KLS GOGTE INSTITUTE OF TECHNOLOGY, BELAGAVI

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

LAB MANUAL

Subject:

Object Oriented Programming

with Java (21CS33)

TERMWORK 1

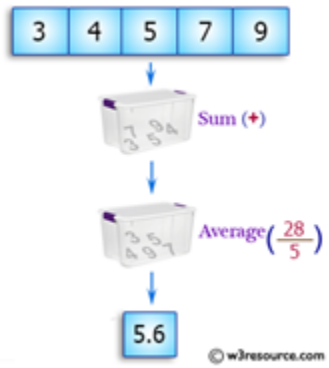
Tittle: Write a program to demonstrate the implementation of a 2-dimension array.

Problem Definition:

Write a Java program to accept IA marks obtained by five students in three subjects. The program should accept marks obtained by each student and display the total marks and the average marks. The average marks are computed using a method as the average of best two marks obtained.

Introduction:

Basics – for 5 subject marks example –



	Column 1	Column 2	Column 3	Column 4
Row 1	a[0][0]	a[0][1]	a[0][2]	a[0][3]
Row 2	a[1][0]	a[1][1]	a[1][2]	a[1][3]
Row 3	a[2][0]	a[2][1]	a[2][2]	a[2][3]

Here is how we can initialize a 2-dimensional array in Java.

Algorithm:

1. Repeat For I = 1 to M

2. Repeat For J = 1 to N

3. Create a 2 – dimensional array

[End of Step 2 For Loop]

[End of Step 1 For Loop]

4. Exit

Implementation Steps:

Step 1: Create 2 – dimensional Array and store marks data and calculate total

Step 2: Compute average function

Step 3: Prompt the outputs to the screen – total and average – for 5 students and 3 subjects –

Observations and Output:

Rubrics of Evaluation:

	Advanced (5 Marks)	Proficient (3 Marks)	Approaching Proficiency (2 Marks)	Beginning (1 Marks)	Marks
• **Syntax** Ability to understand andfollow the rules of the programming language. • **Logic** Ability to specify conditions, control flow, and data structures that are appropriate for the problem domain. • **Correctness** Ability to code formulae and algorithms that reliably produce correct answers or appropriate results.	• Program compiles and contains no evidence of misunderstanding or misinterpreting the syntax of the language. • Program logic is correct, with no known boundary errors, and no redundant or contradictory conditions. • Program produces correct answers or appropriate results for allinputs tested.	• Program compiles and is free from major syntactic misunderstandings, but may contain non-standard usage or superfluous elements. • Program logic is mostly correct, but may contain an occasional boundary error or redundant or contradictory condition. • Program produces correct answers or appropriate results for most inputs.	• Program compiles, but contains errors that signal misunderstanding of syntax – such a s the semicolon in **if(exp);{}** • Program logic is on the right track with no infinite loops, but shows no recognition of boundary conditions (such as < vs. <=) • Program approaches correct answers or appropriate results for most inputs, but can contain miscalculations in some cases.	• Program does not compile or (in a dynamic language) contains typographical errors leading to undefined names. • Program contains some conditions that specify the opposite of what is required (less than vs. greater than), confuse Boolean AND/OR operators, or lead to infiniteloops. • Program does not produce correct answers or appropriate results for most inputs.	
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Signature of faculty:				**Total Marks:**	

TERMWORK 2

Tittle: Write a program to demonstrate the implementation of class and its member methods.

Problem Definition:

Design a class by name myTriangle to model a triangle geometrical object with three sides. Include functions to:

1. Initialize the three sides of the triangle.
2. Determine the type of triangle represented by the three sides (Equilateral/ Isosceles/ Scalene triangle).
3. Compute and return the area of the triangle.

Note:

When three sides are given we use the following formula:

s = (a+b+c) / 2;

area = sqrt(s*(s-a)*(s-b)*(s-c));

Introduction:

A triangle is a three-sided polygon, which has three vertices. The three sides are connected with each other end to end at a point, which forms the angles of the triangle. The sum of all three angles of the triangle is equal to 180 degrees.

Types of Triangle:

- Scalene Triangles
- Isosceles triangles
- Equilateral triangles

If all the three sides are different in length, then its scalene triangle.

If any two sides are equal in length, then it is an isosceles triangle.

If all three sides are equal in length, then it is an equilateral triangle.

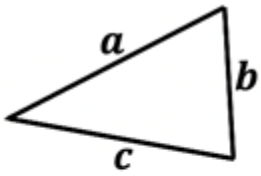
Area is the region occupied by it in a two-dimensional space.

Area = ½ (Product of base and height of a triangle)

Sum of the Lengths of Two Sides of a Triangle:

A polygon is a simple closed figure made up of only line segments. A triangle is the smallest polygon formed by joining three-line segments. These three-line segments are called the sides of the triangle. Any three-line segments cannot form a triangle. A triangle can be drawn only if the sum of any two sides of the triangle is greater than the third side. This is stated as the triangle inequality.

Triangle Inequality



$$a + b > c$$
$$a + c > b$$
$$b + c > a$$

Algorithm:

Step 1: Get inputs – sides of a triangle a, b, c

Step 2: Testing triangle existence – sum of two sides must be greater than the third side.

Step 3: Calculation area of a triangle, Area = ½ X Base X Height

Observation and Output:

Rubrics of Evaluation:

	Advanced (5 Marks)	**Proficient (3 Marks)**	**Approaching Proficiency (2 Marks)**	**Beginning (1 Marks)**	**Marks**
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Signature of faculty:				**Total Marks:**	

TERMWORK 3

Title: Write a program to demonstrate the implementation of parameterized:

a. Methods.

b. Constructor.

