Ammar Meslmani - CBS-01

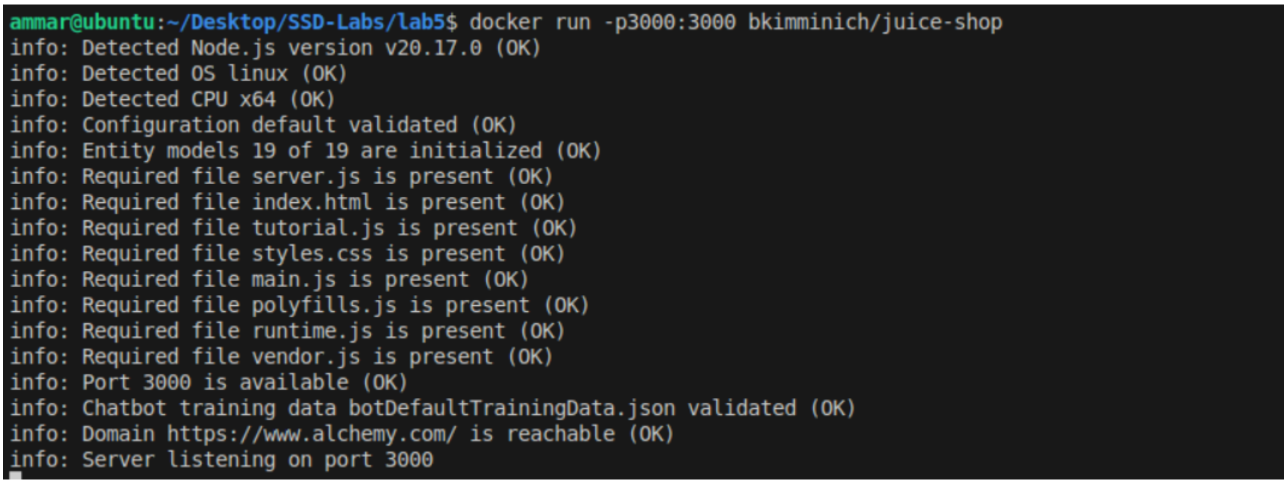
a.meslmani@innopolis.university

the repo link to check the files used in this assignment: full report

Lab 5

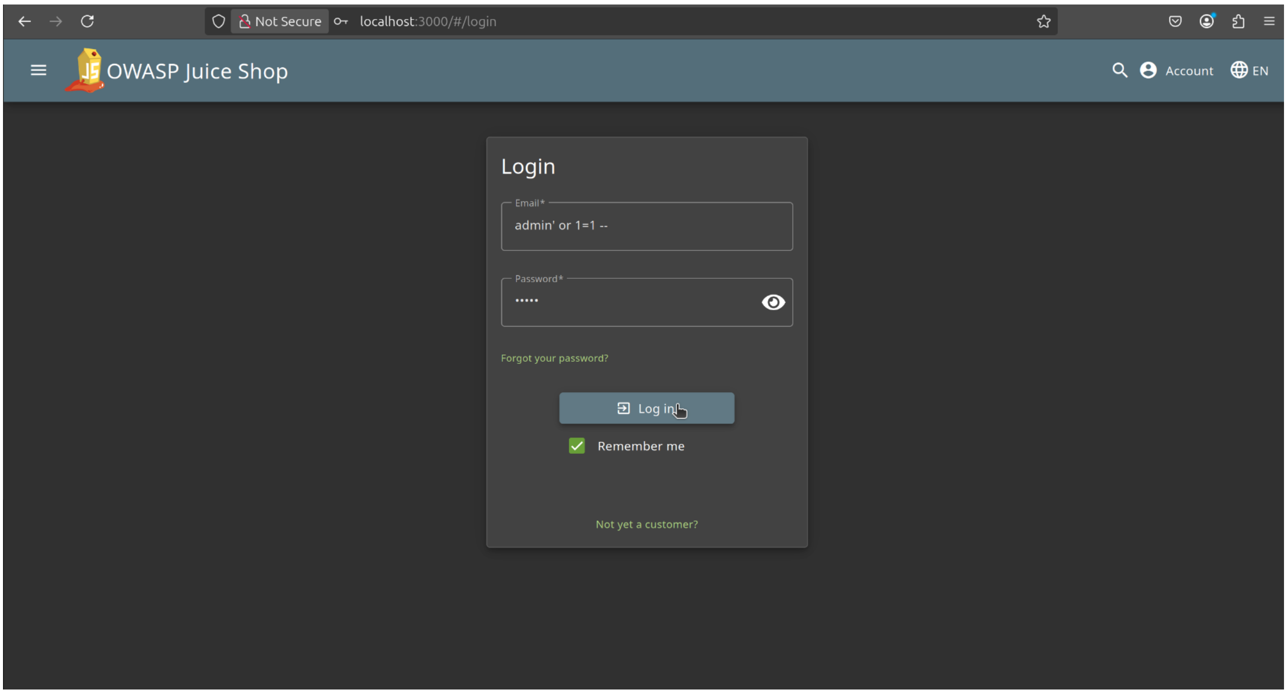
Task 1

- let's pull the docker image and run it on port 3000



```
ammar@ubuntu:~/Desktop/SSD-Labs/lab5$ docker run -p3000:3000 bkimminich/juice-shop
info: Detected Node.js version v20.17.0 (OK)
info: Detected OS linux (OK)
info: Detected CPU x64 (OK)
info: Configuration default validated (OK)
info: Entity models 19 of 19 are initialized (OK)
info: Required file server.js is present (OK)
info: Required file index.html is present (OK)
info: Required file tutorial.js is present (OK)
info: Required file styles.css is present (OK)
info: Required file main.js is present (OK)
info: Required file polyfills.js is present (OK)
info: Required file runtime.js is present (OK)
info: Required file vendor.js is present (OK)
info: Port 3000 is available (OK)
info: Chatbot training data botDefaultTrainingData.json validated (OK)
info: Domain https://www.alchemy.com/ is reachable (OK)
info: Server listening on port 3000
```

