E-commerce Website Security Assessment & Remediation Plan

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Scenario: Small e-commerce website on LAMP stack (DVWA in lab)

1. Executive Summary

This assessment evaluates a fictional e-commerce website (DVWA lab on LAMP) against core Cyber Essentials Plus principles with a focus on web application security. Using AI assistance for rapid analysis and a controlled Kali → DVWA lab for demonstration, we identified critical weaknesses: SQL Injection, Broken Authentication, and Stored Cross-Site Scripting (XSS). Immediate remediation is required for SQL Injection and authentication flaws; security headers and output encoding address XSS. Defense-in-depth and operational controls are recommended to reduce risk and improve resilience.

2. Top 10 Common Web Application Vulnerabilities (AI-Assisted)

• A01: Broken Access Control: Failures in enforcing user permissions allow unauthorized access or actions. Impact: data exposure, privilege escalation.

• A02: Cryptographic Failures: Sensitive data not protected in transit/at rest; weak/legacy crypto. Impact: credential theft, privacy breaches.

• A03: Injection: Untrusted input interpreted as code/queries (SQL/NoSQL/OS/LDAP). Impact: data exfiltration, RCE.

• A04: Insecure Design: Missing threat modeling or insecure business logic. Impact: workflow bypass, systemic weaknesses.

• A05: Security Misconfiguration: Default accounts, verbose errors, open S3/buckets, bad perms. Impact: lateral movement, information disclosure.

• A06: Vulnerable & Outdated Components: Unpatched frameworks/servers/libs. Impact: known exploits → takeover/RCE.

• A07: Identification & Authentication Failures: Weak passwords/sessions, no MFA, flawed resets. Impact: account takeover.

• A08: Software & Data Integrity Failures: Unsigned/unchecked updates/CI-CD artifacts; insecure deserialization. Impact: supply-chain compromise.

• A09: Security Logging & Monitoring Failures: Insufficient/unguarded logs, lack of alerting. Impact: undetected breaches.

• A10: Server-Side Request Forgery (SSRF): Server fetches attacker-controlled URLs. Impact: access to internal services/metadata.

3. AI-Assisted Vulnerability Identification (Provided Snippets & Config)

3.1 Snippet 1 – PHP Login

Code summary:
Receives username/password from POST, interpolates directly into an SQL query, and compares plaintext values.

Identified issues & OWASP mapping:

- SQL Injection (A03: Injection): Direct string concatenation into SQL query enables injection (e.g., ' OR '1'='1).

- Plaintext Password Handling (A02: Cryptographic Failures): Compares plaintext passwords; no hashing, salting, or secure verification.

- Hard-coded Credentials (A05: Security Misconfiguration): Database credentials embedded in source; risk of leakage and reuse.

- Excessive DB Privileges (A05: Security Misconfiguration): Likely overly-permissive DB user.

- Lack of Brute Force Controls (A07: Identification & Authentication Failures): No rate limiting/lockouts/MFA on login.

- Verbose Responses (A05: Security Misconfiguration): Clear success/failure messages aid attackers.

Initial remediation:

• Use prepared statements/parameterized queries (PDO/mysqli).

• Store passwords with Argon2id (or bcrypt) and verify using password_verify().

• Move secrets to environment variables/secret manager; rotate regularly.

• Create least-privilege DB user; revoke unsafe privileges (DROP/ALTER).

• Implement login throttling, account lockout, and optional MFA.

• Generic error messages; detailed errors only in logs.

3.2 Snippet 2 – JavaScript Search (DOM Rendering)

Code summary:
Directly writes user-provided input into the DOM via innerHTML, rendering attacker-controlled markup/scripts.

Identified issues & OWASP mapping:

- DOM-based XSS (A03: Injection (XSS)): Using innerHTML with unsanitized input allows script execution.

Initial remediation:

• Use textContent or safe templating; avoid innerHTML for untrusted data.

• Sanitize input with a vetted library (e.g., DOMPurify).

• Set a strict Content-Security-Policy (CSP) to block inline scripts and restrict sources.

3.3 Configuration Detail – Apache Logs

Apache logs rotate daily under /var/log/apache2 with default permissions.

Identified issues & OWASP mapping:

- Overly Permissive Log Access (A09: Security Logging & Monitoring Failures): Defaults may leave logs readable to unintended users; logs often contain sensitive data.

- Lack of Centralized Monitoring (A09: Security Logging & Monitoring Failures): No forwarding/alerting to detect brute force or anomalies.

- Potential Log Injection/Poisoning (A05: Security Misconfiguration): If application logs raw input, attackers may inject control characters.

Initial remediation:

• Restrict permissions (e.g., chmod 640; owner root, group adm).

• Forward logs to a central SIEM; enable alerting for auth failures and anomalies.

• Sanitize/encode user input before logging; avoid sensitive data in logs.

• Protect log rotation scripts; verify correct logrotate config.

4. Prioritized Remediation & Mitigation Strategy (Personal Input)

Prioritization is based on exploitability and business impact:

• P1 – SQL Injection in login (Critical): trivial exploitation → full DB compromise.

• P2 – Authentication weaknesses (High): brute force, plaintext passwords → account takeover.

• P3 – DOM/Stored XSS (High): session hijack, phishing, supply-chain script injection risks.

• P4 – Hard-coded secrets & misconfiguration (Medium): secret leakage; privilege misuse.

• P5 – Logging/Monitoring weaknesses (Medium): delayed detection → larger blast radius.

5. Detailed Multi-Layered Mitigation (Top 3)

5.1 SQL Injection – Defense in Depth

Code changes (PHP – PDO example):

```
<?php
// Use environment variables for secrets
$dsn = getenv("DB_DSN"); // e.g., mysql:host=127.0.0.1;dbname=mydb;port=3306
$user = getenv("DB_USER");
$pass = getenv("DB_PASS");
$pdo = new PDO($dsn, $user, $pass, [PDO::ATTR_ERRMODE =>
PDO::ERRMODE_EXCEPTION]);
$stmt = $pdo->prepare("SELECT id, password_hash FROM users WHERE username = ?");
$stmt->execute([$username]);
$row = $stmt->fetch(PDO::FETCH_ASSOC);
if ($row && password_verify($password, $row["password_hash"])) {
   // success: regenerate session id
   session_regenerate_id(true);
   echo "Login successful";
} else {
   echo "Invalid credentials";
}
?>
```

Configuration & infra:

• Create least-privilege DB role: only SELECT on authentication tables; no schema changes.

• Enable parameterized queries everywhere; ban concatenated SQL in code reviews.

• Deploy ModSecurity + OWASP CRS to block common SQLi payloads.

• Turn off verbose DB errors in production; log securely with correlation IDs.

• Automated SAST/DAST in CI/CD to catch regressions.

5.2 Authentication Hardening

Code & policy:

• Hash passwords with Argon2id (memory-hard) or bcrypt; use password_hash() / password_verify().

• Enforce strong password policy; add MFA (TOTP/WebAuthn) for privileged users.

• Rate limit login attempts (e.g., 5 per 15 minutes per account/IP) and add exponential backoff.

• Lock out and alert after repeated failures; provide safe self-service unlock.

• Regenerate session IDs after login; set cookies HttpOnly, Secure, SameSite=Lax/Strict; force HTTPS.

• Implement CSRF tokens on all state-changing actions.

Server headers (Apache example):
Header always set Strict-Transport-Security "max-age=31536000; includeSubDomains"
Header always set X-Frame-Options "DENY"
Header always set X-Content-Type-Options "nosniff"

5.3 XSS Prevention

Code changes: replace dangerous DOM sinks and encode output:

```
// BAD
results.innerHTML = 'Showing results for: ' + query;

// GOOD
results.textContent = 'Showing results for: ' + query;
// Or sanitize first: results.innerHTML = DOMPurify.sanitize(userHtml);
```

Security headers (Apache):
Header set Content-Security-Policy "default-src 'self'; script-src 'self'; object-src 'none'; base-uri 'self'; frame-ancestors 'none'"
Header set Referrer-Policy "no-referrer"

• Ban inline scripts and event handlers; use nonces or hashes if inline is unavoidable.

