Ingineria Programării

Cursul 6 – 23 Martie 2020

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Cuprins

- Din Cursurile trecute…
- SOLID Principles
- Design Patterns
  - Definitions
  - Elements
  - Example
  - Classification
- JUnit Testing
  - Netbeans (Exemplu 1)
  - Eclipse (Exemplu 2)

Din Cursurile Trecute

- Etapele Dezvoltării Programelor
- Ingineria Cerinţelor
- Diagrame UML
- SOLID
- GRASP

R – GRASP

- Principii, responsabilități
- Information Expert
- Creator
- Low Coupling
- High Cohesion
- Controller

R – SOLID and Other Principles

- SOLID Principles
  - SRP – Single Responsibility Principle
  - OCP – Open/Closed Principle
  - LSP – Liskov Substitution Principle
  - ISP – Interface Segregation Principle
  - DIP – Dependency Inversion Principle
- DRY – Don't Repeat Yourself
- YAGNI – You Aren't Gonna Need It
- KISS – Keep It Simple, Stupid

Cuprins

- Din Cursurile trecute…
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  - Definitions
  - Elements
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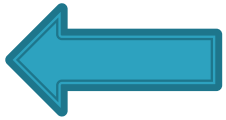


Design Patterns – Why?

- **If a problem occurs over and over again**, a solution to that problem has been used effectively (solution = pattern)

- When you make a design, you **should know the names of some common solutions**. Learning design patterns is good for people to **communicate each other effectively**

Design Patterns – Definitions

- "Design patterns capture solutions that have developed and evolved over time" (GOF – ***Gang-Of-Four*** (because of the four authors who wrote it), *Design Patterns: Elements of Reusable Object-Oriented Software)*

- **In software engineering (or computer science), a design pattern is a general repeatable solution to a commonly occurring problem in software design**

- The **design patterns** are language-independent strategies for solving common object-oriented design problems

Gang of Four

- Initial was the name given to a leftist political faction composed of four Chinese Communist party officials
- The name of the book (“Design Patterns: Elements of Reusable Object-Oriented Software”) is too long for e-mail, so “book by the gang of four” became a shorthand name for it
- That got shortened to "**GOF book**“. Authors are: *Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides*
- The **design patterns** in their book are *descriptions of communicating objects and classes that are customized to solve a general design problem in a particular context*

Design Patterns – Elements

1. Pattern name
2. Problem
3. Solution
4. Consequences

Design Patterns – Pattern name

- A handle **used to describe a design problem**, its solutions, and consequences in a word or two
- Naming a pattern immediately increases our **design vocabulary**. It lets us design at a higher level of abstraction
- Having a **vocabulary** for patterns lets us talk about them with our colleagues, in our documentation
- Finding good names has been one of the hardest parts of developing our catalog

Design Patterns – Problem

- Describes **when** to apply the pattern. It explains the problem and its **context**
- It might describe specific design problems such as how to represent **algorithms** as objects
- It might describe **class** or **object** structures that are symptomatic of an inflexible design
- Sometimes the problem will include a **list of conditions** that must be met before it makes sense to apply the pattern

Design Patterns – Solution

- Describes the elements that make up the **design, their relationships, responsibilities,** and **collaborations**
- The solution **doesn't describe a particular concrete design or implementation**, because a pattern is like a template that can be applied in many different situations
- Instead, the pattern provides an **abstract description of a design problem** and **how** a general arrangement of elements (classes and objects in our case) **solves it**

Design Patterns – Consequences

- Are the results and trade-offs of applying the pattern
- They are critical for **evaluating design alternatives** and for **understanding the costs and benefits** of applying the pattern
- The consequences for software often concern **space** and **time trade-offs**, they can address **language and implementation issues** as well
- Include its impact on a system's **flexibility, extensibility, or portability**
- Listing these consequences explicitly helps you **understand and evaluate** them

Example of (Micro) pattern

- **Pattern name**: Initialization
- **Problem**: It is important for some code sequence to be executed only once at the beginning of the execution of the program.
- **Solution**: The solution is to use a static variable that holds information on whether or not the code sequence has been executed.
- **Consequences**: The solution requires the language to have a static variable that can be allocated storage at the beginning of the execution, initialized prior to the execution and remain allocated until the program termination.

Describing Design Patterns 1

- **Pattern Name and Classification**
- **Intent** – the answer to question: *What does the design pattern do*?
- **Also Known As**
- **Motivation** – A scenario that illustrates a design problem and how the class and object structures in the pattern solve the problem
- **Applicability** – *What are the situations in which the design pattern can be applied*? *How can you recognize these situations*?
- **Related Patterns**

Describing Design Patterns 2

- **Structure** – A graphical representation of the classes in the pattern
- **Participants** – The classes and/or objects participating in the design pattern and their responsibilities
- **Collaborations** – How the participants collaborate to carry out their responsibilities
- **Consequences** – *How does the pattern support its objectives*?
- **Implementation** – *What techniques should you be aware of when implementing the pattern*?
- **Sample Code**
- **Known Uses** – Examples of the pattern found in real systems

Design Patterns – Classification

- **Creational patterns**
- **Structural patterns**
- **Behavioral patterns**
- NOT in GOF: Fundamental, Partitioning, GRASP, GUI, Organizational Coding, Optimization Coding, Robustness Coding, Testing, Transactions, Distributed Architecture, Distributed Computing, Temporal, Database, Concurrency patterns

Creational Patterns

- **Abstract Factory** groups object factories that have a common theme
- **Builder** constructs complex objects by separating construction and representation
- **Factory Method** creates objects without specifying the exact class to create
- **Prototype** creates objects by cloning an existing object
- **Singleton** restricts object creation for a class to only one instance
- Not in GOF book: Lazy initialization, Object pool, Multiton, Resource acquisition (is initialization)

Structural Patterns

- **Adapter** allows classes with incompatible interfaces to work together
- **Bridge** decouples an abstraction from its implementation so that the two can vary independently
- **Composite** composes zero-or-more similar objects so that they can be manipulated as one object.
- **Decorator** dynamically adds/overrides behavior in an existing method of an object
- **Facade** provides a simplified interface to a large body of code
- **Flyweight** reduces the cost of creating and manipulating a large number of similar objects
- **Proxy** provides a placeholder for another object to control access, reduce cost, and reduce complexity

