C-DAC Mumbai

Subject: Algorithm and Data Structure
Assignment 1

Solve the assignment with following thing to be added in each question.

-Program
-Flow chart
-Explanation
-Output
-Time and Space complexity

1. Armstrong Number
Problem: Write a Java program to check if a given number is an Armstrong number.

Test Cases:

Input: 153
Output: true
Input: 123
Output: false
Program code:

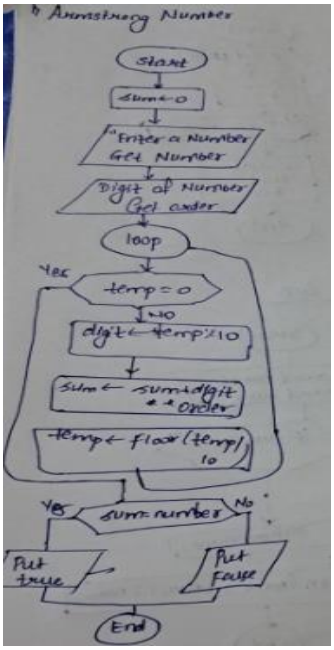
```
import java.util.Scanner;

public class Armstrong {
public static void main(String[] args) {
    Scanner sc = new Scanner(System.in);
    System.out.println("Enter a Number:");
    int num = sc.nextInt();

    int n1 = num;
    int result = 0, rem, n = 0;

    while (num != 0) {
        num /= 10;
        n++;
    }
    num = n1;
    while (num != 0) {
        rem = num % 10;
        result += Math.pow(rem, n);
        num /= 10;
    }
    if (n1 == result) {
        System.out.println(n1 + " is an Armstrong number.");
    } else {
```

```
            System.out.println(n1 + " is not an Armstrong number.");
        }
    }
}
```

Output:

```
D:\FOLDER\Assignment1_ADS>java Armstrong
Enter a Number:
153
153 is an Armstrong number.

D:\FOLDER\Assignment1_ADS>java Armstrong
Enter a Number:
123
123 is not an Armstrong number.
```

Flow Chart:



Code Explanation:

- Enter a number and stores it in num.
- It first counts the number of digits in the number (n) by repeatedly dividing num by 10.
- Then, it calculates the sum of each digit raised to the power of n using Math.pow().
- Finally, we checks if the sum is equal to the original number (n1). If true, it declares it as an Armstrong number; otherwise, it is not an armstromg number.

Time complexity: Olog(n)
Space complexity: O(1)

2. Prime Number
Problem: Write a Java program to check if a given number is prime.

Test Cases:

Input: 29

Output: true
Input: 15
Output: false
Program code:

```
import java.util.Scanner;
public class PrimeNumber{
public static void main(String[] args){
        Scanner sc = new Scanner(System.in);

        System.out.print("Enter a number: ");
        int number = sc.nextInt();

        boolean isPrime = true;
        if(number <= 1){
                isPrime = false;
        }
        else{
                for(int i = 2; i<number;i++){
                        if(number % i == 0){
                                isPrime = false;
                                break;
                        }
                }
        }

        if(isPrime){
                System.out.println( number +" is a prime number");
        }
        else{
                System.out.println(number + " is not a prime number");
        }
        sc.close();
 }
}
```

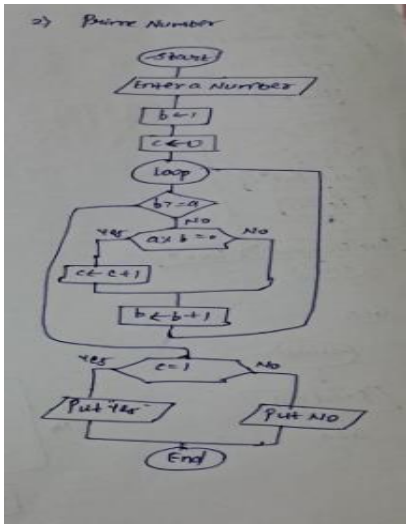
Output:

```
D:\FOLDER\Assignment1_ADS>java PrimeNumber
Enter a number:
29
29 is a prime number

D:\FOLDER\Assignment1_ADS>java PrimeNumber
Enter a number:
15
15 is not a prime number
```

Code Explanation:

- The function takes an integer n as input.
- It determines if a number is prime or not by comparing it to one.
- If the number is bigger than 1, it checks to see if it is divisible by any value in this range by looping from 2 to number-1.
- The number is indicated as not prime if a divisor is identified; if not, it is prime.

Flow chart:



Time Complexity:

- **Worst case:** O(N), where N is the input number. The for loop runs up to N-2 times, checking for divisors.
- **Best case:** O(1),

Space complexity: O(1)

3. Factorial

Problem: Write a Java program to compute the factorial of a given number.

