

Best Coding Practices & Industry Standards in Java

1. Code Readability & Formatting

✓ Follow Standard Naming Conventions

- Use meaningful and descriptive names.
- Class names: **PascalCase** (e.g., `PatientRecord`)
- Method names: **camelCase** (e.g., `calculateTotalAmount()`)
- Constants: **UPPER_CASE_SNAKE_CASE** (e.g., `MAX_LIMIT`)

✓ Maintain Proper Indentation & Formatting

- Use 4 spaces per indentation level.
- Keep lines short (ideally ≤ 80 –100 characters).
- Use meaningful spacing for readability.

Example:

Java

```
public class PatientRecord {  
    private String patientName;  
  
    public void displayDetails() {  
        System.out.println("Patient Name: " + patientName);  
    }  
}
```

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2. Use Proper Indentation & Formatting

- ✓ Use 4 spaces per indentation level (avoid tabs).
- ✓ Keep lines within 80-100 characters for readability.
- ✓ Use braces `{ }` even for single-line `if` statements

```
Java
if (age > 18) {
    System.out.println("Eligible to vote.");
}
```

3. Write Small & Focused Methods

- ✓ A method should perform one task only.
- ✓ Keep methods $\leq 20-30$ lines for clarity.
- ✓ Avoid hardcoding values – use constants.

Example:

```
Java
public double calculateDiscount(double price) {
    final double DISCOUNT_RATE = 0.10;
    return price * DISCOUNT_RATE;
}
```

4. Use Comments & Documentation

- ✓ Write **Javadoc comments** for classes and methods.
- ✓ Avoid **excessive** or **obvious** comments.

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Example:

```
Java
/**
 * Calculates the total amount including tax.
 * @param price The base price of the item.
 * @param taxRate The tax rate percentage.
 * @return Total price after tax.
 */
public double calculateTotal(double price, double taxRate) {
    return price + (price * taxRate / 100);
}
```

5. Use Meaningful Conditions

- ✓ Avoid unnecessary comparisons.
- ✓ Use **boolean expressions** directly.

```
Java
//Bad Practice:
if (isAvailable == true) {    // Unnecessary comparison
    System.out.println("Available");
}

//Good Practice:
if (isAvailable) {           // Simpler condition
    System.out.println("Available");
}
```

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6. Use Proper Exception Handling

- ✓ Use **specific exceptions** (not just `Exception`).
- ✓ Handle errors gracefully.

Example:

```
Java
try {
    int result = 10 / 0; // This will cause an exception
} catch (ArithmeticException e) {
    System.out.println("Error: Division by zero is not allowed.");
}
```

7. Avoid Redundant Object Creation

- ✓ Use **existing objects** instead of creating new ones unnecessarily.

```
Java
//Bad Practice:
String name = new String("John"); // Unnecessary object creation

//Good Practice:
String name = "John"; // Efficient way
```

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8. Use StringBuilder Instead of String Concatenation

✔ Use **StringBuilder** for repeated string modifications.

```
Java
//Bad Practice:
String message = "Hello";
message += " World"; // Creates multiple unnecessary objects

//Good Practice:
StringBuilder sb = new StringBuilder("Hello");
sb.append(" World");
System.out.println(sb.toString());
```

9. Use Collections Properly

✔ Use **ArrayList** instead of **LinkedList** for most cases.

✔ Use **HashMap** instead of **Hashtable** if thread safety is not required.

Example:

```
Java
List<String> names = new ArrayList<>();
names.add("Alice");
names.add("Bob");
```

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10. Use Logging Instead of `System.out.println`

✓ Use **SLF4J** or **Log4j** instead of printing to console.

Example:

```
Java
import org.slf4j.Logger;
import org.slf4j.LoggerFactory;

public class MyApp {
    private static final Logger logger = LoggerFactory.getLogger(MyApp.class);

    public static void main(String[] args) {
        logger.info("Application started successfully.");
    }
}
```

11. Keep Code DRY (Don't Repeat Yourself)

✓ **Avoid duplicating code** – use methods or constants.

```
Java
//Bad Practice (Repeating Code):
double price1 = 100;
double price2 = 200;
double total1 = price1 + (price1 * 0.10);
double total2 = price2 + (price2 * 0.10);

//Good Practice (Using a Method):
public double calculateTotal(double price) {
    return price + (price * 0.10);
}
```

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12. Version Control & Code Reviews

- ✓ Write meaningful commit messages.
- ✓ Use branches for new features.

```
git commit -m "Fix: Improved error handling in PaymentService"
```

