An Overview to SQL Injection Attacks and its Countermeasures

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Abstract:
Web applications are those applications which run in a web browser. These applications are accepted in some data and send it to a database for further processing. There are a number of attacks on web applications like cross site scripting, cross site request forgery, but SQL injection attacks are the most prominent. Number of papers in Literature has been projected ways to avoid SQL injection attacks by examining dynamic SQL query semantics at runtime in the application layer. This paper contains the study of SQLIA and its prevention techniques. SQL injection attacks on web application have become one of the most important information security concerns [Pinzo'n C et al., 2010]. These SQL injection attacks are extremely widespread and pose a serious security threat [Khoury et al., 2011]. In today's world SQL injection is one of the most dangerous security threats in database.

1. Literature survey of SQL injection

SQL injection is the attacks related to backend database results in unauthorized access to private or confidential information stored [Kiani M et al., 2008]. Also the attacker intrudes to the web application database to access the data [Tajpour & JorJor Zade, 2010]. Exploitation of SQL injection vulnerability (SQLIV) through successful attacks might result in authentication bypassing, leaking of private information, etc. [Shahriar, H & Zulkernine, M]. SQL injection attacks are very harmful as they targets interactive web application that employs database services. [Wei & Muthuprasanna, 2006]. The SQL injection attacks allow an attacker to access the underlying database, execute arbitrary commands at intent and receive a dynamically generated output [Kosuga et al., 2007].

If the web application containing vulnerability can allows malicious users to obtain unrestricted access to private and confidential information.This mechanism used by hackers to steal data from the organization. It allows a hacker to gain control over the database of an application and consequently hackers may be able to alter data [Shanmughaneethi et al., 2009]. An attacker can inject in the original SQL query and obtain, change or view data.

2. An Overview of Prevention Techniques

2.1. AIIDA- SQL

This prevention techniques work against SQL injection attacks and proposed by the author. They mentioned that SQL injection attacks are the most critical attacks from the web application. The techniques against SQLIA called Adaptive Intelligent Intrusion Detector Agent (AIIDA- SQL) According to the author; the experimental results using this technique are good in real practice [Pinzo'n C et al., 2010].

2.2. Black Box Web Application Security Scanner

Standard security features are not enough to protect web application form hacking, threats, SQL injection, XSS, CSRF and hence black box testing is used. According to author SQL injection is the most critical web application vulnerability. Author also mentioned that black box scanners are having some weaknesses. It is not good enough to identify vulnerable programs that browses world wide web in a methodical, automated manner called as web crawling , user login etc. the black box testing tool had a poor detection rate so that author proposed a set of recommendation that could enhance the rate of detection [Khoury et al., 2011].

2.3. Augmented Attack Tree Modeling

SQL injection attacks are classified into seven types [J. Viegas et al., 2006]

- Tautologies
- Legal/Logical Incorrect queries
- UNION query
- Piggy – Backed Queries
- Stored procedures
- Inference, and alternate encoding

There are two types of an attack tree modeling [Jie Wang et al., 2010]

- Conventional Attack trees
- Augmented Attack tree

This attack tree model is not only applicable to SQLIA but also Cross Site Request Forgery Attacks (CSRF). The method presented by the author is generic and hence it can be applicable to other kinds of web based attacks.

2.4. Automated Fix Generator

SQL injection is an example of taint based vulnerability that has been responsible for a large number of security failures to perform some promised act or obligation in recent years. Untrusted data from the user is tracked when it flows unsafely into a security critical operation and hence vulnerability is flagged. In SQL injection the user can add some additional conditions or commands to a database query, thus allowing the user to bypass authentication or alter data. Automated fix generator detects and fix SQL queries that contains SQL injection vulnerability (SQLIV). For testing purpose author used phpBB v2.0 [Dysart & Sherriff, 2008]. Anomaly Based Character Distribution Models

The anomaly detection process uses a number of different models to identify anomalous state for each basic block of a web application. A model is a set of procedure used to evaluate a certain features of a state variable associated with the block.

The author used anomaly based approach to detect SQL injection attacks and it is superior to existing model which works against SQLIV [Kiani M et al., 2008]. VIPER tool for penetration testing [Angelo Ciampa].

According to the authors, they have suggested a tool called VIPER to perform penetration testing of web applications. This tool relies on a knowledge base of heuristics that guides the generation of the SQL queries. This tool first identifies the hyperlink structure and its input form.

2.5. Hidden Web Crawling [Xin Et Al., 2010]

SQLIV are the most prominent issues in today's World Wide Web. Many traditional vulnerability scanners are available, but they are unable to fulfill the requirements. Author proposed a mechanism based on hidden web crawling to achieve the goal. The authors also compare their tool with other traditional scanners and tested on the public web sites. The results show that the proposed tool is well over the traditional web scanners.

2.6. High interaction Honeypot System [Jiao Ma et al., 2011]

Honeypots are a very original approach to computer security. The honeypot are classified in two categories

- Low interaction : fake services
- High interaction : complete access

Here authors proposed a high interaction honeypot system against SQLIV. They used two approaches.

- Modifying PHP extension for mysql to intercept data based request
- Adopting exception based and signature based detection techniques.

The results show that this system is very efficient against SQLIV.

2.7. Music

Much vulnerability are discovered after the deployment of software implementation such as buffer overflows, SQL injection and format string bug are the most commonly occurring security flaws in software implementation [Shahriar, H & Zulkernine, M]. In 2004 the denial of service exploitation alone, cost more than 26 million dollars in financial losses to business organization [L. Gordon et al., 2004]. MUSIC –mutation based SQL injection Vulnerability checking proposed by the author which is good enough to protect such type of attacks which is not addressed by the existing testing approaches. The discovered vulnerabilities can be fixed and the losses incurred by the end user can be prevented.

2.8. Preventing SQL Injection Attacks in Stored Procedures

This prevention mechanism proposed by the authors. According to authors stored procedures act as a medication against SQL injection attacks. A stored procedure is nothing but a subroutine available to application that accesses a relational database system. The techniques proposed in this paper by the author to eliminate the occurrence of such attacks are a permutation of static application code analysis with runtime validation

Conclusion

2.9. SQL injection is most powerful and easiest attack method on web application [Pinzo'n C et al., 2010]. The effects of these attacks may turn into loss of private and vital information. From this paper, we have studied that different authors proposed a number of

countermeasures against SQLIV and SQLIA. The VIPER tools perform the penetration testing[Angelo et al.] by using SQL injection AIIDA-SQL tool, black box scanners, augmented attack tree modeling, automated fix generator, hidden web crawling etc.

From this paper, we can conclude that several solutions exist to prevent SQL injection attacks, but no concrete solution is presents.

3. References

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