GLOBALRAIN

Practices for Secure Software Report

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Document Revision History

Version	Date	Author	Comments
1.0	12/10/2025	Zion Kinniebrew	Recommendation & Software Report

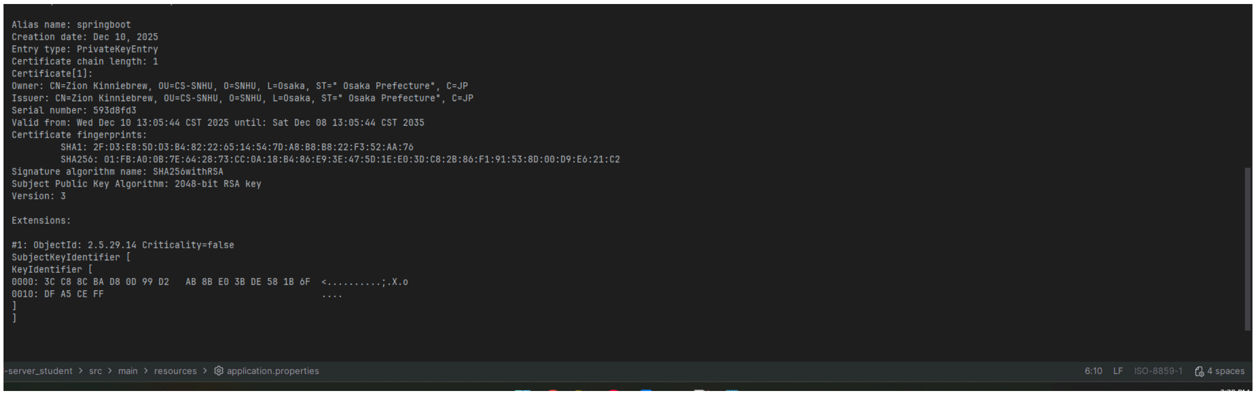
Client

Developer
Zion Kinniebrew

1. Algorithm Cipher

For the Artemis Financial checksum verification system, the recommended Algorithm Cipher is the SHA-256 (Secure Hash Algorithm 256-bit) cryptographic hash function. As part of the secure SHA-2 family, this industry-standard algorithm, published by NIST in 2001, is used for data integrity and checksum verification (not encryption) by creating a unique, one-way, 256-bit fingerprint from any input data. It processes data in 512-bit blocks and produces a 64-character hexadecimal output. While SHA-256 is not an encryption cipher, the overall system implements secure communication using HTTPS/TLS, which utilizes asymmetric cryptography (public/private key pairs) via a self-signed certificate with RSA-2048 asymmetric encryption for the SSL/TLS handshake. Despite the alternative SHA-3, SHA-256 remains widely trusted across financial, healthcare, and government systems for data integrity.