• Template engines with automatic context-aware encoding (e.g., Mustache, Twig).

• Unit tests for output encoding; SAST rules for dangerous sinks (innerHTML, document.write).

6. Breaking Things Mindset – Chained Attack Scenario

1. **Step 1 – XSS attack:**
    - The attacker puts a malicious script in the search page.
    - A support agent clicks the attacker's link.
    - The script steals the agent's login cookie.
2. **Step 2 – Use stolen session:**
    - With the cookie, the attacker logs in as the agent.

- They now have access to the admin panel.

3. **Step 3 – File upload attack:**
   - The attacker uploads a fake "image" that is actually a PHP web shell.
   - Because the site does not check uploads properly, it accepts the file.
4. **Step 4 – Steal database info:**
   - The attacker uses the web shell to read hidden files (like .env).
   - This reveals database username and password.
   - They then steal all user data from the database.

🛡️ **How our defenses stop it**

- **CSP + output encoding** → block the XSS at the start.
- **Secure cookies (HttpOnly, SameSite) & MFA** → even if XSS runs, cookies can't be stolen or abused easily.
- **File upload validation** → only real images are allowed, not PHP scripts.
- **Least-privilege DB user & secret management** → even if someone gets in, damage is very limited.

7. Use of AI Tools & Personal Contribution

AI tools (ChatGPT) were used to accelerate identification of common vulnerabilities, propose initial remediations, and draft secure code patterns. Limitations observed: AI suggestions can be generic, environment-agnostic, or omit operational context; all outputs were validated and tailored to the LAMP/DVWA setup. Personal contributions included: lab build and validation (Kali ↔ DVWA), hands-on exploitation (sqlmap, Hydra, XSS), prioritization based on impact to an e-commerce context, creation of multi-layer defenses (code, headers, WAF, ops), and assembling this report.

8. Tools Used

• AI: ChatGPT (analysis and drafting).

• Attack tools: sqlmap (SQLi), Hydra (brute force).

• Platform: Kali Linux, DVWA on Windows (WAMP), Oracle VirtualBox.

• References: OWASP Top 10 2021, PHP manual, Apache HTTP Server docs.

Appendix: Lab Evidence (Screenshots)

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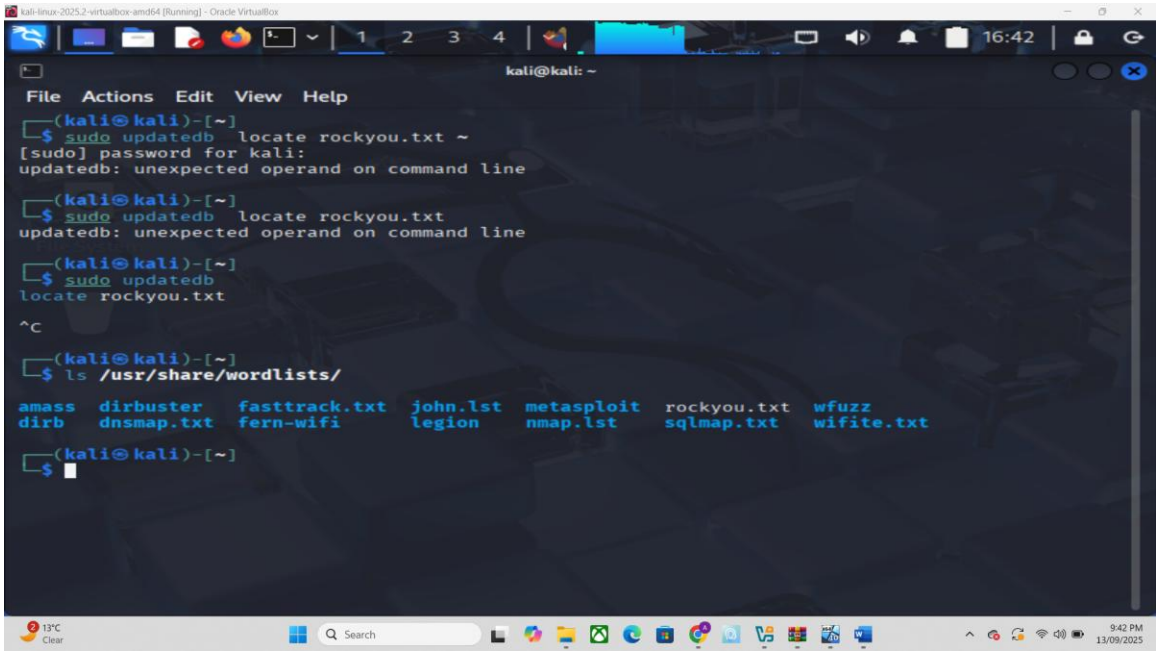

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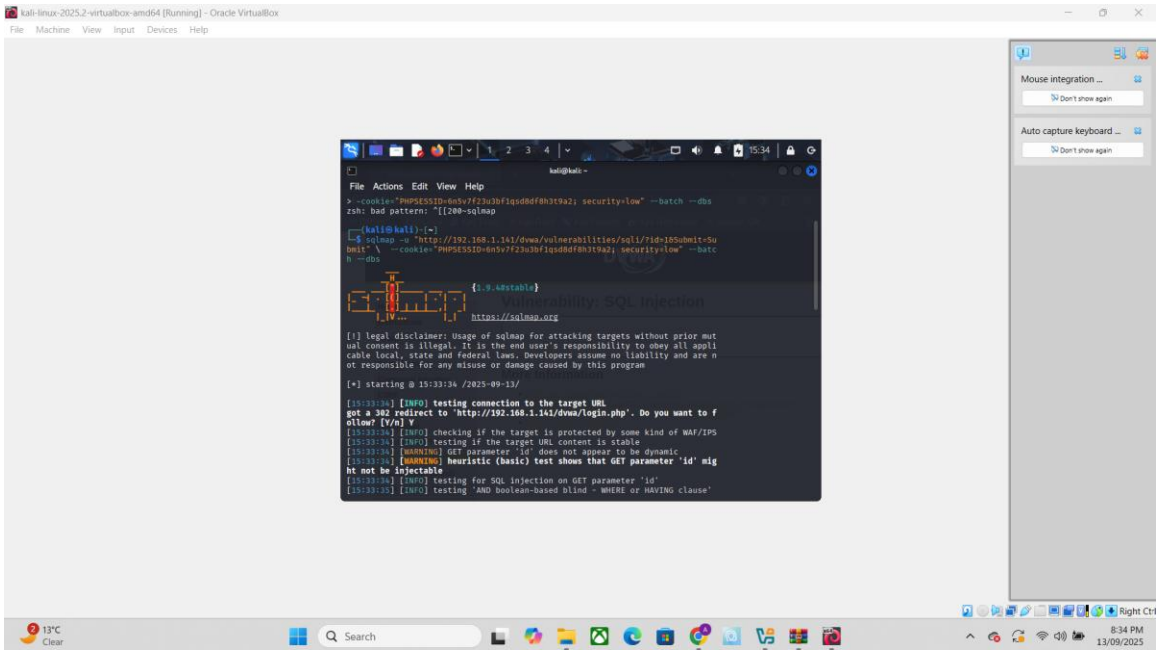

