Connecting Intelligence

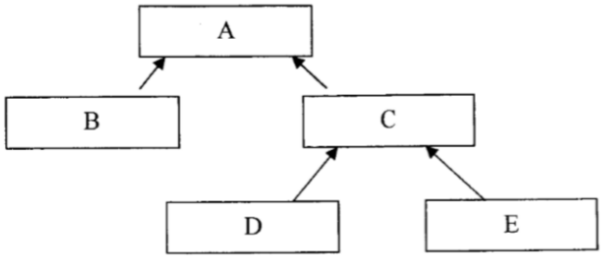
Institute of Computer Engineering Technology

iCET Certified Master

ASSIGNMENT

Assignement	WEEK 05 - Object Oriented Programming
Name	Inheritance and Polymorphism
Ass. Date	19th February 2024

01. Considering the class diagram given below, identify classes, super classes, sub classes and implement them using Java OOP.



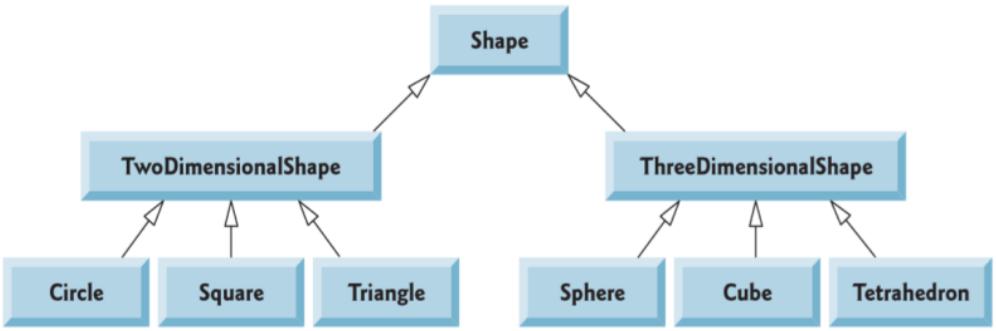
02. Inheritance is one of the key concepts in Object Oriented Programming. Describe "inheritance" with real-world examples.

03. Describe the ways in which inheritance promotes software reuse, saves time during program development, and helps prevent errors.

04. Create Java class hierarchies for the following cases:

Super Class	Sub Classes
Student	GraduateStudent, UndergraduateStudent
Shape	Circle, Triangle, Rectangle, Sphere, Cube
Loan	CarLoan, HomeImprovementLoan, MortgageLoan
Employee	Employee Faculty, Staff
BankAccount	CheckingAccount, SavingsAccount

05. Expand the class "Shape" of exercise 04 with the following class hierarchy.



06. Draw an inheritance hierarchy for students at a university. Use **Student** as the superclass of the hierarchy, then extend **Student** with classes **UndergraduateStudent** and **GraduateStudent**. Continue to extend the hierarchy as deep (i.e., as many levels) as possible. For example, **Freshman**, **Sophomore**, **Junior,** and **Senior** might extend **UndergraduateStudent**, and **DoctoralStudent** and **MastersStudent** might be subclasses of **GraduateStudent**. After drawing the hierarchy, implement all classes with suitable attributes and methods.

07. Write an inheritance hierarchy for classes **Quadrilateral**, **Trapezoid**, **Parallelogram**, **Rectangle,** and **Square**. Use **Quadrilateral** as the superclass of the hierarchy. Create and use a **Point** class to represent the points in each shape. Make the hierarchy as deep (i.e., as many levels) as possible. Specify the instance variables and methods for each class. The private instance variables of **Quadrilateral** should be the x-y coordinate pairs for the four endpoints of the **Quadrilateral**. Write a program that instantiates objects of your classes and outputs each object's area (except Quadrilateral).

08. Given:

```
import javax.swing.JFrame;
class CalculatorView extends JFrame{
        //Just a window
 }
class Demo{
      public static void main(String []args){
            CalculatorView v1=new CalculatorView();
            v1.setSize(300,300);
            v1.setTitle("Calculator");
            v1.setDefaultCloseOperation(CalculatorView.EXIT_ON_CLOSE);
            v1.setVisible(true);
      }
}
```

Describe the software reusability in OOP using the above Java application.

09. Which of the following statements are true?
    A. Inheritance reduces program development time.
    B. Java does not support multiple inheritances.
    C. In single inheritance, a class is derived from one direct superclass.
    D. A subclass is more specific than its superclass and represents a smaller group of objects.
    E. In an 'is-a' relationship, an object of a subclass also can be treated as an object of its superclass.
    F. A 'has-a' relationship represents composition. In a 'has-a' relationship, a class object contains references to objects of other classes.