✓ Conduct Code Reviews

- Use tools like **SonarLint** and **Checkstyle** for static code analysis.
 - Encourage peer reviews for better quality.
-

13. Concurrency & Thread Safety

✓ Use **ExecutorService** Instead of **Thread**

- Helps in managing a thread pool efficiently.

```
ExecutorService executor = Executors.newFixedThreadPool(10);  
executor.submit(() -> System.out.println("Task executed"));
```

✓ Minimize Synchronization

- Use **volatile**, **AtomicInteger**, **ConcurrentHashMap** where necessary.
 - Prefer immutable objects for thread safety.
-

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14. Object-Oriented Principles (OOP)

✓ Follow SOLID Principles

- **Single Responsibility Principle (SRP)** – Each class should do one thing.
- **Open/Closed Principle** – Classes should be open for extension, but closed for modification.
- **Liskov Substitution Principle** – Subtypes should be replaceable for their base types.
- **Interface Segregation Principle** – Don't force implementations to use unnecessary methods.
- **Dependency Inversion Principle** – Depend on abstractions, not concrete classes.

```
Java
public interface Payment {
    void processPayment();
}
public class CreditCardPayment implements Payment {
    @Override
    public void processPayment() {
        System.out.println("Processing Credit Card Payment...");
    }
}
```

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15. Code Efficiency & Performance

✓ Use Efficient Data Structures

- Prefer `ArrayList` over `LinkedList` in most cases.
- Use `HashMap` instead of `Hashtable` for non-thread-safe operations.
- Use `StringBuilder` instead of `String` for concatenations.

```
StringBuilder sb = new StringBuilder();  
sb.append("Hello").append(" World");
```

✓ Avoid Redundant Object Creation

- Use `static` factory methods where possible.
 - Reuse objects instead of creating new instances.
-

16. Testing & CI/CD Best Practices

✓ Write Unit Tests

- Use **JUnit** and **Mockito** for testing.
- Follow **AAA** pattern – Arrange, Act, Assert.

```
Java  
@Test  
public void testCalculateTotalAmount() {  
    double result = service.calculateTotal(100, 5);  
    assertEquals(105, result, 0.01);  
}
```

✓ Use CI/CD for Automated Builds

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- Integrate tools like **Jenkins**, **GitHub Actions**, **GitLab CI/CD**.
 - Ensure test coverage in **SonarQube**.
-

17. Security Best Practices

✅ Validate Inputs & Use Prepared Statements

- Prevent SQL injection using parameterized queries.

```
String query = "SELECT * FROM users WHERE username = ?";  
  
PreparedStatement stmt = conn.prepareStatement(query);  
  
stmt.setString(1, username);
```

✅ Avoid Hardcoded Credentials

- Store secrets in environment variables or vaults.
-

Final Summary

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✓ Best Practice

Follow naming conventions

Use indentation & formatting

Keep methods short

Use meaningful conditions

Handle exceptions properly

Avoid redundant object creation

Use `StringBuilder` for concatenation

Use collections wisely

Use logging instead of
`System.out.println`

Keep code **DRY**

🚀 Why It's Important

Improves readability

Makes code clean

Improves maintainability

Reduces confusion

Prevents crashes

Saves memory

Improves performance

Optimizes data handling

Better debugging

Reduces redundancy

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Code Coverage in Java using SonarQube and JUnit

♦ What is Code Coverage?

Code coverage is a measure of how much of your application code is executed during testing. SonarQube helps analyze **code quality** and **coverage** by integrating with JUnit and JaCoCo.

1. Tools Required

To measure code coverage using **SonarQube** and **JUnit**, you need:

- ✓ **SonarQube** – Code quality and security analysis.
 - ✓ **JaCoCo** – Java Code Coverage (integrates with JUnit).
 - ✓ **JUnit 5** – Unit testing framework.
 - ✓ **Maven/Gradle** – Build automation tool.
-

2. Setup SonarQube for Code Coverage

♦ Step 1: Install and Start SonarQube

If you haven't installed SonarQube:

 **Start SonarQube Locally (Using Docker)**

```
docker run -d --name sonarqube -p 9000:9000 sonarqube:lts
```

👉 SonarQube will be available at **http://localhost:9000** (default credentials: **admin/admin**).

