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Aim: Implement Scala programs to demonstrate class, objects and demonstrate inheritance

Theory:

1. Object

Object is a real world entity. It contains state and behavior. Laptop, car, cell phone are the real world objects. Object typically has two characteristics:
State: data values of an object are known as its state.
Behavior: functionality that an object performs is known as its behavior.
Object in Scala is an instance of class. It is also known as runtime entity.

2. Class

Class is a template or a blueprint. It is also known as collection of objects of similar type. In scala, a class can contain: Data member, Member method, Constructor, Block, Nested class Super class information etc.You **must initialize all instance variables** in the class. There **is no default scope**. If you don't specify access scope, it is public. There must be an object in which main method is defined. It provides starting point for your program. Here, we have created an example of class.
Scala Sample Example of Class

```
class Student {
var id:Int = 0;                    // All fields must be initialized
var name:String = null;
}
object MainObject{
def main(args:Array[String]){
var s = new Student()              // Creating an object
println(s.id+" "+s.name);
}
}
```

Scala Sample Example2 of Class with Constructor
In scala, you can create class like this also. Here, constructor is created in class definition. This is called primary constructor.

```
class Student(id:Int, name:String){     // Primary constructor
def show(){
println(id+" "+name)
}
}
object MainObject{
def main(args:Array[String]){
var s = new Student(100,"Martin")   // Passing values to constructor
s.show()             // Calling a function by using an object
}
}
```

Scala Example of class that maintains the records of students

```
class Student(id:Int, name:String){
def getRecord(){
println(id+" "+name);
}
}

object MainObject{
def main(args: Array[String]){
var student1 = new Student(101,"Raju");
var student2 = new Student(102,"Martin");
student1.getRecord();
student2.getRecord();
}
}
```

1.1 Scala Anonymous object

In scala, you can create anonymous object. An object which has no reference name is called anonymous object. It is good to create anonymous object when you don't want to reuse it further.

Scala Anonymous Object Example

```
class Arithmetic{
def add(a:Int, b:Int){
var add = a+b;
println("sum = "+add);
}
}
object MainObject{
def main(args:Array[String]){
new Arithmetic().add(10,10);  //Example of Anonymous Object

}
}
```

1.2 Scala Singleton Object

Singleton object is an object which is **declared by using object keyword instead by class**. No object is required to call methods declared inside singleton object. In Scala, there is no static concept. So Scala creates a singleton object to provide entry point for your program execution.

If **you don't create singleton object**, your code will **compile successfully** but **will not produce any output**. Methods declared inside Singleton Object are accessible globally. A singleton object can extend classes and traits.

1.3 Scala Singleton Object Example

```
object Singleton {
def main(args:Array[String]){
SingletonObject.hello ()        // No need to create object.
}
}
object SingletonObject {
def hello(){
println("Hello, This is Singleton Object")
}
}
```

1.4 Scala Companion Object

In Scala, when you have a class with same name as singleton object, it is called companion class and the singleton object is called companion object.

The companion class and its companion object both must be defined in the same source file.

Scala Companion Object Example

```
class ComapanionClass{
def hello(){
println("Hello, this is Companion Class.")
}
}
object CompanoinObject{
def main(args:Array[String]){
new ComapanionClass().hello()
println("And this is Companion Object.")
}
}
```

3. **Scala Constructor**
In scala, if you don't specify primary constructor, compiler creates a constructor which is known as primary constructor. All the statements of class body treated as part of constructor. It is also known as default constructor.

```
class Student{
println("Hello from default constructor");
}
```

Scala provides a concept of primary constructor with the definition of class. You don't need to define explicitly constructor if your code has only one constructor. It helps to optimize code. You can create primary constructor with zero or more parameters.
Scala Primary Constructor Example

```
class Student(id:Int, name:String){
def showDetails(){
println(id+" "+name);
}
}

object MainObject{
def main(args:Array[String]){
var s = new Student(101,"Rama");
s.showDetails()
}
}
```

3.1 Scala Secondary (auxiliary) Constructor
You can create any number of auxiliary constructors in a class. You must call primary constructor from inside the auxiliary constructor. this keyword is used to call constructor from other constructor. When calling other constructor make it first line in your constructor.
Scala Secondary Constructor Example

```
class Student(id:Int, name:String){
var age:Int = 0
def showDetails(){
println(id+" "+name+" "+age)
}
def this(id:Int, name:String,age:Int){
this(id,name)       // Calling primary constructor, and it is first line
this.age = age
}
}

object MainObject{
def main(args:Array[String]){
var s = new Student(101,"Rama",20);
s.showDetails()
}
}
```

Scala Example: Constructor Overloading
In scala, you can overload constructor. Let's see an example.

```
class Student(id:Int){
def this(id:Int, name:String)={
this(id)
println(id+" "+name)
}
println(id)
}
object MainObject{
```

```
def main(args:Array[String]){
new Student(101)
new Student(100,"India")
}
}
```

