Java Cohesion and Coupling

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Introduced in 2026-04-02-refactoring[1] (Lecture, Week 6, Part 2).

Modularization

The process of dividing a large system (a monolith) into smaller, more manageable pieces that can be worked on and tested independently before being reassembled into the final product. This raises a question: what if the resulting modules are highly dependent on each other?

Coupling

The degree of interdependence between different modules, classes, or components of a system.

- **High coupling** — strong interconnections, where a change in one module can cascade through others.
- **Low coupling** — greater independence and isolation between modules.

[1] courses/csse2002/2026-04-02-refactoring.pdf

Levels of coupling (tightly → loosely coupled)

1. **Content** — one class directly manipulates another's data (e.g. public fields instead of private).
2. **Common** — sharing access to the same global data/variables.
3. **External** — sharing something imposed by an external source, e.g. a data format.
4. **Control** — one class controls what happens in another by passing it information/instructions.
5. **Stamp** — sharing a data structure, but each class only needs access to a select part of it.
6. **Data** — sharing data through means such as parameter passing in methods.
7. **None** — no dependency at all (most loosely coupled).

Worked classification examples

Classifying real code against the levels above (my own reasoned classification, following the definitions above — the lecture posed these as open discussion questions without a printed answer key):

```
public void sinh(int x) {...}
public void cosh(int x) {...}
public void tanh(int x) {
    return sinh(x) / cosh(x);
}
```

`tanh` only interacts with `sinh`/`cosh` by passing/receiving simple parameters — **data coupling**.

```
public class R { int x, y, z; char a, b, c; }
public static void compute(R r) {
    return r.x * r.y; // only touches x and y
}
```

`compute` is handed the whole `R` object but only needs two of its six fields — **stamp coupling**.

```
public static void compute(R r) {
    return r.x * r.y * r.z / r.a + r.b + r.c; // uses every field
}
```

Here every field of `R` is actually used, so passing the whole object is fully justified — this is just **data coupling** via a composite value, not stamp coupling (contrast with the previous example, which only used part of the structure).

```
public static runReport(String name, int age, String phone, Date birth, String
 ↪  address) {...}
```

Five separate simple parameters — still **data coupling**, though a long parameter list like this is itself often a separate code smell (see java-refactoring[2]) worth considering bundling into an object.

Cohesion

The degree of interrelatedness and focus among the elements *within* a module, class, or component.

- **High cohesion** — elements are closely related and contribute collectively to one specific functionality.
- **Low cohesion** — elements are less focused, serving multiple unrelated purposes.

Levels of cohesion (low → high)

1. **Coincidental** — elements grouped arbitrarily, with no clear relationship.
2. **Temporal** — elements grouped because they execute at the same time/phase.
3. **Procedural** — elements grouped by their involvement in a specific sequence of steps.
4. **Communicational** — elements work together to manipulate a shared data structure.
5. **Sequential** — elements organised in a linear sequence, where one's output is the next's input.
6. **Functional** — elements grouped around a single, specific functionality or task (most cohesive).

Worked example

```
public void performTasks(int[] numbers, String text) {
    // Task 1: sum the numbers
    int sum = 0;
    for (int num : numbers) { sum += num; }
    System.out.println("Sum of numbers: " + sum);

    // Task 2: reverse the text
    StringBuilder reversedText = new StringBuilder();
    for (int i = text.length() - 1; i >= 0; i--) {
     ↪  reversedText.append(text.charAt(i)); }
```

[2] courses/csse2002/java-refactoring.pdf

```
    System.out.println("Reversed text: " + reversedText);
}
```

Summing numbers and reversing text share no real purpose — they're only in the same method because they happen to run one after another. This is low (coincidental, or at best temporal) cohesion, and a sign `performTasks` should be split into two focused methods.

Is this class cohesive?

> A `Car` class contains: Fuel, Steering, Speed, Route planner, Public holiday calculator.

Fuel/Steering/Speed are all core to a car's own physical behaviour, but a route planner and (especially) a public-holiday calculator are unrelated concerns bolted onto the class — this is **low cohesion**, and a sign the class is trying to do too much (a "God class"); the unrelated pieces should be split into their own classes.

Considerations

- Classes should be **highly cohesive** — a single, easily understood concept.
- Classes should have **loose coupling** to each other — this reduces overall system complexity.

Good modularization (high cohesion, low coupling) groups tightly-interconnected elements together into the same module and minimises connections *between* modules, unlike bad modularization, where connections are scattered across module boundaries with no clear grouping.