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Course Instructor:	Prof. Shilpa S B , Prof. Pushplata Dubey, Prof. Sneha Prasad		

Glossary – Object Oriented Programming with Java

Acronym	**Stands for**
OOP	Object-Oriented Programming
API	Application Programming Interface
AWT	Abstract Windowing Toolkit
JDK	Java Development Kit
JVM	Java Virtual Machine.
RMI	Remote Method Invocation
MVC	Model-View-Controller

Acronym	**Brief explanation**
Object-Oriented Programming	Object-oriented programming organizes a program around its data (that is, objects) and a set of well-defined interfaces to that data. An object-oriented program can be characterized as data controlling access to code.
data abstraction	refers to the process of hiding the complexity of data by exposing only essential features to the user.

Java Buzzwords

Simple	easy for the professional programmer to learn and use effectively.
Robust	the program must execute reliably in a variety of systems.
Multithreaded	allows to write programs that do many things simultaneously.
Architecture-Neutral	“write once; run anywhere, any time, forever.”

Interpreted and High Performance	● bytecode was carefully designed so that it would be easy to translate directly into native machine code for very high performance by using a just-in-time compiler. ● Java run-time systems that provide this feature lose none of the benefits of the platform-independent code.
.Distributed	Java is designed for the distributed environment of the Internet because it handles TCP/IP protocols. enables a program to invoke methods across a network.
Dynamic	bytecode may be dynamically updated on a running system.

The Three OOP Principles

Encapsulation	Mechanisms that allow each object to have its own data and methods.
Inheritance	Used for code reusability. It Refers to the capability of creating a new *class* from an existing class.
Polymorphism	Capability of having methods with the same names and parameter types exhibit different behavior depending on the receiver.

Acronym	**Brief explanation**
Applet	An applet is a special kind of Java program that is designed to be transmitted over the Internet and automatically executed by a Java-compatible web browser.
Bytecode	Bytecode is a highly optimized set of instructions designed to be executed by the Java run-time system.
Servlets	A servlet is a small program that executes on the server. Just as applets dynamically extend the functionality of a web browser, servlets dynamically extend the functionality of a web server.
Garbage Collection	objects are destroyed and their memory released for later reallocation automatically
Strongly Typed Language	Every variable has a type, every expression has a type, and every type is strictly defined. Second, all assignments, whether explicit or via parameter passing in method calls, are checked for type compatibility. The Java compiler checks all expressions and parameters to ensure that the types are compatible.
Variables	the basic unit of storage in a Java program. Combining an identifier, a type, and an optional initializer defines a variable. *type identifier* [= *value*]
Type Casting	To create a conversion between two incompatible types, you must use a cast. A cast is simply an explicit type conversion.

	(target-type) value

array	A fixed-size object that can hold zero or more items of the array's declared type
	type var-name[ ];
	array-var = new type [size];

String type	The String type is used to declare string variables.

class	blueprint for creating an object. A class contains all *attributes and behaviors* that describe or make up the object.
	class classname { type instance-variable1;
	// ..
	. type instance-variableN;
	type methodname1(parameter-list)
	{ // body of method }
	... type methodnameN(parameter-list)
	{ // body of method }
	}

instance-variable	The data, or variables, are defined within a class.it describes the Characteristics of the object
Methods	operations (or actions) that objects perform
object	a class is a new data type. it is used to declare objects of that type. *class-var = new classname ( );*
Constructors	initializes an object immediately upon creation. It has the same name as the class in which it resides and is syntactically similar to a method.

finalize( )	Java runs time calls that method whenever it is about to recycle an object of that class.
	protected void finalize( ) {
	// finalization code here }

Recursion	Recursion is the process of defining something in terms of itself
Abstract Class	define a superclass that declares the structure of a given abstraction without providing a complete implementation of every method.
Object Class	An object is a superclass of all other classes. This means that a reference variable of type Object can refer to an object of any other class