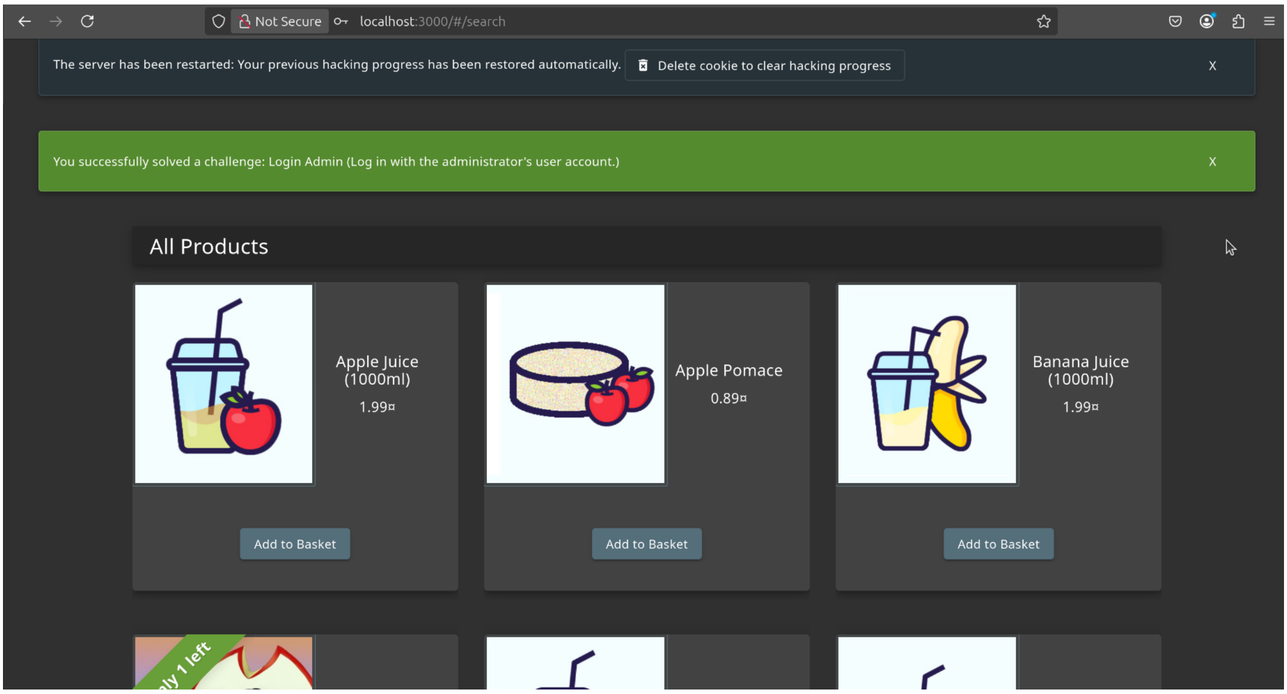
- let's log in as **admin** using **SQL Injection**



Email* admin' or 1=1 --

Password* •••••

☑ Remember me

- 

  localhost:3000/#/search

  The server has been restarted: Your previous hacking progress has been restored automatically.

  You successfully solved a challenge: Login Admin (Log in with the administrator's user account.)

  All Products

  Apple Juice (1000ml) 1.99¤

  Apple Pomace 0.89¤

  Banana Juice (1000ml) 1.99¤

- now let's create `docker-compose` file to run `waf` on top of the juice shop

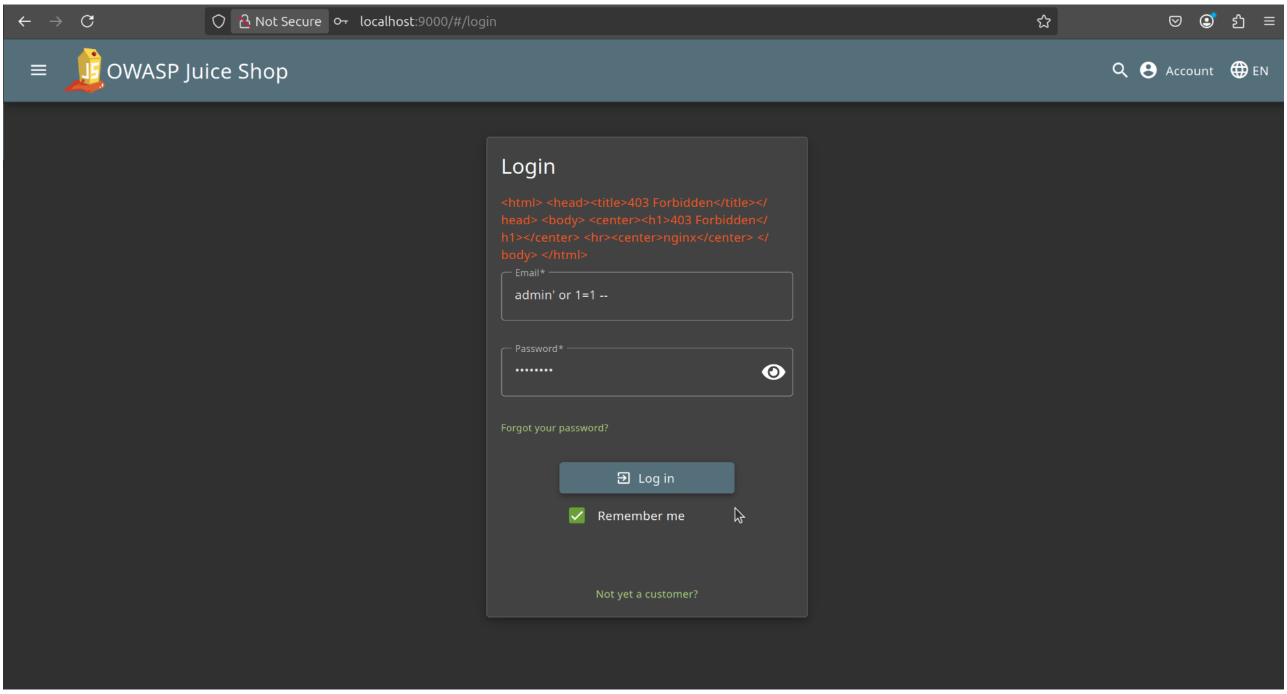
```
services:
  app:
    container_name: jucie-shop
    image: bkimminich/juice-shop
    networks:
      - appnet

  waf:
    container_name: web-application-firewall
    image: owasp/modsecurity-crs:nginx
    environment:
      - BACKEND=http://app:3000
    ports:
      - "9000:8080"
    networks:
      - appnet

networks:
  appnet:
    driver: bridge
```

