Test-Driven Development

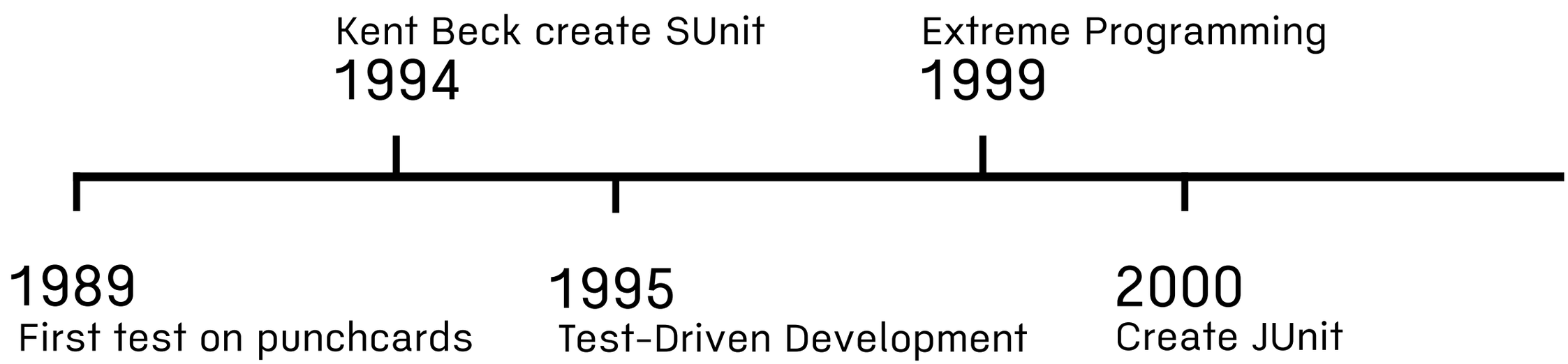
in Java

SPRINT3R

Siam Chamnankit Co., Ltd., Odd-e (Thailand) Co., Ltd. and Alliance

What is TDD ?

Testing timeline

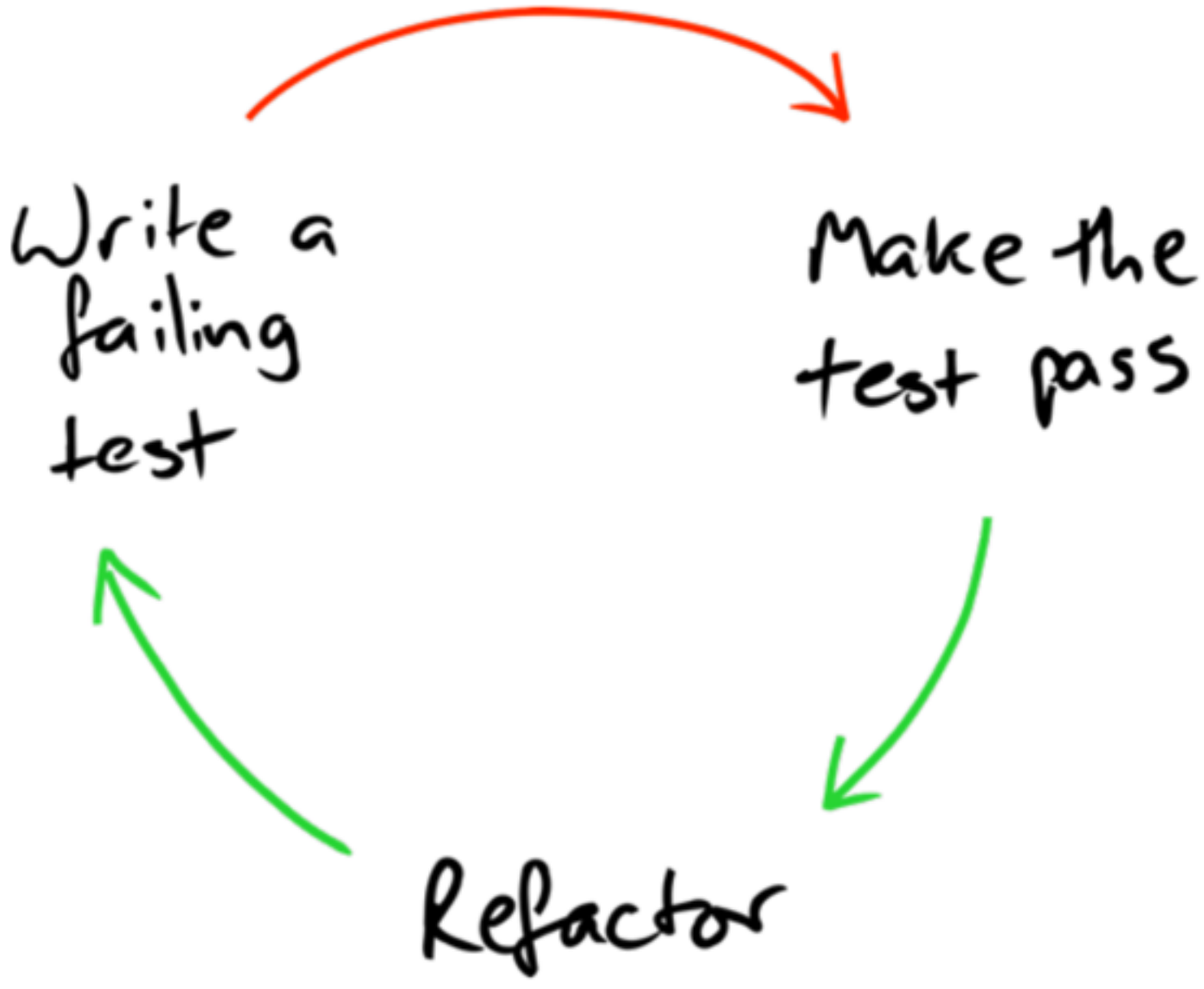


Simple TDD Rules

Write a failing automated test before you write any code

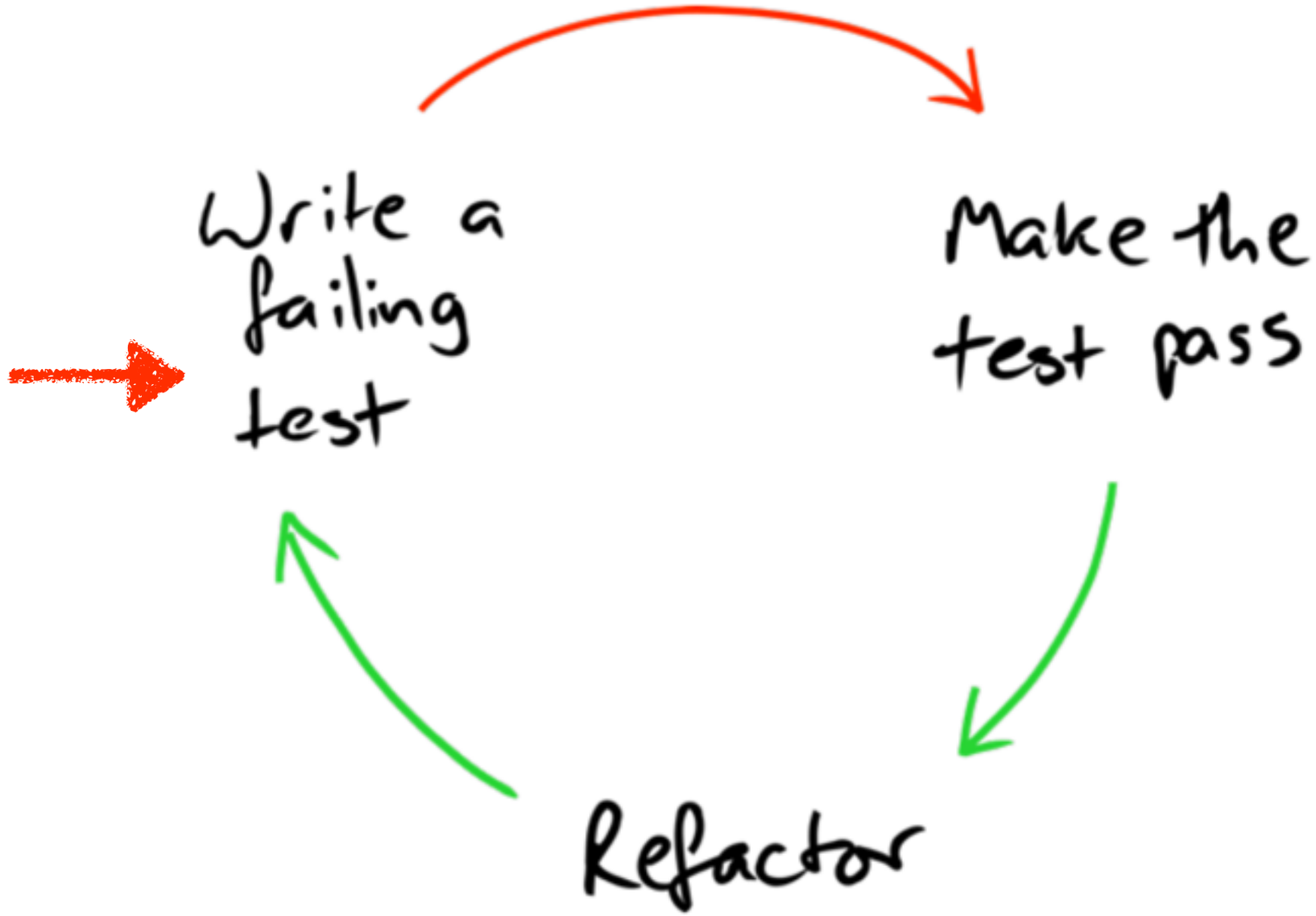
Remove duplication

TDD Cycle



Improve TDD Cycle

Start with THINK



วิธีการทำให้ Test Pass

Fake or Hard code

Triangulation

Use obvious implementation

Why TDD ?

ทำไมต้อง TDD

เพื่อทำความเข้าใจกับปัญหาต่างๆ

คุณเข้าใจปัญหาหรือไม่ ?

ทำไมต้อง TDD

Software **เปลี่ยนแปลง**อยู่เสมอ

คนเรามัก**มโน** และ ทำ**ผิดพลาด**อยู่เสมอ

ทำไมต้อง TDD

Test นั้นช่วยคุณสร้างสิ่งที่ **นโม**

และสร้างความคาดหวังขึ้นมา

ทำไมต้อง TDD

บอกคุณว่า ผิดตรงไหน

ไม่ต้องเสียเวลา **debug**

ทำไมต้อง TDD

ได้รับ feedback ที่รวดเร็ว

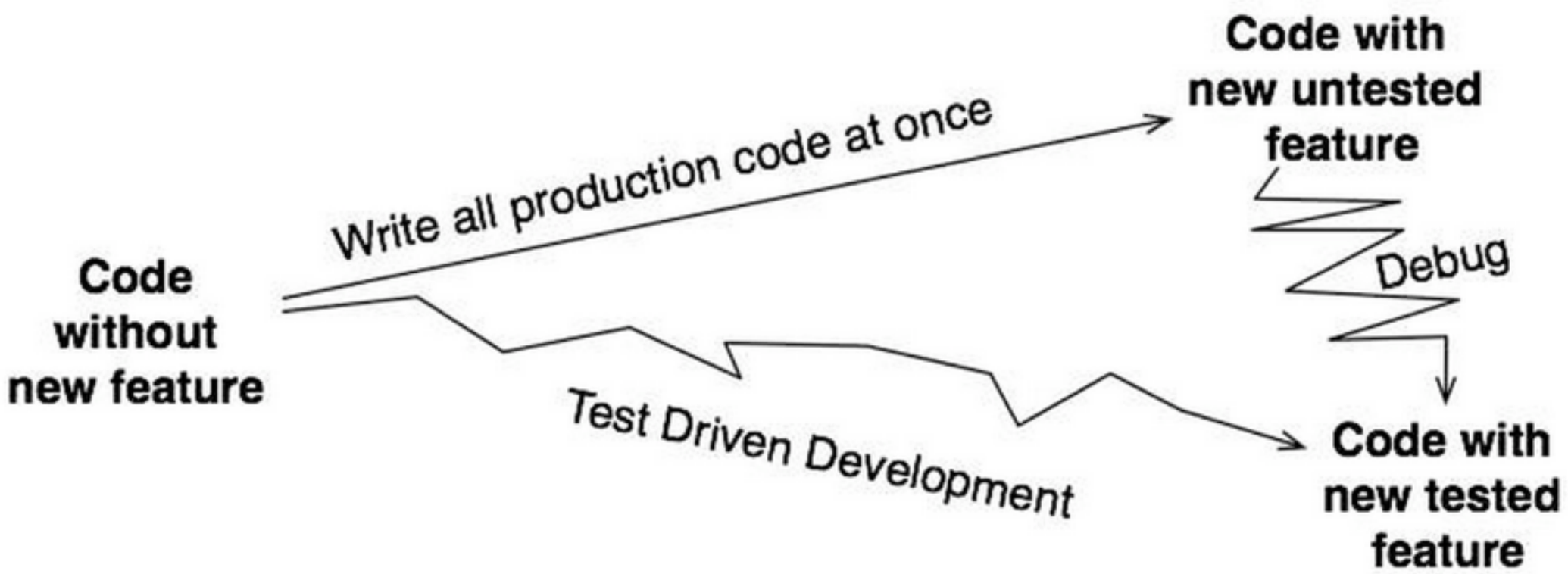
Many small changes vs **One Big Change**

ทำไมต้อง TDD

ให้ developer ทำงานเป็นทีมได้ดีขึ้น

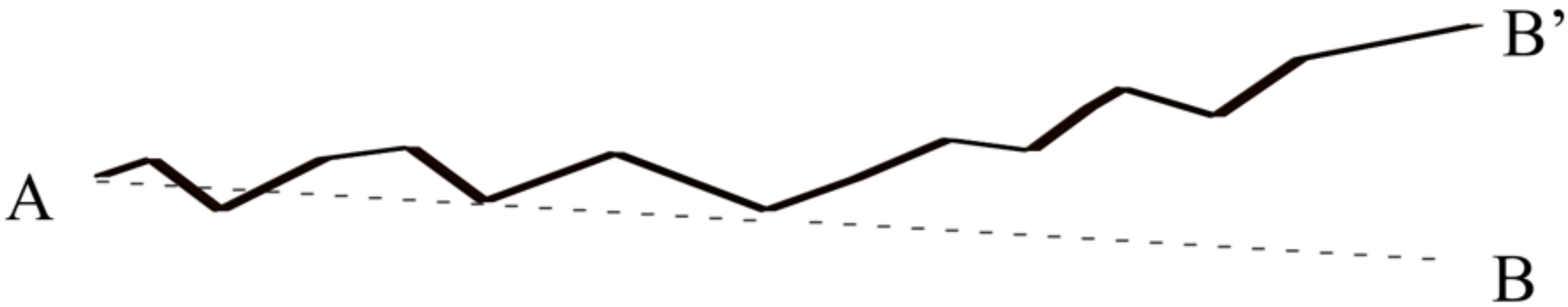
TDD vs DLP

DLP = Debug Later Programming



รูปจาก http://www.renaissancesoftware.net/

Remember :: Small step



Proactive vs Reactive

หาปัญหาก่อน

ทดสอบทีหลัง

ตรวจสอบ req ก่อนทำ

แก้ไขตาม defect ที่แจ้ง

ตรวจสอบ code

debug code

Test ที่ดีต้อง FIRST

Fast
Independent
Repeatable
Self-validating
Timely

สิ่งที่ไม่ใช่ Unit test

External service

- File system
- Database
- WebService
- API calls

สิ่งที่ไม่ใช่ Unit test

Over specification

Compare screen image

Compare HTML

Workshop #1

Circular Buffer

http://en.wikipedia.org/wiki/Circular_buffer

SPRINT3R

Siam Chamnankit Co., Ltd., Odd-e (Thailand) Co., Ltd. and Alliance

Workshop #2

Kata Range

http://codingdojo.org/cgi-bin/index.pl?KataRange

SPRINT3R

Siam Chamnankit Co., Ltd., Odd-e (Thailand) Co., Ltd. and Alliance

Unit

with JUnit

Anatomy JUnit 4

Test Name

```
public class FizzBuzzTest {

    @Test
    public void sayFizzWhenNumberIsDevidedByThree() {
        FizzBuzz fizzBuzz = new FizzBuzz();
        String actualResult = fizzBuzz.say(3);
        assertEquals("Fizz", actualResult);
    }

}
```

Annotation

Test Case Name

Test Naming

“What ’s in a name ?”