Problem Statement: A certain small bank intends to automate a few of its banking operations for its customers. Design a class by name mybankAccount to store the customer data having following details:

1.accountNumber 2. acctType 3. Name 4. Address 5. accountBalance

The class must have both default and parameterized constructors. Write appropriate method to compute interest accrued on accountBalance based on accountType and time in years. Assume 5% for S/B account 6.5% for RD account and 7.65 for FD account. Further, add two methods withdrawAmount/depositAmount with amount as input to withdraw and deposit respectively. The withdrawAmount method must report in-sufficient balance if accountBalance falls below Rs. 1000.

Introduction:

Parameterized Methods:

Information can be passed to methods as parameters. Parameters act as variables inside the method.

Parameters are specified after the method name, inside the parentheses. You can add as many parameters as you want, just separate them with a comma.

The below example has a method that takes a String called fname as parameter. When the method is called, we pass along a first name, which is used inside the method to print the full name:

Example:

```
public class Main {
```

```
 static void myMethod(String fname) {
   System.out.println(fname + " Refsnes");
 }
 public static void main(String[] args) {
   myMethod("Liam");
   myMethod("Jenny");
   myMethod("Anja");
 }
```

Parameterized constructors:

In Java, a constructor is a block of codes similar to the method. It is called when an instance of the class is created. At the time of calling constructor, memory for the object is allocated in the memory.

It is a special type of method which is used to initialize the object.

Every time an object is created using the new() keyword, at least one constructor is called.

It calls a default constructor if there is no constructor available in the class. In such case, Java compiler provides a default constructor by default.

There are two types of constructors in Java: no-arg constructor, and parameterized constructor.

A constructor which has a specific number of parameters is called a parameterized constructor.

The parameterized constructor is used to provide different values to distinct objects. However, you can provide the same values also.

In the below example, we have created the constructor of Student class that have two parameters. We can have any number of parameters in the constructor.

```
class Student4{
    int id;
    String name;
    //creating a parameterized constructor
    Student4(int i,String n){
    id = i;
    name = n;
    }
    //method to display the values
    void display(){System.out.println(id+" "+name);}
    public static void main(String args[]){
    //creating objects and passing values
    Student4 s1 = new Student4(111,"Karan");
    Student4 s2 = new Student4(222,"Aryan");
    //calling method to display the values of object
    s1.display();
    s2.display();
    }

    }
```

Algorithm:

TASK 1 : Build the class with appropriate member variables, constructors and methods.

TASK 2 : Instantiate three objects of above type and perform different operations on the same.

TASK 3 : Write a function to display all the three customer details in a tabular form with appropriate column headings.

Step 1:Create a Bank account method and collect the name, address and other details from the user

Step 2:Create BankAcc constructor and assign the details

Step 3: Compute Interest by using following functions

Step 4: Calculate deposit and withdraw based on details

Observations and Output:

Rubrics of Evaluation:

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Signature of faculty:				**Total Marks:**	

TERMWORK- 4

Title: Write a program to demonstrate the implementation of inheritance.

Problem Statement:

A company has two types of employees – Full Time and Par time. The company records for each employee his/her name, age, address, salary and gender. Given the basic salary of the Full Time employee the components of his/her gross salary are: Dearness allowance – 75% of basic salary, HRA – 7.5% of basic salary, IT – 10% of basic. The salary of a Part time employee is dependent on the qualification, experience, number of working hours and the rate per hour, as below:

	Qualification		
Experience	BE	MTech	Ph.D
1-5 years	300 Rs.	500 Rs.	800 Rs.
6-10 years	400 Rs.	700 Rs.	1200 Rs.
>10 years	500 Rs.	1000 Rs.	1500 Rs.

Introduction:

Inheritance in Java is a mechanism in which one object acquires all the properties and behaviors of a parent object. It is an important part of OOPs (Object Oriented programming system).

The idea behind inheritance in Java is that you can create new classes that are built upon existing classes. When you inherit from an existing class, you can reuse methods and fields of the parent class. Moreover, you can add new methods and fields in your current class also.

Inheritance represents the **IS-A relationship** which is also known as a *parent-child* relationship.

Terms used in Inheritance

- **Class:** A class is a group of objects which have common properties. It is a template or blueprint from which objects are created.
- **Sub Class/Child Class:** Subclass is a class which inherits the other class. It is also called a derived class, extended class, or child class.
- **Super Class/Parent Class:** Superclass is the class from where a subclass inherits the features. It is also called a base class or a parent class.
- **Reusability:** As the name specifies, reusability is a mechanism which facilitates you to reuse the fields and methods of the existing class when you create a new class. You can use the same fields and methods already defined in the previous class.

When a class inherits another class, it is known as a *single inheritance*. In the example given below, Dog class inherits the Animal class, so there is the single inheritance.

```
class Animal{
    void eat(){System.out.println("eating...");}
}
class Dog extends Animal{
void bark(){System.out.println("barking...");}
}
class TestInheritance{
public static void main(String args[]){
Dog d=new Dog();
d.bark();
d.eat();
}
}
```

Algorithm:

Model this as a problem of hierarchical inheritance by:

1) Identifying the super class with its data members and member functions.

2) Identify the sub-class/sub-classes and their associated data members and member functions.

Test the program by creating objects of the classes that are so identified.

Steps to be followed in programming are:

Step 1: Create a class Employee with the following details

Step 2: Create a subclass FTEmployee with Employee as a base class

Step 3: Create one more sublass PTEmployee with the base class Employee

Step 4: Create a main class and create objects using FTEmployee and PTEmployee derived classes

Observations and Output:

Rubrics of Evaluation:

	Advanced (5 Marks)	**Proficient (3 Marks)**	**Approaching Proficiency (2 Marks)**	**Beginning (1 Marks)**	**Marks**
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Signature of faculty:				**Total Marks:**	

TERMWORK 5a

Title: Write a program to demonstrate the implementation of method overloading.

Problem Definition: Create a Stack class having an integer array say elem and top_of_stack as instance variables. Define three overloaded methods having the following signatures:

a. initStack(int size) to create an array of specified size and initialize the top_of_stack

b. initStack(Stack another) to initialize the Stack object with state of the Stack object "another"

c. initStack(int [] a) to initialize contents of a[] to the instance variable elem.