Test Cases:

Input: 5
Output: 120
Input: 0
Output: 1

Program:

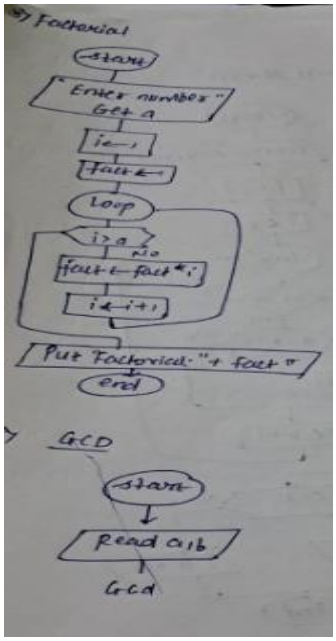
```
class Factorial{

    static int fact(int n) {
        if (n <= 1) {
            return 1;
        } else {
            return n * fact(n - 1);
        }
    }

    public static void main(String args[]) {
        System.out.println(fact(5));
```

```
        }
    }
```

Output:

```
D:\FOLDER\Assignment1_ADS>java Factorial
120
```

Flow chart:



Code Explanation:

• The factorial of a given number n can be found using the recursive function fact().
• The basic case returns 1 as the factorial of 0 and 1 is 1 after determining whether n is less than or equal to 1.
• Otherwise, the method recursively calls itself with n-1, multiplying n with the factorial of n-1 until it reaches the base case.
• The program runs fact(5) in the main() method and outputs the result (5! = 120).

Time complexity: O(n)

Space complexity: O(n)

4. Fibonacci Series
Problem: Write a Java program to print the first n numbers in the Fibonacci series.

Test Cases:

Input: n = 5
Output: [0, 1, 1, 2, 3]
Input: n = 8
Output: [0, 1, 1, 2, 3, 5, 8, 13]

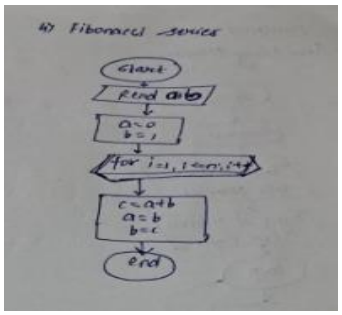
Programing code:

```
import  java.util.Scanner;
public class Fibonacci{
	public static void main(String[] arge){
		Scanner sc = new Scanner(System.in);
		System.out.println("Enter number for fibseq: ");
		int n = sc.nextInt();
		int a = 0;
		int b = 1;

		System.out.println(" fibonacci series: ");

		for(int i = 1; i<=n;i++){
			System.out.println(a);
			int c = a+b;
			a = b;
			b = c;
		}
	sc.close();
	}

}
```

Output:

```
D:\FOLDER\Assignment1_ADS>java Fibonacci.java
Enter number for fibseq:
5
 fibonacci series:
0
1
1
2
3

D:\FOLDER\Assignment1_ADS>java Fibonacci.java
Enter number for fibseq:
8
 fibonacci series:
0
1
1
2
3
5
8
13
```

Flowchart:



5. Find GCD
Problem: Write a Java program to find the Greatest Common Divisor (GCD) of two numbers.

Test Cases:

Input: a = 54, b = 24
Output: 6
Input: a = 17, b = 13
Output: 1

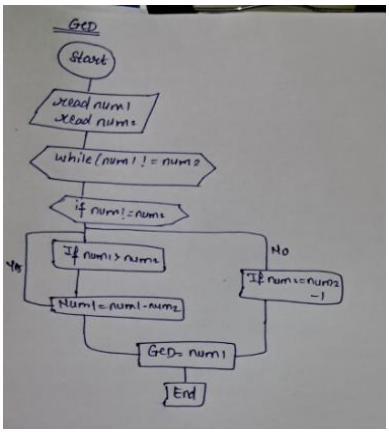
Program code:

```
import java.util.Scanner;
public class GCD {
private static int gcd(int n1, int n2) {
if(n2==0)
return n1;
return gcd(n2,n1%n2);
}
public static void main(String[] args) {
Scanner sc=new Scanner(System.in);
System.out.println("Enter Two Number:");
int n1=sc.nextInt();
int n2=sc.nextInt();
System.out.println("GCD:"+gcd(n1,n2));
}
}
```

Output:

```
D:\FOLDER\Assignment1_ADS>java GCD
Enter Two Number:
54 24
GCD:6
```

Flow chart:



Explaination:
Initialize Numbers the two numbers are taken from the user and passed to the function, which checks to see if n2 is equal to 0 and returns n1 otherwise performing a recursion.

Time Complexity: O(log(n))
Space Complexity: O(log(n))

6. Find Square Root
Problem: Write a Java program to find the square root of a given number (using integer approximation).