3.2 Scala Method Overloading

Scala provides method overloading feature which allows us to define methods of same name but having different parameters or data types. It helps to optimize code.

```
class Arithmetic{
def add(a:Int, b:Int){
var sum = a+b
println(sum)
}
def add(a:Int, b:Int, c:Int){
var sum = a+b+c
println(sum) }  }
object MainObject{
def main(args:Array[String]){
var a  = new Arithmetic();
a.add(10,10);
a.add(10,10,10);  }
}
```

4. Scala Method Overloading Example by using Different Data Type

```
class Arithmetic{
def add(a:Int, b:Int){
var sum = a+b
println(sum)  }
def add(a:Double, b:Double){
var sum = a+b
println(sum) }
}
object MainObject{
def main(args:Array[String]){
var b = new Arithmetic()
b.add(10,10)
b.add(10.0,20.0)  }
}
```

5. Scala this

In scala, this is a keyword and used to refer current object. You can call instance variables, methods, constructors by using this keyword.

```
class ThisExample{
var id:Int = 0
var name: String = ""
def this(id:Int, name:String){
this()
this.id = id
this.name = name
}
def show(){
println(id+" "+name)
}
}
object MainObject{
def main(args:Array[String]){
```

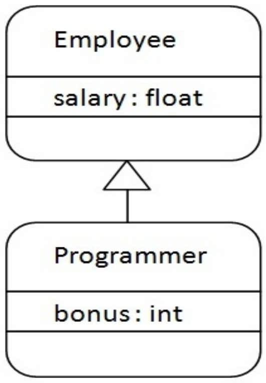
```
var t = new ThisExample(101,"Martin")
t.show()
}
}
```

5.1 Scala Constructor Calling by using this keyword

```
class Student(name:String){
def this(name:String, age:Int){
this(name)
println (name+" "+age)  }
}
object MainObject{
def main(args:Array[String]){
var s = new Student("Rama",100)  }
}
```

6. Scala Inheritance

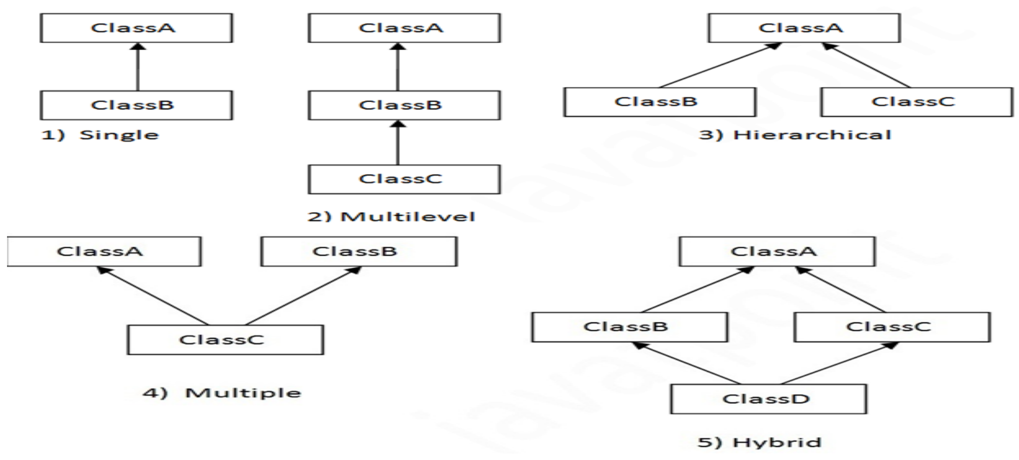
Inheritance is an object oriented concept which is used to reusability of code. You can achieve inheritance by using extends keyword. To achieve inheritance a class must extend to other class. A class which is extended called super or parent class. a class which extends class is called derived or base class.



Scala Single Inheritance Example

```
class Employee{
   var salary:Float = 10000
}
class Programmer extends Employee{
   var bonus:Int = 5000
   println("Salary = "+salary)
   println("Bonus = "+bonus)
}
object MainObject{
   def main(args:Array[String]){
      new Programmer()
   }
}
```

6.2 Types of Inheritance in Scala



6.3 Scala Multilevel Inheritance Example

```
class A{
var salary1 = 10000
}

class B extends A{
   var salary2 = 20000
}
class C extends B{
   def show(){
      println("salary1 = "+salary1)
      println("salary2 = "+salary2)
   }
}
object MainObject{
   def main(args:Array[String]){{
      var c = new C()
      c.show()

   }
}
```

7. Scala Method Overriding

When a subclass has the same name method as defined in the parent class, it is known as method overriding. When subclass wants to provide a specific implementation for the method defined in the parent class, it overrides method from parent class. In Scala, you must use either override keyword or override annotation to override methods from parent class.

