Lab #03

"Data Structures and Algorithms"

Exercises

Lab Tasks:

1. Write a program that takes an integer value (k) as input and prints the sequence of numbers from k to 0 in descending order.

- Input:

```java
import java.util.Scanner;

public class JavaApplication3Aneeq230 {

    // Recursive method to print sequence from k to 0
    public static void printDescending(int k) {
        // Base case: if k is less than 0, stop recursion
        if (k == 0) {
            return;
        }
        // Print the current value of k
        System.out.print(k + " ");
        // Recursive call with k - 1
        printDescending(k - 1);
    }

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

        // Input from the user
        System.out.print("Enter integer value for k: ");
        int k = scanner.nextInt();
        printDescending(k);
    }
}
```

Output:

```
Enter integer value for k: 5
5 4 3 2 1 BUILD SUCCESSFUL (total time: 1 second)
```

2. Write a program to reverse your full name using Recursion.

- Input:

```java
import java.util.Scanner;

public class JavaApplication3Aneeq230 {
    public static void main(String[] args) {
        Scanner scanner=new Scanner(System.in);
        System.out.println("Enter your full Name: ");
        String name=scanner.nextLine();
        System.out.println("Reversed Name: ");
        reverse(name);
    }
    public static void reverse(String name) {
        if (name.isEmpty()) {
            return;
        }
        reverse(name.substring(1));
        System.out.println(name.charAt(0));
    }
}
```

Output:

```
Enter your full Name:
Aneeq Shams
Reversed Name:
s
m
a
h
s

q
e
e
n
A
```

3. Write a program to calculate the sum of numbers from 1 to N using recursion. N should be user input.

- Input:

```java
import java.util.Scanner;

public class JavaApplication3Aneeq230 {
    public static int calculateSum(int N) {
        return (N == 1) ? 1 : N + calculateSum(N - 1);
    }

    public static void main(String[] args) {
        Scanner scanner = new Scanner(System.in);
        System.out.print("Enter an integer value (N): ");
        int N = scanner.nextInt();
        System.out.println("Sum from 1 to " + N + " is: " + calculateSum(N));
    }
}
```

Output:

```
run:
Enter an integer value (N): 5
Sum from 1 to 5 is: 15
```

4. Write a recursive program to calculate the sum of elements in an array

- Input:

```java
public class JavaApplication3Aneeq230 {
    public static int sumArray(int[] arr, int n) {

        if (n <= 0) {
            return 0;
        }

        return arr[n - 1] + sumArray(arr, n - 1);
    }

    public static void main(String[] args) {
        int[] array = {1, 2, 3, 4, 5};
        int sum = sumArray(array, array.length);
        System.out.println("Sum of array elements: " + sum);
    }
}
```

Output:
```
run:
Sum of array elements: 15
```

5. Write a recursive program to calculate the factorial of a given integer n

- Input:

```java
import java.util.Scanner;

public class JavaApplication3Aneeq230 {
    public static int factorial(int n) {
        return (n <= 1) ? 1 : n * factorial(n - 1);
    }
    public static void main(String[] args) {
        Scanner scanner = new Scanner(System.in);
        System.out.print("Enter an integer: ");
        int n = scanner.nextInt();

        System.out.println("Factorial of " + n + " is: " + factorial(n));
    }
}
```

   Output:
```
run:
Enter a positive integer: 3
Factorial of 3 is: 6
```

6. Write a program to count the digits of a given number using recursion

- Input:
```java
import java.util.Scanner;
public class JavaApplication3Aneeq230 {
    public static int countDigits(int n) {
        return (n == 0) ? 0 : 1 + countDigits(n / 10);
    }
    public static void main(String[] args) {
        Scanner scanner = new Scanner(System.in);
        System.out.print("Enter a number: ");
        int n = scanner.nextInt();
        System.out.println("Number of digits: " + countDigits(Math.abs(n)));
    }
}
```

   Output:
```
run:
Enter a number: 123
Number of digits: 3
```

Home Tasks:

1. Write a java program to find the N-th term in the Fibonacci series using Memoization.

- Input:

```java
import java.util.Scanner;

public class JavaApplication3Aneeq230 {
    private static int[] memo = new int[1000]; // Memo array with default 0 values

    public static int fibonacci(int n) {
        if (n <= 1) return n;
        if (memo[n] != 0) return memo[n];
        return memo[n] = fibonacci(n - 1) + fibonacci(n - 2);
    }

    public static void main(String[] args) {
        Scanner scanner = new Scanner(System.in);
        System.out.print("Enter the term N: ");
        int n = scanner.nextInt();

        System.out.println("The " + n + "-th term in the Fibonacci series is: " + fibonacci(n));
        scanner.close();
    }
}
```

Output:

```
run:
Enter the term N: 6
The 6-th term in the Fibonacci series is: 8
```

2. Write a program to count the digits of a given number using recursion.

- Input:

```java
import java.util.Scanner;

public class JavaApplication3Aneeq230 {
    public static int countDigits(int n) {
        return (n == 0) ? 0 : 1 + countDigits(n / 10);
    }

    public static void main(String[] args) {
        Scanner scanner = new Scanner(System.in);
        System.out.print("Enter a number: ");
        int n = (scanner.nextInt());

        System.out.println("Number of digits: " + (n == 0 ? 1 : countDigits(n)));
    }
}
```

Output:

```
run:
Enter a number: 234
Number of digits: 3
```

3. Write a java program to check whether a given string is a palindrome or not. A palindrome is a string that reads the same forwards and backwards.Print "YES" if the string is a palindrome, otherwise print "NO"

- Input:

```java
import java.util.Scanner;

public class JavaApplication3Aneeq230 {
    public static boolean isPalindrome(String str, int start, int end) {
        if (start >= end) return true; // Base case: All characters checked
        return (str.charAt(start) == str.charAt(end)) && isPalindrome(str, start + 1, end - 1);
    }

    public static void main(String[] args) {
        Scanner scanner = new Scanner(System.in);
        System.out.print("Enter a string: ");
        String str = scanner.nextLine();

        System.out.println(isPalindrome(str, 0, str.length() - 1) ? "YES" : "NO");
        scanner.close();
    }
}
```

Output:

```
run:
Enter a string: rotator
YES
```

4. Write a recursive program to find the greatest common divisor (GCD) of two numbers using Euclid's algorithm.

- Input:

```java
import java.util.Scanner;

public class JavaApplication3Aneeq230 {
    public static int gcd(int a, int b) {
        return (b == 0) ? a : gcd(b, a % b);
    }

    public static void main(String[] args) {
        Scanner scanner = new Scanner(System.in);
        System.out.print("Enter two numbers: ");
        int a = scanner.nextInt();
        int b = scanner.nextInt();

        System.out.println("GCD is: " + gcd(a, b));
    }
}
```

Output:

```
run:
Enter two numbers: 54 62
GCD is: 2
```