- **note**: port 9000 was used for `waf` because port 8080 is reserved by another service

- now let's try again to log in as admin

- 

  Login

  <html> <head><title>403 Forbidden</title></head> <body> <center><h1>403 Forbidden</h1></center> <hr><center>nginx</center> </body> </html>

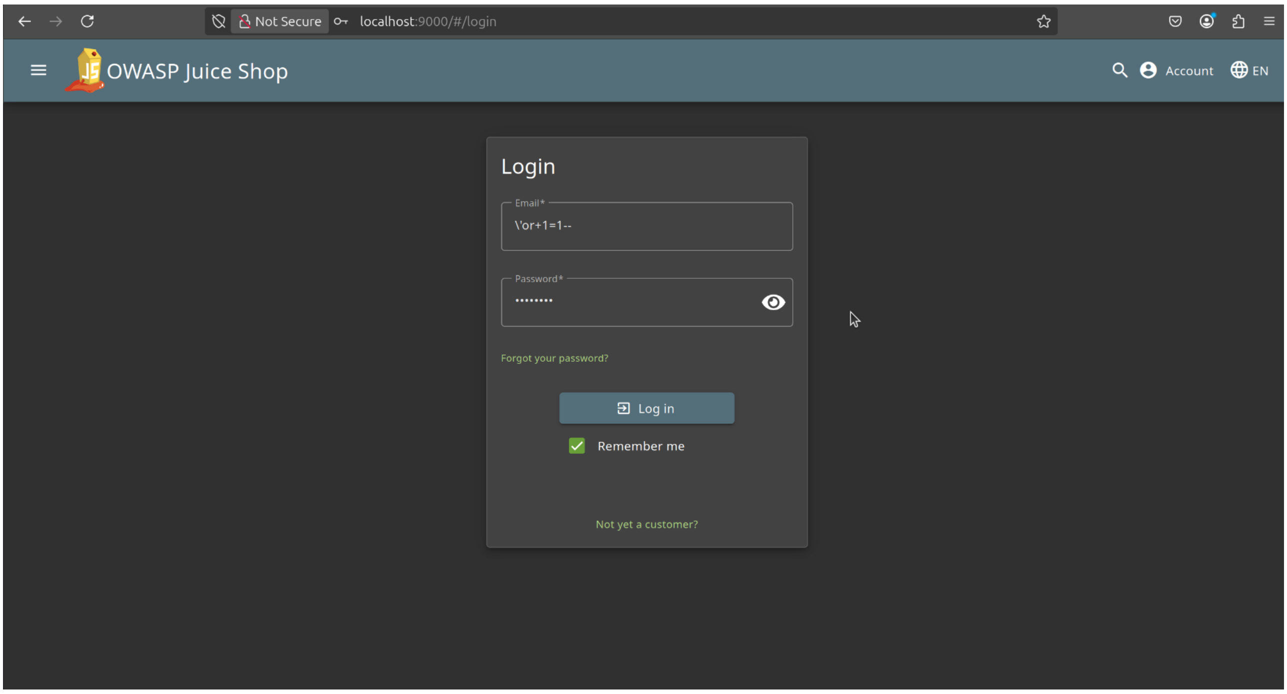
  Email*: admin' or 1=1 --

  Password*: ••••••••

  ☑ Remember me

- `waf` prevented us from `SQL-Injection` attack!