Test Cases:

Input: x = 16
Output: 4
Input: x = 27
Output: 5

Program code:

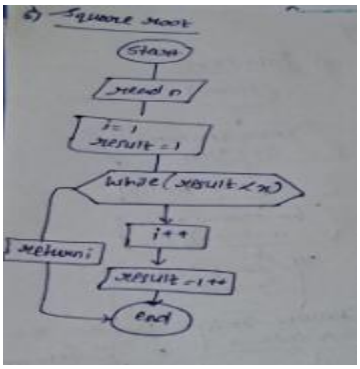
```
import java.util.Scanner;
public class Squareroot{
static int Sqrt(int x)
{
if (x == 0 || x == 1)
return x;
int i = 1, result = 1;
while (result < x) {
i++;
result = i * i;
}
return i ;
}
public static void main(String[] args)
{
Scanner sc=new Scanner(System.in);
System.out.println("Enter a number:");
```

```
int x = sc.nextInt();
System.out.print("Square Root:"+Sqrt(x));
}
}
```

Output:

```
D:\FOLDER\Assignment1_ADS>java Squareroot.java
Enter a number:
16
Square Root:4
```

Flow chart:



Code Explanation:

Take input Number number from user check number is 0 or 1 it is 0 or 1 then return that number.then use the while condition to set I=1 and result=1; if the result is less than num, then increment I and execute result=i*I.

Time Complexity: O(1)
Space Complexity: O(1)

7. Find Repeated Characters in a String

Problem: Write a Java program to find all repeated characters in a string.

Test Cases:

Input: "programming"
Output: ['r', 'g', 'm']
Input: "hello"
Output: ['l']

Program code:

```
import java.util.Scanner;
public class RepeatedCharacters {
private static void findRepeat(String str) {
char[] c=str.toCharArray();
System.out.println("Repeated Character:");
for(int i=0;i<str.length();i++) {
for(int j=i+1;j<str.length();j++)
{
```

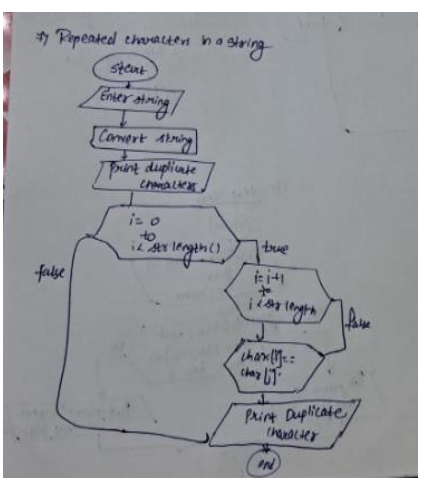
```
if(c[i]==c[j])
{
System.out.print(c[j]+" ");
   }
  }
 }
}
public static void main(String[] args) {
Scanner sc=new Scanner(System.in);
System.out.println("Enter a String:");
String str=sc.nextLine();
findRepeat(str);
 }
}
```

Output:

```
D:\FOLDER\Assignment1_ADS>java RepeatedCharacters
Enter a String:
programming
Repeated Character:
r g m
D:\FOLDER\Assignment1_ADS>java RepeatedCharacters
Enter a String:
hello
Repeated Character:
l
D:\FOLDER\Assignment1_ADS>
```

Time Complexity: O(n)
Space Complexity: O(1)

Flow chart:



Code Explanation:

Using a for loop and a string converter from the user, convert the input string to char using to Char Array. If char[I]==char[j], the value is saved in char[j] and printed.

8. First Non-Repeated Character
Problem: Write a Java program to find the first non-repeated character in a string.

Test Cases:

Input: "stress"
Output: 't'
Input: "aabbcc"
Output: null

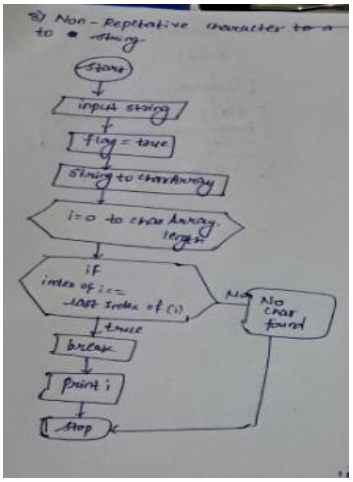
Program code:

```
import java.util.Scanner;
public class NonRepeatedCharacter{
	public static void main(String[] args){
		Scanner sc = new Scanner(System.in);
		System.out.print("Enter String: ");
		String str = sc.nextLine();
		char[] arr = str.toCharArray();

		for(int i=0; i<arr.length; i++)
		{
			for(int j=i+1; j<arr.length; j++)
			{
				if(arr[i] != arr[j])
				{
					System.out.println(arr[j]);
					System.exit(0);

				}
				else
				{
					System.out.println("null");
					System.exit(0);
				}
			}
		}

	}
}
```