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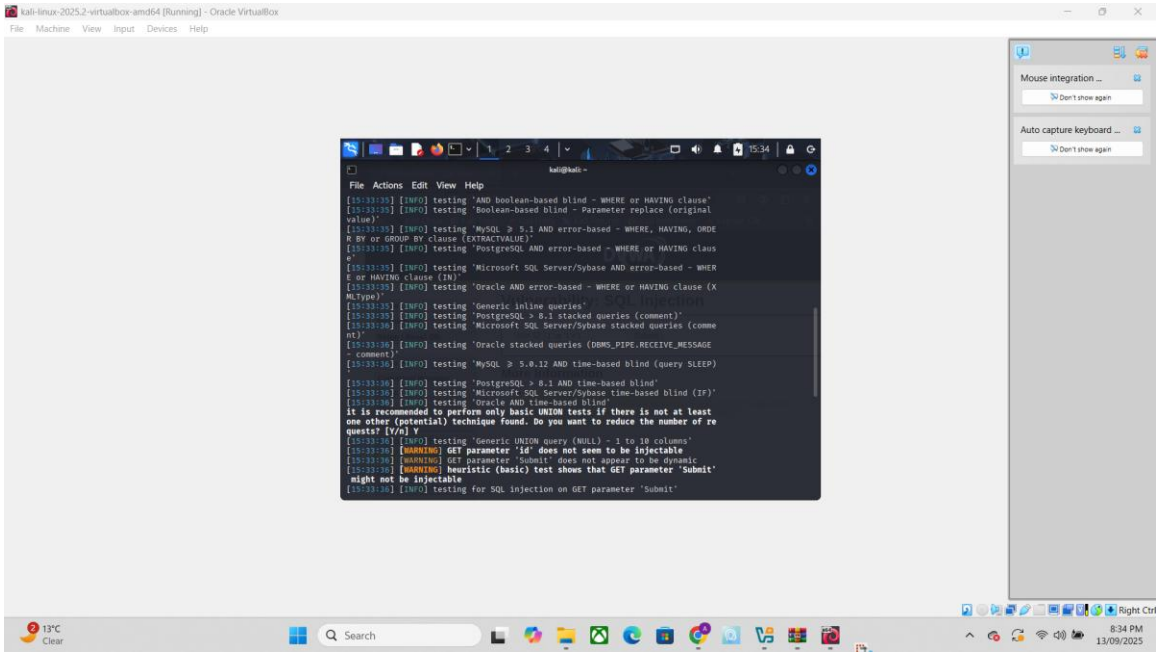

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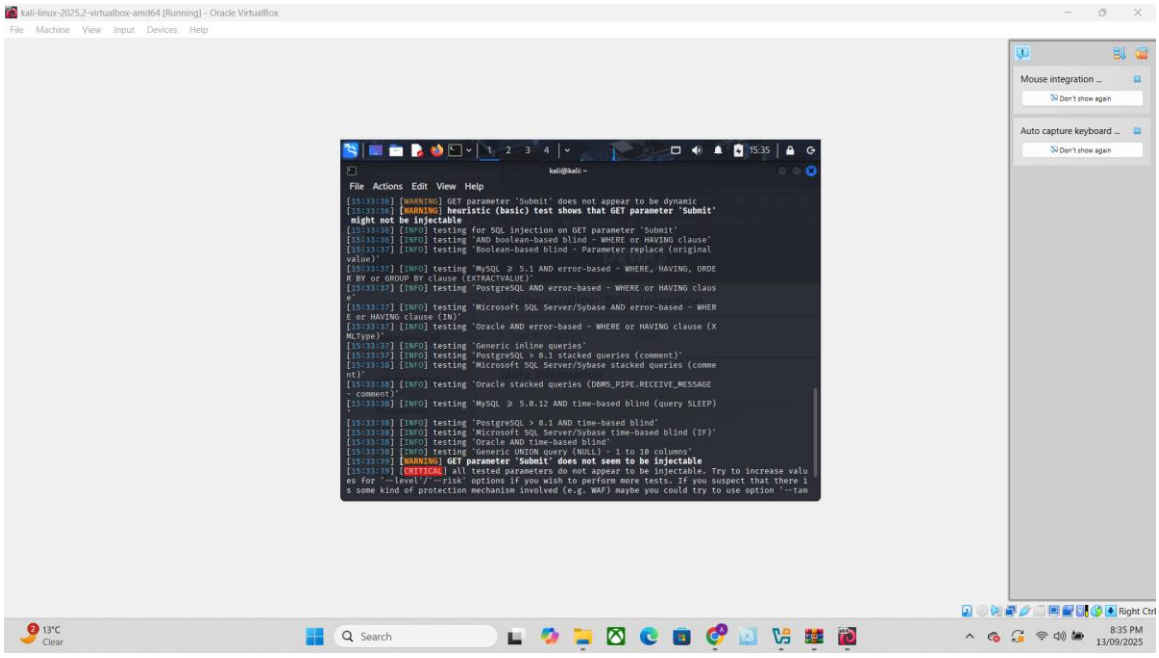

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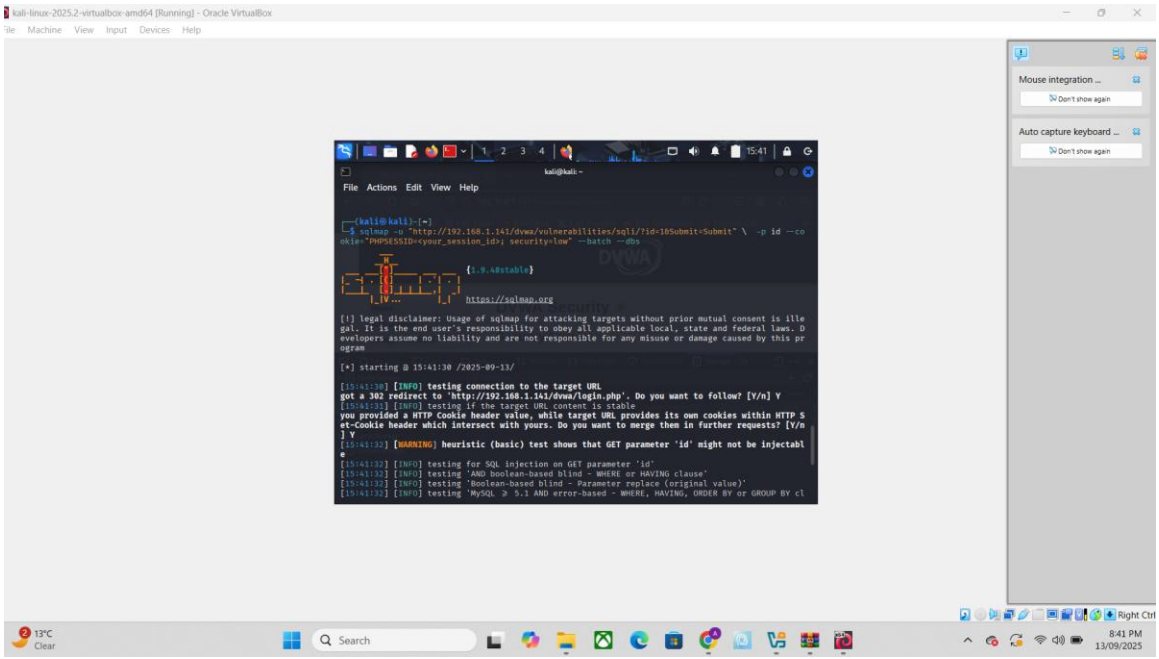