2. Certificate Generation

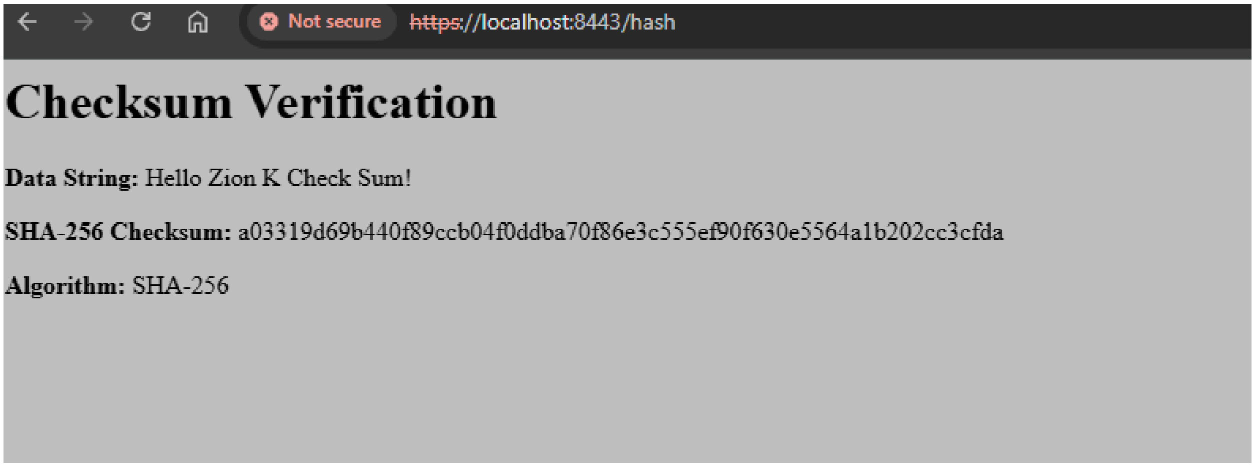


```
Alias name: springboot
Creation date: Dec 10, 2025
Entry type: PrivateKeyEntry
Certificate chain length: 1
Certificate[1]:
Owner: CN=Zion Kinniebrew, OU=CS-SNHU, O=SNHU, L=Osaka, ST=" Osaka Prefecture", C=JP
Issuer: CN=Zion Kinniebrew, OU=CS-SNHU, O=SNHU, L=Osaka, ST=" Osaka Prefecture", C=JP
Serial number: 593d8fd3
Valid from: Wed Dec 10 13:05:44 CST 2025 until: Sat Dec 08 13:05:44 CST 2035
Certificate fingerprints:
         SHA1: 2F:D3:E8:5D:D3:B4:82:22:65:14:54:7D:A8:B8:B8:22:F3:52:AA:76
         SHA256: 01:FB:A0:0B:7E:64:28:73:CC:0A:18:B4:86:E9:3E:47:5D:1E:E0:3D:C8:2B:86:F1:91:53:8D:00:D9:E6:21:C2
Signature algorithm name: SHA256withRSA
Subject Public Key Algorithm: 2048-bit RSA key
Version: 3

Extensions:

#1: ObjectId: 2.5.29.14 Criticality=false
SubjectKeyIdentifier [
KeyIdentifier [
0000: 3C C8 8C BA D8 0D 99 D2   AB 8B E0 3B DE 58 1B 6F  <.........;.X.o
0010: DF A5 CE FF                                        ....
]
]
```

-server_student > src > main > resources > application.properties
6:10
LF
ISO-8859-1
4 spaces

.

3. Deploy Cipher



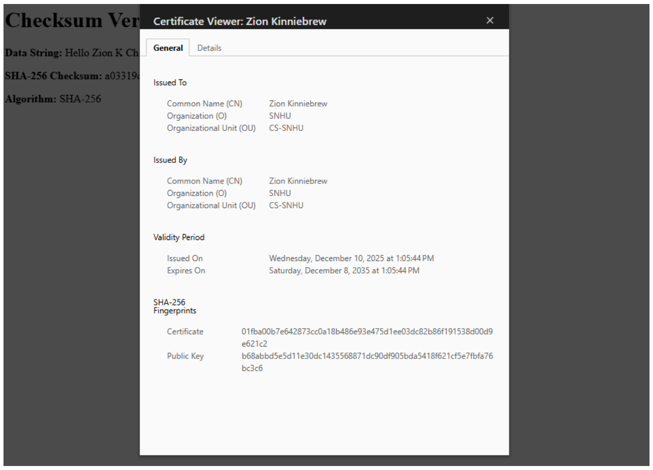
Checksum Verification

Data String: Hello Zion K Check Sum!

SHA-256 Checksum: a03319d69b440f89ccb04f0ddba70f86e3c555ef90f630e5564a1b202cc3cfda

Algorithm: SHA-256

4. Secure Communications



Checksum Ver

Data String: Hello Zion K Ch

SHA-256 Checksum: a03319

Algorithm: SHA-256

Certificate Viewer: Zion Kinniebrew

Issued To

Common Name (CN) Zion Kinniebrew
Organization (O) SNHU
Organizational Unit (OU) CS-SNHU

Issued By

Common Name (CN) Zion Kinniebrew
Organization (O) SNHU
Organizational Unit (OU) CS-SNHU

