COMSATS University Islamabad Abbottabad Campus

SUBMITTED BY: ZULQARNAIN HAIDER

REG #: SP24-BSE-179

SUBJECT: Data Structure Lab 2

SUBMITTED TO: Nauman khan

DATE: 10-09-2025

Q1: Pizza Billing System

```java
import java.util.Scanner;

public class PizzaBillingSystem {

    public static void main(String[] args) {
        Scanner input = new Scanner(System.in);
        int bill = 0;
        String size;

        while (true) {
            System.out.print("Enter pizza size (small/medium/large): ");
            size = input.nextLine().toLowerCase();

            if (size.equals("small")) {
                bill = 100;
                break;
            } else if (size.equals("medium")) {
                bill = 200;
                break;
            } else if (size.equals("large")) {
                bill = 300;
                break;
            } else {
                System.out.println("Invalid size! Please try again.\n");
            }
        }

        while (true) {
            System.out.print("Do you want pepperoni? (yes/no): ");
            String pepperoni = input.nextLine().toLowerCase();

            if (pepperoni.equals("yes")) {
                if (size.equals("small")) {
                    bill += 30;
                } else {
                    bill += 50;
                }
                break;
            } else if (pepperoni.equals("no")) {
                break;
            } else {
                System.out.println("Invalid input! Please enter yes or
no.\n");
            }
        }

        while (true) {
            System.out.print("Do you want extra cheese? (yes/no): ");
            String cheese = input.nextLine().toLowerCase();

            if (cheese.equals("yes")) {
                bill += 20;
                break;
            } else if (cheese.equals("no")) {
                break;
            } else {
                System.out.println("Invalid input! Please enter yes or
no.\n");
            }
        }

        System.out.println("\nYour Final Bill is: " + bill + " rupees");

        input.close();
    }
}
```

Output:

```
C:\Users\DELL\.jdks\openjdk-24.0.1\bin\java.exe "-javaagent:D:\Intellijet\IntelliJ IDEA Community
Edition 2025.1.4.1\lib\idea_rt.jar=49438" -Dfile.encoding=UTF-8 -Dsun.stdout.encoding=UTF-8 -
Dsun.stderr.encoding=UTF-8 -classpath
C:\Users\DELL\IdeaProjects\MarkingSystem\out\production\MarkingSystem PizzaBillingSystem
Enter pizza size (small/medium/large): mini
Invalid size! Please try again.

Enter pizza size (small/medium/large): small
Do you want pepperoni? (yes/no): yes
Do you want extra cheese? (yes/no): no

Your Final Bill is: 130 rupees

Process finished with exit code 0
```

Q2: Array Analyzer

```
import java.util.Scanner;
public class ArrayAnalyzer {

     public static void main(String[] args) {

          Scanner input = new Scanner(System.in);
          System.out.println("Enter the number of Element: ");
          int n = input.nextInt();
          int [] arr = new int[n];

          for(int i=0; i<n; i++)
          {
               System.out.println("Enter number "+(i+1)+":");
               arr[i] = input.nextInt();
          }
          int sum = 0, min = arr[0], max = arr[0];
          int evenCount = 0, oddCount = 0;

          for (int num : arr) {
               sum += num;

               if (num < min) min = num;
               if (num > max) max = num;

               if (num % 2 == 0)
                    evenCount++;
               else
                    oddCount++;
          }

          double average = (n > 0) ? (double) sum / n : 0;

          System.out.println(" Array Analyzer Results ");
          System.out.print("Array: ");
          for (int num : arr) {
               System.out.print(num + " ");
          }

          System.out.println("\nSum: " + sum);
          System.out.println("Average: " + average);
          System.out.println("Minimum: " + min);
          System.out.println("Maximum: " + max);
          System.out.println("Even numbers count: " +
evenCount);System.out.println("Odd numbers count: " + oddCount);

          System.out.print("Array in reverse order: ");
          for (int i = n - 1; i >= 0; i--) {
               System.out.print(arr[i] + " ");
          }
     }
}
```