That which we call a rose

by any other name would smell

as sweet

Romeo and Juliet

Guide to Test Writing

Don’t say “**test**”, say “**should**”

SPRINT3R

Siam Chamnankit Co., Ltd., Odd-e (Thailand) Co., Ltd. and Alliance

Don’t use the word “test”

Use the word “should”

```
tranferShouldDeductSumFromSourceAccountBalance()

transferShouldAddSumLessFeesToDestinationAccountBalance()

depositShouldAddAmountToAccountBalance()
```

Guide to Test Writing

Don’t test your class, test **behaviour**

SPRINT3R

Siam Chamnankit Co., Ltd., Odd-e (Thailand) Co., Ltd. and Alliance

Guide to Test Writing

Test class names are important too

Structure your test well

Tests are **deliverable** too

Test Structure

The ratio of time spent (code)

versus writing is

over 10 to 1

Robert C. Martin, Clean Code

Good Unit Test

```
@Test
public void sayFizzWhenNumberIsDevidedByThree() {
    FizzBuzz fizzBuzz = new FizzBuzz();

    String actualResult = fizzBuzz.say(3);

    assertEquals("Fizz", actualResult);
}
```

Arrange

Act

Assert

Setup Pattern

```
@Test
public void sayFizzWhenNumberIsDevidedByThree() {
    FizzBuzz fizzBuzz = new FizzBuzz();

    String actualResult = fizzBuzz.say(3);

    assertEquals("Fizz", actualResult);
}

@Test
public void sayBuzzWhenNumberIsDevidedByFive() {
    FizzBuzz fizzBuzz = new FizzBuzz();

    String actualResult = fizzBuzz.say(5);

    assertEquals("Buzz", actualResult);
}
```

Setup Pattern

Inline Setup

```
@Test
public void sayFizzWhenNumberIsDevidedByThree() {
    FizzBuzz fizzBuzz = new FizzBuzz();

    String actualResult = fizzBuzz.say(3);

    assertEquals("Fizz", actualResult);
}

@Test
public void sayBuzzWhenNumberIsDevidedByFive() {
    FizzBuzz fizzBuzz = new FizzBuzz();

    String actualResult = fizzBuzz.say(5);

    assertEquals("Buzz", actualResult);
}
```

Setup Pattern

```
@Test
public void sayFizzWhenNumberIsDevidedByThree() {
    FizzBuzz fizzBuzz = setup();
    String actualResult = fizzBuzz.say(3);
    assertEquals("Fizz", actualResult);
}
```

Delegate Setup

```
@Test
public void sayBuzzWhenNumberIsDevidedByFive() {
    FizzBuzz fizzBuzz = setup();
    String actualResult = fizzBuzz.say(5);
    assertEquals("Buzz", actualResult);
}

private FizzBuzz setup() {
    FizzBuzz fizzBuzz = new FizzBuzz();
    return fizzBuzz;
}
```

Setup Pattern

```
@Before
public void initial() {
    fizzBuzz = new FizzBuzz();
}
```

Implicit Setup

```
@Test
public void sayFizzWhenNumberIsDevidedByThree() {
    String actualResult = fizzBuzz.say(3);
    assertEquals("Fizz", actualResult);
}

@Test
public void sayBuzzWhenNumberIsDevidedByFive() {
    String actualResult = fizzBuzz.say(5);
    assertEquals("Buzz", actualResult);
}
```

Implicit Teardown

```
@After
public void clearResources(){
    fizzBuzz = null;
}
```

Ignore Testcase

```
@Ignore("Pending implemetation")
@Test
public void sayFizzWhenNumberIsDevidedByThree() {
    FizzBuzz fizzBuzz = new FizzBuzz();
    String actualResult = fizzBuzz.say(3);
    assertEquals("Fizz", actualResult);
}
```

Handle Exception

Traditional approach

```
@Test
public void invalidWhenNumberLessThanOne() {
    try {
        fizzBuzz.say(0);
        fail();
    } catch (IllegalStateException expected) {
    }
}
```

Expected Annotation

```
@Test(expected=IllegalStateException.class)
public void invalidWhenNumberLessThanOne() {
        fizzBuzz.say(0);
}
```

ExpectedException Rule

```java
@Rule
public ExpectedException thrown = ExpectedException.none();

@Test
public void invalidWhenNumberLessThanOne() {
    thrown.expect(IllegalStateException.class);
    fizzBuzz.say(0);
}
```

Data-Driven with JUnit

@Parameterized

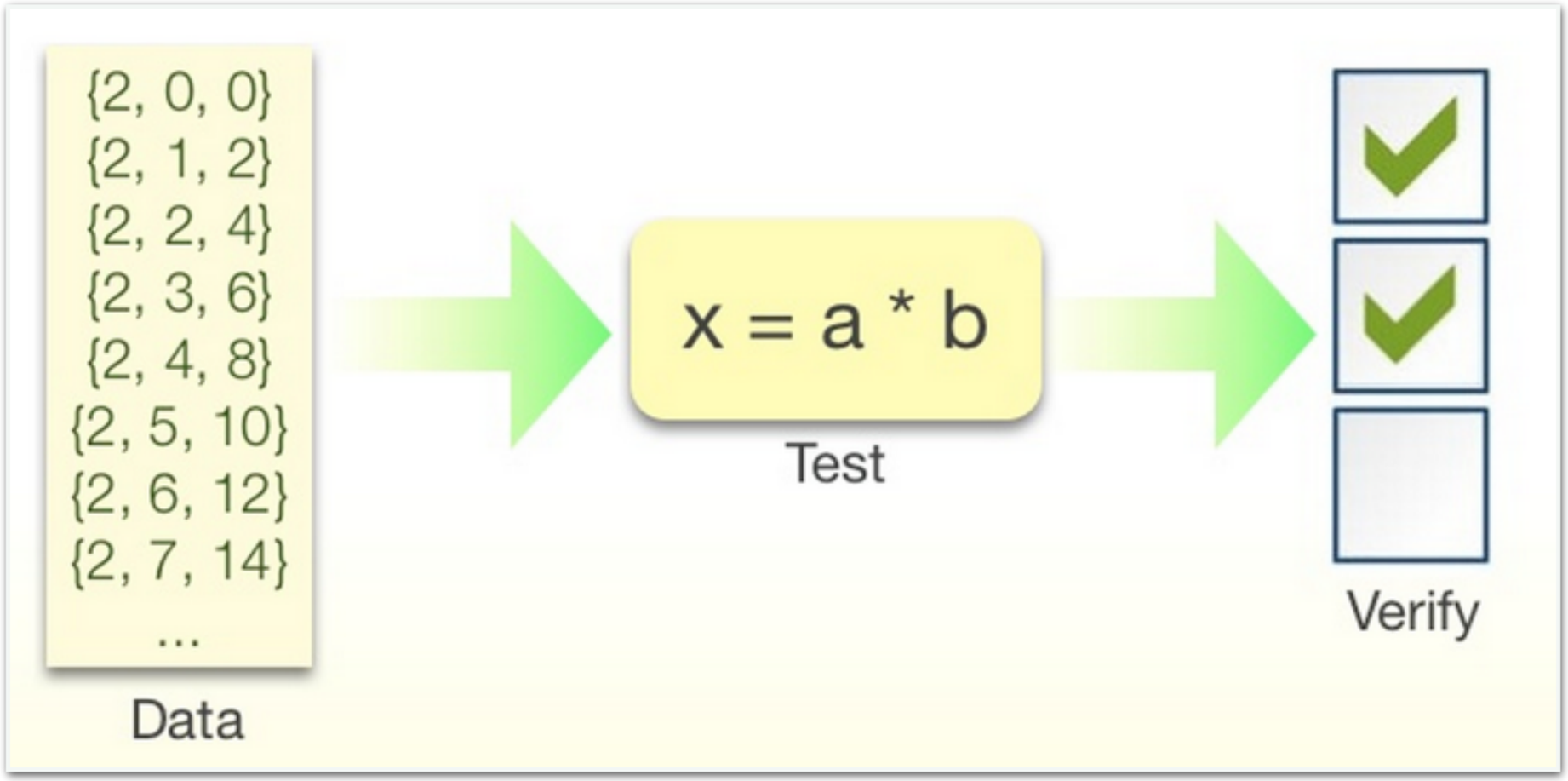
SPRINT3R

Siam Chamnankit Co., Ltd., Odd-e (Thailand) Co., Ltd. and Alliance

Using parameterized

Set of test data
Expected result
Define test that uses the test data
Verify result against expected result

Data-Driven Development



Demo

@Parameterized
with Calculate Grade

Input	Expected Result
80	A
70	B
60	C
50	D
40	F

Step 1 :: Test Data

Input	Expected Result
80	A
70	B
60	C
50	D
40	F

Step 2 :: Add Runner

```
@RunWith(Parameterized.class)
public class CalculateGradeTest {

    private int score;
    private String expectedGrade;

    public CalculateGradeTest(int score, String expectedGrade) {
        this.score = score;
        this.expectedGrade = expectedGrade;
    }

    @Test
    public void convertScoreToGrade() {
    }

}
```

Step 3 :: Matching fields

```
@RunWith(Parameterized.class)
public class CalculateGradeTest {

    private int score;
    private String expectedGrade;

    public CalculateGradeTest(int score, String expectedGrade) {
        this.score = score;
        this.expectedGrade = expectedGrade;
    }

    @Test
    public void convertScoreToGrade() {
    }

}
```

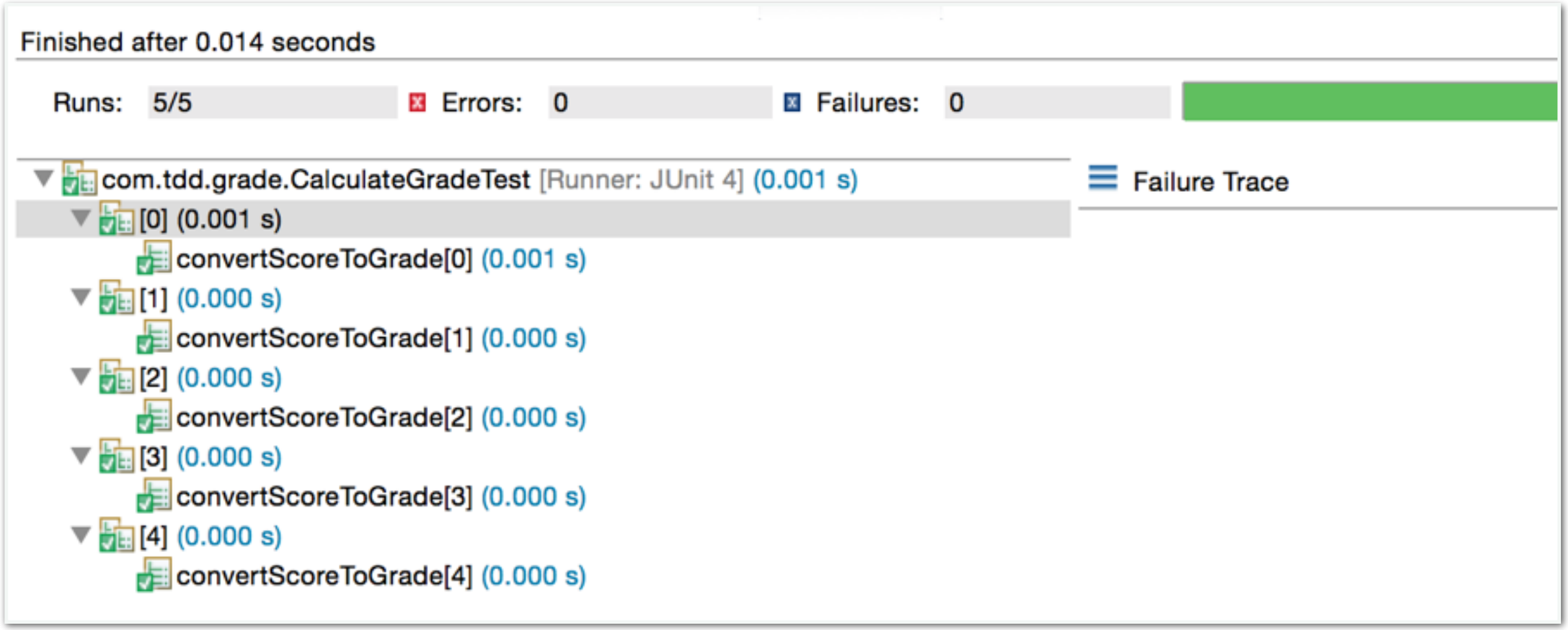
Step 4 :: Define test case

```java
@RunWith(Parameterized.class)
public class CalculateGradeTest {

    private int score;
    private String expectedGrade;

    public CalculateGradeTest(int score, String expectedGrade) {
        this.score = score;
        this.expectedGrade = expectedGrade;
    }

    @Test
    public void convertScoreToGrade() {
    }

}
```

Step 5 :: Add @parameters

```
@RunWith(Parameterized.class)
public class CalculateGradeTest {

    private int score;
    private String expectedGrade;

    @Parameters
    public static Collection<Object[]> data(){
        return Arrays.asList(new Object[][]{
                {80, "A"},
                {70, "B"},
                {60, "C"},
                {50, "D"},
                {40, "F"}
        });
    }
```

Step 6 :: Test Result



Workshop

@Parameterized

with Calculator

Operand 1	Operator	Operand 2	Expected
1	+	1	2
2	+	2	4
1	-	1	0
2	-	1	1
3	*	1	3
3	*	2	6

Workshop #3

Kata LCD Digit

http://cyber-dojo.org/

SPRINT3R

Siam Chamnankit Co., Ltd., Odd-e (Thailand) Co., Ltd. and Alliance

Continuous Testing

with **Infinitest**

Support **Eclipse IDE** and **IntelliJ**

Run your tests in background when you save your code

https://infinitest.github.io/

SPRINT3R

Siam Chamnankit Co., Ltd., Odd-e (Thailand) Co., Ltd. and Alliance

TDD in Real world

Design Principle

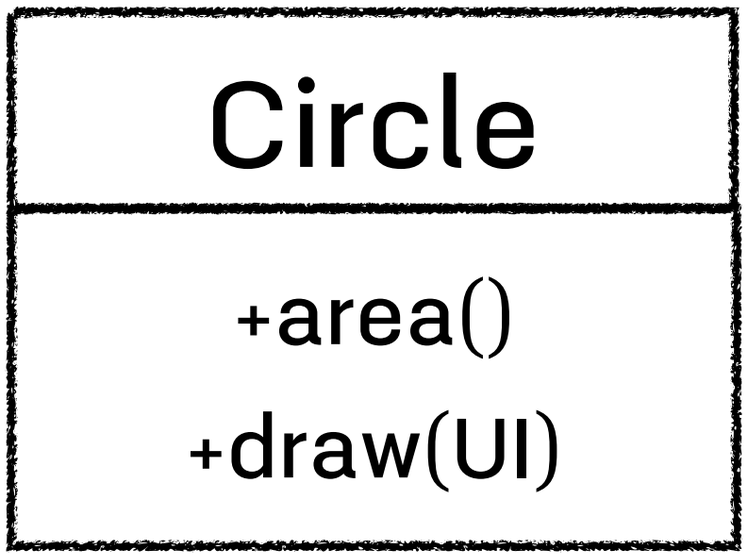
SPRINT3R

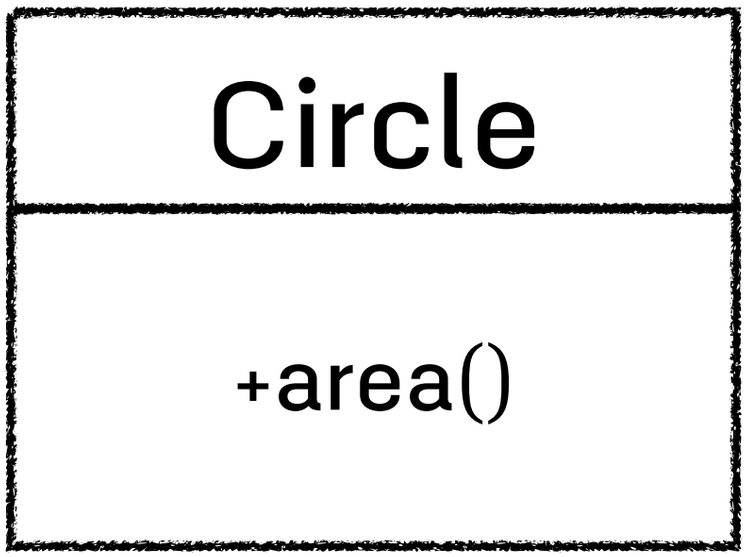
Siam Chamnankit Co., Ltd., Odd-e (Thailand) Co., Ltd. and Alliance

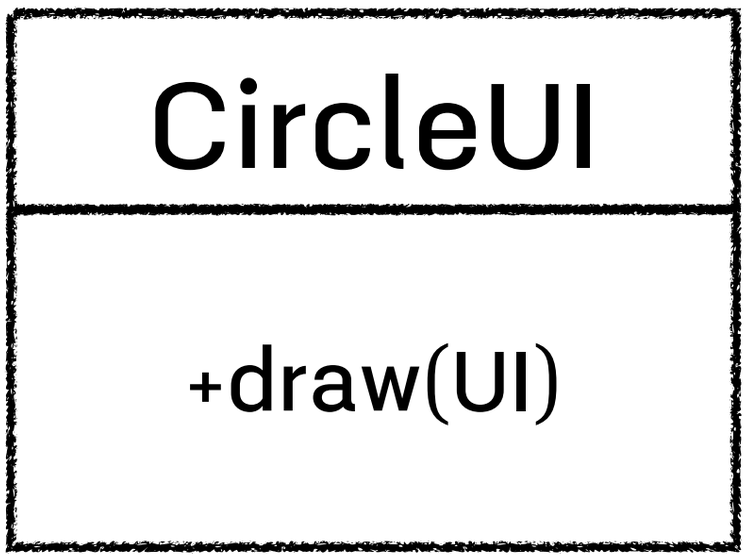

SOLID
Software development is not a Jenga game.