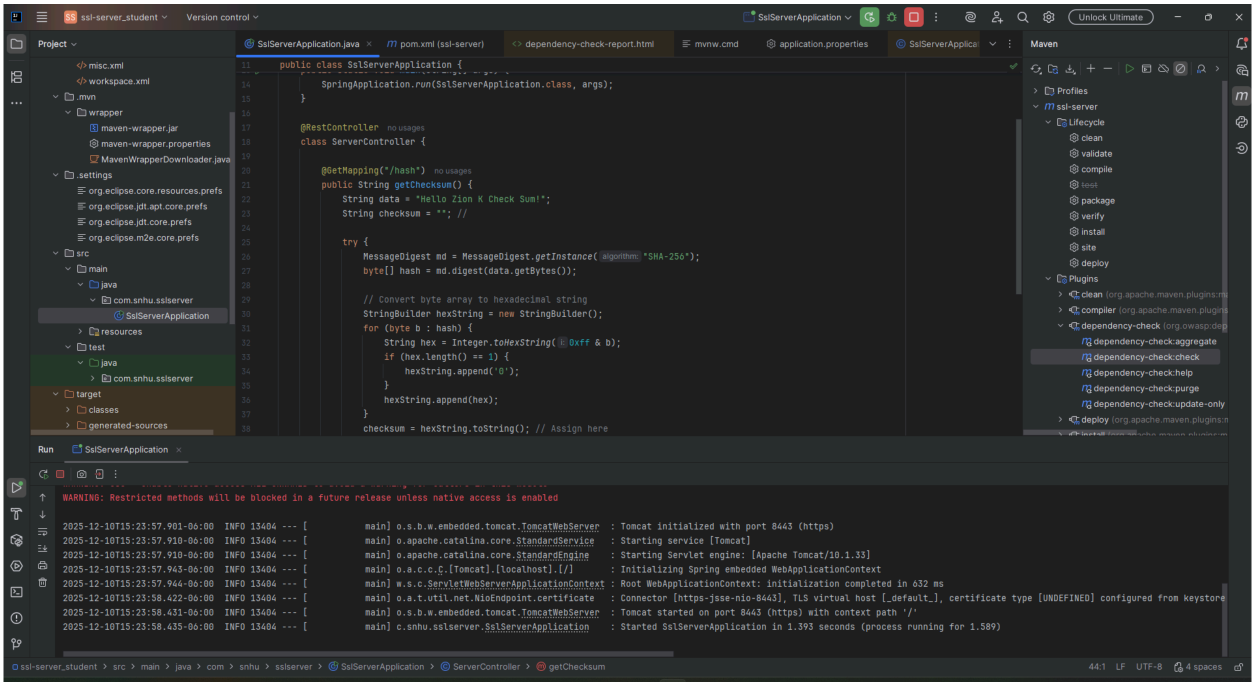
Validity Period

Issued On Wednesday, December 10, 2025 at 1:05:44 PM
Expires On Saturday, December 8, 2035 at 1:05:44 PM

SHA-256 Fingerprints

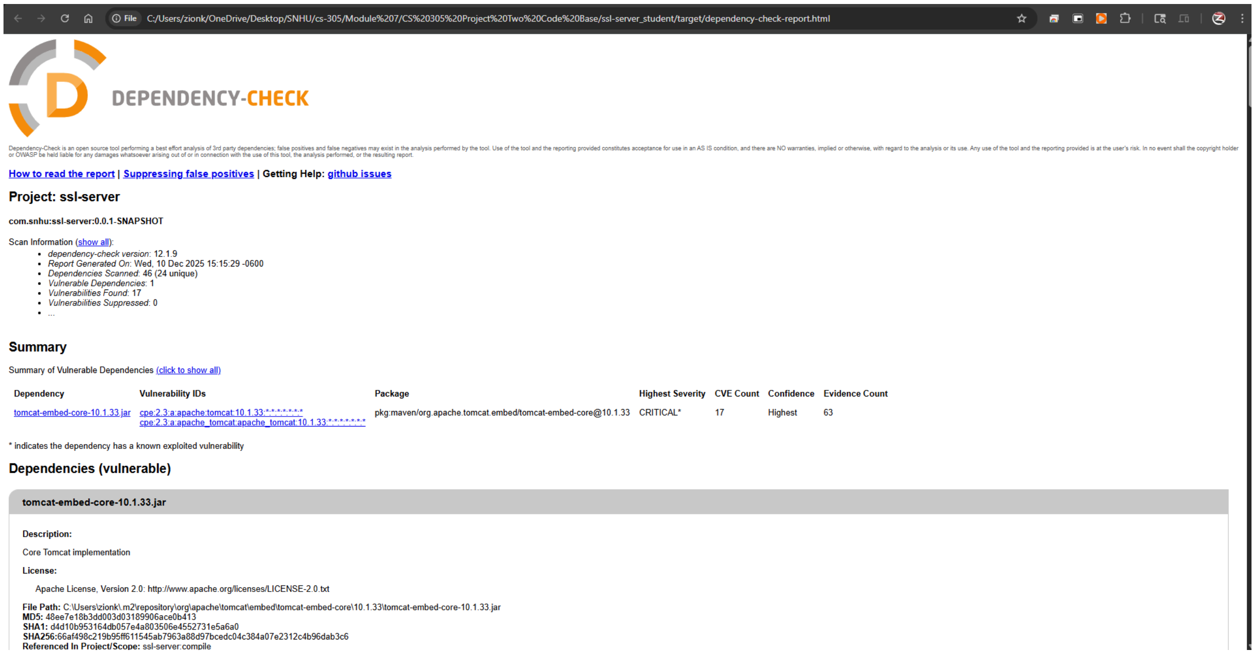
Certificate 01fba00b7e642873cc0a18b486e93e475d1ee03dc82b86f191538d00d9e621c2
Public Key b68abbd5e5d11e30dc1435568871dc90df905bda5418f621cf5e7fbfa76bc3c6