10. Which of these code lines will cause a compile error? Explain your answer.

```
//----------------------A.java-------------------------------
class A{
        int a;
        void printA(){
                System.out.println("a : "+a);
        }
}
//----------------------B.java-------------------------------
class B{
        int b;
        void printB(){
                System.out.println("b : "+b);          //Line 1
        }
        void callPrintAB(){
                printA();                               //Line 2
                printB();                               //Line 3
        }
        void printAB(){
                System.out.println("a : "+a);          //Line 4
                System.out.println("b : "+b);          //Line 5
        }
}
```

11. Which of the following are true statements?
    A. The relationship between a class and its superclass is an example of a "has-a" relationship.
    B. The relationship between a class and its superclass is an example of an "is-a" relationship.
    C. The relationship between a class and a field within the class is an example of a "has-a" relationship.
    D. The relationship between a class and a field within the class is an example of an "is-a" relationship.

12. Which of the following statements describes the relationship between Superclasses and Subclasses?
    A. A subclass cannot access the private members of its superclass, but it can access the non-private members.
    B. Superclass constructors are not inherited by subclasses.
    C. A subclass can invoke a constructor of its superclass by using the keyword super, followed by a set of parentheses containing the superclass constructor arguments. This must appear as the first statement in the subclass constructor's body.
    D. A superclass method can be overridden in a subclass to declare an appropriate implementation for the subclass.
    E. When a subclass redefines a superclass method by using the same signature, the subclass is said to overload that superclass method.

13. Given:

```
class Super{
        public void aMethod(int a){}
}
class Sub extends Super{
        //Line 12
}
```

Which statement(s), inserted at line 12, will compile
A. public void aMethod(int a){}
B. public void aMethod(int data){}
C. public void aMethod(double a){}
D. public void aMethod(int[] a){}

14. What will happen when you compile and run the program? Explain your answer.

```
class A{
        A(int i){}
}
class B extends A{}
class Demo{
        public static void main(String []args){
                new B();
        }
}
```

15. Which of these code lines will cause a compile error? Explain your answer.

```
class A{}
class B extends A{}
class C extends A{}
class D extends B{}
class Demo{
        public static void main(String args[]){
                A a1=new A();           //Line 1
                B b1=new B();           //Line 2
                C c1=new C();           //Line 3
                D d1=new D();           //Line 4

                A a2=a1;                //Line 5
                a2=b1;                  //Line 6
                a2=c1;                  //Line 7
                a2=d1;                  //Line 8

                B b2=a1;                //Line 9
                b2=c1;                  //Line 10
                b2=d1;                  //Line 11

                C c2=a1;                //Line 12
                c2=b1;                  //Line 13
                c2=d1;                  //Line 14

                D d2=a1;                //Line 15
                d2=b1;                  //Line 16
                d2=c1;                  //Line 17
        }
}
```

16. Which of the following most closely describes the process of overriding?
    A. A class with the same name replaces the functionality of a class defined earlier in the hierarchy
    B. A method with the same name completely replaces the functionality of a method earlier in the hierarchy
    C. A method with the same name but different parameters gives multiple uses for the same method name
    D. A class is prevented from accessing methods in its immediate ancestor.

17. Given:

```
class Animal{}
class Shape{}
//Line 12
```

Which statement(s), inserted at line 12, will compile?
A. class Animal extends Shape{}
B. class Shape extends Animal{}
C. class Lion extends Animal, Shape{}
D. class AnimalShape{}

18. Given:

```
class A{
    public void aMethod(int a){
        System.out.println("aMethod of A");
    }
}
class B extends A{
    public void aMethod(int a){
        System.out.println("aMethod of B");
    }
}
class C extends B{
    public void aMethod(int a){
        System.out.println("aMethod of C");
    }
}
```

```
class Demo{
    public static void main(String args[]){
        A a1=new A();
        A a2=new B();
        A a3=new C();
        B b1=new B();
        B b2=new C();
        C c1=new C();
        //Line 12
    }
}
```

Which of the following can be inserted at line 12 to prove the mechanism of "dynamic method dispatch" in OOP?

