
WE HATE CODE
The joy of maintaining dead code

ABOUT ME.

@hansolo_

Gerrit Grunwald | Developer Advocate | Azul

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WHO LOVES TO MAINTAIN LEGACY CODE...?

SOME STATS...

4 HOURS A WEEK...

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...EQUATES TO $85 BILLION ANNUALLY!

Sources: Evans Data Corp, CIA Factbook, Stripe research

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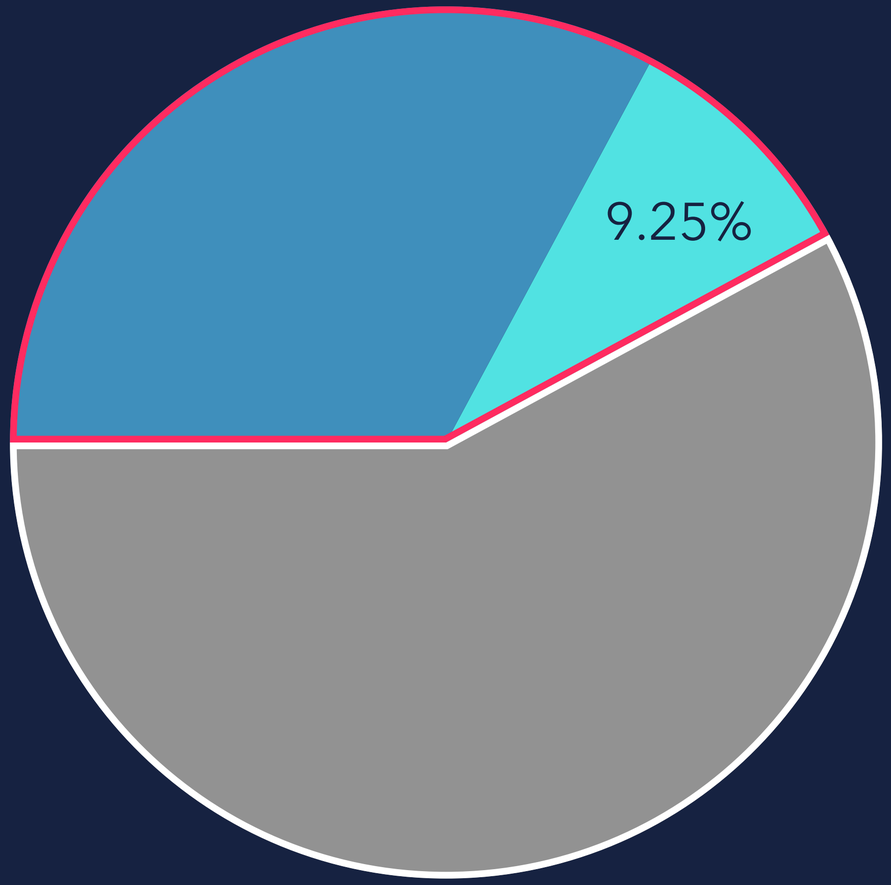
THE DEVELOPER WORK WEEK



41.1 total hours

Average developer work week

- 17.3 hours
  modifying, debugging, refactoring and bad code
- 13.5 hours
  Technical debt
- 3.8 hours
  Bad code

Sources: Evans Data Corp, CIA Factbook, Stripe research

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MORE INFO...

https://www.pullrequest.com/blog/cost-of-bad-code/

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AND WHAT DOES IT COST YOU...?

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BAD CODE

WHAT DOES IT COST YOU...?

- Time
- Productivity
- Agility
- Money
- Reputation

TWO TYPES OF BAD CODE...

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LEGACY CODE

DEAD CODE

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LEGACY CODE

LEGACY CODE

IS CODE THAT...

- Was written for no longer supported os, hardware, api's etc.

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- Was written for no longer supported os, hardware, api's etc.
- Cannot be tested automatically
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- Lacks documentation

LEGACY CODE

IS CODE THAT...

- Was written for no longer supported os, hardware, api's etc.
- Cannot be tested automatically
- Is no longer developed or maintained
- Lacks documentation
- You are afraid to touch

WHY STILL USING IT...?

WHY STILL USING IT...?

BECAUSE...

- It works

WHY STILL USING IT...?

BECAUSE...

- It works
- There is no replacement available

WHY STILL USING IT...?

BECAUSE...

- It works
- There is no replacement available
- Nobody is able to understand it

WHY STILL USING IT...?

BECAUSE...

- It works
- There is no replacement available
- Nobody is able to understand it
- No one knows if it is still in use

HOW TO HANDLE IT...?

HOW TO HANDLE IT...

SOLUTIONS TO HANDLE LEGACY CODE

- Refactoring

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HOW TO HANDLE IT...

SOLUTIONS TO HANDLE LEGACY CODE

- Refactoring
- Rewrite everything

HOW TO HANDLE IT...

SOLUTIONS TO HANDLE LEGACY CODE

- Refactoring
- Rewrite everything
- Find out if it is used at all

REFACTORING

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SOLUTION

- You need to understand the code first

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- You can make use of static code analysis tools

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REFACTORING

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- You need to understand the code first
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  - CheckStyle, SpotBugs, PMD, SonarQube and others
- You need the time to do it

REWRITE

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SOLUTION

- You need to know what the code does

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- It's like a new project with all it's work (and cost) involved

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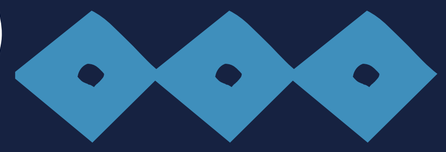
REWRITE

SOLUTION

- You need to know what the code does
- It's like a new project with all it's work (and cost) involved
- You need to know the requirements
- You need the time to rewrite the code

ONE QUESTION REMAINS...



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IS IT USED AT ALL...?

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DEAD CODE...

WHAT IS IT...?

- ☠ Unused Imports, Variables, Methods and Classes

DEAD CODE...

WHAT IS IT...?

- Unused Imports, Variables, Methods and Classes
- Unreachable code

DEAD CODE...

WHAT IS IT...?

- Unused Imports, Variables, Methods and Classes
- Unreachable code
- Redundant functions

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WHY IS IT A PROBLEM...?

REASONS...

- Reduced Readability and Maintainability
  Clutters the codebase, making it harder for developers to read and understand the program's logic

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  Larger source files and compiled binaries, which can impact performance, consume space and increase cost

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- **Increased potential for Security Issues**
  Adding dependencies always comes with the risk of vulnerable transitive dependencies

WHERE DOES IT COME FROM...?

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- **Merging code branches**
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- **Lack of awareness**
  Large projects make it hard to identify code changes which creates obsolete code sections

HOW TO REMOVE IT...?

HOW TO REMOVE IT...?

POSSIBLE SOLUTIONS...

- IDE's e.g. Intellij IDEA

DEAD CODE

DEMO CODE

```
public class Main {
    private static final String CLASS_NAME = Main.class.getName();
    private              String tmp        = "unused";

    static { ... }


    public Main() {...}


    private void method1() { ... }

    private void method2() { ... }

    private void method3() { ... } // Unused Method

    private void method4() { ... }


    public static void main(String[] args) { new Main(); }
}
```

DEAD CODE

INTELLIJ IDEA

- Select "**Code**" from menu

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DEAD CODE

INTELLIJ IDEA

- Select "Code" from menu
  - Select "Analyze Code"

DEAD CODE

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- Select "Code" from menu
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DEAD CODE

INTELLIJ IDEA

- Select "Code" from menu
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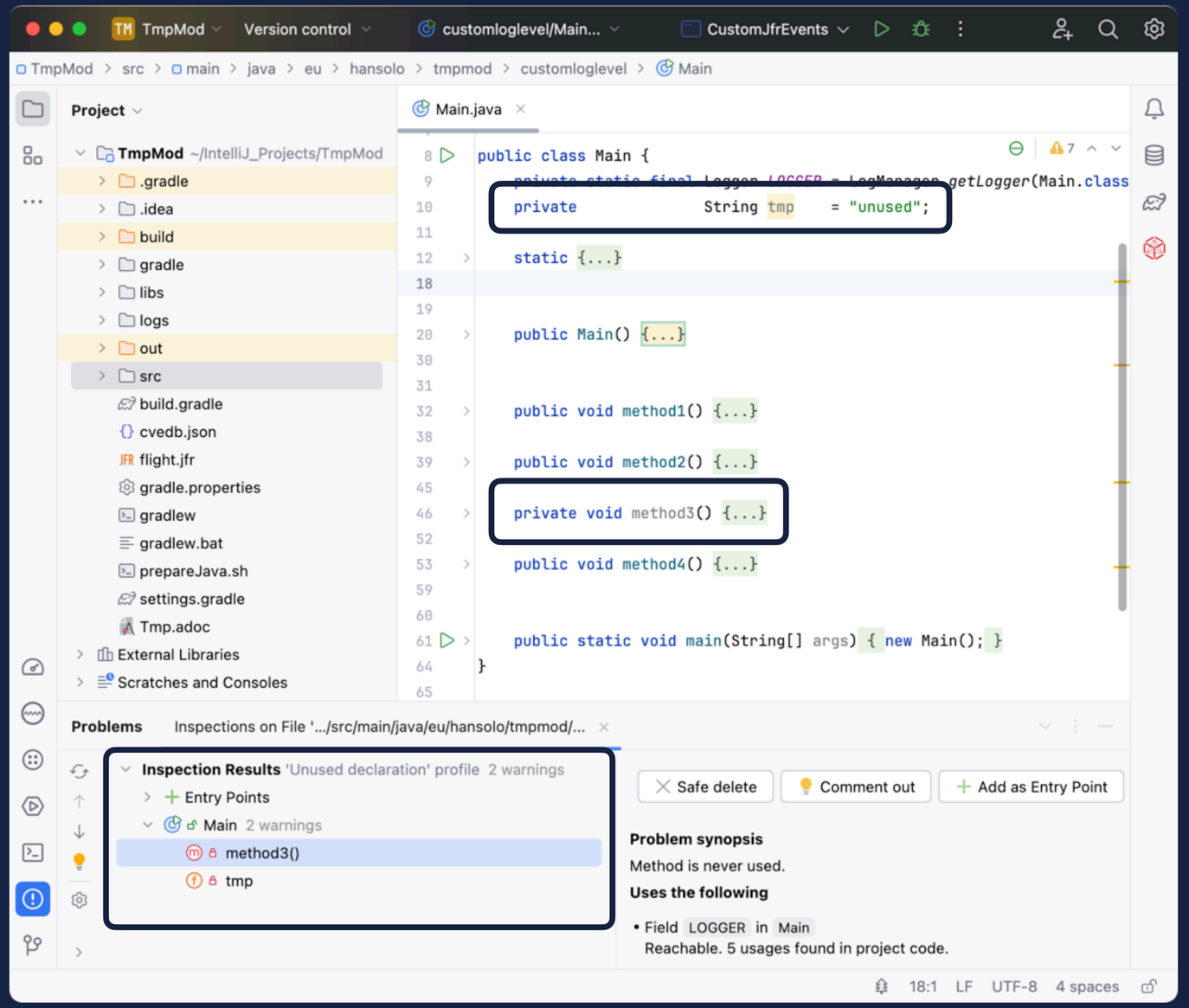
    - Select "Run Inspection by Name"
      - Select "Unused declaration Java|Declaration redundancy"