Write following methods:

a. push(): Pushes the element onto the stack,

b. pop(): Returns the element on the top of the stack, removing it in the process, and

c. peek(): Returns the element on the top of the stack, but does not remove it.

Also write methods that check whether stack is full and stack is empty and return boolean value true or false appropriately.

Introduction:

Method Overloading in Java

Method overloading in java is a feature that allows a class to have more than one method with the same name, but with different parameters.

Java supports method overloading through two mechanisms:

1.By changing the number of parameters

2.By changing the data type of parameters Overloading by changing the number of parameters A method can be overloaded by changing the number of parameters.

What is Method overloading in Java?

“Method overloading is a feature of Java in which a class has more than one method of the same name and their parameters are different.”
In other words, we can say that Method overloading is a concept of Java in which we can create multiple methods of the same name in the same class, and all methods work in different ways. When more than one method of the same name is created in a Class, this type of method is called the Overloaded Method.

We can easily understand about method of overloading by the below example:
Suppose we have to write a method to find the square of an integer number. We can write this method as follows:

```
public void intSquare ( int number )
{
 int square = number * number;
 System.out.printIn("Method with Integer Argument Called:"+square);
}
public void doubleSquare(double number)
{
 double square = number * number;
 System.out.printIn("Method with double Argument Called:"+square);
}

public void longSquare(long number)
{
long square = number * number;
System.out.printIn("Method with long Argument Called:"+square);
}
```

If we look carefully, to find the square of a number only, according to the data type of the number, we have to take three names as follows:

intSquare()
doubleSquare()
longSquare()

If it is possible that a programmer has to take only one name and the program itself decides which method to use for which type of value, then it will be easier for the programmer to get the same. There is no need to memorize the names of more than one method for type work. In Java, we can give the above three methods the same name.

If we provide only the square () name instead of giving different names to the above three methods and write the rest of the description as follows, then Java's Compiler does not generate any error.

```
public void Square ( int number )
{
        int square = number * number;
        System.out.printIn("Method with Integer Argument Called:"+square);
 }
public void Square(double number)
 {
        double square = number * number;
        System.out.printIn("Method with double Argument Called:"+square);
}
public void Square(long number)
 {
       long square = number * number;
       System.out.printIn("Method with long Argument Called:"+square);
}
```

If we define these three methods in a class, then these methods can be called Overloaded Methods as they have the same name. Let us develop CalculateSquare Class to understand this, which is as follows:

```
class CalculateSquare
 {
        public void square()
         {
                System.out.println("No Parameter Method Called");
         }
        public int square( int number )
        {
                int square = number * number;
                System.out.println("Method with Integer Argument Called:"+square);
        }
        public float square( float number ){
                 float square = number * number;
                 System.out.println("Method with float Argument Called:"+square);
        }
        public static void main(String[] args) {
                CalculateSquare obj = new CalculateSquare();
                obj.square();
                obj.square(5);
                obj.square(2.5);
          }
 }
```

Note: We have not provided any argument in the ‘parenthesis’ of the square() method in our program. In this case, the Compiler Class calls the method in which no Parameter has been defined to achieve the Argument.

Output:

No Parameter Method Called
Method with Integer Argument Called: 25
Method with float Argument Called: 6.25

In this way, we can define more than one Methods of the same name in a class, which is called Method Overloading, and the Java compiler itself performs the appropriate Method Call for an object, based on the Data Type of the Arguments of the Methods.

Benefits of using Method Overloading

Method overloading increases the readability of the program.

1. This provides flexibility to programmers so that they can call the same method for different types of data.
2. This makes the code look clean.
3. This reduces the execution time because the binding is done in compilation time itself.
4. Method overloading minimizes the complexity of the code.
5. With this, we can use the code again, which saves memory.

Algorithm:

Step 1: Create a Stack class with

Step 2: Declare 2 member variables: ele(int array) and top(int).

Step 3: Create member functions

Function INITSTACK(int size)

Step 1: Create an int array of length size

Step 2: Initialize top = -1

Function INITSTACK(Stack another)

Step 1: Create an int array(ele) of size "length"(of object another)

Step 2: Initialize top = -1

Step 3: Call PUSH to copy the items of "ele" to the array of "another".

Function INITSTACK(Array a)

Step 1: Create an int array(ele) of length of "a"

Step 2: Initialize top = -1

Step 3: Call PUSH to copy the items of "a" to the array of "another".

Function PUSH(Element) Operation in Stack

Step 1: If Top=Max-1 , Display “Overflow : Stack is full” and Exit

Step 2: Top=Top+1

Step 3: Stack[TOP]=Element

Function POP()

Step 1: If TOP=-1, Display “Underflow: Stack is empty” and Exit

Step 2: Initialize delElement=ele[Top]

Step 3: Top=Top-1

Step 4: Return delElement

Function PEEK()

Step 1: Return ele[Top]

Function Main()

Step 1: Create 3 objects(s1,s2,s3) of the Stack Class

Step 2: Call PUSH to push an item into s1

Step 3: Call INITSTACK(s1) on object s2

Step 4: Create an int array "array" with elements initialized

Step 5: Call INITSTACK(array)

Step 6:Define a integer variable 'top' and initialize with '-1'. (int top = -1)

Step 7:Call pop and peek functions and display the value returned(element on top of stack)

Observations and output:

Rubrics of Evaluation:

	Advanced (5 Marks)	**Proficient (3 Marks)**	**Approaching Proficiency (2 Marks)**	**Beginning (1 Marks)**	**Marks**
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• **Completeness** Ability to apply rigorous case analysis to the problem domain. • **Clarity** Ability to format and document code for human consumption.	• Program shows evidenceof excellent case analysis, and all possible cases are handled appropriately. • Program contains appropriate documentation for all major functions, variables, or non-trivial algorithms. Formatting, indentation, and other white space aids readability.	• Program shows evidence of case analysis that is mostly complete, but may have missed minor or unusual cases. • Program contains some documentation on major functions, variables, or non-trivial algorithms. Indentation and other formatting is appropriate.	• Program shows some evidence of case analysis, but may be missing significant cases or mistaken in how to handle some cases. • Program contains some documentation (at least the student's name and program's purpose), but has occasionally misleading indentation.	• Program shows little recognition of how different cases must be handled differently. • Program contains no documentation, or grossly misleading indentation.	
Viva Voce	Demonstrate outstanding ability to answer the questions with clarity, confidence and appropriateness w.r.t. subjectmatter	Demonstrate adequate ability to answer questions w.r.t. subject matter	Demonstrate satisfactory ability to answer questions w.r.t.subject matter	Demonstrate poor ability to answer questions w.r.t. subject matter	
Signature of faculty:				**Total Marks:**	

TERMWORK 5b

Title: Write a program to demonstrate the implementation of method overriding

DeImplement the following class hierarchy. In the Cuboid class, override the method computeArea() and computePerimeter() of Rectangle class to compute the surface area and perimeter of a rectangle cuboid. Add a method computeVolume() in Cuboid class to compute volume of the cuboid. Assuming length, width and height as l, w and h respectively,

formula to find the surface area = 2(lw) + 2(hl) + 2(hw)
formula to find the perimeter = 2l + 2w
formula to find the volume = l x w x h

Observations and output:

Rubrics of Evaluation:

	Advanced (5 Marks)	**Proficient (3 Marks)**	**Approaching Proficiency (2 Marks)**	**Beginning (1 Marks)**	**Marks**
• **Syntax** Ability to understand andfollow the rules of the programming language. • **Logic** Ability to specify conditions, control flow, and data structures that are appropriate for the problem domain. • **Correctness** Ability to code formulae and algorithms that reliably produce correct answers or appropriate results.	• Program compiles and contains no evidence of misunderstanding or misinterpreting the syntax of the language. • Program logic is correct, with no known boundary errors, and no redundant or contradictory conditions. • Program produces correct answers or appropriate results for allinputs tested.	• Program compiles and is free from major syntactic misunderstandings, but may contain non-standard usage or superfluous elements. • Program logic is mostly correct, but may contain an occasional boundary error or redundant or contradictory condition. • Program produces correct answers or appropriate results for most inputs.	• Program compiles, but contains errors that signal misunderstanding of syntax – such a s the semicolon in **if(exp);{}** • Program logic is on the right track with no infinite loops, but shows no recognition of boundary conditions (such as < vs. <=) • Program approaches correct answers or appropriate results for most inputs, but can contain miscalculations in some cases.	• Program does not compile or (in a dynamic language) contains typographical errors leading to undefined names. • Program contains some conditions that specify the opposite of what is required (less than vs. greater than), confuse Boolean AND/OR operators, or lead to infiniteloops. • Program does not produce correct answers or appropriate results for most inputs.	
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Viva Voce	Demonstrate outstanding ability to answer the questions with clarity, confidence and appropriateness w.r.t. subjectmatter	Demonstrate adequate ability to answer questions w.r.t. subject matter	Demonstrate satisfactory ability to answer questions w.r.t.subject matter	Demonstrate poor ability to answer questions w.r.t. subject matter	
Signature of faculty:				**Total Marks:**	

TERMWORK 6

Title: Write a program to demonstrate Run-time Polymorphism.

Problem definition: Design an abstract class Car to have carName, chassiNum, modelName as member variables and add two abstract methods, startCar and operateSteering . Inherit MarutiCar and BmwCar from Car class and override the two abstract methods in their own unique way. Design a driver class to have driver name, gender and age as data members and add a method driveCar with abstract class reference variable as argument and invoke the two basic operations namely, startCar and operateStearing and demonstrate run-time polymorphism.

Introduction:

Runtime polymorphism in Java is also popularly known as Dynamic Binding or Dynamic Method Dispatch. In this process, the call to an overridden method is resolved dynamically at runtime rather than at compile-time. You can achieve Runtime polymorphism via Method Overriding.

Method Overriding is done when a child or a subclass has a method with the same name, parameters, and return type as the parent or the superclass; then that function overrides the function in the superclass. In simpler terms, if the subclass provides its definition to a method already present in the superclass; then that function in the base class is said to be overridden.
Also, it should be noted that runtime polymorphism can only be achieved through functions and not data members.
Overriding is done by using a reference variable of the superclass. The method to be called is determined based on the object which is being referred to by the reference variable. This is also known as Upcasting.
Upcasting takes place when the Parent class's reference variable refers to the object of the child class. For example:

```
class A{}
class B extends A{}
```

A a=new B(); //upcasting

Example of run-time polymorphism in java

We will create two classes Car and Innova, Innova class will extend the car class and will override its run() method.

```
class Car
{
        void run()
        {
        System.out.println(" running");
        }
}
class innova extends Car
{
        void run();
        {
                System.out.println(" running fast at 120km");
        }
        public static void main(String args[])
        {
                Car c = new innova();
                c.run();
        }
}
```

Algorithm:

Car class

Step 1:Create abstract class Car

Step 2: In the constructor initialize the name, chassi and model of the car

Step 3: Declare 2 abstract functions(startCar() and operateSteering())

Step 4: Display the name, chassi and model of the car.