Task 2

- let's try another pattern to bypass `waf` by exploiting `SQL-Injection`
- 

  Login

  Email*: \'or+1=1--

  Password*: ••••••••

  ☑ Remember me

- let's add a custom rule to prevent this pattern (a regex to reject the `\` and `'` characters since they are not valid for emails)
- `custom-rule.conf` file was created:

```
SecRule ARGS|REQUEST_HEADERS "@rx ^\\'" \
    "id:999903,\
    phase:2,\
    deny,\
    capture,\
    t:none,t:urlDecodeUni,\
    msg:'Blocking input starting with backslash and single quote',\
    logdata:'Matched Data: %{TX.0} found',\
    tag:'application-multi',\
    tag:'security',\
    tag:'sql-injection',\
    ver:'OWASP_CRS/4.13.0',\
    severity:'CRITICAL',\
    setvar:'tx.inbound_anomaly_score_pl1=+%
{tx.critical_anomaly_score}'"
```

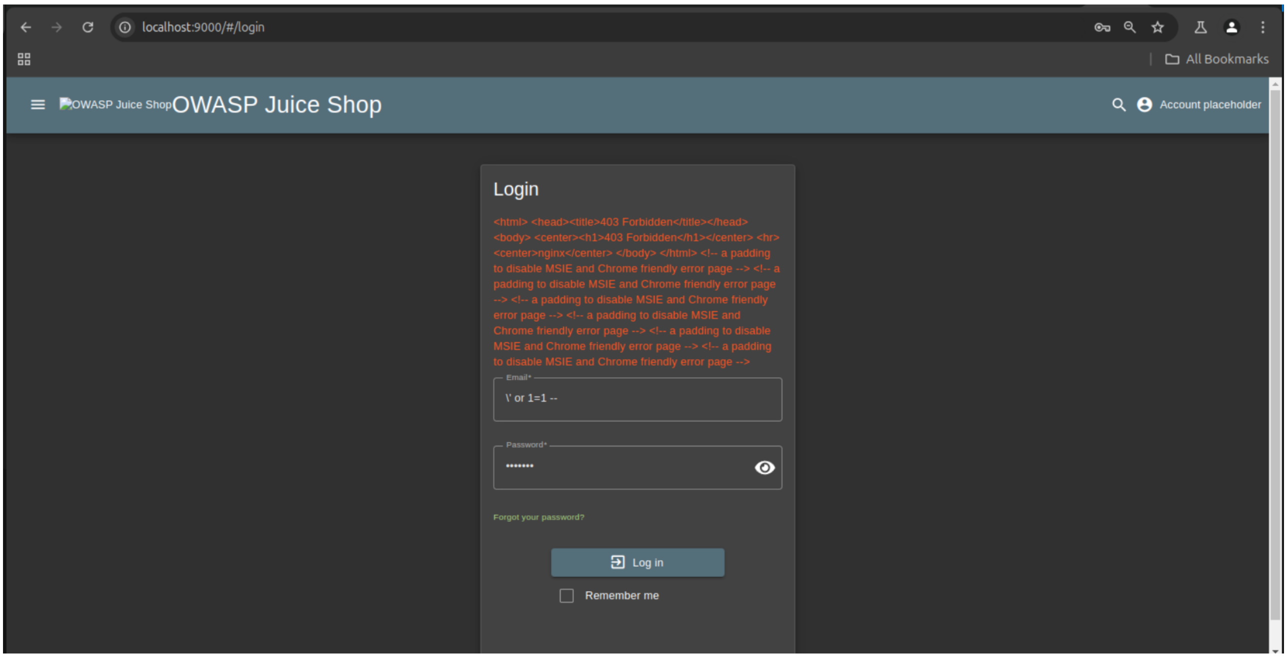
- and then it got mounted to the `waf` image through `docker-compose.yml` file

```
services:
  app:
    container_name: jucie-shop
    image: bkimminich/juice-shop
    ports:
      - "3000:3000"
    networks:
      - appnet

  waf:
    container_name: web-application-firewall
    image: owasp/modsecurity-crs:nginx
    volumes:
      - ./custom_rules/custom-rule.conf:/etc/modsecurity.d/owasp-
crs/rules/custom-rule.conf
    environment:
      - BACKEND=http://app:3000
    ports:
      - "9000:8080"
    networks:
      - appnet

networks:
  appnet:
    driver: bridge
```

- after restarting the docker image, and attempting to bypass the waf again using the previous pattern used we get:

- 

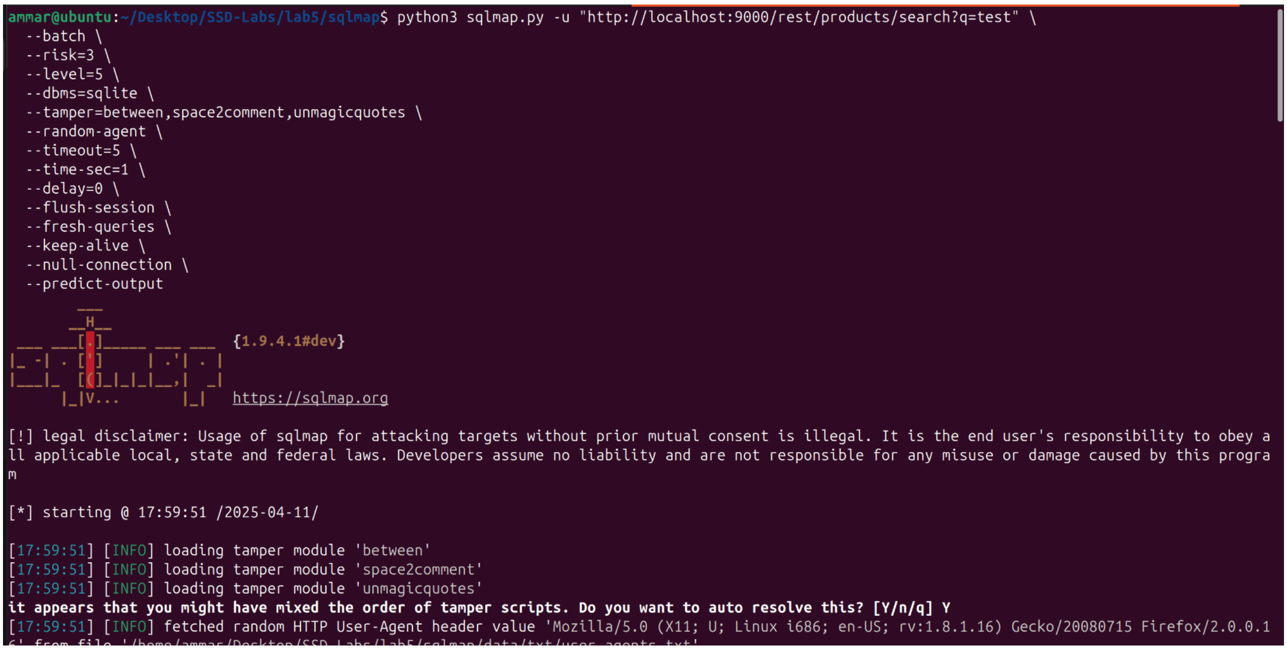
  Login

  <html> <head><title>403 Forbidden</title></head> <body> <center><h1>403 Forbidden</h1></center> <hr> <center>nginx</center> </body> </html> <!-- a padding to disable MSIE and Chrome friendly error page --> <!-- a padding to disable MSIE and Chrome friendly error page --> <!-- a padding to disable MSIE and Chrome friendly error page --> <!-- a padding to disable MSIE and Chrome friendly error page --> <!-- a padding to disable MSIE and Chrome friendly error page --> <!-- a padding to disable MSIE and Chrome friendly error page -->

  Email*: \' or 1=1 --

  Password*: ••••••••

- now let's run `sqlmap` to test if the `waf` is injectable

- 

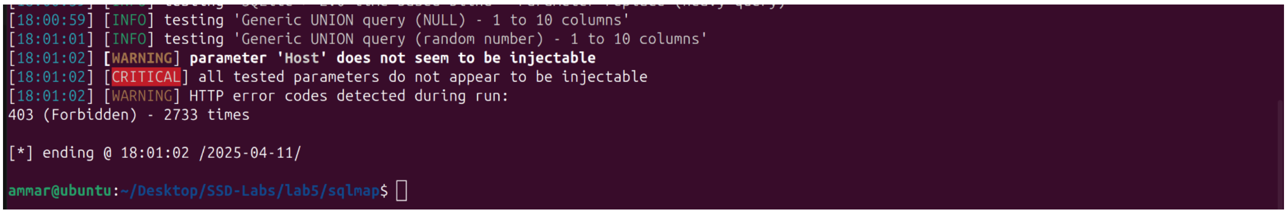
```
ammar@ubuntu:~/Desktop/SSD-Labs/lab5/sqlmap$ python3 sqlmap.py -u "http://localhost:9000/rest/products/search?q=test" \
  --batch \
  --risk=3 \
  --level=5 \
  --dbms=sqlite \
  --tamper=between,space2comment,unmagicquotes \
  --random-agent \
  --timeout=5 \
  --time-sec=1 \
  --delay=0 \
  --flush-session \
  --fresh-queries \
  --keep-alive \
  --null-connection \
  --predict-output
        ___
       __H__
 ___ ___[.]_____ ___ ___  {1.9.4.1#dev}
|_ -| . [']     | .'| . |
|___|_  [(]_|_|_|__,|  _|
      |_|V...       |_|   https://sqlmap.org

[!] legal disclaimer: Usage of sqlmap for attacking targets without prior mutual consent is illegal. It is the end user's responsibility to obey a
ll applicable local, state and federal laws. Developers assume no liability and are not responsible for any misuse or damage caused by this progra
m

[*] starting @ 17:59:51 /2025-04-11/

[17:59:51] [INFO] loading tamper module 'between'
[17:59:51] [INFO] loading tamper module 'space2comment'
[17:59:51] [INFO] loading tamper module 'unmagicquotes'
it appears that you might have mixed the order of tamper scripts. Do you want to auto resolve this? [Y/n/q] Y
[17:59:51] [INFO] fetched random HTTP User-Agent header value 'Mozilla/5.0 (X11; U; Linux i686; en-US; rv:1.8.1.16) Gecko/20080715 Firefox/2.0.0.1
6' from file '/home/ammar/Desktop/SSD-Labs/lab5/sqlmap/data/txt/user-agents.txt'
```

- final results:

- 

```
[18:00:59] [INFO] testing 'SQLite > 2.0 time-based blind - Parameter replace (heavy query)'
[18:00:59] [INFO] testing 'Generic UNION query (NULL) - 1 to 10 columns'
[18:01:01] [INFO] testing 'Generic UNION query (random number) - 1 to 10 columns'
[18:01:02] [WARNING] parameter 'Host' does not seem to be injectable
[18:01:02] [CRITICAL] all tested parameters do not appear to be injectable
[18:01:02] [WARNING] HTTP error codes detected during run:
403 (Forbidden) - 2733 times

[*] ending @ 18:01:02 /2025-04-11/

ammar@ubuntu:~/Desktop/SSD-Labs/lab5/sqlmap$ 
```

