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COURSE	:	JAVA PROGRAMMING
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### 1. a) Multilevel inheritance calculator

#### Source code :

```
import java.lang.Math;
import java.util.Scanner;

class calculator
{
    double x = 0.0,y =0.0, result =0.0;
    public void set_value(double a , double b)
    {
        x = a ;
        y = b ;
    }

    public void show_result()
    {
        System.out.println(result);
    }
}

class simple_calculator extends calculator
{
    public void add()
    {
        result = x + y ;
    }
    public void sub()
    {
        result = x - y ;
    }
    public void mul()
    {
        result = x * y ;
    }
}
```

```

    public void div()
    {
        result = x / y ;
    }
}
class Sceintfic_calculator extends simple_calculator{

```

```

    public void pow()
    {
        result = Math.pow(x, y);
    }

```

```

    public void sqrt()
    {
        result = Math.sqrt(x);
    }

```

```

    public void epow()
    {
        result = Math.exp(x);
    }

```

```

}

```

```

public class multilevel_eg1 {

```

```

    public static void main(String[] args) {

```

```

        double input1=0.00 , input2 = 0.00;
        Sceintfic_calculator obj = new Sceintfic_calculator();

```

```

        int choice = 0 ;
        System.out.print("\t Name : Nithish G \n\t Regno No.: 19BCS0012\n");
        System.out.print("\t -----");

```

```

        while (choice!= 999)
        {

```

```

            System.out.println("\n\n 1.Addtion  2.Subration  3.Multiplication");
            System.out.println(" 4.Division  5.Power    6. Square  7.Epower");

```

```

            System.out.print("\n Enter the Choice : ");
            Scanner read = new Scanner (System.in);
            choice = read.nextInt();

```

```

            if(choice <= 5)
            {

```

```

                System.out.print(" Enter Input 1 \t = ");
                input1 = read.nextDouble();

```

```

        System.out.print(" Enter Input 2 \t = ");
        input2 = read.nextDouble();
    }
    else
    {
        System.out.print(" Enter Input    : ");
        input1 = read.nextDouble();
    }
    switch(choice)
    {
    case 1:
        obj.set_value(input1,input2);
        obj.add();
        System.out.print(" Addition of "+ input1+" + " + input2 + " = ");
        obj.show_result();
        System.out.print(" -----");
        break;
    case 2:
        obj.set_value(input1,input2);
        obj.sub();
        System.out.print(" Subraction of "+ input1+" - " + input2 + " = ");
        obj.show_result();
        System.out.print(" -----");
        break;
    case 3:
        obj.set_value(input1,input2);
        obj.mul();
        System.out.print(" Multiplication of "+ input1+" x " + input2 + " = ");
        obj.show_result();
        System.out.print(" -----");
        break;
    case 4:
        obj.set_value(input1,input2);
        obj.div();
        System.out.print(" Division of "+ input1+" / " + input2 + " = ");
        obj.show_result();
        System.out.print(" -----");
        break;
    case 5:
        obj.set_value(input1,input2);
        obj.pow();
        System.out.print(" Power of "+ input1+" ^ " + input2 + " = ");
        obj.show_result();
        System.out.print(" -----");

```

**break;**

**case 6:**

```
obj.set_value(input1,0);
obj.sqrt();
System.out.print(" Squart root of "+ +input1+" = ");
obj.show_result();
System.out.print(" -----");
```

**break;**

**case 7:**

```
obj.set_value(input1,0);
obj.epow();
System.out.print(" EPower root of "+ input1 + " = ");
obj.show_result();
System.out.print(" -----");
```

**break;**

**default :**

```
System.out.println(" invaild Input .....");
System.out.print(" -----");
```

}

}

}

}

Output

```
<terminated> multilevel_eg1 [Java Application] C:\Program Files\Java\jdk1.7
Name      : Nithish G
Regno No.: 19BCS0012
-----

1.Addition  2.Subration  3.Multiplication
4.Division  5.Power     6. Square root  7.Epower

Enter the Choice : 1
Enter Input 1    = 23.42
Enter Input 2    = 43.21
Addition of 23.42 + 43.21 = 66.63
-----

1.Addition  2.Subration  3.Multiplication
4.Division  5.Power     6. Square root  7.Epower

Enter the Choice : 2
Enter Input 1    = 45.32
Enter Input 2    = 21.12
Subraction of 45.32 - 21.12 = 24.2

51
52
53
54
55
56
57 String[] args) {
58
59     input2 = 0.00;
60     obj = new Sceintfic_
61
62
63     Name      : Nithis
64     -----
65
66
67     n("\n\n 1.Addtion
68     n(" 4.Division  5.Po
69
70     "\n Enter the Choice
71     w Scanner (System .i
```

Subtraction of 45.32 - 21.12 = 24.2

1.Addtion 2.Subration 3.Multiplication  
4.Division 5.Power 6. Square root 7.Epower

Enter the Choice : 3

Enter Input 1 = 4.12

Enter Input 2 = 5.2

Multiplication of 4.12 x 5.2 = 21.4240000000000

1.Addtion 2.Subration 3.Multiplication  
4.Division 5.Power 6. Square root 7.Epower

Enter the Choice : 4

Enter Input 1 = 91.9

Enter Input 2 = 8

Division of 91.9 / 8.0 = 11.4875

1.Addtion 2.Subration 3.Multiplication  
4.Division 5.Power 6. Square root 7.Epower

Enter the Choice : 5

Enter Input 1 = 2

Enter Input 2 = 6

Power of 2.0 ^ 6.0 = 64.0

1.Addtion 2.Subration 3.Multiplication  
4.Division 5.Power 6. Square root 7.Epower

Enter the Choice : 6

Enter Input : 2704

Squart root of 2704.0 = 52.0

1.Addtion 2.Subration 3.Multiplication  
4.Division 5.Power 6. Square root 7.Epower

Enter the Choice : 7

Enter Input : 3

EPower root of 3.0 = 20.085536923187668

1.Addtion 2.Subration 3.Multiplication  
4.Division 5.Power 6. Square root 7.Epower

Enter the Choice : 999

System Exit....

```
70 // Enter the Choice
71 // Scanner (System .i
72 xtInt();
73
74
75 int(" Enter Input 1
76 .nextDouble();
77 int(" Enter Input 2
78 .nextDouble();
79
```

```
57 String[] args) {
58
59 input2 = 0.00;
60 obj = new Sceintfic_
61
62
63 Name : Nithis
64 t -----
65
66
67 n("\n\n 1.Addtion
68 n(" 4.Division 5.Po
69
70 "\n Enter the Choice
71 // Scanner (System .i
72 xtInt();
73
74
75 int(" Enter Input 1
76 .nextDouble();
77 int(" Enter Input 2
78 .nextDouble();
79
```

```
68 n(" 4.Division 5.Po
69
70 "\n Enter the Choice
71 // Scanner (System .i
72 xtInt();
73
74
75 int(" Enter Input 1
76 .nextDouble();
77 int(" Enter Input 2
78 .nextDouble();
79
```