Key word	**Brief explanation**
break	it can be used to exit a loop
continue	it continue running the loop but stops processing the remainder of the code in its body for this particular iteration
return	it causes program control to transfer back to the caller of the method.
this	his can be used inside any method to refer to the current object.
public	When a member of a class is modified by public, then that member can be accessed by any other code.
private	When a member of a class is modified by private, then that member can be accessed by by other members of its class.
protected	When a member of a class is modified by protected, then that member can be accessed applies by same class, subclasses, and classes in the same package. it is default modifier
static	it can be accessed before any objects of its class are created, and without reference to any object. static have several restrictions: ● They can only directly call other static methods. ● They can only directly access static data. ● They cannot refer to this or super in any way
final	The keyword final has three uses. ● First, it can be used to create the equivalent of a named constant ● second,To disallow a method from being overridden, ● third,to prevent a class from being inherited

extends	it denote inheritance from a superclass. When a class extends another, it class inherits all the accessible methods and fields of the superclass.
	class subclass-name extends superclass-name
	{ // body of class }

super	Whenever a subclass needs to refer to its immediate superclass, it can do so by use of the keyword super. ● it always refers to the superclass of the subclass in which it is used *super.member* *Here, member* can be either a method or an instance variable.

- A subclass can call a constructor defined by its superclass by use of the following form of super: super(arg-list);

abstract (type modifie) You can require that certain methods be overridden by subclasses by specifying the abstract type modifier.

package The package statement defines a name space in which classes are stored .Any classes declared within that file will belong to the specified package.

```
package pkg;
```

import A package in Java is used to group related classes.

To use a class or a package from the library, you need to use the import keyword.

```
import pkg1 [.pkg2].(classname | *);
```

interface using interface, you can specify what a class must do, but not how it does it. Interfaces are syntactically similar to classes, but they lack instance variables Java allows you to fully utilize the “one interface, multiple methods” aspect of polymorphism.

```
access interface name {
 return-type method-name1(parameter-list);
  type final-varname1 = value;
//...
return-type method-nameN(parameter-list);
 type final-varnameN = value; }
```

*One interface can inherit another by use of the keyword extends.

implements To implement an interface, include the implements clause in a class definition, and then create the methods required by the interface.

```
class classname [extends superclass] [implements interface [,interface...]] {
// class-body }
```

exception an object that describes an exceptional (that is, error) condition that has occurred in a piece of code. When an exceptional condition arises, an object representing that exception is created and thrown in the method that caused the error

try-catch Program statements that need to be monitor for exceptions are contained within a try block. If an exception occurs within the try block, it is thrown. Your code can catch this exception (using catch) and handle it in some rational manner.

```
 try {
 // block of code to monitor for errors }
```

	catch (ExceptionType1 exOb) {
	// exception handler for ExceptionType1 }
	catch (ExceptionType2 exOb) {
	// exception handler for ExceptionType2 }
	// ...
	finally { // block of code to be executed after try block ends }

throw	to throw an exception explicitly in program throw ThrowableInstance;
throws	A throws clause lists the types of exceptions that a method might throw. type method-name(parameter-list) throws exception-list { // body of method }
finally	finally creates a block of code that will be executed after a try /catch block has completed. k. The finally block will execute whether or not an exception is thrown. *The finally clause is optional. However, each try statement requires at least one catch or a finally clause.
multithreaded program	g. A multithreaded program contains two or more parts that can run concurrently. Each part of such a program is called a thread, *multithreading introduces an asynchronous behavior to your programs
Thread class	Thread encapsulates a thread of execution.. To create a new thread, your program will either extend Thread or implement the Runnable interface.

methods defined by Thread

suspend( )	to pause the execution of a thread
resume( )	restart the execution of a thread
stop( )	stop the execution of a thread
getState( )	It returns a value of type Thread.State that indicates the state of the thread at the time at which the call was made. values can be BLOCKED or NEW or RUNNABLE etc.
Synchronization	When two or more threads need access to a shared resource, they need some way to ensure that the resource will be used by only one thread at a time. The process by which this is achieved is called synchronization.
monitor object	A monitor is an object that is used as a mutually exclusive lock. Only one thread can own a monitor at a given time. When a thread acquires a lock, it is said to have entered the monitor.

