Course Name : Secure Software Development

Project Title : Full-Spectrum Web Application Hardening
(Vulnerability Assessment & Secure Coding using OWASP Top 10)

Team Members :

Name	**ID**
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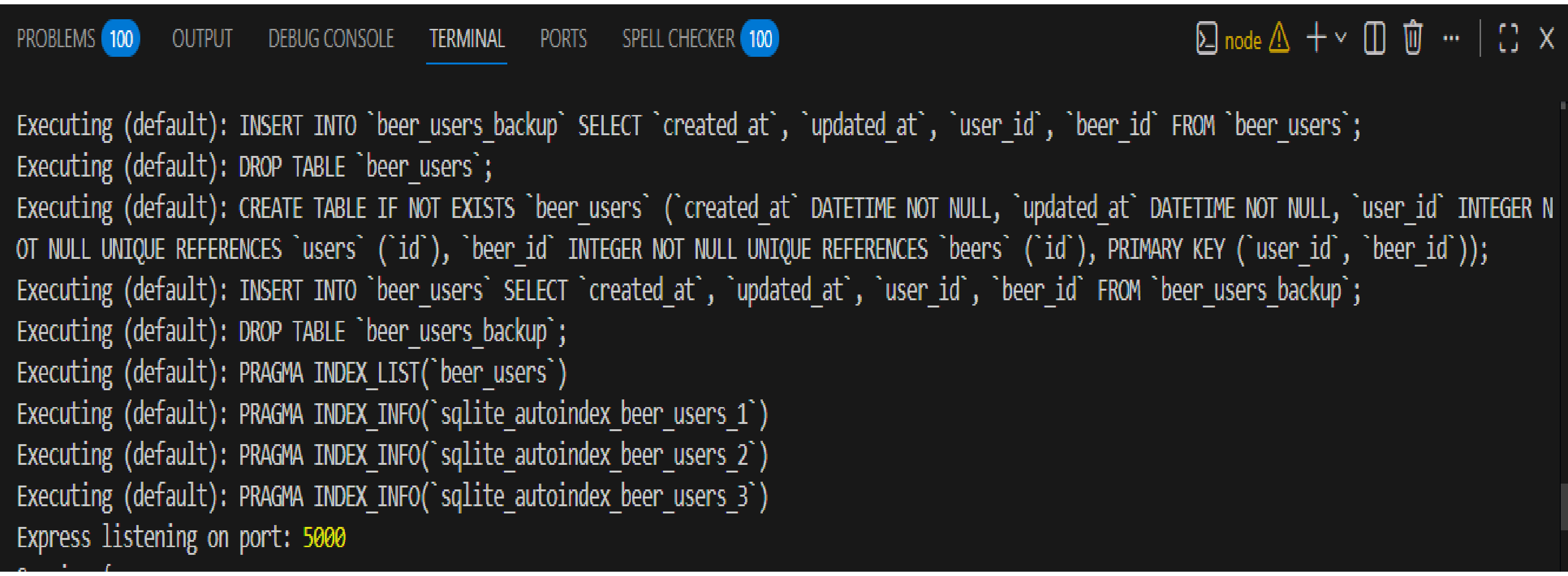
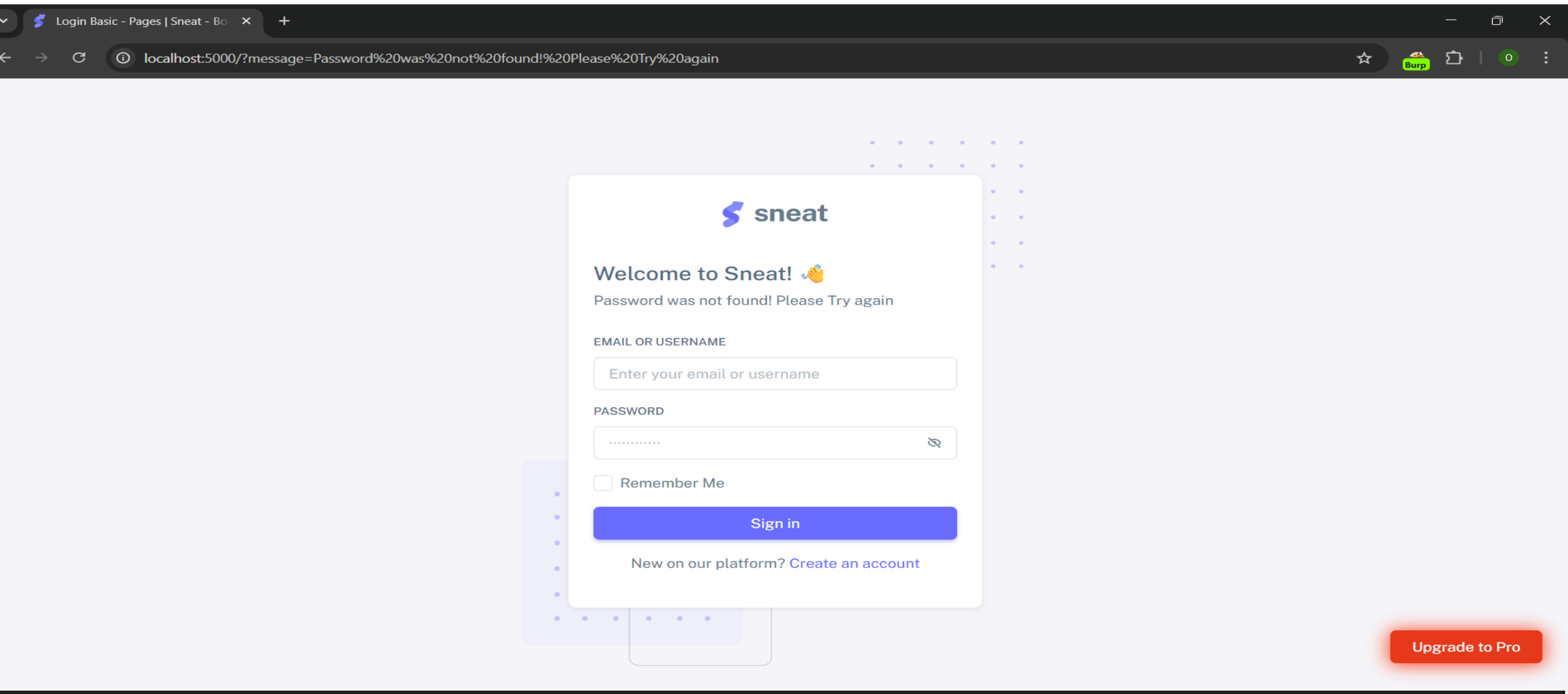
Abdelrahman Adel Shahin	**2305432**
Youssef Ashraf Abdelmohsen	**2305102**

Tools & Technologies : Node.js – Express.js – SQLite – Sequelize
OWASP ZAP – Semgrep – Postman – bcrypt – Helmet



```
Executing (default): INSERT INTO `beer_users_backup` SELECT `created_at`, `updated_at`, `user_id`, `beer_id` FROM `beer_users`;
Executing (default): DROP TABLE `beer_users`;
Executing (default): CREATE TABLE IF NOT EXISTS `beer_users` (`created_at` DATETIME NOT NULL, `updated_at` DATETIME NOT NULL, `user_id` INTEGER N
OT NULL UNIQUE REFERENCES `users` (`id`), `beer_id` INTEGER NOT NULL UNIQUE REFERENCES `beers` (`id`), PRIMARY KEY (`user_id`, `beer_id`));
Executing (default): INSERT INTO `beer_users` SELECT `created_at`, `updated_at`, `user_id`, `beer_id` FROM `beer_users_backup`;
Executing (default): DROP TABLE `beer_users_backup`;
Executing (default): PRAGMA INDEX_LIST(`beer_users`)
Executing (default): PRAGMA INDEX_INFO(`sqlite_autoindex_beer_users_1`)
Executing (default): PRAGMA INDEX_INFO(`sqlite_autoindex_beer_users_2`)
Executing (default): PRAGMA INDEX_INFO(`sqlite_autoindex_beer_users_3`)
Express listening on port: 5000
```

The vulnerable Node.js Express application was successfully deployed in a local development environment and started listening on port 5000.



Login Basic - Pages | Sneat - Bo

localhost:5000/?message=Password%20was%20not%20found!%20Please%20Try%20again

sneat

Welcome to Sneat! 👋

Password was not found! Please Try again

EMAIL OR USERNAME

Enter your email or username

PASSWORD

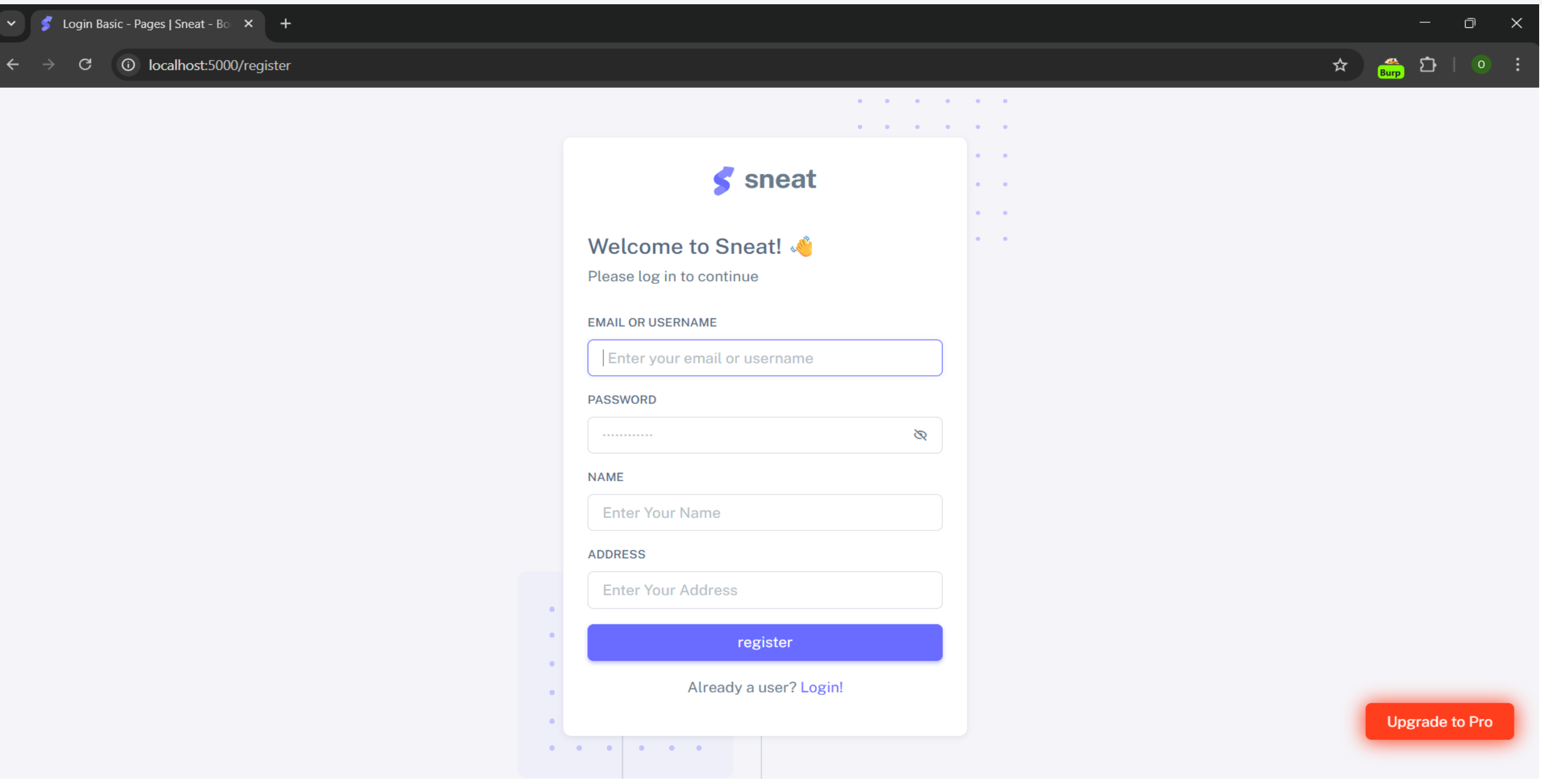
············

Remember Me

Sign in

New on our platform? Create an account

Upgrade to Pro



Login Basic - Pages | Sneat - Bo

localhost:5000/register

sneat

Welcome to Sneat! 👋

Please log in to continue

EMAIL OR USERNAME

Enter your email or username

PASSWORD

············

NAME

Enter Your Name

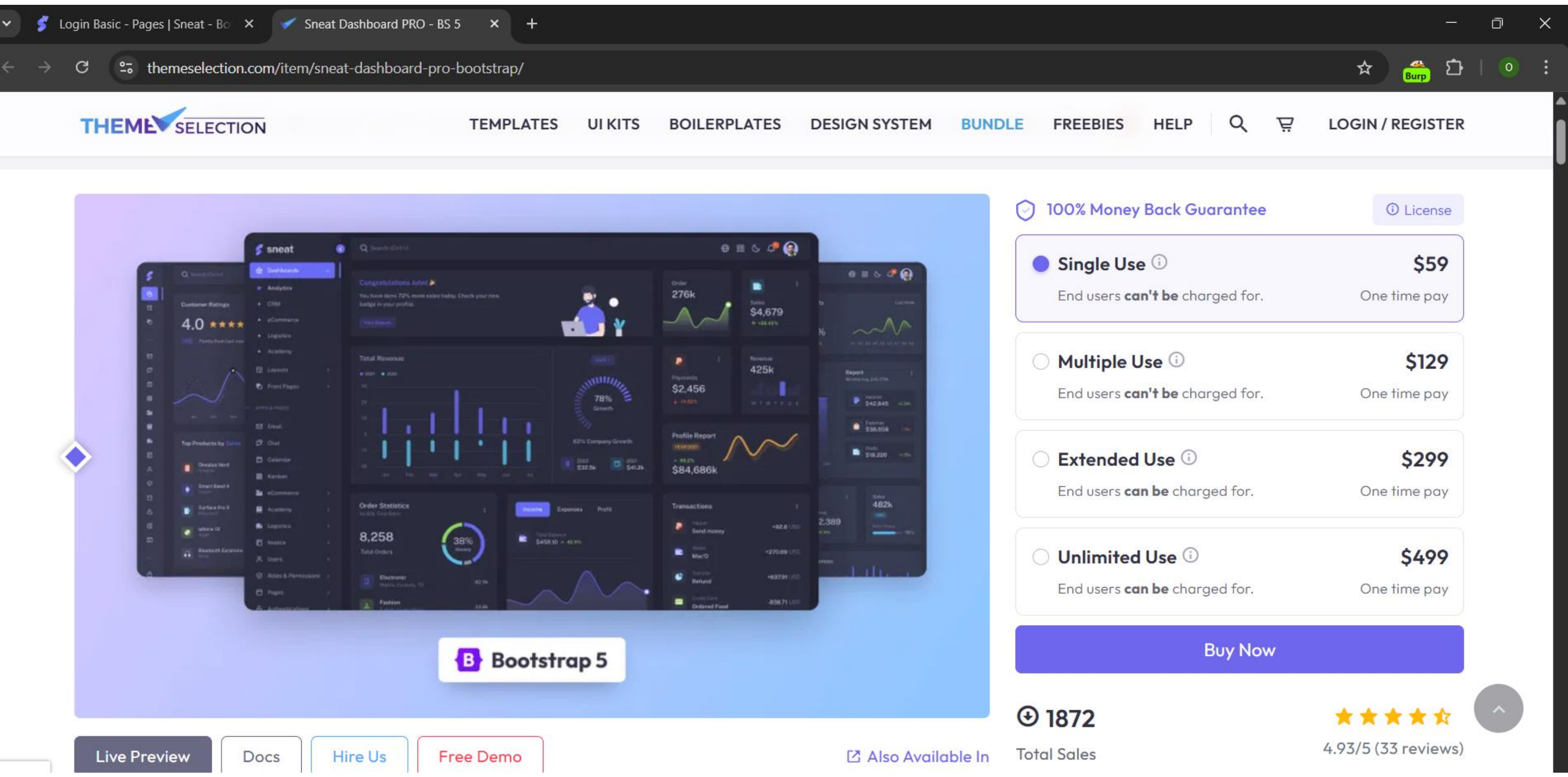
ADDRESS

Enter Your Address

register

Already a user? Login!