Single Responsibility Principle
Just because you *can* doesn't mean you *should*.

Single Responsibility Principle




Circle
+area()


CircleUI
+draw(UI)

Workshop #4

Single Responsibility Principle

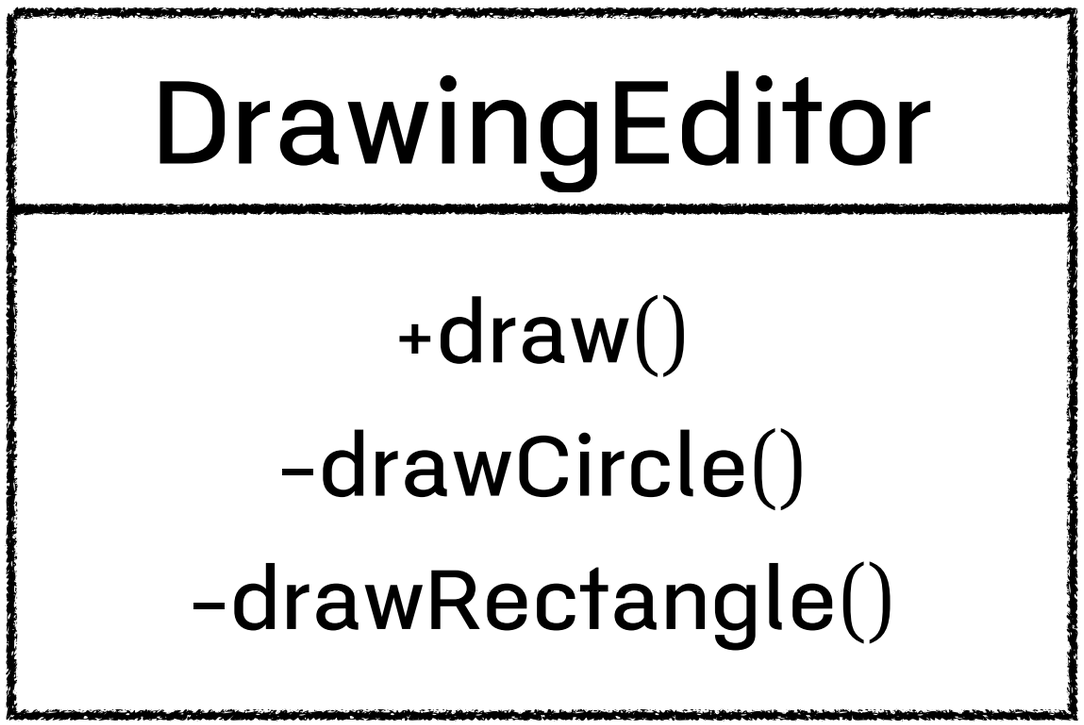
SPRINT3R

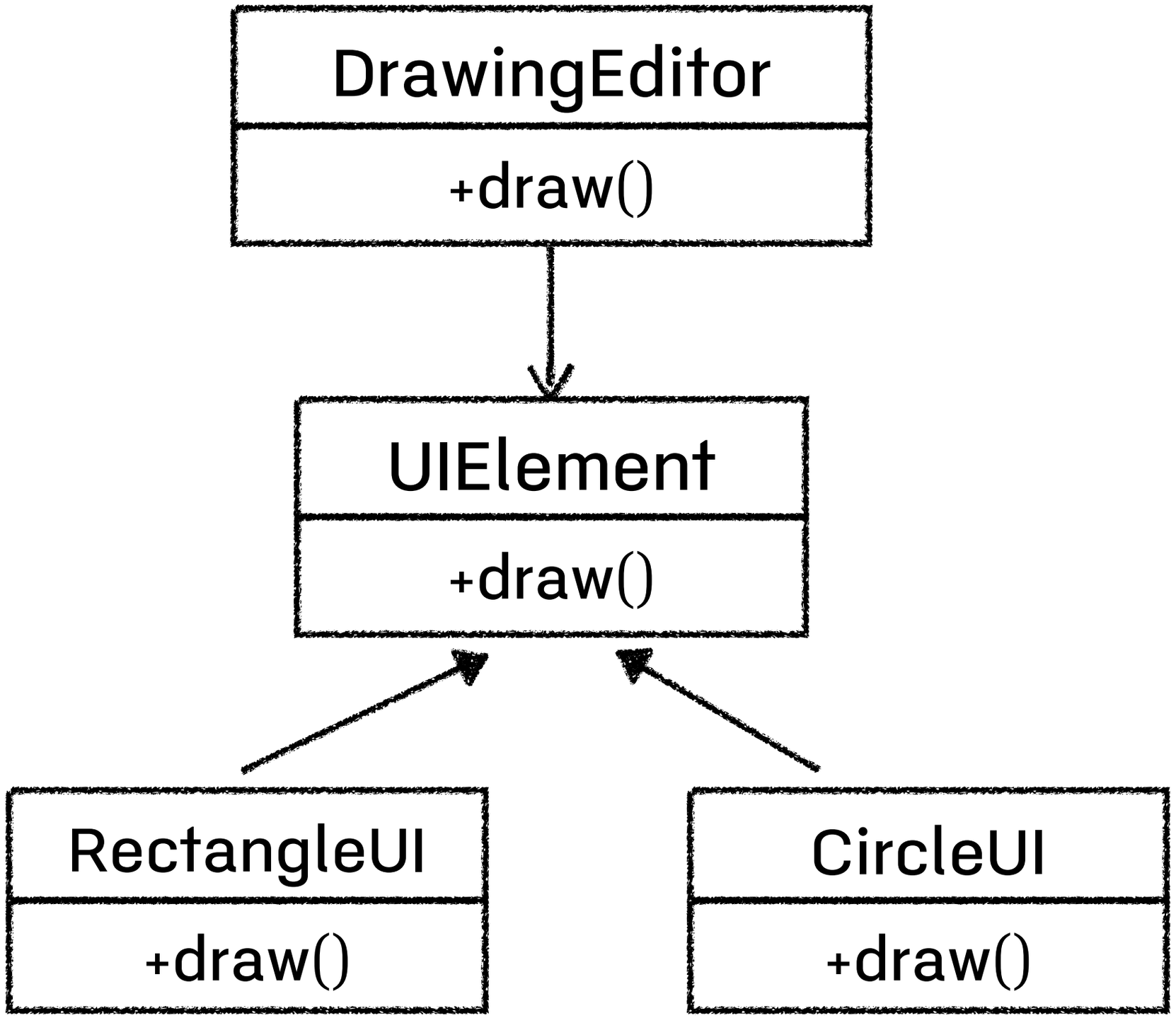
Siam Chamnankit Co., Ltd., Odd-e (Thailand) Co., Ltd. and Alliance

SPRINT3R

Siam Chamnankit Co., Ltd., Odd-e (Thailand) Co., Ltd. and Alliance

Open/Closed Principle



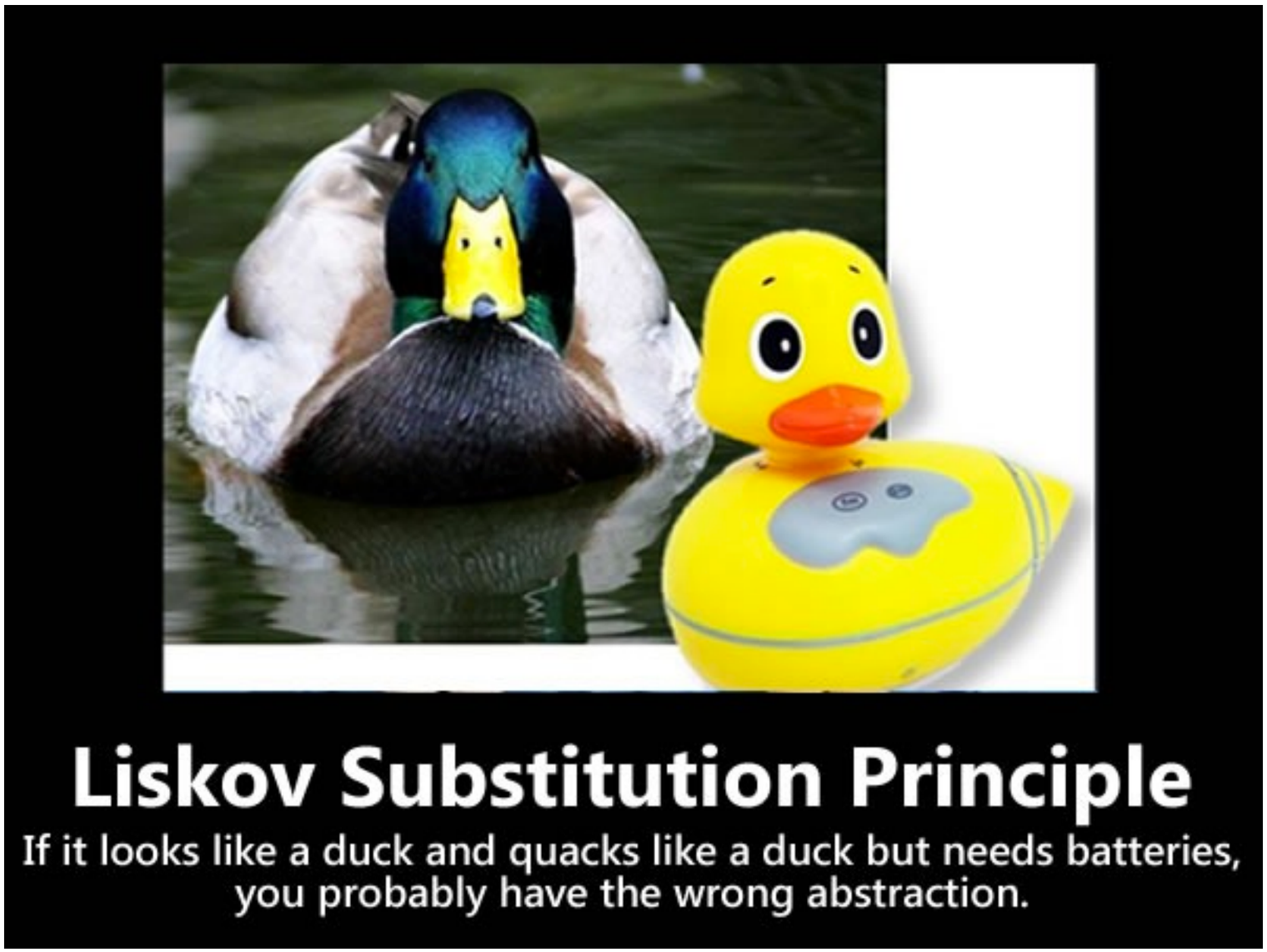

DrawingEditor
+draw()
UIElement
+draw()
RectangleUI
+draw()
CircleUI
+draw()

Workshop #5

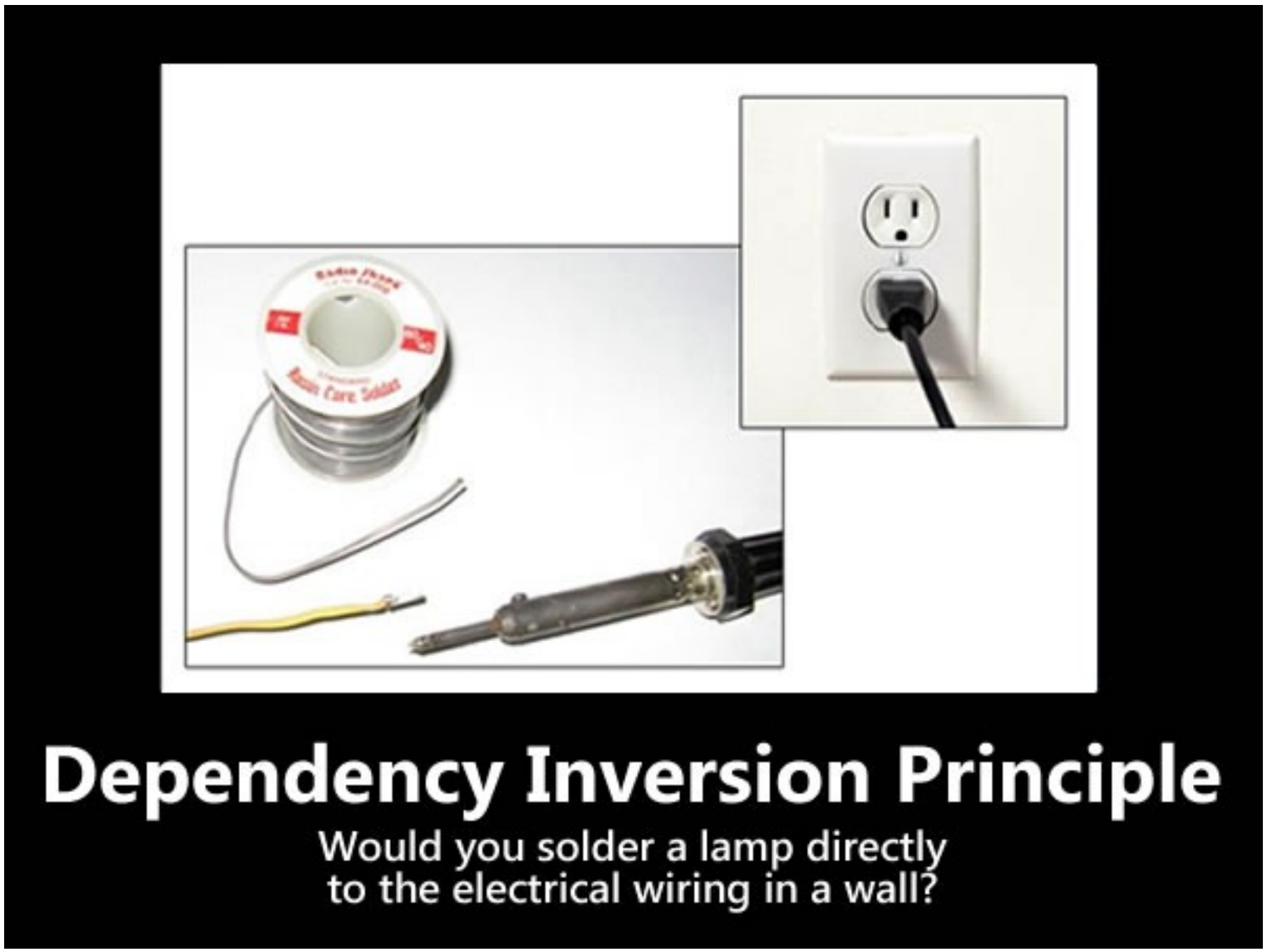
Open/Closed Principle

SPRINT3R

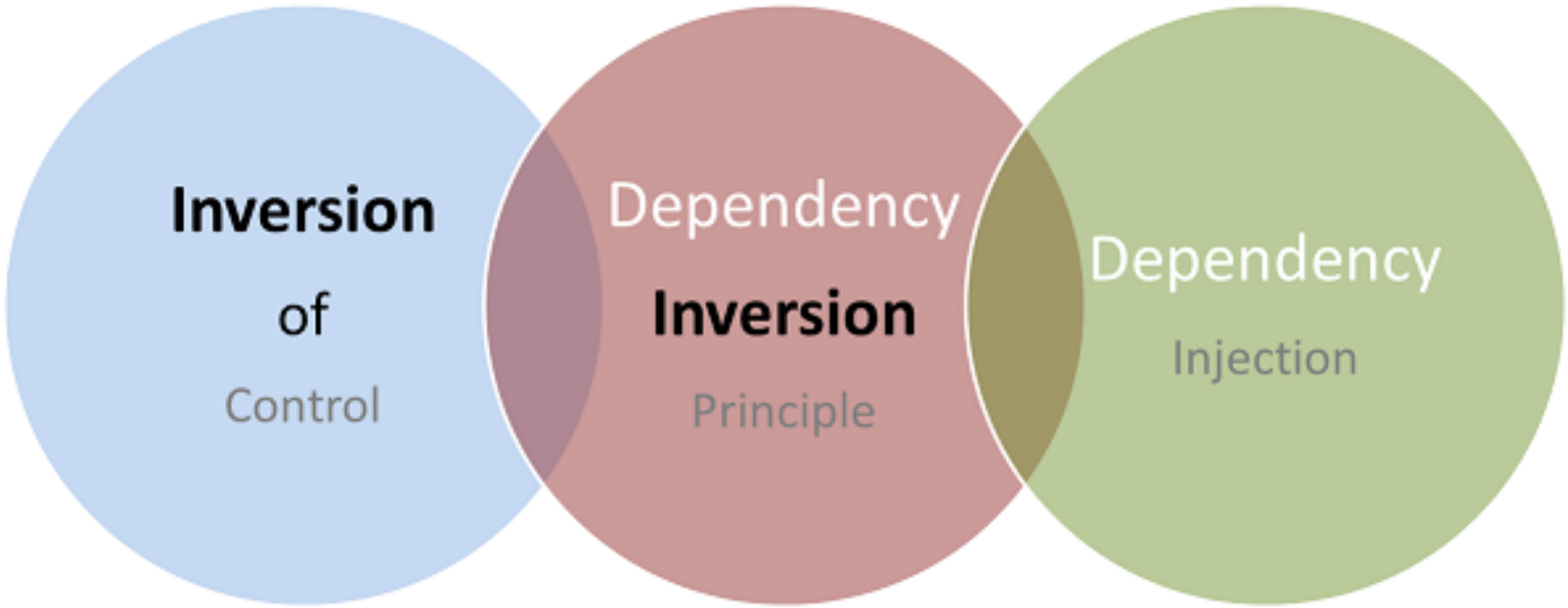
Siam Chamnankit Co., Ltd., Odd-e (Thailand) Co., Ltd. and Alliance


Liskov Substitution Principle
If it looks like a duck and quacks like a duck but needs batteries,
you probably have the wrong abstraction.