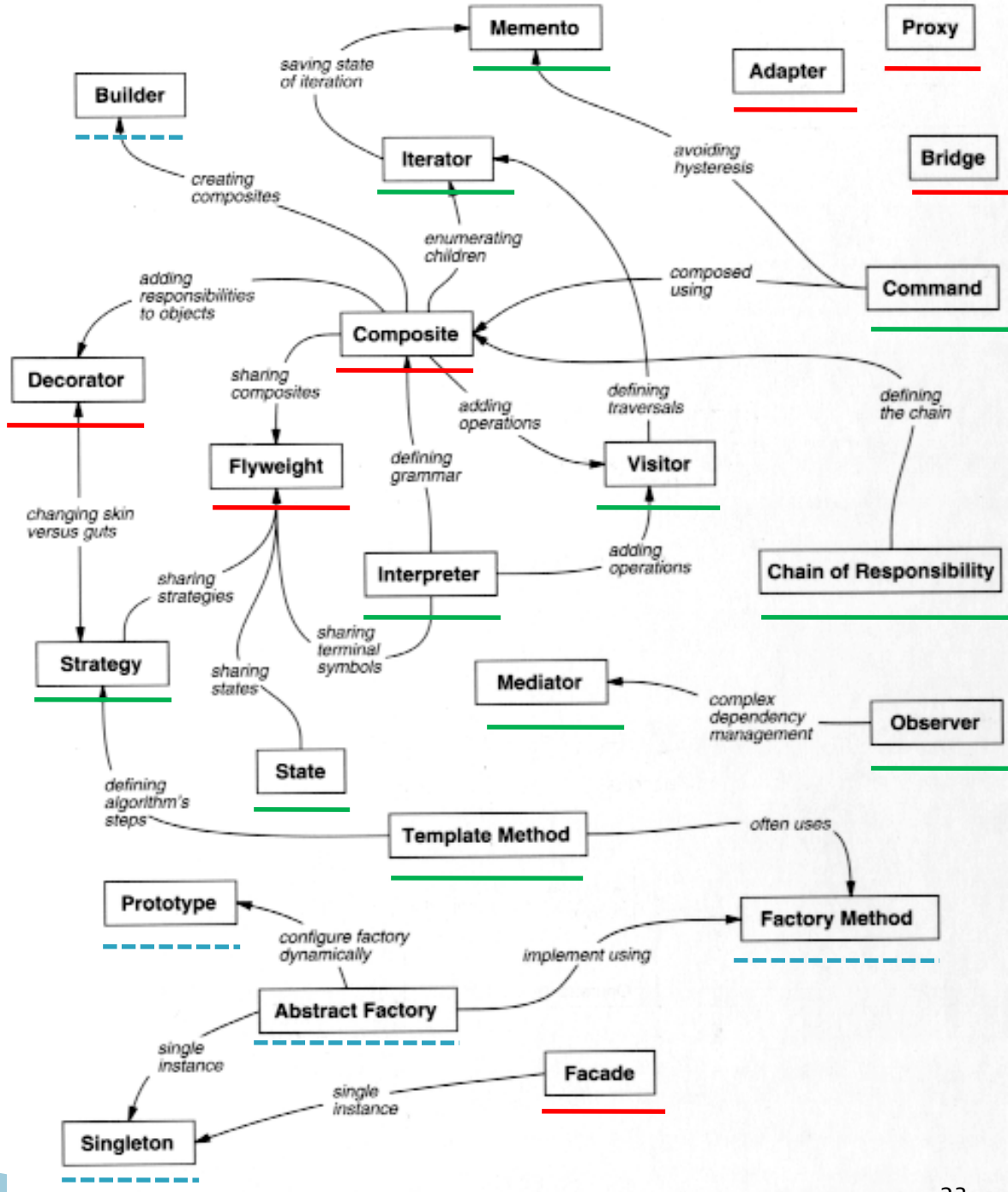
Behavioral patterns 1

- **Chain of responsibility** delegates commands to a chain of processing objects
- **Command** creates objects which encapsulate actions and parameters
- **Interpreter** implements a specialized language
- **Iterator** accesses the elements sequentially
- **Mediator** allows loose coupling between classes by being the only class that has detailed knowledge of their methods
- **Memento** provides the ability to restore an object to its previous state

Behavioral patterns 2

- **Observer** allows to observer objects to see an event
- **State** allows an object to alter its behavior when its internal state changes
- **Strategy** allows one of a family of algorithms to be selected on-the-fly at runtime
- **Template** defines an algorithm as an abstract class, allowing its subclasses to provide concrete behavior
- **Visitor** separates an algorithm from an object structure
- Not in GOF book: Null Object, Specification

- Patterns
  - Creational
  - Structural
  - Behavioral



Design Pattern Relationships

How to Select a Design Pattern?

- With more than 20 design patterns to choose from, it might be hard to find the one that addresses a particular design problem

- Approaches to finding the design pattern that's right for your problem:
  1. *Consider how design patterns solve design problems*
  2. *Scan Intent sections*
  3. *Study relationships between patterns*
  4. *Study patterns of like purpose (comparison)*
  5. *Examine a cause of redesign*
  6. *Consider what should be variable in your design*

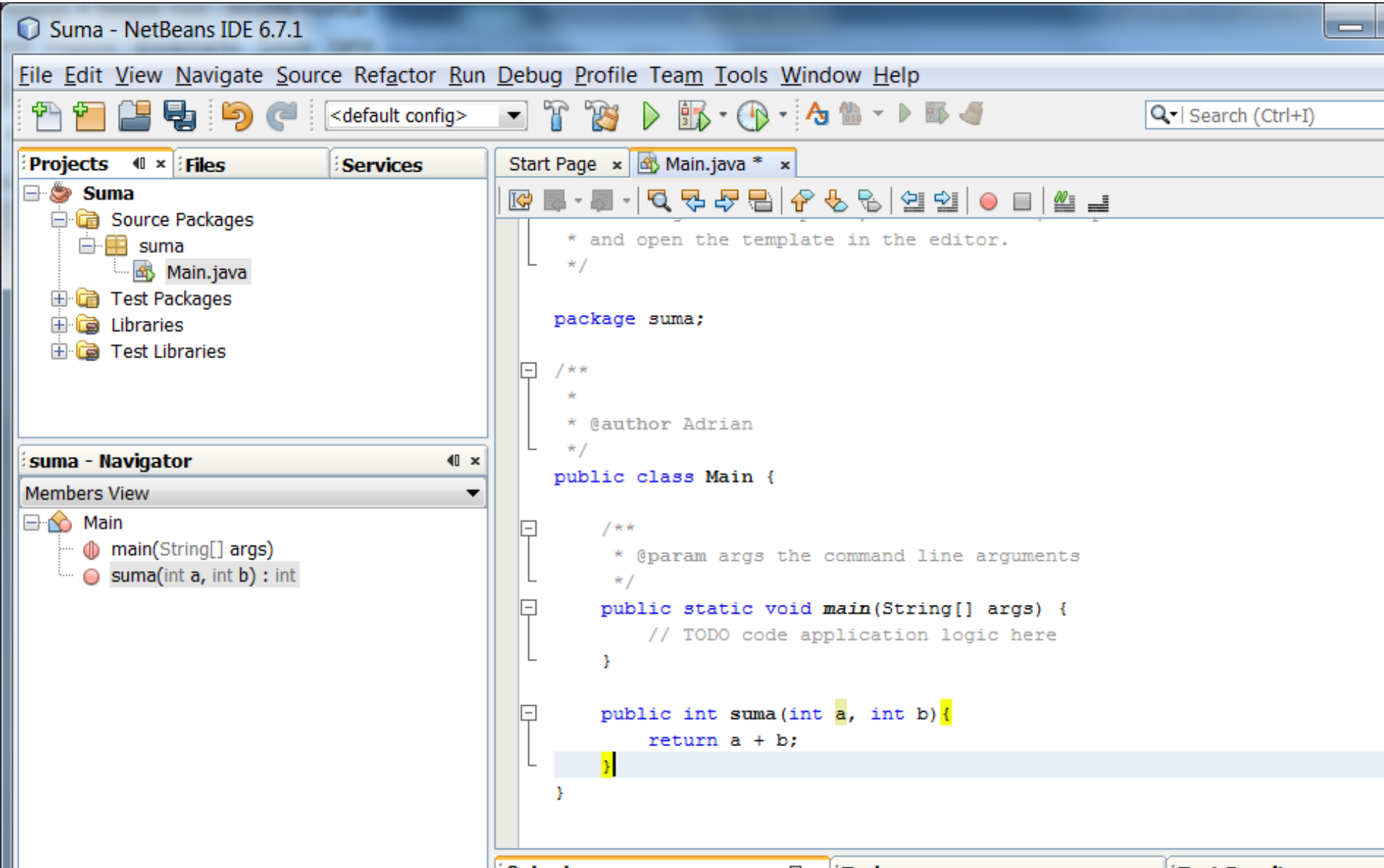
How to Use a Design Pattern?