Upgrade to Pro



Login Basic - Pages | Sneat - Bo

Sneat Dashboard PRO - BS 5

themeselection.com/item/sneat-dashboard-pro-bootstrap/

100% Money Back Guarantee   License

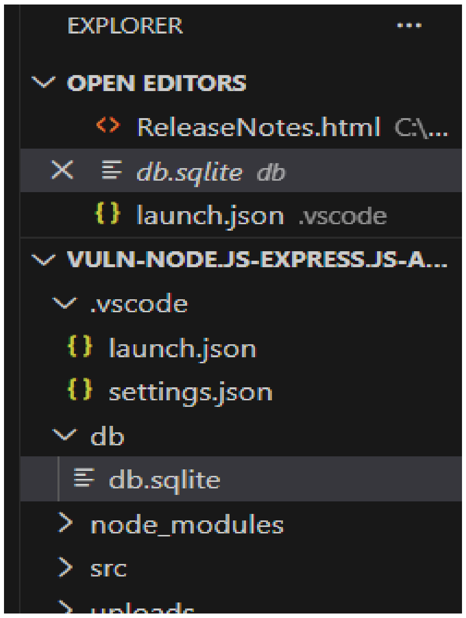
●	Single Use End users **can't be** charged for.	$59 One time pay
○	Multiple Use End users **can't be** charged for.	$129 One time pay
○	Extended Use End users **can be** charged for.	$299 One time pay
○	Unlimited Use End users **can be** charged for.	$499 One time pay

Buy Now

1872
Total Sales

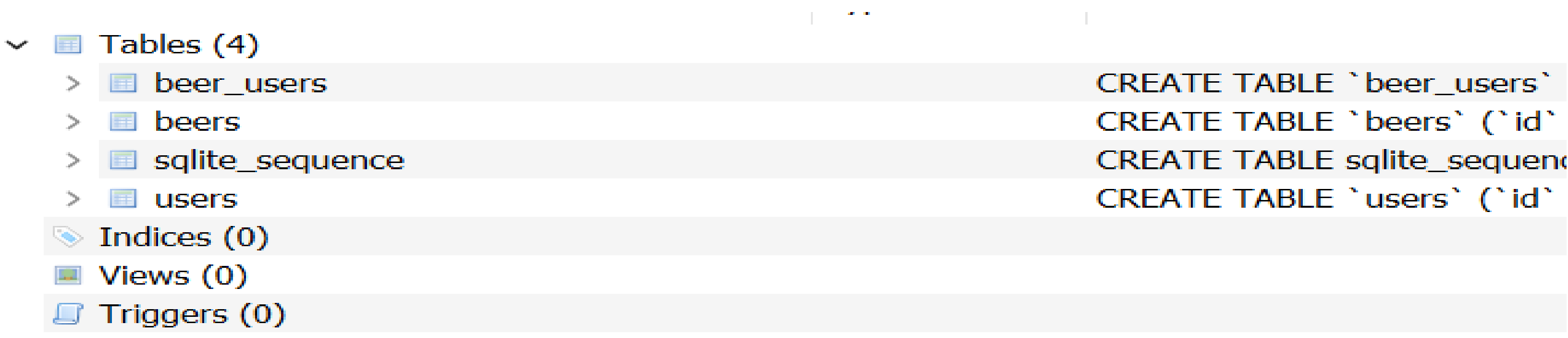
4.93/5 (33 reviews)

The web application was accessed through a browser to verify that all routes are reachable.

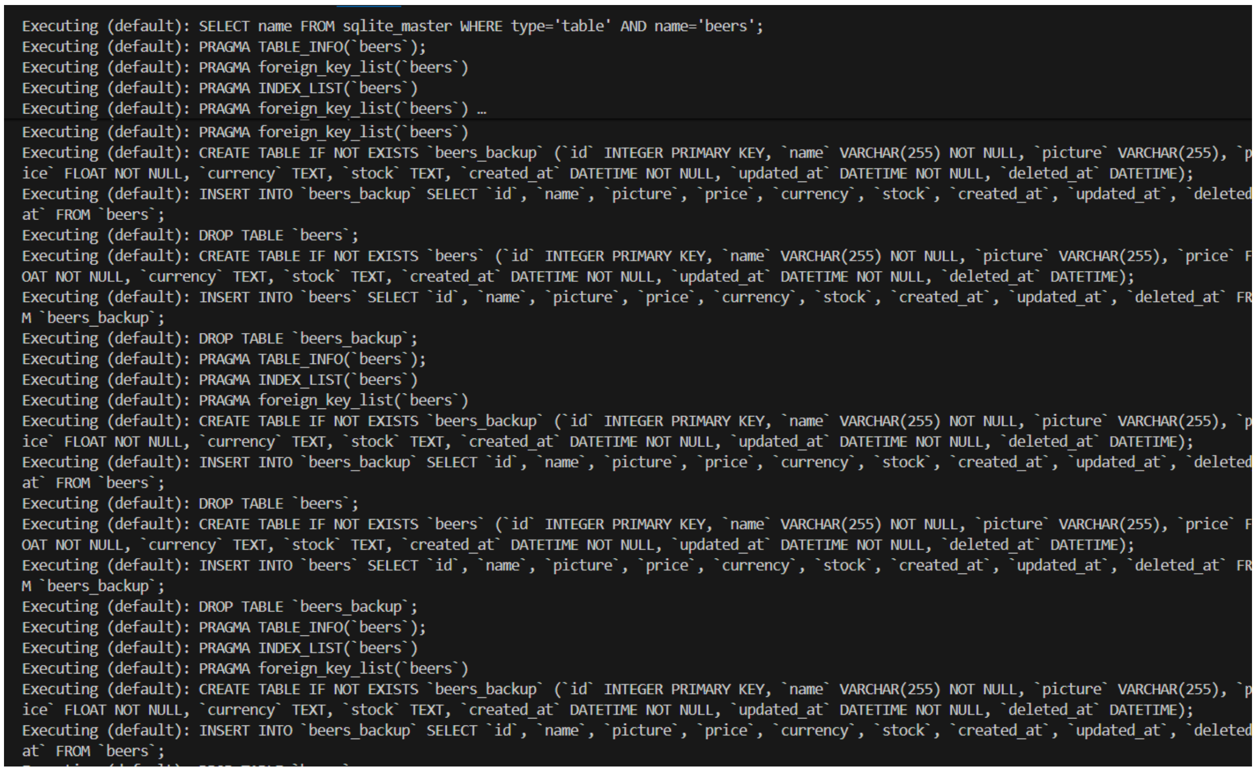

EXPLORER

OPEN EDITORS
ReleaseNotes.html C:\...
db.sqlite db
launch.json .vscode

VULN-NODE.JS-EXPRESS.JS-A...
.vscode
launch.json
settings.json
db
db.sqlite
node_modules
src

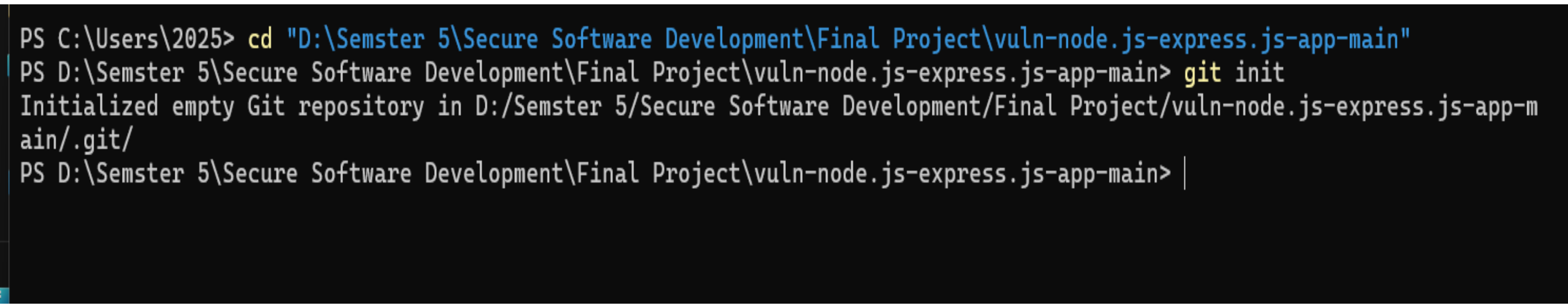

```
Tables (4)
  beer_users          CREATE TABLE `beer_users`
  beers               CREATE TABLE `beers` (`id`
  sqlite_sequence     CREATE TABLE sqlite_sequen
  users               CREATE TABLE `users` (`id`
Indices (0)
Views (0)
Triggers (0)
```

The application relies on an SQLite database, and all required tables were automatically created using Sequelize ORM during application startup.

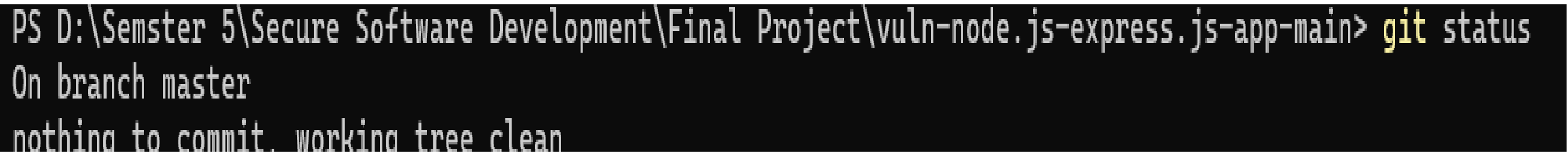


```
Executing (default): SELECT name FROM sqlite_master WHERE type='table' AND name='beers';
Executing (default): PRAGMA TABLE_INFO(`beers`);
Executing (default): PRAGMA foreign_key_list(`beers`)
Executing (default): PRAGMA INDEX_LIST(`beers`)
Executing (default): PRAGMA foreign_key_list(`beers`) …
Executing (default): PRAGMA foreign_key_list(`beers`)
Executing (default): CREATE TABLE IF NOT EXISTS `beers_backup` (`id` INTEGER PRIMARY KEY, `name` VARCHAR(255) NOT NULL, `picture` VARCHAR(255), `p
ice` FLOAT NOT NULL, `currency` TEXT, `stock` TEXT, `created_at` DATETIME NOT NULL, `updated_at` DATETIME NOT NULL, `deleted_at` DATETIME);
Executing (default): INSERT INTO `beers_backup` SELECT `id`, `name`, `picture`, `price`, `currency`, `stock`, `created_at`, `updated_at`, `deleted
at` FROM `beers`;
Executing (default): DROP TABLE `beers`;
Executing (default): CREATE TABLE IF NOT EXISTS `beers` (`id` INTEGER PRIMARY KEY, `name` VARCHAR(255) NOT NULL, `picture` VARCHAR(255), `price` F
OAT NOT NULL, `currency` TEXT, `stock` TEXT, `created_at` DATETIME NOT NULL, `updated_at` DATETIME NOT NULL, `deleted_at` DATETIME);
Executing (default): INSERT INTO `beers` SELECT `id`, `name`, `picture`, `price`, `currency`, `stock`, `created_at`, `updated_at`, `deleted_at` FR
M `beers_backup`;
Executing (default): DROP TABLE `beers_backup`;
Executing (default): PRAGMA TABLE_INFO(`beers`);
Executing (default): PRAGMA INDEX_LIST(`beers`)
Executing (default): PRAGMA foreign_key_list(`beers`)
Executing (default): CREATE TABLE IF NOT EXISTS `beers_backup` (`id` INTEGER PRIMARY KEY, `name` VARCHAR(255) NOT NULL, `picture` VARCHAR(255), `p
ice` FLOAT NOT NULL, `currency` TEXT, `stock` TEXT, `created_at` DATETIME NOT NULL, `updated_at` DATETIME NOT NULL, `deleted_at` DATETIME);
Executing (default): INSERT INTO `beers_backup` SELECT `id`, `name`, `picture`, `price`, `currency`, `stock`, `created_at`, `updated_at`, `deleted
at` FROM `beers`;
Executing (default): DROP TABLE `beers`;
Executing (default): CREATE TABLE IF NOT EXISTS `beers` (`id` INTEGER PRIMARY KEY, `name` VARCHAR(255) NOT NULL, `picture` VARCHAR(255), `price` F
OAT NOT NULL, `currency` TEXT, `stock` TEXT, `created_at` DATETIME NOT NULL, `updated_at` DATETIME NOT NULL, `deleted_at` DATETIME);
Executing (default): INSERT INTO `beers` SELECT `id`, `name`, `picture`, `price`, `currency`, `stock`, `created_at`, `updated_at`, `deleted_at` FR
M `beers_backup`;
Executing (default): DROP TABLE `beers_backup`;
Executing (default): PRAGMA TABLE_INFO(`beers`);
Executing (default): PRAGMA INDEX_LIST(`beers`)
Executing (default): PRAGMA foreign_key_list(`beers`)
Executing (default): CREATE TABLE IF NOT EXISTS `beers_backup` (`id` INTEGER PRIMARY KEY, `name` VARCHAR(255) NOT NULL, `picture` VARCHAR(255), `p
ice` FLOAT NOT NULL, `currency` TEXT, `stock` TEXT, `created_at` DATETIME NOT NULL, `updated_at` DATETIME NOT NULL, `deleted_at` DATETIME);
Executing (default): INSERT INTO `beers_backup` SELECT `id`, `name`, `picture`, `price`, `currency`, `stock`, `created_at`, `updated_at`, `deleted
at` FROM `beers`;
```

Automatic table creation without strict validation can increase the attack surface in insecure applications.



```
PS C:\Users\2025> cd "D:\Semster 5\Secure Software Development\Final Project\vuln-node.js-express.js-app-main"
PS D:\Semster 5\Secure Software Development\Final Project\vuln-node.js-express.js-app-main> git init
Initialized empty Git repository in D:/Semster 5/Secure Software Development/Final Project/vuln-node.js-express.js-app-m
ain/.git/
PS D:\Semster 5\Secure Software Development\Final Project\vuln-node.js-express.js-app-main> |
```



```
PS D:\Semster 5\Secure Software Development\Final Project\vuln-node.js-express.js-app-main> git status
On branch master
nothing to commit, working tree clean
```

A baseline vulnerable version of the application was committed before conducting any security testing.