- full report:

-
```
python3 sqlmap.py -u "http://localhost:9000/rest/products/search?
q=test" \
  --batch \
  --risk=3 \
  --level=5 \
  --dbms=sqlite \
  --tamper=between,space2comment,unmagicquotes \
  --random-agent \
  --timeout=5 \
  --time-sec=1 \
  --delay=0 \
  --flush-session \
  --fresh-queries \
  --keep-alive \
  --null-connection \
  --predict-output
        ___
       __H__
 ___ ___[.]_____ ___ ___  {1.9.4.1#dev}
|_ -| . [']     | .'| . |
|___|_  [(]_|_|_|__,|  _|
      |_|V...       |_|   https://sqlmap.org

[!] legal disclaimer: Usage of sqlmap for attacking targets without
prior mutual consent is illegal. It is the end user's responsibility
to obey all applicable local, state and federal laws. Developers
assume no liability and are not responsible for any misuse or damage
caused by this program

[*] starting @ 17:59:51 /2025-04-11/

[17:59:51] [INFO] loading tamper module 'between'
[17:59:51] [INFO] loading tamper module 'space2comment'
[17:59:51] [INFO] loading tamper module 'unmagicquotes'
it appears that you might have mixed the order of tamper scripts. Do
you want to auto resolve this? [Y/n/q] Y
[17:59:51] [INFO] fetched random HTTP User-Agent header value
'Mozilla/5.0 (X11; U; Linux i686; en-US; rv:1.8.1.16) Gecko/20080715
Firefox/2.0.0.16' from file '/home/ammar/Desktop/SSD-
Labs/lab5/sqlmap/data/txt/user-agents.txt'
[17:59:51] [INFO] testing connection to the target URL
[17:59:51] [INFO] checking if the target is protected by some kind of
WAF/IPS
[17:59:51] [CRITICAL] heuristics detected that the target is protected
by some kind of WAF/IPS
are you sure that you want to continue with further target testing?
[Y/n] Y
[17:59:51] [INFO] testing NULL connection to the target URL
[17:59:51] [INFO] NULL connection is supported with HEAD method
('Content-Length')
[17:59:51] [INFO] testing if the target URL content is stable
[17:59:52] [INFO] target URL content is stable
[17:59:52] [INFO] testing if GET parameter 'q' is dynamic
[17:59:52] [INFO] GET parameter 'q' appears to be dynamic
[17:59:52] [WARNING] heuristic (basic) test shows that GET parameter
'q' might not be injectable
[17:59:52] [INFO] testing for SQL injection on GET parameter 'q'
[17:59:52] [INFO] testing 'AND boolean-based blind - WHERE or HAVING
```

```
clause'
[17:59:53] [INFO] testing 'OR boolean-based blind - WHERE or HAVING clause'
[17:59:53] [INFO] testing 'OR boolean-based blind - WHERE or HAVING clause (NOT)'
[17:59:54] [INFO] testing 'AND boolean-based blind - WHERE or HAVING clause (subquery - comment)'
[17:59:55] [INFO] testing 'OR boolean-based blind - WHERE or HAVING clause (subquery - comment)'
[17:59:55] [INFO] testing 'AND boolean-based blind - WHERE or HAVING clause (comment)'
[17:59:55] [INFO] testing 'OR boolean-based blind - WHERE or HAVING clause (comment)'
[17:59:55] [INFO] testing 'OR boolean-based blind - WHERE or HAVING clause (NOT - comment)'
[17:59:55] [INFO] testing 'Boolean-based blind - Parameter replace (original value)'
[17:59:55] [INFO] testing 'Boolean-based blind - Parameter replace (DUAL)'
[17:59:55] [INFO] testing 'Boolean-based blind - Parameter replace (DUAL - original value)'
[17:59:55] [INFO] testing 'Boolean-based blind - Parameter replace (CASE)'
[17:59:55] [INFO] testing 'Boolean-based blind - Parameter replace (CASE - original value)'
[17:59:56] [INFO] testing 'HAVING boolean-based blind - WHERE, GROUP BY clause'
[17:59:56] [INFO] testing 'Generic inline queries'
[17:59:56] [INFO] testing 'SQLite AND boolean-based blind - WHERE, HAVING, GROUP BY or HAVING clause (JSON)'
[17:59:56] [INFO] testing 'SQLite OR boolean-based blind - WHERE, HAVING, GROUP BY or HAVING clause (JSON)'
[17:59:57] [INFO] testing 'SQLite inline queries'
[17:59:57] [INFO] testing 'SQLite > 2.0 stacked queries (heavy query - comment)'
[17:59:57] [WARNING] time-based comparison requires larger statistical model, please wait....................... (done)
[17:59:58] [INFO] testing 'SQLite > 2.0 stacked queries (heavy query)'
[17:59:59] [INFO] testing 'SQLite > 2.0 AND time-based blind (heavy query)'
[17:59:59] [INFO] testing 'SQLite > 2.0 OR time-based blind (heavy query)'
[17:59:59] [INFO] testing 'SQLite > 2.0 AND time-based blind (heavy query - comment)'
[17:59:59] [INFO] testing 'SQLite > 2.0 OR time-based blind (heavy query - comment)'
[18:00:00] [INFO] testing 'SQLite > 2.0 time-based blind - Parameter replace (heavy query)'
it is recommended to perform only basic UNION tests if there is not at least one other (potential) technique found. Do you want to reduce the number of requests? [Y/n] Y
[18:00:00] [INFO] testing 'Generic UNION query (NULL) - 1 to 10 columns'
[18:00:00] [INFO] testing 'Generic UNION query (random number) - 1 to
```

```
10 columns'
[18:00:01] [WARNING] GET parameter 'q' does not seem to be injectable
[18:00:01] [INFO] testing if parameter 'User-Agent' is dynamic
[18:00:01] [INFO] parameter 'User-Agent' appears to be dynamic
[18:00:01] [WARNING] heuristic (basic) test shows that parameter
'User-Agent' might not be injectable
[18:00:01] [INFO] testing for SQL injection on parameter 'User-Agent'
[18:00:01] [INFO] testing 'AND boolean-based blind - WHERE or HAVING
clause'
[18:00:03] [INFO] testing 'OR boolean-based blind - WHERE or HAVING
clause'
[18:00:04] [INFO] testing 'OR boolean-based blind - WHERE or HAVING
clause (NOT)'
[18:00:05] [INFO] testing 'AND boolean-based blind - WHERE or HAVING
clause (subquery - comment)'
[18:00:07] [INFO] testing 'OR boolean-based blind - WHERE or HAVING
clause (subquery - comment)'
[18:00:07] [INFO] testing 'AND boolean-based blind - WHERE or HAVING
clause (comment)'
[18:00:07] [INFO] testing 'OR boolean-based blind - WHERE or HAVING
clause (comment)'
[18:00:07] [INFO] testing 'OR boolean-based blind - WHERE or HAVING
clause (NOT - comment)'
[18:00:08] [INFO] testing 'Boolean-based blind - Parameter replace
(original value)'
[18:00:08] [INFO] testing 'Boolean-based blind - Parameter replace
(DUAL)'
[18:00:08] [INFO] testing 'Boolean-based blind - Parameter replace
(DUAL - original value)'
[18:00:08] [INFO] testing 'Boolean-based blind - Parameter replace
(CASE)'
[18:00:08] [INFO] testing 'Boolean-based blind - Parameter replace
(CASE - original value)'
[18:00:08] [INFO] testing 'HAVING boolean-based blind - WHERE, GROUP
BY clause'
[18:00:09] [INFO] testing 'Generic inline queries'
[18:00:09] [INFO] testing 'SQLite AND boolean-based blind - WHERE,