Deadlock	A special type of error that you need to avoid that relates specifically to multitasking is deadlock, which occurs when two threads have a circular dependency on a pair of synchronized objects.
enum	an enumeration is a list of named constants enum Apple { Jonathan, GoldenDel, RedDel, Winesap, Cortland }
Autoboxing	Autoboxing is the process by which a primitive type is automatically encapsulated (boxed) into its equivalent type wrapper whenever an object of that type is needed. There is no need to explicitly construct an object
Swing	create window-based applications. It is built on the top of AWT (Abstract Windowing Toolkit) API and entirely written in java. Two Key Swing Features ● Components Are Lightweight ● Pluggable Look and Feel

Program 1

Title: Write a program in java to pass argument and count how many parameters are passed.

Problem Description: The program counts the number of parameters passed at the command prompt and displays them along with their occurrence.

Method: The method utilized here is to access the command line arguments using the args array in the main method. The length of this array is then used to determine the number of parameters passed.

Code

```
public class Prg1 {
  public static void main(String[] args) {
        for (int i = 0; i < args.length; i++)
        {
                    int count = 1;
              for (int j = i + 1; j < args.length; j++)
              {
                    if (args[i].equals(args[j]))
                    {
                    count++;
                    args[j] = ""; // Mark the counted argument to avoid duplicate counting
                    }
                    }
                          // Display the argument and its count if it's not already counted
                    if (!args[i].equals(""))
                    {
                          System.out.println(args[i] + ": " + count);
                    }
        }
  }
}
```

Program 2

Title: Write a java program to create and display the student details.

Problem Description: The problem involves creating a Java class named Student, which contains variables for USN, Name, Branch, and Phone. The task further requires writing a Java program to instantiate 'n' Student objects and printing their details with appropriate headings.

Method: In this program, the 'Student' class encapsulates the details of a student, and the main program creates an array of Student objects, initializes each object with sample data, and then print out the details of each student.

Code

```
import java.util.Scanner;

class Student1{

   String usn;

   String name;

   String branch;

   String phone;

  void read()

  {

            Scanner s=new Scanner(System.in);

            System.out.println("Enter usn");

             usn=s.next();

             System.out.println("Enter name");

             name=s.next();

             System.out.println("Enter branch");

             branch=s.next();

             System.out.println("Enter phone");

             phone=s.next();


  }

   // Method to display student details

   void display() {

      System.out.println("USN: " + usn);
```

```
        System.out.println("Name: " + name);
        System.out.println("Branch: " + branch);
        System.out.println("Phone: " + phone);
        System.out.println(); // Empty line for better formatting
    }
}
public class Student {
    public static void main(String[] args) {
            Scanner s=new Scanner(System.in);
        System.out.println("Enter number of students");
        int n=s.nextInt();
        Student1[] s1=new Student1[n];
        for (int i = 0; i < n; i++)
        {
          s1[i] = new Student1();
        }
        for(int i=0;i<n;i++)
        {
            s1[i].read();
        }
        for(int i=0;i<n;i++)
        {
            s1[i].display();
        }
    }
}
```

Program 3:

Title: Write a java program to implement staff hierarchy.

Problem Description: The problem involves designing a superclass named Staff with attributes such as: StaffId, Name, Phone, and Salary. Additionally, three subclasses: Teaching, Technical, and Contract-are to be created with specific attributes for each category. The task requires writing a Java program to read and display at least three staff objects from all three categories.

Method: In this example, the Staff superclass encapsulates common attributes shared by all staff members, while the Teaching, Technical, and Contract subclasses define specific attributes for each category of staff. The main program creates and displays at least three staff objects from each category.