## 1 b). Hierarchical inheritance ( Calculate Areas)

Source Code:

```
import java.util.Scanner;

abstract class graphic
{
    double input1 ,input2, input3;
    abstract void get_values();
    abstract void show_area();
    static Scanner read = new Scanner(System.in);
}

class Circle1 extends graphic
{
    void get_values()
    {
        System.out.println("      Area of Circle ");
        System.out.println("      ----- ");
        System.out.print(" Enter Radius      : ");
        this.input1 = read.nextDouble();
    }
    void show_area()
    {
        System.out.println(" Area of Circle      : " + ((3.14) * (input1 * input1))+ "\n");
    }
}

class Rectangle extends graphic
{
    void get_values()
    {
        System.out.println("      Area of Rectangle ");
        System.out.println("      ----- ");
        System.out.print(" Enter length      : ");
        input1 = read.nextDouble();
        System.out.print(" Enter Width      : ");
        input2 = read.nextDouble();
    }
    void show_area()
    {
        System.out.print(" Area of Rectangle  : " + (input1*input2)+"\n\n");
    }
}
```

```

}
class Triangle extends graphic
{
    void get_values()
    {
        System.out.println("        Area of Triangle ");
        System.out.println("        ----- ");
        System.out.print(" Enter 1st side   : ");
        input1 = read.nextDouble();
        System.out.print(" Enter 2nd side   : ");
        input2 = read.nextDouble();
        System.out.print(" Enter 3rd side   : ");
        input3 = read.nextDouble();
    }
    void show_area()
    {
        double s = (input1+input2+input3)/2;

        System.out.print(" Area of Tringle   : " + Math.sqrt(s*((s-input1)*(s-input2)*(s-
input3))))+"\n\n");
    }
}
class Square extends graphic
{
    void get_values()
    {
        System.out.println("        Area of Square ");
        System.out.println("        ----- ");
        System.out.print(" Length of side   : ");
        input1 = read.nextDouble();
    }
    void show_area()
    {
        System.out.print(" Area of Square   : " + (input1*input1)+"\n");
    }
}
public class Hierarchical_area {

    public static void main(String[] args) {

        System.out.print("\tName   : Nithish G \n\tReg No. : 19BCS0012\n");
        System.out.print("-----\n\n");
    }
}

```

```

Circle1 circle= new Circle1();
Rectangle rectangle = new Rectangle();
Triangle triangle = new Triangle();
Square square = new Square();

```

```

circle.get_values();
circle.show_area();

```

```

rectangle.get_values();
rectangle.show_area();

```

```

triangle.get_values();
triangle.show_area();

```

```

square.get_values();
square.show_area();

```

```

}

```

```

}

```

## Output

The screenshot displays a Java IDE with two main windows: 'Console' and 'multilevel\_eg1.java'.

**Console Output:**

```

<terminated> Hierarchical_area [Java Application] C:\Program File
Name      : Nithish G
Reg No.   : 19BCS0012

-----
      Area of Circle
-----
Enter Radius      : 5.3
Area of Circle    : 88.2026

      Area of Rectangle
-----
Enter length      : 13.4
Enter Width       : 21
Area of Rectangle : 281.4000000000000003

      Area of Triangle
-----
Enter 1st side    : 13
Enter 2nd side    : 9
Enter 3rd side    : 15
Area of Tringle   : 58.16517428840044

      Area of Square
-----
Length of side    : 15
Area of Square    : 225.0

```

**Source Code (multilevel\_eg1.java):**

```

78
79 }
80 public class Hierarchical_area
81
82     public static void main(S
83
84         System.out.print("\tN
85         System.out.print("-----
86
87         Circle1 circle= new C
88         Rectangle rectangle =
89         Triangle triangle =
90         Square square = new S
91
92         circle.get_values();
93         circle.show_area();
94
95         rectangle.get_values(
96         rectangle.show_area()
97
98         triangle.get_values()
99         triangle.show_area();
100
101         square.get_values();
102         square.show_area();
103
104     }
105

```



2. Create a base class Fruit with name, taste and size as its attributes. Create a method called eat() which describes the name of the fruit and its taste. Inherit the same in 2 other classes Apple and Orange and override the eat() method to represent each fruit taste.