Interface Segregation Principle
You want me to plug this in *where?*

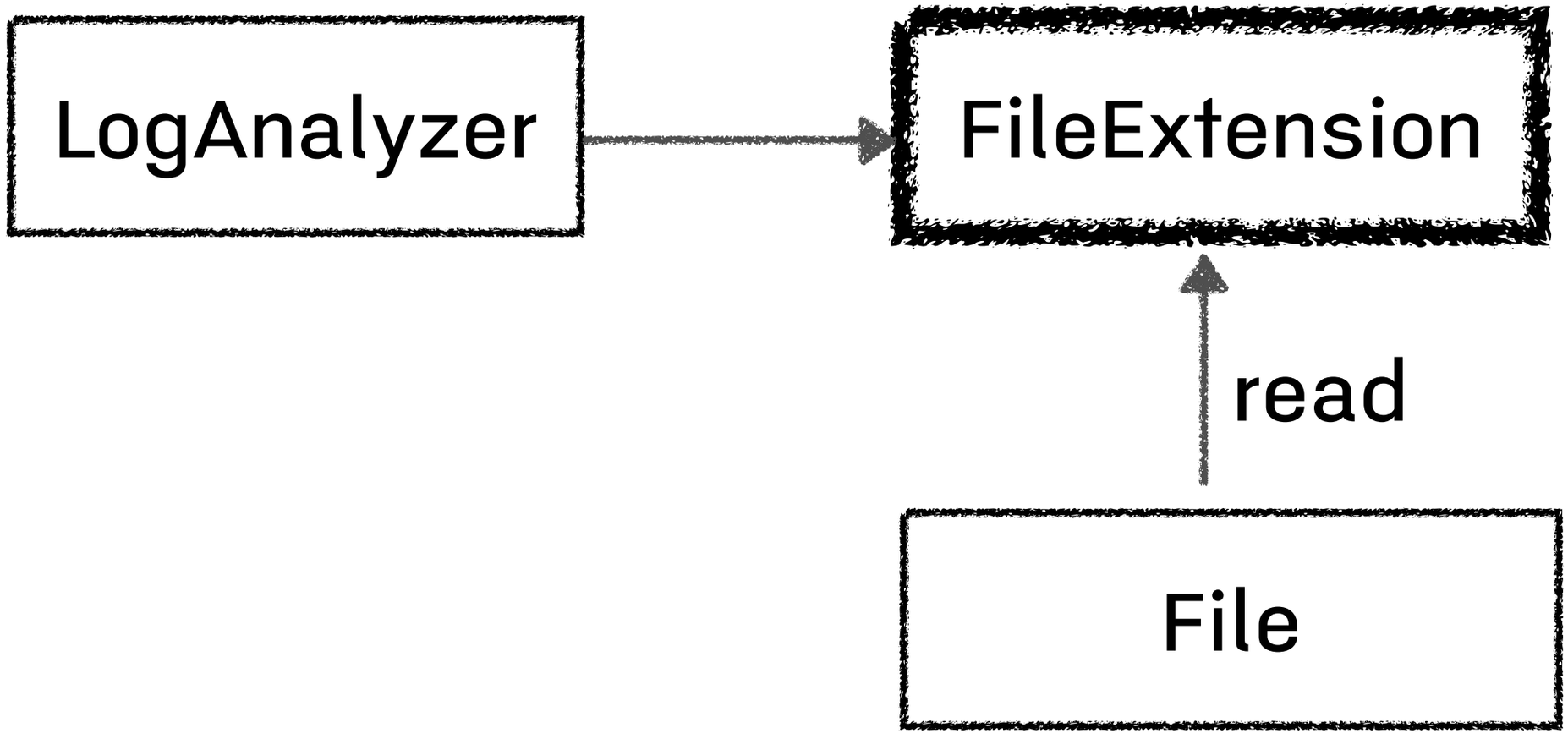

Dependency Inversion Principle
Would you solder a lamp directly
to the electrical wiring in a wall?

Dependency Inversion Principle



Dependency Inversion Principle

Move to new class



Workshop #6

Discuss about FileExtension.java

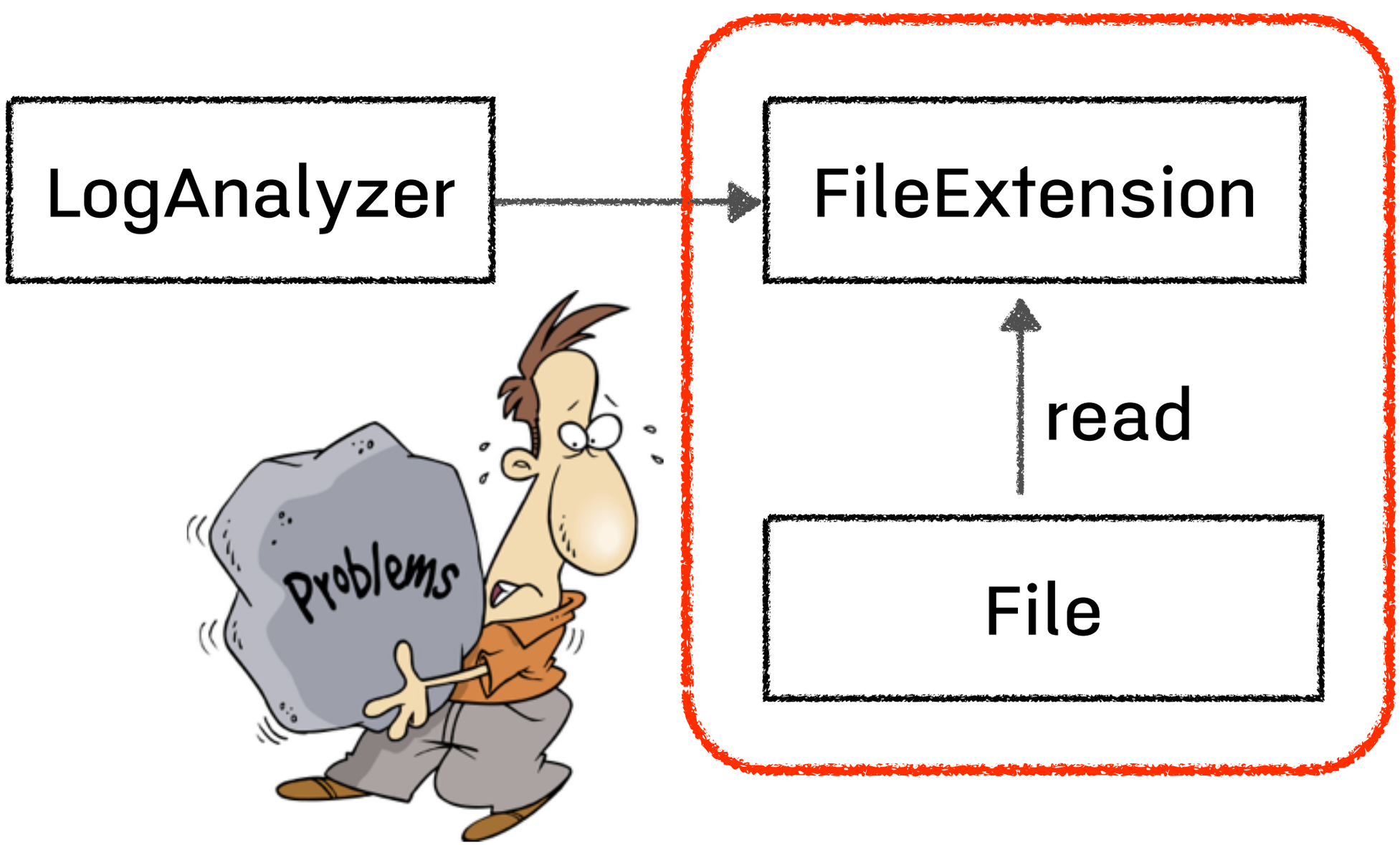
SPRINT3R

Siam Chamnankit Co., Ltd., Odd-e (Thailand) Co., Ltd. and Alliance

Problem ?

Fast
Independent
Repeatable
Self-validating
Timely

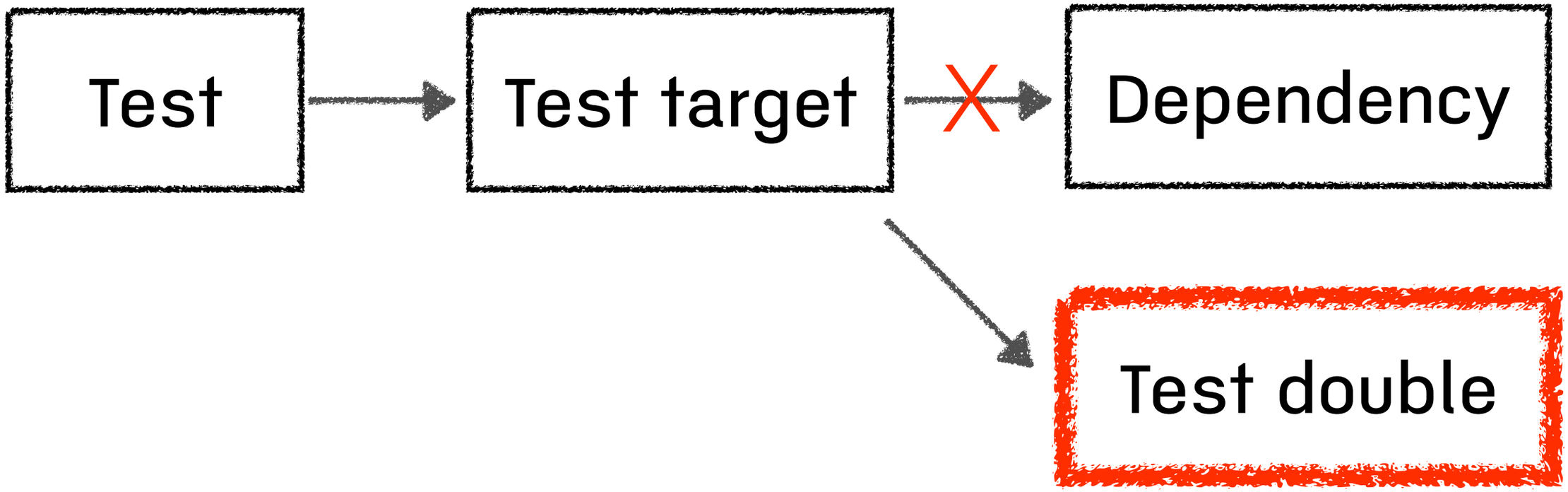
Dependency with File



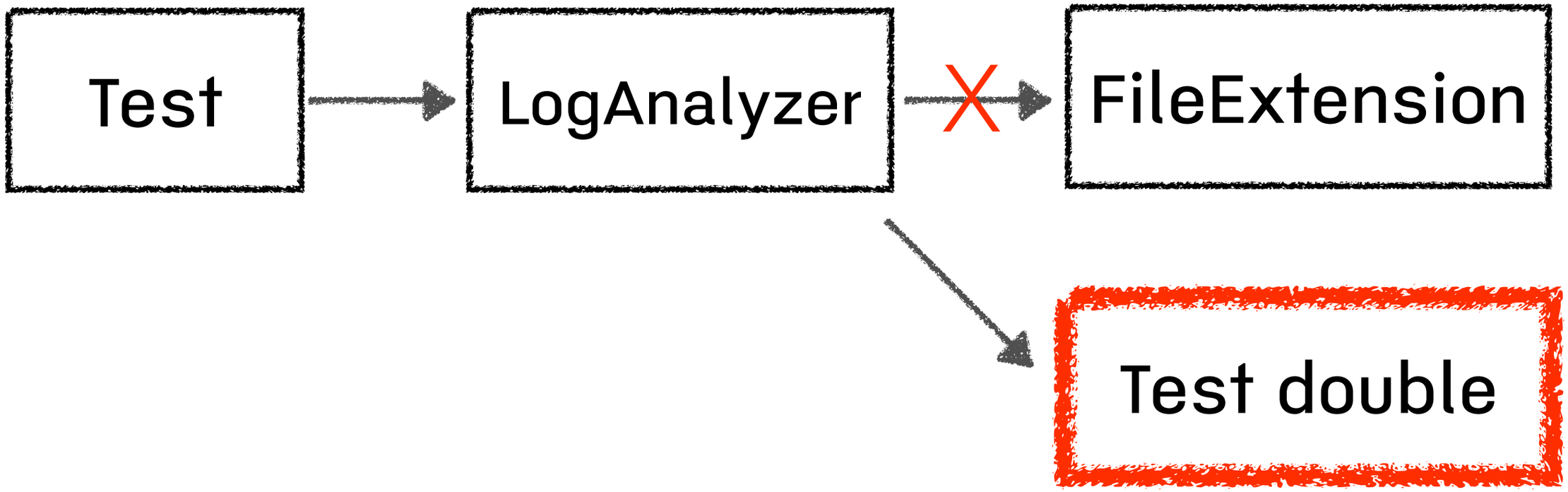
Discuss

How to Break dependency ?