Operating System: Windows 11 Pro

Runtime: Node.js v14.x

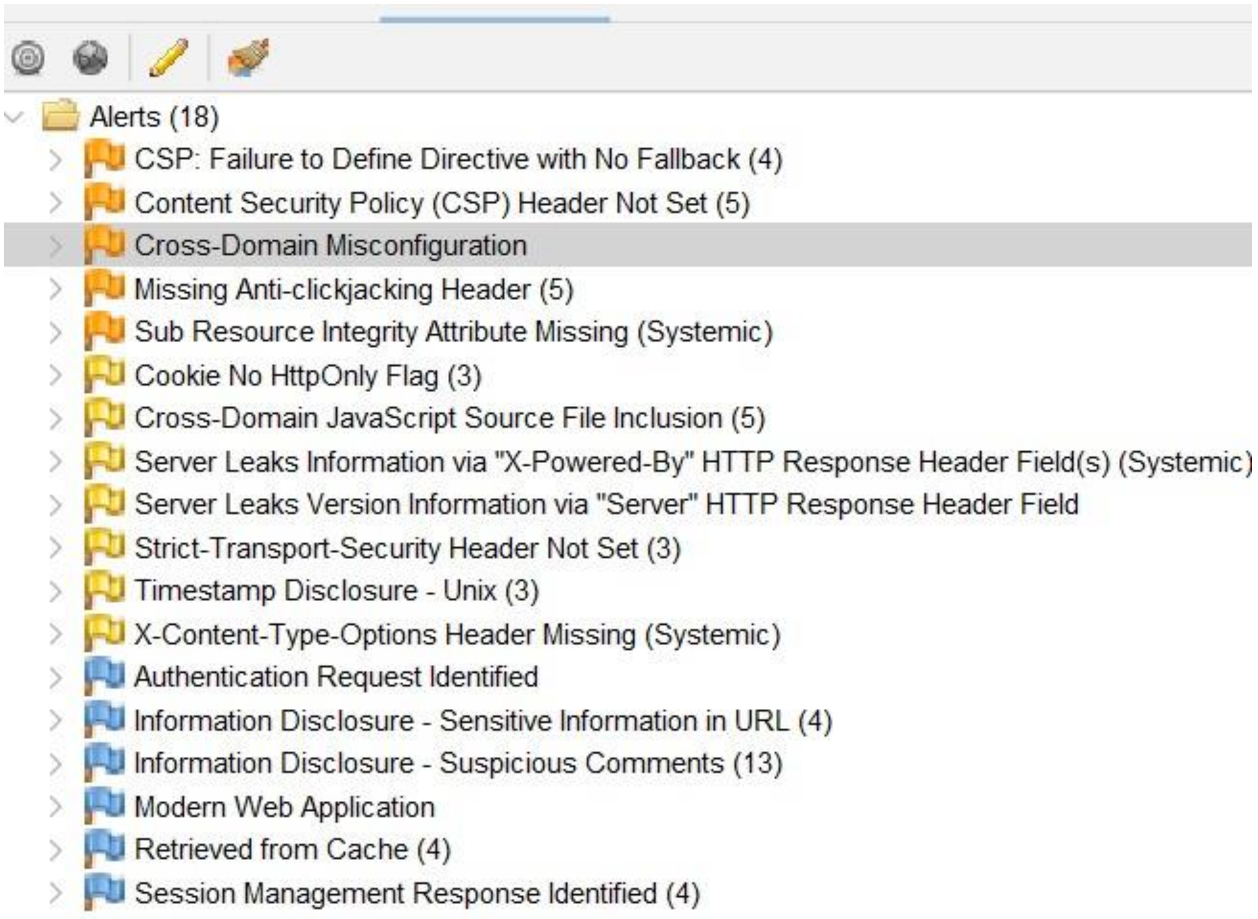
Framework: Express.js

Database: SQLite

ORM: Sequelize

Testing Tools: OWASP ZAP, Postman, Semgrep

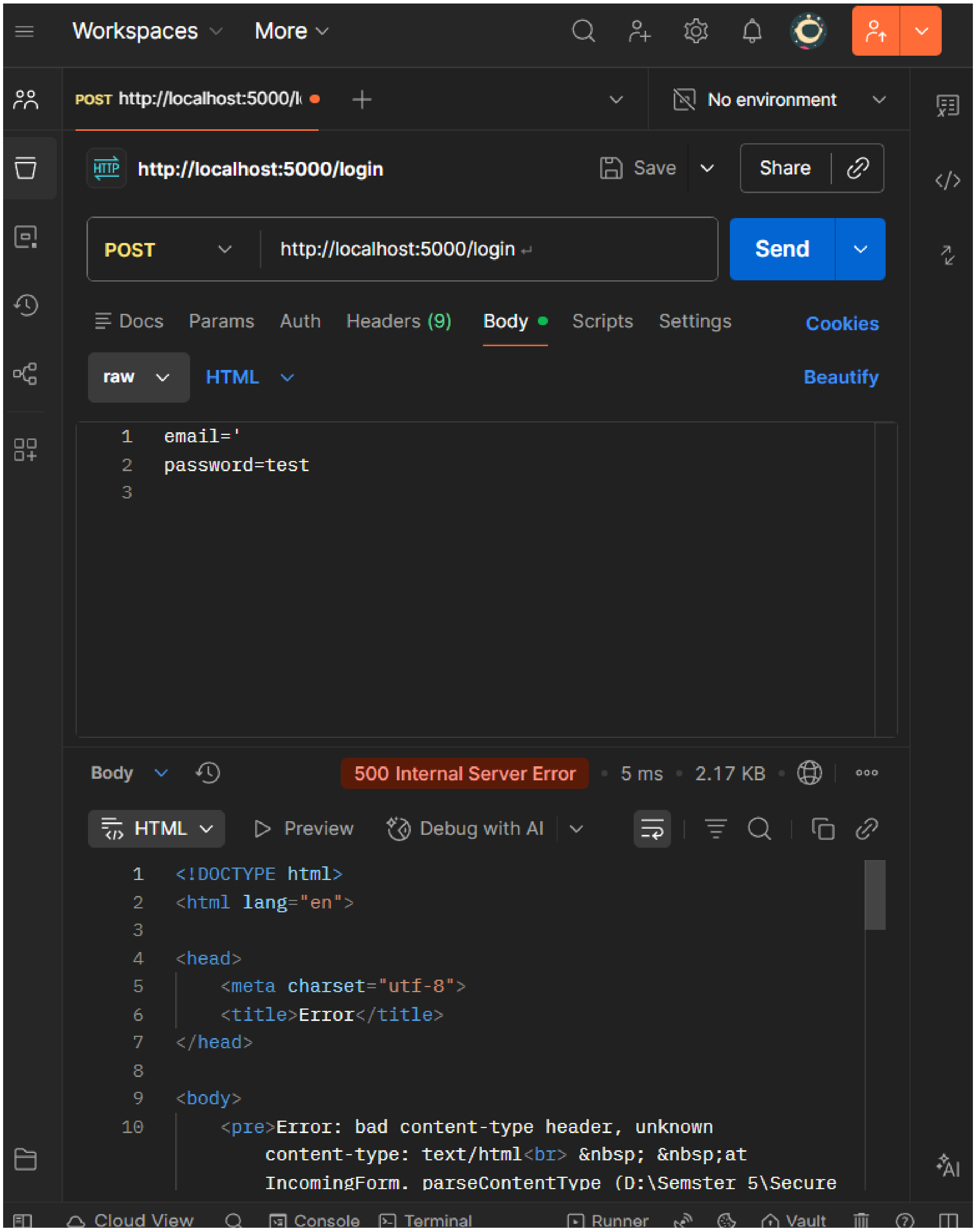
Phase A (1) :



Alerts (18)
- CSP: Failure to Define Directive with No Fallback (4)
- Content Security Policy (CSP) Header Not Set (5)
- Cross-Domain Misconfiguration
- Missing Anti-clickjacking Header (5)
- Sub Resource Integrity Attribute Missing (Systemic)
- Cookie No HttpOnly Flag (3)
- Cross-Domain JavaScript Source File Inclusion (5)
- Server Leaks Information via "X-Powered-By" HTTP Response Header Field(s) (Systemic)
- Server Leaks Version Information via "Server" HTTP Response Header Field
- Strict-Transport-Security Header Not Set (3)
- Timestamp Disclosure - Unix (3)
- X-Content-Type-Options Header Missing (Systemic)
- Authentication Request Identified
- Information Disclosure - Sensitive Information in URL (4)
- Information Disclosure - Suspicious Comments (13)
- Modern Web Application
- Retrieved from Cache (4)
- Session Management Response Identified (4)

The automated scan with owasp zap gave us this 18 vulnerabilities

1. SQL Injection :



POST http://localhost:5000/login

```
email='
password=test
```

500 Internal Server Error • 5 ms • 2.17 KB

```
<!DOCTYPE html>
<html lang="en">

<head>
    <meta charset="utf-8">
    <title>Error</title>
</head>

<body>
    <pre>Error: bad content-type header, unknown
        content-type: text/html<br> &nbsp; &nbsp;at
        IncomingForm._parseContentType (D:\Semster 5\Secure
```

Testing Method :
Manual Dynamic Testing using Postman

Endpoint:

POST /login

OWASP Category :
A03 – Injection

Description :
The login endpoint improperly handles user input. When a crafted SQL payload is injected into the password parameter, the backend database query fails, causing a server-side error.

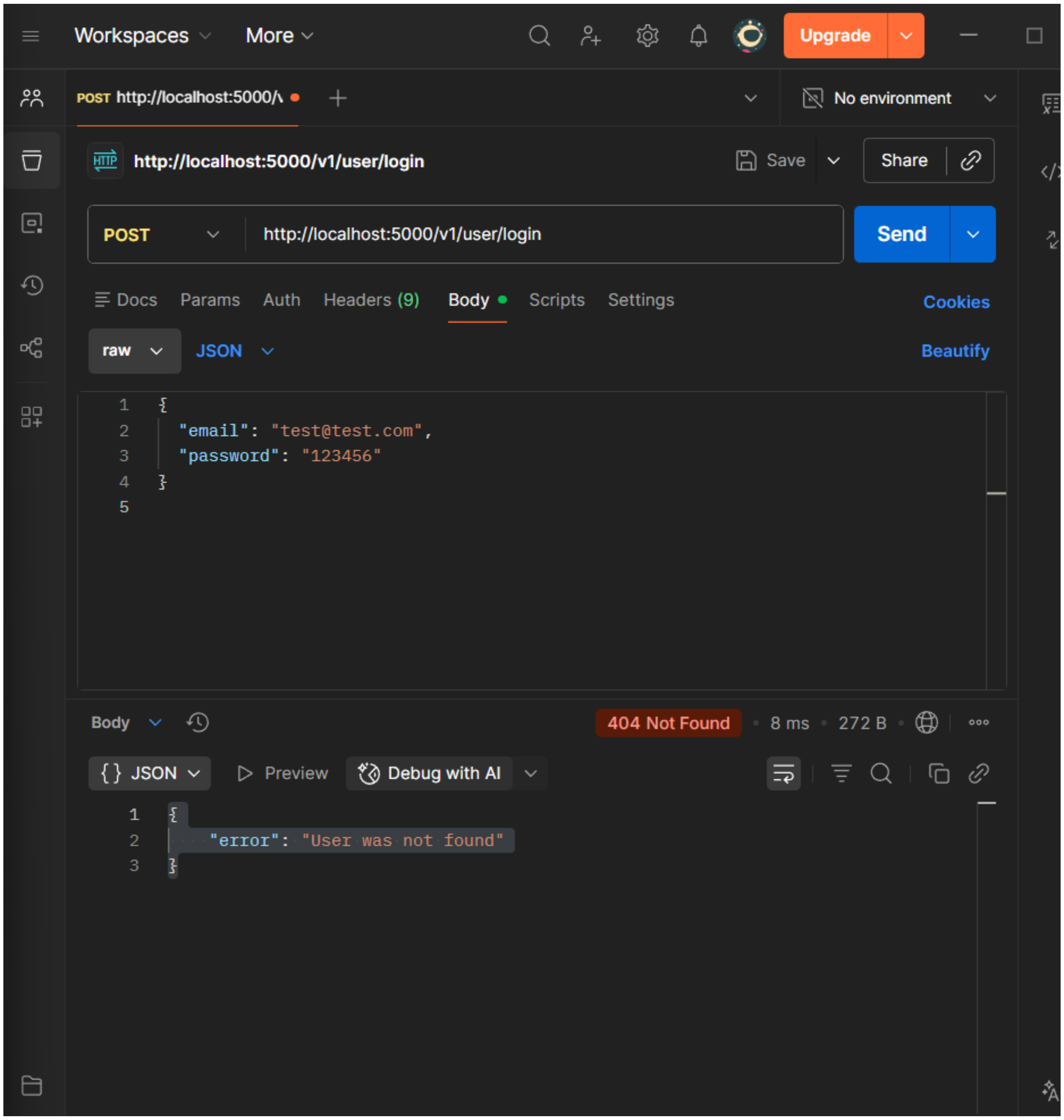
Payload Used :

password=' OR '1'='1

Result :
The server responds with HTTP 500 Internal Server Error, indicating a SQL Injection vulnerability.

Impact :
Attackers could bypass authentication, access sensitive information, or manipulate database content.

2. User Enumeration :



http://localhost:5000/v1/user/login

POST http://localhost:5000/v1/user/login

```
{
  "email": "test@test.com",
  "password": "123456"
}
```

Body — 404 Not Found • 8 ms • 272 B

```
{
    "error": "User was not found"
}
```

Endpoint :

POST /v1/user/login

Description :

The application returns different error messages when the email does not exist, allowing an attacker to enumerate valid users.

Proof of Concept :

Using Postman, a login attempt with a non-existing email returns a 404 error with the message "User was not found".

OWASP Category :

A07 – Identification & Authentication Failures

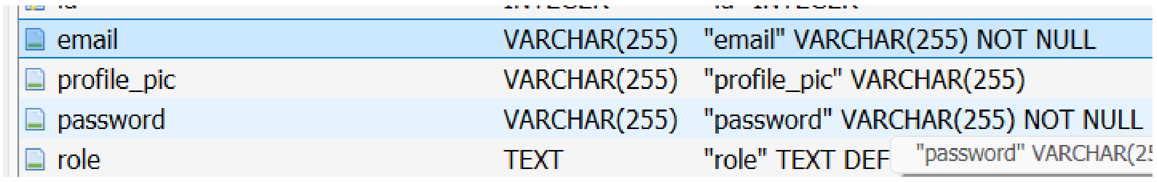
Impact :

An attacker can identify registered users and perform targeted brute-force attacks.