Code

```
import java.util.Scanner;
class Staff {
        String staffID, name, phone, salary;
        Scanner input = new Scanner(System.in);
        void read()
        {
                System.out.println("Enter StaffID");
                staffID = input.next();
                name = input.next();
                phone = input.next();
                salary = input.next();
        }
        void display()
      {
        System.out.print(staffID+"\t"+name+"\t"+phone+"\t"+salary+"\t");
        }
}
class Teaching extends Staff {
        String domain, publication;
        void read()
        {
                super.read(); // call super class read method
                System.out.println("Enter Domain");
                domain = input.next();
                System.out.println("Enter Publication");
                publication = input.next();
        }
        void display() {
                super.display(); // call super class display() method
                System.out.println(domain+"\t"+publication);
        }
}
class Technical extends Staff {
        String Skills;
        void read()
        {
                super.read(); // call super class read method
                System.out.println("Enter Skills");
                Skills = input.next();
        }
        void display()
        {
                super.display(); // call super class display() method
                System.out.println(Skills);
        }
}
class Contract extends Staff
{
        String period;
        void read()
        {
                super.read(); // call super class read method
                System.out.println("Enter Period");
                period = input.next();
        }
      @Override
        void display() {
                super.display(); // call super class display() method
                System.out.println(period);
        }
}
public class StaffDemo
{
        public static void main(String[] args)
        {
                Scanner input = new Scanner(System.in);
                System.out.println("Enter number of staff details to be created");
                int n = input.nextInt();
                Teaching ts[] = new Teaching[n];
                Technical tech[] = new Technical[n];
                Contract c[] = new Contract[n];
                // Read Staff information under 3 categories
                for (int i = 0; i < n; i++)
                {
                        System.out.println("Enter Teaching staff information");
                        ts[i] = new Teaching();
                        ts[i].read();
                }
                for (int i = 0; i < n; i++) {
                        System.out.println("Enter Technical staff information");
                        tech[i] = new Technical();
                        tech[i].read();
                }
                for (int i = 0; i < n; i++) {
                        System.out.println("Enter Contract staff information");
                        c[i] = new Contract();
                        c[i].read();
                }
                // Display Staff Information
                System.out.println("\n STAFF DETAILS: \n");
                System.out.println("-----TEACHING STAFF DETAILS----- ");
                for (int i = 0; i < n; i++)
                        ts[i].display();
                System.out.println("-----TECHNICAL STAFF DETAILS-----");
                for (int i = 0; i < n; i++)
                        tech[i].display();
                System.out.println("-----CONTRACT STAFF DETAILS-----");
                for (int i = 0; i < n; i++)
                        c[i].display();

                }
}
```

Program 4:

Title: Write a java program to implement Box class application to depict constructor overloading.

Problem Description: Given three classes called A, B, and C, C can be a subclass of B, which is a subclass of A. When this type of situation occurs, each subclass inherits all of the traits found in all of its super classes. methods with different parameters.

Method: In this program, C inherits all aspects of B and A. To see how a multilevel hierarchy can be useful, consider the following program. In it, the subclass BoxWeight is used as a superclass to create the subclass called Shipment. Shipment inherits all of the traits of BoxWeight and Box, and adds a field called cost, which holds the cost of shipping such a parcel.

Theory Reference: Module 3

Code

```
class Box {

   double length;

   double width;

   double height;
```

```
    // Default constructor
    Box() {
        length = -1;
        width = -1;
        height = -1;
    }
    // Parameterized constructor
    Box(double len, double wid, double hgt) {
        length = len;
        width = wid;
        height = hgt;
    }
    // Copy constructor
    Box(Box ob) {
        length = ob.length;
        width = ob.width;
        height = ob.height;
    }
    Box(double len)
    {
            width=height=length=len;
    }

    // Method to calculate volume
    double volume() {
        return length * width * height;
    }
}
```

```
// Define the BoxWeight class that extends Box
class BoxWeight extends Box {
   double weight;
   // Default constructor
   BoxWeight() {
         super();
      weight = -1;
   }
   // Parameterized constructor
   BoxWeight(double len, double wid, double hgt, double wt) {
      super(len, wid, hgt);
      weight = wt;
   }
   // Copy constructor
   BoxWeight(BoxWeight ob) {
      super(ob);
      weight = ob.weight;
   }
   BoxWeight(double len, double wt)
   {
         super(len);
         weight=wt;
   }

}
// Define the Shipment class that extends BoxWeight
class Shipment extends BoxWeight {
   double cost;

   // Default constructor
```

```
    Shipment() {
        super();
      cost = -1;
    }
    // Parameterized constructor
    Shipment(double len, double wid, double hgt, double wt, double c) {
      super(len, wid, hgt, wt);
      cost = c;
    }
    // Copy constructor
    Shipment(Shipment ob) {
      super(ob);
      cost = ob.cost;
    }
    Shipment(double len, double wt, double c)
    {
        super(len,wt);
        cost=c;
    }
}
public class BoxClassApplication
{
    public static void main(String[] args)
    {
        Shipment shipment1 =new Shipment(10, 20, 15, 10, 3.41);
        Shipment shipment2 =new Shipment(2, 3, 4, 0.76, 1.28);
        double vol;
        vol = shipment1.volume();
        System.out.println("Volume of shipment1 is " + vol);
        System.out.println("Weight of shipment1 is "+ shipment1.weight);
```

```
            System.out.println("Shipping cost: $" + shipment1.cost);
            System.out.println();
            vol = shipment2.volume();
            System.out.println("Volume of shipment2 is " + vol);
            System.out.println("Weight of shipment2 is "+ shipment2.weight);
            System.out.println("Shipping cost: $" + shipment2.cost);
    }
}
```