FIND UNUSED CODE...

INTELLIJ IDEA



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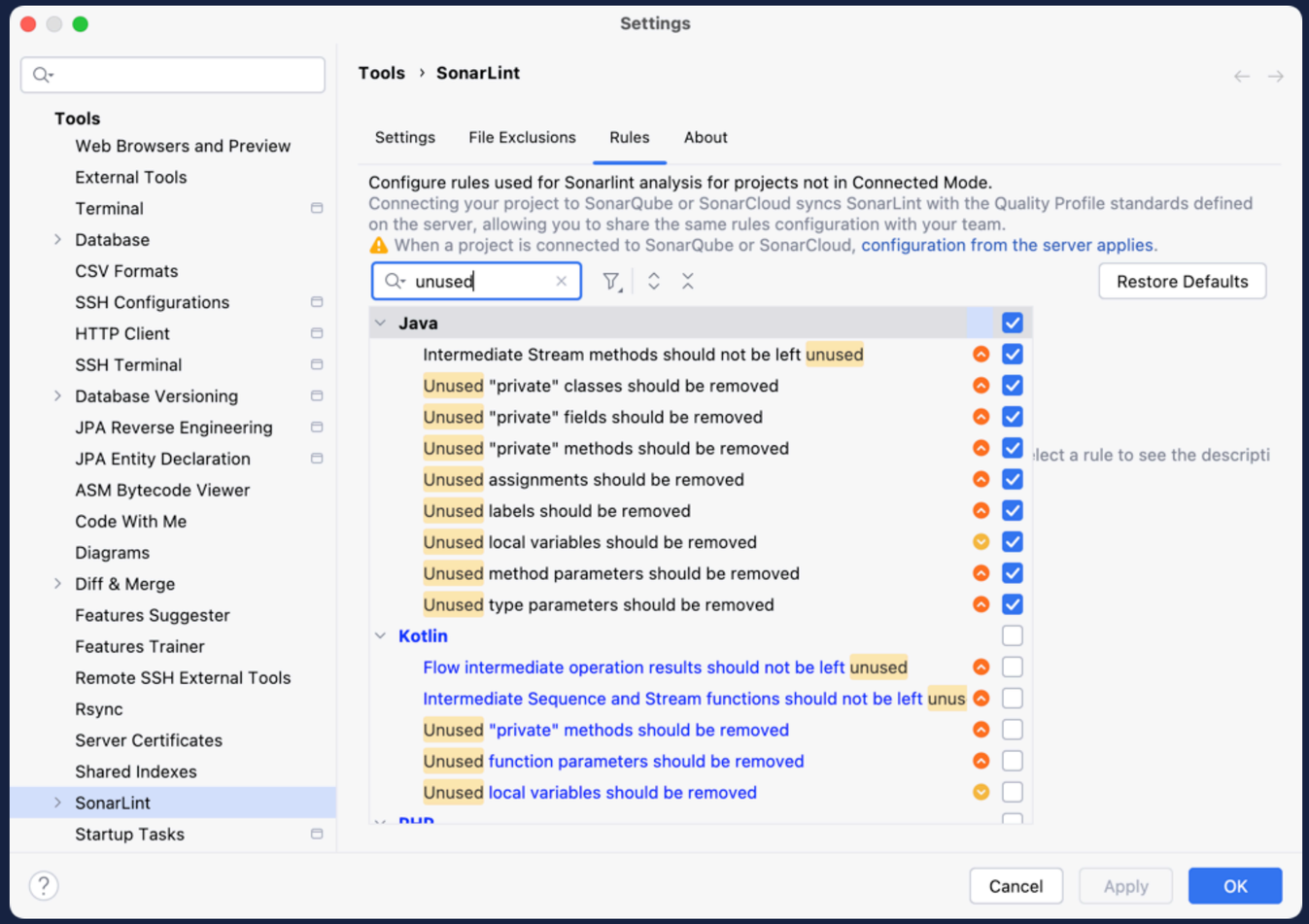
HOW TO REMOVE IT...?

POSSIBLE SOLUTIONS...

- IDE's e.g. Intellij IDEA
- Sonarqube ide

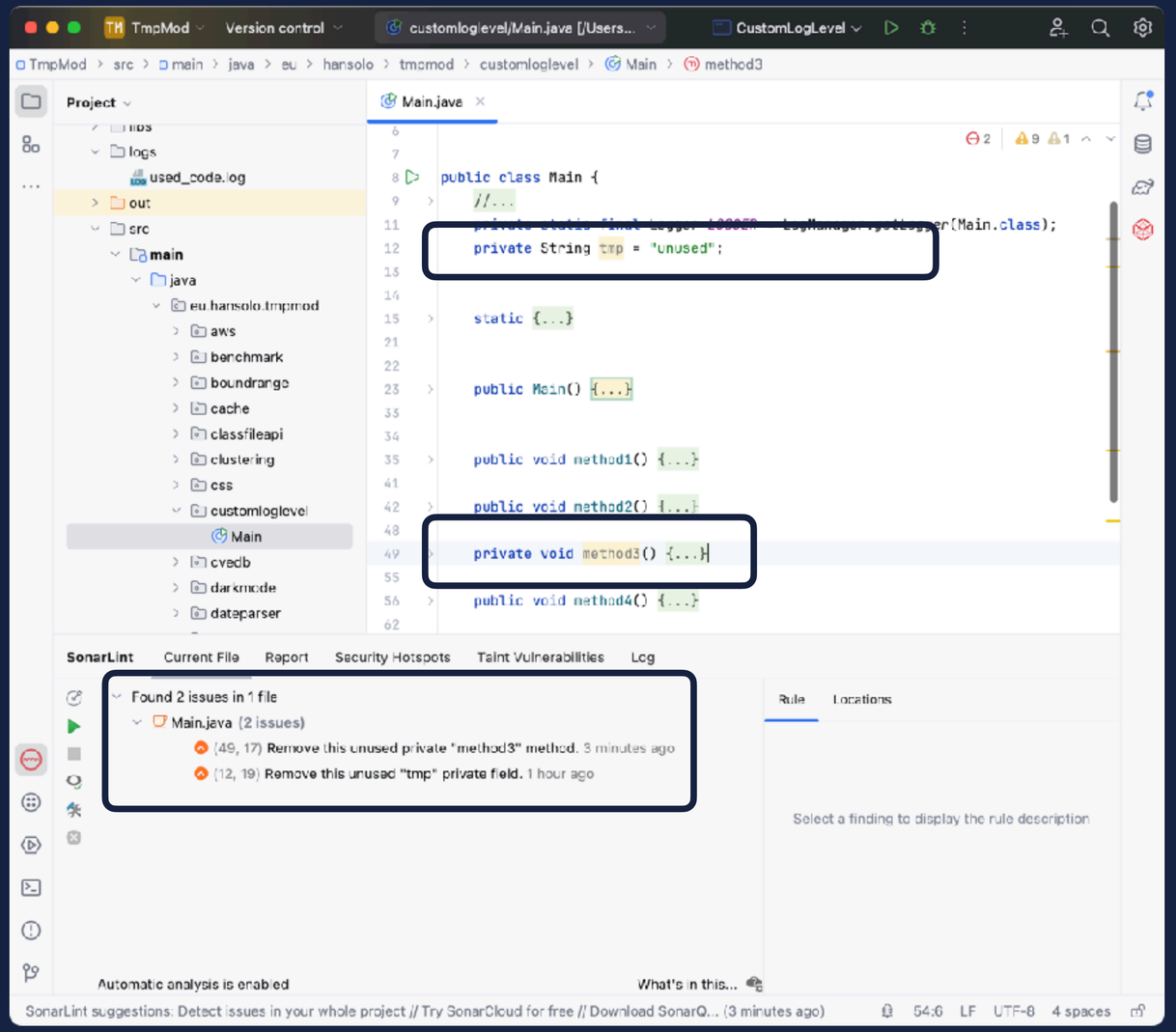
DEAD CODE

SONARQUBE IDE



DEAD CODE

SONARQUBE IDE



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WHERE TO GET IT...?