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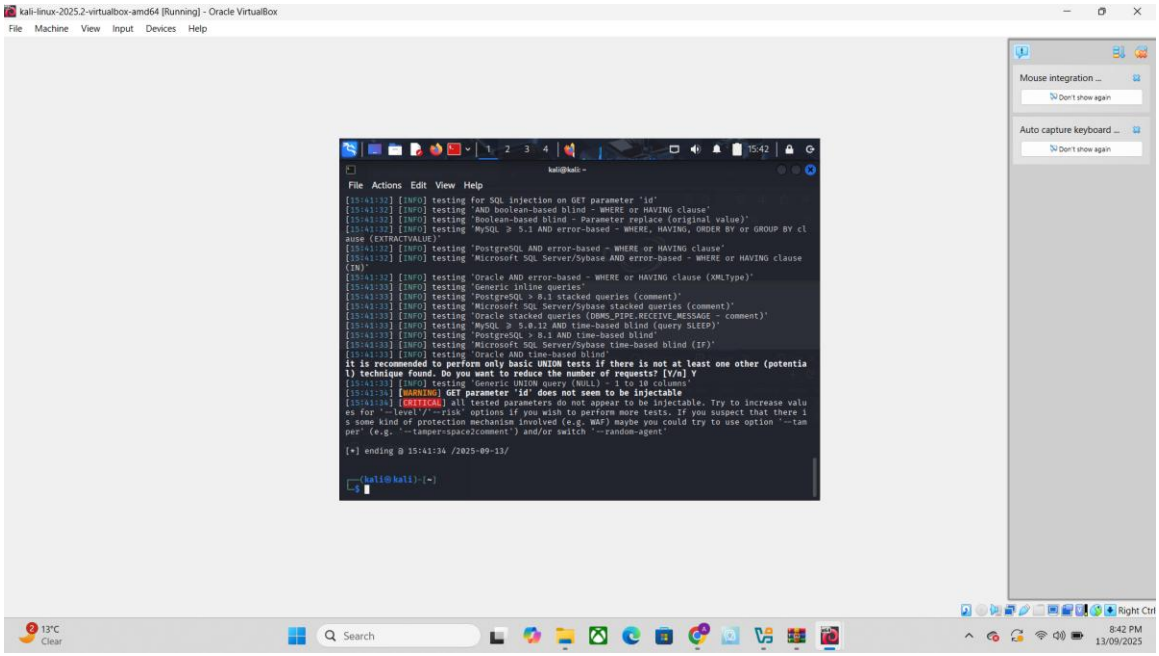

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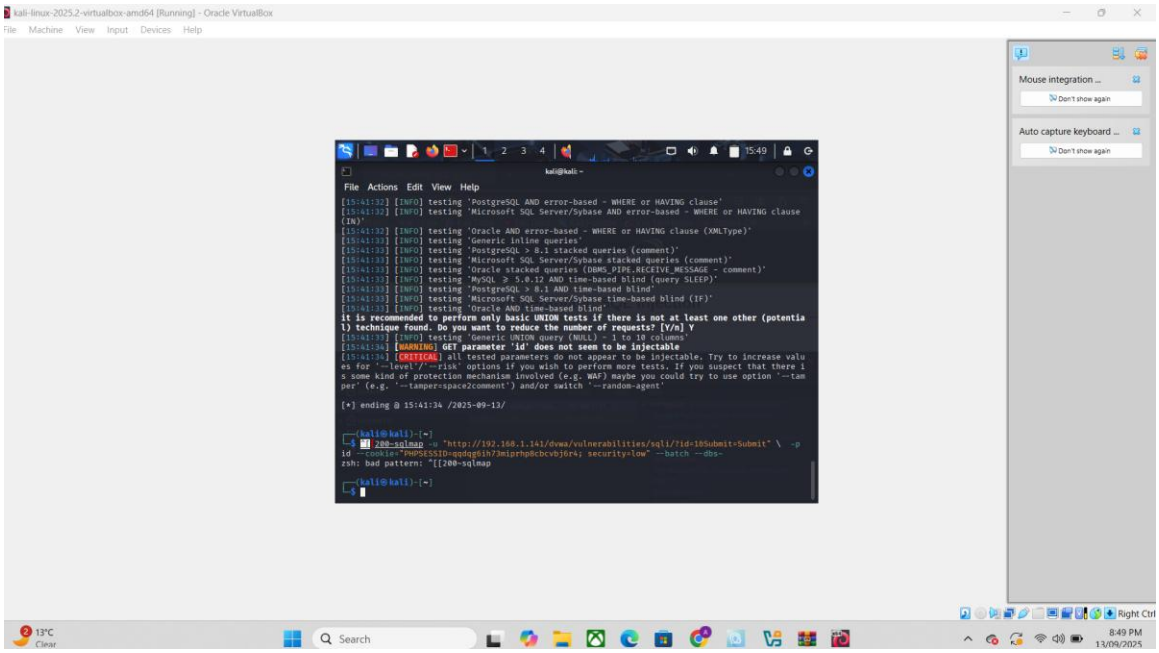

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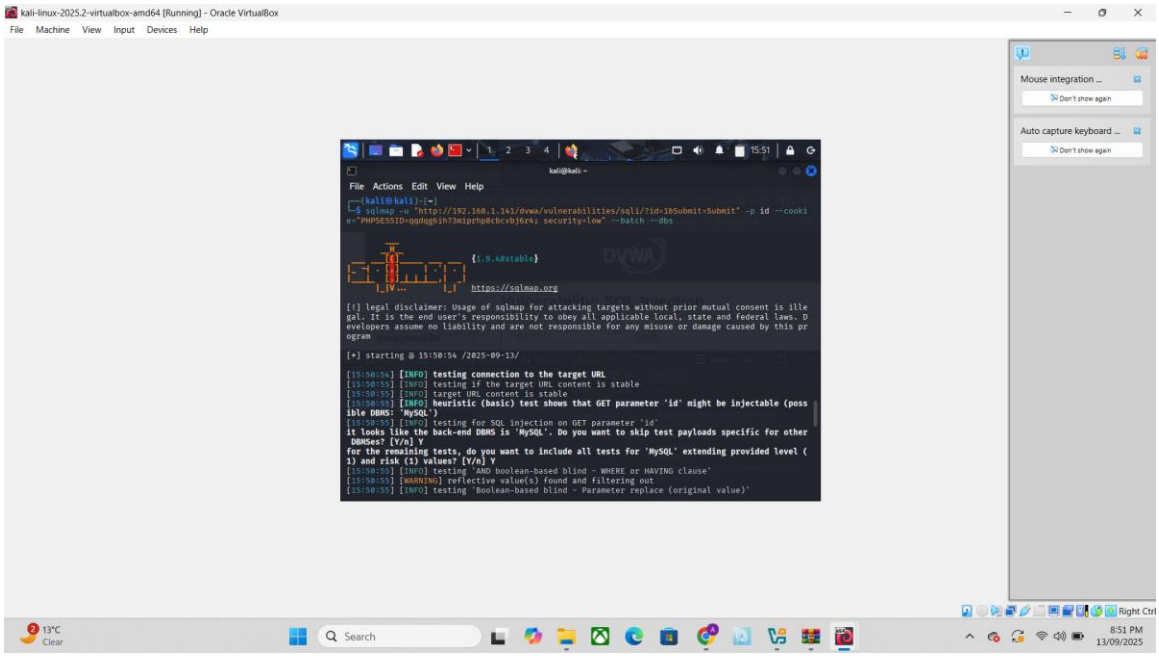