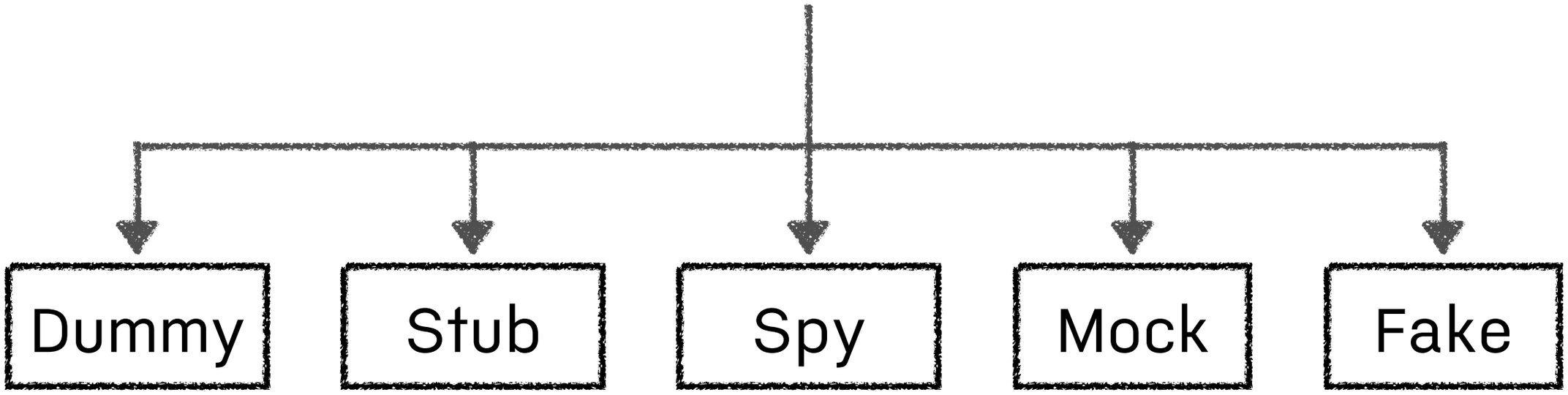
Isolate Dependency



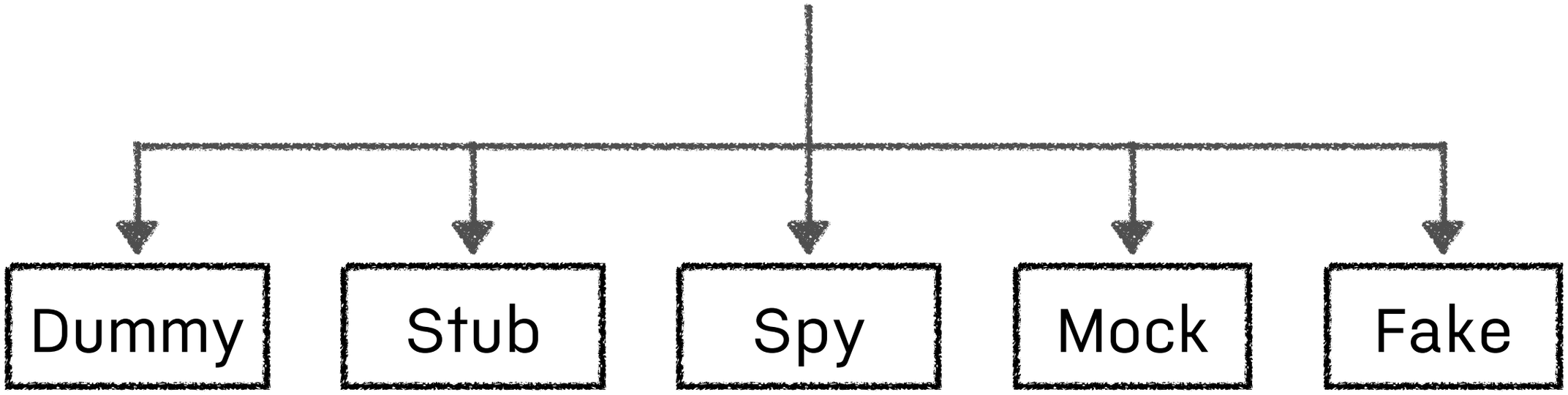
Isolate Dependency



Test Double

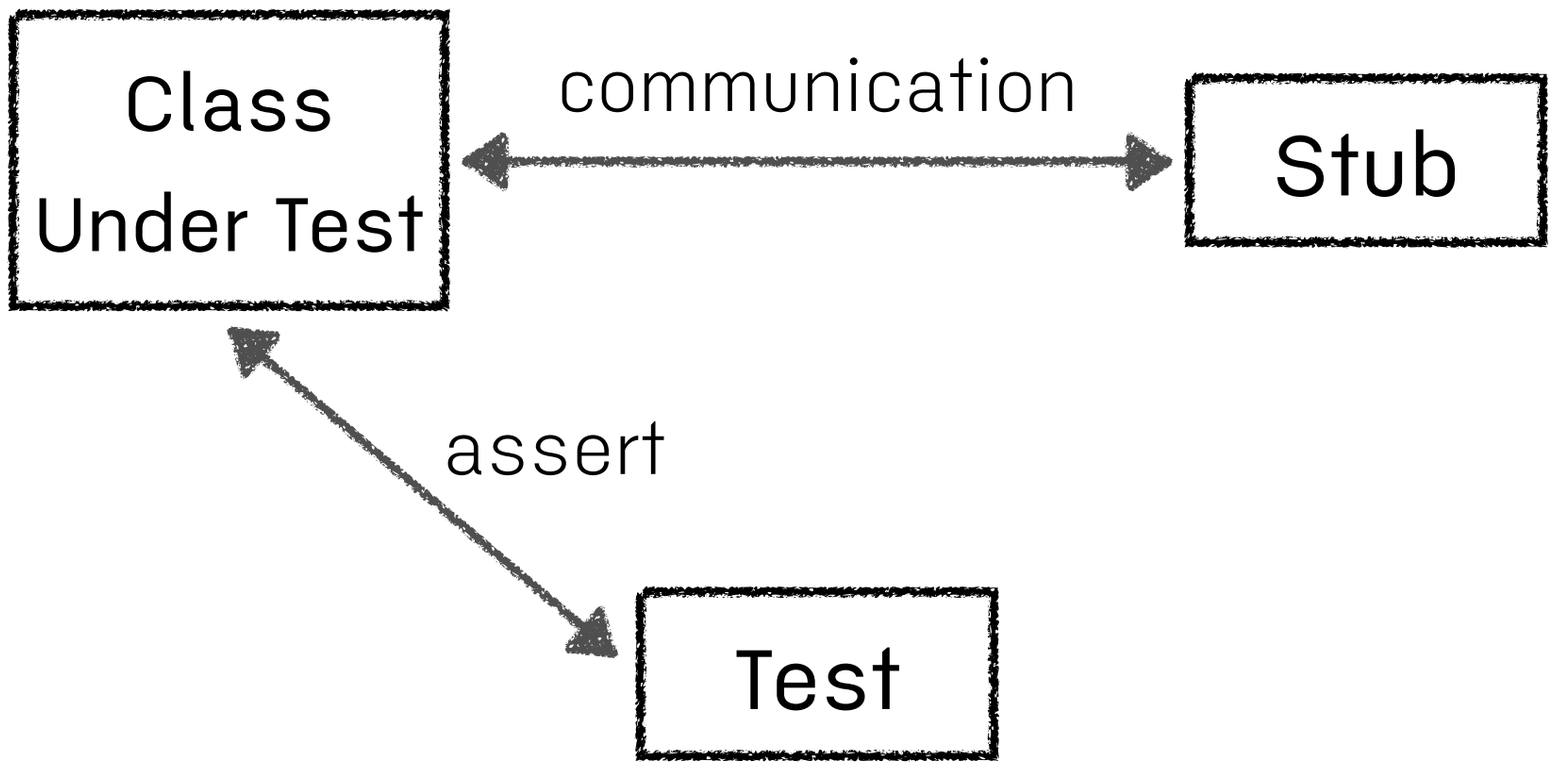


Test Double



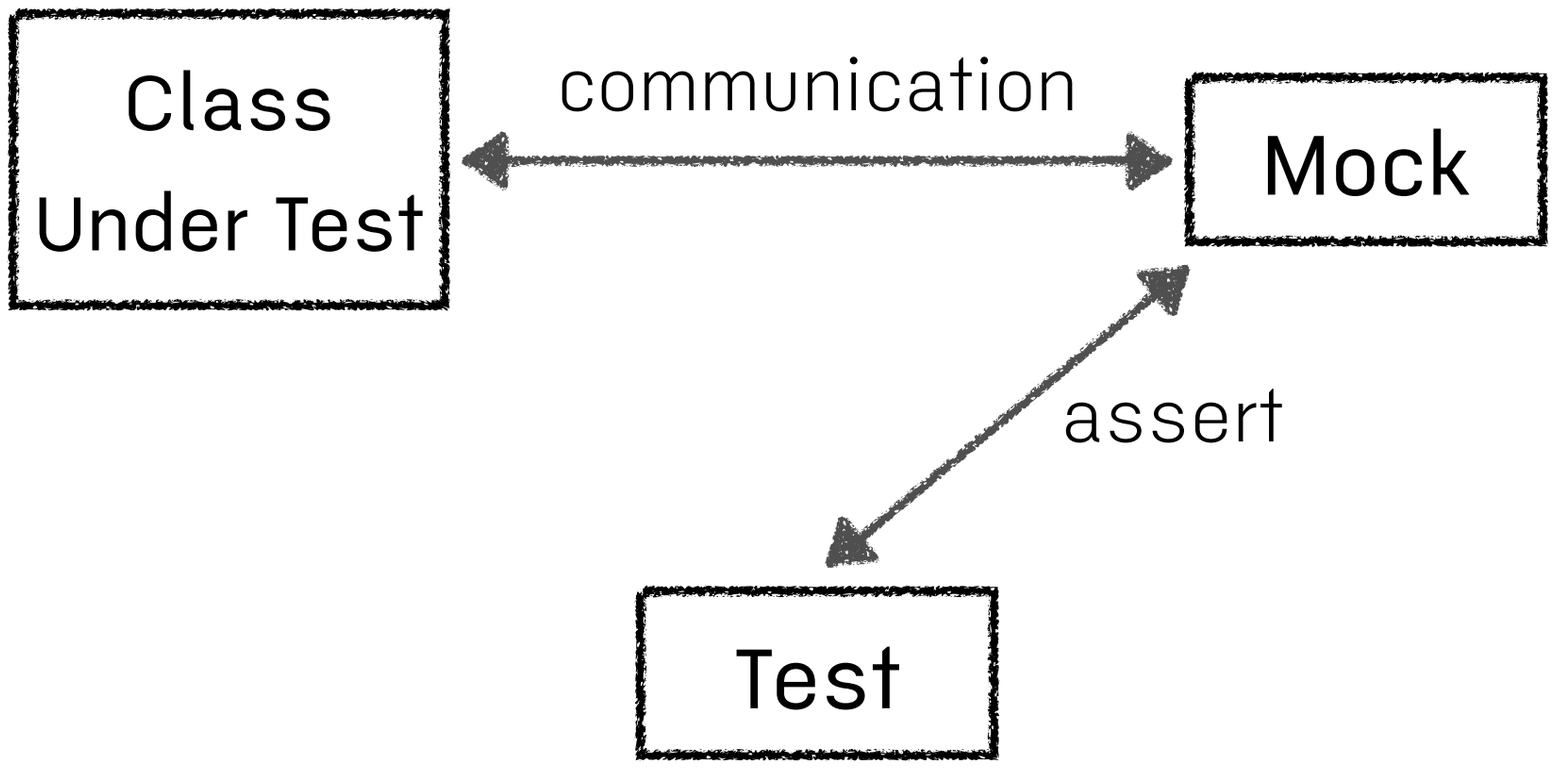
Configuration & **Hard code**

Stub



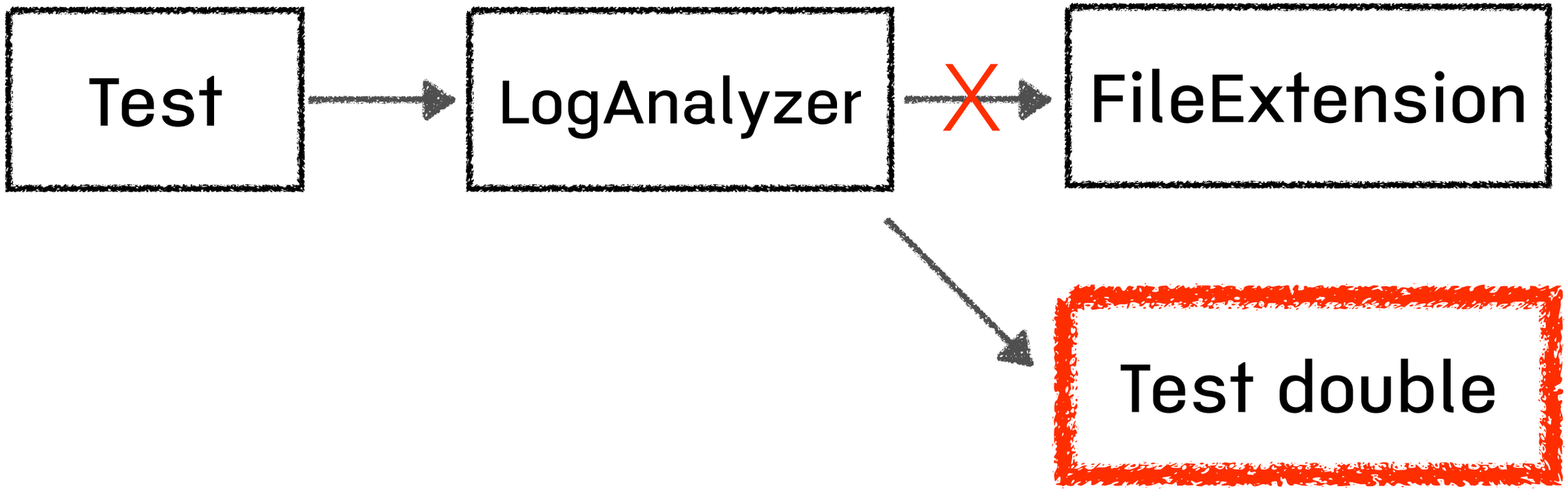
Make sure the test run smoothly

Mock object



To verify that the test pass

How to use Test double ?



Demo & Discuss

Break dependency with File System

Problem ?

```
public class LogAnalyzer {

    private String fileName;

    public LogAnalyzer(String fileName) {
        this.fileName = fileName;
    }

    public boolean checkFileExtension() {
        FileExtension fileExtension = new FileExtension(this.fileName);
        return fileExtension.isValid();
    }

}
```

Problem ?

```
public class LogAnalyzer {

    private String fileName;

    public LogAnalyzer(String fileName) {
        this.fileName = fileName;
    }

    public boolean checkFileExtension() {
        FileExtension fileExtension = new FileExtension(this.fileName);
        return fileExtension.isValid();
    }

}
```

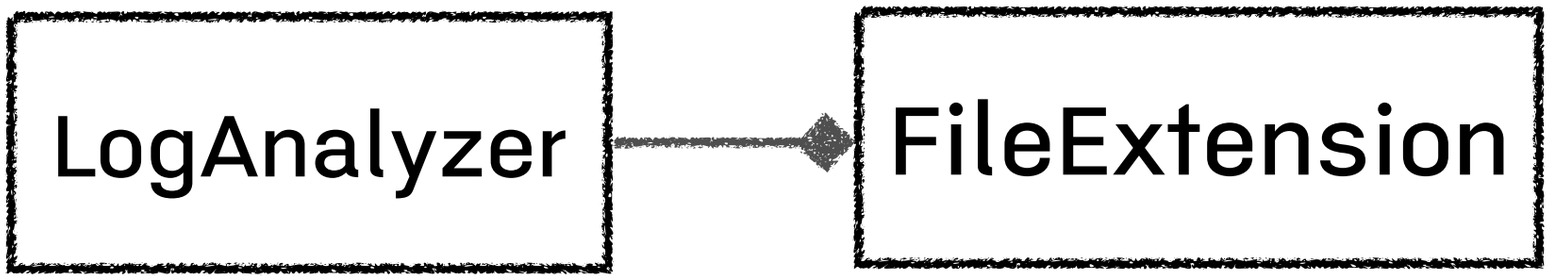
Code tight coupling !!

Discuss

How to solve this problem ?

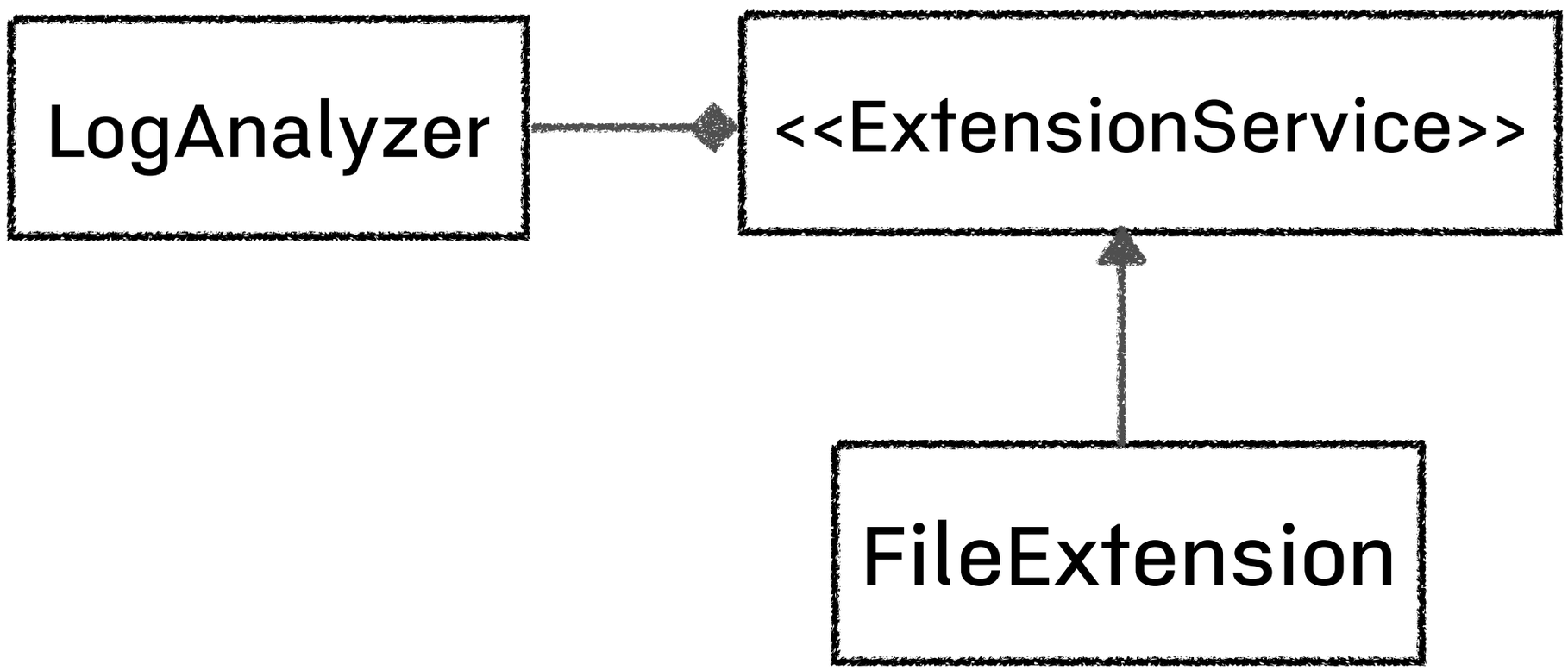
All about Abstraction

Tight coupling !!