1. *Read the pattern once through for an overview*
2. *Go back and study the Structure*, Participants, and Collaborations sections
3. *Look at the Sample Code section to see a concrete example*
4. *Choose names for pattern participants that are meaningful in the application context*
5. *Define the classes*
6. *Define application-specific names for operations in the pattern*
7. *Implement the operations to carry out the responsibilities and collaborations in the pattern*

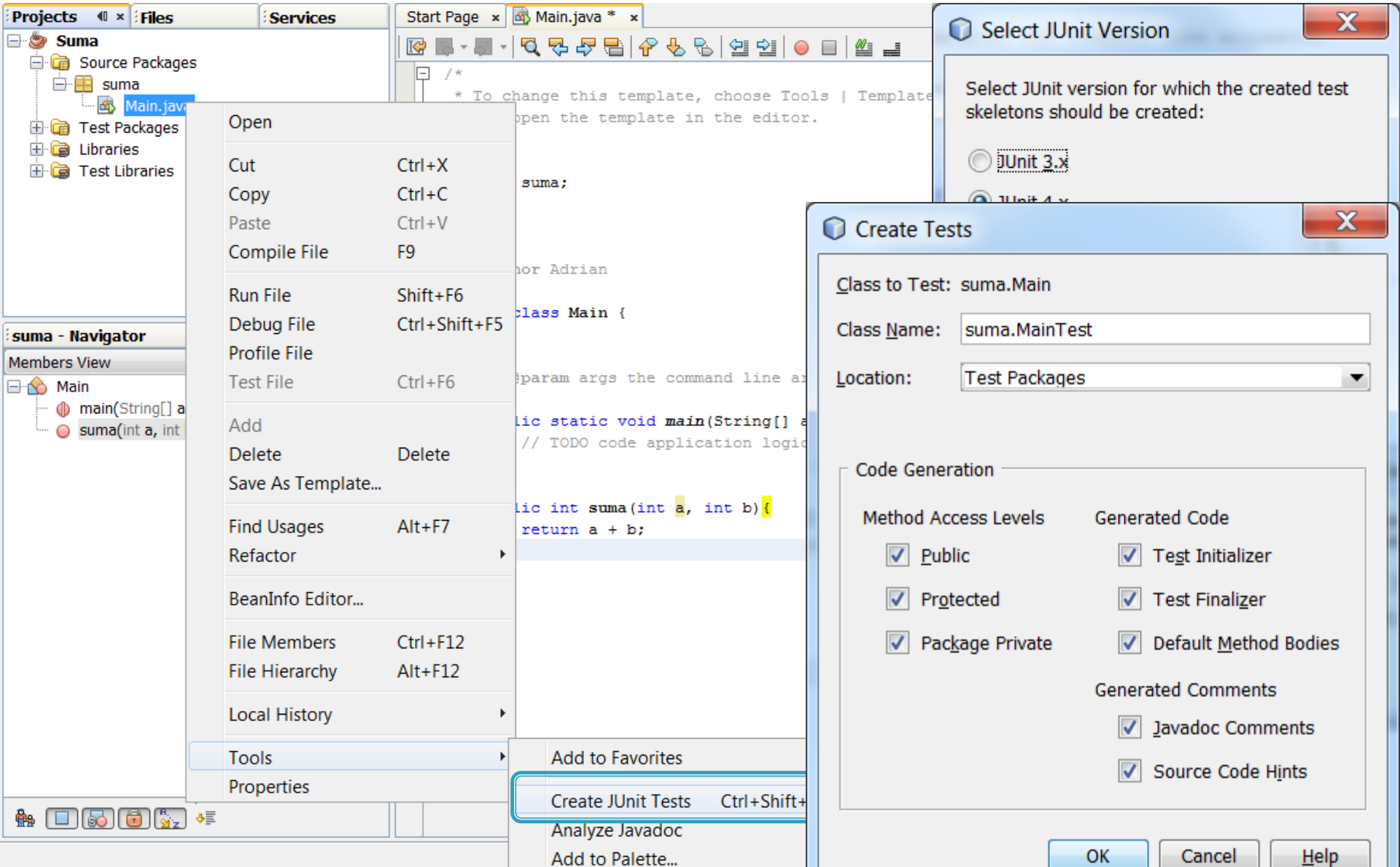
Unit Testing

- Testarea unei funcţii, a unui program, a unui ecran, a unei funcţionalităţi
- Se face de către programatori
- Predefinită
- Rezultatele trebuie documentate
- Se folosesc simulatoare pentru Input şi Output

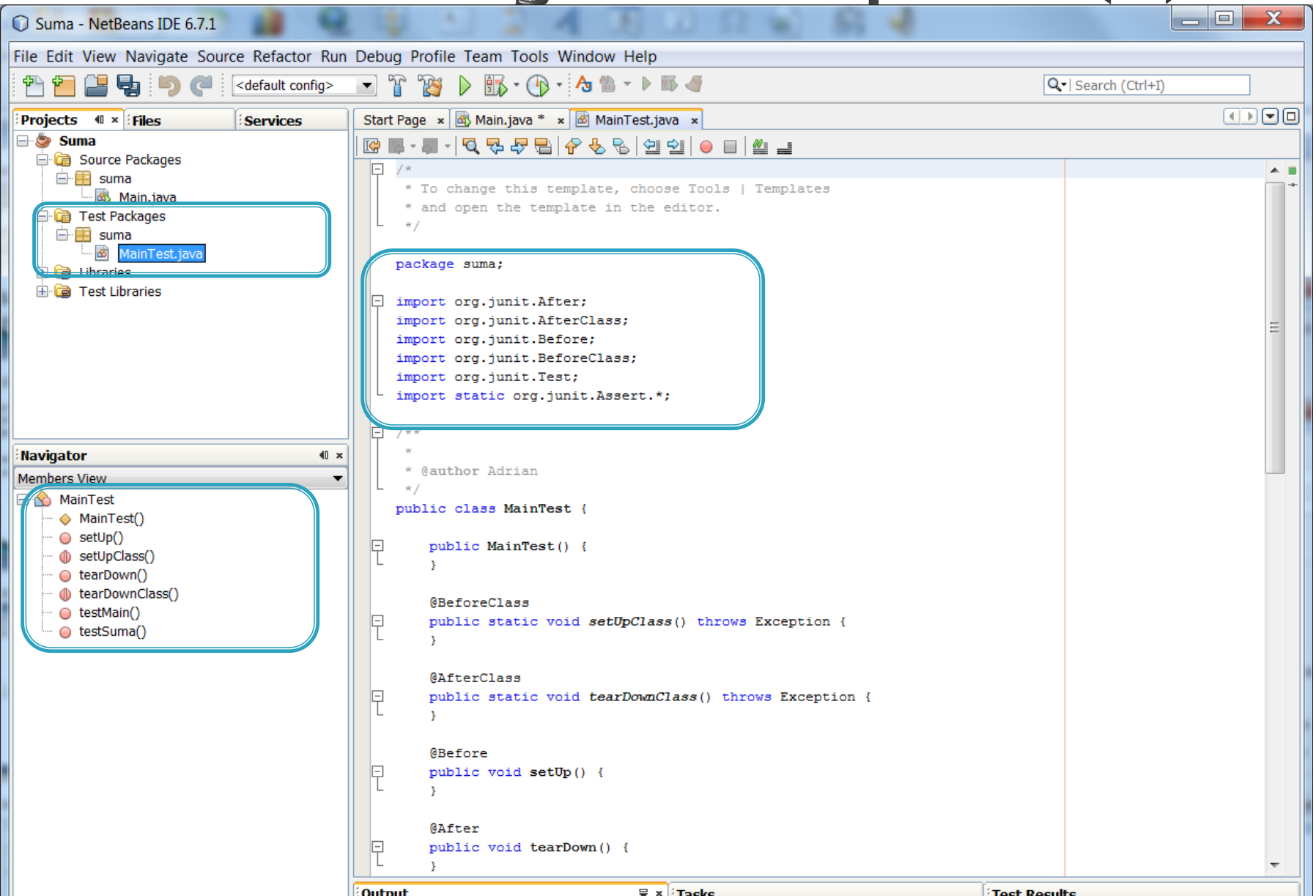
Unit Testing – Exemplu 1 (1)