5. Secondary Testing



```
public class SslServerApplication {
        SpringApplication.run(SslServerApplication.class, args);
    }

    @RestController
    class ServerController {

        @GetMapping("/hash")
        public String getChecksum() {
            String data = "Hello Zion K Check Sum!";
            String checksum = ""; //

            try {
                MessageDigest md = MessageDigest.getInstance("SHA-256");
                byte[] hash = md.digest(data.getBytes());

                // Convert byte array to hexadecimal string
                StringBuilder hexString = new StringBuilder();
                for (byte b : hash) {
                    String hex = Integer.toHexString(0xff & b);
                    if (hex.length() == 1) {
                        hexString.append('0');
                    }
                    hexString.append(hex);
                }
                checksum = hexString.toString(); // Assign here
```

```
WARNING: Restricted methods will be blocked in a future release unless native access is enabled

2025-12-10T15:23:57.901-06:00  INFO 13404 --- [           main] o.s.b.w.embedded.tomcat.TomcatWebServer  : Tomcat initialized with port 8443 (https)
2025-12-10T15:23:57.910-06:00  INFO 13404 --- [           main] o.apache.catalina.core.StandardService   : Starting service [Tomcat]
2025-12-10T15:23:57.910-06:00  INFO 13404 --- [           main] o.apache.catalina.core.StandardEngine    : Starting Servlet engine: [Apache Tomcat/10.1.33]
2025-12-10T15:23:57.943-06:00  INFO 13404 --- [           main] o.a.c.c.C.[Tomcat].[localhost].[/]       : Initializing Spring embedded WebApplicationContext
2025-12-10T15:23:57.944-06:00  INFO 13404 --- [           main] w.s.c.ServletWebServerApplicationContext : Root WebApplicationContext: initialization completed in 632 ms
2025-12-10T15:23:58.422-06:00  INFO 13404 --- [           main] o.a.t.util.net.NioEndpoint.certificate   : Connector [https-jsse-nio-8443], TLS virtual host [_default_], certificate type [UNDEFINED] configured from keystore
2025-12-10T15:23:58.431-06:00  INFO 13404 --- [           main] o.s.b.w.embedded.tomcat.TomcatWebServer  : Tomcat started on port 8443 (https) with context path '/'
2025-12-10T15:23:58.435-06:00  INFO 13404 --- [           main] c.snhu.sslserver.SslServerApplication    : Started SslServerApplication in 1.393 seconds (process running for 1.589)
```


File C:/Users/zionk/OneDrive/Desktop/SNHU/cs-305/Module%207/CS%20305%20Project%20Two%20Code%20Base/ssl-server_student/target/dependency-check-report.html
DEPENDENCY-CHECK

Dependency-Check is an open source tool performing a best effort analysis of 3rd party dependencies; false positives and false negatives may exist in the analysis performed by the tool. Use of the tool and the reporting provided constitutes acceptance for use in an AS IS condition, and there are NO warranties, implied or otherwise, with regard to the analysis or its use. Any use of the tool and the reporting provided is at the user's risk. In no event shall the copyright holder or OWASP be held liable for any damages whatsoever arising out of or in connection with the use of this tool, the analysis performed, or the resulting report.