### Source Code

```
class fruit
{
    String fruit_name;
    String fruit_taste;
    float fruit_size;
    fruit(String name,String taste, float size)
    {
        fruit_name= name;
        fruit_taste= taste;
        fruit_size= size;
    }
}

class apple extends fruit
{
    apple(String n , String t , float s )
    {
        super(n,t,s);
    }
    public void eat ()
    {
        System.out.println("\n\nName of the Fruit : "+ fruit_name);
        System.out.println("Taste of the Fruit : "+ fruit_taste);
        System.out.println("Size of the Fruit : "+ fruit_size+" cm");
    }
}

class Orange extends fruit
{
    Orange(String n , String t , float s )
    {
        super(n,t,s);
    }
    public void eat ()
    {
        System.out.println("\n\nName of the Fruit : "+ fruit_name);
        System.out.println("Taste of the Fruit : "+ fruit_taste);
        System.out.println("Size of the Fruit : "+ fruit_size+"cm");
    }
}
```

```

public class method_overriding_eg {
    public static void main(String[] NITHISH) {

        System.out.print("\t Name      : Nithish G \n\t Regno No.: 19BCS0012\n");
        System.out.print("\t -----");

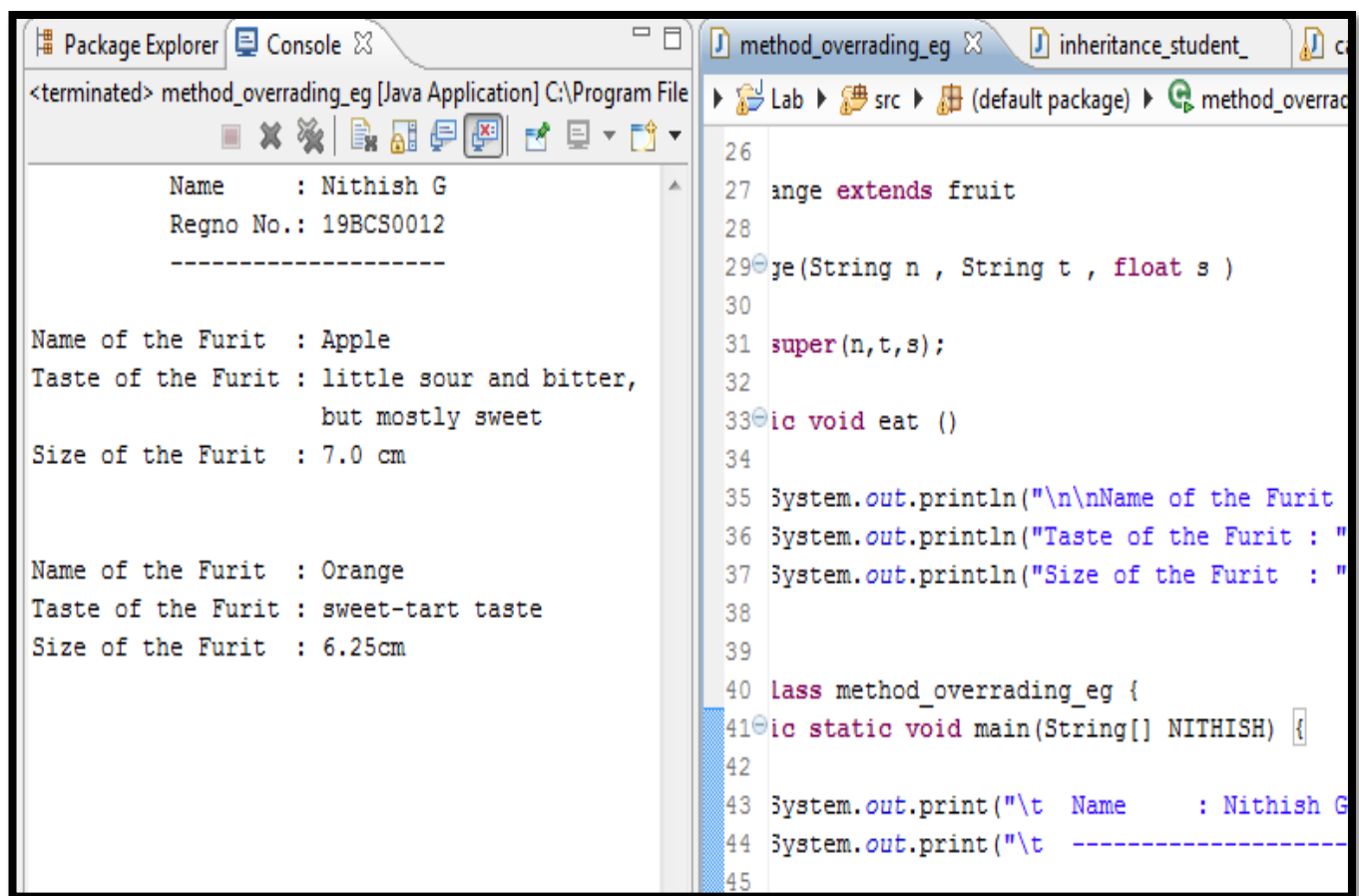
        apple obj1 = new apple("Apple", "little sour and bitter,\n\t\t but mostly sweet" , 7);

        Orange obj2 = new Orange("Orange", "sweet-tart taste" , 6.25f);
        obj1.eat();
        obj2.eat();

    }
}

```

### Output



The screenshot shows an IDE with two windows. The left window, titled 'Console', displays the output of the Java application. The right window, titled 'method\_overriding\_eg', shows the source code of the program.

**Console Output:**

```

Name      : Nithish G
Regno No.: 19BCS0012
-----

Name of the Furit : Apple
Taste of the Furit : little sour and bitter,
                  but mostly sweet
Size of the Furit  : 7.0 cm

Name of the Furit : Orange
Taste of the Furit : sweet-tart taste
Size of the Furit  : 6.25cm

```

**Source Code (method\_overriding\_eg.java):**

```

26
27  class apple extends fruit
28
29  apple(String n , String t , float s )
30
31  apple(n,t,s);
32
33  public void eat ()
34
35  {
36      System.out.println("\n\nName of the Furit : " + n);
37      System.out.println("Taste of the Furit : " + t);
38      System.out.println("Size of the Furit : " + s);
39  }
40
41  class method_overriding_eg {
42
43  public static void main(String[] NITHISH) {
44
45      System.out.print("\t Name      : Nithish G \n\t Regno No.: 19BCS0012\n");
46      System.out.print("\t -----");
47
48      apple obj1 = new apple("Apple", "little sour and bitter,\n\t\t but mostly sweet" , 7);
49
50      Orange obj2 = new Orange("Orange", "sweet-tart taste" , 6.25f);
51      obj1.eat();
52      obj2.eat();
53  }
54  }

```

3. Create a class named 'Animal' which includes methods like eat() and sleep(). Create a child class of Animal named 'Bird' and override the parent class methods. Add a new method named fly(). Create an instance of Animal class and invoke the eat and sleep methods using this object. Create an instance of Bird class and invoke the eat, sleep and fly methods using this object.