MarutiCar class

Step 1: Create class MarutiCar (inherits Car)

Step 2: In the constructor initialize the name, chassi and model of the car by calling the super class constructor

Step 3: function startCar() display a message

Step 4: function operateSteering() display a message

BmwCar class

Step 1: Create class BmwCar (inherits Car)

Step 2: In the constructor initialize the name, chassi and model of the car by calling the super class constructor

Step 3: function startCar() displays a message

Step 4: function operateSteering() displays a message

Driver class

Step 1:Create class Driver

Step 2: In the constructor initialize the name, age and gender

Step 3: function driveCar(Car obj) displays name, age and gender

Step 4: Call display(), startCar() and operateSteering() with object obj

Main class

Step 1: Create class Driver

Step 2: Create an object "m" of MarutiCar and initialize

Step 3: Create an object "b" of BmwCar and initialize

Step 4: Create an object "dl" of Driver and initialize

Step 5: Call driveCar(object m)

Step 6: Call driveCar(object b)

Output and Observations:

Rubrics of Evaluation:

	Advanced (5 Marks)	Proficient (3 Marks)	Approaching Proficiency (2 Marks)	Beginning (1 Marks)	Marks
• **Syntax** Ability to understand andfollow the rules of the programming language. • **Logic** Ability to specify conditions, control flow, and data structures that are appropriate for the problem domain. • **Correctness** Ability to code formulae and algorithms that reliably produce correct answers or appropriate results.	• Program compiles and contains no evidence of misunderstanding or misinterpreting the syntax of the language. • Program logic is correct, with no known boundary errors, and no redundant or contradictory conditions. • Program produces correct answers or appropriate results for allinputs tested.	• Program compiles and is free from major syntactic misunderstandings, but may contain non-standard usage or superfluous elements. • Program logic is mostly correct, but may contain an occasional boundary error or redundant or contradictory condition. • Program produces correct answers or appropriate results for most inputs.	• Program compiles, but contains errors that signal misunderstanding of syntax – such a s the semicolon in **if(exp);{}** • Program logic is on the right track with no infinite loops, but shows no recognition of boundary conditions (such as < vs. <=) • Program approaches correct answers or appropriate results for most inputs, but can contain miscalculations in some cases.	• Program does not compile or (in a dynamic language) contains typographical errors leading to undefined names. • Program contains some conditions that specify the opposite of what is required (less than vs. greater than), confuse Boolean AND/OR operators, or lead to infiniteloops. • Program does not produce correct answers or appropriate results for most inputs.	
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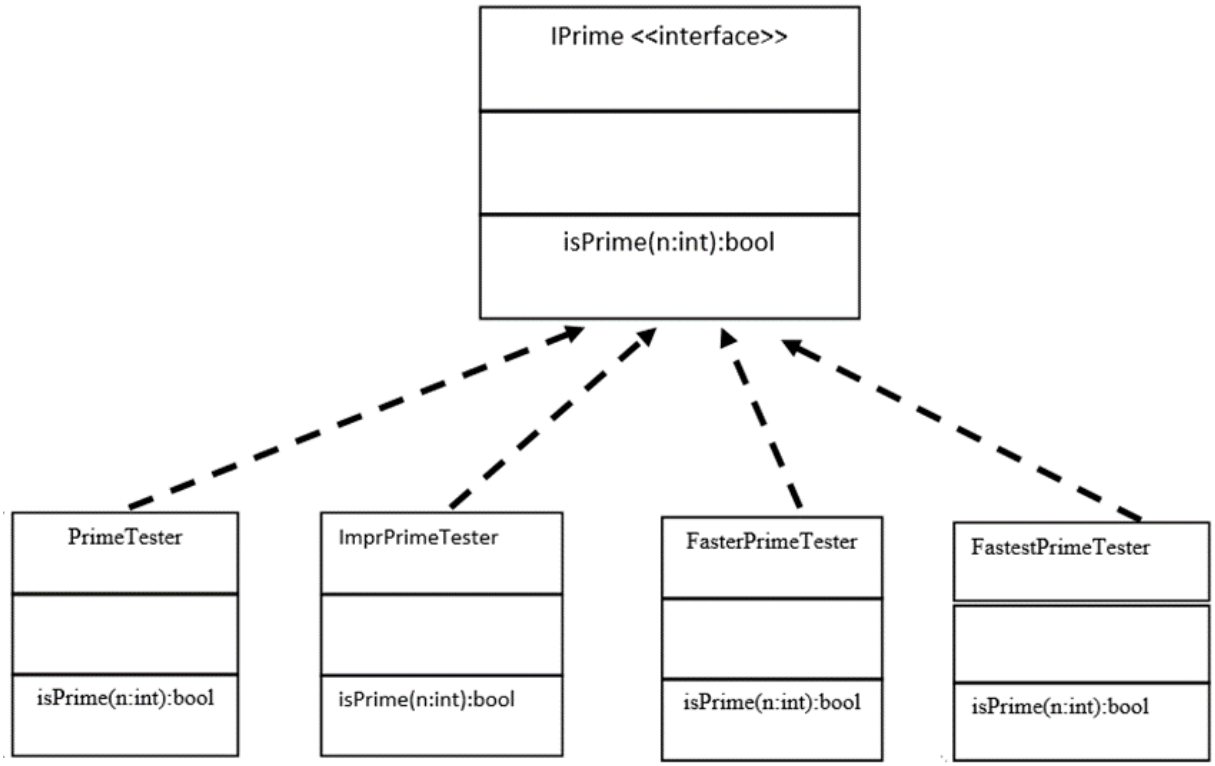
Signature of faculty:				**Total Marks:**	

TERMWORK 7

Title: Write a program to demonstrate the implementation of interfaces.

Problem Definition: Write a Java application to implement the following UML diagram.

- PrimeTester class implements isPrime() method by iterating from 2 to n-1 for a given number n
- ImprPrimeTester class implements isPrime() method by iterating from 2 to n/2
- FasterPrimeTester class implements isPrime() method by iterating from 2 to
- FastestPrimeTester class implements isPrime() method using Fermat's Little theorem.
    - Fermat's Little Theorem:
    - If n is a prime number, then for every a, 1 < a < n-1,
        - a^{n-1} % n = 1



Introduction:

An interface is an abstract "class" that is used to group related methods with "empty" bodies:

To access the interface methods, the interface must be "implemented" (kind of like inherited) by another class with the implements keyword (instead of extends). The body of the interface method is provided by the "implement" class

Example:

The implements keyword is used to implement an interface.