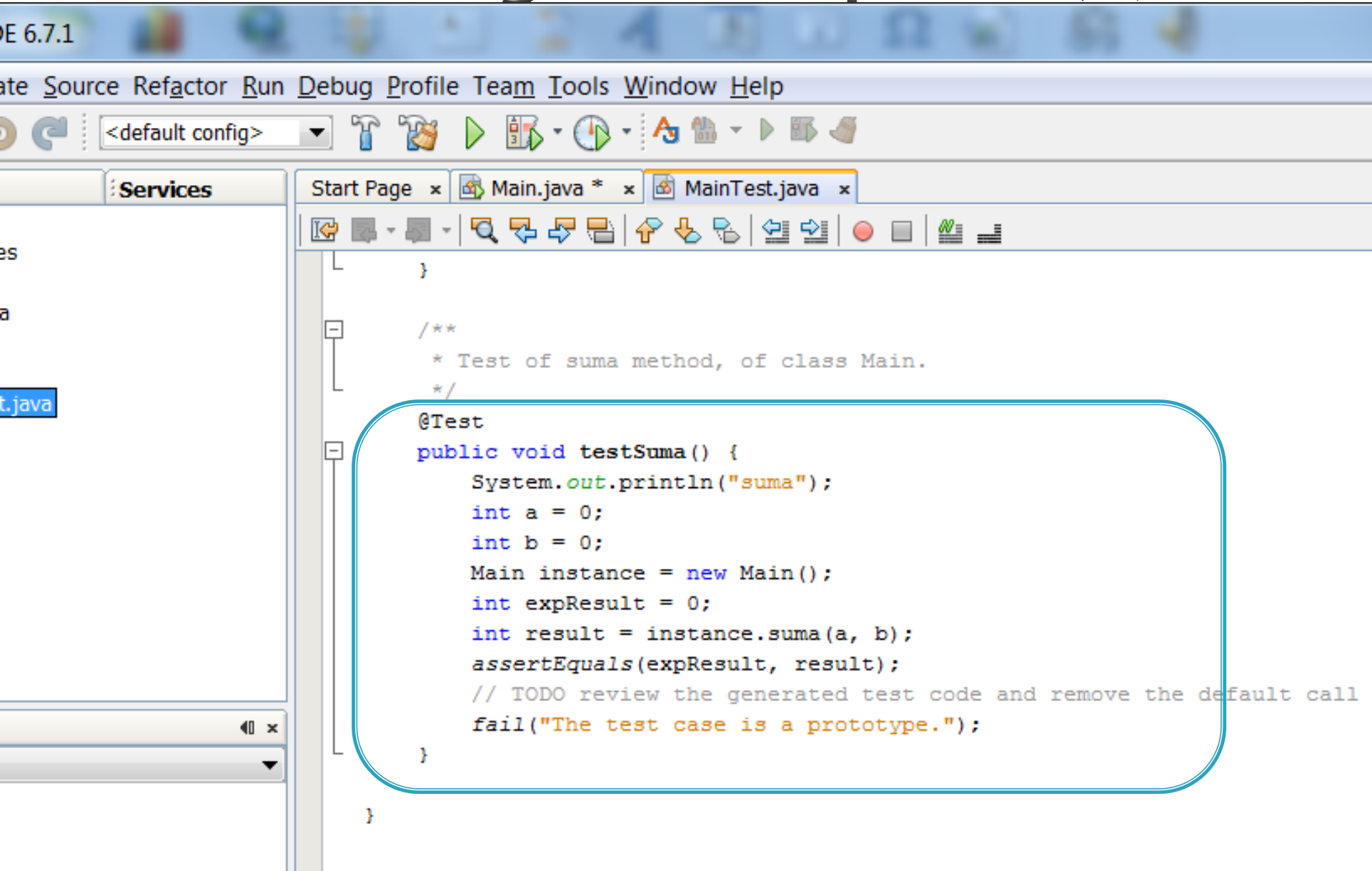
Unit Testing – Exemplu 1 (2)



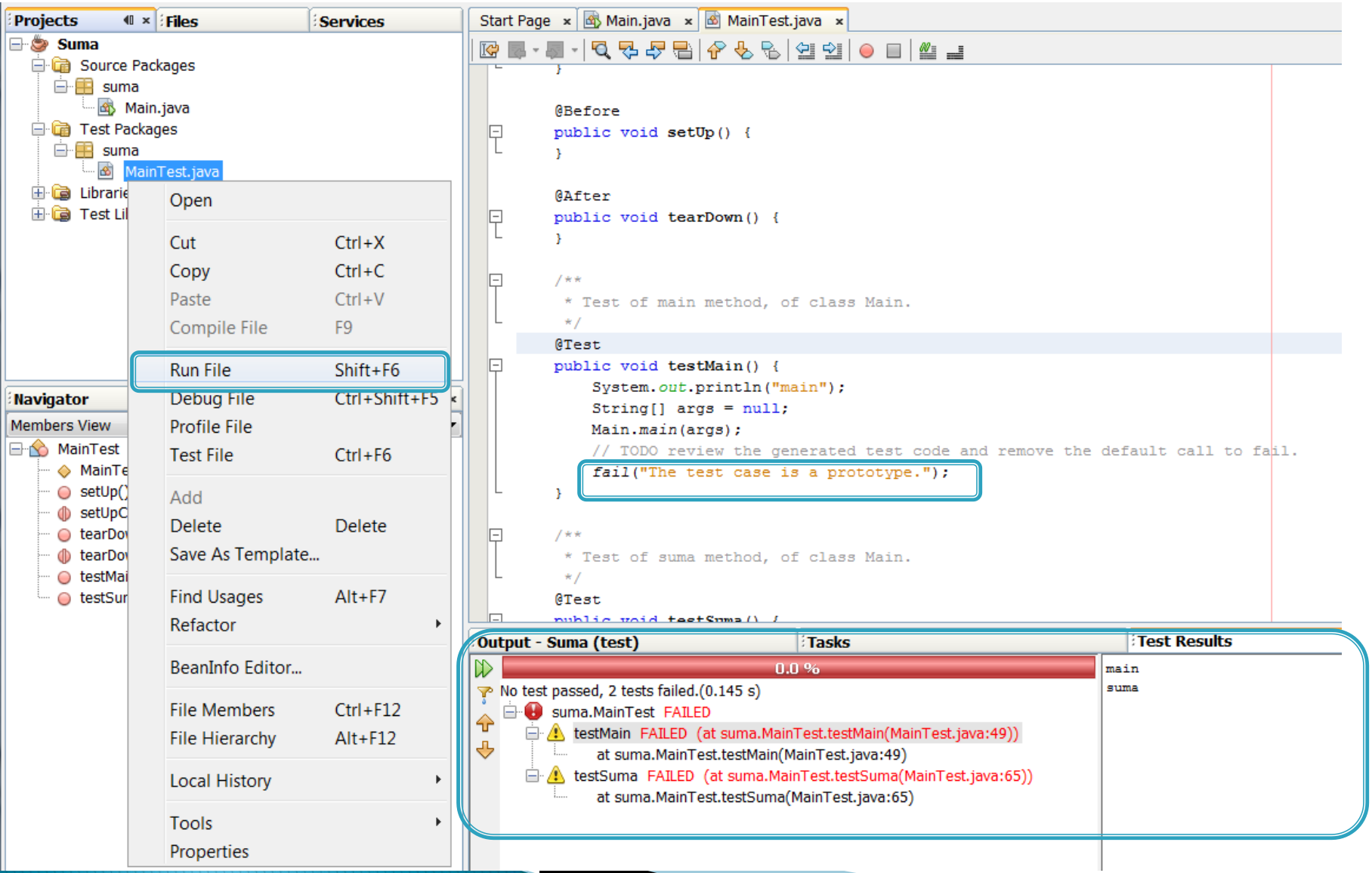
Unit Testing – Exemplu 1 (3)