### Source Code:

```

class Animal{

    public void Eat()
    {
        System.out.println(" Class : Animal \n method : Eat \n");
    }
    public void sleep(){
        System.out.println(" Class : Animal \n method : Sleep \n");
    }

}

class Bird{

    public void Eat()
    {
        System.out.println(" Class : Bird \n method : Eat \n");
    }
    public void sleep(){
        System.out.println(" Class : Bird \n method : Sleep \n");
    }
    public void Fly(){
        System.out.println(" Class : Bird \n method : Fly \n");
    }

}

public class animal_inheritance
{

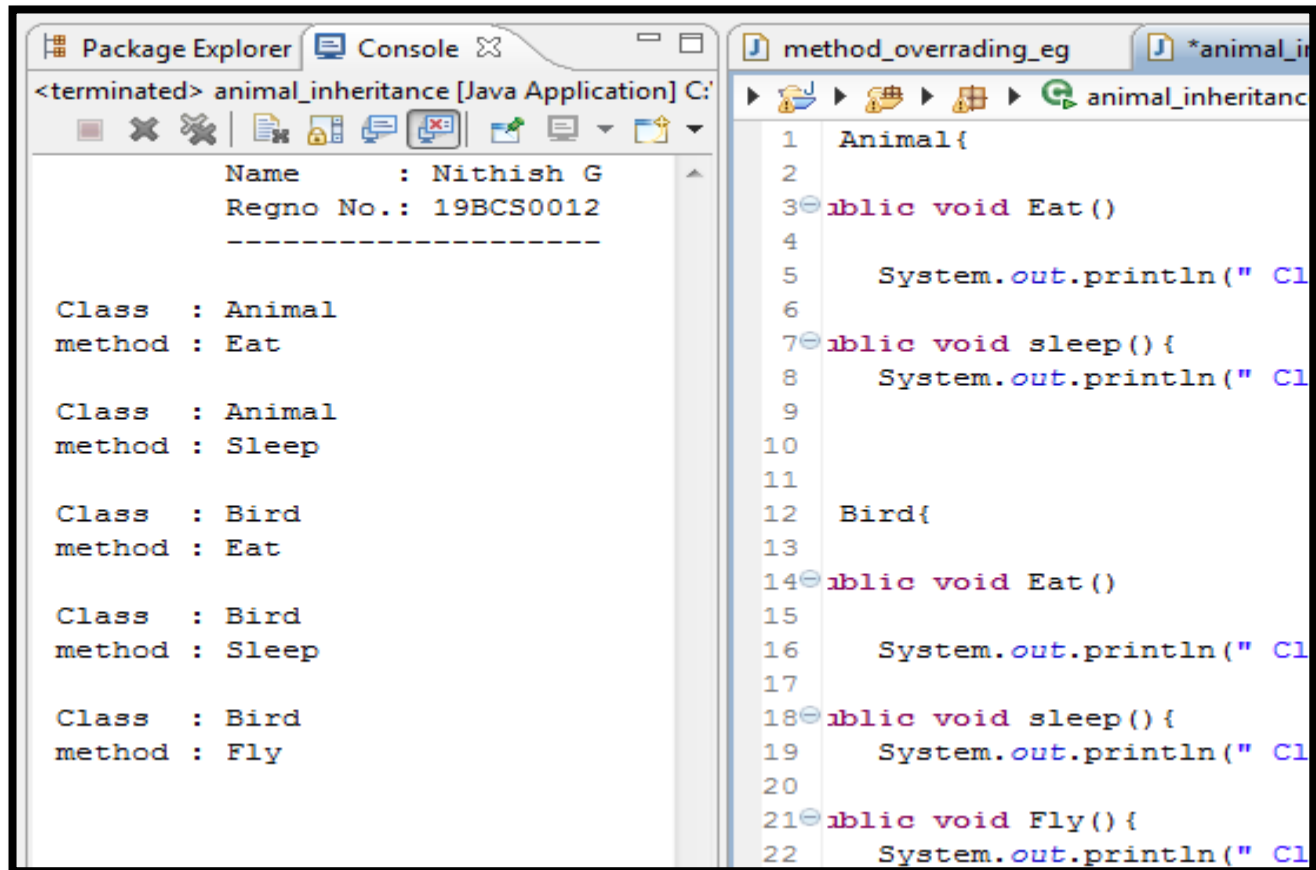
    public static void main(String[] args) {
        System.out.print("\t Name      : Nithish G \n\t Regno No.: 19BCS0012\n");
        System.out.print("\t ----- \n\n");
        Animal ob1 = new Animal();
        Bird ob2 = new Bird();

        ob1.Eat();
        ob1.sleep();
        ob2.Eat();
        ob2.sleep();
        ob2.Fly();
    }

}

```

## Output



```
<terminated> animal_inheritance [Java Application] C:\
Name      : Nithish G
Regno No.: 19BCS0012
-----

Class   : Animal
method : Eat

Class   : Animal
method : Sleep

Class   : Bird
method : Eat

Class   : Bird
method : Sleep

Class   : Bird
method : Fly

method_overriding_eg
*animal_inheritance
1  Animal{
2
3  public void Eat ()
4
5      System.out.println(" Cl
6
7  public void sleep() {
8      System.out.println(" Cl
9
10
11
12  Bird{
13
14  public void Eat ()
15
16      System.out.println(" Cl
17
18  public void sleep() {
19      System.out.println(" Cl
20
21  public void Fly() {
22      System.out.println(" Cl
```

4. Create a superclass, Student, and two subclasses, Undergrad and Grad. The superclass Student should have the following data members: name, ID, grade, age, and address. The superclass, Student should have one method: boolean isPassed (double grade) The purpose of the isPassed method is to take one parameter, grade (value between 0 and 100) and check whether the grade has passed the requirement for passing a course. In the Student class this method should be empty as an abstract method. The two subclasses: Grad and Undergrad, will inherit all data members of the Student class and override the method isPassed. For the UnderGrad class, if the grade is above 70.0, then isPassed returns true, otherwise it returns false. For the Grad class, if the grade is above 80.0, then isPassed returns true, otherwise returns false. Create a test class for your three classes. In the test class, create one Grad object and one Undergrad object. For each object, provide a grade and display the results of the isPassed method.

## Source Code

```
abstract class Student {

    String student_name = "", student_address = "";
    int student_ID , student_age ;
    double student_grade;

    abstract boolean isPassed (double grade);
```

```

}
class Undergrad extends Student {

    Undergrad(String name ,int id, int age, String addr)
    {

        student_name = name ;
        student_ID = id;
        student_age = age;
        student_address= addr;

        System.out.println("Student_Name    : " +student_name );
        System.out.println("Student_ID      : " +student_ID );
        System.out.println("Student_Age    : " +student_age );
        System.out.println("Student_Address : " +student_address );

    }
}

```

```
String result = "";
```

```

public boolean isPassed ( double grade )
{
    student_grade = grade;
    System.out.println("Student_grad    : " +student_grade );

    if (student_grade>70)
    {
        this.result = "Passed";
        System.out.println("Result          : " + result);
        return true;
    }
    else
        this.result = "Failed";
        System.out.println("Result          : " + result);
        return false;
    }
}

```

```

}
class Grad extends Student {

    Grad(String name ,int id, int age, String addr)
    {

        student_name = name ;

        student_ID = id;