Output:

```
C:\Users\DELL\.jdks\openjdk-24.0.1\bin\java.exe "-javaagent:D:\Intellijet\IntelliJ IDEA Community
Edition 2025.1.4.1\lib\idea_rt.jar=49489" -Dfile.encoding=UTF-8 -Dsun.stdout.encoding=UTF-8 -
Dsun.stderr.encoding=UTF-8 -classpath
C:\Users\DELL\IdeaProjects\MarkingSystem\out\production\MarkingSystem ArrayAnalyzer
Enter the number of Element:
5
Enter number 1:
5
Enter number 2:
6
Enter number 3:
7
Enter number 4:
8
Enter number 5:
9
 Array Analyzer Results
Array: 5 6 7 8 9
Sum: 35
Average: 7.0
Minimum: 5
Maximum: 9
Even numbers count: 2
Odd numbers count: 3
Array in reverse order: 9 8 7 6 5
Process finished with exit code 0
```

Q3: Utility Method Pack

```java
import java.util.Scanner;

public class UtilityMethodPack {

    public static int add(int a, int b) {
        return a + b;
    }

    public static int subtract(int a, int b) {
        return a - b;
    }

    public static long multiply(int a, int b) {
        return (long) a * b;
    }

    public static double divide(int a, int b) {
        if (b == 0) {
            System.out.println("Error: Cannot divide by zero!");
            return Double.NaN;
        }
        return (double) a / b;
    }

    public static int maxOfThree(int a, int b, int c) {
        int max = a;
        if (b > max) max = b;
        if (c > max) max = c;
        return max;
    }


    public static boolean isPrime(int n) {
        if (n <= 1) return false;
        for (int i = 2; i <= Math.sqrt(n); i++) {
            if (n % i == 0)
                return false;
        }
        return true;
    }

    public static void main(String[] args) {
        Scanner sc = new Scanner(System.in);

        System.out.print("Enter first number: ");
        int x = sc.nextInt();
        System.out.print("Enter second number: ");
        int y = sc.nextInt();

        System.out.println("\n--- Utility Method Pack Results ---");
        System.out.println("Addition: " + add(x, y));
        System.out.println("Subtraction: " + subtract(x, y));
        System.out.println("Multiplication: " + multiply(x, y));
        System.out.println("Division: " + divide(x, y));

        System.out.print("\nEnter three numbers to find maximum:\n");
        int a = sc.nextInt();
        int b = sc.nextInt();
        int c = sc.nextInt();
        System.out.println("Maximum of three: " + maxOfThree(a, b,
c));
        System.out.print("\nEnter a number to check if it is prime: ");
        int num = sc.nextInt();
        System.out.println(num + " is prime? " + isPrime(num));

        sc.close();
    }
}
```

Output:

```
C:\Users\DELL\.jdks\openjdk-24.0.1\bin\java.exe "-javaagent:D:\Intellijet\IntelliJ IDEA Community
Edition 2025.1.4.1\lib\idea_rt.jar=49522" -Dfile.encoding=UTF-8 -Dsun.stdout.encoding=UTF-8 -
Dsun.stderr.encoding=UTF-8 -classpath
C:\Users\DELL\IdeaProjects\MarkingSystem\out\production\MarkingSystem UtilityMethodPack
Enter first number: 9
Enter second number: 8

--- Utility Method Pack Results ---
Addition: 17
Subtraction: 1
Multiplication: 72
Division: 1.125

Enter three numbers to find maximum:
```

Q4: Method Overloading: Area Calculator

```java
import java.util.Scanner;

public class AreaCalculator {
    public static double area(double radius) {
        return Math.PI * radius * radius;
    }

    public static double area(double length, double width) {
        return length * width;
    }

    public static double areaSquare(double side) {
        return side * side;
    }

    public static void main(String[] args) {
        Scanner sc = new Scanner(System.in);

        System.out.print("Enter radius of circle: ");
        double r = sc.nextDouble();
        System.out.println("Area of Circle = " + area(r));

        System.out.print("\nEnter length of rectangle: ");
        double l = sc.nextDouble();
        System.out.print("Enter width of rectangle: ");
        double w = sc.nextDouble();
        System.out.println("Area of Rectangle = " + area(l,
w));
        System.out.print("\nEnter side of square: ");
        double s = sc.nextDouble();
        System.out.println("Area of Square = " +
areaSquare(s));
        sc.close();
    }
}
```