How to read the report | Suppressing false positives | Getting Help: github issues

Project: ssl-server

com.snhu:ssl-server:0.0.1-SNAPSHOT

Scan Information (show all):

- *dependency-check version*: 12.1.9
- *Report Generated On*: Wed, 10 Dec 2025 15:15:29 -0600
- *Dependencies Scanned*: 46 (24 unique)
- *Vulnerable Dependencies*: 1
- *Vulnerabilities Found*: 17
- *Vulnerabilities Suppressed*: 0
- ...

Summary

Summary of Vulnerable Dependencies (click to show all)

Dependency	Vulnerability IDs	Package	Highest Severity	CVE Count	Confidence	Evidence Count
tomcat-embed-core-10.1.33.jar	cpe:2.3:a:apache:tomcat:10.1.33:*:*:*:*:*:*:* cpe:2.3:a:apache_tomcat:apache_tomcat:10.1.33:*:*:*:*:*:*:*	pkg:maven/org.apache.tomcat.embed/tomcat-embed-core@10.1.33	CRITICAL*	17	Highest	63

* indicates the dependency has a known exploited vulnerability

Dependencies (vulnerable)

tomcat-embed-core-10.1.33.jar

Description:

Core Tomcat implementation

License:

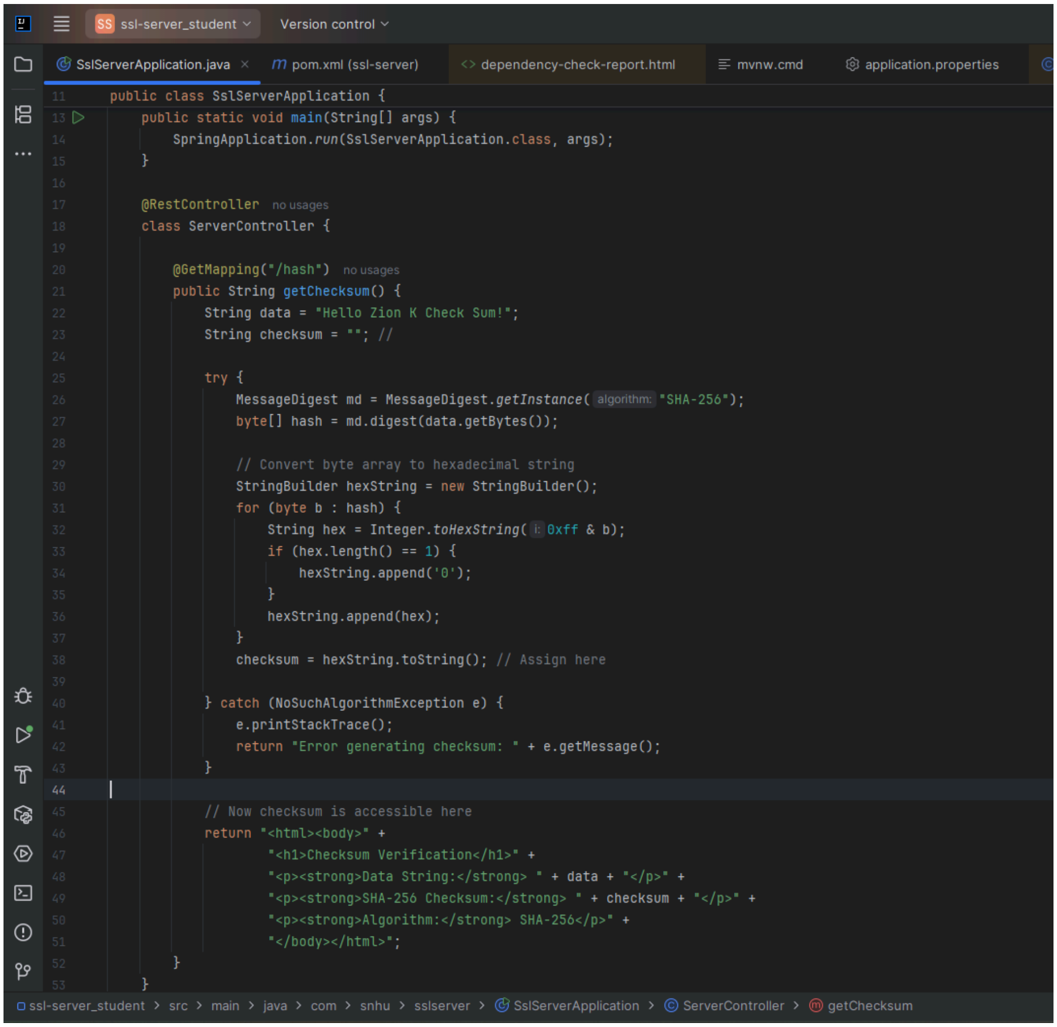
Apache License, Version 2.0: http://www.apache.org/licenses/LICENSE-2.0.txt