SONARQUBE IDE

https://sonarsource/products/sonarlint

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HOW TO REMOVE IT...?

POSSIBLE SOLUTIONS...

- IDE's e.g. Intellij IDEA
- Sonarqube ide
- OpenRewrite

OPEN REWRITE

WHAT IS IT...?

- A community driven open source project

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OPEN REWRITE

WHAT IS IT...?

- A community driven open source project
- Enables developers to effectively eliminate technical debt
- Contains an auto-refactoring engine
- Has 'Recipes' to clean up code
  (e.g. to remove unused variables, methods etc.)

DEAD CODE

DEMO CODE

```
public class Main {
    private static final String CLASS_NAME = Main.class.getName();
    private              String tmp        = "unused";

    static { ... }


    public Main() {...}


    private void method1() { ... }

    private void method2() { ... }

    private void method3() { ... } // Unused Method

    private void method4() { ... }


    public static void main(String[] args) { new Main(); }
}
```

DEAD CODE

ADD RECIPE TO PROJECT POM FILE

```
...
<build>
    <plugins>
        <plugin>
            <groupId>org.openrewrite.maven</groupId>
            <artifactId>rewrite-maven-plugin</artifactId>
            <version>6.0.0</version>
            <configuration>
                <exportDatatables>true</exportDatatables>
                <activeRecipes>
                    <recipe>org.openrewrite.staticanalysis.RemoveUnusedPrivateMethods</recipe>
                </activeRecipes>
            </configuration>
            <dependencies>
                <dependency>
                    <groupId>org.openrewrite.recipe</groupId>
                    <artifactId>rewrite-static-analysis</artifactId>
                    <version>2.0.0</version>
                </dependency>
            </dependencies>
        </plugin>
    </plugins>
</build>
...
```

DEAD CODE

EXECUTE MVN TASK

```
mvn rewrite:run
```

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    private void method4() { ... }


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}
```

WHERE TO GET IT...?

OPEN REWRITE

https://github.com/openrewrite

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BUT WHAT ABOUT...

ZOMBIE

CODE

MAINTAINED CODE...

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...NEVER
EXECUTED

HOW TO FIND IT...?

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ONLY IN A RUNNING SYSTEM...

ZOMBIE CODE

HOW TO FIND IT...?

- Tombstone logging using static initialisers and custom log levels

ZOMBIE CODE

LOG4J CONFIGURATION

```xml
<?xml version="1.0" encoding="UTF-8"?>
<Configuration status="warn">

    <CustomLevels>
        <CustomLevel name="USED_CLASS"  intLevel="550" />
        <CustomLevel name="USED_METHOD" intLevel="551" />
    </CustomLevels>

</Configuration>
```

ZOMBIE CODE

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    </CustomLevels>

    <Appenders>
        <Console name="console" target="SYSTEM_OUT">
            <PatternLayout pattern="%d %-7level %logger{36} %msg%n"/>
        </Console>
        <File name="logfile" fileName="logs/used_code.log">
            <PatternLayout pattern="%d %-7level %logger{36} %msg%n"/>
        </File>
    </Appenders>

</Configuration>
```

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        <File name="logfile" fileName="logs/used_code.log">
            <PatternLayout pattern="%d %-7level %logger{36} %msg%n"/>
        </File>
    </Appenders>

    <Loggers>
        <Root level="used_method"> <!-- Can be used to define class or method level logging -->
            <AppenderRef ref="console" level="used_method" />
            <AppenderRef ref="logfile" level="used_method" />
        </Root>
    </Loggers>

</Configuration>
```

ZOMBIE CODE

DEMO CODE

```
public class Main {
    private static final Logger LOGGER = LogManager.getLogger(Main.class);
```

ZOMBIE CODE

DEMO CODE

```
public class Main {
    private static final Logger LOGGER = LogManager.getLogger(Main.class);

    static {
        LOGGER.log(Level.valueOf("USED_CLASS"), "");
    }
```

ZOMBIE CODE

DEMO CODE

```
public class Main {
    private static final Logger LOGGER = LogManager.getLogger(Main.class);

    static {
        LOGGER.log(Level.valueOf("USED_CLASS"), "");
    }


    public Main() {
        for (int i = 0 ; i < 3 ; i++) {
            switch (i) {
                case 0 -> method1();
                case 1 -> method2();
                case 2 -> method4();
            }
            try { new Thread().sleep(3000); } catch (InterruptedException e) {}
        }
    }
```

ZOMBIE CODE

DEMO CODE

```
public class Main {
    private static final Logger LOGGER = LogManager.getLogger(Main.class);

    static {
        LOGGER.log(Level.valueOf("USED_CLASS"), "");
    }


    public Main() {...}


    public void method1() { LOGGER.log(Level.valueOf("USED_METHOD"), "method1()"); }

    public void method2() { LOGGER.log(Level.valueOf("USED_METHOD"), "method2()"); }

    public void method3() { LOGGER.log(Level.valueOf("USED_METHOD"), "method3()"); } // Unused method

    public void method4() { LOGGER.log(Level.valueOf("USED_METHOD"), "method4()"); }


    public static void main(String[] args) {
        new Main();
    }
}
```

ZOMBIE CODE

LOGFILE CONTENT OF DEMOCODE

```
2024-11-11 11:27:06,068 USED_CLASS eu.hansolo.tmpmod.customloglevel.Main
2024-11-11 11:27:06,069 USED_METHOD eu.hansolo.tmpmod.customloglevel.Main method1()
2024-11-11 11:27:11,075 USED_METHOD eu.hansolo.tmpmod.customloglevel.Main method2()
2024-11-11 11:27:16,084 USED_METHOD eu.hansolo.tmpmod.customloglevel.Main method4()
```

No output from method3()

ZOMBIE CODE

TOMBSTONE LOGGING PROBLEMS

- You only get the used classes and methods
- You need to find a way to find the unused classes and methods

ZOMBIE CODE

HOW TO FIND IT...?

- Tombstone logging using static initialisers and custom log levels
- Java Flight Recorder and Mission Control

ZOMBIE CODE

CUSTOM JFR EVENTS

```
public class UsedClassEvent extends jdk.jfr.Event {
    final String className;


    public UsedClassEvent(final String className) {
        this.className = className;
    }
}
```

ZOMBIE CODE

CUSTOM JFR EVENTS

```
public class UsedClassEvent extends jdk.jfr.Event {
    final String className;


    public UsedClassEvent(final String className) {
        this.className = className;
    }
}




public class UsedMethodEvent extends jdk.jfr.Event {
    final String methodName;


    public UsedMethodEvent(final String methodName) {
        this.methodName = methodName;
    }
}
```

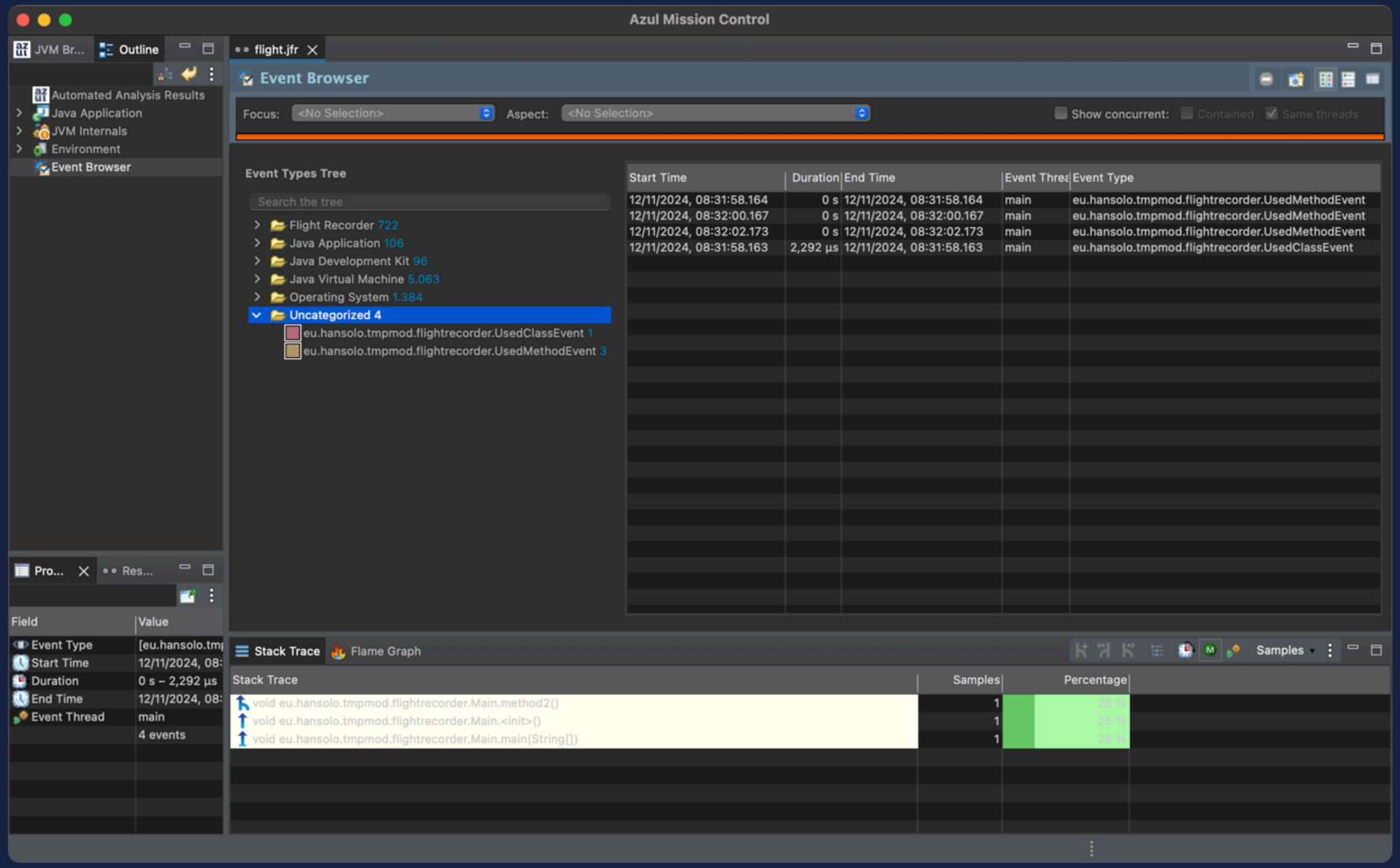
ZOMBIE CODE

DEMO CODE

