WEEK 5

Name:Ramesh Harisabapathi Chettiar

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PRACTICE PROBLEM 1: Access Modifiers - The Four Levels of Security

Understanding private, default, protected, public modifiers

```
// File: AccessModifierDemo.java

package com.company.security;

public class AccessModifierDemo {

// TODO: Create four different fields with different access modifiers:

// - privateField (int) - only accessible within this class

// - defaultField (String) - accessible within same package

// - protectedField (double) - accessible in package + subclasses

// - publicField (boolean) - accessible everywhere

// TODO: Create four methods with matching access levels:

// - privateMethod() - prints "Private method called"

// - defaultMethod() - prints "Default method called"

// - protectedMethod() - prints "Protected method called"
```

```
// - publicMethod() - prints "Public method called"
// TODO: Create a constructor that initializes all fields
// TODO: Create a public method testInternalAccess() that:
// - Accesses and prints all four fields
// - Calls all four methods
// - Demonstrates that private members are accessible within same class
public static void main(String[] args) {
// TODO: Create an AccessModifierDemo object
// TODO: Try to access each field and method
// TODO: Document in comments which ones work and which cause errors
// TODO: Call testInternalAccess() to show internal accessibility
}
}
// TODO: Create a second class in the SAME package:
class SamePackageTest {
public static void testAccess() {
// TODO: Create AccessModifierDemo object
// TODO: Try accessing each field and method
// TODO: Document which access modifiers work within same package
```

```
}
}
```

Ans.

```
package com.company.security;

public class AccessModifierDemo {
    private int privateField;
    String defaultField;
    protected double protectedField;
    public boolean publicField;

    public AccessModifierDemo(int privateField, String
defaultField,
                              double protectedField, boolean publicField) {
        this.privateField = privateField;
        this.defaultField = defaultField;
        this.protectedField = protectedField;
        this.publicField = publicField;
    }

    private void privateMethod() {
        System.out.println("Private method called");
```

```
}

void defaultMethod() {
    System.out.println("Default method called");
}

protected void protectedMethod() {
    System.out.println("Protected method called");
}

public void publicMethod() {
    System.out.println("Public method called");
}

public void testInternalAccess() {
    System.out.println("Private field: " + privateField);
    System.out.println("Default field: " + defaultField);
    System.out.println("Protected field: " + protectedField);
    System.out.println("Public field: " + publicField);

    privateMethod();
    defaultMethod();
```

```
        protectedMethod();
        publicMethod();
    }

    public static void main(String[] args) {
        AccessModifierDemo demo = new
AccessModifierDemo(1, "default", 3.14, true);

        System.out.println(demo.publicField);
        demo.publicMethod();

        demo.testInternalAccess();
    }
}

class SamePackageTest {
    public static void testAccess() {
        AccessModifierDemo demo = new
AccessModifierDemo(1, "test", 2.5, false);

        System.out.println(demo.defaultField);
        System.out.println(demo.protectedField);
```

```
        System.out.println(demo.publicField);

        demo.defaultMethod();
        demo.protectedMethod();
        demo.publicMethod();
    }
}
```

Q2. Data Hiding Mastery

Implementing proper encapsulation with private fields and public methods

```
public class SecureBankAccount {
```

// TODO: Create private fields that should NEVER be accessed directly:

// - accountNumber (String) - read-only after creation

// - balance (double) - only modified through controlled methods

// - pin (int) - write-only for security

// - isLocked (boolean) - internal security state

// - failedAttempts (int) - internal security counter

// TODO: Create private constants:

// - MAX_FAILED_ATTEMPTS (int) = 3

// - MIN_BALANCE (double) = 0.0

// TODO: Create constructor that takes accountNumber and initial balance

// TODO: Initialize pin to 0 (must be set separately)

// TODO: Create PUBLIC methods for controlled access:

// Account Info Methods:

// - getAccountNumber() - returns account number

// - getBalance() - returns current balance (only if not locked)

// - isAccountLocked() - returns lock status

// Security Methods:

// - setPin(int oldPin, int newPin) - changes PIN if old PIN correct

// - validatePin(int enteredPin) - checks PIN, handles failed attempts

// - unlockAccount(int correctPin) - unlocks if PIN correct

// Transaction Methods:

// - deposit(double amount, int pin) - adds money if PIN valid

// - withdraw(double amount, int pin) - removes money if PIN valid and sufficient funds

// - transfer(SecureBankAccount target, double amount, int pin) - transfers between accounts

// TODO: Create private helper methods:

// - lockAccount() - sets isLocked to true

// - resetFailedAttempts() - resets counter to 0

// - incrementFailedAttempts() - increases counter, locks if needed

public static void main(String[] args) {

// TODO: Create two SecureBankAccount objects

// TODO: Try to access private fields directly (should fail)

// TODO: Demonstrate proper usage through public methods:

// - Set PINs for both accounts

// - Make deposits and withdrawals

// - Show security features (account locking)

// - Transfer money between accounts

// TODO: Attempt security breaches:

// - Wrong PIN multiple times

// - Withdrawing more than balance

// - Operating on locked account

}

}

Ans. public class SecureBankAccount {

    private final String accountNumber;

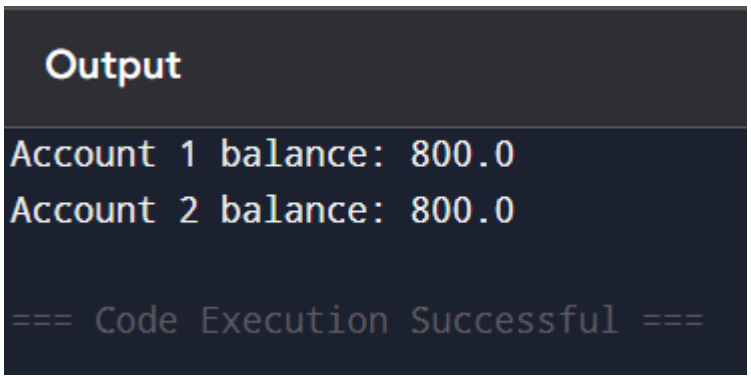
```
    private double balance;
    private int pin;
    private boolean isLocked;
    private int failedAttempts;

    private static final int MAX_FAILED_ATTEMPTS = 3;
    private static final double MIN_BALANCE = 0.0;

    public SecureBankAccount(String accountNumber, double
initialBalance) {
        this.accountNumber = accountNumber;
        this.balance = initialBalance;
        this.pin = 0;
        this.isLocked = false;
        this.failedAttempts = 0;
    }

    public String getAccountNumber() {
        return accountNumber;
    }

    public double getBalance() {
        if (isLocked) throw new IllegalStateException("Account locked");
        return balance;
```

```
}

public boolean isAccountLocked() {
    return isLocked;
}

public void setPin(int oldPin, int newPin) {
    if (validatePin(oldPin)) {
        this.pin = newPin;
        resetFailedAttempts();
    }
}

public boolean validatePin(int enteredPin) {
    if (isLocked) return false;

    if (enteredPin == pin) {
        resetFailedAttempts();
        return true;
    } else {
        incrementFailedAttempts();
        return false;
    }
}
```

```
    public void unlockAccount(int correctPin) {
        if (correctPin == pin) {
            isLocked = false;
            resetFailedAttempts();
        }
    }

    public void deposit(double amount, int pin) {
        if (!validatePin(pin)) throw new SecurityException("Invalid PIN");
        if (amount <= 0) throw new IllegalArgumentException("Invalid
amount");
        balance += amount;
    }

    public void withdraw(double amount, int pin) {
        if (!validatePin(pin)) throw new SecurityException("Invalid PIN");
        if (amount <= 0) throw new IllegalArgumentException("Invalid
amount");
        if (balance - amount < MIN_BALANCE) throw new
IllegalArgumentException("Insufficient funds");
        balance -= amount;
    }
```

```
    public void transfer(SecureBankAccount target, double amount, int
pin) {
        withdraw(amount, pin);
        target.deposit(amount, target.pin);
    }

    private void lockAccount() {
        isLocked = true;
    }

    private void resetFailedAttempts() {
        failedAttempts = 0;
    }

    private void incrementFailedAttempts() {
        failedAttempts++;
        if (failedAttempts >= MAX_FAILED_ATTEMPTS) {
            lockAccount();
        }
    }

    public static void main(String[] args) {
        SecureBankAccount acc1 = new SecureBankAccount("123",
1000);
```

```
        SecureBankAccount acc2 = new SecureBankAccount("456", 500);

        acc1.setPin(0, 1234);
        acc2.setPin(0, 5678);

        acc1.deposit(200, 1234);
        acc1.withdraw(100, 1234);
        acc1.transfer(acc2, 300, 1234);

        System.out.println("Account 1 balance: " + acc1.getBalance());
        System.out.println("Account 2 balance: " + acc2.getBalance());
    }
}
```