```

```
student_age = age;  
student_address= addr;
```

```
System.out.println("Student_Name : "+student_name );  
System.out.println("Student_ID : "+student_ID );  
System.out.println("Student_Age : "+student_age );  
System.out.println("Student_Address : "+student_address );
```

```
}
```

```
String result = "";
```

```
public boolean isPassed ( double grade )
```

```
{
```

```
    student_grade = grade;
```

```
System.out.println("Student_grad : "+student_grade );
```

```
if (student_grade>80)
```

```
{
```

```
    this.result = "Passed";
```

```
    System.out.println("Result : "+ result);
```

```
    return true;
```

```
}
```

```
else
```

```
    this.result = "Failed";
```

```
System.out.println("Result : "+ result);
```

```
    return false;
```

```
}
```

```
}
```

```
public class inheritance_student_grade {
```

```
public static void main(String[] NITHISH) {
```

```
    System.out.print("\t Name      : Nithish G \n\t Regno No.: 19BCS0012\n");  
    System.out.print("\t ----- \n");
```

```
    System.out.println("\t\t Grad");  
    System.out.print("\t\t ----- \n");
```

```
    Grad[] ob2 = new Grad[2];  
    ob2[0] = new Grad("Nithish" ,12 , 18, "vellore");  
    ob2[0].isPassed(88.8);  
    System.out.println();
```

```
    ob2[1] = new Grad("Kumar" ,13 , 18,"chennai");  
    ob2[1].isPassed(62.2);  
    System.out.print("----- \n");  
    System.out.println("\t UnderGrad");  
    System.out.print("\t ----- \n");  
    Undergrad[] ob1 = new Undergrad[2];
```

```
    ob1[0] = new Undergrad("Viknesh" ,14 , 17, "vellore");  
    ob1[0].isPassed(72.8);
```

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

```
    ob1[1] = new Undergrad("Ramesh" ,15 , 17, "vellore");  
    ob1[1].isPassed(68.8);
```

```
}
```

```
}
```

## Output:

```
<terminated> inheritance_student_grade [Java Application] C:\Pr
Name      : Nithish G
Regno No.: 19BCS0012
-----
          Grad
-----
Student_Name      : Nithish
Student_ID        : 12
Student_Age       : 18
Student_Address   : vellore
Student_grad      : 88.8
Result           : Passed

Student_Name      : Kumar
Student_ID        : 13
Student_Age       : 18
Student_Address   : chennai
Student_grad      : 62.2
Result           : Failed
-----

          UnderGrad
-----
Student_Name      : Viknesh
Student_ID        : 14
Student_Age       : 17
Student_Address   : vellore
Student_grad      : 72.8
Result           : Passed

Student_Name      : Ramesh
Student_ID        : 15
Student_Age       : 17
Student_Name      : Ramesh
Student_ID        : 15
Student_Age       : 17
Student_Address   : vellore
Student_grad      : 68.8
Result           : Failed

Lab > src > (default
79
80
81
82
83 inheritance_student_gra
84
85 void main(String[]
86
87 t.print("\t Name
88 t.print("\t -----
89
90 t.println("\t\t Gra
91 t.print("\t\t-----
92
93 2 = new Grad[2];
94 new Grad("Nithish"
95 Passed(88.8);
96 t.println();
97
98 new Grad("Kumar" ,1
99 Passed(62.2);
100 t.print("-----
101 t.println("\t
102 t.print("\t ---
103 [] ob1 = new Underg
104
105 new Undergrad("Vikn
106 Passed(72.8);
107
108 t.println();

Problems @ Javadoc Decla
105 new Undergrad("Vikn
106 Passed(72.8);
107
108 t.println();

inheritance_student_grade.java
```

5. Write a Java program which has Interface class for Stack Operations.

(i) A Class that implements the Stack Interface and creates a fixed length Stack

### Source Code:

```
import java.util.Scanner;
import java.util.NoSuchElementException;
```



```
interface Stack {

    void push(int data) throws Exception;

    int pop() throws Exception;

    int top() throws Exception;

    boolean isEmpty();

    int size();
}

class FixedArrayStack implements Stack {

    protected int[] stack;

    protected int top = -1;
    public static final int CAPACITY = 3;

    public FixedArrayStack() {
        stack = new int [FixedArrayStack.CAPACITY];
    }

    public void push(int data) throws Exception {
        if (size() == CAPACITY){
            throw new IndexOutOfBoundsException("StackOrverflowException.");
        } else {
            stack[++top] = data;
        }
    }

    public int top() throws Exception {
        if (isEmpty())
            throw new NoSuchElementException("Stack is empty.");
        return stack[top];
    }

    public int pop() throws Exception {
        int data;
        if (isEmpty())
            throw new NoSuchElementException("Stack is empty.");
```

```
data = stack[top];
```

```
stack[top--] = Integer.MIN_VALUE;
```

```
return data;
```

```
}
```

```
public int size() {
```

```
    return (top + 1);
```

```
}
```

```
public boolean isEmpty() {
```

```
    return (top < 0);
```

```
}
```

```
public String toString() {
```

```
    String s = "[";
```

```
    if (size() > 0)
```

```
        s += stack[0];
```

```
    if (size() > 1)
```

```
        for (int i = 1; i <= size() - 1; i++) {
```

```
            s += ", " + stack[i];
```

```
        }
```

```
    return s + "]";
```

```
}
```

```
}
```

```
public class Stack_interface_fixed_length {
```

```
    static Scanner scanner = new Scanner(System.in);
```

```
    public static void main(String[] args) {
```

```
        System.out.print("\t Name      : Nithish G \n\t Regno No.: 19BCS0012\n");
```

```
        System.out.print("\t ----- \n");
```

```
        Stack stack = new FixedArrayStack();
```

```
        System.out.println("    Stack created with size : " + FixedArrayStack.CAPACITY);
```

```
        System.out.println("    -----");
```

```
        while(true){
```

```
            System.out.println("\n 1    2    3    4    5 ");
```

```
            System.out.print(" push() pop() top() iterate() exit(1)\n Choice : ");
```

```

int choice = scanner.nextInt();

try {

    switch(choice) {
case 1:
        System.out.println(" Enter a number to push : ");
        stack.push(scanner.nextInt());
        System.out.print(" -----");
        break;

case 2:
        System.out.println(" popped element : " + stack.pop());
        System.out.print(" -----");
        break;

case 3:
        System.out.println(" top element : " + stack.top());
        System.out.print(" -----");
        break;

case 4:
        System.out.println(" elements are : " + stack.toString());
        System.out.print(" -----");
        break;

case 5:
        System.out.print(" exit the sytem: ");
        System.exit(1);
        break;

default :
        System.out.println("invalid option.....");

    }

} catch (Exception e) {
    System.err.println(" error message : " + e.getMessage());
}
}
}
}

```

## Output:

<terminated> Stack\_interface\_fixed\_length [Java Application] C:\Prog

Name : Nithish G  
Regno No.: 19BCS0012

-----  
Stack created with size : 3  
-----

1 2 3 4 5  
push() pop() top() iterate() exit(1)  
Choice : 1  
Enter a number to push : 12  
-----