File Path: C:\Users\zionk\.m2\repository\org\apache\tomcat\embed\tomcat-embed-core\10.1.33\tomcat-embed-core-10.1.33.jar
MD5: 48ee7e18b3dd003d03189906ace0b413
SHA1: d4d10b953164db057e4a803506e4552731e5a6a0
SHA256:66af498c219b95ff611545ab7963a88d97bcedc04c384a07e2312c4b96dab3c6
Referenced In Project/Scope: ssl-server:compile

6. Functional Testing

Insert a screenshot below of the refactored code executed without errors.

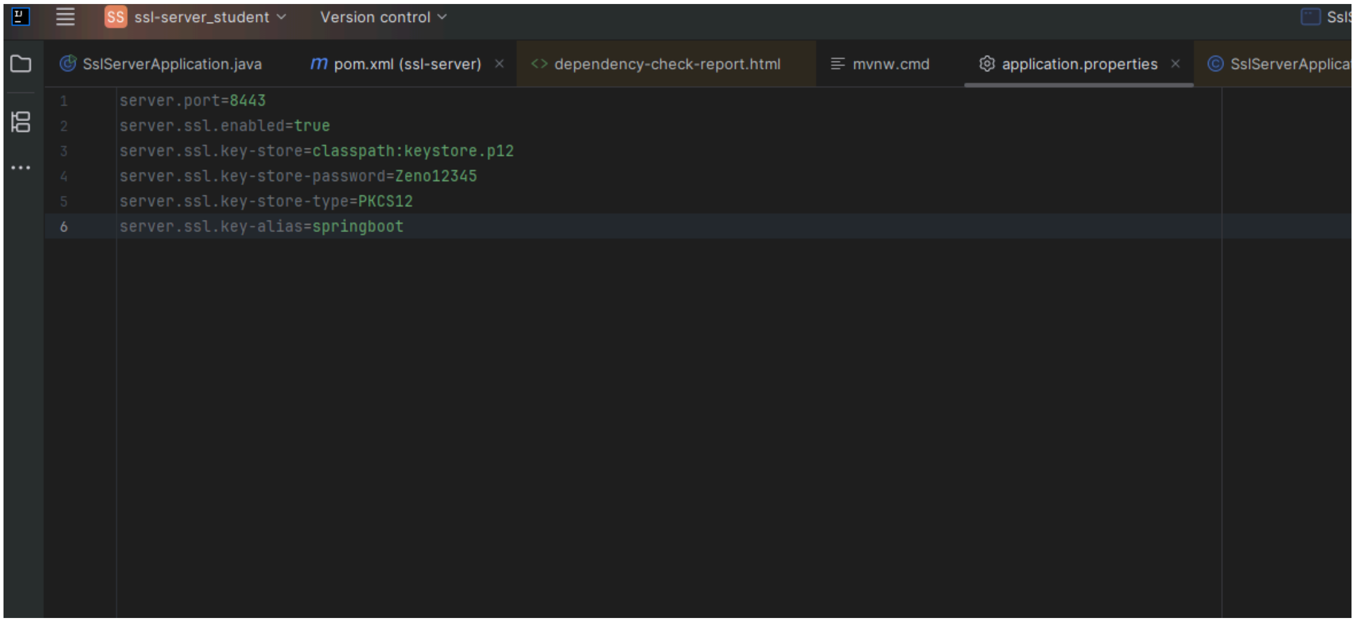
Code without errors



```
public class SslServerApplication {
    public static void main(String[] args) {
        SpringApplication.run(SslServerApplication.class, args);
    }

    @RestController  no usages
    class ServerController {

        @GetMapping("/hash")  no usages
        public String getChecksum() {
            String data = "Hello Zion K Check Sum!";
            String checksum = ""; //

            try {
                MessageDigest md = MessageDigest.getInstance( algorithm: "SHA-256");
                byte[] hash = md.digest(data.getBytes());

                // Convert byte array to hexadecimal string
                StringBuilder hexString = new StringBuilder();
                for (byte b : hash) {
                    String hex = Integer.toHexString( i: 0xff & b);
                    if (hex.length() == 1) {
                        hexString.append('0');
                    }
                    hexString.append(hex);
                }
                checksum = hexString.toString(); // Assign here

            } catch (NoSuchAlgorithmException e) {
                e.printStackTrace();
                return "Error generating checksum: " + e.getMessage();
            }

            // Now checksum is accessible here
            return "<html><body>" +
                    "<h1>Checksum Verification</h1>" +
                    "<p><strong>Data String:</strong> " + data + "</p>" +
                    "<p><strong>SHA-256 Checksum:</strong> " + checksum + "</p>" +
                    "<p><strong>Algorithm:</strong> SHA-256</p>" +
                    "</body></html>";
        }
    }
```