Q3. JavaBean Standards

Implementation

Creating professional JavaBean-compliant classes

```
import java.io.Serializable;

public class EmployeeBean implements Serializable {

// TODO: Create private fields following JavaBean conventions:

// - employeeId (String)

// - firstName (String)

// - lastName (String)

// - salary (double)

// - department (String)

// - hireDate (java.util.Date)

// - isActive (boolean)

// TODO: Create default no-argument constructor (JavaBean requirement)

// TODO: Create parameterized constructor for convenience

// TODO: Generate standard JavaBean getter methods:

// - getEmployeeId(), getFirstName(), getLastName(), etc.

// - Follow naming convention: get + PropertyName

// - For boolean: isActive() instead of getIsActive()

// TODO: Generate standard JavaBean setter methods:

// - setEmployeeId(String id), setFirstName(String name), etc.

// - Follow naming convention: set + PropertyName

// - Include validation where appropriate
```

// TODO: Create computed properties (getters without corresponding fields):

// - getFullName() - returns firstName + " " + lastName

// - getYearsOfService() - calculates years since hireDate

// - getFormattedSalary() - returns salary with currency formatting

// TODO: Create derived properties with validation:

// - setFullName(String fullName) - splits into firstName/lastName

// - setSalary(double salary) - validates positive amount

// TODO: Override toString() to display all properties

// TODO: Override equals() and hashCode() based on employeeId

public static void main(String[] args) {

// TODO: Create EmployeeBean using default constructor + setters

// TODO: Create EmployeeBean using parameterized constructor

// TODO: Demonstrate all getter methods

// TODO: Test computed properties

// TODO: Test validation in setter methods

// TODO: Show JavaBean in action with collections (sorting, searching)

// TODO: Create an array of EmployeeBeans and demonstrate:

// - Sorting by salary using computed properties

// - Filtering active employees

// - Bulk operations using JavaBean conventions

}

}

// TODO: Create a JavaBean utility class:

class JavaBeanProcessor {

// TODO: Create static method printAllProperties(EmployeeBean emp)

// - Uses reflection to find all getter methods

// - Calls each getter and prints property name and value

// - Demonstrates JavaBean introspection capabilities

// TODO: Create static method copyProperties(EmployeeBean source, EmployeeBean target)

// - Uses reflection to copy all properties from source to target

// - Demonstrates JavaBean framework integration potential

}

Ans. import java.io.Serializable;

import java.util.Date;

import java.text.NumberFormat;

```
public class EmployeeBean implements Serializable {
    private String employeeId;
    private String firstName;
    private String lastName;
    private double salary;
    private String department;
    private Date hireDate;
    private boolean isActive;

    public EmployeeBean() {}

    public EmployeeBean(String employeeId, String firstName,
String lastName,
                    double salary, String department, Date hireDate,
boolean isActive) {
        this.employeeId = employeeId;
        this.firstName = firstName;
        this.lastName = lastName;
        this.salary = salary;
        this.department = department;
        this.hireDate = hireDate;
```