A. a1.myMethod(100);
B. a2.myMethod(100);
C. a3.myMethod(100);
D. b1.myMethod(100);
E. b2.myMethod(100);
F. c1.myMethod(100);

19. What will happen when you compile and run the following program? Explain your answer.

```
class Super{
    public Super(int i){
        System.out.println("Super(int)");
    }
}
class Sub extends Super{
    public Sub(int i){
        System.out.println("Sub(int)");
    }
}
class Demo{
    public static void main(String []args){
        Sub s1=new Sub(100);
    }
}
```

20. Which of the following lines can be inserted at line 12 Will the code will compile? Explain your answer.

```
class Super{
    int a=10;
    static int x=100;
    Super(){
        System.out.println("Super()");
    }
    Super(int i){
        System.out.println("Super(int)");
    }
}
class Sub extends Super{
    int b=20;
    static int y=200;
    Sub(int i){
        //Insert code Line 12
        System.out.println("Sub(int)");
    }
}
```

A. super(a); B. super(b); C. super(x);
D. super(y); E. super(i); F. super(100);

21. Describe the mechanism of invoking a superclass constructor at a subclass with an appropriate example.

22. "Attributes in a class don't override, they will hide in the subclass", Explain this using appropriate examples.

23. Assume that class A extends class B, which extends class C. Also, all three classes implement the method test(). How can a method in class A invoke the test() method defined in class C? Select the one correct answer.

A. test(); B. super.test();
C. super.super.test(); D. ::test();
E. C.test(); F. It is not possible to invoke test()
G. method defined in C from a method in A.

24. Given:

```
class Mixer {
        Mixer() { }
        Mixer(Mixer m) { m1 = m; }
        Mixer m1;

        public static void main(String[] args) {
                Mixer m2 = new Mixer();
                Mixer m3 = new Mixer(m2); m3.go();
                Mixer m4 = m3.m1; m4.go();
                Mixer m5 = m2.m1; m5.go();
        }
        void go() {
                System.out.print("hi ");
        }
}
```

What is the result?

A. hi
B. hi hi
C. hi hihi
D. Compilation fails
E. hi, followed by an exception
F. hi hi, followed by an exception

25. Draw object diagrams for the following steps:

```
class A{}
class B extends A{}
class C extends B{}
class D extends B{}
class Demo{
        public static void main(String args[]){
                A[] ar=new A[5];                //Step 1
                ar[0]=new A();                  //Step 2
                ar[1]=new B();                  //Step 3
                ar[2]=new C();                  //Step 4
                ar[3]=new D();                  //Step 5
                A[] ar2={new A(),new B(), new C(),new D()};      //Step 6
        }
}
```

26. Describe “Runtime Polymorphism” using the following example.

```
class Figure {
        double dim1;
        double dim2;
        Figure(double a, double b) {
                dim1 = a;
                dim2 = b;
        }
        double area() {
                System.out.println("undefined");
                return 0;
        }
}
class Rectangle extends Figure {
        Rectangle(double a, double b) {
                super(a, b);
        }
       // override area for the rectangle
       double area() {
                System.out.println("Inside Area for Rectangle.");
                return dim1 * dim2;
      }
}
class Triangle extends Figure {
     Triangle(double a, double b) {
                super(a, b);
     }
     // override area for right triangle
      double area() {
                System.out.println("Inside Area for Triangle.");
                return dim1 * dim2 / 2;
       }
}
```

```
class FindAreas {
    public static void main(String args[]) {
        Figure f = new Figure(10, 10);
        Rectangle r = new Rectangle(9, 5);
        Triangle t = new Triangle(10, 8);
        Figure figref;
        figref = r;
        System.out.println("Area is " + figref.area());
        figref = t;
        System.out.println("Area is " + figref.area());
        figref = f;
        System.out.println("Area is " + figref.area());
    }
}
```

27. Given:

```
class A{
    static{System.out.print("A ");}
}
class B extends A{
    static{System.out.print("B ");}
    }
class C extends B{
    static{System.out.print("C ");}
}
class D extends B{
    static{System.out.print("D ");}
}
class E extends C{
    static{System.out.print("E ");}
}
class Demo{
    public static void main (String[] args) {
            new D();new F();
    }
}
```

What is the output?

A. A B D A B C E B. A B C D E C. A B D C F D. A B D

28. Draw a class Diagram for the following classes.

```
class A{}
class B extends A{}
class C extends B{}
class D extends B{}
class E extends C{}
class F extends C{}
class G extends E{}
```

29. You are given a class hierarchy with an instance of the class Dog. The class **Dog** is a child of **Mammal** and the class **Mammal** is a child of the class **Vertebrate**. The class Vertebrate has a method called move which prints out the string "move". The class **Mammal** overrides this method and prints out the string "walks". The class **Dog** overrides this method and prints out the string "walks on paws". Given an instance of the class **Dog**, how can you access the ancestor method move in **Vertebrate** so it prints out the string "move";

A. d.super().super().move();
B. d.parent().parent().move();
C. d.move();
D. none of the above;

30. Which of the following statements are true?

A. A static method is also known as a class method.
B. A class method is not associated with a particular instance of the class.
C. The keyword "this" cannot be used inside the body of a static method.
D. The keyword "super" may be used in the body of a static method

31. Assume that the superclass constructor invocation statement 'super' appears explicitly in a subclass constructor. If a compile-time error is to be avoided then the arguments for the superclass constructor invocation statement, 'super', cannot refer to which of the following?