Output:

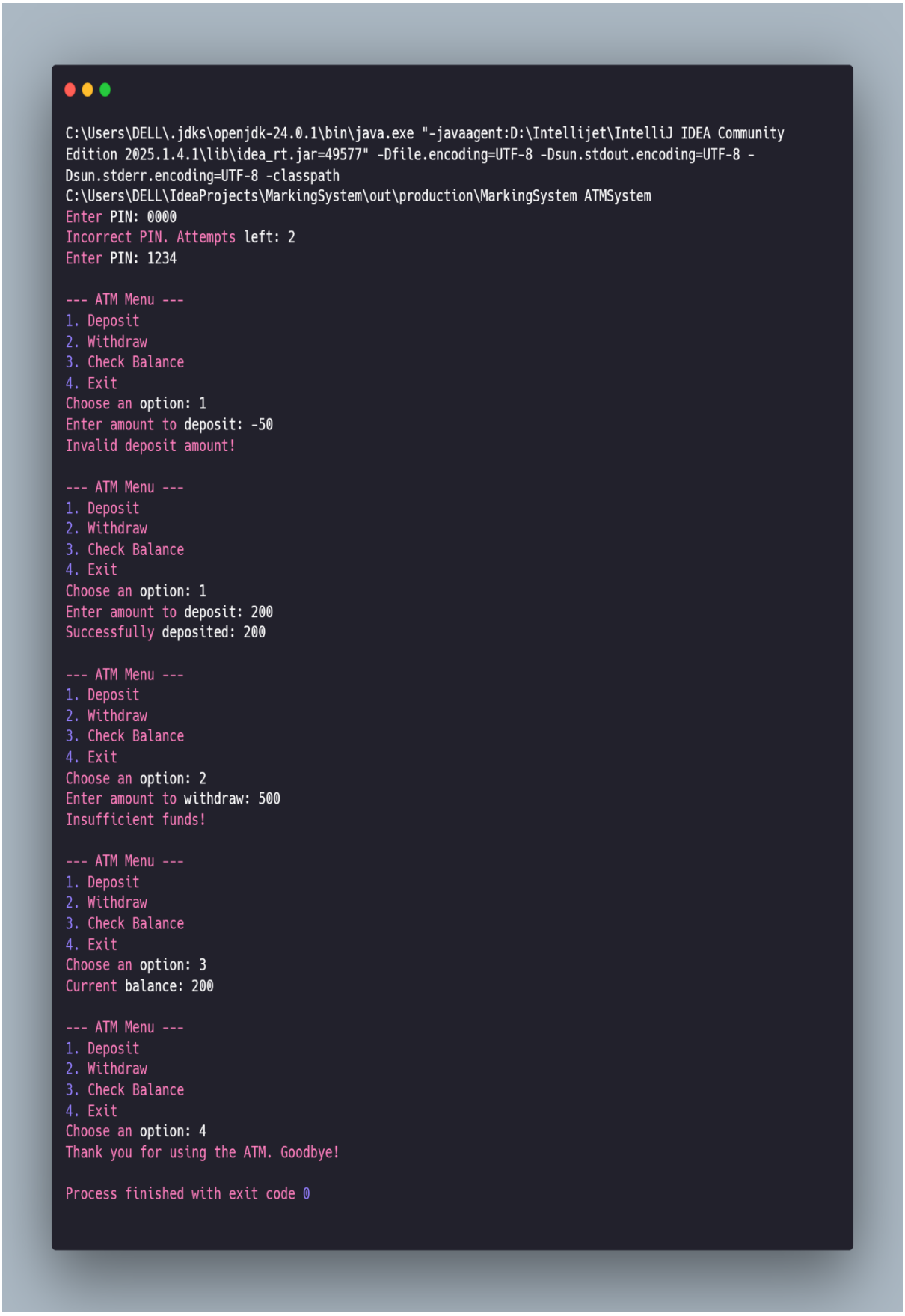
```
C:\Users\DELL\.jdks\openjdk-24.0.1\bin\java.exe "-javaagent:D:\Intellijet\IntelliJ IDEA Community
Edition 2025.1.4.1\lib\idea_rt.jar=49547" -Dfile.encoding=UTF-8 -Dsun.stdout.encoding=UTF-8 -
Dsun.stderr.encoding=UTF-8 -classpath
C:\Users\DELL\IdeaProjects\MarkingSystem\out\production\MarkingSystem AreaCalculator
Enter radius of circle: 8
Area of Circle = 201.06192982974676

Enter length of rectangle: 8
Enter width of rectangle: 5
Area of Rectangle = 40.0

Enter side of square: 6
Area of Square = 36.0

Process finished with exit code 0
```