All about Abstraction

Loose coupling !!

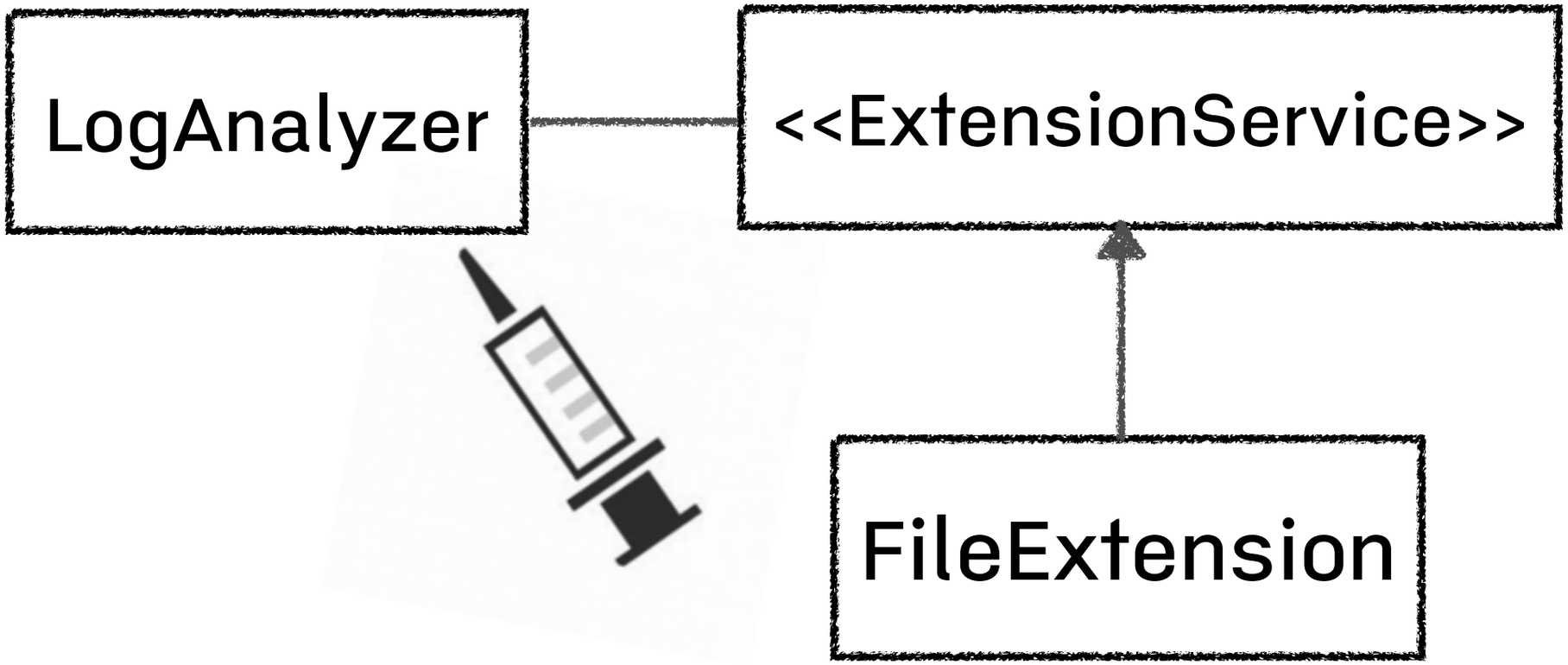


Demo & Discuss

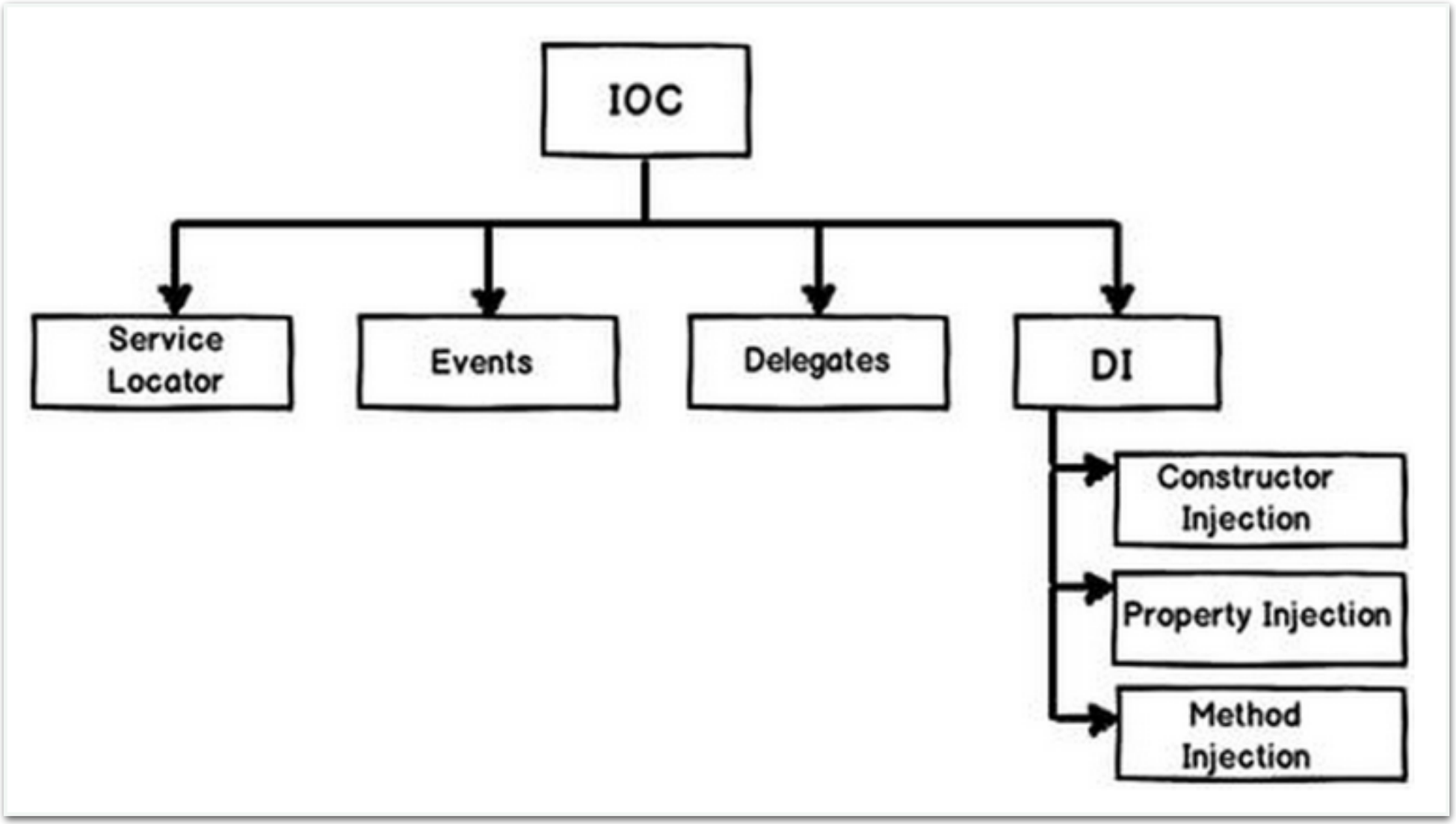
Dependency Inversion Principle (DIP)

How to use FileExtension ?

Loose coupling



Dependency Injection



Dependency Injection

Constructor Injection

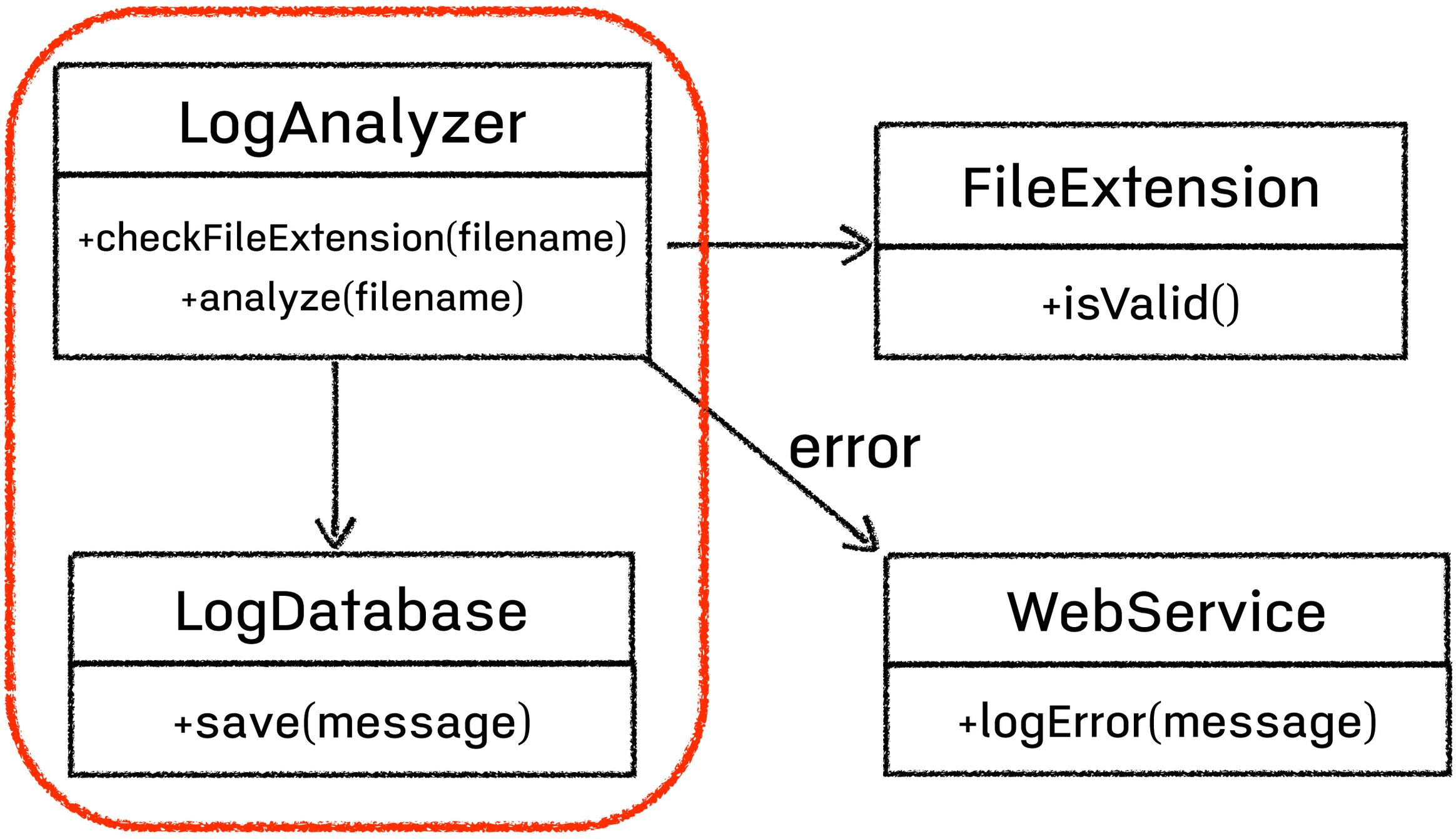
Property Injection

Method Injection

Demo & Discuss

Dependency Injection of LogAnalyzer

Workshop


LogAnalyzer
+checkFileExtension(filename)
+analyze(filename)
FileExtension
+isValid()
error
LogDatabase
+save(message)
WebService
+logError(message)

Workshop #7

Stub with Database

SPRINT3R

Siam Chamnankit Co., Ltd., Odd-e (Thailand) Co., Ltd. and Alliance

Discuss

About value of Stub database !!

Problem

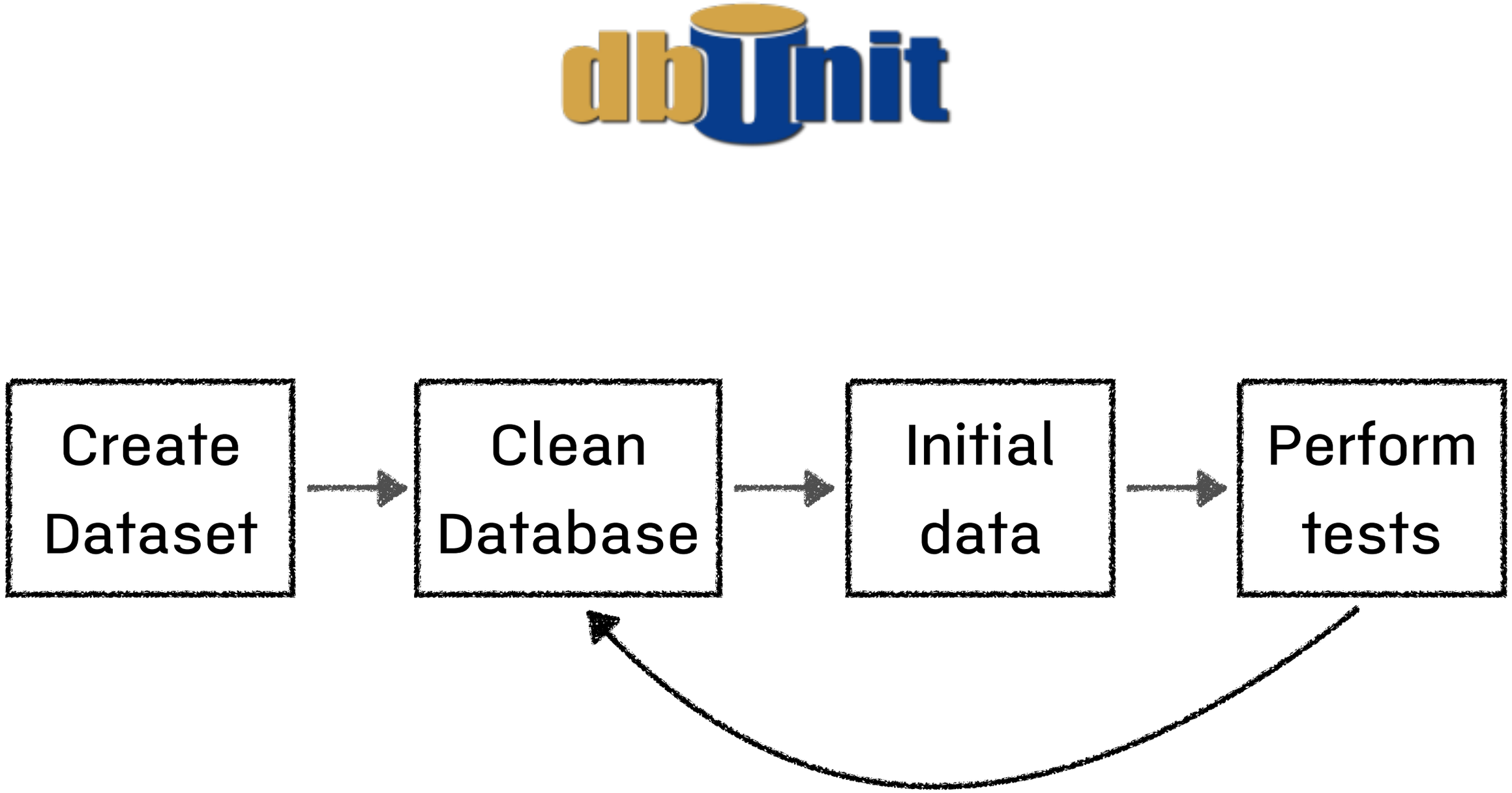
เมื่อทำการเปลี่ยน Schema database ?

ใช้ database จะมีคณค่ากว่า stub ไหม ?

