

"Method Invocation Monitoring in PDFBox"

Part 3

Prepared for

Prof. Benoit Baudry

Prepared by

Ali Maher

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Abstract

Building on the prior case study, which explored monitoring method invocations and system properties within the "PDFBox" project, this report documents a follow-up effort to refine the tracking of runtime calls to third-party methods. This report introduces the use of AspectJ, which was developed to monitor method invocations in PDFBox repository.

Brief Summary


- Project Setup
- Updating the "pom.xml" file by adding the dependencies related to **AspectJ**.

```
124         <dependency>
125             <groupId>org.aspectj</groupId>
126             <artifactId>aspectjrt</artifactId>
127             <version>1.9.7</version>
128         </dependency>
129         <dependency>
130             <groupId>org.aspectj</groupId>
131             <artifactId>aspectjweaver</artifactId>
132             <version>1.9.7</version>
133         </dependency>
```

Figure 1: dependencies

- Add the **aop.xml** file. I added this file in the resources folder in a new folder named "META-INF".

```

1  <?xml version="1.0" encoding="UTF-8"?>
2  <aspectj>
3      <aspects>
4       <aspect name="org.apache.pdfbox.encryption.AspectJ" />
5      </aspects>
6      <weaver options="-verbose -showWeaveInfo" />
7  </aspectj>
8

```

Figure 2: targeting configure

- Create the AspectJ file and configure it monitor the BouncyCastle methods.

```

@Pointcut("execution(* org.bouncycastle.*.*(..))")
public void bouncyCastleMethods() {}

@Before("bouncyCastleMethods()")
public void logBouncyFounded(JoinPoint joinPoint) {
    String content = "founded bouncy: " + joinPoint.getSignature().toString();
    TestPublicKeyEncryption.number_of_method_invocations++;
    System.out.println(content);
    writeFile(content);
}

```

Figure 3: AspectJ code, defining pointcuts, and where to monitor

- I use the test file located in "**pdfbox/pdfbox/src/test/java/org/apache/pdfbox/encryption**" folder named "**TestPublicKeyEncryption**". I used this file because it is an encryption test file. The PDFBOX does its encryption processes with BouncyCastle, which is the best option.
- I also save the logs in a file named "bouncycastle_methods.log".
- I monitored **168240** method invocations from bouncycastle.
- **Run:** For running the test file you need to add a VM option to the running configurations. You should add the following in the filed of VM options:
"-javaagent:[location-to-aspectjweaver-1.9.7.jar]"

About the output

```
founded bouncy: int org.bouncycastle.jcajce.io.CipherInputStream.available()
founded bouncy: int org.bouncycastle.jcajce.io.CipherInputStream.read(byte[], int, int)
founded bouncy: int org.bouncycastle.jcajce.io.CipherInputStream.nextChunk()
founded bouncy: byte[] org.bouncycastle.jcajce.io.CipherInputStream.finaliseCipher()
founded bouncy: int org.bouncycastle.cms.CMSTypedStream.FullReaderStream.read(byte[], int, int)
founded bouncy: int org.bouncycastle.util.io.Streams.readFully(InputStream, byte[], int, int)
founded bouncy: int org.bouncycastle.jcajce.io.CipherInputStream.read(byte[], int, int)
founded bouncy: int org.bouncycastle.jcajce.io.CipherInputStream.nextChunk()
number_of_method_invocations1: 168240

Process finished with exit code 0
```

Figure 4: output

References

1. <https://arxiv.org/pdf/2208.01321>
2. <https://pdfbox.apache.org/3.0/commandline.html>
3. <https://github.com/apache/pdfbox/>
4. <https://www.bouncycastle.org/>
5. <https://www.youtube.com/watch?v=5jeZjmwhIbQ>
6. <https://www.baeldung.com/aspectj>
7. <https://docs.spring.io/spring-framework/docs/4.3.15.RELEASE/spring-framework-reference/html/aop.html>
8. <https://stackoverflow.com/questions/60295366/how-to-monitor-method-execution-at-third-party-library>
9. <https://eclipse.dev/aspectj/doc/released/progguide/semantics-pointcuts.html>
10. <https://stackoverflow.com/questions/16318426/aspectj-pointcut-for-constructor-using-java-lang-reflection>

The project files with doc are also available on my [GitHub](#).

Thank you for your time and consideration.