Unit Testing – Exemplu 1 (4)

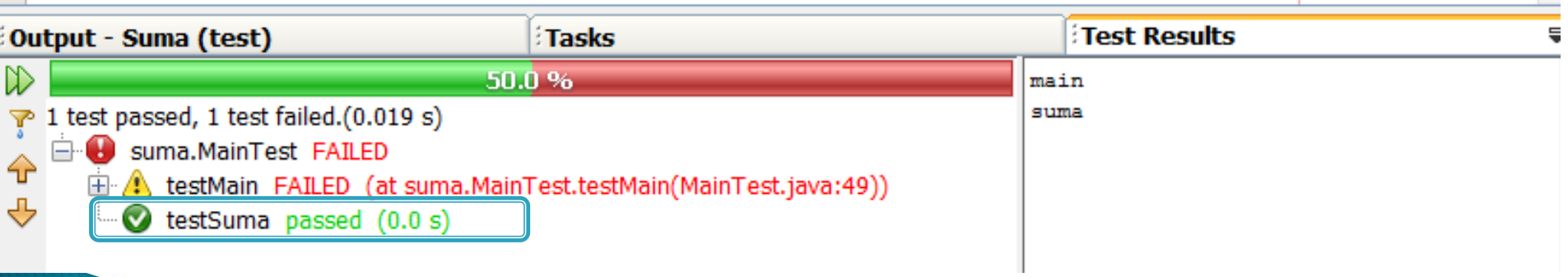


Unit Testing – Exemplu 1 (5)



Unit Testing – Exemplu 1 (6)

```
    @Test
    public void testSuma() {
        System.out.println("suma");
        int a = 0;
        int b = 0;
        Main instance = new Main();
        int expResult = 0;
        int result = instance.suma(a, b);
        assertEquals(expResult, result);
        // TODO review the generated test code and remove the default call to fail.
        //fail("The test case is a prototype.");
    }
}
```



Unit Testing – Example 2 (1)

BasicOperations.java | BasicOperationsTest.java

```
package math;

public class BasicOperations {

    public int add(int x, int y){
        return x + y;
    }

    public int min(int x, int y){
        return x + y;
    }

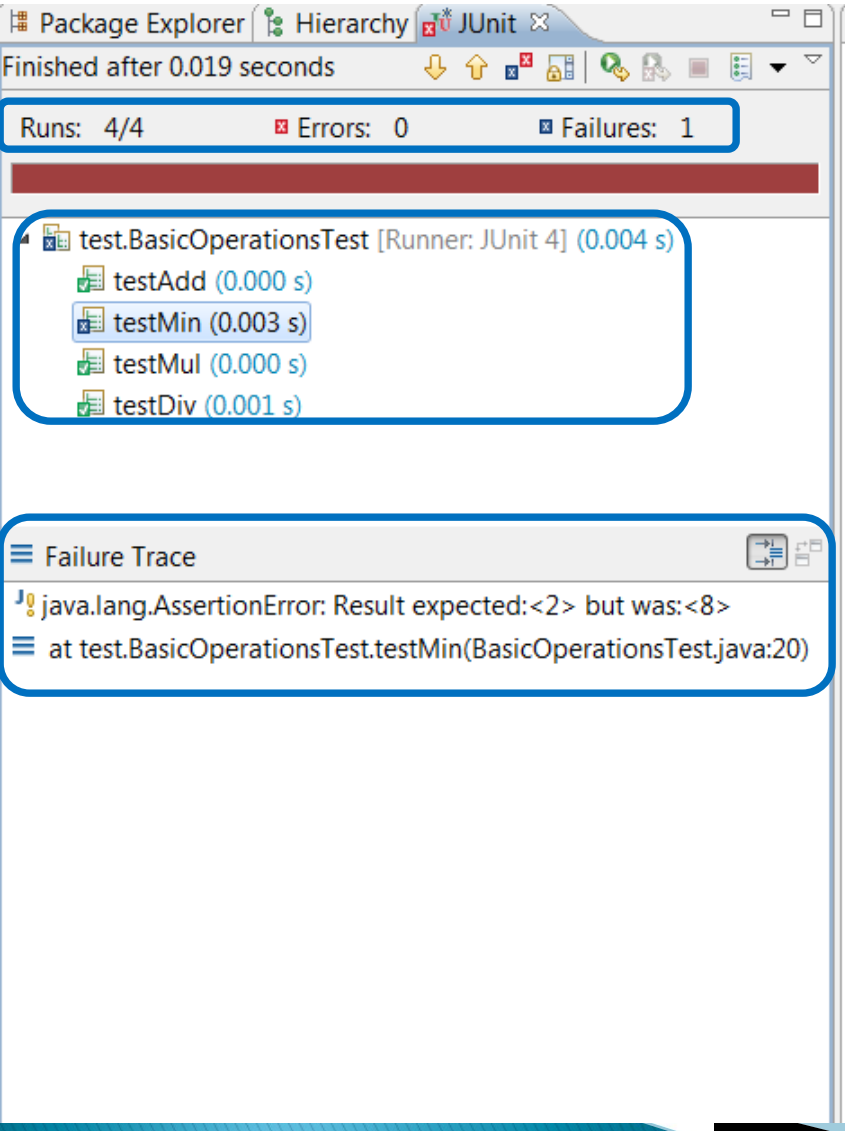
    public int mul(int x, int y){
        return x * y;
    }

    public int div(int x, int y){
        return x / y;
    }

    /**
     * @param args
     */
    public static void main(String[] args) {
        // TODO Auto-generated method stub
        BasicOperations bc = new BasicOperations();
        System.out.println(bc.add(3,5));
    }

}
```

Unit Testing – Example 2 (2)



