**Implement the following projects which focus on different aspects of Java programming, including:**

Object-Oriented Programming principles

Exception handling

File operations

Data structures

Input validation

User interface design

**1. Calculator Application**

Create a simple calculator that can perform basic operations (add, subtract, multiply, divide) using methods using object oriented programming in Java.

Key points:

- Use switch statement for operations

- Handle division by zero

- Implement input validation

Solution:

import java.util.Scanner;

//Custom exception for calculator operations

class CalculatorException extends Exception {

public CalculatorException(String message) {

super(message);

}

}

//Calculator operations interface

interface CalculatorOperations {

double add(double a, double b);

double subtract(double a, double b);

double multiply(double a, double b);

double divide(double a, double b) throws CalculatorException;

}

//Calculator implementation class

class Calculator implements CalculatorOperations {

@Override

public double add(double a, double b) {

return a + b;

}

@Override

public double subtract(double a, double b) {

return a - b;

}

@Override

public double multiply(double a, double b) {

return a \* b;

}

@Override

public double divide(double a, double b) throws CalculatorException {

if (b == 0) {

throw new CalculatorException("Division by zero is not allowed");

}

return a / b;

}

public double calculate(double num1, double num2, char operator) throws CalculatorException {

switch (operator) {

case '+':

return add(num1, num2);

case '-':

return subtract(num1, num2);

case '\*':

return multiply(num1, num2);

case '/':

return divide(num1, num2);

default:

throw new CalculatorException("Invalid operator: " + operator);

}

}

}

//Input validator class

class InputValidator {

public static void validateNumber(String input) throws CalculatorException {

try {

Double.parseDouble(input);

} catch (NumberFormatException e) {

throw new CalculatorException("Invalid number format: " + input);

}

}

public static void validateOperator(char operator) throws CalculatorException {

if (operator != '+' && operator != '-' && operator != '\*' && operator != '/') {

throw new CalculatorException("Invalid operator: " + operator);

}

}

}

//Main class with user interface

public class CalculatorApp {

private static final Calculator calculator = new Calculator();

private static final Scanner scanner = new Scanner(System.in);

public static void main(String[] args) {

while (true) {

try {

displayMenu();

// Get first number

System.out.print("Enter first number (or 'q' to quit): ");

String input = scanner.nextLine();

if (input.equalsIgnoreCase("q")) {

break;

}

InputValidator.validateNumber(input);

double num1 = Double.parseDouble(input);

// Get operator

System.out.print("Enter operator (+, -, \*, /): ");

char operator = scanner.nextLine().charAt(0);

InputValidator.validateOperator(operator);

// Get second number

System.out.print("Enter second number: ");

input = scanner.nextLine();

InputValidator.validateNumber(input);

double num2 = Double.parseDouble(input);

// Perform calculation

double result = calculator.calculate(num1, num2, operator);

System.out.printf("Result: %.2f %c %.2f = %.2f%n",

num1, operator, num2, result);

} catch (CalculatorException e) {

System.out.println("Error: " + e.getMessage());

} catch (Exception e) {

System.out.println("An unexpected error occurred: " + e.getMessage());

}

System.out.println("\nPress Enter to continue...");

scanner.nextLine();

}

System.out.println("Thank you for using the calculator!");

scanner.close();

}

private static void displayMenu() {

System.out.println("\n=== Simple Calculator ===");

System.out.println("Available operations:");

System.out.println("+ : Addition");

System.out.println("- : Subtraction");

System.out.println("\* : Multiplication");

System.out.println("/ : Division");

System.out.println("q : Quit");

System.out.println("=====================\n");

}

}

o/p

=== Simple Calculator ===

Available operations:

+ : Addition

- : Subtraction

\* : Multiplication

/ : Division

q : Quit

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Enter first number (or 'q' to quit): 6

Enter operator (+, -, \*, /): +

Enter second number: 8

Result: 6.00 + 8.00 = 14.00

Press Enter to continue...

=== Simple Calculator ===

Available operations:

+ : Addition

- : Subtraction

\* : Multiplication

/ : Division

q : Quit

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