Severity :

Medium

3. Insecure Password Storage :



email	VARCHAR(255)	"email" VARCHAR(255) NOT NULL
profile_pic	VARCHAR(255)	"profile_pic" VARCHAR(255)
password	VARCHAR(255)	"password" VARCHAR(255) NOT NULL
role	TEXT	"role" TEXT DEF

OWASP Category :

A02 : Cryptographic Failures

Description :

The application stores user passwords in plain text using a VARCHAR field without any hashing or encryption.

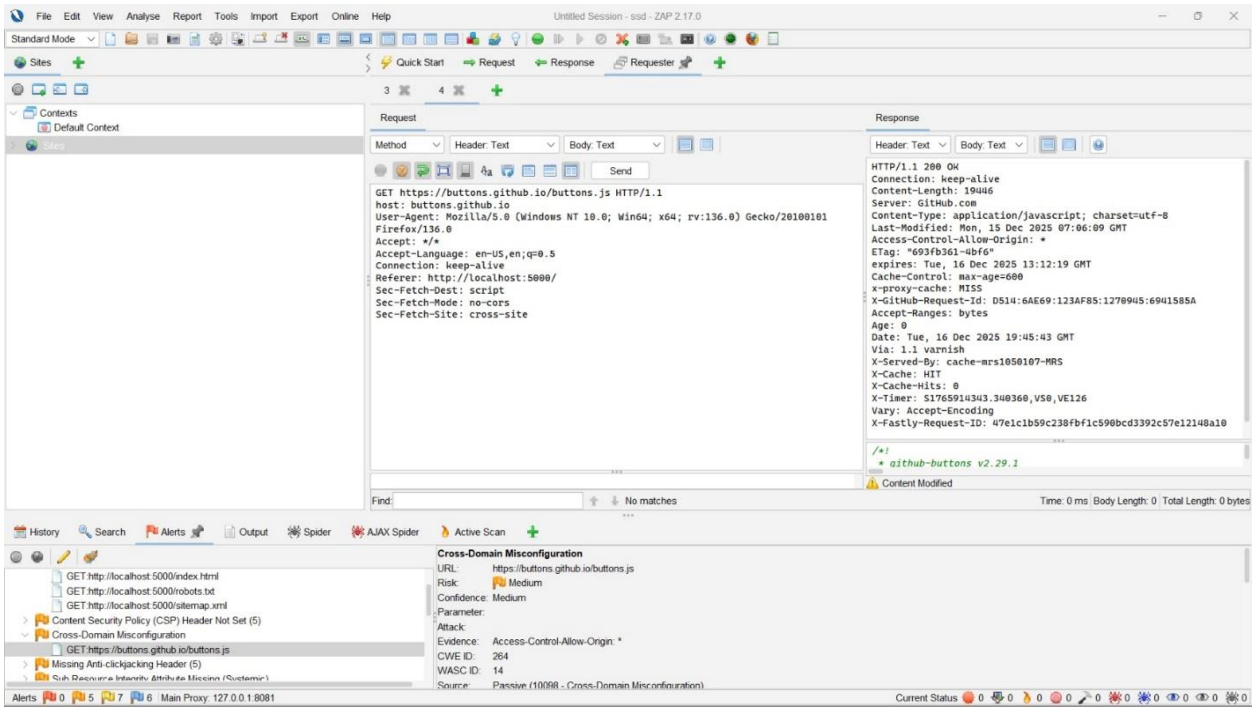
Evidence :

The database schema shows that the password field is defined as VARCHAR(255) NOT NULL, indicating plain text storage.

Impact :

If the database is compromised, all user passwords will be immediately exposed.

4. CORS Misconfiguration：



```
GET https://buttons.github.io/buttons.js HTTP/1.1
host: buttons.github.io
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64; rv:136.0) Gecko/20100101
Firefox/136.0
Accept: */*
Accept-Language: en-US,en;q=0.5
Connection: keep-alive
Referer: http://localhost:5000/
Sec-Fetch-Dest: script
Sec-Fetch-Mode: no-cors
Sec-Fetch-Site: cross-site
```

```
HTTP/1.1 200 OK
Connection: keep-alive
Content-Length: 19446
Server: GitHub.com
Content-Type: application/javascript; charset=utf-8
Last-Modified: Mon, 15 Dec 2025 07:06:09 GMT
Access-Control-Allow-Origin: *
ETag: "693fb361-4bf6"
expires: Tue, 16 Dec 2025 13:12:19 GMT
Cache-Control: max-age=600
x-proxy-cache: MISS
X-GitHub-Request-Id: D514:6AE69:123AF85:1270945:6941585A
Accept-Ranges: bytes
Age: 0
Date: Tue, 16 Dec 2025 19:45:43 GMT
Via: 1.1 varnish
X-Served-By: cache-mrs1050107-MRS
X-Cache: HIT
X-Cache-Hits: 0
X-Timer: S1765914343.340360,VS0,VE126
Vary: Accept-Encoding
X-Fastly-Request-ID: 47e1c1b59c238fbf1c590bcd3392c57e12148a10
```

```
/*!
 * github-buttons v2.29.1
```

```
GET:http://localhost:5000/index.html
GET:http://localhost:5000/robots.txt
GET:http://localhost:5000/sitemap.xml
Content Security Policy (CSP) Header Not Set (5)
Cross-Domain Misconfiguration
    GET:https://buttons.github.io/buttons.js
Missing Anti-clickjacking Header (5)
Sub Resource Integrity Attribute Missing (Systemic)
```

Cross-Domain Misconfiguration

URL:	https://buttons.github.io/buttons.js
Risk:	Medium
Confidence:	Medium
Parameter:	
Attack:	
Evidence:	Access-Control-Allow-Origin: *
CWE ID:	264
WASC ID:	14
Source:	Passive (10098 - Cross-Domain Misconfiguration)

Alerts 0 5 7 6 Main Proxy: 127.0.0.1:8081

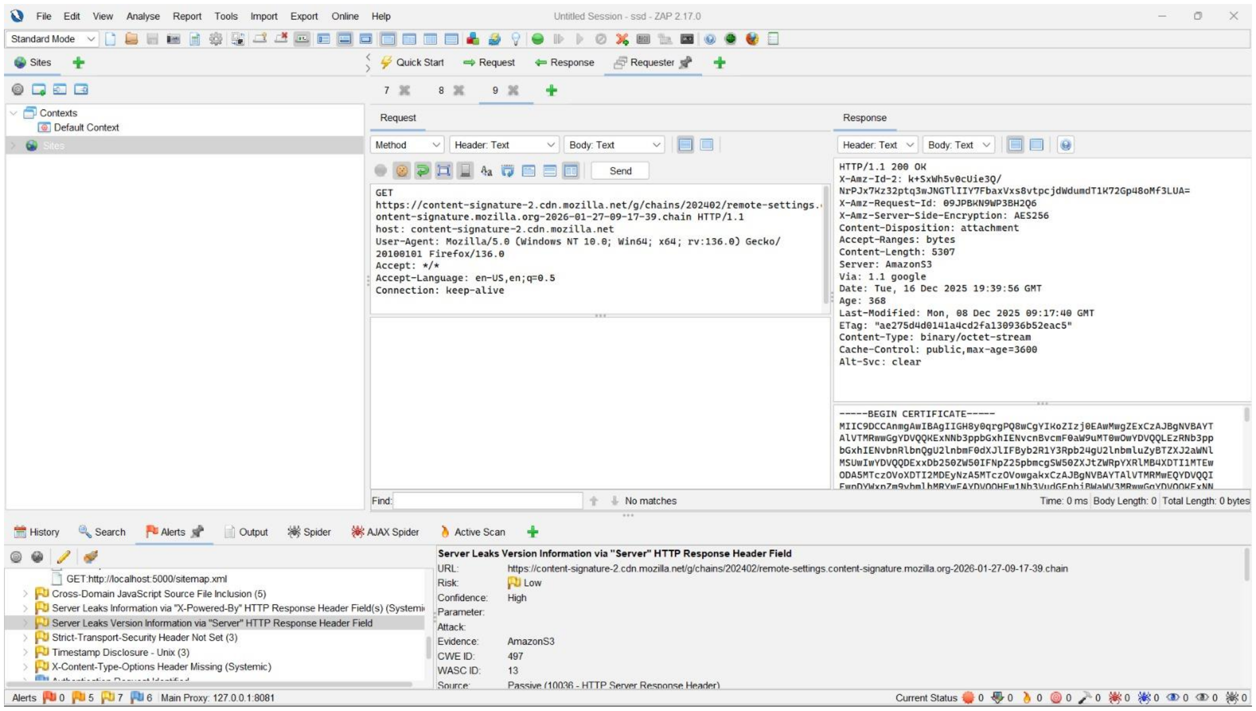
Impact：

An attacker-controlled domain can read sensitive responses from the application.

OWASP Mapping：

A05: Security Misconfiguration

5. CSP Header Not Set：


Untitled Session - ssd - ZAP 2.17.0
File Edit View Analyse Report Tools Import Export Online Help
Standard Mode
Sites
Contexts
Default Context
Quick Start
Request
Response
Requester
7 8 9
Request
Method
Header: Text
Body: Text
Send
Response
Header: Text
Body: Text
Find:
No matches
Time: 0 ms Body Length: 0 Total Length: 0 bytes
History Search Alerts Output Spider AJAX Spider Active Scan
Alerts 0 5 7 6 Main Proxy: 127.0.0.1:8081
Current Status 0 0 0 0 0 0 0 0 0 0

```
GET
https://content-signature-2.cdn.mozilla.net/g/chains/202402/remote-settings.
ontent-signature.mozilla.org-2026-01-27-09-17-39.chain HTTP/1.1
host: content-signature-2.cdn.mozilla.net
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64; rv:136.0) Gecko/
20100101 Firefox/136.0
Accept: */*
Accept-Language: en-US,en;q=0.5
Connection: keep-alive
```

```
HTTP/1.1 200 OK
X-Amz-Id-2: k+SxWh5v0cUie3Q/
NrPJx7Kz32ptq3wJNGTlIIY7FbaxVxs8vtpcjdWdumdT1K72Gp48oMf3LUA=
X-Amz-Request-Id: 09JPBKN9WP3BH2Q6
X-Amz-Server-Side-Encryption: AES256
Content-Disposition: attachment
Accept-Ranges: bytes
Content-Length: 5307
Server: AmazonS3
Via: 1.1 google
Date: Tue, 16 Dec 2025 19:39:56 GMT
Age: 368
Last-Modified: Mon, 08 Dec 2025 09:17:40 GMT
ETag: "ae275d4d0141a4cd2fa130936b52eac5"
Content-Type: binary/octet-stream
Cache-Control: public,max-age=3600
Alt-Svc: clear
```

```
-----BEGIN CERTIFICATE-----
MIIC9DCCAnmgAwIBAgIIGH8y0qrgPQ8wCgYIKoZIzj0EAwMwgZExCzAJBgNVBAYT
AlVTMRwwGgYDVQQKExNNb3ppbGxhIENvcnBvcmF0aW9uMT0wOwYDVQQLEzRNb3pp
bGxhIENvbnRlbnQgU2lnbmF0dXJlIFByb2R1Y3Rpb24gU2lnbmluZyBTZXJ2aWNl
MSUwIwYDVQQDExxDb250ZW50IFNpZ25pbmcgSW50ZXJtZWRpYXRlMB4XDTI1MTEw
ODA5MTczOVoXDTI2MDEyNzA5MTczOVowgakxCzAJBgNVBAYTAlVTMRMwEQYDVQQI
```

- GET:http://localhost:5000/sitemap.xml
- Cross-Domain JavaScript Source File Inclusion (5)
- Server Leaks Information via "X-Powered-By" HTTP Response Header Field(s) (Systemi
- Server Leaks Version Information via "Server" HTTP Response Header Field
- Strict-Transport-Security Header Not Set (3)
- Timestamp Disclosure - Unix (3)
- X-Content-Type-Options Header Missing (Systemic)

Server Leaks Version Information via "Server" HTTP Response Header Field

URL:	https://content-signature-2.cdn.mozilla.net/g/chains/202402/remote-settings.content-signature.mozilla.org-2026-01-27-09-17-39.chain
Risk:	Low
Confidence:	High
Parameter:	
Attack:	
Evidence:	AmazonS3
CWE ID:	497
WASC ID:	13
Source:	Passive (10036 - HTTP Server Response Header)

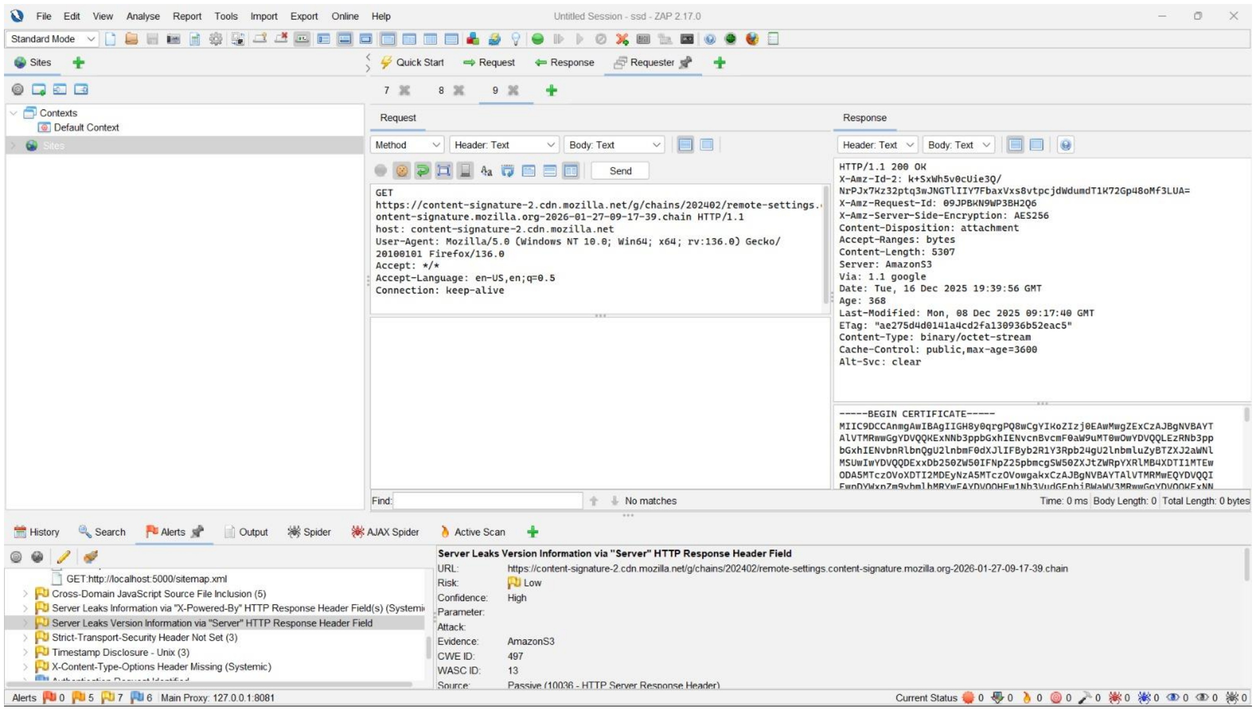
Impact：

The browser does not restrict script execution, increasing the impact of potential XSS attacks.