Program 5:
Title: Write a java program to solve the Tower of Hanoi Problem using Stack.

Problem Description: Move all the disks stacked on the first tower over to the last tower using a helper tower in the middle. While moving the disks, certain rules must be followed. Only one disk can be moved. A larger disk cannot be placed on a smaller disk.

Method: In this program, Solving the Tower of Hanoi problem using a stack is an elegant and efficient approach. The Tower of Hanoi problem involves three rods and a number of disks of different sizes that can slide onto any rod. The puzzle starts with the disks in a neat stack in ascending order of size on one rod, with the smallest disk at the top, and the objective is to move the entire stack to another.

Theory Reference: Module 3 Page no:157

Code:

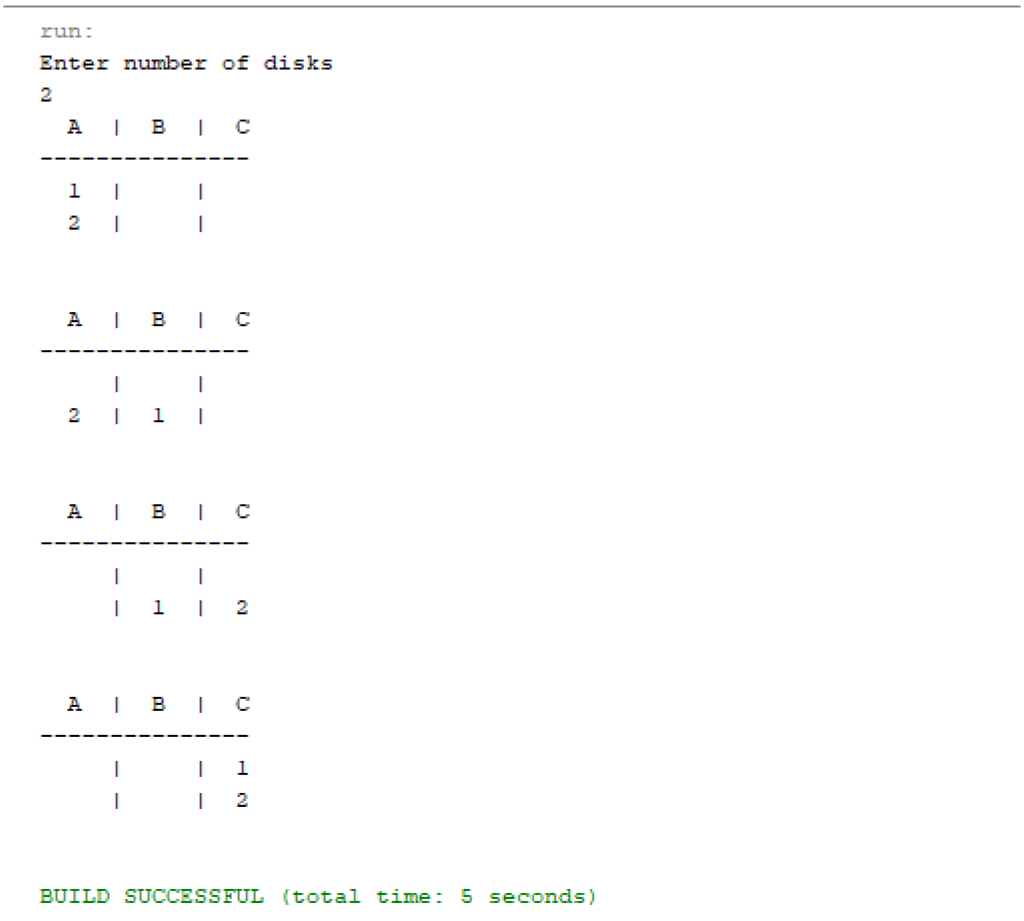
```
import java.util.*;


 /* Class TowerOfHanoiUsingStacks */
 public class p5
 {
     public static int N;
     /* Creating Stack array  */
     public static Stack<Integer>[] tower = new Stack[4];


     public static void main(String[] args)
     {
         Scanner scan = new Scanner(System.in);
         tower[1] = new Stack<Integer>();
         tower[2] = new Stack<Integer>();
         tower[3] = new Stack<Integer>();
         /* Accepting number of disks */
         System.out.println("Enter number of disks");
         int num = scan.nextInt();
         N = num;
         toh(num);
     }
```

```
/* Function to push disks into stack */
    public static void toh(int n)
    {
        for (int d = n; d > 0; d--)
            tower[1].push(d);
        display();
        move(n, 1, 2, 3);
    }
    /* Recursive Function to move disks */
    public static void move(int n, int a, int b, int c)
    {
        if (n > 0)
        {
            move(n-1, a, c, b);
            int d = tower[a].pop();
            tower[c].push(d);
            display();
            move(n-1, b, a, c);
        }
    }
    /*  Function to display */
    public static void display()
    {
        System.out.println("  A  |  B  |  C");
        System.out.println("---------------");
        for(int i = N - 1; i >= 0; i--)
        {
            String d1 = " ", d2 = " ", d3 = " ";
            try
            {
                d1 = String.valueOf(tower[1].get(i));
            }
            catch (Exception e){
            }
            try
            {
                d2 = String.valueOf(tower[2].get(i));
            }
            catch(Exception e){
            }
            try
            {
                d3 = String.valueOf(tower[3].get(i));
            }
            catch (Exception e){
            }
            System.out.println("  "+d1+"  |  "+d2+"  |  "+d3);
        }
        System.out.println("\n");
    }
}
```