```
public class Main {
    private static final String CLASS_NAME = Main.class.getName();

    static {
        new UsedClassEvent(CLASS_NAME.commit();
    }


    public Main() {...}


    public void method1() { new UsedMethodEvent(String.join("|", CLASS_NAME, "method1()")).commit(); }

    public void method2() { new UsedMethodEvent(String.join("|", CLASS_NAME, "method2()")).commit(); }

    public void method3() { new UsedMethodEvent(String.join("|", CLASS_NAME, "method3()")).commit(); }

    public void method4() { new UsedMethodEvent(String.join("|", CLASS_NAME, "method4()")).commit();}


    public static void main(String[] args) {
        new Main();
    }
}
```

ZOMBIE CODE

MISSION CONTROL



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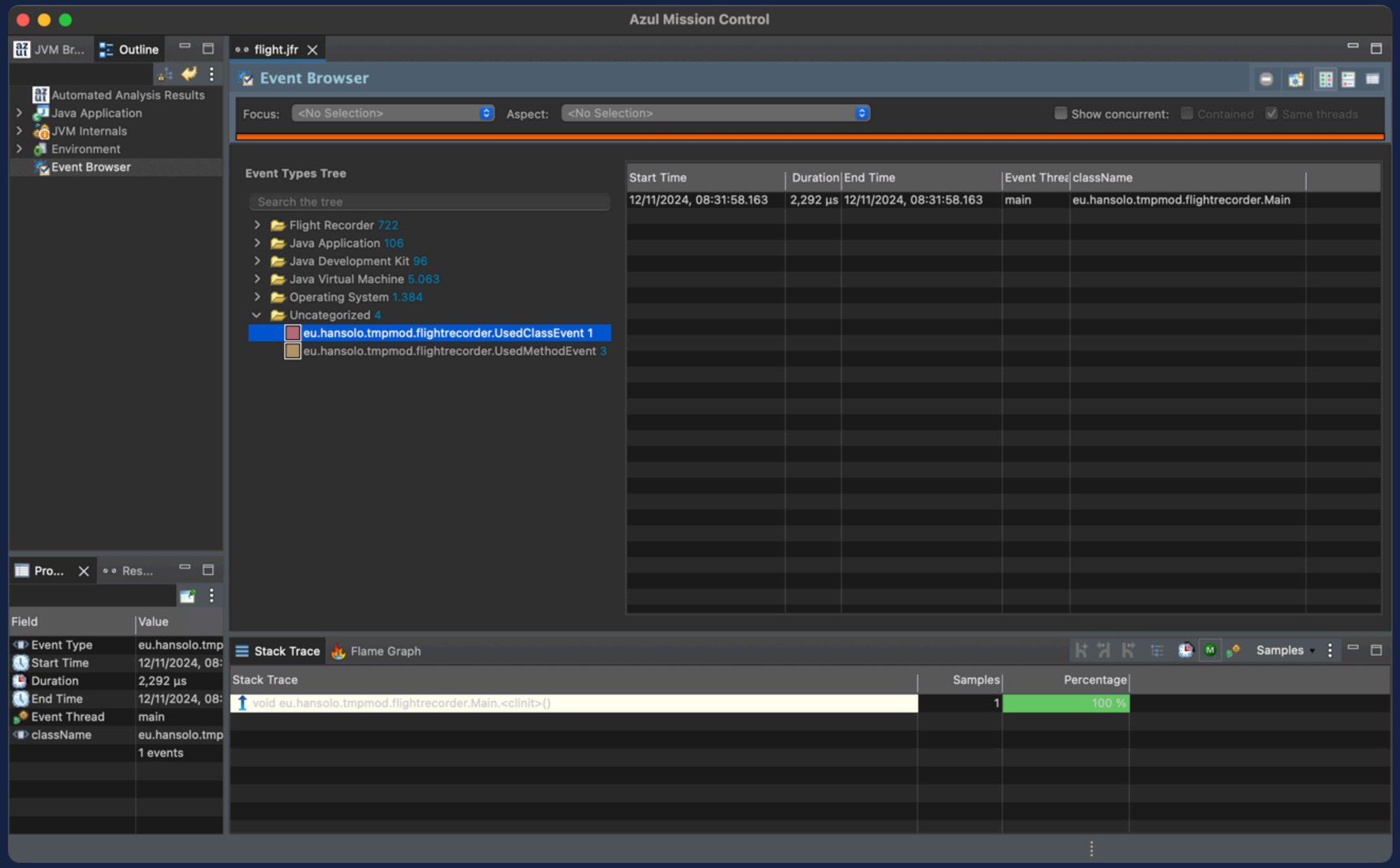

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ZOMBIE CODE

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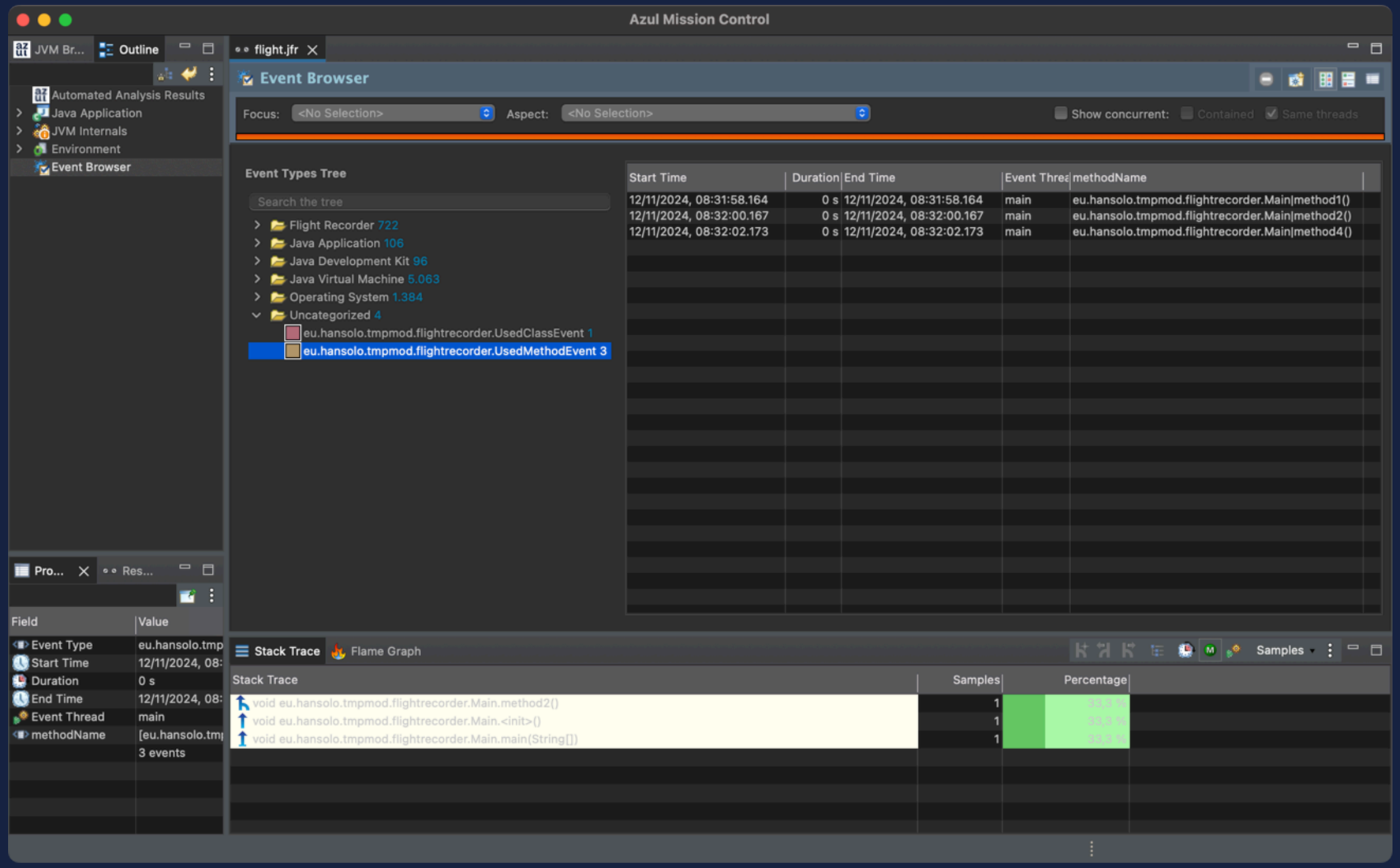


ZOMBIE CODE

JFR + MISSION CONTROL PROBLEMS

- You only get the used classes and methods
- You need to find a way to find the unused classes and methods

BUT A LOT OF WORK!

OTHER SOLUTIONS...

OTHER SOLUTIONS...

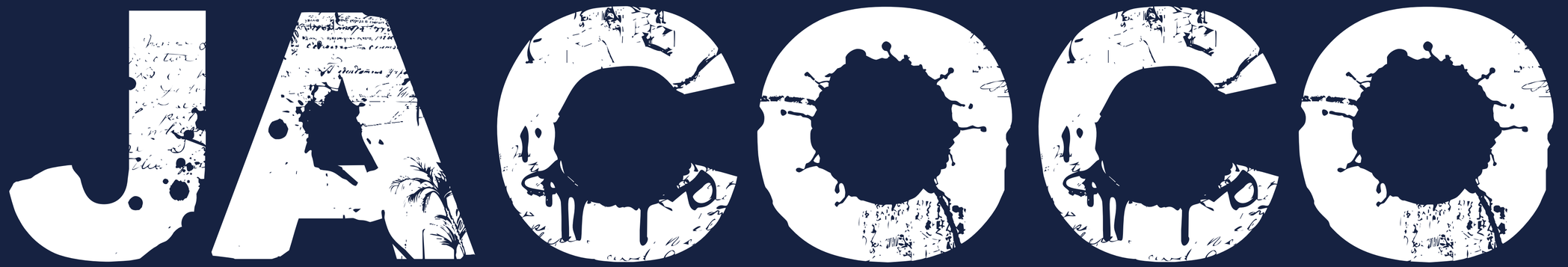
HOW TO FIND ZOMBIE CODE...?

- Java Code Coverage (JaCoCo)

OTHER SOLUTIONS...

HOW TO FIND ZOMBIE CODE...?

- Java Code Coverage (JaCoCo)