Output:

```
D:\FOLDER\Assignment1_ADS>java NonRepeatedCharacter.java
Enter String: stress
t

D:\FOLDER\Assignment1_ADS>java NonRepeatedCharacter.java
Enter String: aabbcc
null
```

Flow chart:



Code Explanation:

1. First we set string and converts the string to a character array (arr).
2. It uses two nested loops to compare each character with the subsequent ones in the array.
3. If the character at index i is not equal to the character at index j (first non-repeated), it prints the character and exits.
4. If the characters are equal (repeated), it prints "null" and exits the program immediately.

Time complexity: $O(n^2)$
Space complexity: $O(1)$

9. Integer Palindrome
Problem: Write a Java program to check if a given integer is a palindrome.

Test Cases:

Input: 121
Output: true
Input: -121
Output: false
Program code:

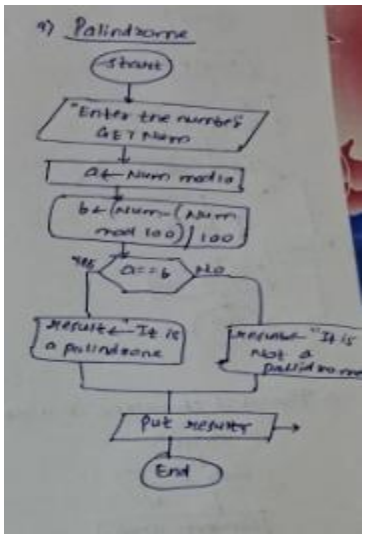
```
import java.util.Scanner;
public class IntegerPalindrome {
```

```
    public static void main(String[] args) {
        Scanner sc = new Scanner(System.in);
        System.out.print("Enter a word: ");
        String input = sc.nextLine();

        boolean isPalindrome = true;
        int left = 0;
        int right = input.length() - 1;

        while (left < right) {
            if (input.charAt(left) != input.charAt(right)) {
                isPalindrome = false;
                break;
            }
            left++;
            right--;
        }

        if (isPalindrome) {
            System.out.println(input + " is a palindrome.");
        } else {
            System.out.println(input + " is not a palindrome.");
        }
    }
}
```

Output:

```
D:\FOLDER\Assignment1_ADS>java IntegerPalidrome.java
Enter a word: 121
121 is a palindrome.
```

Flow chart:



Algorithm:

1: First Initialize the Variables
2: Compare Characters from Both Ends
3. Increment left and decrement right
4. Repeat steps 2-3 until left pointer meets or crosses right
5.print result.

Time Complexity: O(n)
Space Complexity: O(1)

10. Leap Year
Problem: Write a Java program to check if a given year is a leap year.

Test Cases:

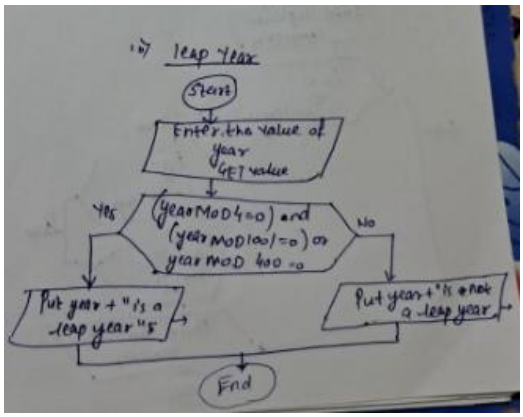
Input: 2020
Output: true
Input: 1900
Output: false
Program code:

```
import java.util.*;
class LeapYear{
    public static void main(String args[]) {
        Scanner sc = new Scanner(System.in);
        System.out.print("Enter the year you want to choose: ");
        int year = sc.nextInt();
        if (year % 4 == 0 && year %100 != 0 || year % 400 == 0)
        {
            System.out.println(true);
        }
        else
        {
            System.out.println(false);
        }
    }
}
```

Output:

```
D:\FOLDER\Assignment1_ADS>java LeapYear.java
Enter the year you want to choose: 2020
true

D:\FOLDER\Assignment1_ADS>java LeapYear.java
Enter the year you want to choose: 1900
false
```

Flow chart:



Explanation:

1: Firstly get user Input
2: Check Divisibility by 4
3: If year is divisible by 100, it must also be divisible by 400 to be a leap year
4:If year is divisible by 100 but not 400, it's not a leap year (then goto Step 6)
5:If year passes checks step 2,3, it's a leap year
6:Display leap year or not

Time Complexity: O(n)
Space Complexity: O(1)