A. Static variables declared in this class or any superclass.
B. Instance variables declared in this class or any superclass.
C. Static methods declared in this class or any superclass.
D. Instance methods declared in this class or any superclass.
E. The keyword "this".
F. The keyword "super".

32. Create classes called **Vehicle**, **Car**, **Bus**, **Van,** and **VehicleQueue** without using fix-length arrays.

```
class Demo{
    public static void main(String args[]){
        VehicleQueue queue=new VehicleQueue();
        queue.enQueue(new Car("C001"));
        queue.enQueue(new Bus("B001"));
        queue.enQueue(new Bus("B002"));
        queue.enQueue(new Car("C002"));
        queue.enQueue(new Car("C003"));
        queue.enQueue(new Van("V001"));
        queue.enQueue(new Car("V002"));
        queue.enQueue(new Bus("B003"));
        queue.printVehicleQueue();
                //[C001, B001, B002, C002, C003, V001, V002, B003]
        queue.callPark();
        /*  Car Parking C001
            Bus Parking B001
            Bus Parking B002
            Car Parking C002
            Car Parking C003
            Van Parking V001
            Van Parking V001
            Bus Parking B003  */
        queue.printVehicleQueue();
                //[B001, B002, C002, C003, V001, V002, B003]
    }
}
```

33. Given the following class definition, which of the following can be legally placed after the comment line?

```
//Here ?
class Base{
        public Base(int i){

        }
}
class MyOver extends Base{
      public static void main(String arg[]){
          MyOver m = new MyOver(10);
      }
      MyOver(int i){
          super(i);
      }
      MyOver(String s, int i){
          this(i);
          //Here
      }
}
```

A. MyOver m = new MyOver();
B. super();
C. this("Hello",10);
D. Base b = new Base(10);

34. Create class **"CustomerStack"**

```
class Customer{
    private int code;
    private String name;
    public Customer(int code, String name){
        this.code=code;this.name=name;
    }
}
class Demo{
    public static void main(String args[]){
        CustomerStack stack=new CustomerStack();
        stack.push(new Customer(1001,"Danapala"));
        stack.push(new Customer(1002,"Gunapala"));
        stack.push(new Customer(1003,"Somapala"));
        stack.push(new Customer(1004,"Siripala"));
        stack.printCustomerStack();
            //[1004-Siripala, 1003-Gunapala, 1002-Gunapala, 1001-Danapala]
        stack.pop();
        stack.printCustomerStack();
            //[1004-Siripala, 1003-Gunapala, 1002-Gunapala, 1001-Danapala]
    }
}
```

35. Given:

```
class A{
    void m(A a){
        System.out.print("A");
    }
}
class B extends A{
    void m(B b){
        System.out.print("B");
    }
}
class C extends B{
    void m(C c){
        System.out.print("C");
    }
}
class D{
    public static void main(String args[]){
        A a=new A();
        B b=new B();
        C c=new C();
        c.m(a);
        c.m(b);
        c.m(c);
    }
}
```

What is the result of attempting to compile and run the program?

A. ABC B. ACC C. AAA
D. BCC E. BBC F. Compiler error
G. None of the above

36. Which statement(s) are true?

A. Has-a relationships always rely on inheritance.
B. Has-a relationships always rely on instance variables.
C. Has-a relationships always require at least two class types.
D. Has-a relationships always rely on polymorphism.
E. Has-a relationships are always tightly coupled.

37. Given:

```
class Customer{
        String name="Danapala";
        static String city="Galle";
        public Customer(){
            printCustomer();
        }
        void printCustomer(){
            System.out.println("Super : "+name+" -> "+city);
        }
}
class RegularCustomer extends Customer{
        String name="Somapala";
        static String city="Panadura";
        void printCustomer(){
            System.out.println("Sub : "+name+" -> "+city);
        }
}

class Demo{
        public static void main(String arg[]){
            new RegularCustomer();
        }
}
```

What is the output? Explain your answer:

A. Prints Customer : Danapala -> Galle
B. Prints Customer : null -> Galle
C. Prints Regular Customer : null -> Panadura
D. Prints Sub : null -> Panadura