BasicOperations.java | BasicOperationsTest.java

```
package test;

import static org.junit.Assert.*;

public class BasicOperationsTest {

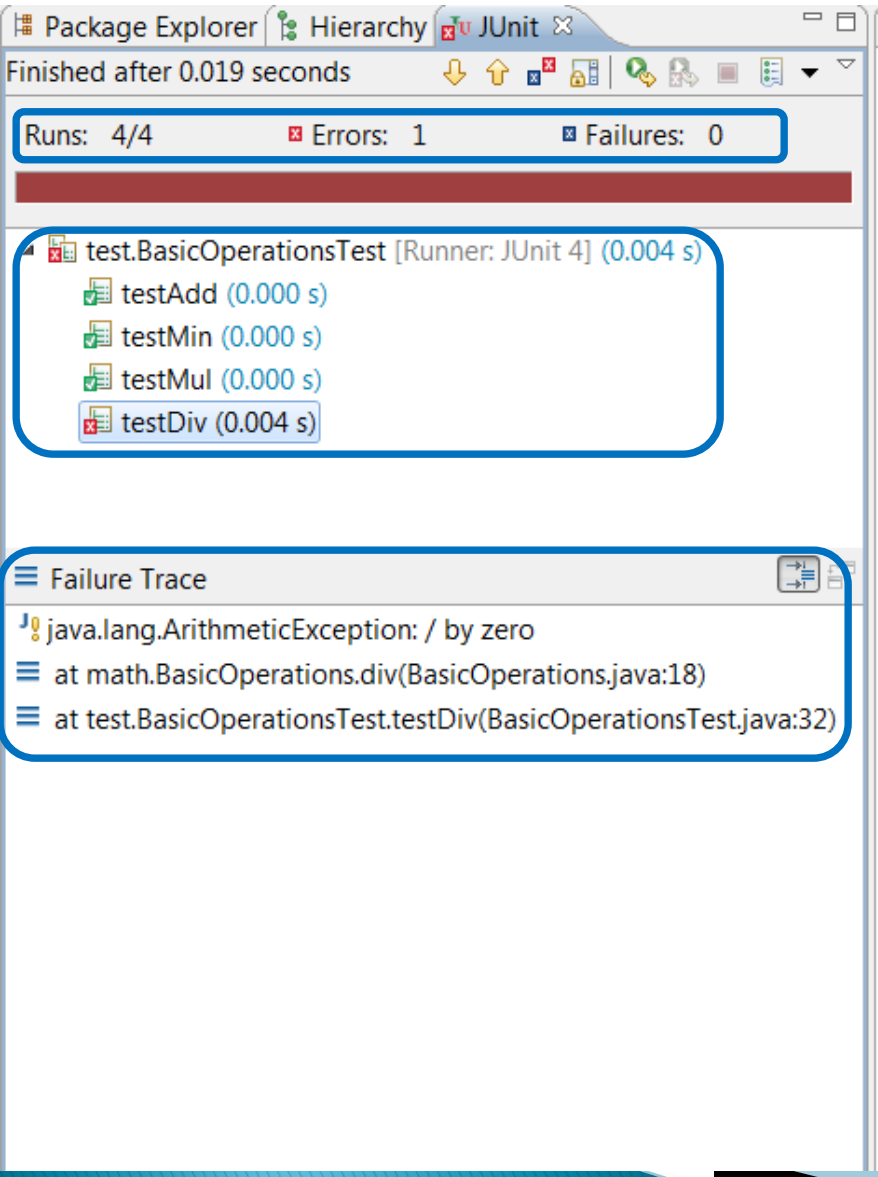
    @Test
    public void testAdd() {
        BasicOperations bo = new BasicOperations();
        assertEquals("Result", 8, bo.add(3, 5));
    }

    @Test
    public void testMin() {
        BasicOperations bo = new BasicOperations();
        assertEquals("Result", 2, bo.min(5, 3));
    }

    @Test
    public void testMul() {
        BasicOperations bo = new BasicOperations();
        assertEquals("Result", 15, bo.mul(3, 5));
    }

    @Test
    public void testDiv() {
        BasicOperations bo = new BasicOperations();
        assertEquals("Result", 2, bo.div(4, 2));
    }
}
```

Unit Testing – Example 2 (3)



BasicOperations.java | BasicOperationsTest.java

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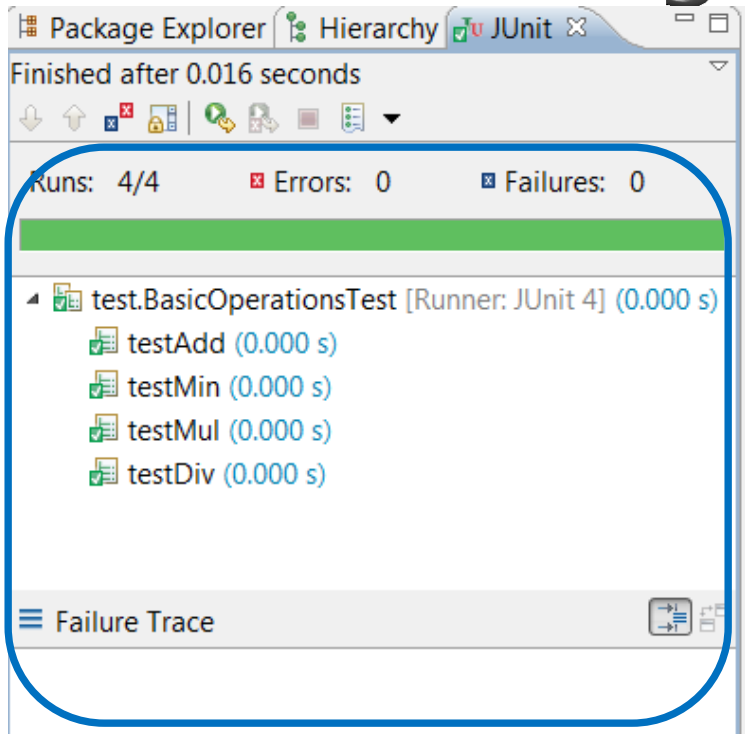
    }

    @Test
    public void testMul() {
        BasicOperations bo = new BasicOperations();
        assertEquals("Result", 15, bo.mul(3, 5));
    }

    @Test
    public void testDiv() {
        BasicOperations bo = new BasicOperations();
        assertEquals("Result", 0, bo.div(4, 0));
    }
}
```

Unit Testing – Example 2 (4)



BasicOperations.java | BasicOperationsTest.java

```
package test;

import static org.junit.Assert.*;

public class BasicOperationsTest {

    @Test
    public void testAdd() {
        BasicOperations bo = new BasicOperations();
        assertTrue("Result", 8 == bo.add(3, 5));
    }

    @Test
    public void testMin() {
        BasicOperations bo = new BasicOperations();
        assertFalse("Result", ! (3 != bo.min(5, 3)));
    }

    @Test
    public void testMul() {
        BasicOperations bo = new BasicOperations();
        assertEquals("Result", 15, bo.mul(3, 5));
    }