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♦ Step 2: Add JaCoCo to Your Java Project

For Maven (Add to `pom.xml`)

```
Java
<build>
  <plugins>
    <!-- JaCoCo Plugin for Code Coverage -->
    <plugin>
      <groupId>org.jacoco</groupId>
      <artifactId>jacoco-maven-plugin</artifactId>
      <version>0.8.8</version>
      <executions>
        <execution>
          <goals>
            <goal>prepare-agent</goal>
          </goals>
        </execution>
        <execution>
          <id>report</id>
          <phase>verify</phase>
          <goals>
            <goal>report</goal>
          </goals>
        </execution>
      </executions>
    </plugin>

    <!-- SonarQube Plugin -->
    <plugin>
      <groupId>org.sonarsource.scanner.maven</groupId>
      <artifactId>sonar-maven-plugin</artifactId>
      <version>3.9.1.2184</version>
    </plugin>
  </plugins>
</build>
```

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♦ Step 3: Configure SonarQube in `sonar-project.properties`

Create a `sonar-project.properties` file in the root of your project:

```
Java
sonar.projectKey=MyJavaProject
sonar.projectName=Java Code Coverage
sonar.host.url=http://localhost:9000
sonar.login=admin
sonar.password=admin
sonar.sources=src/main/java
sonar.tests=src/test/java
sonar.java.binaries=target/classes
sonar.coverage.jacoco.xmlReportPaths=target/site/jacoco/jacoco.xml
```

3. Write Java Code & JUnit Tests

♦ Java Class (Calculator.java)

```
Java
public class Calculator {
    public int add(int a, int b) {
        return a + b;
    }

    public int subtract(int a, int b) {
        return a - b;
    }

    public int multiply(int a, int b) {
        return a * b;
    }
}
```

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♦ JUnit Test Class (CalculatorTest.java)

```
Java
import org.junit.jupiter.api.Test;
import static org.junit.jupiter.api.Assertions.*;

public class CalculatorTest {
    @Test
    public void testAddition() {
        Calculator calculator = new Calculator();
        assertEquals(5, calculator.add(2, 3));
    }

    @Test
    public void testSubtraction() {
        Calculator calculator = new Calculator();
        assertEquals(2, calculator.subtract(5, 3));
    }
}
```

4. Run Tests and Generate Coverage Report 🚀

♦ Step 1: Run Tests with JaCoCo

Run the following command to generate code coverage:

```
mvn clean test jacoco:report
```

📌 This will generate the **JaCoCo report** at:

📁 <target/site/jacoco/index.html>

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♦ Step 2: Analyze Code Coverage with SonarQube

Now, run SonarQube analysis:

```
mvn sonar:sonar
```

👉 Go to <http://localhost:9000> and log in to see the coverage report! 🎯

5. Automating Code Coverage in CI/CD ⚙️

GitHub Actions (Maven + SonarQube + JaCoCo)

To automate code coverage in a CI/CD pipeline, create `.github/workflows/sonarqube.yml`:

```
Unset
name: Java CI with SonarQube

on:
  push:
    branches:
      - main

jobs:
  sonar:
    runs-on: ubuntu-latest

    steps:
      - name: Checkout Code
        uses: actions/checkout@v3

      - name: Set up JDK 17
        uses: actions/setup-java@v3
        with:
          distribution: 'temurin'
          java-version: '17'

      - name: Build and Test with JaCoCo
        run: |
```


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```
mvn clean test jacoco:report

- name: Run SonarQube Analysis
  run: |
    mvn sonar:sonar -Dsonar.host.url=http://localhost:9000
    -Dsonar.login=admin
```

6. SonarQube Coverage Report Example

Once the analysis is complete, SonarQube provides detailed **code coverage reports**:

- ✓ **Overall Code Coverage (%)**
- ✓ **Lines Covered vs. Uncovered**
- ✓ **Branch Coverage** (if all conditions are tested)
- ✓ **Duplicated Code Detection**
- ✓ **Code Smells & Vulnerabilities**

7. Best Practices for Code Coverage

- ✓ **Aim for 80-90% coverage** (but don't chase 100%).
 - ✓ Focus on **business-critical logic** (avoid testing trivial code).
 - ✓ Ensure **branch and condition coverage** (not just line coverage).
 - ✓ **Mock external dependencies** in unit tests (use Mockito).
 - ✓ Automate **SonarQube analysis in CI/CD** (GitHub Actions, Jenkins).
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8. Summary

◆ Step

✓ Action

Setup SonarQube & JaCoCo

Install SonarQube, add JaCoCo to Maven/Gradle

Write JUnit Tests

Use **JUnit 5** for unit testing

Run Tests & Generate Coverage

```
mvn clean test jacoco:report
```

Analyze with SonarQube

```
mvn sonar:sonar
```

Automate in CI/CD

Use **GitHub Actions** / **Jenkins**