OUTPUT:



```
run:
Enter number of disks
2
  A  |  B  |  C
---------------
  1  |     |
  2  |     |


  A  |  B  |  C
---------------
     |     |
  2  |  1  |


  A  |  B  |  C
---------------
     |     |
     |  1  |  2


  A  |  B  |  C
---------------
     |     |  1
     |     |  2


BUILD SUCCESSFUL (total time: 5 seconds)
```

Program 6:

Title: “Write a Java Program to calculate area and perimeter of variety of shapes (circle and triangle)”

Problem Description: Develop a JAVA program to create an abstract class Shape with abstract methods calculateArea() and calculatePerimeter(). Create subclasses Circle and Triangle that extend the Shape class and implement the respective methods to calculate the area and perimeter of each shape.

Method: Ensure that the program is well-structured, follows object-oriented principles, and provides clear and concise output demonstrating the functionality of each class and method.

Theory Reference: Module 3 Page no:157

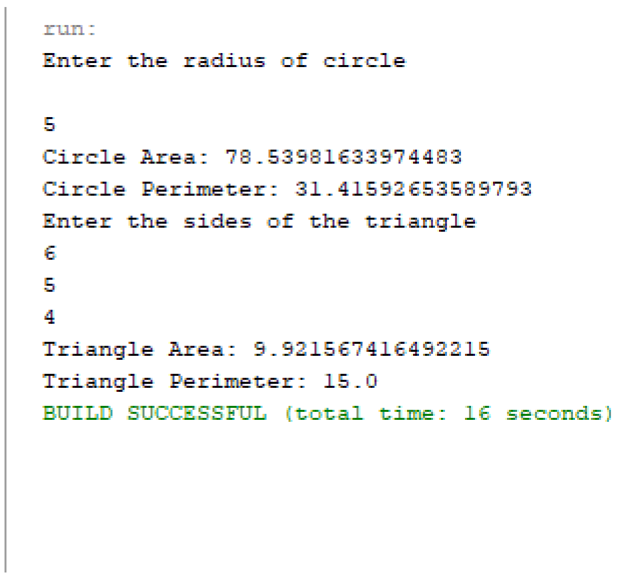
Code:

```
import java.util.Scanner;
// Abstract class Shape
abstract class Shape {
    // Abstract methods
    abstract double calculateArea();
    abstract double calculatePerimeter();
}
// Subclass Circle
class Circle extends Shape {
    private double radius;

    // Constructor
    public Circle(double radius) {
        this.radius = radius;
    }
    // Implementation of abstract methods
    @Override
    double calculateArea() {
        return Math.PI * radius * radius;
    }
    @Override
    double calculatePerimeter() {
        return 2 * Math.PI * radius;
    }
}
// Subclass Triangle
class Triangle extends Shape {
    private double side1, side2, side3;

    // Constructor
    public Triangle(double side1, double side2, double side3) {
        this.side1 = side1;
        this.side2 = side2;
        this.side3 = side3;
    }
    // Implementation of abstract methods
    @Override
    double calculateArea() {
        // Using Heron's formula
        double s = (side1 + side2 + side3) / 2;
        return Math.sqrt(s * (s - side1) * (s - side2) * (s - side3));
    }
    @Override
    double calculatePerimeter() {
        return side1 + side2 + side3;
    }
}
// Main class to test the program
public class p6 {
    public static void main(String[] args) {
        // Circle with radius 5
        Scanner sc=new Scanner(System.in);
        System.out.println("Enter the radius of circle");
        int r=sc.nextInt();
        Shape circle = new Circle(r);
        System.out.println("Circle Area: " + circle.calculateArea());
        System.out.println("Circle Perimeter: " + circle.calculatePerimeter());
        System.out.println("Enter the sides of the triangle");