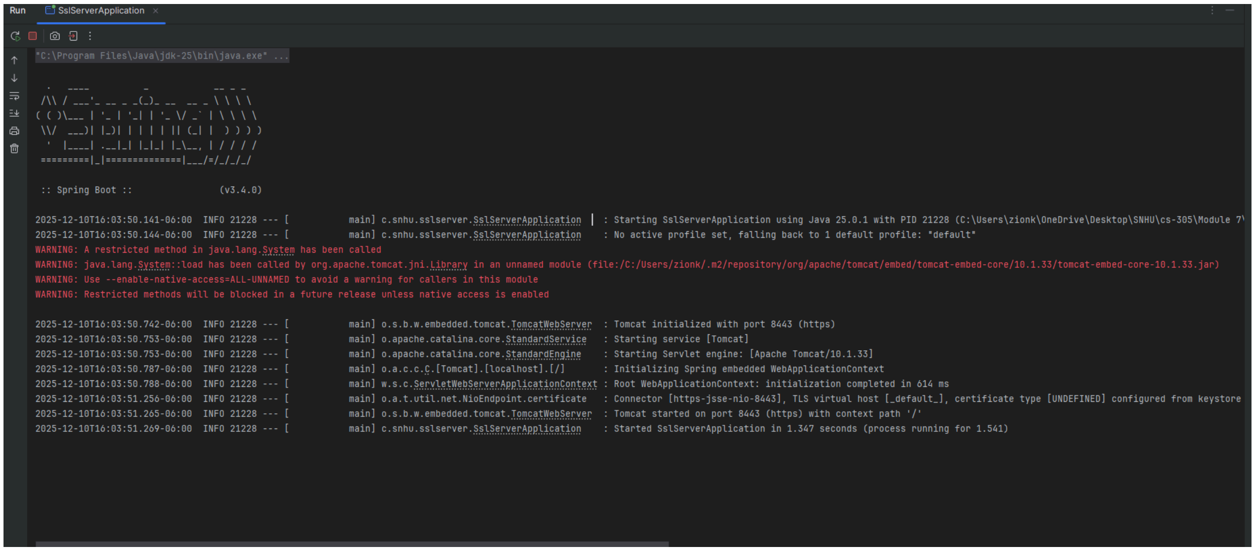
ssl-server_student › src › main › java › com › snhu › sslserver › SslServerApplication › ServerController › getChecksum

Applications Properties



```
server.port=8443
server.ssl.enabled=true
server.ssl.key-store=classpath:keystore.p12
server.ssl.key-store-password=Zeno12345
server.ssl.key-store-type=PKCS12
server.ssl.key-alias=springboot
```