Q5: Mini Projects

Project 1: ATM Simulation System

```java
import java.util.Scanner;

public class ATMSystem {
    private static int balance = 0;

    public static void deposit(int amount) {
        if (amount > 0) {
            balance += amount;
            System.out.println("Successfully deposited: " + amount);
        } else {
            System.out.println("Invalid deposit amount!");
        }
    }

    public static void withdraw(int amount) {
        if (amount <= 0) {
            System.out.println("Invalid withdrawal amount!");
        } else if (amount > balance) {
            System.out.println("Insufficient funds!");
        } else {
            balance -= amount;
            System.out.println("Successfully withdrawn: " + amount);
        }
    }

    public static void checkBalance() {
        System.out.println("Current balance: " + balance);
    }

    public static void main(String[] args) {
        Scanner sc = new Scanner(System.in);
        final int PIN = 1234;
        boolean loggedIn = false;

        for (int i = 1; i <= 3; i++) {
            System.out.print("Enter PIN: ");
            int enteredPin = sc.nextInt();

            if (enteredPin == PIN) {
                loggedIn = true;
                break;
            } else {
                System.out.println("Incorrect PIN. Attempts left: " + (3 - i));
            }
        }

        if (!loggedIn) {
            System.out.println("Account locked! Too many wrong attempts.");
            sc.close();
            return;
        }

        while (true) {
            System.out.println("\n--- ATM Menu ---");
            System.out.println("1. Deposit");
            System.out.println("2. Withdraw");
            System.out.println("3. Check Balance");
            System.out.println("4. Exit");
            System.out.print("Choose an option: ");

            int choice = sc.nextInt();

            switch (choice) {
                case 1:
                    System.out.print("Enter amount to deposit: ");
                    int dep = sc.nextInt();
                    deposit(dep);
                    break;

                case 2:
                    System.out.print("Enter amount to withdraw: ");
                    int wit = sc.nextInt();
                    withdraw(wit);
                    break;

                case 3:
                    checkBalance();
                    break;

                case 4:
                    System.out.println("Thank you for using the ATM.
Goodbye!");
                    sc.close();
                    break;

                default:
                    System.out.println("Invalid option! Try again.");
                    continue;
            }
            if (choice == 4) break;
        }
    }
}
```