- It **cannot** be used to create objects (in the example above, it is not possible to create an “Animal” object in the MyMainClass)
- Interface methods does not have a body – the body is provided by the “implement" class
- On implementation of an interface, you must override all of its methods
- Interface methods are by default abstract and public
- Interface attributes are by default public, static and final
- An interface cannot contain a constructor (as it cannot be used to create objects)

Algorithm:

1. Create an interface IsPrime and declare isPrime(int n) method without its body
2. Create a class PrimeTester which implements IsPrime interface
3. Override the method isPrime(int n) declared in IsPrime interface and check whether a number is prime or not using the formula given for PrimeTester class
4. Create a class ImprPrimeTester which implements IsPrime interface
5. Override the method isPrime(int n) declared in IsPrime interface and check whether a number is prime or not using the formula given for ImprPrimeTester class
6. Create a class FasterPrimeTester which implements IsPrime interface
7. Override the method isPrime(int n) declared in IsPrime interface and check whether a number is prime or not using the formula given for FasterPrimeTester class
8. Create a class FastestPrimeTester which implements IsPrime interface

9. Override the method isPrime(int n) declared in IsPrime interface and check whether a number is prime or not using the formula given for FastestPrimeTester class
10. Create a driver class and define main method
11. Create objects of the PrimeTester, ImprPrimeTester, FasterPrimeTester and FastestPrimeTester classes to initiate isPrime(int n) method and display the result

Observations and Output:

Rubrics of Evaluation:

	Advanced (5 Marks)	**Proficient (3 Marks)**	**Approaching Proficiency (2 Marks)**	**Beginning (1 Marks)**	**Marks**
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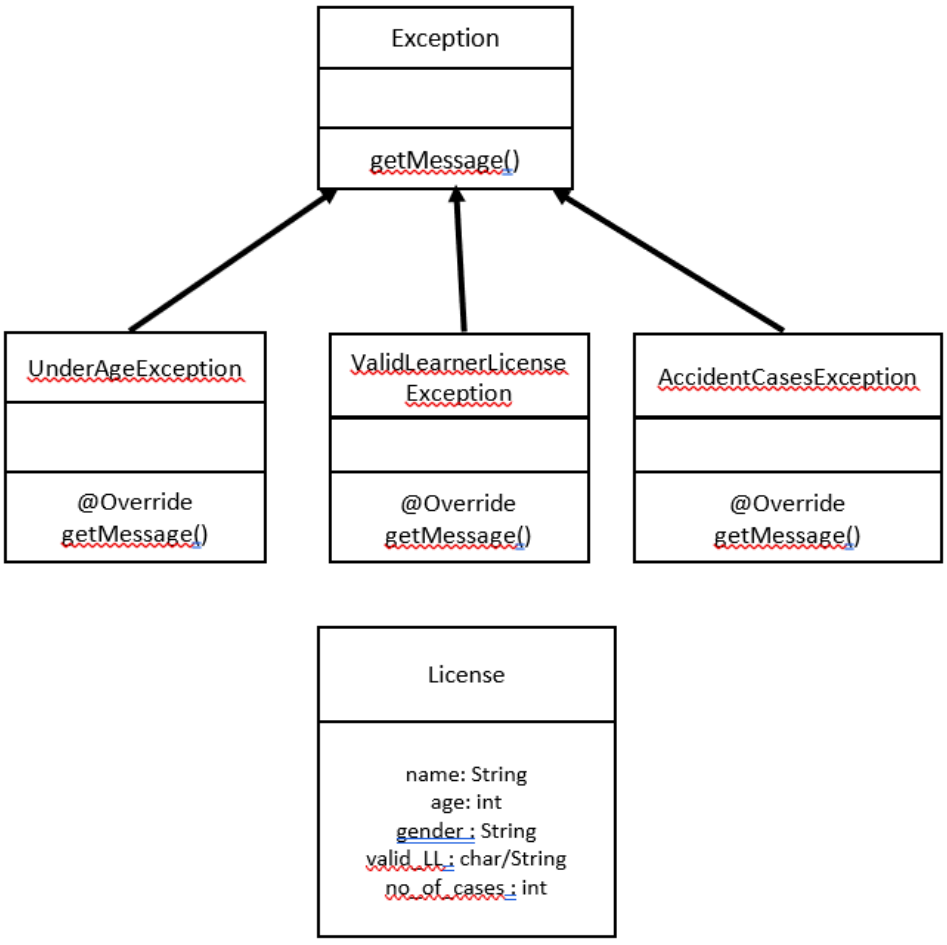
Signature of faculty:				**Total Marks:**	

TERMWORK 8

Title: Write a program to demonstrate the implementation of customized exception handling.

Problem Definition: Assume that you have received a request from the transport authority for automating the task of issuing the permanent license for two wheelers. The mandatory condition to issue the license are: 1) the applicant must be over 18 years of age and 2) holder of a valid learner's license and 3) no accident cases in the last one year.

Write a Java program that reads user details as required (use the Scanner class). Create user defined exceptions to check for the three conditions imposed by the transport authority. Based on the inputs entered by the user, decide and display whether or not a license has to be issued or an error message as defined by the user exception.



Introduction:

In Java, we can create our own exceptions that are derived classes of the Exception class. Creating our own Exception is known as a custom exception or user-defined exception. Basically, Java custom exceptions are used to customize the exception according to user need.

Consider the example 1 in which InvalidAgeException class extends the Exception class.