1 2 3 4 5  
push() pop() top() iterate() exit(1)  
Choice : 1  
Enter a number to push : 13  
-----

1 2 3 4 5  
push() pop() top() iterate() exit(1)  
Choice : 1  
Enter a number to push : 14  
-----

1 2 3 4 5  
push() pop() top() iterate() exit(1)  
Choice : 1  
Enter a number to push : 15  
error message : StackOverFlowException.  
-----

1 2 3 4 5  
push() pop() top() iterate() exit(1)  
Choice : 4  
elements are : [12, 13, 14]  
-----

1 2 3 4 5  
push() pop() top() iterate() exit(1)  
Choice : 3  
top element : 14  
-----

1 2 3 4 5  
push() pop() top() iterate() exit(1)  
Choice : 2  
popped element : 14  
-----

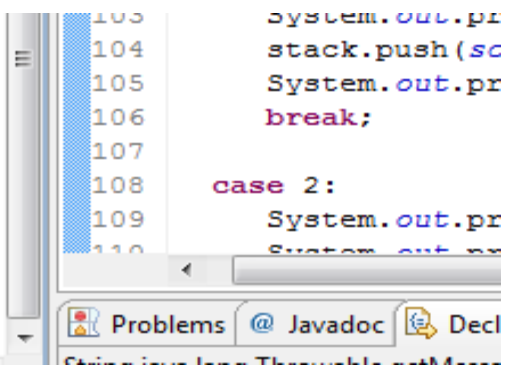
1 2 3 4 5  
push() pop() top() iterate() exit(1)  
Choice : 2  
popped element : 13  
-----

1 2 3 4 5  
push() pop() top() iterate() exit(1)  
Choice : 2  
popped element : 12  
-----

(default package)

```
81
82
83
84 public static void
85
86     System.out.pri
87     System.out.pri
88
89     Stack stack = n
90     System.out.prin
91     System.out.prin
92
93     while(true) {
94         System.out.printl
95         System.out.print (
96
97         int choice = scan
98
99         try {
100
101             switch(choice)
102             case 1:
103                 System.out.pr
104                 stack.push(sc
105                 System.out.pr
106                 break;
107
108             case 2:
109                 System.out.pr
110                 System.out.pr
111
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```

```
-----
1      2      3      4      5
push() pop() top() iterate() exit(1)
Choice : 2
error message : Stack is empty.
-----
1      2      3      4      5
push() pop() top() iterate() exit(1)
Choice : 5
exit the Stack :
```



## (ii) A Class that implements the Stack Interface and creates a Dynamic length Stack.

### Source code

```
import java.util.Scanner;
import java.util.NoSuchElementException;

interface dynamicStack {

    void push(int data) throws Exception;

    int pop() throws Exception;

    int top() throws Exception;

    boolean isEmpty();

    int size();
}

class dynamicArrayStack implements Stack {

    protected int capacity;

    protected int[] stack;

    protected int top = -1;

    public dynamicArrayStack(int length) {
        this.capacity = length;
        stack = new int[this.capacity];
    }
}
```

```
public void push(int data) throws Exception {  
    if (size() == capacity){  
        throw new IndexOutOfBoundsException("StackOrverflowException.");  
    } else {  
        stack[++top] = data;  
    }  
}
```

```
public int top() throws Exception {  
    if (isEmpty())  
        throw new NoSuchElementException("Stack is empty.");  
    return stack[top];  
}
```

```
public int pop() throws Exception {  
    int data;  
    if (isEmpty())  
        throw new NoSuchElementException("Stack is empty.");  
    data = stack[top];  
  
    stack[top--] = Integer.MIN_VALUE;  
    return data;  
}
```

```
public int size() {  
    return (top + 1);  
}
```

```
public boolean isEmpty() {  
    return (top < 0);  
}
```

```

public String toString() {
    String s = "[";
    if (size() > 0)
        s += stack[0];
    if (size() > 1)
        for (int i = 1; i <= size() - 1; i++) {
            s += ", " + stack[i];
        }
    return s + "]";
}
}

```

```

public class Stack_interface_dynamic_length {
    static Scanner read = new Scanner(System.in);

    public static void main(String[] args) {

        System.out.print("\t Name      : Nithish G \n\t Regno No.: 19BCS0012\n");
        System.out.print("\t ----- \n");

        System.out.print("Enter the Size of Stack : ");
        int size = read.nextInt();
        Stack stack = new dynamicArrayStack(size);
        System.out.println("    Stack created with size : " + FixedArrayStack.CAPACITY);
        System.out.println("    -----");

        while(true){
            System.out.println("\n 1    2    3    4    5 ");
            System.out.print("  push() pop() top() iterate() exit(1)\n Choice : ");

```