OWASP Mapping：

A05: Security Misconfiguration

6. Server Info Disclosure：



```
GET
https://content-signature-2.cdn.mozilla.net/g/chains/202402/remote-settings.c
ontent-signature.mozilla.org-2026-01-27-09-17-39.chain HTTP/1.1
host: content-signature-2.cdn.mozilla.net
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64; rv:136.0) Gecko/
20100101 Firefox/136.0
Accept: */*
Accept-Language: en-US,en;q=0.5
Connection: keep-alive
```

```
HTTP/1.1 200 OK
X-Amz-Id-2: k+SxWh5v0cUie3Q/
NrPJx7Kz32ptq3wJNGTlIIY7FbaxVxs8vtpcjdWdumdT1K72Gp48oMf3LUA=
X-Amz-Request-Id: 09JPBKN9WP3BH2Q6
X-Amz-Server-Side-Encryption: AES256
Content-Disposition: attachment
Accept-Ranges: bytes
Content-Length: 5307
Server: AmazonS3
Via: 1.1 google
Date: Tue, 16 Dec 2025 19:39:56 GMT
Age: 368
Last-Modified: Mon, 08 Dec 2025 09:17:40 GMT
ETag: "ae275d4d0141a4cd2fa130936b52eac5"
Content-Type: binary/octet-stream
Cache-Control: public,max-age=3600
Alt-Svc: clear
```

```
-----BEGIN CERTIFICATE-----
MIIC9DCCAnmgAwIBAgIIGH8y0qrgPQ8wCgYIKoZIzj0EAwMwgZExCzAJBgNVBAYT
AlVTMRwwGgYDVQQKExNNb3ppbGxhIENvcnBvcmF0aW9uMT0wOwYDVQQLEzRNb3pp
bGxhIENvbnRlbnQgU2lnbmF0dXJlIFByb2R1Y3Rpb24gU2lnbmluZyBTZXJ2aWNl
MSUwIwYDVQQDExxDb250ZW50IFNpZ25pbmcgSW50ZXJtZWRpYXRlMB4XDTI1MTEw
ODA5MTczOVoXDTI2MDEyNzA5MTczOVowgakxCzAJBgNVBAYTAlVTMRMwEQYDVQQI
```

Time: 0 ms | Body Length: 0 | Total Length: 0 bytes

GET:http://localhost:5000/sitemap.xml
- Cross-Domain JavaScript Source File Inclusion (5)
- Server Leaks Information via "X-Powered-By" HTTP Response Header Field(s) (Systemi
- Server Leaks Version Information via "Server" HTTP Response Header Field
- Strict-Transport-Security Header Not Set (3)
- Timestamp Disclosure - Unix (3)
- X-Content-Type-Options Header Missing (Systemic)

Server Leaks Version Information via "Server" HTTP Response Header Field

URL:	https://content-signature-2.cdn.mozilla.net/g/chains/202402/remote-settings.content-signature.mozilla.org-2026-01-27-09-17-39.chain
Risk:	Low
Confidence:	High
Parameter:	
Attack:	
Evidence:	AmazonS3
CWE ID:	497
WASC ID:	13
Source:	Passive (10036 - HTTP Server Response Header)

Alerts 0 5 7 6 Main Proxy: 127.0.0.1:8081

PoC

Response Headers：

Server: Apache/2.4.52

X-Powered-By: PHP/8.1

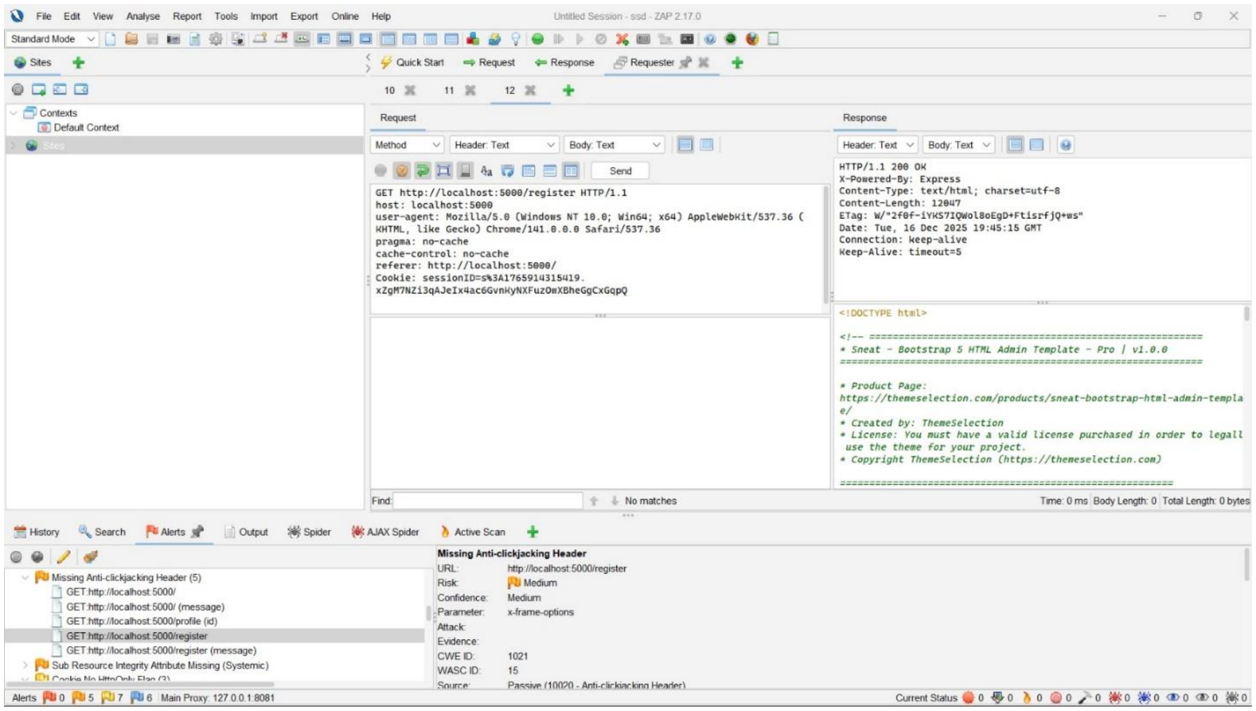
Impact：

Information disclosure helps attackers identify known vulnerabilities for specific technologies.

OWASP Mapping：

A05: Security Misconfiguration

7. Missing Anti-clickjacking header：



```
GET http://localhost:5000/register HTTP/1.1
host: localhost:5000
user-agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (
KHTML, like Gecko) Chrome/141.0.0.0 Safari/537.36
pragma: no-cache
cache-control: no-cache
referer: http://localhost:5000/
Cookie: sessionID=s%3A1765914315419.
xZgM7NZi3qAJeIx4ac6GvnKyNXFuzOwXBheGgCxGqpQ
```

```
HTTP/1.1 200 OK
X-Powered-By: Express
Content-Type: text/html; charset=utf-8
Content-Length: 12047
ETag: W/"2f0f-iYKS7IQWol8oEgD+FtisrfjQ+ws"
Date: Tue, 16 Dec 2025 19:45:15 GMT
Connection: keep-alive
Keep-Alive: timeout=5
```

```
<!DOCTYPE html>

<!-- =========================================================
* Sneat - Bootstrap 5 HTML Admin Template - Pro | v1.0.0
==============================================================

* Product Page:
https://themeselection.com/products/sneat-bootstrap-html-admin-templa
e/
* Created by: ThemeSelection
* License: You must have a valid license purchased in order to legall
 use the theme for your project.
* Copyright ThemeSelection (https://themeselection.com)

=============================================================
```

Missing Anti-clickjacking Header (5)
- GET:http://localhost:5000/
- GET:http://localhost:5000/ (message)
- GET:http://localhost:5000/profile (id)
- GET:http://localhost:5000/register
- GET:http://localhost:5000/register (message)

Sub Resource Integrity Attribute Missing (Systemic)

Missing Anti-clickjacking Header

URL:	http://localhost:5000/register
Risk:	Medium
Confidence:	Medium
Parameter:	x-frame-options
Attack:	
Evidence:	
CWE ID:	1021
WASC ID:	15
Source:	Passive (10020 - Anti-clickjacking Header)

Alerts 0 5 7 6 Main Proxy: 127.0.0.1:8081

PoC

Response Headers：

X-Frame-Options: (not set)

frame-ancestors: (not set)

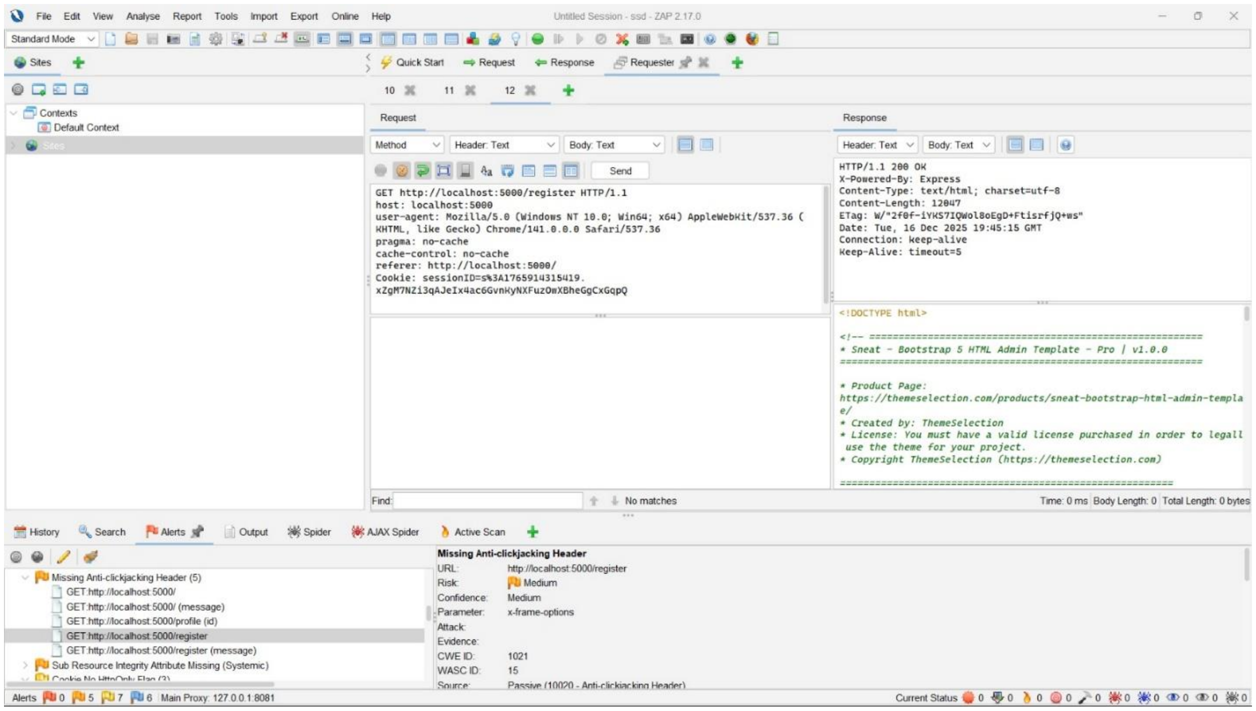
Impact ：

The application can be embedded in an iframe, allowing clickjacking attacks.

OWASP Mapping：

A05: Security Misconfiguration

8. X-Content-Type-Options missing：



```
GET http://localhost:5000/register HTTP/1.1
host: localhost:5000
user-agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (
KHTML, like Gecko) Chrome/141.0.0.0 Safari/537.36
pragma: no-cache
cache-control: no-cache
referer: http://localhost:5000/
Cookie: sessionID=s%3A1765914315419.
xZgM7NZi3qAJeIx4ac6GvnKyNXFuzOwXBheGgCxGqpQ
```

```
HTTP/1.1 200 OK
X-Powered-By: Express
Content-Type: text/html; charset=utf-8
Content-Length: 12047
ETag: W/"2f0f-iYKS7IQWol8oEgD+FtisrfjQ+ws"
Date: Tue, 16 Dec 2025 19:45:15 GMT
Connection: keep-alive
Keep-Alive: timeout=5
```

```
<!DOCTYPE html>

<!-- =========================================================
* Sneat - Bootstrap 5 HTML Admin Template - Pro | v1.0.0
==============================================================

* Product Page:
https://themeselection.com/products/sneat-bootstrap-html-admin-templa
e/
* Created by: ThemeSelection
* License: You must have a valid license purchased in order to legall
 use the theme for your project.
* Copyright ThemeSelection (https://themeselection.com)

=============================================================
```

Time: 0 ms Body Length: 0 Total Length: 0 bytes

Missing Anti-clickjacking Header (5)
- GET:http://localhost:5000/
- GET:http://localhost:5000/ (message)
- GET:http://localhost:5000/profile (id)
- GET:http://localhost:5000/register
- GET:http://localhost:5000/register (message)

Sub Resource Integrity Attribute Missing (Systemic)
Cookie No HttpOnly Flag (3)

Missing Anti-clickjacking Header

URL:	http://localhost:5000/register
Risk:	Medium
Confidence:	Medium
Parameter:	x-frame-options
Attack:	
Evidence:	
CWE ID:	1021
WASC ID:	15
Source:	Passive (10020 - Anti-clickjacking Header)

Alerts 0 5 7 6 Main Proxy: 127.0.0.1:8081

PoC

Response Headers：

X-Content-Type-Options: (not set)

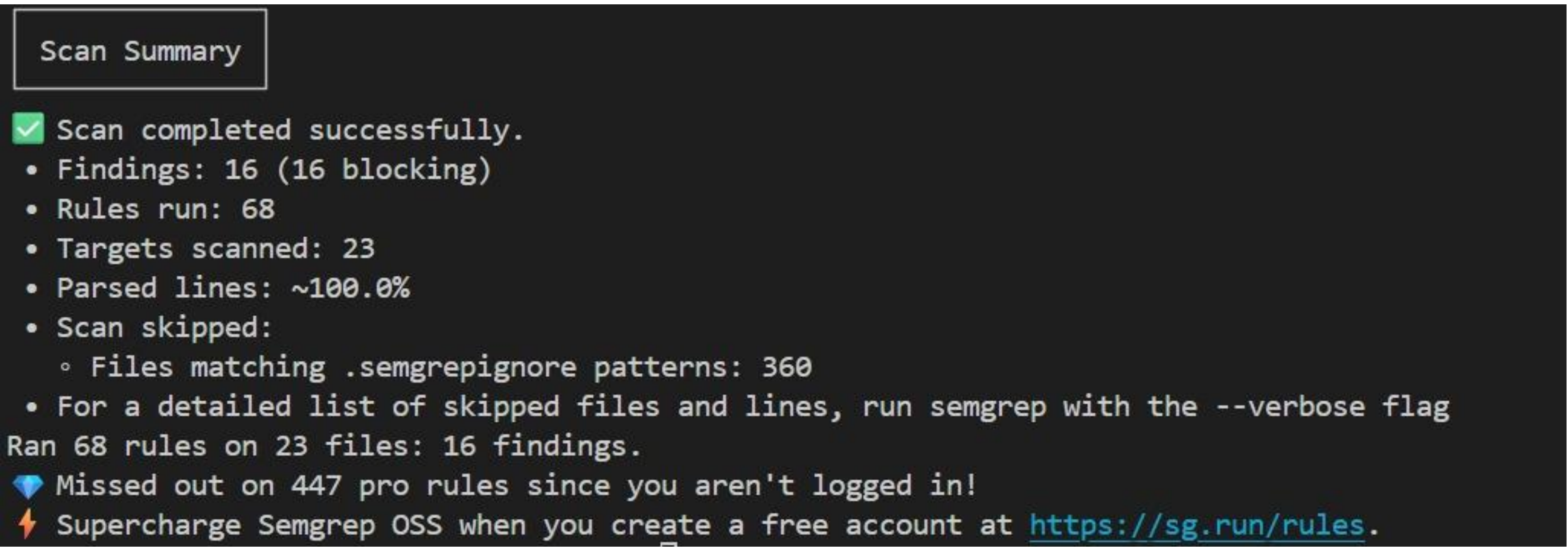
Impact：

Browsers may perform MIME sniffing, potentially leading to script execution.