Using the custom exception, we can have our own exception and message. Here, we have passed a string to the constructor of superclass i.e. Exception class that can be obtained using getMessage() method on the object we have created**.**

```
// class representing custom exception
class InvalidAgeException  extends Exception
{
    public InvalidAgeException (String str)
    {
        // calling the constructor of parent Exception
        super(str);
    }
}
```

```
// class that uses custom exception InvalidAgeException
public class TestCustomException1
{

  // method to check the age
  static void validate (int age) throws InvalidAgeException{
    if(age < 18){

      // throw an object of user defined exception
      throw new InvalidAgeException("age is not valid to vote");
  }
    else {
      System.out.println("welcome to vote");
      }
   }
```

```
    // main method
    public static void main(String args[])
    {
        try
        {
            // calling the method
            validate(13);
        }
        catch (InvalidAgeException ex)
        {
            System.out.println("Caught the exception");

            // printing the message from InvalidAgeException object
            System.out.println("Exception occured: " + ex);
        }

        System.out.println("rest of the code...");
    }
}
```

In the above code, constructor of InvalidAgeException takes a string as an argument. This string is passed to the constructor of parent class Exception using the super() method. Also the constructor of Exception class can be called without using a parameter and calling super() method is not mandatory.

Algorithm:

1. Create a License class
2. Read the input for a person's name, age, gender, validLLR, no_of_accidents in past one year
3. Create a driver class and define main method and initiate validateApplicant() method
4. In validateApplicant(applicant) method,
5. Create a class UnderAgeException which extends Exception class
6. Create a class ValidLLRException which extends Exception class
7. Create a class NumAccidentsException which extends Exception class

Observations and Output:

Rubrics of Evaluation:

	Advanced (5 Marks)	Proficient (3 Marks)	Approaching Proficiency (2 Marks)	Beginning (1 Marks)	Marks
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Signature of faculty:				**Total Marks:**	

TERMWORK 9

Title: Write a program to demonstrate the implementation of string handling.

Problem Definition: Two strings will be anagram to each other if and only if they contain the same number of characters (order of the characters doesn't matter). That is, If the two strings are anagram to each other, then one string can be rearranged to form the other string. For Example: creative and reactive are anagrams. Write a Java program to test whether two strings are anagrams or not. (listen and silent, stressed and desserts, dusty and study)

Introduction: Scanner Class in Java: Scanner is a class in java.util package used for obtaining the input of the primitive types like int, double, etc. and strings. It is the easiest way to read input in a Java program, though not very efficient if you want an input method for scenarios where time is a constraint like in competitive programming.

- To create an object of Scanner class, we usually pass the predefined object System.in, which represents the standard input stream. We may pass an object of class File if we want to read input from a file.
- To read numerical values of a certain data type XYZ, the function to use is nextXYZ(). For example, to read a value of type short, we can use nextShort()
- To read strings, we use nextLine().
- To read a single character, we use next().charAt(0). next() function returns the next token/word in the input as a string and charAt(0) function returns the first character in that string.

- The Scanner class reads an entire line and divides the line into tokens. Tokens are small elements that have some meaning to the Java compiler. For example, suppose there is an input string: How are you In this case, the scanner object will read the entire line and divides the string into tokens: “How”, “are” and “you”. The object then iterates over each token and reads each token using its different methods.

How to use scanner class for strings?

Java's Scanner String input method

1. Import java.util.*; to make Java's Scanner class available.
2. Use the new keyword to create an instance of the Scanner class.
3. Pass the static System.in object to the Scanner's constructor.
4. Use Scanner's next() method to take input one String at a time.

isLowerCase( ): The method determines whether the specified char value is lowercase.

Syntax : boolean isLowerCase(char ch)

isUpperCase() Method: This method determines whether the specified char value is uppercase.

Syntax: boolean isUpperCase(char ch)

Algorithm:

1. Start
2. Input both the string literals
3. Convert the obtained strings to LowerCase.
4. Call check_anagrams( ) method by passing those strings
5. In check_anagrams() method,
    i. Create character arrays of the given strings and store them in two variables
    ii. Call sort method by passing each character array individually
    iii. Display the result
6. In sort( ) method
    i. Sort the character array in ascending order by using any sorting technique
    ii. Return the result in String
7. Stop

Output and Observations:

Rubrics of Evaluation:

	Advanced (5 Marks)	Proficient (3 Marks)	Approaching Proficiency (2 Marks)	Beginning (1 Marks)	Marks
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Signature of faculty:				**Total Marks:**	

TERMWORK 10a

Title: Write a program to demonstrate the implementation of Collection framework and interfaces

Problem Definition: Write a Java program to implement ArrayList of Strings using Collection framework. Add the following entries to the array list.

<"Alpha", "Beta", "Gamma", "Delta", "Epsilon", "Zeta", "Eta">

Use Iterator to display the contents of the list, to remove Gamma from the list. Display the contents of the list after deletion. Use ListIterator to add Gamma back and to modify the objects being iterated, and display the list backwards. Sort and display the ArrayList elements in ascending and descending order. Find whether the key element is present in the list or not using linear search

Introduction:

Java provides a set of standard collection classes that implement Collection interfaces. Some of the classes provide full implementations that can be used as-is and others are abstract class, providing skeletal implementations that are used as starting points for creating concrete collections.

How to Use an Iterator?

Often, you will want to cycle through the elements in a collection. For example, you might want to display each element.

The easiest way to do this is to employ an iterator, which is an object that implements either the Iterator or the ListIterator interface.