    @Test
    public void testDiv() {
        BasicOperations bo = new BasicOperations();
        if(bo.div(4, 2) == 3)
            fail("Incorrect result!");
    }
}
```

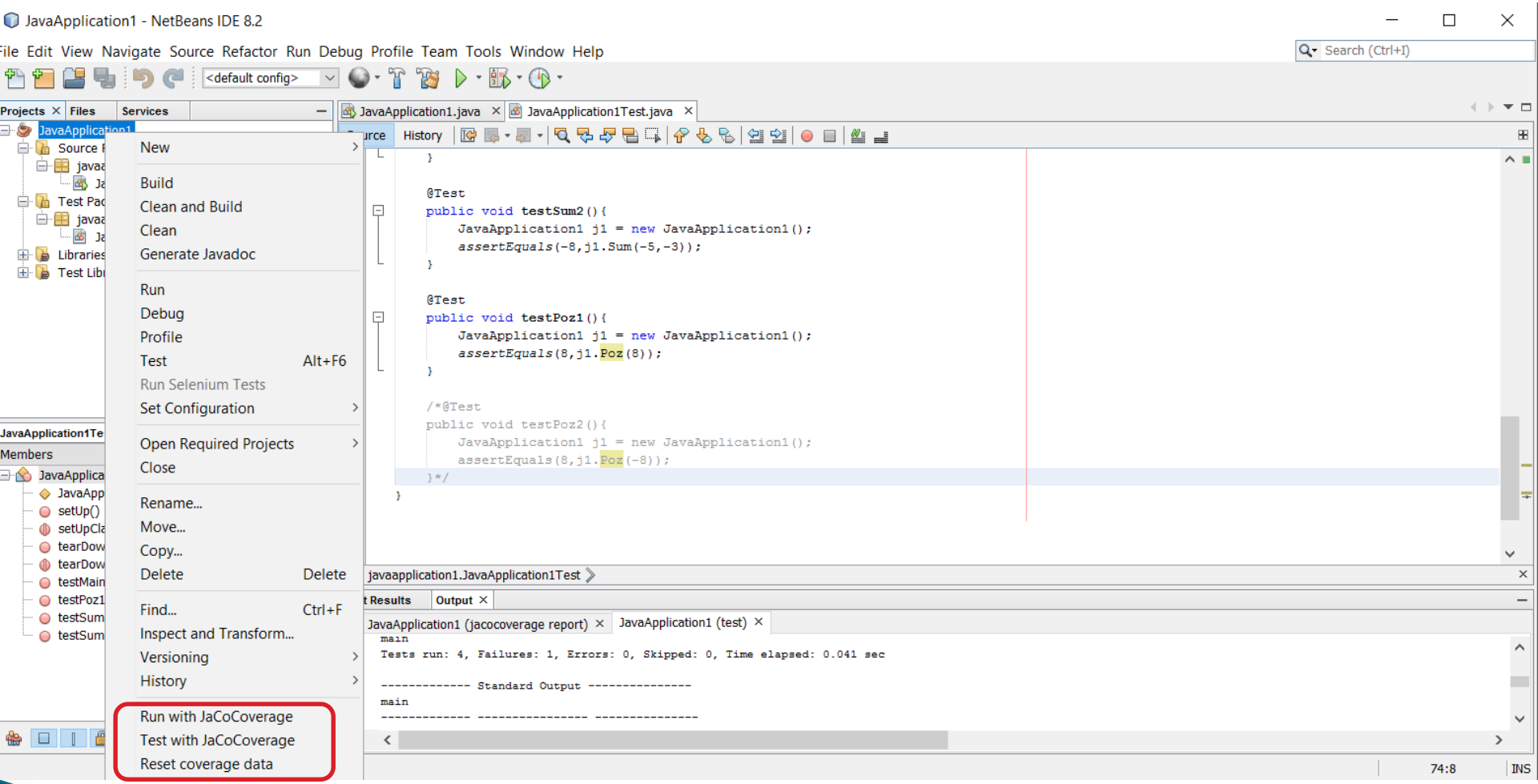
Code Coverage

- NetBeans – TikiOne JaCoCoverage:
- http://plugins.netbeans.org/plugin/48570/tikione-jacocoverage

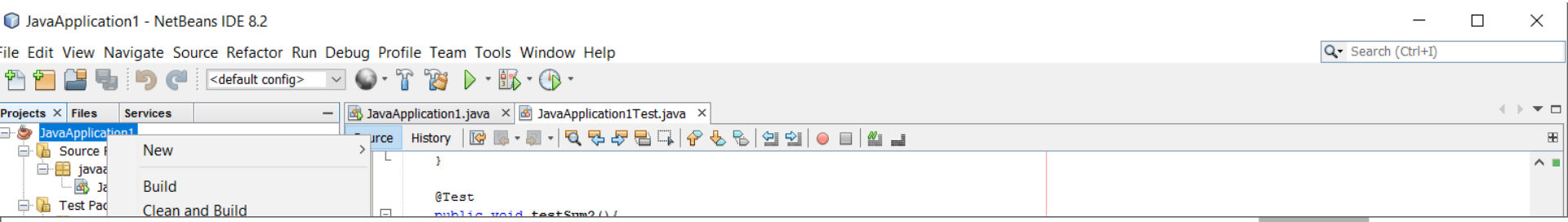
- Java Code Coverage for Eclipse:
- http://www.eclemma.org/

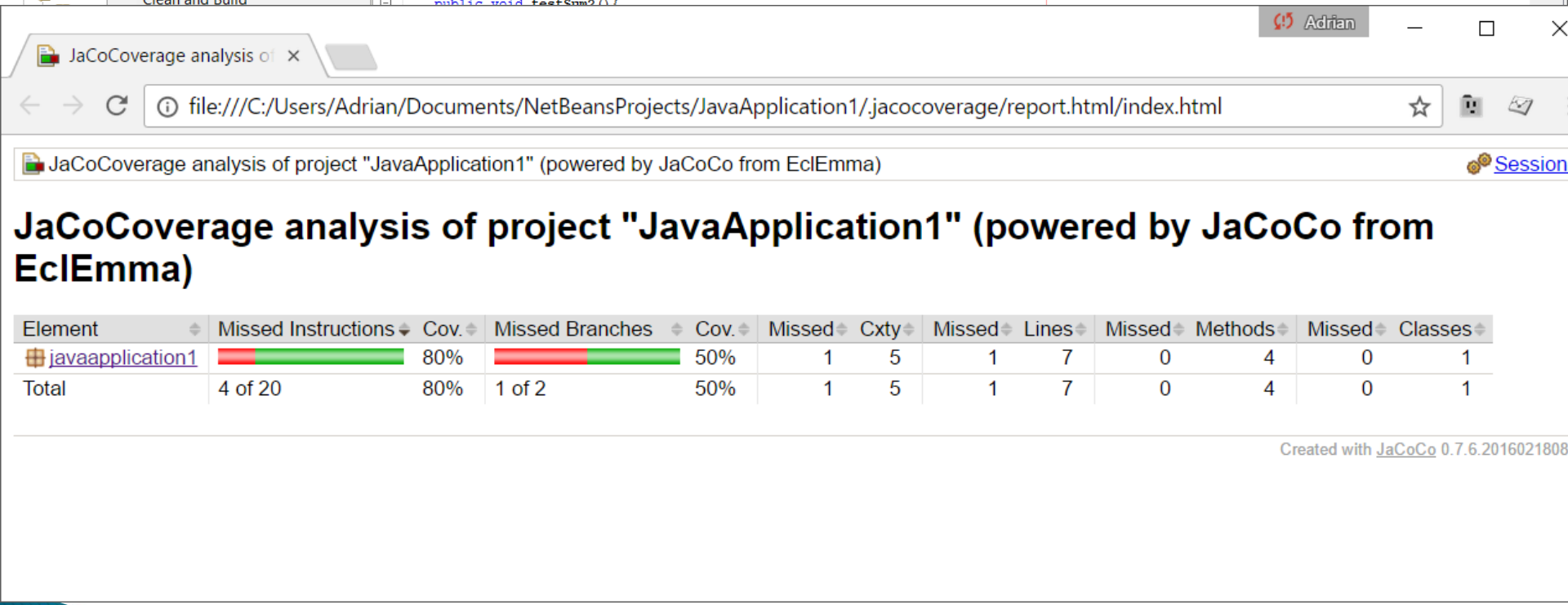
- IntelliJ – Running with coverage:
- https://www.jetbrains.com/help/idea/2016.3/running-with-coverage.html

NetBeans – 1


JavaApplication1 - NetBeans IDE 8.2
File Edit View Navigate Source Refactor Run Debug Profile Team Tools Window Help
Search (Ctrl+I)
<default config>
Projects
Files
Services
JavaApplication1.java
JavaApplication1Test.java
History
New
Build
Clean and Build
Clean
Generate Javadoc
Run
Debug
Profile
Test Alt+F6
Run Selenium Tests
Set Configuration
Open Required Projects
Close
Rename...
Move...
Copy...
Delete Delete
Find... Ctrl+F
Inspect and Transform...
Versioning
History
Run with JaCoCoverage
Test with JaCoCoverage
Reset coverage data
@Test
public void testSum2(){
JavaApplication1 j1 = new JavaApplication1();
assertEquals(-8,j1.Sum(-5,-3));
}
@Test
public void testPoz1(){
JavaApplication1 j1 = new JavaApplication1();
assertEquals(8,j1.Poz(8));
}
/*@Test
public void testPoz2(){
JavaApplication1 j1 = new JavaApplication1();
assertEquals(8,j1.Poz(-8));
}*/
}
javaapplication1.JavaApplication1Test
Output
JavaApplication1 (jacocoverage report)
JavaApplication1 (test)
main
Tests run: 4, Failures: 1, Errors: 0, Skipped: 0, Time elapsed: 0.041 sec
Standard Output
main
74:8
INS

NetBeans – 2


JavaApplication1 - NetBeans IDE 8.2
File Edit View Navigate Source Refactor Run Debug Profile Team Tools Window Help
Search (Ctrl+I)
<default config>
Projects
Files
Services
JavaApplication1.java
JavaApplication1Test.java
History
New
Build
Clean and Build
@Test


Adrian
JaCoCoCoverage analysis o
file:///C:/Users/Adrian/Documents/NetBeansProjects/JavaApplication1/.jacocoverage/report.html/index.html
JaCoCoCoverage analysis of project "JavaApplication1" (powered by JaCoCo from EclEmma)
Session
JaCoCoCoverage analysis of project "JavaApplication1" (powered by JaCoCo from EclEmma)
Element
Missed Instructions
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Missed Branches
Cov.
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Lines