Fake Database with

SPRINT3R

Siam Chamnankit Co., Ltd., Odd-e (Thailand) Co., Ltd. and Alliance


Create Dataset
Clean Database
Initial data
Perform tests

Supported Database

Oracle

Hypersonic

Microsoft SQL Server

H2

Sybase

PostgreSQL

MySQL

Informix

DB2

Derby

DBUnit Components

Database Connection

DataSet

DatabaseOperation

NONE	REFRESH
INSERT	TRUNCATE_TABLE
UPDATE	CLEAN_INSERT = delete_all + insert
DELETE	
DELETE_ALL	

XML and POJO

```java
public class Log {

    private Long id;
    private String code;
    private String message;
```

```xml
<dataset>
  <LOG ID="1" CODE="200"  MESSAGE="success"/>
  <LOG ID="2" CODE="404"  MESSAGE="data not found"/>
</dataset>
```

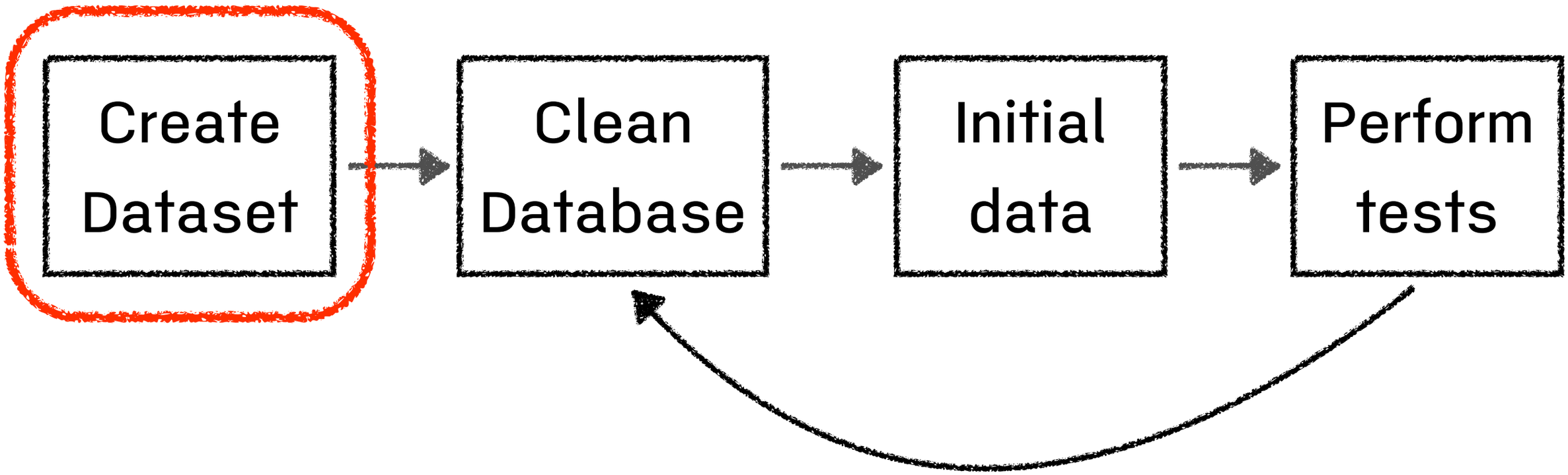
Workshop #8

Fake Database
with

SPRINT3R

Siam Chamnankit Co., Ltd., Odd-e (Thailand) Co., Ltd. and Alliance

Step 1 :: Create dataset



Database schema

schema_log.sql

```
create table if not exists LOG (
  ID int identity primary key,
  CODE varchar,
  MESSAGE   varchar
);
```

Database schema

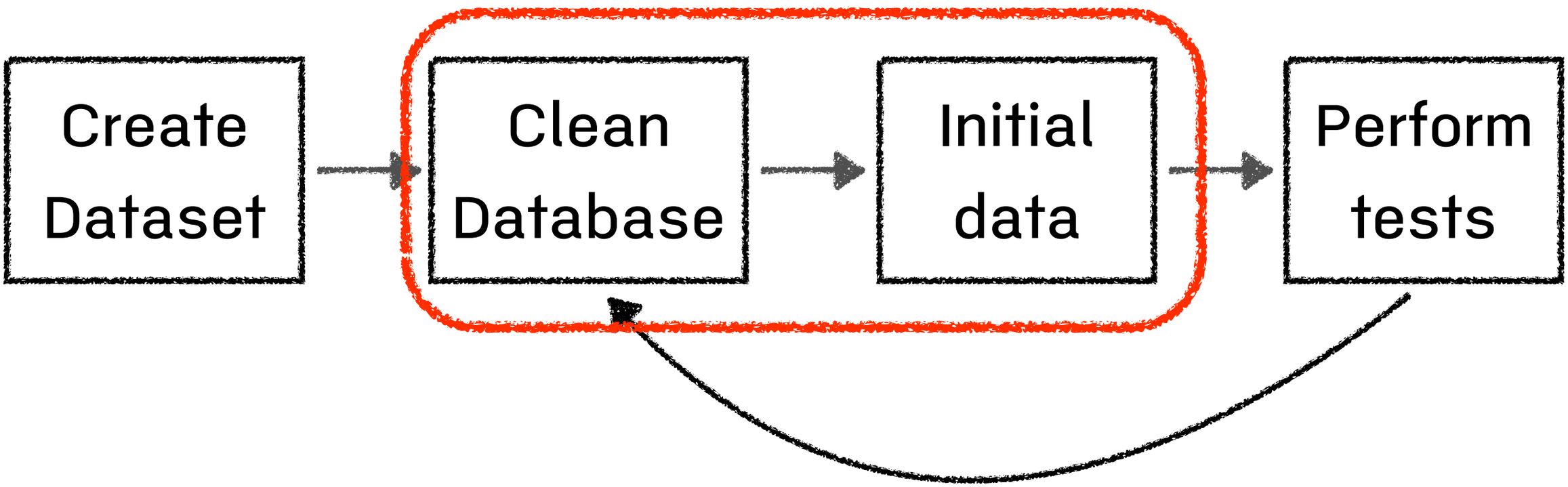
```
public class DBTest {

    private static final String JDBC_DRIVER = org.h2.Driver.class.getName();
    private static final String JDBC_URL = "jdbc:h2:mem:test;DB_CLOSE_DELAY=-1";
    private static final String USER = "sa";
    private static final String PASSWORD = "";
    private static final String UTF8 = "UTF8";

    @BeforeClass
    public static void createSchema() throws Exception {
        RunScript.execute(JDBC_URL, USER, PASSWORD,
                          "src/com/tdd/db/schema_log.sql",
                          Charset.forName(UTF8), false);
    }
```

Dataset as XML

data_log.xml

```
<dataset>
  <LOG ID="1" CODE="200"  MESSAGE="success"/>
  <LOG ID="2" CODE="404"  MESSAGE="data not found"/>
</dataset>
```

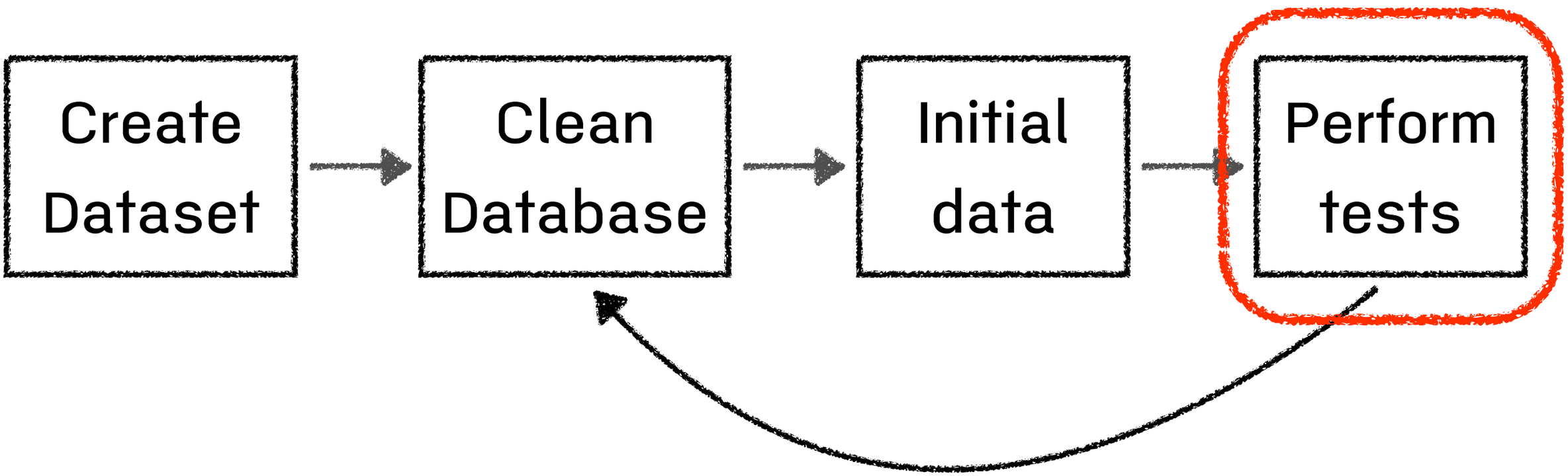
Step 2 :: Clean & Initial database



Clean & Initial database

```
@Before
public void importDataSet() throws Exception {
    IDataSet dataSet = readDataSet();
    cleanlyInsert(dataSet);
}

private IDataSet readDataSet() throws Exception {
    return new FlatXmlDataSetBuilder().build(new File("src/com/tdd/db/data_log.xml"));
}

private void cleanlyInsert(IDataSet dataSet) throws Exception {
    IDatabaseTester databaseTester = new JdbcDatabaseTester(JDBC_DRIVER, JDBC_URL,
                                                            USER, PASSWORD);
    databaseTester.setSetUpOperation(DatabaseOperation.CLEAN_INSERT);
    databaseTester.setDataSet(dataSet);
    databaseTester.onSetup();
}
```

Step 3 :: Perform test



How to perform test ?

```
@Test
public void shouldSuccessWhenAddNewOneLogMessage() throws Exception {
    LogDAO logDAO = new LogDAO(getDataSource());
    boolean actualResult = logDAO.insert(new Log("200", "Success"));
    assertTrue("Add new log message to database is suceed", actualResult);
}
```

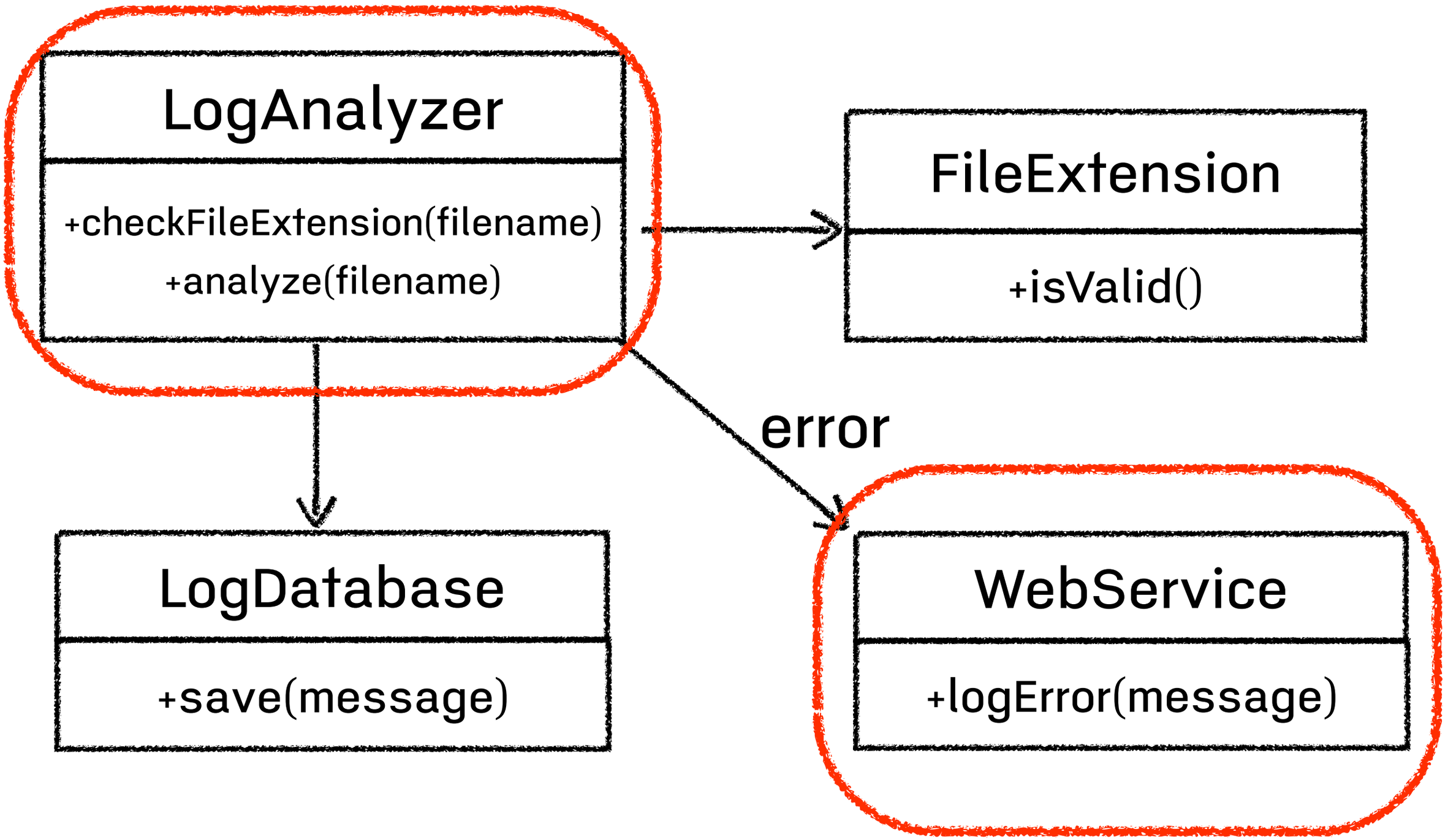
Create database connection

```
private DataSource getDataSource() {
    JdbcDataSource dataSource = new JdbcDataSource();
    dataSource.setURL(JDBC_URL);
    dataSource.setUser(USER);
    dataSource.setPassword(PASSWORD);
    return dataSource;
}
```

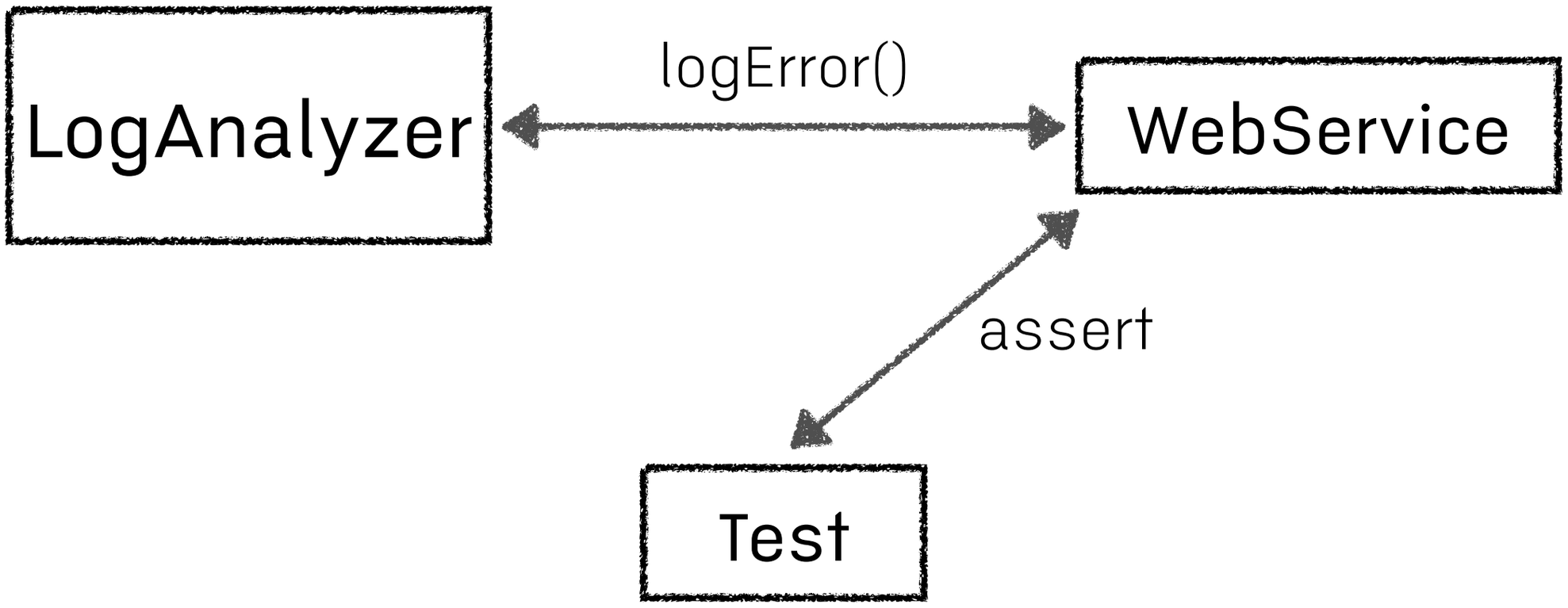
Implement LogDAO

```
public class LogDAO {

    private DataSource dataSource;

    public LogDAO(DataSource dataSource) {
        this.dataSource = dataSource;
    }

    public boolean insert(Log log) throws Exception{
        String sql = "INSERT INTO LOG(CODE, MESSAGE) VALUES(?, ?)";
        PreparedStatement preparedStatement =
                dataSource.getConnection().prepareStatement(sql);
        preparedStatement.setString(1, log.getCode());
        preparedStatement.setString(2, log.getMessage());
        return preparedStatement.executeUpdate() == 1 ? true : false;
    }

}
```