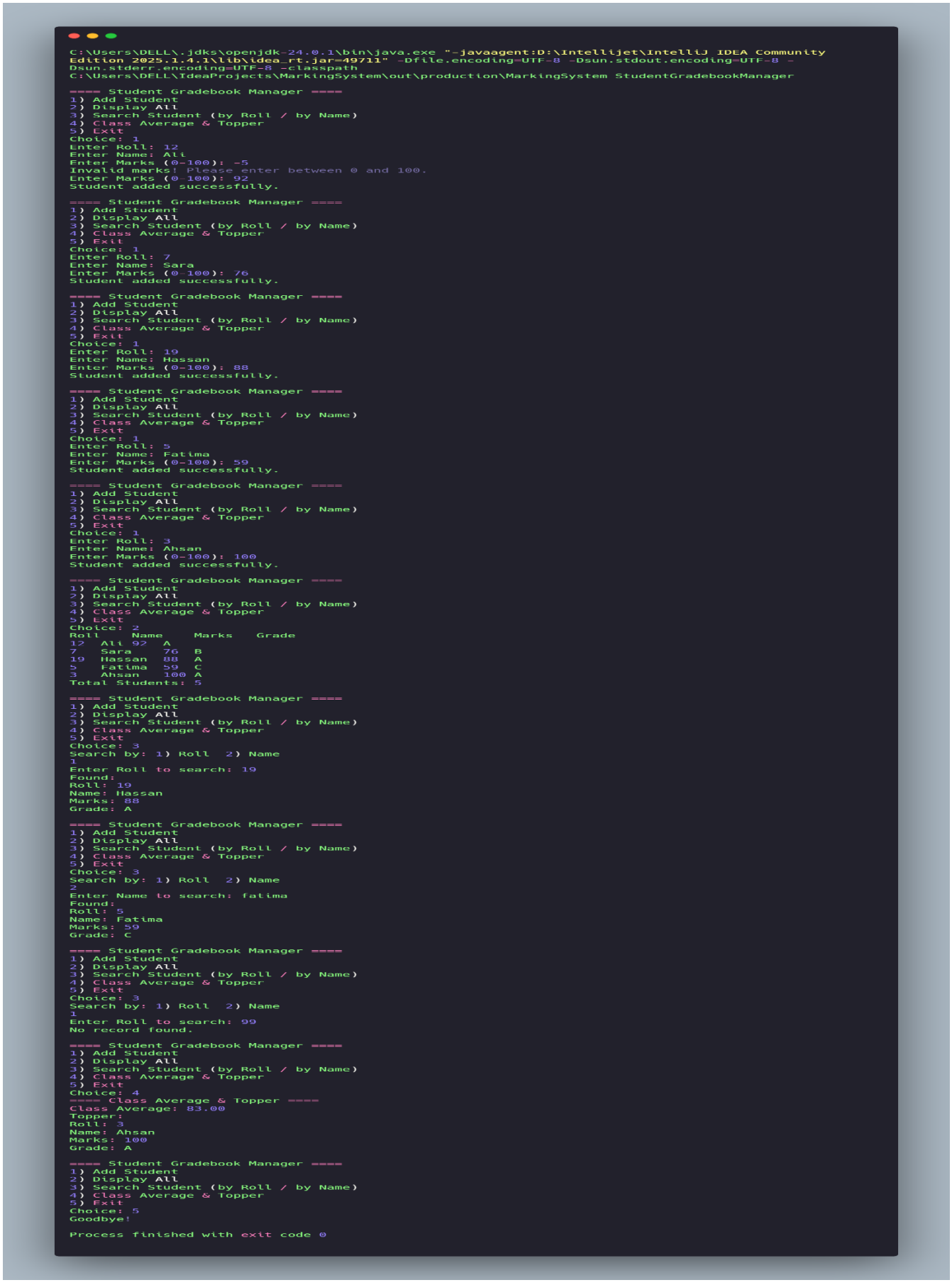
Output:


C:\Users\DELL\.jdks\openjdk-24.0.1\bin\java.exe "-javaagent:D:\Intellijet\IntelliJ IDEA Community Edition 2025.1.4.1\lib\idea_rt.jar=49577" -Dfile.encoding=UTF-8 -Dsun.stdout.encoding=UTF-8 -Dsun.stderr.encoding=UTF-8 -classpath C:\Users\DELL\IdeaProjects\MarkingSystem\out\production\MarkingSystem ATMSystem
Enter PIN: 0000
Incorrect PIN. Attempts left: 2
Enter PIN: 1234
--- ATM Menu ---
1. Deposit
2. Withdraw
3. Check Balance
4. Exit
Choose an option: 1
Enter amount to deposit: -50
Invalid deposit amount!
--- ATM Menu ---
1. Deposit
2. Withdraw
3. Check Balance
4. Exit
Choose an option: 1
Enter amount to deposit: 200
Successfully deposited: 200
--- ATM Menu ---
1. Deposit
2. Withdraw
3. Check Balance
4. Exit
Choose an option: 2
Enter amount to withdraw: 500
Insufficient funds!
--- ATM Menu ---
1. Deposit
2. Withdraw
3. Check Balance
4. Exit
Choose an option: 3
Current balance: 200
--- ATM Menu ---
1. Deposit
2. Withdraw
3. Check Balance
4. Exit
Choose an option: 4
Thank you for using the ATM. Goodbye!
Process finished with exit code 0