```
int choice = read.nextInt();
```

```
try {
```

```
    switch(choice) {
```

```
    case 1:
```

```
        System.out.print(" Enter a number to push : ");
```

```
        stack.push(read.nextInt());
```

```
        System.out.print(" -----");
```

```
        break;
```

```
    case 2:
```

```
        System.out.println(" popped element : " + stack.pop());
```

```
        System.out.print(" -----");
```

```
        break;
```

```
    case 3:
```

```
        System.out.println(" top element : " + stack.top());
```

```
        System.out.print(" -----");
```

```
        break;
```

```
    case 4:
```

```
        System.out.println(" elements are : " + stack.toString());
```

```
        System.out.print(" -----");
```

```
        break;
```

```
    case 5:
```

```
        System.out.print(" exit the sytem: ");
```

```
        System.exit(1);
```

```
    break;
```



**default :**

```
System.out.println("invalid option.....");
```

```
}
```

```
} catch (Exception e) {
```

```
System.err.println(" error message : " + e.getMessage());
```

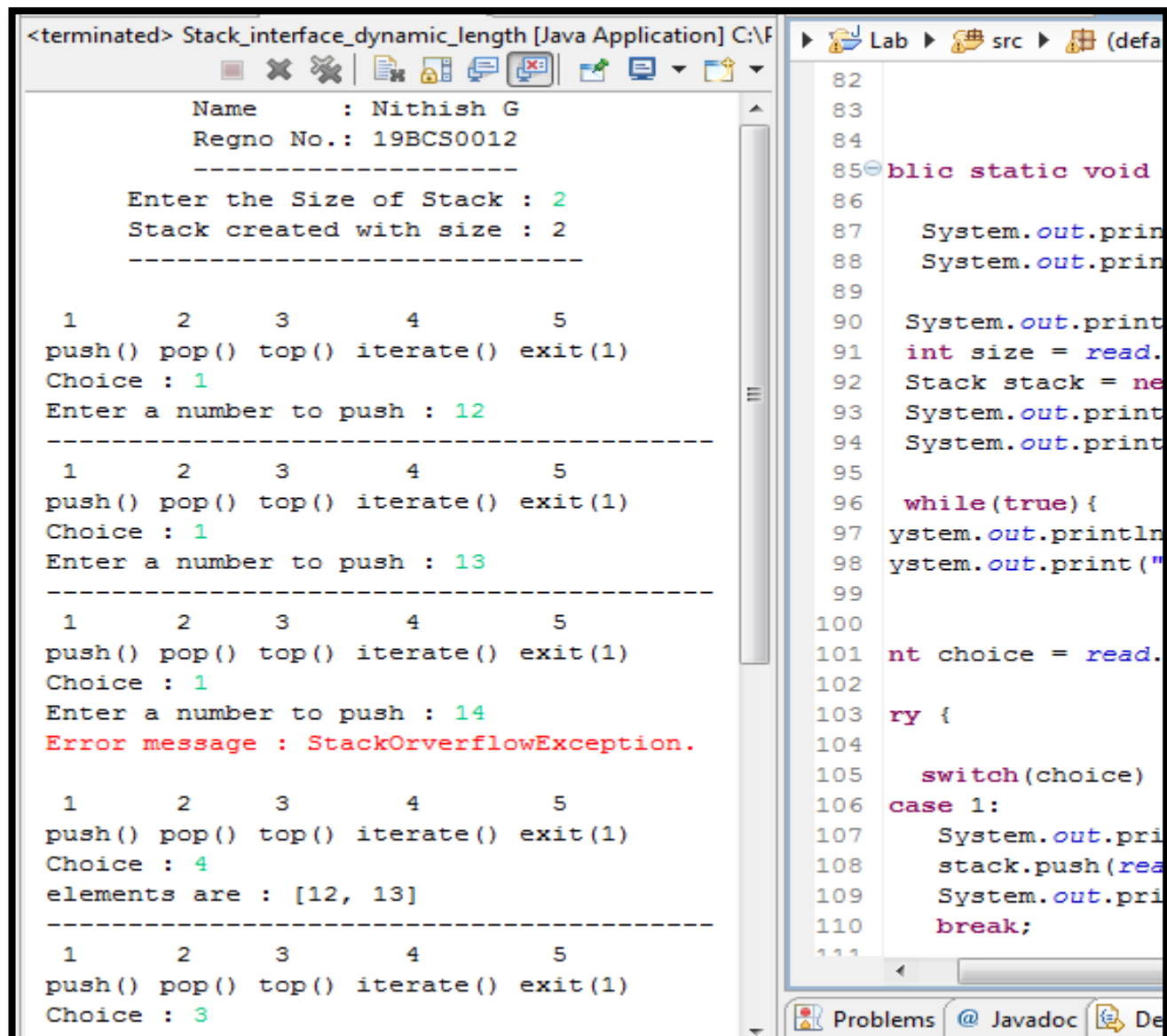
```
}
```

```
}
```

```
}
```

```
}
```

## Output



```
<terminated> Stack_interface_dynamic_length [Java Application] C:\F
Name      : Nithish G
Regno No.: 19BCS0012
-----
Enter the Size of Stack : 2
Stack created with size : 2
-----

1      2      3      4      5
push() pop() top() iterate() exit(1)
Choice : 1
Enter a number to push : 12
-----

1      2      3      4      5
push() pop() top() iterate() exit(1)
Choice : 1
Enter a number to push : 13
-----

1      2      3      4      5
push() pop() top() iterate() exit(1)
Choice : 1
Enter a number to push : 14
Error message : StackOverflowException.

1      2      3      4      5
push() pop() top() iterate() exit(1)
Choice : 4
elements are : [12, 13]
-----

1      2      3      4      5
push() pop() top() iterate() exit(1)
Choice : 3

82
83
84
85 public static void
86
87     System.out.prin
88     System.out.prin
89
90     System.out.print
91     int size = read.
92     Stack stack = ne
93     System.out.print
94     System.out.print
95
96     while(true){
97     ystem.out.println
98     ystem.out.print("
99
100
101     nt choice = read.
102
103     ry {
104
105         switch(choice)
106     case 1:
107         System.out.pri
108         stack.push(rea
109         System.out.pri
110         break;
111
```

The screenshot shows a Java IDE with two windows. The left window displays the output of a stack program, and the right window shows the corresponding source code.

**Output Window:**

```

top element : 13
-----
1       2       3       4       5
push() pop() top() iterate() exit(1)
Choice : 2
popped element : 13
-----
1       2       3       4       5
push() pop() top() iterate() exit(1)
Choice : 2
popped element : 12
-----
1       2       3       4       5
push() pop() top() iterate() exit(1)
Choice : 2
Error message : Stack is empty.
-----
1       2       3       4       5
push() pop() top() iterate() exit(1)
Choice : 5
Exit the Stack....

```

**Source Code Window:**

```

93  System.out.println("Top element : " + top());
94  System.out.println("Popped element : " + popped());
95
96  while(true){
97      System.out.println("Enter your choice : ");
98      System.out.print(choice);
99
100
101      int choice = readInt();
102
103      try {
104
105          switch(choice){
106              case 1:
107                  System.out.println("Pushing element : " + element);
108                  stack.push(element);
109                  System.out.println("Element pushed successfully");
110                  break;
111

```

6. Write a Java program using Synchronized Threads, which demonstrates Producer Consumer concepts.

#### Source Code:

```

class Shop1
{

    int materials;

    boolean spaceavailable = false;

    public synchronized void put(int materials)
    {

        while (spaceavailable)
        {

            try{ wait(); } catch( Exception e ) {}

        }

        System.out.println("Produced value --> put method : " + materials);

        this.materials = materials;

```

```

spaceavailable = true;
notify();
}

public synchronized void get()
{
while (!spaceavailable)
{
try { wait (); } catch( Exception e ) {}
}
System.out.println("Consumer value --> put method : " + materials);
System.out.println("");
spaceavailable = false;
notify();
}
}

class Producer1 implements Runnable
{

Shop1 shop;

public Producer1(Shop1 shop)
{
this.shop =shop;
Thread t = new Thread(this, "Producer");
t.start();
}

public void run()
{
int i =0;
while(true)
{
shop.put(i++);
try { Thread.sleep(1000) ; } catch(Exception e) {}
}
}
}

```