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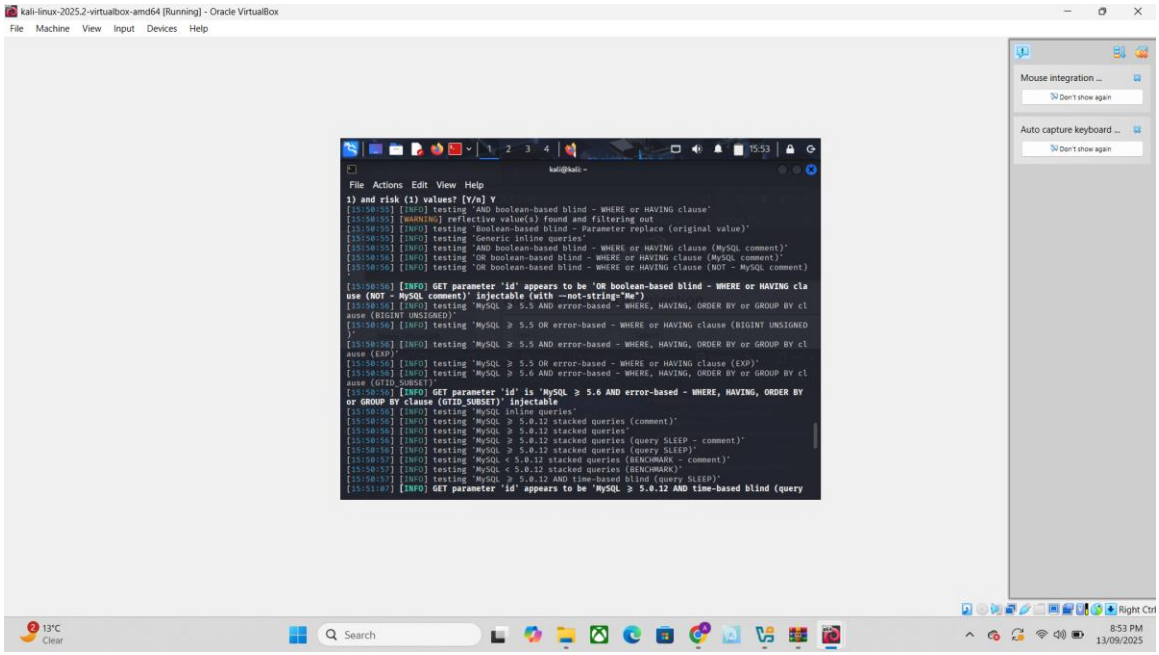

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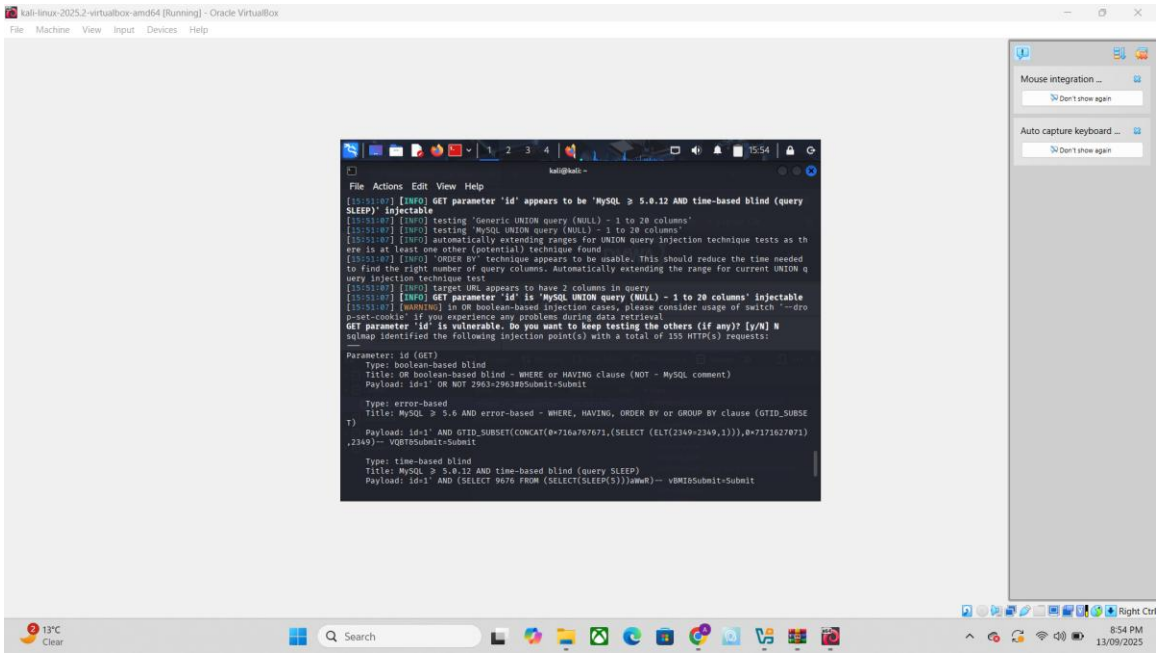

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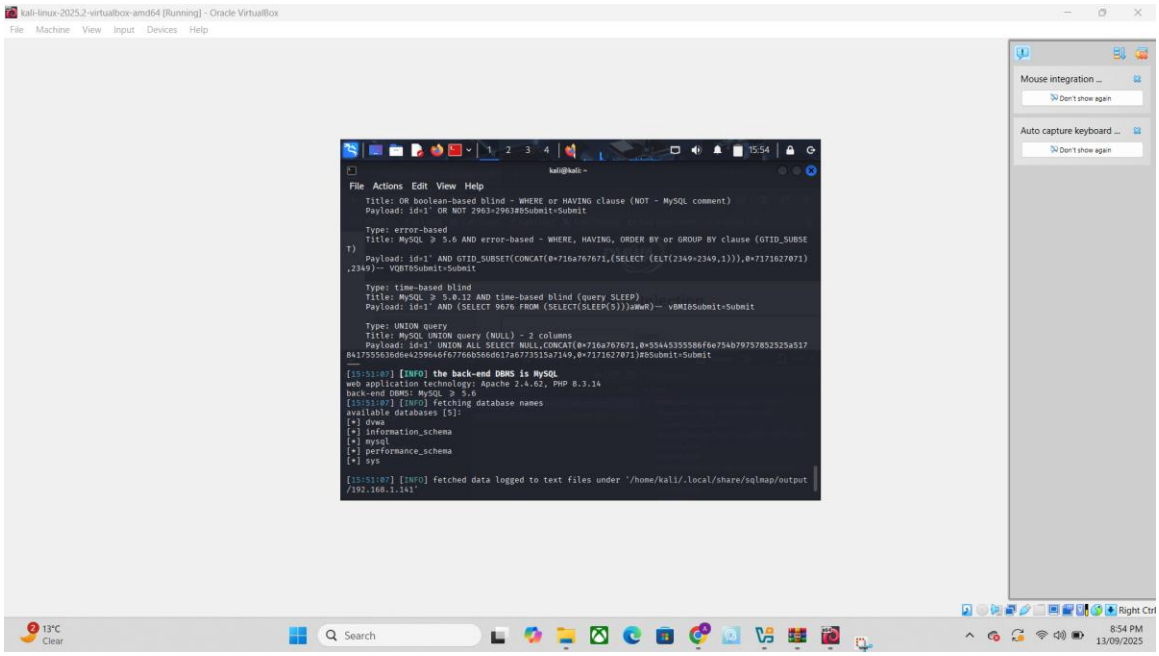