- Azul Intelligence Cloud



Java Code Coverage

JACOCO

WHAT IS IT...?

- A free tool to report code coverage on automated test suites

JACOCO

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- Collects coverage metrics through a Java agent when the class loader loads classes

JACOCO

WHAT IS IT...?

- A free tool to report code coverage on automated test suites
- Collects coverage metrics through a Java agent when the class loader loads classes
- Can be used to detect dead code

JACOCO

HOW DOES IT WORK...?

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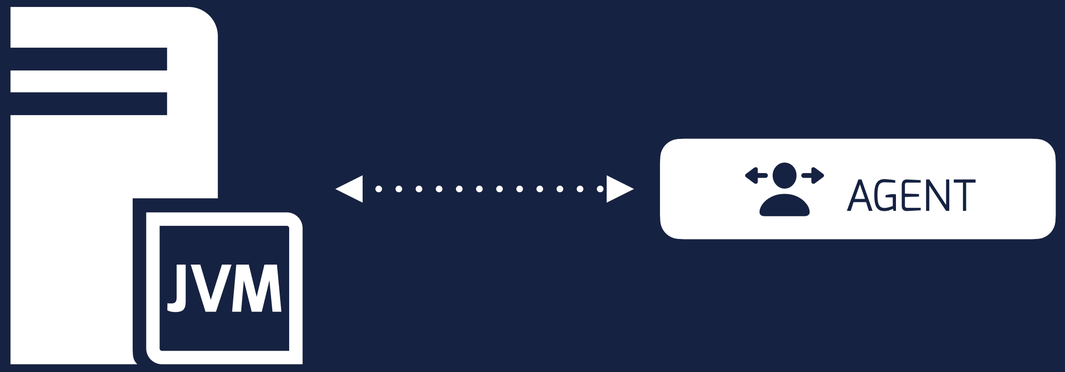
HOW DOES IT WORK...?

JACOCO

JVM runs application

HOW DOES IT WORK...?

JACOCO



JVM runs application

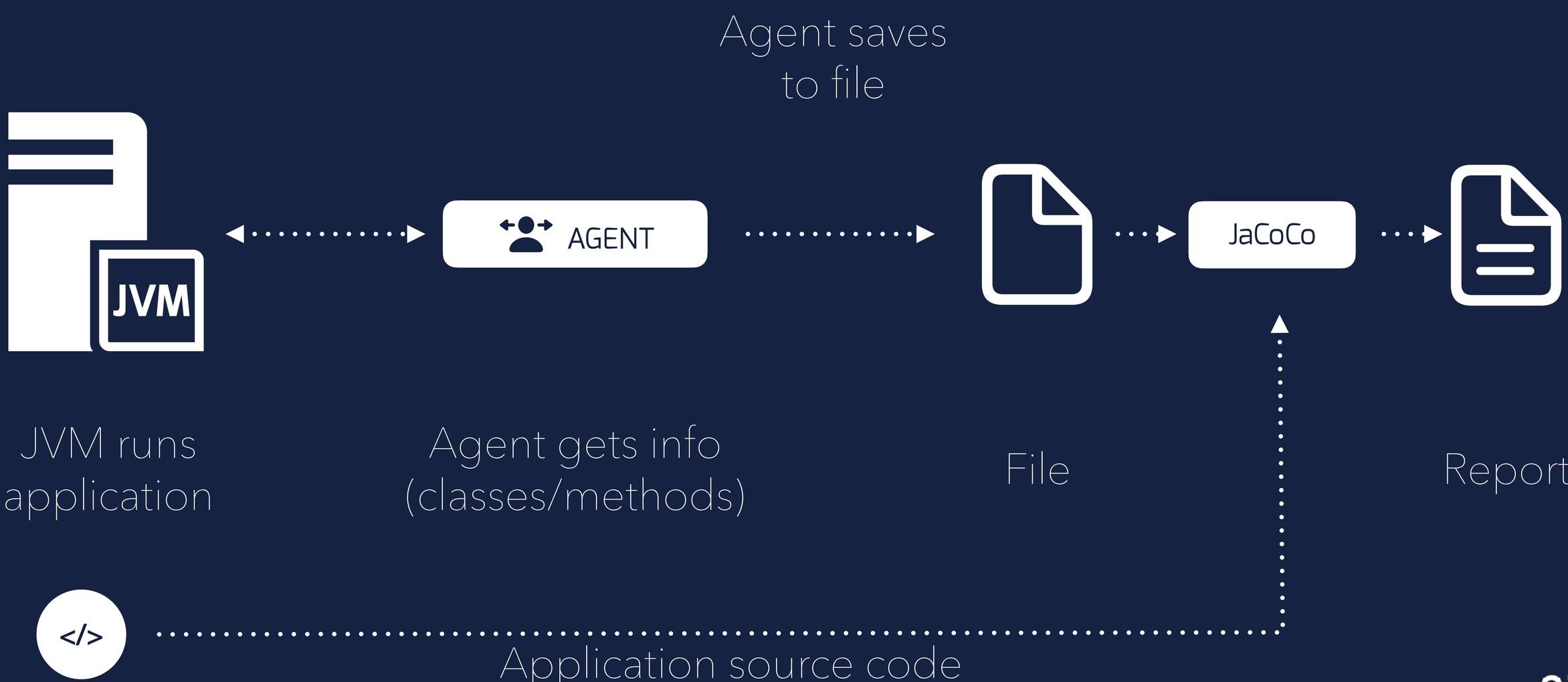
Agent gets info (classes/methods)

HOW DOES IT WORK...?

JACOCO

HOW DOES IT WORK...?

JACOCO



INTERESTING BLOGPOST

BY PICNIC

- Run JaCoCo in production
- Run it within Kubernetes
- Use JaCoCo CLI and scripts to aggregate data
- Create an html report

https://tinyurl.com/4f6m3u5x

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WHERE TO GET IT...?

JACOCO

https://github.com/jacoco/jacoco

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INTELLIGENCE CLOUD

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INTELLIGENCE CLOUD

WHAT IS IT ?