HAVING, GROUP BY or HAVING clause (JSON)'
[18:00:11] [INFO] testing 'SQLite OR boolean-based blind - WHERE,
HAVING, GROUP BY or HAVING clause (JSON)'
[18:00:12] [INFO] testing 'SQLite inline queries'
[18:00:12] [INFO] testing 'SQLite > 2.0 stacked queries (heavy query -
comment)'
[18:00:12] [INFO] testing 'SQLite > 2.0 stacked queries (heavy query)'
[18:00:13] [INFO] testing 'SQLite > 2.0 AND time-based blind (heavy
query)'
[18:00:13] [INFO] testing 'SQLite > 2.0 OR time-based blind (heavy
query)'
[18:00:14] [INFO] testing 'SQLite > 2.0 AND time-based blind (heavy
query - comment)'
[18:00:15] [INFO] testing 'SQLite > 2.0 OR time-based blind (heavy
query - comment)'
[18:00:15] [INFO] testing 'SQLite > 2.0 time-based blind - Parameter
replace (heavy query)'
```

```
[18:00:15] [INFO] testing 'Generic UNION query (NULL) - 1 to 10 columns'
[18:00:16] [INFO] testing 'Generic UNION query (random number) - 1 to 10 columns'
[18:00:16] [WARNING] parameter 'User-Agent' does not seem to be injectable
[18:00:16] [INFO] testing if parameter 'Referer' is dynamic
[18:00:16] [INFO] parameter 'Referer' appears to be dynamic
[18:00:16] [WARNING] heuristic (basic) test shows that parameter 'Referer' might not be injectable
[18:00:16] [INFO] testing for SQL injection on parameter 'Referer'
[18:00:16] [INFO] testing 'AND boolean-based blind - WHERE or HAVING clause'
[18:00:18] [INFO] testing 'OR boolean-based blind - WHERE or HAVING clause'
[18:00:19] [INFO] testing 'OR boolean-based blind - WHERE or HAVING clause (NOT)'
[18:00:21] [INFO] testing 'AND boolean-based blind - WHERE or HAVING clause (subquery - comment)'
[18:00:22] [INFO] testing 'OR boolean-based blind - WHERE or HAVING clause (subquery - comment)'
[18:00:23] [INFO] testing 'AND boolean-based blind - WHERE or HAVING clause (comment)'
[18:00:23] [INFO] testing 'OR boolean-based blind - WHERE or HAVING clause (comment)'
[18:00:23] [INFO] testing 'OR boolean-based blind - WHERE or HAVING clause (NOT - comment)'
[18:00:23] [INFO] testing 'Boolean-based blind - Parameter replace (original value)'
[18:00:23] [INFO] testing 'Boolean-based blind - Parameter replace (DUAL)'
[18:00:23] [INFO] testing 'Boolean-based blind - Parameter replace (DUAL - original value)'
[18:00:23] [INFO] testing 'Boolean-based blind - Parameter replace (CASE)'
[18:00:23] [INFO] testing 'Boolean-based blind - Parameter replace (CASE - original value)'
[18:00:23] [INFO] testing 'HAVING boolean-based blind - WHERE, GROUP BY clause'
[18:00:24] [INFO] testing 'Generic inline queries'
[18:00:24] [INFO] testing 'SQLite AND boolean-based blind - WHERE, HAVING, GROUP BY or HAVING clause (JSON)'
[18:00:26] [INFO] testing 'SQLite OR boolean-based blind - WHERE, HAVING, GROUP BY or HAVING clause (JSON)'
[18:00:27] [INFO] testing 'SQLite inline queries'
[18:00:27] [INFO] testing 'SQLite > 2.0 stacked queries (heavy query - comment)'
[18:00:28] [INFO] testing 'SQLite > 2.0 stacked queries (heavy query)'
[18:00:28] [INFO] testing 'SQLite > 2.0 AND time-based blind (heavy query)'
[18:00:29] [INFO] testing 'SQLite > 2.0 OR time-based blind (heavy query)'
[18:00:30] [INFO] testing 'SQLite > 2.0 AND time-based blind (heavy query - comment)'
```

```
[18:00:30] [INFO] testing 'SQLite > 2.0 OR time-based blind (heavy query - comment)'
[18:00:30] [INFO] testing 'SQLite > 2.0 time-based blind - Parameter replace (heavy query)'
[18:00:30] [INFO] testing 'Generic UNION query (NULL) - 1 to 10 columns'
[18:00:31] [INFO] testing 'Generic UNION query (random number) - 1 to 10 columns'
[18:00:31] [WARNING] parameter 'Referer' does not seem to be injectable
[18:00:31] [INFO] testing if parameter 'Host' is dynamic
[18:00:32] [INFO] parameter 'Host' appears to be dynamic
[18:00:32] [WARNING] heuristic (basic) test shows that parameter 'Host' might not be injectable
[18:00:32] [INFO] testing for SQL injection on parameter 'Host'
[18:00:32] [INFO] testing 'AND boolean-based blind - WHERE or HAVING clause'
[18:00:35] [INFO] testing 'OR boolean-based blind - WHERE or HAVING clause'
[18:00:37] [INFO] testing 'OR boolean-based blind - WHERE or HAVING clause (NOT)'
[18:00:41] [INFO] testing 'AND boolean-based blind - WHERE or HAVING clause (subquery - comment)'
[18:00:44] [INFO] testing 'OR boolean-based blind - WHERE or HAVING clause (subquery - comment)'
[18:00:45] [INFO] testing 'AND boolean-based blind - WHERE or HAVING clause (comment)'
[18:00:45] [INFO] testing 'OR boolean-based blind - WHERE or HAVING clause (comment)'
[18:00:46] [INFO] testing 'OR boolean-based blind - WHERE or HAVING clause (NOT - comment)'
[18:00:46] [INFO] testing 'Boolean-based blind - Parameter replace (original value)'
[18:00:46] [INFO] testing 'Boolean-based blind - Parameter replace (DUAL)'
[18:00:46] [INFO] testing 'Boolean-based blind - Parameter replace (DUAL - original value)'
[18:00:47] [INFO] testing 'Boolean-based blind - Parameter replace (CASE)'
[18:00:47] [INFO] testing 'Boolean-based blind - Parameter replace (CASE - original value)'
[18:00:47] [INFO] testing 'HAVING boolean-based blind - WHERE, GROUP BY clause'
[18:00:49] [INFO] testing 'Generic inline queries'
[18:00:49] [INFO] testing 'SQLite AND boolean-based blind - WHERE, HAVING, GROUP BY or HAVING clause (JSON)'
[18:00:52] [INFO] testing 'SQLite OR boolean-based blind - WHERE, HAVING, GROUP BY or HAVING clause (JSON)'
[18:00:53] [INFO] testing 'SQLite inline queries'
[18:00:53] [INFO] testing 'SQLite > 2.0 stacked queries (heavy query - comment)'
[18:00:54] [INFO] testing 'SQLite > 2.0 stacked queries (heavy query)'
[18:00:55] [INFO] testing 'SQLite > 2.0 AND time-based blind (heavy query)'
```

```
[18:00:56] [INFO] testing 'SQLite > 2.0 OR time-based blind (heavy
query)'
[18:00:57] [INFO] testing 'SQLite > 2.0 AND time-based blind (heavy
query - comment)'
[18:00:58] [INFO] testing 'SQLite > 2.0 OR time-based blind (heavy
query - comment)'
[18:00:59] [INFO] testing 'SQLite > 2.0 time-based blind - Parameter
replace (heavy query)'
[18:00:59] [INFO] testing 'Generic UNION query (NULL) - 1 to 10
columns'
[18:01:01] [INFO] testing 'Generic UNION query (random number) - 1 to
10 columns'
[18:01:02] [WARNING] parameter 'Host' does not seem to be injectable
[18:01:02] [CRITICAL] all tested parameters do not appear to be
injectable
[18:01:02] [WARNING] HTTP error codes detected during run:
403 (Forbidden) - 2733 times

[*] ending @ 18:01:02 /2025-04-11/
```