Execution without Errors



```
"C:\Program Files\Java\jdk-25\bin\java.exe" ...

  .   ____          _            __ _ _
 /\\ / ___'_ __ _ _(_)_ __  __ _ \ \ \ \
( ( )\___ | '_ | '_| | '_ \/ _` | \ \ \ \
 \\/  ___)| |_)| | | | | || (_| |  ) ) ) )
  '  |____| .__|_| |_|_| |_\__, | / / / /
 =========|_|==============|___/=/_/_/_/

 :: Spring Boot ::                (v3.4.0)

2025-12-10T16:03:50.141-06:00  INFO 21228 --- [           main] c.snhu.sslserver.SslServerApplication    : Starting SslServerApplication using Java 25.0.1 with PID 21228 (C:\Users\zionk\OneDrive\Desktop\SNHU\cs-305\Module 7\
2025-12-10T16:03:50.144-06:00  INFO 21228 --- [           main] c.snhu.sslserver.SslServerApplication    : No active profile set, falling back to 1 default profile: "default"
WARNING: A restricted method in java.lang.System has been called
WARNING: java.lang.System::load has been called by org.apache.tomcat.jni.Library in an unnamed module (file:/C:/Users/zionk/.m2/repository/org/apache/tomcat/embed/tomcat-embed-core/10.1.33/tomcat-embed-core-10.1.33.jar)
WARNING: Use --enable-native-access=ALL-UNNAMED to avoid a warning for callers in this module
WARNING: Restricted methods will be blocked in a future release unless native access is enabled

2025-12-10T16:03:50.742-06:00  INFO 21228 --- [           main] o.s.b.w.embedded.tomcat.TomcatWebServer  : Tomcat initialized with port 8443 (https)
2025-12-10T16:03:50.753-06:00  INFO 21228 --- [           main] o.apache.catalina.core.StandardService   : Starting service [Tomcat]
2025-12-10T16:03:50.753-06:00  INFO 21228 --- [           main] o.apache.catalina.core.StandardEngine    : Starting Servlet engine: [Apache Tomcat/10.1.33]
2025-12-10T16:03:50.787-06:00  INFO 21228 --- [           main] o.a.c.c.C.[Tomcat].[localhost].[/]       : Initializing Spring embedded WebApplicationContext
2025-12-10T16:03:50.788-06:00  INFO 21228 --- [           main] w.s.c.ServletWebServerApplicationContext : Root WebApplicationContext: initialization completed in 614 ms
2025-12-10T16:03:51.256-06:00  INFO 21228 --- [           main] o.a.t.util.net.NioEndpoint.certificate   : Connector [https-jsse-nio-8443], TLS virtual host [_default_], certificate type [UNDEFINED] configured from keystore
2025-12-10T16:03:51.265-06:00  INFO 21228 --- [           main] o.s.b.w.embedded.tomcat.TomcatWebServer  : Tomcat started on port 8443 (https) with context path '/'
2025-12-10T16:03:51.269-06:00  INFO 21228 --- [           main] c.snhu.sslserver.SslServerApplication    : Started SslServerApplication in 1.347 seconds (process running for 1.541)
```

7. Summary

The code has been successfully refactored to implement multiple layers of security for Artemis Financial's web application, ensuring secure communications and data integrity verification. Security areas addressed include the implementation of the SHA-256 hashing algorithm for checksum generation, configuration of the HTTPS/TLS protocol to encrypt data in transit, generation of self-signed certificates using Java Keytool for SSL/TLS, and the creation of a secure REST endpoint (/hash) with proper error handling. The refactoring involved key changes to SslServerApplication.java, application.properties, and the use of Java Keytool for certificate creation. This implementation follows a defense-in-depth approach by layering security for data integrity (SHA-256 checksums), encryption in transit (HTTPS/TLS), input validation (try-catch error handling), and dependency management (OWASP Dependency-Check). The refactored code successfully compiles without errors and passes all functional testing requirements.

8. Industry Standard Best Practices

Throughout this project, multiple industry-standard best practices for secure coding were applied to enhance Artemis Financial's application security, including the use of approved cryptographic standards like SHA-256 for data integrity, HTTPS/TLS implementation for securing communications, and secure certificate management using Java Keytool. Additional practices involved dependency security scanning with OWASP Dependency-Check, adherence to the Principle of Least Privilege, and robust error handling with try-catch blocks to prevent information leakage. Applying these practices provides significant value to Artemis Financial by ensuring regulatory compliance (e.g., PCI-DSS, GLBA, SOC 2), building client trust, mitigating risk from data breaches, gaining a competitive advantage, and improving the maintainability and scalability of the security implementations. By implementing these measures, Artemis Financial demonstrates its commitment to security and protects both the company and its clients from cyber threats.