- Cloud service, collecting data from Java Virtual Machine(s)

INTELLIGENCE CLOUD

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- Vulnerability scanning in production

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- Offers information about used/unused code in production
- Vulnerability scanning in production
- Information about used Java Virtual Machine(s)

INTELLIGENCE CLOUD

HOW DOES IT WORK...?

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INTELLIGENCE CLOUD

HOW DOES IT WORK ?

JVM runs
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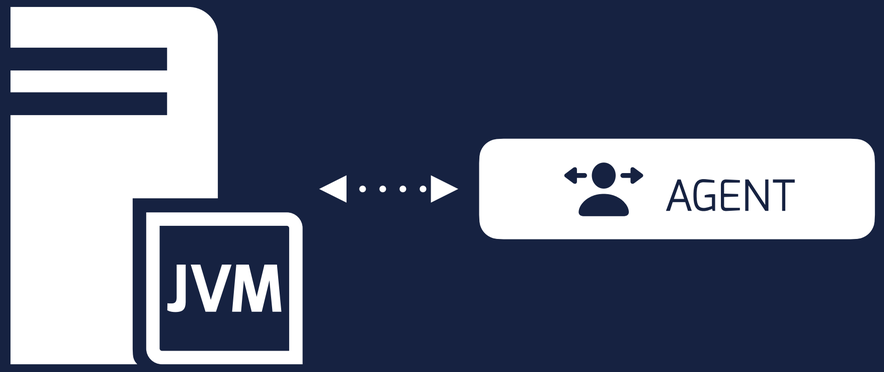
INTELLIGENCE CLOUD

HOW DOES IT WORK ?



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INTELLIGENCE CLOUD

HOW DOES IT WORK ?

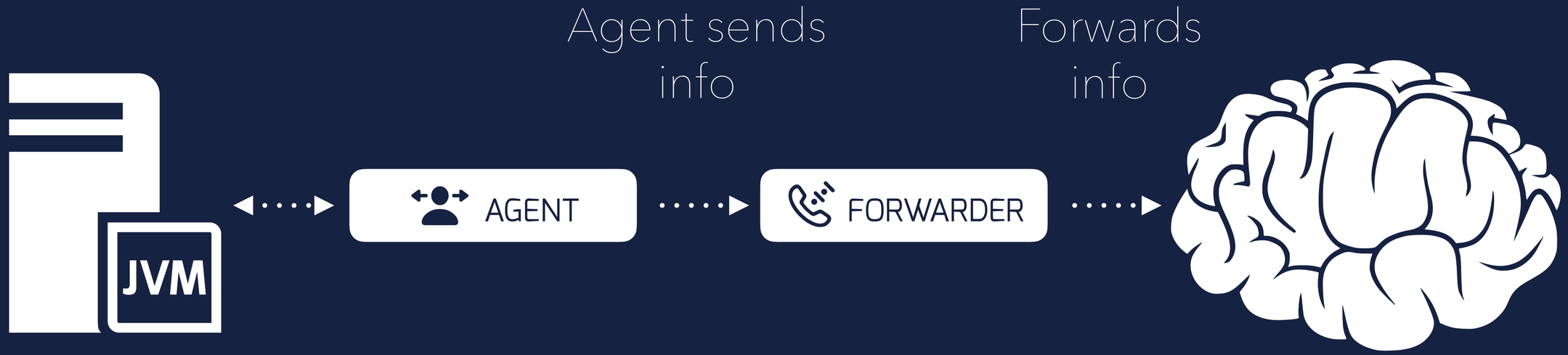
JVM runs application

Agent gets info (classes/methods)

Forwarder runs in infrastructure

INTELLIGENCE CLOUD

HOW DOES IT WORK ?



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Azul IC processes info

INTELLIGENCE CLOUD

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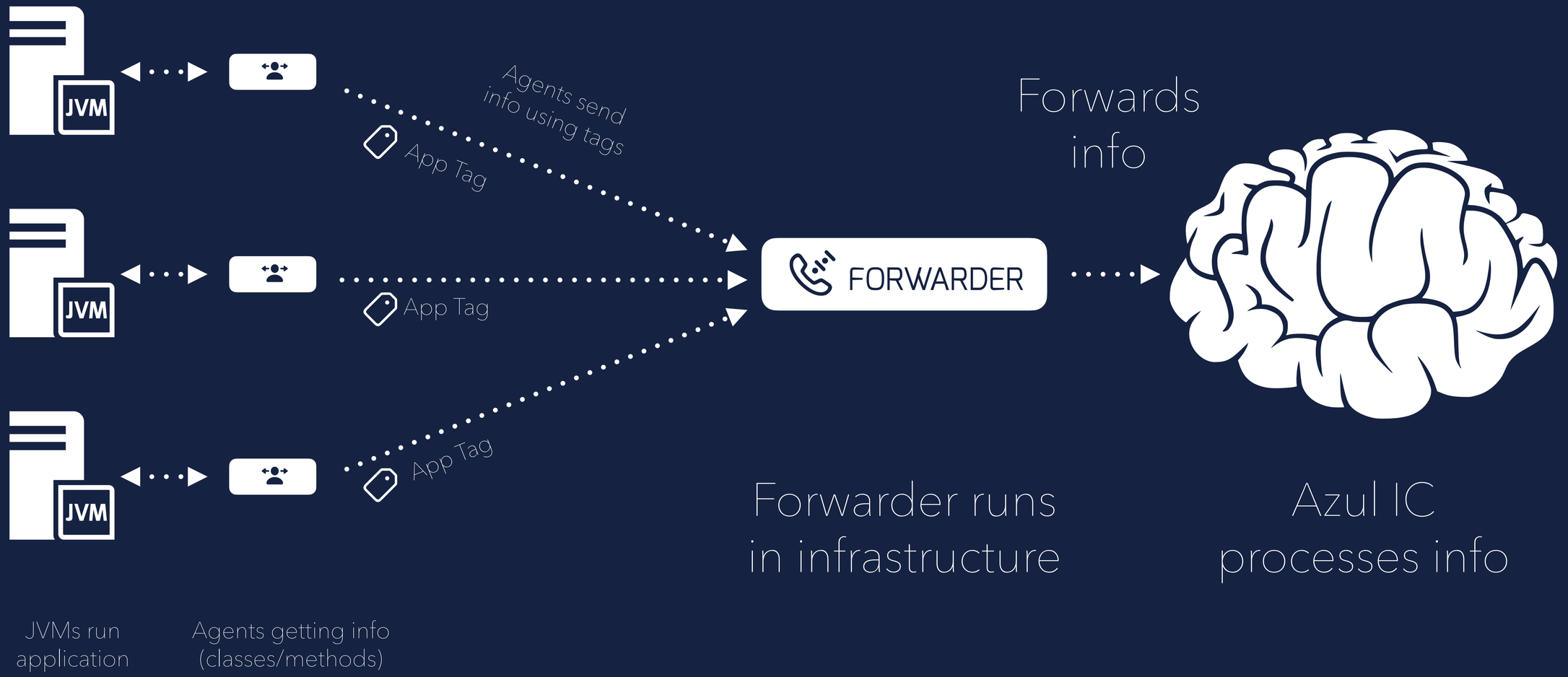

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INTELLIGENCE CLOUD

FIND ZOMBIE CODE...

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INTELLIGENCE CLOUD

FINDING ZOMBIE CODE...

Application

azul

INTELLIGENCE CLOUD