Workshop


LogAnalyzer
+checkFileExtension(filename)
+analyze(filename)
FileExtension
+isValid()
error
LogDatabase
+save(message)
WebService
+logError(message)

Mock object



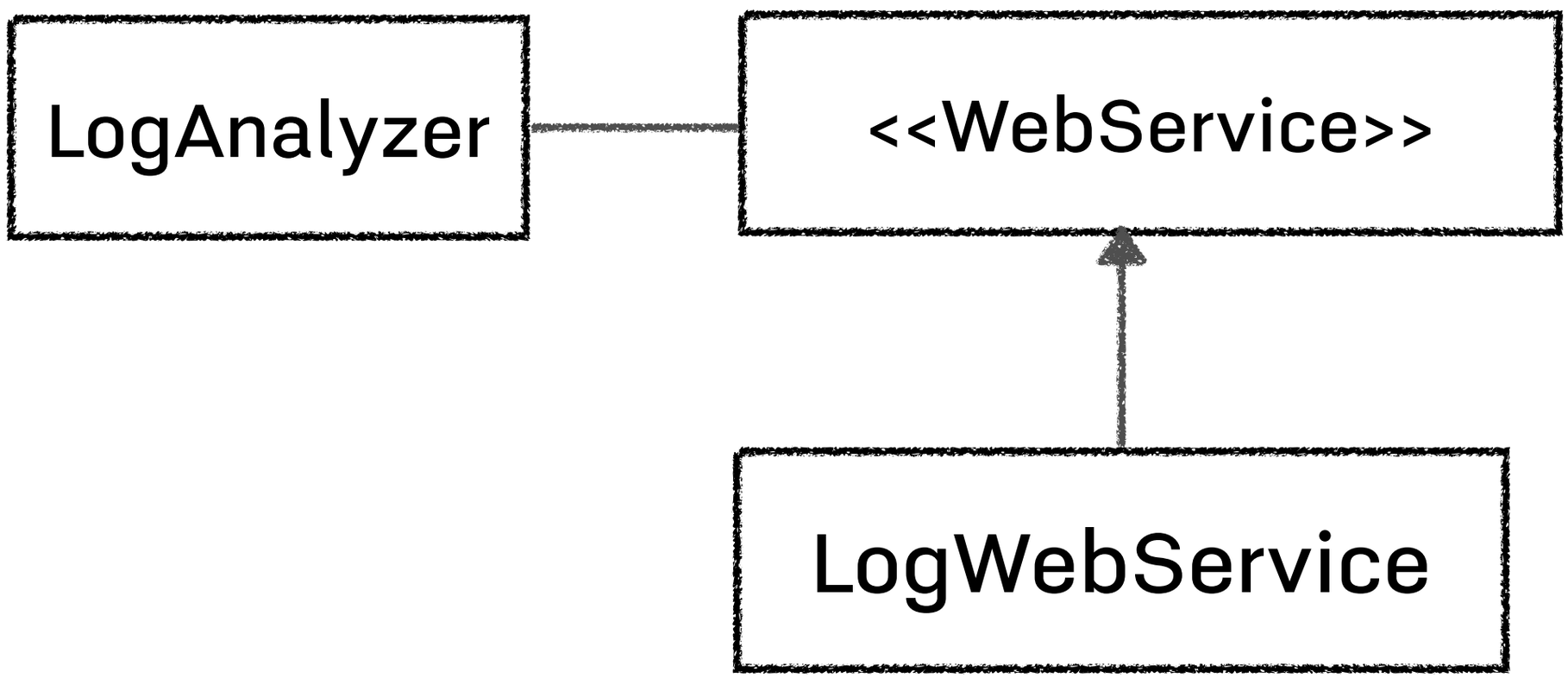
Workshop #9

Mock object with WebService

SPRINT3R

Siam Chamnankit Co., Ltd., Odd-e (Thailand) Co., Ltd. and Alliance

Step 1 :: Break dependency



Step 2 :: Write test

```
@Test
public void analyzeTooShortFilenameThenCallWebService(){
    MockService mockService = new MockService();
    LogAnalyzer logAnalyzer = new LogAnalyzer(mockService);
    String tooShortFilename = "abc.txt";

    logAnalyzer.analyze(tooShortFilename);

    assertEquals("File name is too short:abc.txt", mockService.getLastErrorMessage());
}
```

Step 3 :: Write code

Start coding by your pair

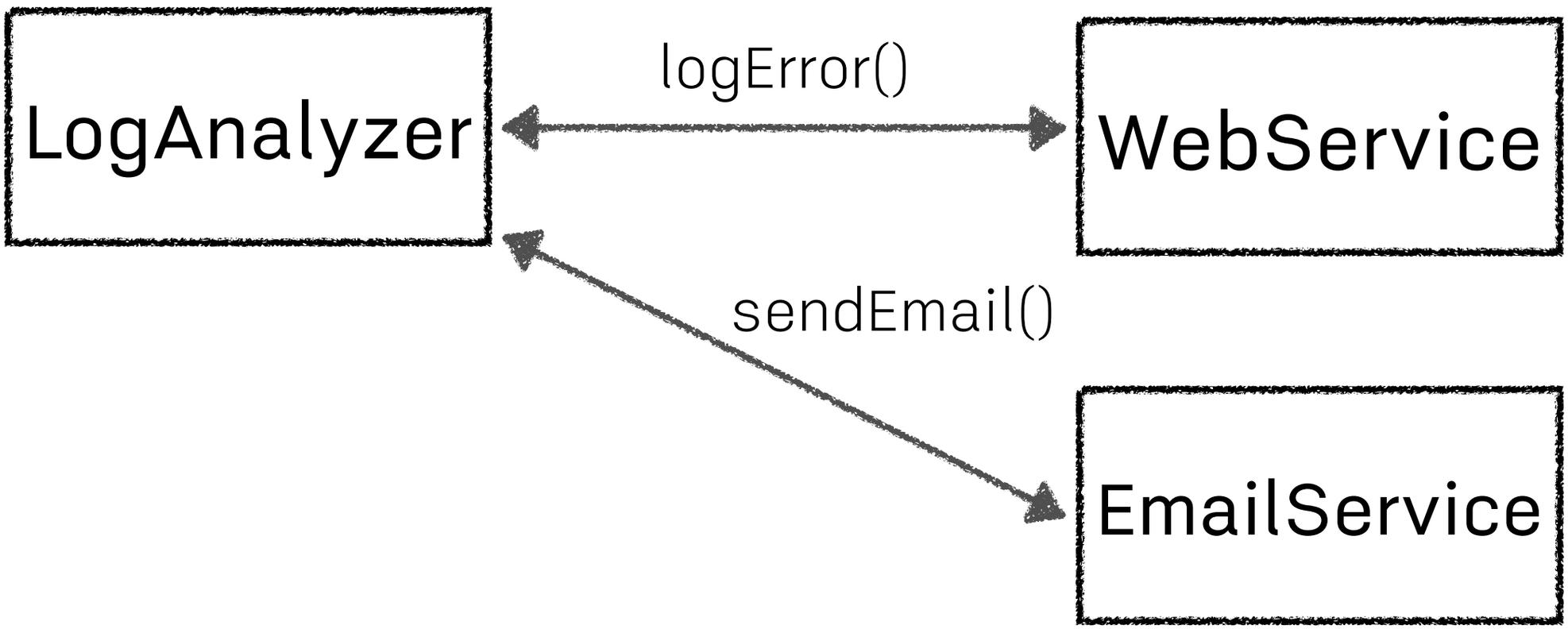
Workshop #10

Using Mock object and stub together

SPRINT3R

Siam Chamnankit Co., Ltd., Odd-e (Thailand) Co., Ltd. and Alliance

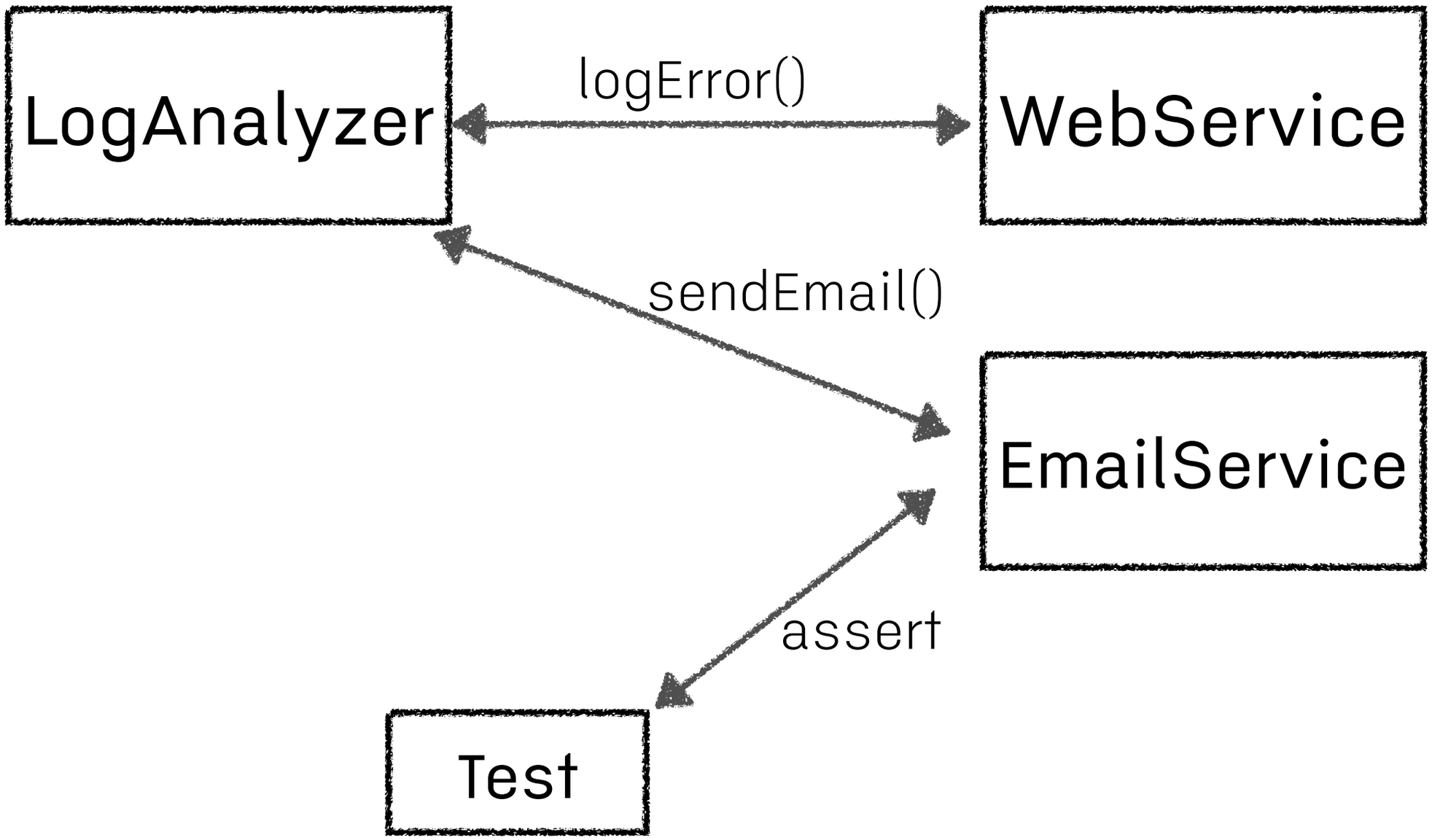
Problem


LogAnalyzer
logError()
WebService
sendEmail()
EmailService

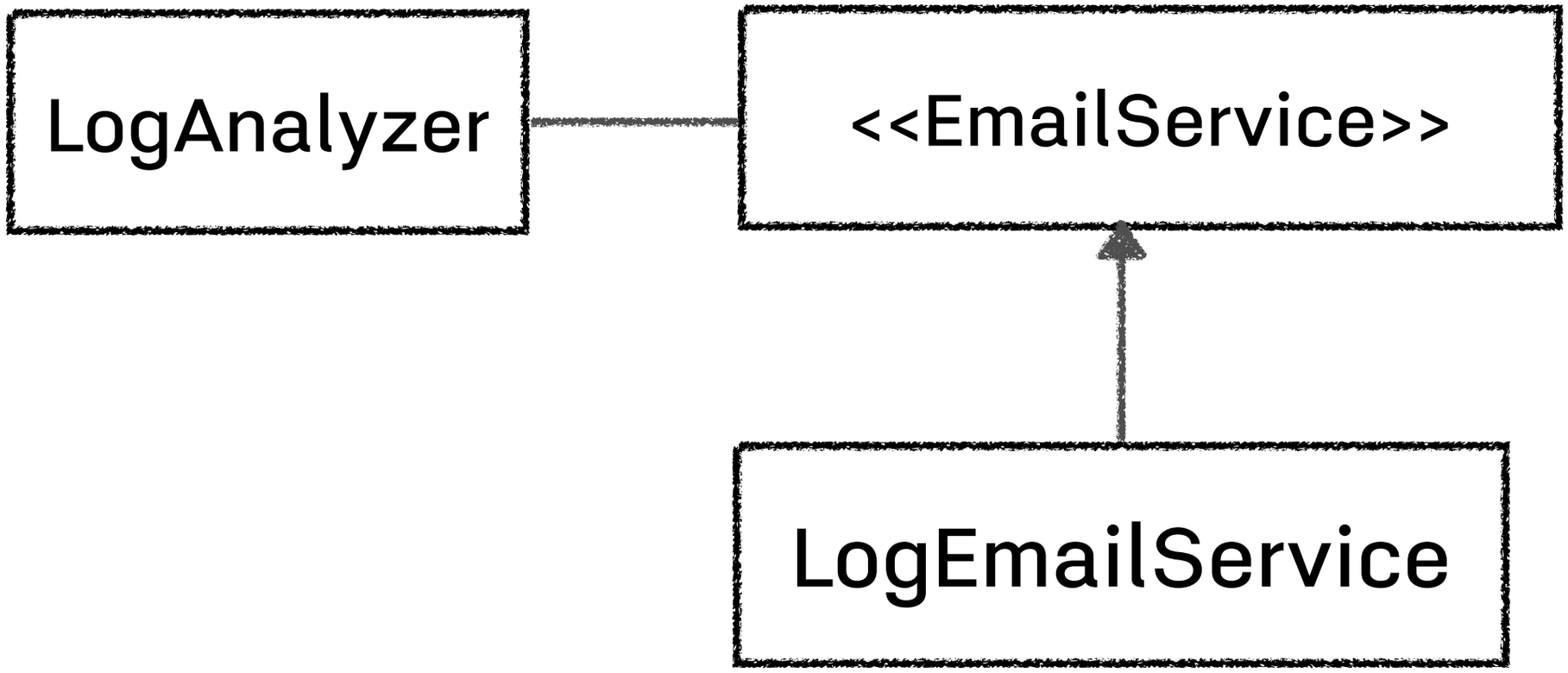
Send Email with expected input ?

```
public void analyze(String filename) {
    if (filename.length() < 8) {
        try {
            this.webService.logError("File name is too short:" + filename);
        } catch (Exception exception) {
            this.emailService.sendEmail("TO", "SUBJECT", exception.getMessage());
        }
    }
}
```

Problem


LogAnalyzer
logError()
WebService
sendEmail()
EmailService
assert
Test

Step 1 :: Break dependency



Step 2 :: Write test

```
@Test
public void analyzeWebServiceThrowsErrorThenSendEmail() throws Exception {
    StubWebService stubWebService = new StubWebService();
    MockEmailService mockEmailService = new MockEmailService();

    LogAnalyzer logAnalyzer = new LogAnalyzer();
    logAnalyzer.setWebService(stubWebService);
    logAnalyzer.setEmailService(mockEmailService);

    logAnalyzer.analyze("abc.txt");

    assertEquals("TO", mockEmailService.getTo());
    assertEquals("SUBJECT", mockEmailService.getSubject());
    assertEquals("Fake exception", mockEmailService.getBody());
}
```

Step 3 :: Write code

Start coding by your pair

Mock Framework

Mockito

Lightweight Java mocking

★ Enable mock creation

★ Enable verification

★ Enable stubbing

https://github.com/mockito/mockito

ฝึก ฝึก ฝึก และ ฝึก

Resources

https://github.com/github-sprint3r/tdd-java-workshop