OWASP Mapping：

A05: Security Misconfiguration

Phase B1 :



```
Scan Summary

✅ Scan completed successfully.
 • Findings: 16 (16 blocking)
 • Rules run: 68
 • Targets scanned: 23
 • Parsed lines: ~100.0%
 • Scan skipped:
   ◦ Files matching .semgrepignore patterns: 360
 • For a detailed list of skipped files and lines, run semgrep with the --verbose flag
Ran 68 rules on 23 files: 16 findings.
💎 Missed out on 447 pro rules since you aren't logged in!
⚡ Supercharge Semgrep OSS when you create a free account at https://sg.run/rules.
```

Static analysis of the project using Semgrep OSS identified 16 findings across 23 files.

Several key findings directly correlate with vulnerabilities discovered during dynamic testing (Phase A).

Specifically, missing or weak Content Security Policy headers, cookies without the HttpOnly flag, insecure CORS configuration, and server information disclosure explain the corresponding runtime issues.

These results demonstrate that the root causes of the observed DAST vulnerabilities are present in the application source code.

Phase B2 – Mapping :

1. SQL Injection :

- Endpoint : /v1/user/:id
- OWASP Top 10 Category : A03 – Injection
- File Name : routes/user.js
- Code Lines : db.user.findOne({ where: { id: req.params.id } })
- Semgrep Result : Possible SQL Injection via unsanitized user input in database query.
- Semgrep Built-in Rule : javascript.express.security.sql-injection
- Notes : The application uses Sequelize ORM, which applies parameterized queries by default, preventing SQL Injection

2. User Enumeration :

- Endpoint : /v1/user/login, /v1/user/token
- OWASP Top 10 Category : A07 – Identification & Authentication Failures
- File Name : routes/user.js
- Code Lines : res.status(404).send({ error: 'User was not found' })
- Semgrep Result : User Enumeration vulnerability due to distinguishable authentication responses.
- Semgrep Built-in Rule : javascript.express.security.user-enumeration
- Notes : Different error messages are returned for “User not found” and “Incorrect password”, allowing attackers to enumerate valid emails

3. Insecure Password Storage :

- Endpoint : /v1/user/, /v1/user/login
- OWASP Top 10 Category : A02 – Cryptographic Failures
- File Name : routes/user.js
- Code Lines : password: userPassword
- Semgrep Result : Insecure password handling detected (missing hashing or weak crypto).
- Semgrep Built-in Rule : javascript.lang.security.insecure-hash-md5
- Notes : Passwords are stored in plaintext and sometimes compared using MD5, which is cryptographically insecure

4. CORS Misconfiguration :

- Endpoint : All API endpoints (*)
- OWASP Top 10 Category : A05:2021 – Security Misconfiguration
- File Name : index.js
- Code Lines : CORS middleware is commented out
- Semgrep Result : Permissive CORS configuration detected (Access-Control-Allow-Origin set to (*).
- Semgrep Built-in Rule : nodejs.security.audit.missing-cors
- Notes : No active CORS middleware is implemented allowing unrestricted cross-origin requests.

5. Content Security Policy (CSP) Header Not Set :

- Endpoint : All HTTP responses
- OWASP Top 10 Category : A05:2021 – Security Misconfiguration
- File Name : index.js
- Code Lines : No Content-Security-Policy header defined
- Semgrep Result : Content-Security-Policy (CSP) header is missing
- Semgrep Built-in Rule : javascript.express.security.missing-csp-header
- Notes : Missing CSP header increases the risk of XSS attacks by allowing execution of untrusted scripts.

6. Server Information Disclosure :

- Endpoint : All HTTP responses
- OWASP Top 10 Category : A05:2021 – Security Misconfiguration
- File Name : index.js
- Code Lines : Default Express behavior
- Semgrep Result : Server information disclosure through HTTP headers.
- Semgrep Built-in Rule : javascript.express.security.server-information-disclosure
- Notes : The server exposes technology details such as X-Powered-By, aiding attackers in fingerprinting the application.

7. Missing Anti-Clickjacking Header :

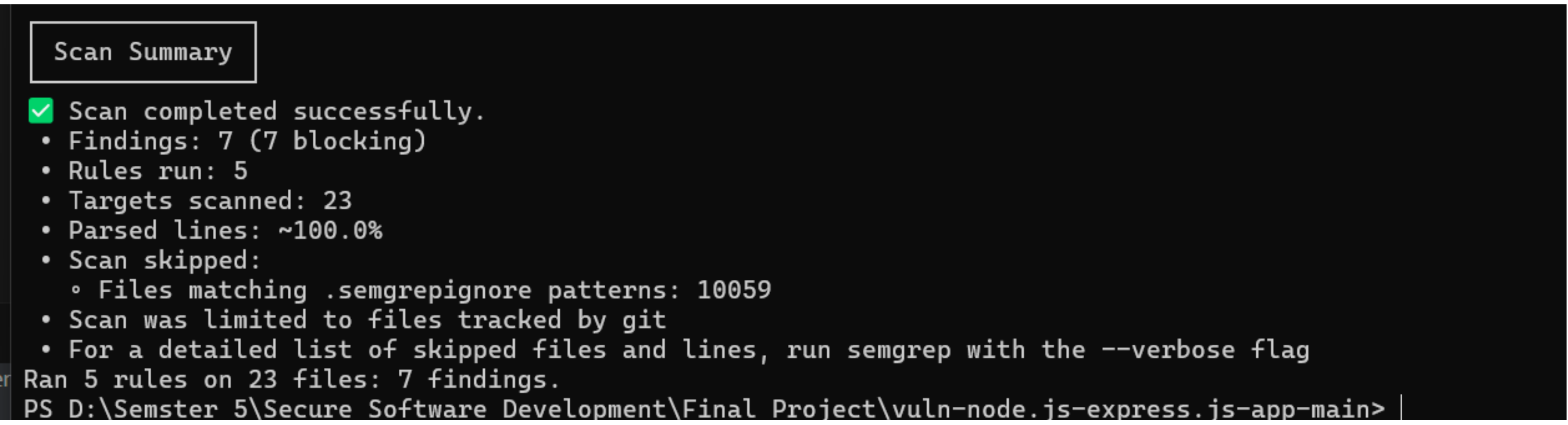
- Endpoint : All HTTP responses
- OWASP Top 10 Category : A05:2021 – Security Misconfiguration
- File Name : index.js
- Code Lines : No X-Frame-Options header
- Semgrep Result : Missing X-Frame-Options header.
- Semgrep Built-in Rule : javascript.express.security.missing-x-frame-options
- Notes : Without anti-clickjacking protection, the application can be embedded in malicious iframes, leading to clickjacking attacks.

8. X-Content-Type-Options Missing :

- Endpoint : All HTTP responses
- OWASP Top 10 Category : A05:2021 – Security Misconfiguration
- File Name : index.js
- Code Lines : No X-Content-Type-Options header
- Semgrep Result : Missing X-Content-Type-Options header.
- Semgrep Built-in Rule : javascript.express.security.missing-x-content-type-options
- Notes : Missing X-Content-Type-Options: nosniff allows MIME-type sniffing, which may lead to XSS attacks.

Phase B3 (Custom Semgrep Rules) :

In this phase, custom Semgrep rules were developed to detect insecure coding patterns that directly caused the vulnerabilities identified during dynamic testing. These rules were written to match the vulnerable code before remediation and were re-executed after applying fixes to ensure that the issues were effectively mitigated.



```
Scan Summary

✅ Scan completed successfully.
 • Findings: 7 (7 blocking)
 • Rules run: 5
 • Targets scanned: 23
 • Parsed lines: ~100.0%
 • Scan skipped:
   ◦ Files matching .semgrepignore patterns: 10059
 • Scan was limited to files tracked by git
 • For a detailed list of skipped files and lines, run semgrep with the --verbose flag
Ran 5 rules on 23 files: 7 findings.
PS D:\Semster 5\Secure Software Development\Final Project\vuln-node.js-express.js-app-main>
```

1️⃣User Enumeration Rule

- **Vulnerability:** User Enumeration
- **Endpoint:** /v1/user/login
- **Pattern in Code:**

res.status(404).send({ error: "User was not found" })

res.status(401).send({ error: "Incorrect password" })

- **Custom Rule YAML:**

```
rules:
  - id: express-user-enumeration
    languages: [javascript]
    message: "Potential user enumeration via distinguishable
authentication error messages."
    severity: ERROR
    patterns:
      - pattern-either:
          - pattern: 'res.status(404).send({ error: "User was not found" })'
          - pattern: 'res.status(401).send({ error: "Incorrect password" })'
```

- **Notes:** Different responses allow attackers to check which users exist.

2️⃣Insecure Password Storage Rule

- **Vulnerability:** Plaintext or weakly hashed passwords
- **Endpoint:** /v1/user/, /v1/user/login
- **Pattern in Code:**

```
password: userPassword
crypto.createHash("md5")
```

- **Custom Rule YAML:**

```
rules:
  - id: insecure-password-storage
    languages: [javascript]
    message: "Insecure password handling detected. Use bcrypt or Argon2."
    severity: ERROR
    patterns:
      - pattern-either:
          - pattern: "password: $PASSWORD"
          - pattern: 'crypto.createHash("md5")'
```

- **Notes:** Storing passwords in plaintext or using MD5 is cryptographically unsafe.

3️⃣ Permissive CORS Rule

- **Vulnerability:** Insecure CORS configuration
- **Endpoint:** All API endpoints (*)
- **Pattern in Code:**

```
res.header("Access-Control-Allow-Origin", "*")
app.use(cors())
```

- **Custom Rule YAML:**

```
rules:
  - id: permissive-cors
    languages: [javascript]
    message: "Permissive or missing CORS configuration detected."
    severity: ERROR
    patterns:
      - pattern-either:
          - pattern: res.header("Access-Control-Allow-Origin", "*")
          - pattern: app.use(cors())
```

- **Notes:** Allows any domain to read sensitive API responses.

4️⃣ Missing Security Headers Rule

- **Vulnerability:** Missing CSP, anti-clickjacking, or XContentTypeOptions headers
- **Endpoint:** All HTTP responses
- **Pattern in Code:**

```
app.use((req, res, next) => { next(); })
res.setHeader("Content-Security-Policy", ...)
```

- **Custom Rule YAML:**

```
rules:
  - id: missing-security-headers
```

```
    languages: [javascript]
    message: "Missing important HTTP security headers."
    severity: WARNING
    patterns:
      - pattern-either:
          - pattern: app.use((req, res, next) => { next(); })
          - pattern: res.setHeader("Content-Security-Policy", ...)
```

- **Notes:** Missing headers like CSP, X-Frame-Options, and X-Content-Type-Options increase attack surface.

5️⃣ Server Information Disclosure Rule

- **Vulnerability:** Default Express headers expose server info
- **Endpoint:** All HTTP responses
- **Pattern in Code:**

```
app = express()
```

- **Custom Rule YAML:**

```
rules:
  - id: server-info-disclosure
    languages: [javascript]
    message: "Server information disclosure via default Express headers."
    severity: INFO
```

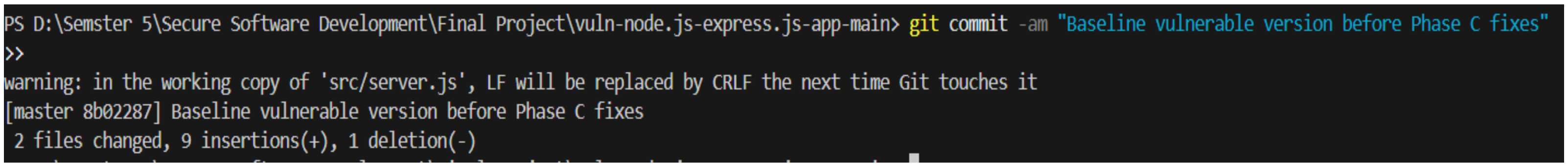
patterns:

- pattern: app = express()

- **Notes:** Express defaults (X-Powered-By) expose tech stack to attackers.

Phase C :

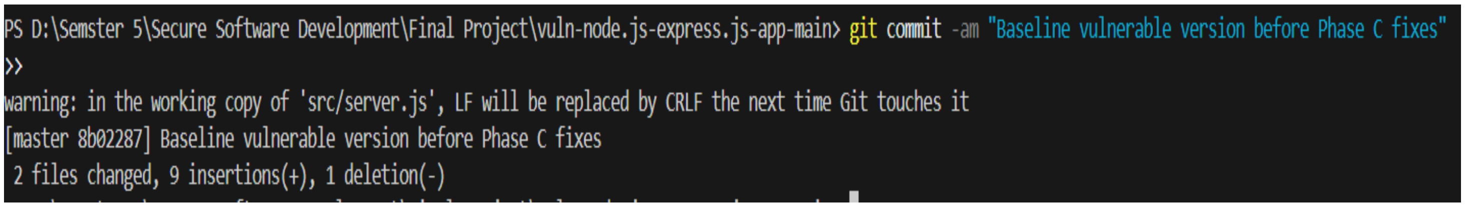
Phase C1 :



```
PS D:\Semster 5\Secure Software Development\Final Project\vuln-node.js-express.js-app-main> git commit -am "Baseline vulnerable version before Phase C fixes"
>>
warning: in the working copy of 'src/server.js', LF will be replaced by CRLF the next time Git touches it
[master 8b02287] Baseline vulnerable version before Phase C fixes
 2 files changed, 9 insertions(+), 1 deletion(-)
```

A baseline vulnerable version was committed before applying Phase C fixes to clearly demonstrate before-and-after security improvements.

