Security testing Python Web applications

CYDWebPyTst3d | 3 days | On-site or online | Hands-on

Your Web application written in Python is tested functionally, so you are done, right? But did you consider feeding in incorrect values? 16Gbs of data? A null? An apostrophe? Negative numbers, or specifically -1 or -2^{31}? Because that's what the bad guys will do – and the list is far from complete.

Testing for security needs a remarkable software security expertise and a healthy level of paranoia, and this is what this course provides: a strong emotional engagement by lots of hands on labs and stories from real life.

The curriculum goes through the common Web application security issues following the OWASP Top Ten but goes far beyond it both in coverage and the details.

A special focus is given to finding all discussed issues during testing, and an overview is provided on security testing methodology, techniques and tools.

So that you are prepared for the forces of the dark side.

So that nothing unexpected happens.

Nothing.

Cyber security skills and drills

Audience

Python developers and testers working on Web applications

Group size

12 participants

Outline

- Cyber security basics
- The OWASP Top Ten
- Security testing
- Common software security weaknesses
- Wrap up

Preparedness

General Python and Web development, testing and QA

31 labs

12 case studies

What you'll have learned

- Getting familiar with essential cyber security concepts
- 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
- Understanding security testing methodology and approaches
- Getting familiar with common security testing techniques and tools
- Managing vulnerabilities in third party components
- Identify vulnerabilities and their consequences
- Learn the security best practices in Python
- Input validation approaches and principles

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Day 1

A2 - Broken Authentication

- Authentication basics
- Multi-factor authentication
- Authentication weaknesses - spoofing
- Spoofing on the Web
- Testing for weak authentication

Case study – PayPal 2FA bypass

- User interface best practices

Lab – On-line password brute forcing

- 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
    - Password policy
    - NIST authenticator requirements for memorized secrets
    - Password length
    - Password hardening
    - Using passphrases

Case study – The Ashley Madison data breach

The dictionary attack

The ultimate crack

Exploitation and the lessons learned

    - (Mis)handling None passwords
    - Testing for password management issues

Day 2

› Security testing

Security testing vs functional testing

Manual and automated methods

Security testing methodology

- Security testing – goals and methodologies
- Overview of security testing processes
- Identifying and rating assets

- Preparation
- Identifying assets
- Identifying the attack surface
- Assigning security requirements

Lab – Identifying and rating assets

- Threat modeling
  - SDL threat modeling
  - Mapping STRIDE to DFD
  - DFD example
  - Attack trees
  - Attack tree example

Lab – Crafting an attack tree

  - Misuse cases
  - Misuse case examples
  - Risk analysis

Lab – Risk analysis

- Security testing approaches
  - Reporting, recommendations, and review

› The OWASP Top Ten

A3 - Sensitive Data Exposure

- Information exposure
- Exposure through extracted data and aggregation

Case study – Strava data exposure

- Error and exception handling principles
- Information exposure through error reporting
- Information leakage via error pages

Lab – Flask information leakage

A4 - XML External Entities (XXE)

- DTD and the entities
- Entity expansion

Lab – Billion laughs attack

- External Entity Attack (XXE)
  - File inclusion with external entities
  - Server-Side Request Forgery with external entities

Lab – External entity attack

Case study – XXE vulnerability in SAP Store

  - Preventing XXE

A5 - Broken Access Control

- Access control basics
- Failure to restrict URL access
- Testing for authorization issues
- Confused deputy
  - Insecure direct object reference (IDOR)
  - *Lab – Insecure Direct Object Reference*
  - Authorization bypass through user-controlled keys
  - *Case study – Authorization bypass on Facebook*
  - *Lab – Horizontal authorization*
  - Testing for confused deputy weaknesses
- File upload
  - Unrestricted file upload
  - Good practices
  - *Lab – Unrestricted file upload*
  - Testing for file upload vulnerabilities

A6 - Security Misconfiguration

- Configuration principles
- Configuration management
- Python configuration best practices
  - Configuring Flask
- Testing for misconfiguration issues

A7 - 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 in Fortnite accounts*
  - Additional protection layers
  - Testing for XSS

Day 3

› The OWASP Top Ten

A8 - Insecure Deserialization

- Serialization and deserialization challenges
- Deserializing untrusted streams
- Deserialization with pickle

Lab – Deserializing with Pickle

- PyYAML deserialization challenges
- Testing for insecure deserialization

A9 - Using Components with Known Vulnerabilities

- Using vulnerable components
- Assessing the environment
- Hardening
- Untrusted functionality import
- Malicious packages in Python
- Importing JavaScript

Lab – Importing JavaScript

Case study – The British Airways data breach

- Vulnerability management
  - Patch management
  - Vulnerability management
  - Bug bounty programs
  - Vulnerability databases
  - Vulnerability rating – CVSS
  - DevOps, the build process and CI / CD
  - Dependency checking in Python

Lab – Detecting vulnerable components

A10 - Insufficient Logging & Monitoring

- Logging and monitoring principles
- Insufficient logging

Case study – Plaintext passwords at Facebook

- Firewalls and Web Application Firewalls (WAF)
- Intrusion detection and prevention

Case study – The Marriott Starwood data breach

Web application security beyond the Top Ten

- Client-side security
- *Lab – Client-side security*
- Tabnabbing
- *Lab – Reverse tabnabbing*
- Frame sandboxing
  - Cross-Frame Scripting (XFS) attack
  - *Lab - Clickjacking*
  - Clickjacking beyond hijacking a click
- Some further best practices
  - HTML5 security best practices
  - CSS security best practices
  - Ajax security best practices

› Security testing

Security testing techniques and tools

- Code analysis
  - Security aspects of code review
  - Static Application Security Testing (SAST)
  - *Lab – Using static analysis tools*
- Dynamic analysis
  - Security testing at runtime
  - Penetration testing
  - Stress testing
  - Dynamic analysis tools
    - Dynamic Application Security Testing (DAST)
    - Web vulnerability scanners
    - *Lab – Using web vulnerability scanners*
    - SQL injection tools
    - *Lab – Using SQL injection tools*
    - Proxy servers
  - Fuzzing

› Common software security weaknesses

Input validation

- Input validation principles
  - *Lab – Input validation*
  - Encoding challenges
  - *Lab – Encoding challenges*

- Validation with regex
- Regular expression denial of service (ReDoS)

Lab – Regular expression denial of service (ReDoS)

- Dealing with ReDoS

- Files and streams
  - Path traversal
  - Path traversal-related examples

Lab – Path traversal

  - Additional challenges in Windows
  - Path traversal best practices
  - Testing for path traversal
  - Format string issues
- Unsafe native code
  - Native code dependence

Lab – Unsafe native code

  - Best practices for dealing with native code

› Wrap up

And now what?

- Software security sources and further reading
- Python resources
- Security testing resources