Iterator enables you to cycle through a collection, obtaining or removing elements. ListIterator extends Iterator to allow bidirectional traversal of a list and the modification of elements

Algorithm:

1. Start
2. Add given element into the ArrayList
3. Using an Iterator remove Gamma from the list
4. Display the contents after the deletion of Gamma
5. Using ListIterator add Gamma back to the list and modify the objects
6. Display the list contents after the modification
7. Using ListIterator, display the modified list backwards
8. Sort the array elements and display the sorted list in ascending and descending order
9. Search the element to be found in the list using linear search
10. Stop

Output and Observations:

Rubrics of Evaluation:

	Advanced (5 Marks)	**Proficient (3 Marks)**	**Approaching Proficiency (2 Marks)**	**Beginning (1 Marks)**	**Marks**
• **Syntax** Ability to understand andfollow the rules of the programming language. • **Logic** Ability to specify conditions, control flow, and data structures that are appropriate for the problem domain. • **Correctness** Ability to code formulae and algorithms that reliably produce correct answers or appropriate results.	• Program compiles and contains no evidence of misunderstanding or misinterpreting the syntax of the language. • Program logic is correct, with no known boundary errors, and no redundant or contradictory conditions. • Program produces correct answers or appropriate results for allinputs tested.	• Program compiles and is free from major syntactic misunderstandings, but may contain non-standard usage or superfluous elements. • Program logic is mostly correct, but may contain an occasional boundary error or redundant or contradictory condition. • Program produces correct answers or appropriate results for most inputs.	• Program compiles, but contains errors that signal misunderstanding of syntax – such a s the semicolon in **if(exp);{}** • Program logic is on the right track with no infinite loops, but shows no recognition of boundary conditions (such as < vs. <=) • Program approaches correct answers or appropriate results for most inputs, but can contain miscalculations in some cases.	• Program does not compile or (in a dynamic language) contains typographical errors leading to undefined names. • Program contains some conditions that specify the opposite of what is required (less than vs. greater than), confuse Boolean AND/OR operators, or lead to infiniteloops. • Program does not produce correct answers or appropriate results for most inputs.	
• **Completeness** Ability to apply rigorous case analysis to the problem domain. • **Clarity** Ability to format and document code for human consumption.	• Program shows evidenceof excellent case analysis, and all possible cases are handled appropriately. • Program contains appropriate documentation for all major functions, variables, or non-trivial algorithms. Formatting, indentation, and other white space aids readability.	• Program shows evidence of case analysis that is mostly complete, but may have missed minor or unusual cases. • Program contains some documentation on major functions, variables, or non-trivial algorithms. Indentation and other formatting is appropriate.	• Program shows some evidence of case analysis, but may be missing significant cases or mistaken in how to handle some cases. • Program contains some documentation (at least the student's name and program's purpose), but has occasionally misleading indentation.	• Program shows little recognition of how different cases must be handled differently. • Program contains no documentation, or grossly misleading indentation.	
Viva Voce	Demonstrate outstanding ability to answer the questions with clarity, confidence and appropriateness w.r.t. subjectmatter	Demonstrate adequate ability to answer questions w.r.t. subject matter	Demonstrate satisfactory ability to answer questions w.r.t.subject matter	Demonstrate poor ability to answer questions w.r.t. subject matter	
Signature of faculty:				**Total Marks:**	

TERMWORK 10b

Title: Write a program to demonstrate the implementation of Lambda Expression

Problem Definition: TaxCalculator interface defines a single method calculateTax that takes in an income and returns a double. The main method creates an instance of TaxCalculator using a lambda expression that calculates the tax amount based on the following criteria:

If the income is less than or equal to 50000, the tax is income * 0.1

If the income is greater than 50000 and less than or equal to 100000, the tax is income * 0.2

If the income is greater than 100000, the tax is income * 0.3

The Predicate interface is used to determine if the tax amount is less than 1000 by creating an instance of isTaxLessThan1000 that takes in a tax and returns a boolean.

The program then defines an array of incomes for 5 employees and calculates the tax amount for each income using the taxCalculator instance. The tax amount and the result of the isTaxLessThan1000 predicate are then printed to the console.

Introduction:

The Lambda expression is used to provide the implementation of an interface which has functional interface. It saves a lot of code. In case of lambda expression, we don't need to define the method again for providing the implementation. Here, we just write the implementation code.

Java lambda expression is treated as a function, so compiler does not create .class file.

Functional Interface

Lambda expression provides implementation of functional interface. An interface which has only one abstract method is called functional interface. Java provides an annotation @FunctionalInterface, which is used to declare an interface as functional interface.

Java Lambda Expression Syntax: (argument-list) -> {body}

Algorithm:

1. Start
2. Define a FunctionalInterface TaxCalculator which has an abstract method calculateTax( )
3. In main method create an instance of TaxCalculator using a lambda expression that calculates the tax amount based on the given criteria
4. Use the Predicate class to determine if the tax amount is less than 1000 by creating an instance of isTaxLessThan1000 and return a boolean value.
5. Create an array of incomes for 5 employees and calculates the tax amount for each income using the taxCalculator instance
6. Display the tax amount and the result of the isTaxLessThan1000 predicate
7. Stop

Output and Observations:

Rubrics of Evaluation:

	Advanced (5 Marks)	Proficient (3 Marks)	Approaching Proficiency (2 Marks)	Beginning (1 Marks)	Marks
• **Syntax** Ability to understand andfollow the rules of the programming language. • **Logic** Ability to specify conditions, control flow, and data structures that are appropriate for the problem domain. • **Correctness** Ability to code formulae and algorithms that reliably produce correct answers or appropriate results.	• Program compiles and contains no evidence of misunderstanding or misinterpreting the syntax of the language. • Program logic is correct, with no known boundary errors, and no redundant or contradictory conditions. • Program produces correct answers or appropriate results for allinputs tested.	• Program compiles and is free from major syntactic misunderstandings, but may contain non-standard usage or superfluous elements. • Program logic is mostly correct, but may contain an occasional boundary error or redundant or contradictory condition. • Program produces correct answers or appropriate results for most inputs.	• Program compiles, but contains errors that signal misunderstanding of syntax – such a s the semicolon in **if(exp);{}** • Program logic is on the right track with no infinite loops, but shows no recognition of boundary conditions (such as < vs. <=) • Program approaches correct answers or appropriate results for most inputs, but can contain miscalculations in some cases.	• Program does not compile or (in a dynamic language) contains typographical errors leading to undefined names. • Program contains some conditions that specify the opposite of what is required (less than vs. greater than), confuse Boolean AND/OR operators, or lead to infiniteloops. • Program does not produce correct answers or appropriate results for most inputs.	
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Signature of faculty:				**Total Marks:**	