Project 2: Student Gradebook Manager:

```java
import java.util.Scanner;

public class StudentGradebookManager {
    static final int MAX = 50;
    static int[] roll = new int[MAX];
    static String[] name = new String[MAX];
    static int[] marks = new int[MAX];
    static int count = 0;

    public static void addStudent(int r, String n, int m) {
        roll[count] = r;
        name[count] = n;
        marks[count] = m;
        count++;
        System.out.println("Student added successfully.");
    }

    public static void displayAll() {
        if (count == 0) {
            System.out.println("No students available.");
            return;
        }

        System.out.println("Roll\tName\tMarks\tGrade");
        for (int i = 0; i < count; i++) {
            System.out.println(roll[i] + "\t" + name[i] + "\t" + marks[i] + "\t" +
grade(marks[i]));
        }
        System.out.println("Total Students: " + count);
    }

    public static void search(int r) {
        boolean found = false;
        for (int i = 0; i < count; i++) {
            if (roll[i] == r) {
                System.out.println("Found:");
                System.out.println("Roll: " + roll[i]);
                System.out.println("Name: " + name[i]);
                System.out.println("Marks: " + marks[i]);
                System.out.println("Grade: " + grade(marks[i]));
                found = true;
                break;
            }
        }
        if (!found) System.out.println("No record found.");
    }

    public static void search(String n) {
        boolean found = false;
        for (int i = 0; i < count; i++) {
            if (name[i].equalsIgnoreCase(n)) {
                System.out.println("Found:");
                System.out.println("Roll: " + roll[i]);
                System.out.println("Name: " + name[i]);
                System.out.println("Marks: " + marks[i]);
                System.out.println("Grade: " + grade(marks[i]));
                found = true;
                break;
            }
        }
        if (!found) System.out.println("No record found.");
    }

    public static double computeAverage(int[] marks, int count) {
        if (count == 0) return 0;
        int sum = 0;
        for (int i = 0; i < count; i++) sum += marks[i];
        return (double) sum / count;
    }

    public static String grade(int m) {
        if (m >= 85) return "A";
        else if (m >= 70) return "B";
        else if (m >= 50) return "C";
        else return "F";
    }

    public static void main(String[] args) {
        Scanner sc = new Scanner(System.in);

        while (true) {
            System.out.println("\n---- Student Gradebook Manager ----");
            System.out.println("1) Add Student");
            System.out.println("2) Display All");
            System.out.println("3) Search Student (by Roll / by Name)");
            System.out.println("4) Class Average & Topper");
            System.out.println("5) Exit");
            System.out.print("Choice: ");
            int choice = sc.nextInt();

            switch (choice) {
                case 1:
                    System.out.print("Enter Roll: ");
                    int r = sc.nextInt();
                    sc.nextLine();
                    System.out.print("Enter Name: ");
                    String n = sc.nextLine();
                    int m;
                    while (true) {
                        System.out.print("Enter Marks (0-100): ");
                        m = sc.nextInt();
                        if (m >= 0 && m <= 100) break;
                        else System.out.println("Invalid marks! Please enter between 0 and 100.");
                    }
                    addStudent(r, n, m);
                    break;

                case 2:
                    displayAll();
                    break;

                case 3:
                    System.out.println("Search by: 1) Roll  2) Name");
                    int opt = sc.nextInt();
                    sc.nextLine();
                    if (opt == 1) {
                        System.out.print("Enter Roll to search: ");
                        search(sc.nextInt());
                    } else if (opt == 2) {
                        System.out.print("Enter Name to search: ");
                        search(sc.nextLine());
                    } else {
                        System.out.println("Invalid option!");
                        continue;
                    }
                    break;

                case 4:
                    if (count == 0) {
                        System.out.println("No students available.");
                    } else {
                        System.out.println("---- Class Average & Topper ----");
                        double avg = computeAverage(marks, count);
                        System.out.printf("Class Average: %.2f\n", avg);

                        int maxMarks = marks[0];
                        int idx = 0;
                        for (int i = 1; i < count; i++) {
                            if (marks[i] > maxMarks) {
                                maxMarks = marks[i];
                                idx = i;
                            }
                        }
                        System.out.println("Topper:");
                        System.out.println("Roll: " + roll[idx]);
                        System.out.println("Name: " + name[idx]);
                        System.out.println("Marks: " + marks[idx]);
                        System.out.println("Grade: " + grade(marks[idx]));
                    }
                    break;

                case 5:
                    System.out.println("Goodbye!");
                    sc.close();
                    return;

                default:
                    System.out.println("Invalid choice! Try again.");
                    continue;
            }
        }
    }
}
```