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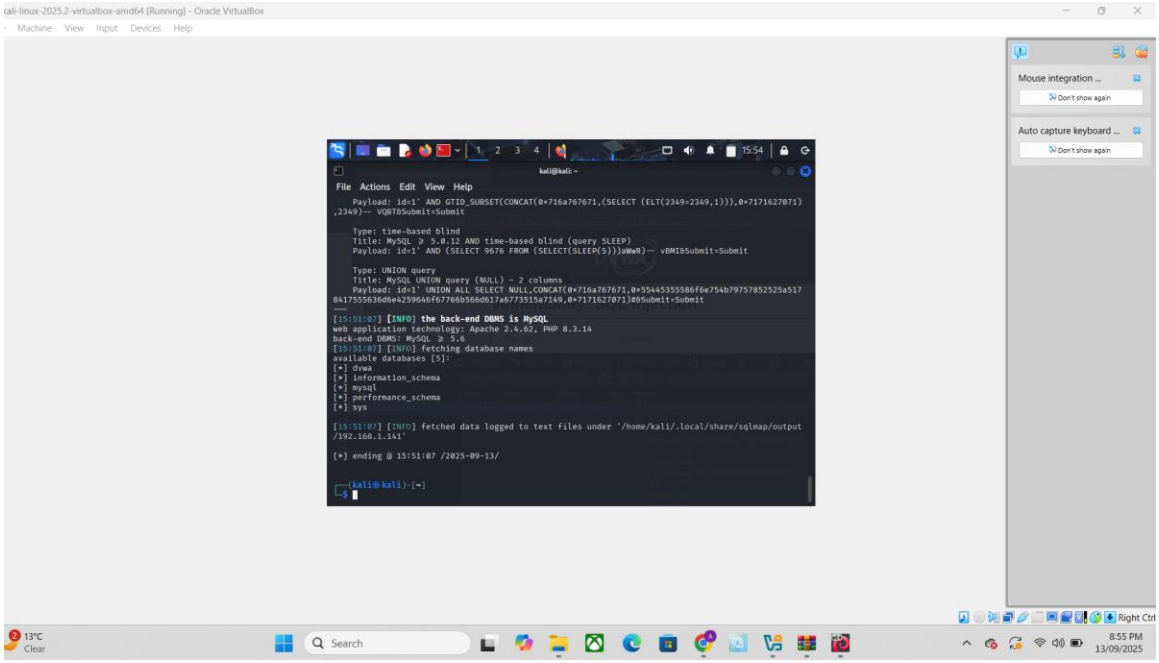

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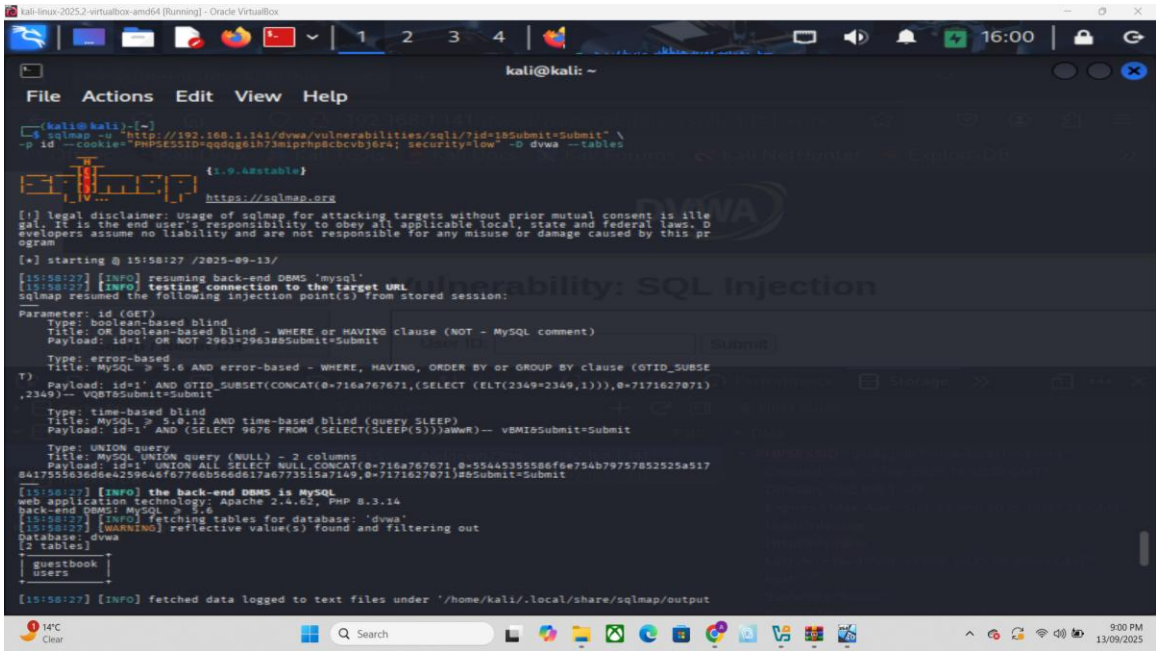

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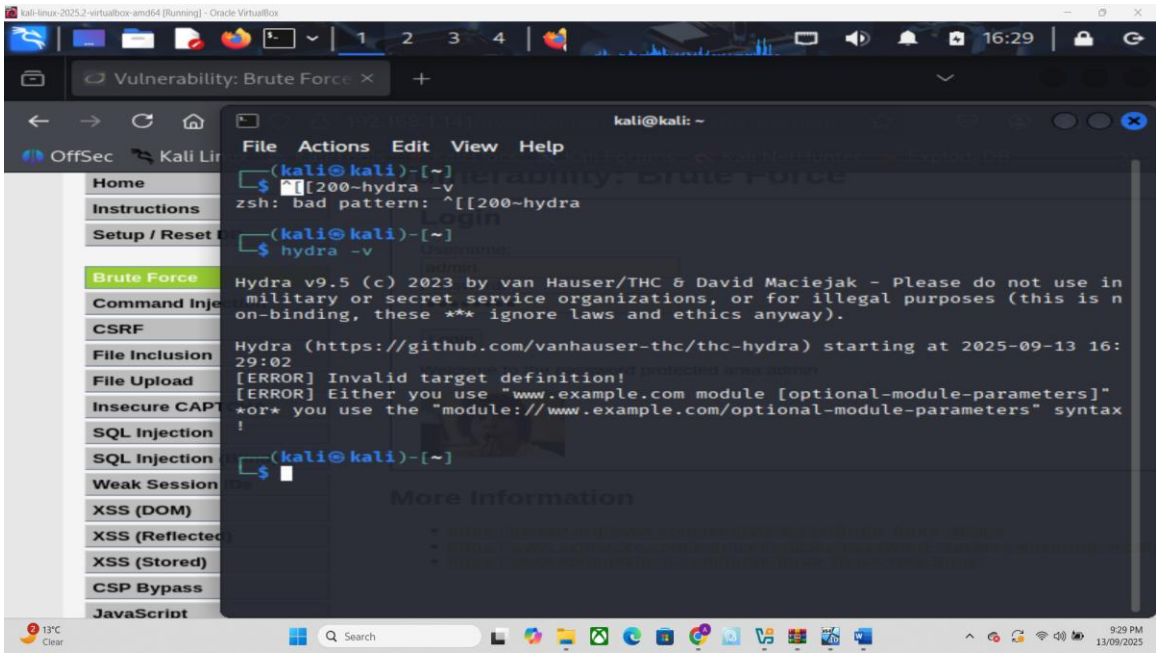