- explaining the flags of the command:
    - `-u`: to specify the url
    - `--batch`: runs sqlmap without prompting for user input (auto-selects default options)
    - `--risk=3`: payload risk level, and level 3 includes dangerous queries
    - `--level=5`: it tests ALL parameters + HTTP headers + Referer/User-Agent
    - `--dbms=sqlite`: it tells sqlmap to use SQLite-specific payloads (since the juice shop uses SQLite)
    - `--tamper=between,space2comment,unmagicquotes`:
        - `between`: replaces `>` with `NOT BETWEEN 0 AND #`
        - `space2comment`: replaces spaces with `/**/` (bypasses space filters)
        - `unmagicquotes`: bypasses `magic_quotes` protection
    - `--random-agent`: it randomizes the HTTP `User-Agent` header
    - `--timeout=5`: it sets timeout to 5 seconds per request to prevent hanging requests
    - `--time-sec=1`: it reduces delay for time-based attacks from 5 sec
    - `--delay=0`: it removes delay between requests
    - `--flush-session`: it clears previous scan data for the target
    - `--fresh-queries`: ignores cached parameter information
    - `--keep-alive`: reuses HTTP connections (persistent sessions)
    - `--null-connection`: retrieves response lengths without downloading bodies
    - `--predict-output`: guesses response content to skip redundant tests for optimization