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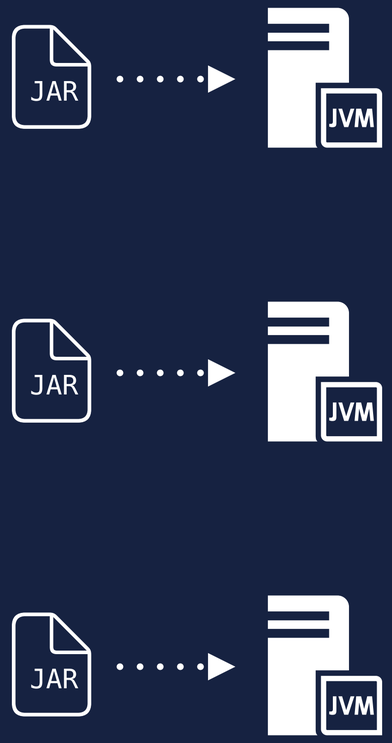

Application

JVMs run Application

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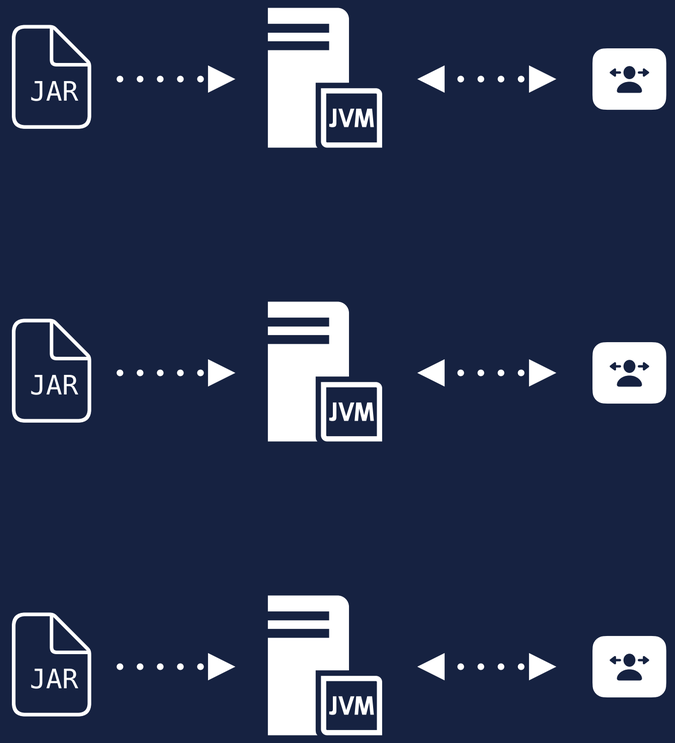
INTELLIGENCE CLOUD

FINDING ZOMBIE CODE...



Application

JVMs run Application

Agents

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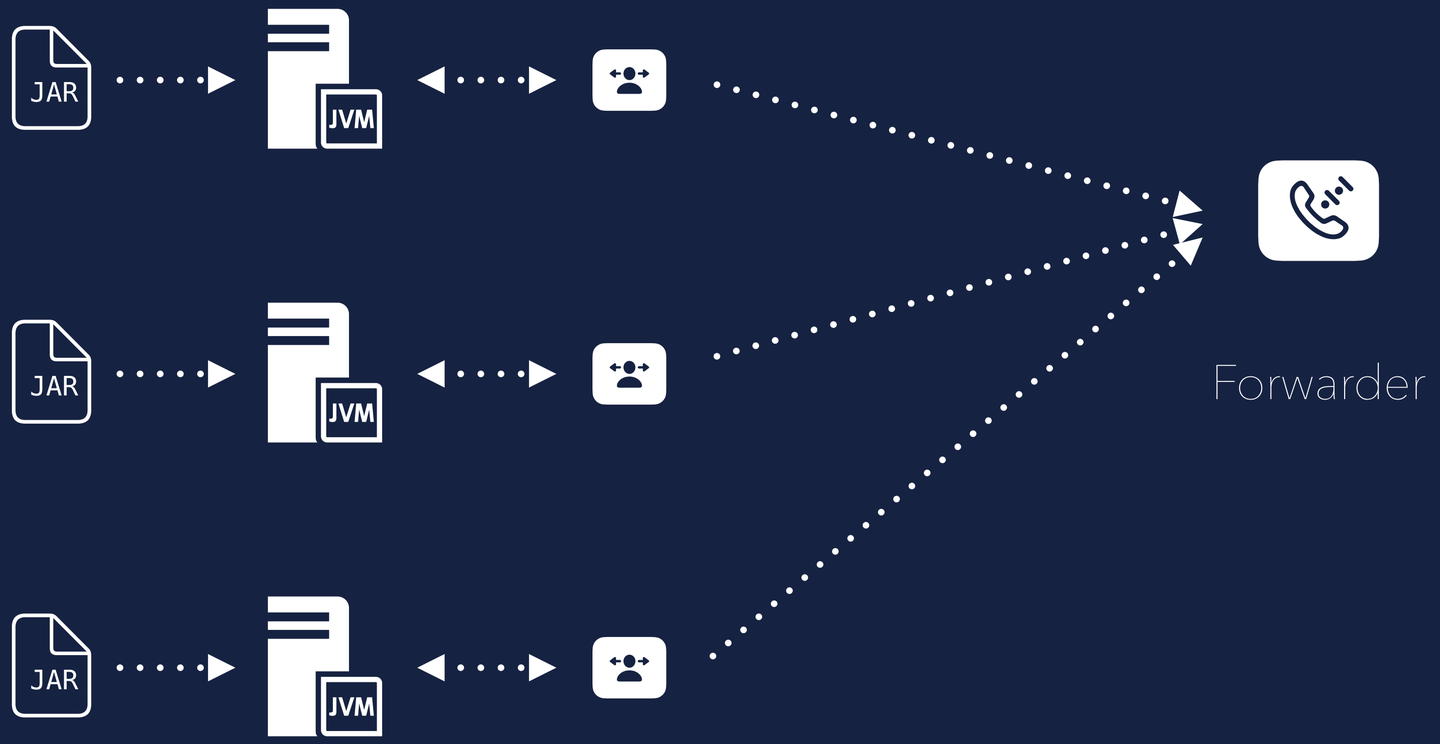
FINDING ZOMBIE CODE...



Application

JVMs run Application

Agents

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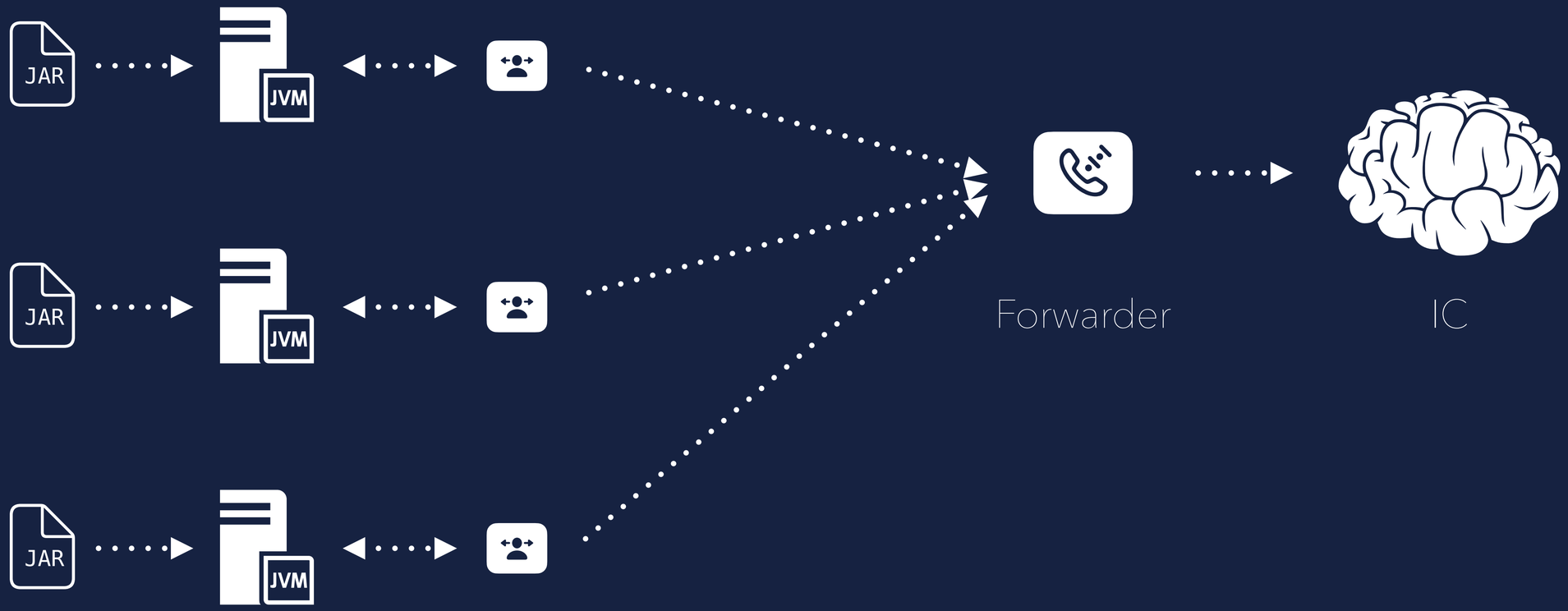
INTELLIGENCE CLOUD

FINDING ZOMBIE CODE...



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Agents

INTELLIGENCE CLOUD

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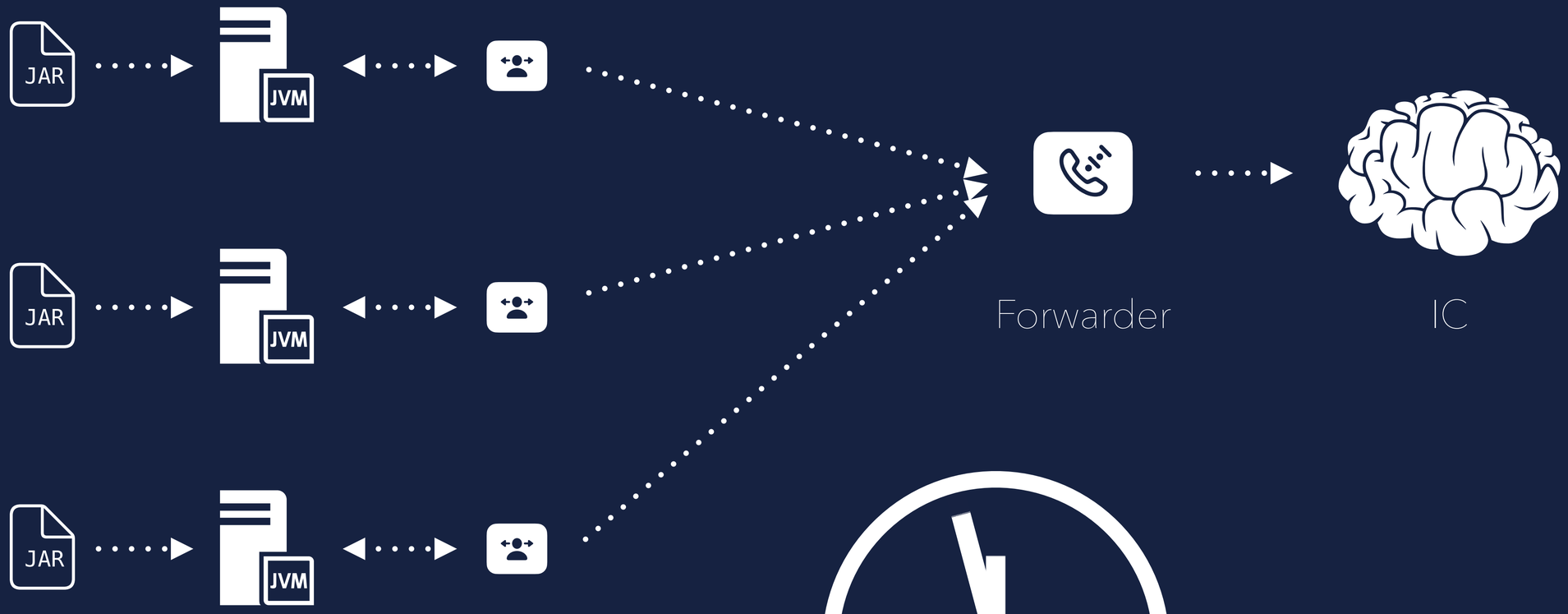

RUN IT FOR SOME TIME...

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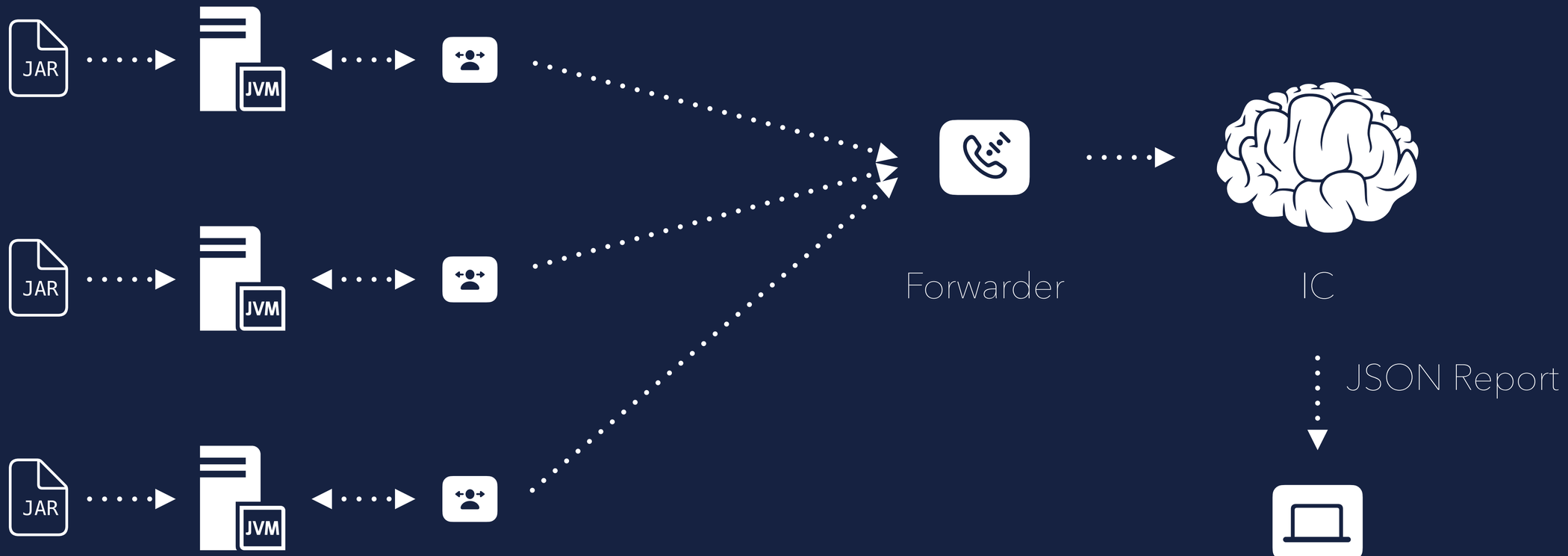
FINDING ZOMBIE CODE...



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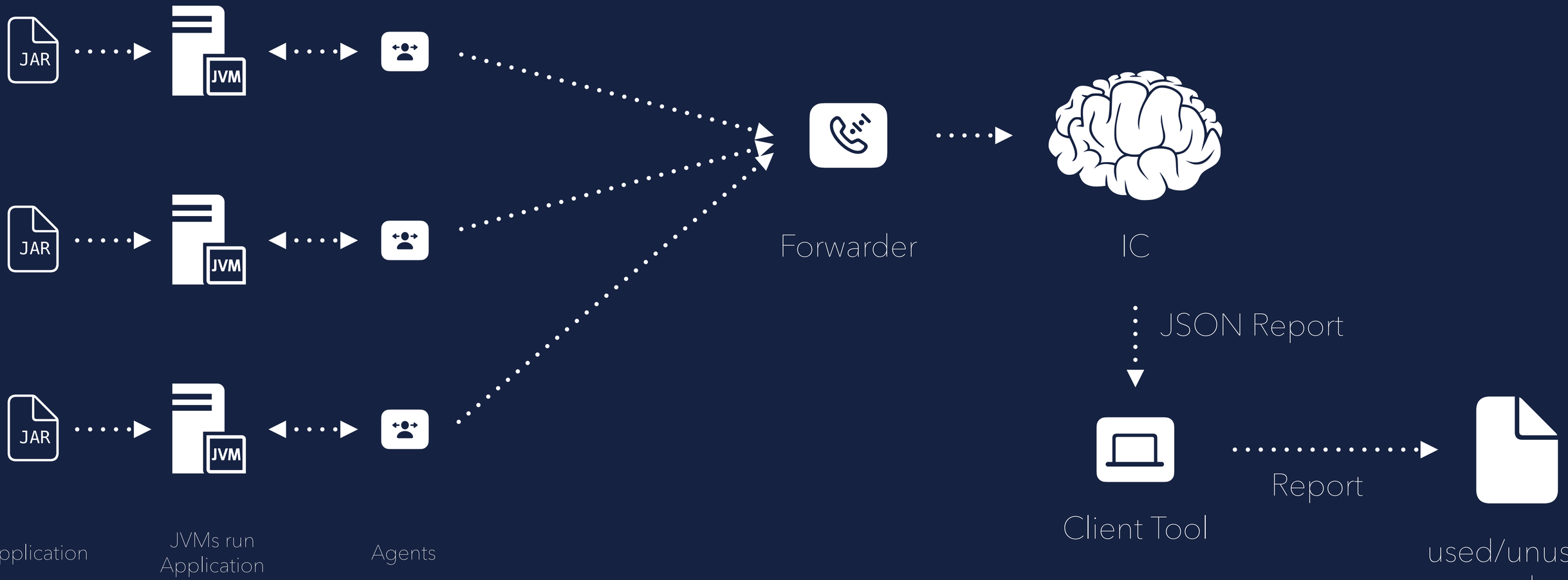
INTELLIGENCE CLOUD

FINDING ZOMBIE CODE...



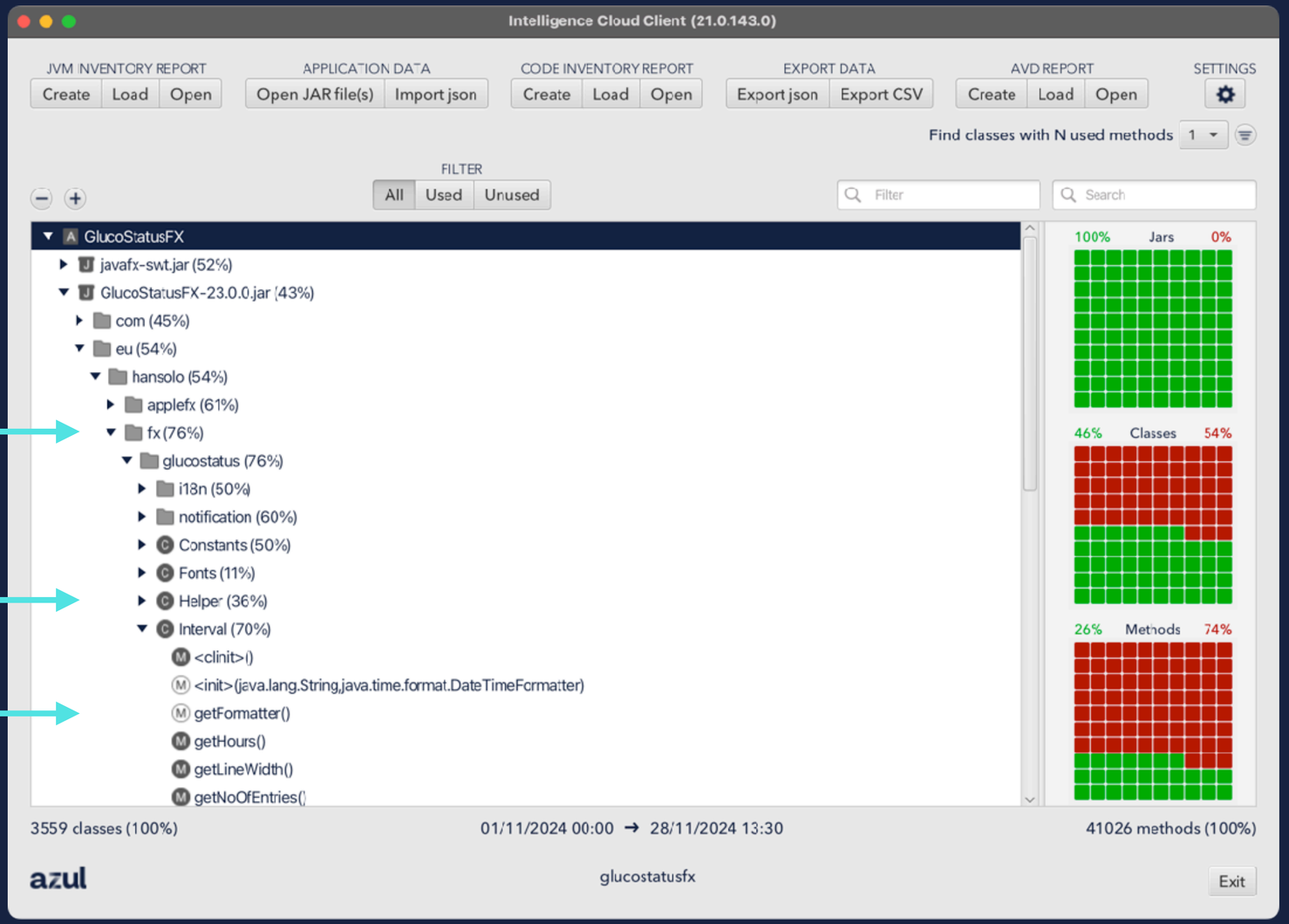
INTELLIGENCE CLOUD

FINDING ZOMBIE CODE...

76% of package used

36% of class used

Unused method



INTELLIGENCE CLOUD

WHAT YOU GET...

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WHAT YOU GET...

AZUL INTELLIGENCE CLOUD

- Ability to find used/unused code in your running application

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- Create reports at any time for specified time frames

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- Method level resolution

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- Ability to find used/unused code in your running application
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- Run app on multiple JVMs at the same time using tags

WHAT YOU GET...

AZUL INTELLIGENCE CLOUD

- Ability to find used/unused code in your running application
- Create reports at any time for specified time frames
- Method level resolution
- Run app on multiple JVMs at the same time using tags
- Offers an API for easy integration in 3rd party tools

WHERE TO GET IT...?

AZUL INTELLIGENCE CLOUD

MORE INFO...

https://www.azul.com/products/intelligence-cloud/

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CONCLUSION

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- Zombie code is real, but hard to find

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CONCLUSION

- Zombie code is real, but hard to find
- Monitoring takes time
- Setup and reporting is challenging
- Document your code, refactor regularly and communicate
- Tools like JaCoCo or Azul Intelligence Cloud can help

THANK YOU

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