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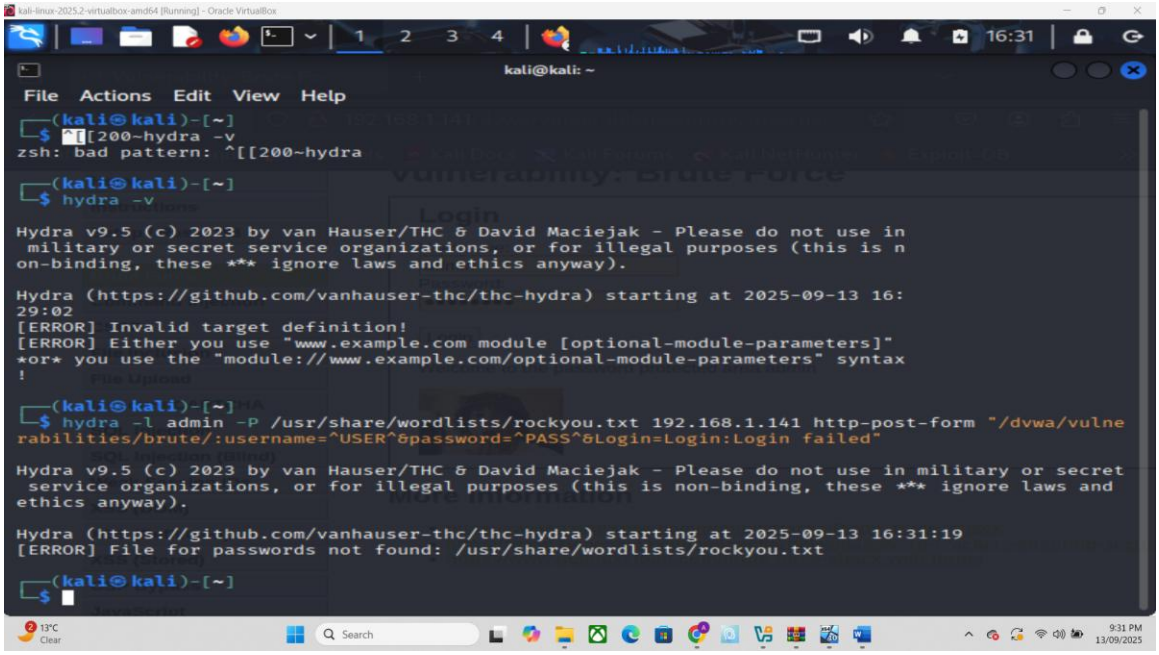

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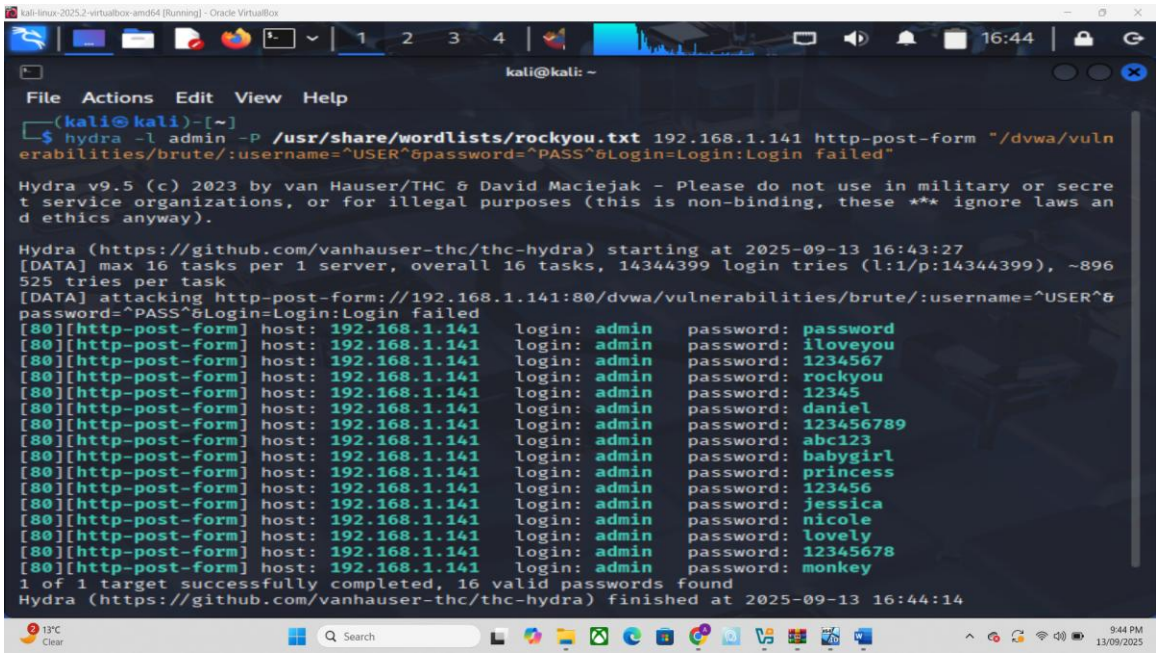

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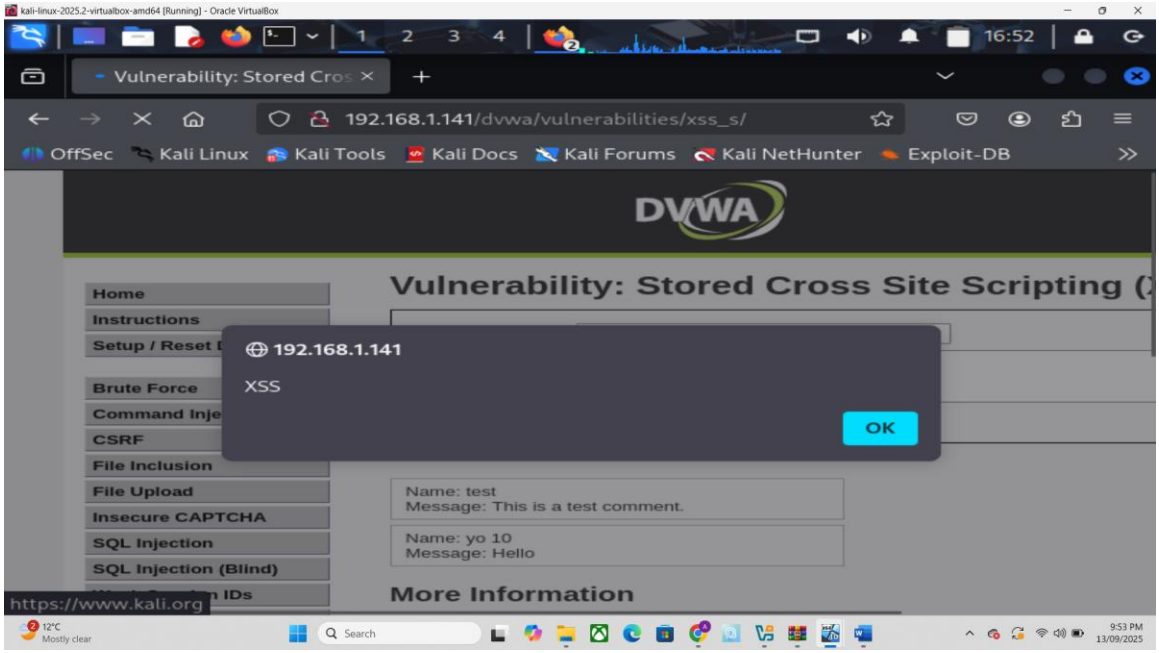