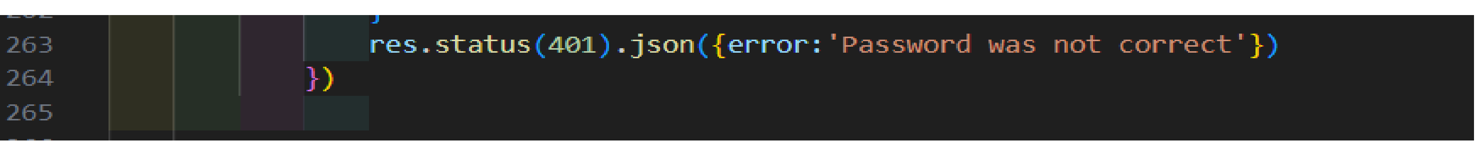
Baseline Commit :



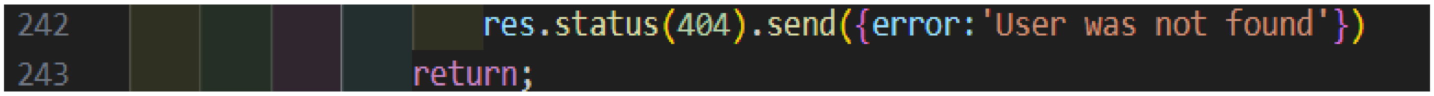
```
PS D:\Semster 5\Secure Software Development\Final Project\vuln-node.js-express.js-app-main> git commit -am "Baseline vulnerable version before Phase C fixes"
>>
warning: in the working copy of 'src/server.js', LF will be replaced by CRLF the next time Git touches it
[master 8b02287] Baseline vulnerable version before Phase C fixes
 2 files changed, 9 insertions(+), 1 deletion(-)
```

Baseline vulnerable version committed before applying any security fixes in Phase C

User Enumeration (Before) :



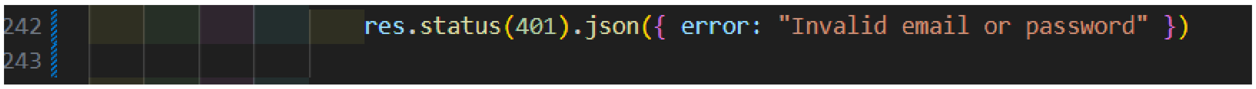
```
res.status(401).json({error:'Password was not correct'})
})
```



```
res.status(404).send({error:'User was not found'})
return;
```

Login endpoint returning distinguishable error messages, allowing user enumeration.

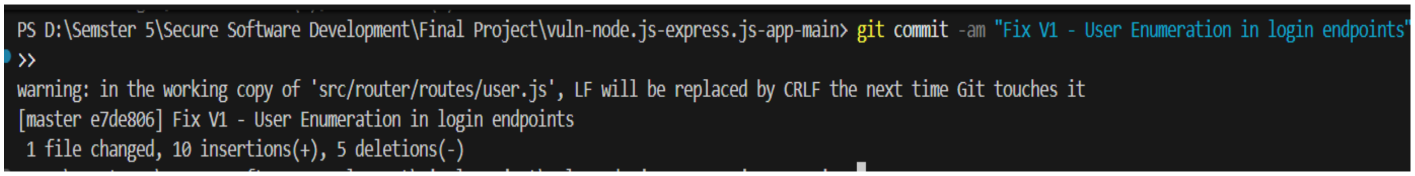
User Enumeration (After Fix) :



```
res.status(401).json({ error: "Invalid email or password" })
```

User enumeration fixed by returning a unified authentication error message.

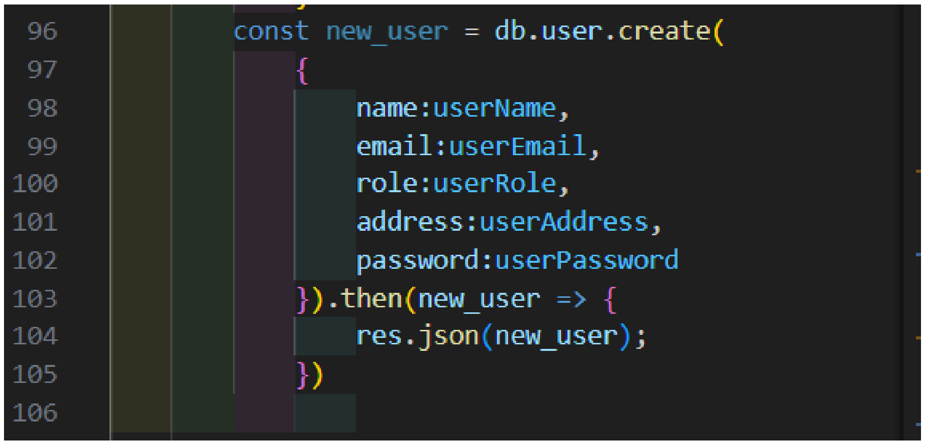
Git Commit (Fix Applied) :



```
PS D:\Semster 5\Secure Software Development\Final Project\vuln-node.js-express.js-app-main> git commit -am "Fix V1 - User Enumeration in login endpoints"
>>
warning: in the working copy of 'src/router/routes/user.js', LF will be replaced by CRLF the next time Git touches it
[master e7de806] Fix V1 - User Enumeration in login endpoints
 1 file changed, 10 insertions(+), 5 deletions(-)
```

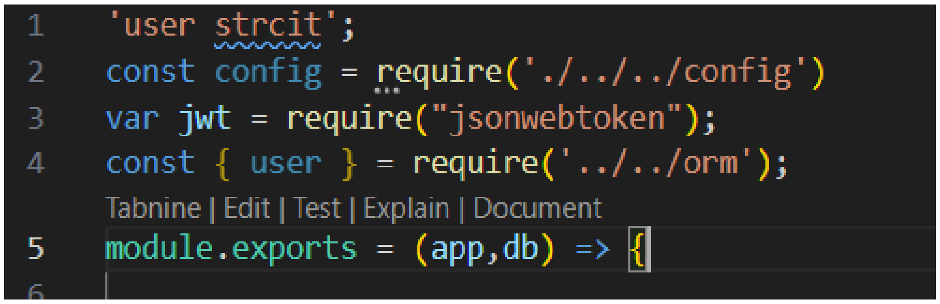
Git commit showing the applied fix for the user enumeration vulnerability.

Secure Password Storage (bcrypt)：

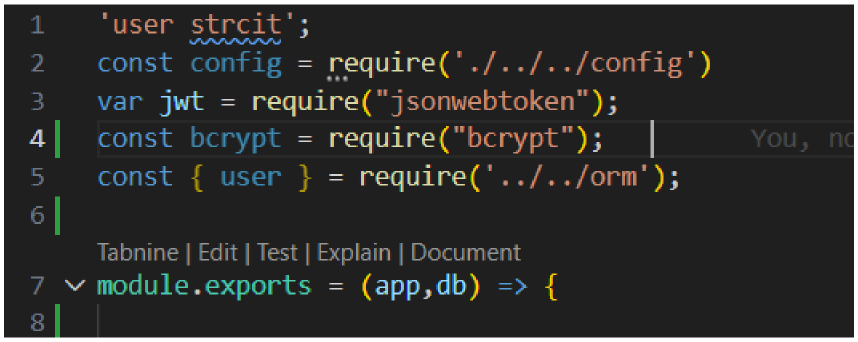

```
            const new_user = db.user.create(
                {
                    name:userName,
                    email:userEmail,
                    role:userRole,
                    address:userAddress,
                    password:userPassword
                }).then(new_user => {
                    res.json(new_user);
                })

```

User passwords are stored in plaintext in the user creation endpoint.

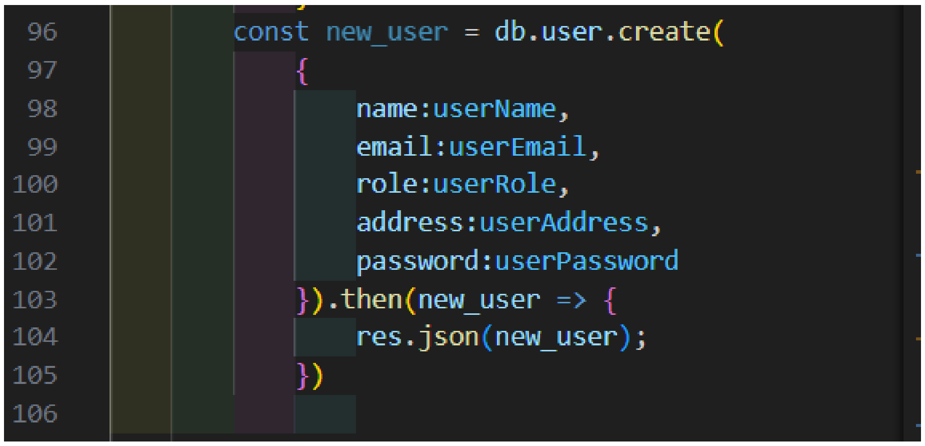

```
'user strcit';
const config = require('./../../config')
var jwt = require("jsonwebtoken");
const { user } = require('../../orm');
Tabnine | Edit | Test | Explain | Document
module.exports = (app,db) => {
```

Password hashing library (bcrypt) was not used in the application before applying the fix.


```
'user strcit';
const config = require('./../../config')
var jwt = require("jsonwebtoken");
const bcrypt = require("bcrypt");        You, no
const { user } = require('../../orm');

Tabnine | Edit | Test | Explain | Document
module.exports = (app,db) => {
```

bcrypt library added to enable secure password hashing.



```
const new_user = db.user.create(
    {
        name:userName,
        email:userEmail,
        role:userRole,
        address:userAddress,
        password:userPassword
    }).then(new_user => {
        res.json(new_user);
    })
```

User passwords were stored in plaintext during user creation.

1️⃣Semgrep – Before Fix

- **Purpose:** Show insecure password storage detection.
- **What to capture:** CLI output of Semgrep before you added bcrypt.
- **Expected finding:** javascript.lang.security.insecure-hash-md5 or similar.
- **Screenshot note:** "Semgrep identified insecure password handling (MD5/plaintext)."

2️⃣Semgrep – After Fix

- **Purpose:** Show that password storage is now secure.
- **What to capture:** CLI output of Semgrep after replacing MD5/plaintext with bcrypt.
- **Expected finding:** No findings for insecure password storage.

- **Screenshot note:** “After applying bcrypt, Semgrep shows no insecure password storage findings.”

1: SQL Injection (in order.js)

- **Problem Description:** The application was directly concatenating user-supplied input (filter and query) into the SQL statement. This allows an attacker to manipulate the query logic, bypass security checks, or access unauthorized data from the database.
- **The Fix:** Implemented **Parameterized Queries** using Sequelize's replacements feature. This ensures that the input is treated strictly as data (literal values) and not as executable SQL code. Additionally, a **whitelist** was added for the filter parameter to ensure only valid column names can be queried.
- **Code Comparison:**

Before (Vulnerable):

```
const sql = "SELECT * FROM beers WHERE " + filter + " = '" + query + "'";

const beers = db.sequelize.query(sql, { type: 'RAW' });
```

After (Secure):

```
// 1. Whitelist allowed columns to prevent column-name injection

const allowedFilters = ['id', 'name', 'style', 'brewery'];

if (!allowedFilters.includes(filter)) {

   return res.status(400).send("Invalid filter");
}

// 2. Use Bind Parameters (:query) for the search value
const sql = `SELECT * FROM beers WHERE ${filter} = :query`;

const beers = db.sequelize.query(sql, {
   replacements: { query: query },
   type: db.sequelize.QueryTypes.SELECT
});
```

Why this is now secure: By using replacements, the database driver automatically escapes the input, making it impossible for a malicious payload like ' OR '1'='1 to be executed. The whitelist further secures the query by preventing attackers from querying sensitive internal columns.

2. Remote Code Execution – RCE :

Vulnerability 3: Insecure Object Deserialization

- **Problem:** Using node-serialize.unserialize() allowed the execution of arbitrary JavaScript functions if they were embedded in the serialized string (using the _$$ND_FUNC$$_ prefix).
- **Fix:** Replaced the insecure library with the built-in JSON.parse().
- **Why Secure:** JSON.parse() only constructs data objects and does not evaluate or execute code contained within the input string.

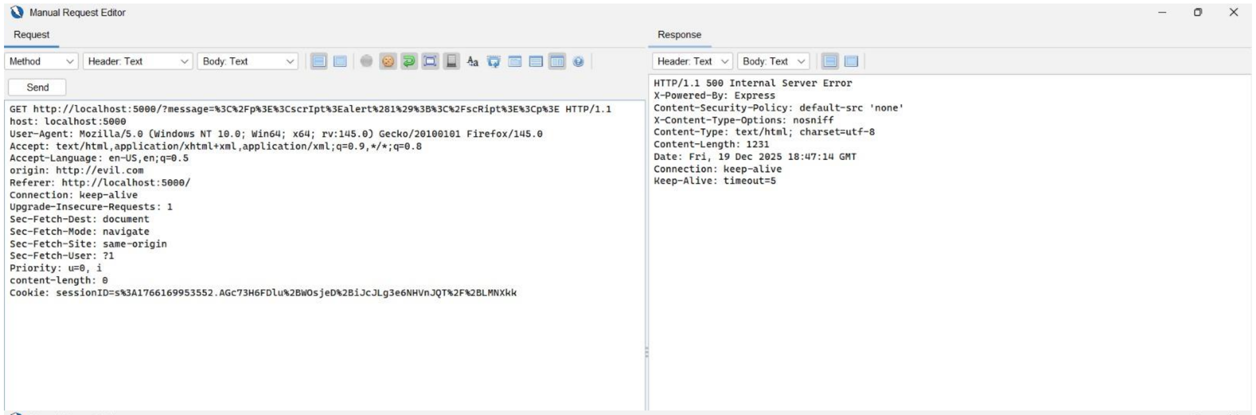
Vulnerability 4: Server-Side Request Forgery (SSRF)

- **Problem:** The application allowed the server to make requests to any URL provided by the user, which could be used to probe internal network services.
- **Fix:** Implemented a **Whitelist** validation. The application now parses the URL and checks the hostname against a list of trusted domains.
- **Why Secure:** The server will refuse to make requests to any domain (including internal ones like 127.0.0.1 or 169.254.169.254) that is not explicitly permitted.