        int s1=sc.nextInt();
        int s2=sc.nextInt();
        int s3=sc.nextInt();
        Shape triangle = new Triangle(s1, s2, s3);
        System.out.println("Triangle Area: " + triangle.calculateArea());
        System.out.println("Triangle Perimeter: " + triangle.calculatePerimeter());
    }
}
```

OUTPUT:



```
run:
Enter the radius of circle

5
Circle Area: 78.53981633974483
Circle Perimeter: 31.41592653589793
Enter the sides of the triangle
6
5
4
Triangle Area: 9.921567416492215
Triangle Perimeter: 15.0
BUILD SUCCESSFUL (total time: 16 seconds)
```

Program 7:

Title: “Java Program: Resizable Interface for Object Resizing with Rectangle Implementation”.

Problem Description: Develop a JAVA program to create an interface Resizable with methods resizeWidth(int width) and resizeHeight(int height) that allow an object to be resized. Create a class Rectangle that implements the Resizable interface and implements the resize methods.

Method: Ensure that the program follows proper object-oriented principles, such as encapsulation and abstraction, and provides clear and concise output demonstrating the resizing functionality.
Theory Reference: Module 3 Page no:157

Code:

```
import java.util.Scanner;
// Interface Resizable
interface Resizable {
    void resizeWidth(int width);
    void resizeHeight(int height);
}
// Class Rectangle implementing Resizable
class Rectangle implements Resizable {
    private int width;
    private int height;
    // Constructor
    public Rectangle(int width, int height) {
        this.width = width;
        this.height = height;
    }
    // Method to resize the width
    @Override
    public void resizeWidth(int newWidth) {
        this.width = newWidth;
        System.out.println("New width: " + width);
    }
  // Method to resize the height
    @Override
    public void resizeHeight(int newHeight) {
        this.height = newHeight;
        System.out.println("New height: " + height);
    }
    // Method to display the current dimensions of the rectangle
    public void displayDimensions() {
        System.out.println("Current dimensions: " + width + " x " +
height);
    }
}
// Main class to test the program
public class p7{
    public static void main(String[] args) {
        // Create a rectangle with width 10 and height 5
        Scanner sc=new Scanner(System.in);

        Rectangle rectangle = new Rectangle(10,5) ;
        rectangle.displayDimensions();
        // Resize the rectangle's width and height
        System.out.println("Enter the new width and height");
        int w=sc.nextInt();
        int h=sc.nextInt();
        rectangle.resizeWidth(w);
        rectangle.resizeHeight(h);
        rectangle.displayDimensions();
    }
}
```

Program 8:

Title: "Java Program: Custom Exception Handling for DivisionByZero and Arithmetic Exceptions".
Problem Description: Develop a Java program that demonstrates the handling of custom exceptions, specifically for DivisionByZero and Arithmetic exceptions. You are required to utilize try-catch blocks along with throw statements to handle these exceptions gracefully.
Method: Ensure that the program demonstrates the proper usage of try-catch blocks, throw statements, and custom exception handling for DivisionByZero and Arithmetic exceptions.
Theory Reference: Module 4 Page no:205

Code:

```
import java.util.Scanner;
//Custom exception class
class DivisionByZeroException extends Exception {
public DivisionByZeroException(String message) {
super(message);
    }
}

public class pgm8 {

   // Method to perform division and throw custom exception if
denominator is zero
    static double divide(int numerator, int denominator) throws
DivisionByZeroException {
    if (denominator == 0) {
    throw new DivisionByZeroException("Cannot divide by zero!");
    }
    return (double) numerator / denominator;
    }
   public static void main(String[] args) {
       // TODO Auto-generated method stub
       Scanner input = new Scanner(System.in);
       System.out.println("Enter numerator and denominator ");
       int numerator = input.nextInt();
        int denominator = input.nextInt();
try {
        double result = divide(numerator, denominator);
        System.out.println("Result of division: " + result);
        }
catch (DivisionByZeroException e) {
        System.out.println("Exception caught: " + e.getMessage());
        }
        finally {
        System.out.println("Finally block executed");
               }
           }
       }
```

Program 9

Title: "Write a Java program to generate random numbers using multiple threads.

Problem Description: Develop a Java program that implements a multi-threaded application with three threads. Each thread has a specific task as described as follows: First Thread (Random Number Generator): This thread generates a random integer every 1 second. Second Thread (Square Computation): This thread receives the random integer generated by the first thread and computes its square. After computing the square, it prints the result. Third Thread (Cube Computation): This thread receives the random integer generated by the first thread and computes its cube. After computing the cube, it prints the result.

Method: Program should demonstrate the multi-threading capabilities of Java and showcase the asynchronous computation of squares and cubes. Additionally, it should handle synchronization and data sharing effectively to prevent race conditions and ensure thread safety.

Theory Reference: Module 4 Page no:205

Code:

```java
import java.util.Random;

class Square extends Thread

{

  int x;

  Square(int n)

  {

    x = n;

  }

  public void run()

  {

    int sqr = x * x;

    System.out.println("Square of " + x + " = " + sqr);

  }

}

class Cube extends Thread

{

  int x;

  Cube(int n)

  {

    x = n;
    }
    public void run()
    {
        int cub = x * x * x;
        System.out.println("Cube of " + x + " = " + cub);
    }
}
class Rnumber extends Thread
{
    public void run()
    {
        Random random = new Random();
        for (int i = 0; i < 5; i++) {
            int randomInteger = random.nextInt(10);
            System.out.println("Random Integer generated : " + randomInteger);
            Square s = new Square(randomInteger);
            s.start();
            Cube c = new Cube(randomInteger);
            c.start();
            try
            {
                Thread.sleep(1000);
            } catch (InterruptedException ex)
            {
                System.out.println(ex);
            }
        }
    }
}
public class P9_New {
    public static void main(String[] args)
    {
        Rnumber n = new Rnumber();
        n.start();
    }
}
```

Program 10:

Title: "Java Swing Program: Creating Buttons with JFrame Inheritance".

Problem Description: Develop a Java program using Swing to create a button and add it to a JFrame object inside the main method. Additionally, you should inherit the JFrame class without explicitly creating an instance of the JFrame class.

Method: Program should demonstrate the creation of a Swing button and its addition to a JFrame object, while also showcasing inheritance of the JFrame class.

Theory Reference: Module 5 Page no: 859

Code:

```
package p10;

import javax.swing.*;  // Importing Swing components

import java.awt.event.*; // For action events

public class p10 {


        public static void main(String[] args) {

                JFrame frame = new JFrame("Text Field Example");

    JButton button = new JButton("Click me");

    // Action listener to display text

    button.addActionListener(new ActionListener() {

      public void actionPerformed(ActionEvent e) {

        JOptionPane.showMessageDialog(frame, "button clicked ");

      }

    });

    // Adding components to frame

    frame.setLayout(new java.awt.FlowLayout());

    frame.add(button);

    frame.setSize(300, 150);

    frame.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);

    frame.setVisible(true);

        }

}
```