**Encapsulation**

1. Student with Grade Validation & Configuration

Ensure marks are always valid and immutable once set.

* Create a Student class with private fields: name, rollNumber, and marks.
* Use a constructor to initialize all values and enforce marks to be between 0 and 100; invalid values reset to 0.
* Provide getter methods, but no setter for marks (immutable after object creation).
* Add displayDetails() to print all fields.

In future versions, you might allow updating marks only via a special inputMarks(int newMarks) method that has stricter logic (e.g. cannot reduce marks). Design accordingly.

2. Rectangle Enforced Positive Dimensions

Encapsulate validation and provide derived calculations.

* Build a Rectangle class with private width and height.
* Constructor and setters should reject or correct non-positive values (e.g., use default or throw an exception).
* Provide getArea() and getPerimeter() methods.
* Include displayDetails() method.

3. Advanced: Bank Account with Deposit/Withdraw Logic

Transaction validation and encapsulation protection.

* Create a BankAccount class with private accountNumber, accountHolder, balance.
* Provide:
  + deposit(double amount) — ignores or rejects negative.
  + withdraw(double amount) — prevents overdraft and returns a boolean success.
  + Getter for balance but no setter.
* Optionally override toString() to display masked account number and details.
* Track transaction history internally using a private list (or inner class for transaction object).
* Expose a method getLastTransaction() but do not expose the full internal list.

4. Inner Class Encapsulation: Secure Locker

Encapsulate helper logic inside the class.

* Implement a class Locker with private fields such as lockerId, isLocked, and passcode.
* Use an inner private class SecurityManager to handle passcode verification logic.
* Only expose public methods: lock(), unlock(String code), isLocked().
* Password attempts should not leak verification logic externally—only success/failure.
* Ensure no direct access to passcode or the inner SecurityManager from outside.

5. Builder Pattern & Encapsulation: Immutable Product

Use Builder design to create immutable class with encapsulation.

* Create an immutable Product class with private final fields such as name, code, price, and optional category.
* Use a static nested Builder inside the Product class. Provide methods like withName(), withPrice(), etc., that apply validation (e.g. non-negative price).
* The outer class should have only getter methods, no setters.
* The builder returns a new Product instance only when all validations succeed.

**Interface**

1. Reverse CharSequence: Custom BackwardSequence

* Create a class BackwardSequence that implements java.lang.CharSequence.
* Internally store a String and implement all required methods: length(), charAt(), subSequence(), and toString().
* The sequence should be the reverse of the stored string (e.g., new BackwardSequence("hello") yields "olleh").
* Write a main() method to test each method.

2. Moveable Shapes Simulation

* Define an interface Movable with methods: moveUp(), moveDown(), moveLeft(), moveRight().
* Implement classes:
  + MovablePoint(x, y, xSpeed, ySpeed) implements Movable
  + MovableCircle(radius, center: MovablePoint)
  + MovableRectangle(topLeft: MovablePoint, bottomRight: MovablePoint) (ensuring both points have same speed)
* Provide toString() to display positions.
* In main(), create a few objects and call move methods to simulate motion.

3. Contract Programming: Printer Switch

* Declare an interface Printer with method void print(String document).
* Implement two classes: LaserPrinter and InkjetPrinter, each providing unique behavior.
* In the client code, declare Printer p;, switch implementations at runtime, and test printing.

4. Extended Interface Hierarchy

* Define interface BaseVehicle with method void start().
* Define interface AdvancedVehicle that extends BaseVehicle, adding method void stop() and boolean refuel(int amount).
* Implement Car to satisfy both interfaces; include a constructor initializing fuel level.
* In Main, manipulate the object via both interface types.

5. Nested Interface for Callback Handling

* Create a class TimeServer which declares a public static nested interface named Client with void updateTime(LocalDateTime now).
* The server class should have method registerClient(Client client) and notifyClients() to pass current time.
* Implement at least two classes implementing Client, registering them, and simulate notifications.

6. Default and Static Methods in Interfaces

* Declare interface Polygon with:
  + double getArea()
  + default method default double getPerimeter(int... sides) that computes sum of sides
  + a static helper static String shapeInfo() returning a description string
* Implement classes Rectangle and Triangle, providing appropriate getArea().
* In Main, call getPerimeter(...) and Polygon.shapeInfo().

**Lambda expressions**

1. Sum of Two Integers
2. Define a functional interface SumCalculator { int sum(int a, int b); } and a lambda expression to sum two integers.
3. Check If a String Is Empty

Create a lambda (via a functional interface like Predicate<String>) that returns true if a given string is empty.  
Predicate<String> isEmpty = s -> s.isEmpty();

1. Filter Even or Odd Numbers
2. Convert Strings to Uppercase/Lowercase
3. Sort Strings by Length or Alphabetically
4. Aggregate Operations (Sum, Max, Average) on Double Arrays
5. Create similar lambdas for max/min.
6. Calculate Factorial