```
class Consumer1 implements Runnable
{
    Shop1 shop;

    public Consumer1(Shop1 shop)
    {
        this.shop = shop;
        Thread t = new Thread (this, "Consumer1");
        t.start();
    }

    public void run()
    {
        while ( true)
        {
            shop.get();

            try{ Thread.sleep(1000);} catch( Exception e) {}

        }
    }
}

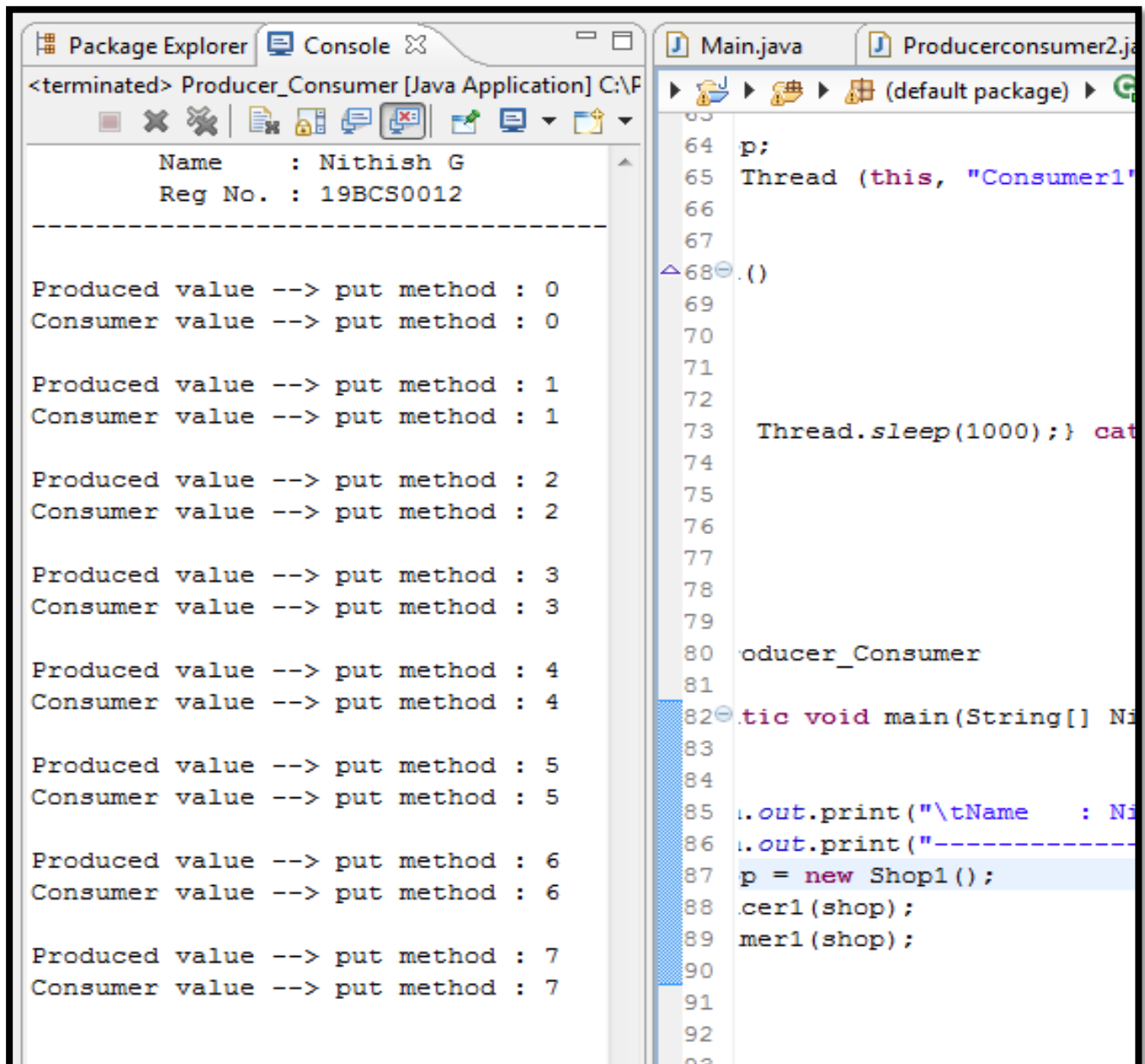
public class Producer_Consumer
{
    public static void main(String[] Nithish)
    {
        System.out.print("\tName   : Nithish G \n\tReg No. : 19BCS0012\n\n");
        Shop1 shop = new Shop1();

        new Producer1(shop);

        new Consumer1(shop);

    }
}
```

## Output:



The screenshot displays an IDE with two main panels. The left panel, titled 'Console', shows the output of a Java application named 'Producer\_Consumer'. The output consists of eight pairs of lines, each pair representing a state where both the producer and consumer have processed a value from 0 to 7. Each line follows the format 'Produced value --> put method : [value]' and 'Consumer value --> put method : [value]'. Above the output, the user's name 'Nithish G' and registration number '19BCS0012' are displayed. The right panel shows the source code of 'Main.java'. The code includes a 'main' method that initializes a 'Shop1' object, creates a 'Producer\_Consumer' object, and starts two threads: 'Consumer1' and 'Producer\_Consumer'. The 'Consumer1' thread is created with a 'Thread' constructor and a 'Runnable' interface implementation. The 'Producer\_Consumer' thread is created with a 'Thread' constructor and a 'Runnable' interface implementation. The code also includes a 'Thread.sleep(1000);' statement to introduce a delay between operations.

```
<terminated> Producer_Consumer [Java Application] C:\F
Name      : Nithish G
Reg No.   : 19BCS0012

Produced value --> put method : 0
Consumer value --> put method : 0

Produced value --> put method : 1
Consumer value --> put method : 1

Produced value --> put method : 2
Consumer value --> put method : 2

Produced value --> put method : 3
Consumer value --> put method : 3

Produced value --> put method : 4
Consumer value --> put method : 4

Produced value --> put method : 5
Consumer value --> put method : 5

Produced value --> put method : 6
Consumer value --> put method : 6

Produced value --> put method : 7
Consumer value --> put method : 7

Main.java
Producerconsumer2.java
(default package)
64 p;
65 Thread (this, "Consumer1"
66
67
68 .()
69
70
71
72
73 Thread.sleep(1000);} cat
74
75
76
77
78
79
80 oducer_Consumer
81
82 tic void main(String[] Ni
83
84
85 l.out.print("\tName      : Ni
86 l.out.print("-----
87 p = new Shop1();
88 cer1(shop);
89 mer1(shop);
90
91
92
93
```

----- Thank You Madam! -----