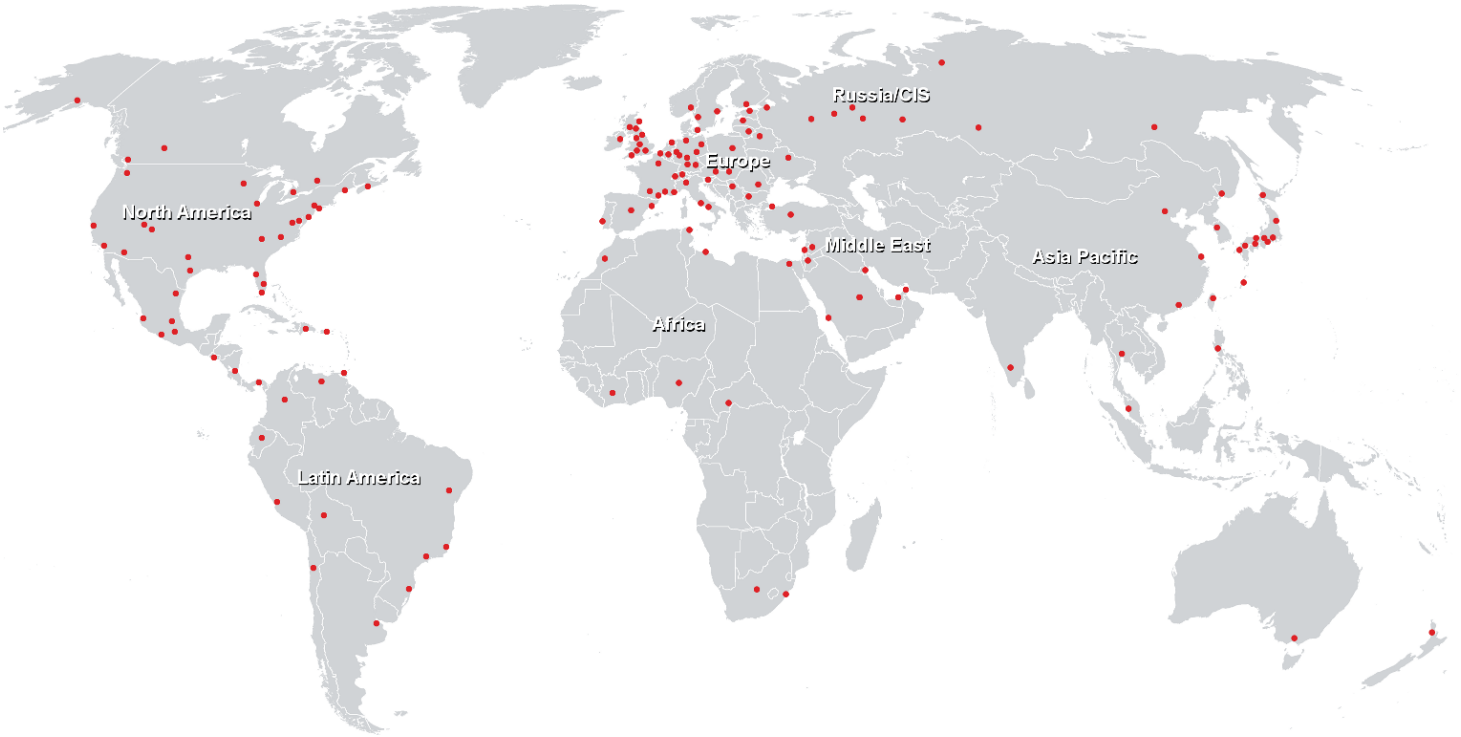

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