Output:



```
C:\Users\DELL\.jdks\openjdk-24.0.1\bin\java.exe "-javaagent:D:\Intellijet\IntelliJ IDEA Community
Edition 2025.1.4.1\lib\idea_rt.jar=49711" -Dfile.encoding=UTF-8 -Dsun.stdout.encoding=UTF-8 -
Dsun.stderr.encoding=UTF-8 -classpath
C:\Users\DELL\IdeaProjects\MarkingSystem\out\production\MarkingSystem StudentGradebookManager

==== Student Gradebook Manager ====
1) Add Student
2) Display All
3) Search Student (by Roll / by Name)
4) Class Average & Topper
5) Exit
Choice: 1
Enter Roll: 12
Enter Name: Ali
Enter Marks (0-100): -5
Invalid marks! Please enter between 0 and 100.
Enter Marks (0-100): 92
Student added successfully.

==== Student Gradebook Manager ====
1) Add Student
2) Display All
3) Search Student (by Roll / by Name)
4) Class Average & Topper
5) Exit
Choice: 1
Enter Roll: 7
Enter Name: Sara
Enter Marks (0-100): 76
Student added successfully.

==== Student Gradebook Manager ====
1) Add Student
2) Display All
3) Search Student (by Roll / by Name)
4) Class Average & Topper
5) Exit
Choice: 1
Enter Roll: 19
Enter Name: Hassan
Enter Marks (0-100): 88
Student added successfully.

==== Student Gradebook Manager ====
1) Add Student
2) Display All
3) Search Student (by Roll / by Name)
4) Class Average & Topper
5) Exit
Choice: 1
Enter Roll: 5
Enter Name: Fatima
Enter Marks (0-100): 59
Student added successfully.

==== Student Gradebook Manager ====
1) Add Student
2) Display All
3) Search Student (by Roll / by Name)
4) Class Average & Topper
5) Exit
Choice: 1
Enter Roll: 3
Enter Name: Ahsan
Enter Marks (0-100): 100
Student added successfully.

==== Student Gradebook Manager ====
1) Add Student
2) Display All
3) Search Student (by Roll / by Name)
4) Class Average & Topper
5) Exit
Choice: 2
Roll    Name    Marks   Grade
12   Ali 92  A
7    Sara    76  B
19   Hassan  88  A
5    Fatima  59  C
3    Ahsan   100 A
Total Students: 5

==== Student Gradebook Manager ====
1) Add Student
2) Display All
3) Search Student (by Roll / by Name)
4) Class Average & Topper
5) Exit
Choice: 3
Search by: 1) Roll  2) Name
1
Enter Roll to search: 19
Found:
Roll: 19
Name: Hassan
Marks: 88
Grade: A

==== Student Gradebook Manager ====
1) Add Student
2) Display All
3) Search Student (by Roll / by Name)
4) Class Average & Topper
5) Exit
Choice: 3
Search by: 1) Roll  2) Name
2
Enter Name to search: fatima
Found:
Roll: 5
Name: Fatima
Marks: 59
Grade: C

==== Student Gradebook Manager ====
1) Add Student
2) Display All
3) Search Student (by Roll / by Name)
4) Class Average & Topper
5) Exit
Choice: 3
Search by: 1) Roll  2) Name
1
Enter Roll to search: 99
No record found.

==== Student Gradebook Manager ====
1) Add Student
2) Display All
3) Search Student (by Roll / by Name)
4) Class Average & Topper
5) Exit
Choice: 4
==== Class Average & Topper ====
Class Average: 83.00
Topper:
Roll: 3
Name: Ahsan
Marks: 100
Grade: A

==== Student Gradebook Manager ====
1) Add Student
2) Display All
3) Search Student (by Roll / by Name)
4) Class Average & Topper
5) Exit
Choice: 5
Goodbye!

Process finished with exit code 0
```