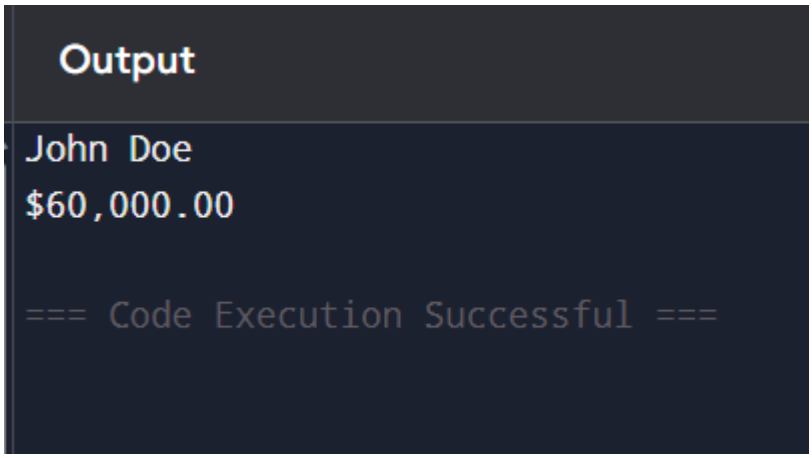
```
        this.isActive = isActive;
    }

    public String getEmployeeId() { return employeeId; }
    public String getFirstName() { return firstName; }
    public String getLastName() { return lastName; }
    public double getSalary() { return salary; }
    public String getDepartment() { return department; }
    public Date getHireDate() { return hireDate; }
    public boolean isActive() { return isActive; }

    public void setEmployeeId(String employeeId) {
this.employeeId = employeeId; }
    public void setFirstName(String firstName) { this.firstName
= firstName; }
    public void setLastName(String lastName) { this.lastName =
lastName; }
    public void setSalary(double salary) {
        if (salary < 0) throw new
IllegalArgumentException("Salary cannot be negative");
        this.salary = salary;
    }
```

```
    public void setDepartment(String department) {
this.department = department; }
    public void setHireDate(Date hireDate) { this.hireDate =
hireDate; }
    public void setActive(boolean active) { isActive = active; }

    public String getFullName() {
        return firstName + " " + lastName;
    }

    public int getYearsOfService() {
        if (hireDate == null) return 0;
        long diff = new Date().getTime() - hireDate.getTime();
        return (int) (diff / (1000L * 60 * 60 * 24 * 365));
    }

    public String getFormattedSalary() {
        return
NumberFormat.getCurrencyInstance().format(salary);
    }

    public void setFullName(String fullName) {
        String[] parts = fullName.split(" ");
```

```
    this.firstName = parts[0];
    this.lastName = parts.length > 1 ? parts[1] : "";
}

@Override
public String toString() {
    return "EmployeeBean{" +
            "employeeId='" + employeeId + '\'' +
            ", firstName='" + firstName + '\'' +
            ", lastName='" + lastName + '\'' +
            ", salary=" + salary +
            ", department='" + department + '\'' +
            ", hireDate=" + hireDate +
            ", isActive=" + isActive +
            '}';
}

@Override
public boolean equals(Object o) {
    if (this == o) return true;
    if (o == null || getClass() != o.getClass()) return false;
    EmployeeBean that = (EmployeeBean) o;
```

```
        return employeeId.equals(that.employeeId);
    }

    @Override
    public int hashCode() {
        return employeeId.hashCode();
    }

    public static void main(String[] args) {
        EmployeeBean emp1 = new EmployeeBean();
        emp1.setEmployeeId("E001");
        emp1.setFullName("John Doe");
        emp1.setSalary(50000);
        emp1.setActive(true);

        EmployeeBean emp2 = new EmployeeBean("E002",
"Jane", "Smith",
                                60000, "IT", new Date(), true);

        System.out.println(emp1.getFullName());
        System.out.println(emp2.getFormattedSalary());
    }
```

}



Q4. Immutable Objects - The

Unbreakable Design

Creating completely immutable objects with defensive programming

import java.util.*;

import java.time.LocalDate;

// TODO: Make this class immutable by following all immutability rules

public final class ImmutableStudent {

// TODO: Declare ALL fields as private and final:

// - studentId (String)

// - name (String)

// - birthDate (LocalDate)

// - courses (List<String>) - mutable collection that needs defensive copying

// - grades (Map<String, Double>) - mutable collection that needs defensive copying

// - graduationDate (LocalDate) - can be null initially

// TODO: Create constructor that:

// - Takes all parameters including collections

// - Makes defensive copies of all mutable parameters

// - Validates all inputs (non-null, non-empty where appropriate)

// - Initializes all final fields

// TODO: Create getter methods that:

// - Return primitive/immutable values directly

// - Return defensive copies of mutable objects

// - NEVER expose internal mutable state

// - getStudentId() - returns String directly

// - getName() - returns String directly

// - getBirthDate() - returns LocalDate directly (immutable)

// - getCourses() - returns new ArrayList copy

// - getGrades() - returns new HashMap copy

// - getGraduationDate() - returns LocalDate (can be null)

// TODO: Create computed property methods:

// - getAge() - calculates from birth date

// - getGPA() - calculates from grades map

// - getTotalCourses() - returns course count

// - isGraduated() - returns true if graduation date is set

// TODO: Create "modification" methods that return NEW instances:

// - withGraduationDate(LocalDate date) - returns new ImmutableStudent with graduation

date set

// - withAdditionalCourse(String course) - returns new ImmutableStudent with course added

// - withGrade(String course, double grade) - returns new ImmutableStudent with grade

added/updated

// - withName(String newName) - returns new ImmutableStudent with updated name

// TODO: Override Object methods properly:

// - equals(Object obj) - based on all fields including collections

// - hashCode() - consistent with equals, stable across calls

// - toString() - includes all relevant information

// TODO: Create builder pattern for complex construction:

public static class Builder {

// TODO: Create private mutable fields for building

// TODO: Create fluent setter methods that return Builder

// TODO: Create build() method that returns ImmutableStudent

// TODO: Include validation in build() method

}

// TODO: Create factory methods:

// - createBasicStudent(String id, String name, LocalDate birthDate)

// - createGraduatedStudent(String id, String name, LocalDate birthDate, LocalDate

graduationDate)

public static void main(String[] args) {

// TODO: Test immutability extensively:

// 1. Create ImmutableStudent with collections

List<String> courses = new ArrayList<>(Arrays.asList("Math", "Science"));

Map<String, Double> grades = new HashMap<>();

grades.put("Math", 95.0);

grades.put("Science", 87.0);

// TODO: Create student and verify original collections can be modified without affecting

student

// 2. Test that returned collections are defensive copies:

// TODO: Get courses/grades from student and modify them

// TODO: Verify original student is unchanged

// 3. Test "modification" methods:

// TODO: Use withXXX methods to create new instances

// TODO: Verify original student is unchanged

// TODO: Verify new instances have expected changes

// 4. Test Builder pattern:

// TODO: Create complex student using builder

// TODO: Show fluent interface in action

// 5. Test in collections:

// TODO: Use ImmutableStudent as HashMap key

// TODO: Add to HashSet and verify no duplicates

// TODO: Sort collection of students

```
// 6. Test thread safety:
// TODO: Access same ImmutableStudent from multiple threads
// TODO: Show no synchronization needed
// TODO: Compare with mutable equivalent and show benefits:
// - Thread safety
// - Reliable hashing
// - No defensive copying needed when sharing
// - Simplified reasoning about state
}
}
import java.util.*;
import java.time.LocalDate;
import java.time.Period;

public final class ImmutableStudent {
    private final String studentId;
    private final String name;
    private final LocalDate birthDate;
    private final List<String> courses;
    private final Map<String, Double> grades;
    private final LocalDate graduationDate;

    public ImmutableStudent(String studentId, String name, LocalDate
birthDate,
```

```
                    List<String> courses, Map<String, Double> grades,
                    LocalDate graduationDate) {
        this.studentId = Objects.requireNonNull(studentId);
        this.name = Objects.requireNonNull(name);
        this.birthDate = Objects.requireNonNull(birthDate);
        this.courses = new
ArrayList<>(Objects.requireNonNull(courses));
        this.grades = new HashMap<>(Objects.requireNonNull(grades));
        this.graduationDate = graduationDate;
    }

    public String getStudentId() { return studentId; }
    public String getName() { return name; }
    public LocalDate getBirthDate() { return birthDate; }
    public List<String> getCourses() { return new ArrayList<>(courses); }
    public Map<String, Double> getGrades() { return new
HashMap<>(grades); }
    public LocalDate getGraduationDate() { return graduationDate; }

    public int getAge() {
        return Period.between(birthDate, LocalDate.now()).getYears();
    }

    public double getGPA() {
```

```
        if (grades.isEmpty()) return 0.0;
        double sum =
grades.values().stream().mapToDouble(Double::doubleValue).sum();
        return sum / grades.size();
    }

    public int getTotalCourses() {
        return courses.size();
    }

    public boolean isGraduated() {
        return graduationDate != null;
    }

    public ImmutableStudent withGraduationDate(LocalDate date) {
        return new ImmutableStudent(studentId, name, birthDate,
courses, grades, date);
    }

    public ImmutableStudent withAdditionalCourse(String course) {
        List<String> newCourses = new ArrayList<>(courses);
        newCourses.add(course);
        return new ImmutableStudent(studentId, name, birthDate,
newCourses, grades, graduationDate);
    }
```

```
    public ImmutableStudent withGrade(String course, double grade) {
        Map<String, Double> newGrades = new HashMap<>(grades);
        newGrades.put(course, grade);
        return new ImmutableStudent(studentId, name, birthDate,
courses, newGrades, graduationDate);
    }

    public ImmutableStudent withName(String newName) {
        return new ImmutableStudent(studentId, newName, birthDate,
courses, grades, graduationDate);
    }

    @Override
    public boolean equals(Object o) {
        if (this == o) return true;
        if (o == null || getClass() != o.getClass()) return false;
        ImmutableStudent that = (ImmutableStudent) o;
        return studentId.equals(that.studentId);
    }

    @Override
    public int hashCode() {
        return studentId.hashCode();
```

```
}

@Override
public String toString() {
    return "ImmutableStudent{" +
            "studentId='" + studentId + '\'' +
            ", name='" + name + '\'' +
            ", birthDate=" + birthDate +
            ", courses=" + courses +
            ", grades=" + grades +
            ", graduationDate=" + graduationDate +
            '}';
}

public static class Builder {
    private String studentId;
    private String name;
    private LocalDate birthDate;
    private List<String> courses = new ArrayList<>();
    private Map<String, Double> grades = new HashMap<>();
    private LocalDate graduationDate;

    public Builder studentId(String studentId) {
        this.studentId = studentId;
```

```
    return this;
}

public Builder name(String name) {
    this.name = name;
    return this;
}

public Builder birthDate(LocalDate birthDate) {
    this.birthDate = birthDate;
    return this;
}

public Builder courses(List<String> courses) {
    this.courses = new ArrayList<>(courses);
    return this;
}

public Builder grades(Map<String, Double> grades) {
    this.grades = new HashMap<>(grades);
    return this;
}

public Builder graduationDate(LocalDate graduationDate) {
```

```
            this.graduationDate = graduationDate;
            return this;
        }

        public ImmutableStudent build() {
            return new ImmutableStudent(studentId, name, birthDate,
courses, grades, graduationDate);
        }
    }

    public static void main(String[] args) {
        List<String> courses = Arrays.asList("Math", "Science");
        Map<String, Double> grades = new HashMap<>();
        grades.put("Math", 95.0);
        grades.put("Science", 87.0);

        ImmutableStudent student = new ImmutableStudent("S001",
"John",
                                        LocalDate.of(2000, 1, 1),
                                        courses, grades, null);

        ImmutableStudent graduatedStudent =
student.withGraduationDate(LocalDate.now());

        System.out.println("Original: " + student.getGPA());
```

```
        System.out.println("Graduated: " + graduatedStudent.getGPA());
    }
}
```