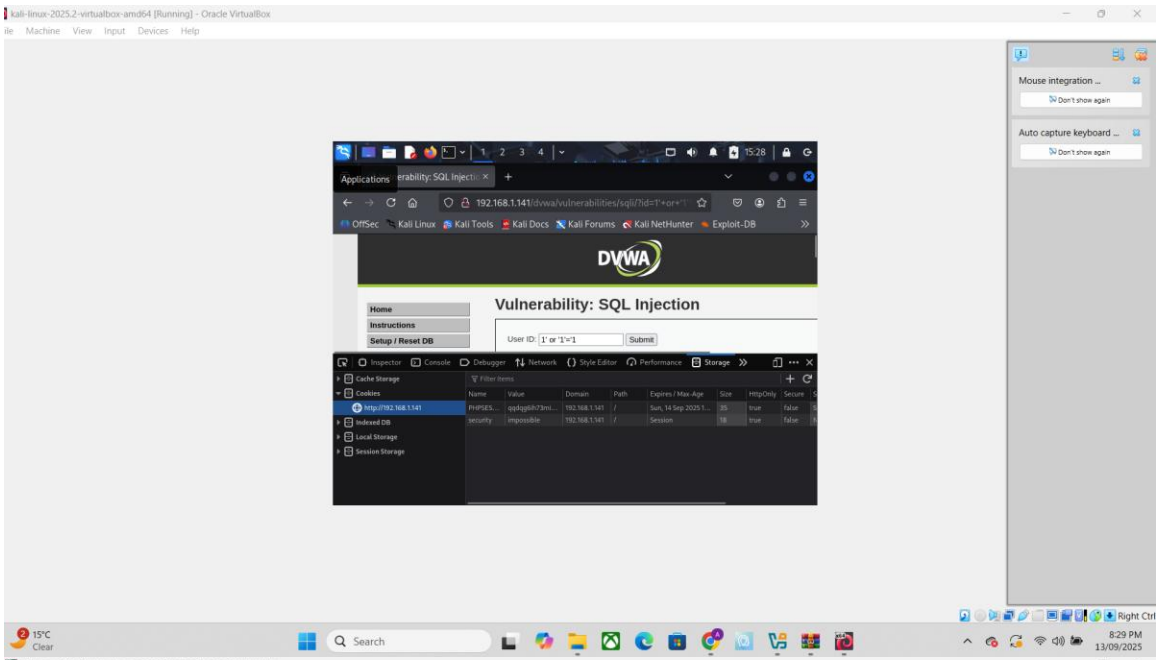
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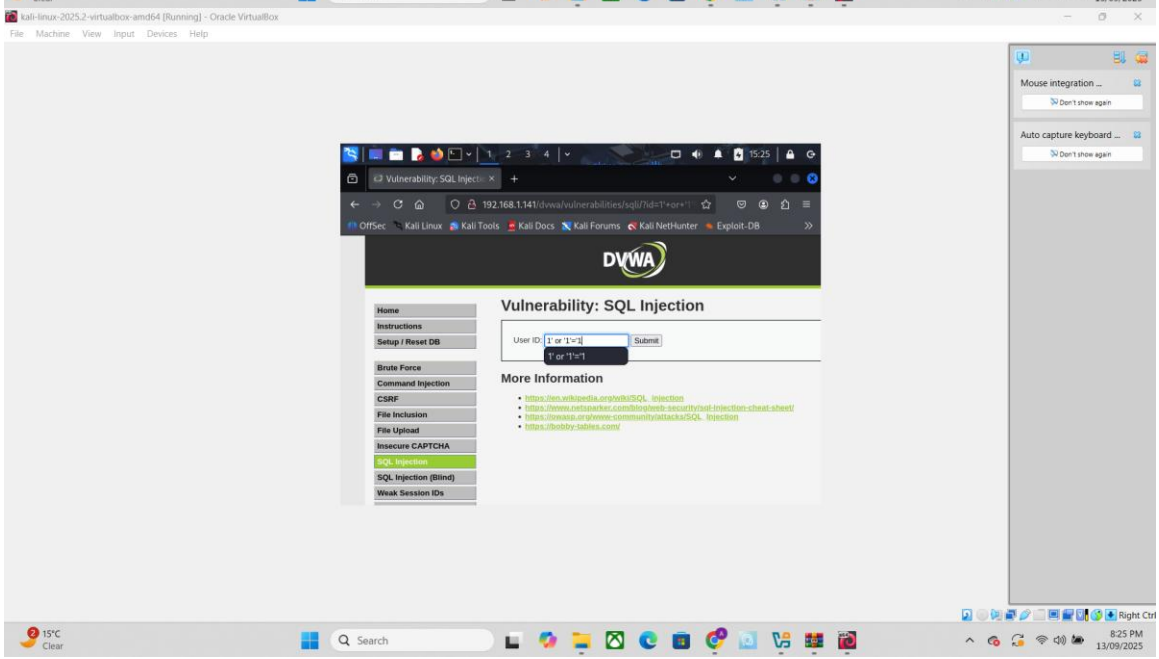
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Instructions
Setup / Reset DB
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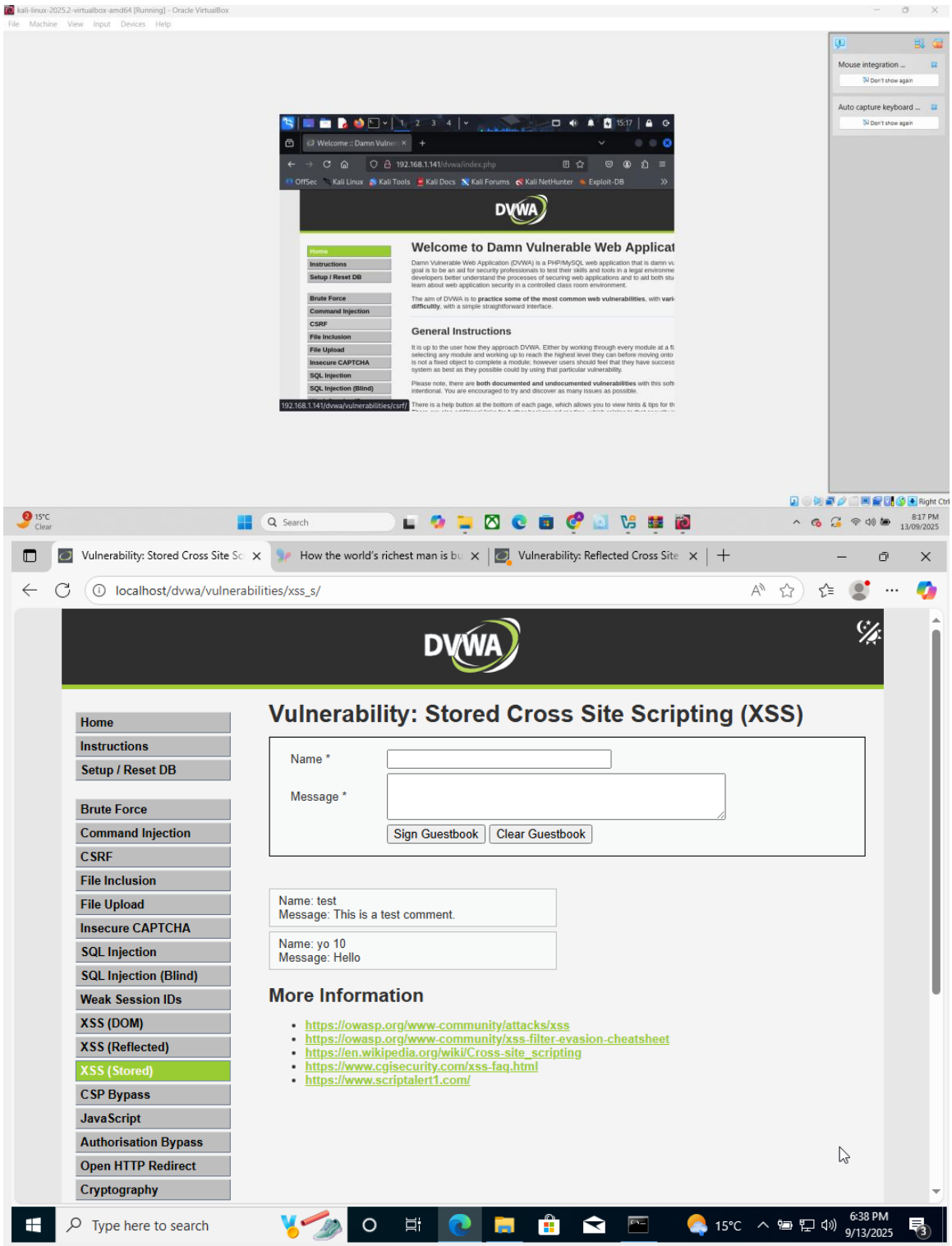
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