Vulnerability 5: Open Redirect

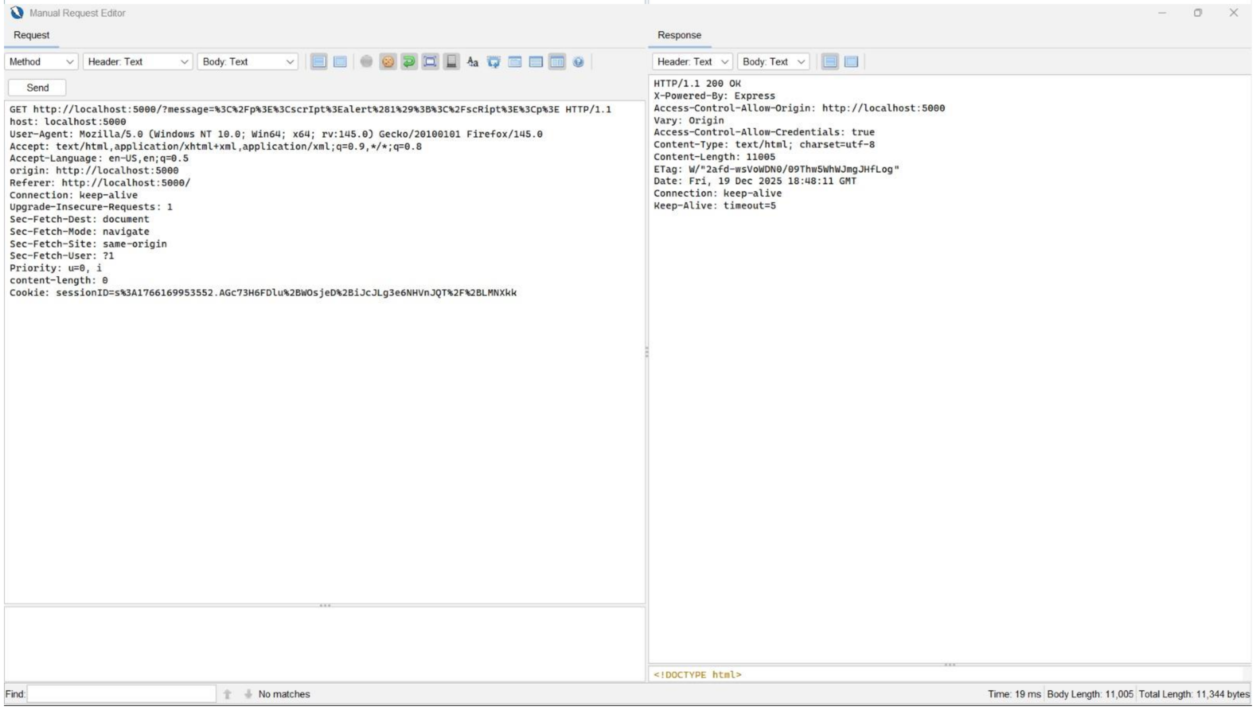
- **Problem:** Attackers could use the /v1/redirect/ endpoint to send users to malicious phishing sites, leveraging the trust of the main application's domain.
- **Fix:** Added URL validation that restricts redirection to a predefined list of safe hostnames.
- **Why Secure:** Users can no longer be redirected to arbitrary, potentially malicious domains.

CORS Misconfiguration – Fix Summary :



```
GET http://localhost:5000/?message=%3C%2Fp%3E%3CscrIpt%3Ealert%281%29%3B%3C%2FscRipt%3E%3Cp%3E HTTP/1.1
host: localhost:5000
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64; rv:145.0) Gecko/20100101 Firefox/145.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
origin: http://evil.com
Referer: http://localhost:5000/
Connection: keep-alive
Upgrade-Insecure-Requests: 1
Sec-Fetch-Dest: document
Sec-Fetch-Mode: navigate
Sec-Fetch-Site: same-origin
Sec-Fetch-User: ?1
Priority: u=0, i
content-length: 0
Cookie: sessionID=s%3A1766169953552.AGc73H6FDlu%2BWOsjeD%2BiJcJLg3e6NHVnJQT%2F%2BLMNXkk
```

```
HTTP/1.1 500 Internal Server Error
X-Powered-By: Express
Content-Security-Policy: default-src 'none'
X-Content-Type-Options: nosniff
Content-Type: text/html; charset=utf-8
Content-Length: 1231
Date: Fri, 19 Dec 2025 18:47:14 GMT
Connection: keep-alive
Keep-Alive: timeout=5
```



```
GET http://localhost:5000/?message=%3C%2Fp%3E%3CscrIpt%3Ealert%281%29%3B%3C%2FscRipt%3E%3Cp%3E HTTP/1.1
host: localhost:5000
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64; rv:145.0) Gecko/20100101 Firefox/145.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
origin: http://localhost:5000
Referer: http://localhost:5000/
Connection: keep-alive
Upgrade-Insecure-Requests: 1
Sec-Fetch-Dest: document
Sec-Fetch-Mode: navigate
Sec-Fetch-Site: same-origin
Sec-Fetch-User: ?1
Priority: u=0, i
content-length: 0
Cookie: sessionID=s%3A1766169953552.AGc73H6FDlu%2BWOsjeD%2BiJcJLg3e6NHVnJQT%2F%2BLMNXkk
```

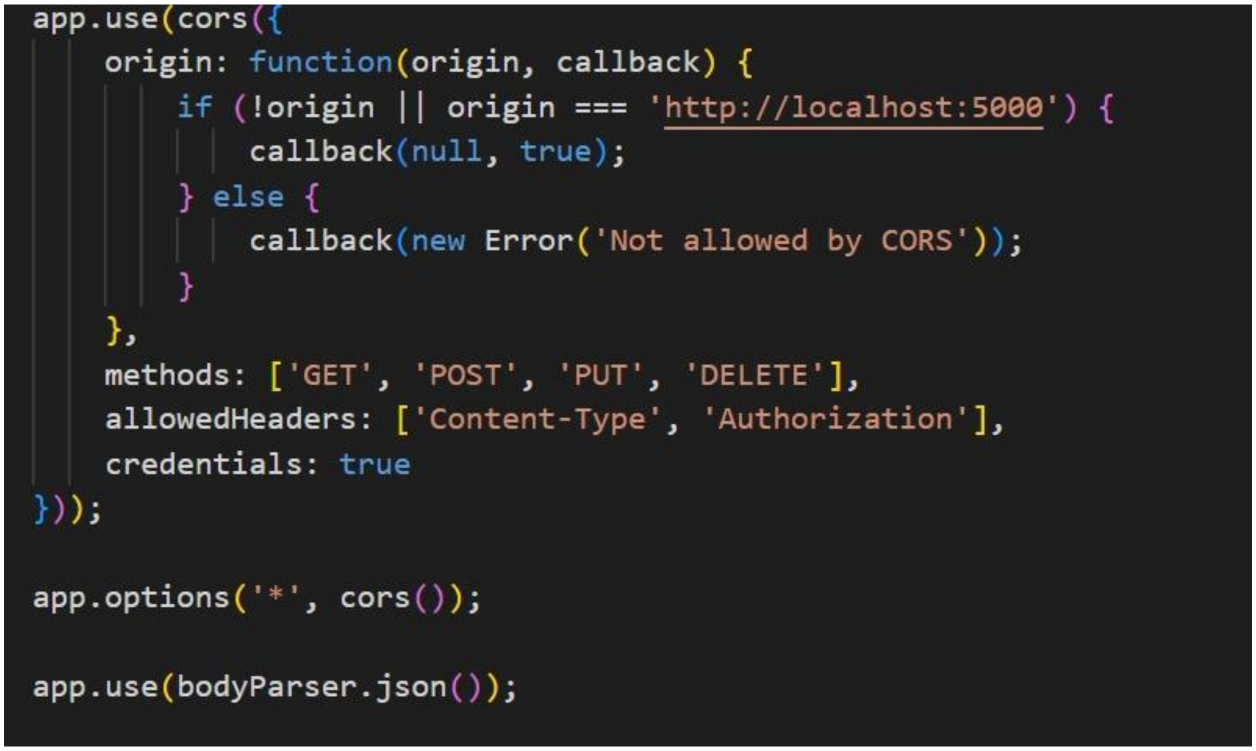
```
HTTP/1.1 200 OK
X-Powered-By: Express
Access-Control-Allow-Origin: http://localhost:5000
Vary: Origin
Access-Control-Allow-Credentials: true
Content-Type: text/html; charset=utf-8
Content-Length: 11005
ETag: W/"2afd-wsVoWDN0/09Thw5WhWJmgJHfLog"
Date: Fri, 19 Dec 2025 18:48:11 GMT
Connection: keep-alive
Keep-Alive: timeout=5
```

```
<!DOCTYPE html>
```

Time: 19 ms Body Length: 11,005 Total Length: 11,344 bytes

CORS Misconfiguration Fix :

The application now enforces a strict allowlist-based CORS policy. Requests from untrusted origins no longer receive CORS headers, preventing cross-origin data access. ZAP verification confirms removal of wildcard origin.



```
app.use(cors({
    origin: function(origin, callback) {
        if (!origin || origin === 'http://localhost:5000') {
            callback(null, true);
        } else {
            callback(new Error('Not allowed by CORS'));
        }
    },
    methods: ['GET', 'POST', 'PUT', 'DELETE'],
    allowedHeaders: ['Content-Type', 'Authorization'],
    credentials: true
}));

app.options('*', cors());

app.use(bodyParser.json());
```

OWASP Category : A05:2021 – Security Misconfiguration

File Modified : src/server.js

Issue :

The application allowed permissive CORS behavior (* or no restriction), enabling any external origin to access the API.

Fix Implemented :

A strict allowlist-based CORS policy was added using the cors middleware.

const cors = require('cors');

```
const corsOptions = {
  origin: function (origin, callback) {
    const allowedOrigins = ['http://localhost:5000'];
    if (allowedOrigins.includes(origin)) {
      return callback(null, true);
    }
    return callback(null, false);
  },
  credentials: true
};

app.use(cors(corsOptions));
```

Result

Only trusted origins are allowed.

Requests from untrusted origins do not receive CORS headers.

Wildcard (*) usage is fully removed.

Verification

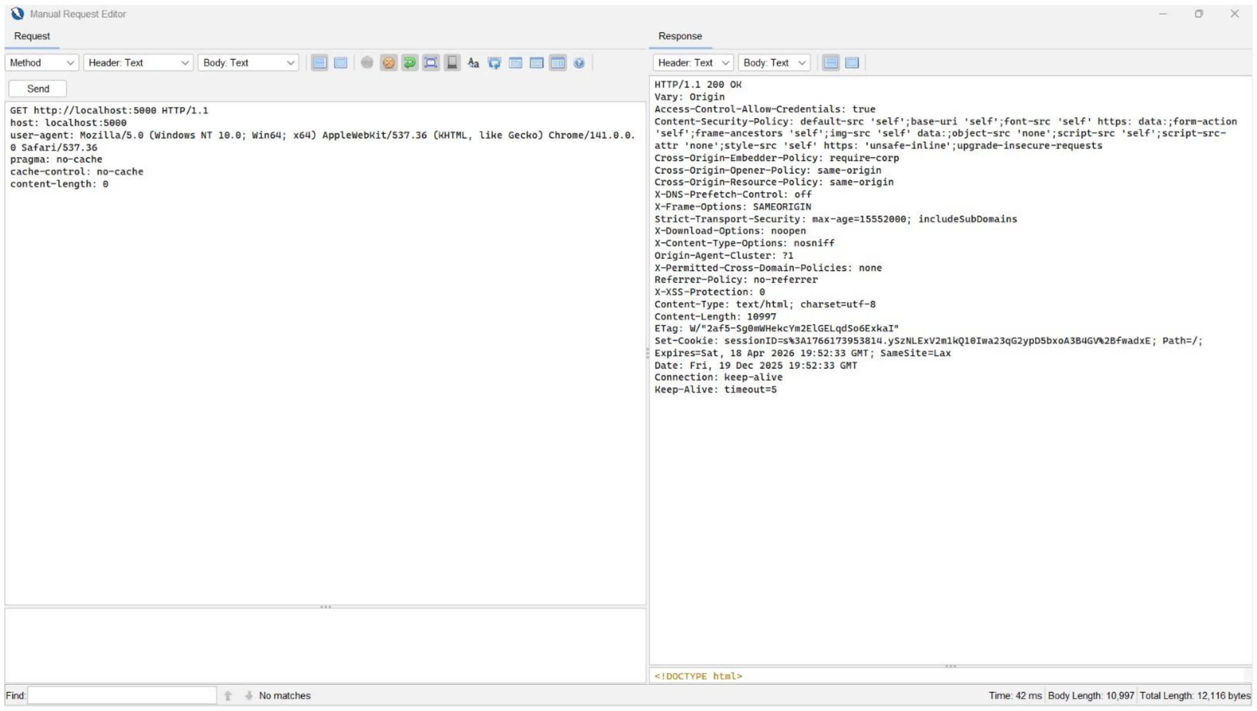
localhost:5000 → 200 OK

evil.com → Blocked (no CORS headers)

OWASP ZAP no longer flags CORS misconfiguration.

Vulnerabilities Addressed :

1. Content Security Policy (CSP) Header Not Set
2. Missing Anti-Clickjacking Header (X-Frame-Options)
3. X-Content-Type-Options Missing
4. Server Information Disclosure



```
GET http://localhost:5000 HTTP/1.1
host: localhost:5000
user-agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/141.0.0.
0 Safari/537.36
pragma: no-cache
cache-control: no-cache
content-length: 0
```

```
HTTP/1.1 200 OK
Vary: Origin
Access-Control-Allow-Credentials: true
Content-Security-Policy: default-src 'self';base-uri 'self';font-src 'self' https: data:;form-action
'self';frame-ancestors 'self';img-src 'self' data:;object-src 'none';script-src 'self';script-src-
attr 'none';style-src 'self' https: 'unsafe-inline';upgrade-insecure-requests
Cross-Origin-Embedder-Policy: require-corp
Cross-Origin-Opener-Policy: same-origin
Cross-Origin-Resource-Policy: same-origin
X-DNS-Prefetch-Control: off
X-Frame-Options: SAMEORIGIN
Strict-Transport-Security: max-age=15552000; includeSubDomains
X-Download-Options: noopen
X-Content-Type-Options: nosniff
Origin-Agent-Cluster: ?1
X-Permitted-Cross-Domain-Policies: none
Referrer-Policy: no-referrer
X-XSS-Protection: 0
Content-Type: text/html; charset=utf-8
Content-Length: 10997
ETag: W/"2af5-Sg0mWHekcYm2ElGELqdSo6ExkaI"
Set-Cookie: sessionID=s%3A1766173953814.ySzNLExV2m1kQ10Iwa23qG2ypD5bxoA3B4GV%2BfwadxE; Path=/;
Expires=Sat, 18 Apr 2026 19:52:33 GMT; SameSite=Lax
Date: Fri, 19 Dec 2025 19:52:33 GMT
Connection: keep-alive
Keep-Alive: timeout=5
```

```
<!DOCTYPE html>
```

1. CSP Header Not Set :

- Before : No Content-Security-Policy → browser could execute untrusted scripts.
- After : Added Helmet's CSP → restricts which scripts, styles, and resources can load.
- Effect : Reduces XSS and code injection risk.

2. Missing Anti-Clickjacking Header

- Before : No X-Frame-Options → pages could be embedded in other sites' iframes.
- After : Helmet sets X-Frame-Options: SAMEORIGIN → blocks untrusted frame embedding.
- Effect : Prevents clickjacking attacks.

3. X-Content-Type-Options Missing :

- Before : Browser could sniff MIME types → potential XSS attacks.
- After : Helmet sets X-Content-Type-Options: nosniff → forces correct MIME handling.
- Effect : Stops MIME sniffing attacks.

4. Server Information Disclosure :

- Before : Express default X-Powered-By revealed server → aids attacker fingerprinting.
- After : Helmet removes X-Powered-By → hides server technology details.
- Effect : Reduces information available to attackers.

- Summary:

Adding helmet() in server.js ensures proper security headers are set, mitigating CSP, anti-clickjacking, MIME sniffing, and server disclosure vulnerabilities.