# IMMUTABILITY IN JAVA (A Comprehensive Guide)

## 1. What is Immutability?

An object whose state cannot change after creation.

Examples in Java:

String name = "Java"; // Immutable  
Integer num = 10; // Immutable  
LocalDate date = LocalDate.now(); // Immutable

## 2. How to Achieve Immutability

Rules for Immutable Classes:

|  |  |
| --- | --- |
| Rule | Explanation |
| final class | Prevents subclassing. Example: public final class ImmutablePerson { ... } |
| private final fields | No direct access/modification after construction. |
| No setters | Only provide getters (e.g., getName()). |
| Defensive copies | For mutable fields (e.g., List, Date), return copies in getters. |
| Constructor initialization | All fields must be set once at creation. |

Example Code:

import java.util.\*;  
  
public final class ImmutableEmployee {  
 private final String name;  
 private final int id;  
 private final List<String> departments;  
  
 public ImmutableEmployee(String name, int id, List<String> departments) {  
 this.name = name;  
 this.id = id;  
 this.departments = new ArrayList<>(departments); // Defensive copy  
 }  
  
 // Getters (NO setters!)  
 public String getName() { return name; }  
 public int getId() { return id; }  
 public List<String> getDepartments() {  
 return new ArrayList<>(departments); // Return copy  
 }  
}

## 3. Immutable Collections

Ways to Create Them:

// Java 9+ (Best)  
List<String> immutableList = List.of("A", "B", "C");  
Set<String> immutableSet = Set.of("X", "Y");  
Map<String, Integer> immutableMap = Map.of("Key1", 1, "Key2", 2);  
  
// Pre-Java 9  
List<String> unmodifiableList = Collections.unmodifiableList(new ArrayList<>(originalList));

## 4. Benefits of Immutability

✔ Thread-safe → No synchronization needed.

✔ Predictable state → No side effects.

✔ Cacheable → Safe to reuse (e.g., String pool).

✔ Secure → Prevents unauthorized modifications.

## 5. When to Use Immutability?

Value objects (e.g., Money, Address).

Configuration data (e.g., application settings).

Keys in HashMap/HashSet (to prevent hash corruption).