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Methods
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Classes
javaapplication1
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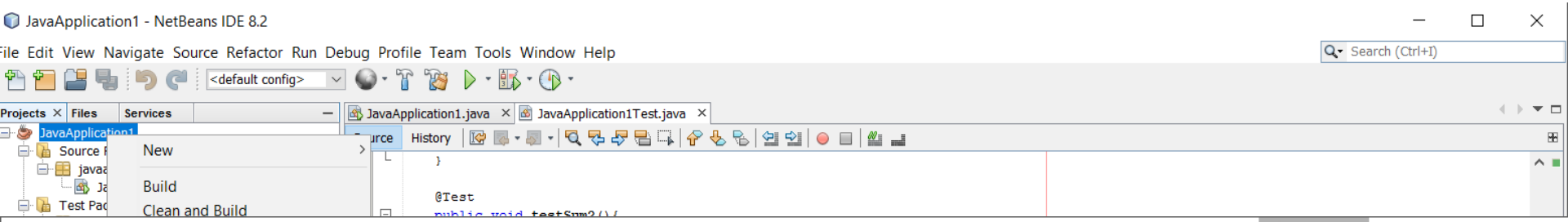
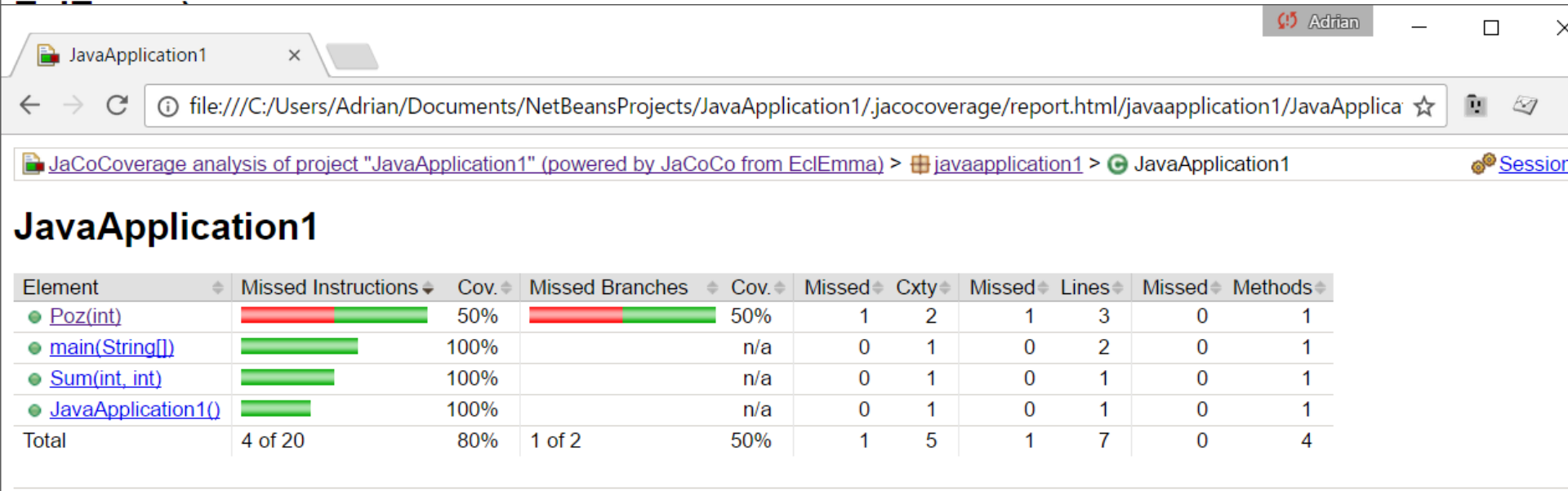
NetBeans – 3





JavaApplication1

Element	Missed Instructions	Cov.	Missed Branches	Cov.	Missed	Cxty	Missed	Lines	Missed	Methods
Poz(int)		50%		50%	1	2	1	3	0	1
main(String[])		100%		n/a	0	1	0	2	0	1
Sum(int, int)		100%		n/a	0	1	0	1	0	1
JavaApplication1()		100%		n/a	0	1	0	1	0	1
Total	4 of 20	80%	1 of 2	50%	1	5	1	7	0	4

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Concluzii

- SOLID
- Design Patterns
  - Definitions, Elements, Example, Classification
- JUnit Testing

Myths

- **Clients**
  - A general description of the objectives is sufficient to begin writing program
  - Requirements are constantly changing, but the software is flexible and can easy adapts
- **Developers**
  - Once the program is written and it is functional, our role has ended
  - Until the program doesn't work, we can not assess the quality
  - The only good product is the functional program
  - Software Engineering will create voluminous and unnecessary documentation and will cause delays

Design Patterns – Întrebări

- 1) Argumentați pentru folosirea DP.
- 2) Veniți cu argumente pentru a nu folosi diagrame sau DP.
- Criticism: http://sourcemaking.com/design_patterns

Bibliografie

- Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides: *Design Patterns: Elements of Reusable Object-Oriented Software* (GangOfFour)
- Ovidiu Gheorghieş, Curs 7 IP
- Adrian Iftene, Curs 9 TAIP: http://thor.info.uaic.ro/~adiftene/Scoala/2011/TAIP/Courses/TAIP09.pdf

Links

- Gang-Of-Four: http://c2.com/cgi/wiki?GangOfFour, http://www.uml.org.cn/c%2B%2B/pdf/DesignPatterns.pdf
- Design Patterns Book: http://c2.com/cgi/wiki?DesignPatternsBook
- About Design Patterns: http://www.javacamp.org/designPattern/
- Design Patterns – Java companion: http://www.patterndepot.com/put/8/JavaPatterns.htm
- Java Design patterns: http://www.allapplabs.com/java_design_patterns/java_design_patterns.htm
- Overview of Design Patterns: http://www.mindspring.com/~mgrand/pattern_synopses.htm
- Gang of Four: http://en.wikipedia.org/wiki/Gang_of_four
- JUnit in Eclipse: http://www.vogella.de/articles/JUnit/article.html
- JUnit in NetBeans: http://netbeans.org/kb/docs/java/junit-intro.html

Vă Mulţumesc!

Pentru prezenţă,
răbdare,
colaborare...