Scala Method Overriding Example 1

```
class Vehicle{
   def run(){
      println("vehicle is running")
   }
}
class Bike extends Vehicle{
    override def run(){
      println("Bike is running")
   }
}
object MainObject{
   def main(args:Array[String]){
      var b = new Bike()
      b.run()
   }
}
```

7.1 Scala Method Overriding Example 2

This example shows how subclasses override the method of parent class.

```
class Bank{
        def getRateOfInterest()={
            0
        }
    }   ]
class SBI extends Bank{
        override def getRateOfInterest()={
         8
        }
    }
class ICICI extends Bank{
        override def getRateOfInterest()={
            7
        }
    }
class AXIS extends Bank{
        override def getRateOfInterest()={
            9
        }
    }
object MainObject{
        def main(args:Array[String]){
            var s=new SBI();
            var i=new ICICI();
            var a=new AXIS();
            println("SBI Rate of Interest: "+s.getRateOfInterest());
            println("ICICI Rate of Interest: "+i.getRateOfInterest());
            println("AXIS Rate of Interest: "+a.getRateOfInterest());
        }
    }
```

7.2 Scala Field Overriding Example1

```
class Vehicle{
    var speed:Int = 60

}
class Bike extends Vehicle{
   var speed:Int = 100
    def show(){
        println(speed)
    }
}
object MainObject{
    def main(args:Array[String]){
        var b = new Bike()
        b.show()
    }
}
```

8. **Scala Final**

Final is a keyword, which is used to prevent inheritance of super class members into derived class. You can declare final variables, methods and classes also.

Scala Final Variable Example

You can't override final variables in subclass. Let's see an example.

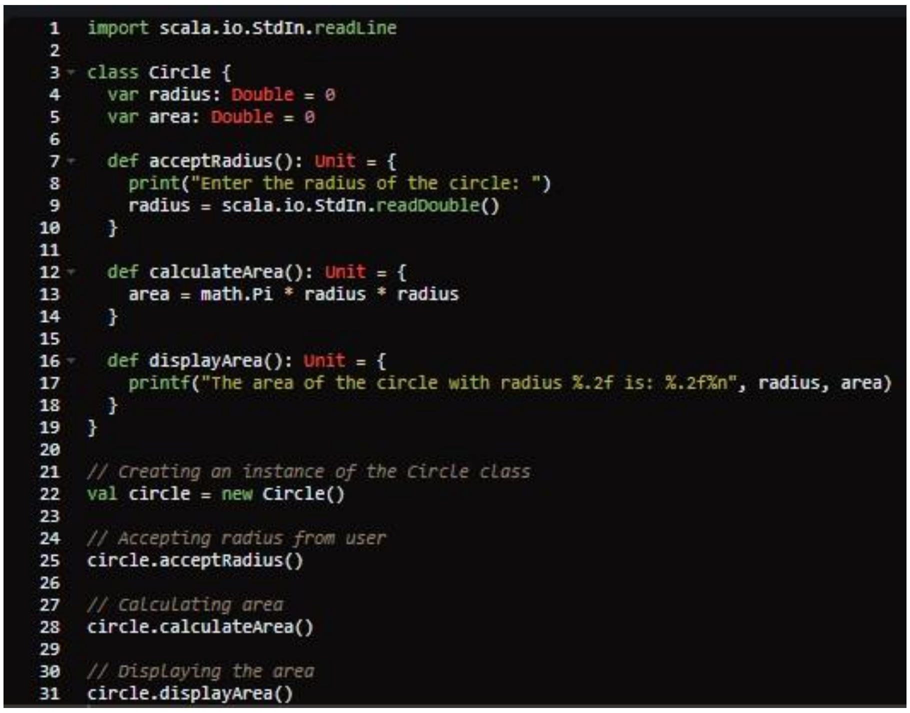
```
class Vehicle{
     final val speed:Int = 60
```

```
class Bike extends Vehicle{
override val speed:Int = 100
def show(){
println(speed)
    }
}
object MainObject{
    def main(args:Array[String]){
var b = new Bike()          b.show()
    }
}
```

9. Lab assignment to be completed in this session

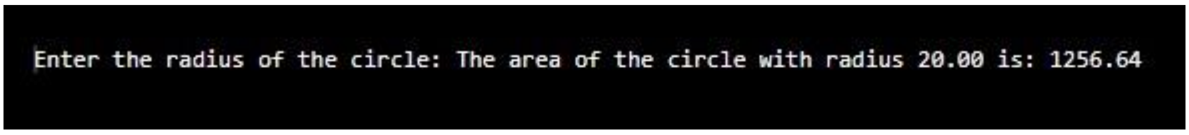
Q1) Write a program to make a class called as Circle. It should have three methods namely: accept radius, calculate area and display the area.

CODE :



```
import scala.io.StdIn.readLine

class Circle {
  var radius: Double = 0
  var area: Double = 0

  def acceptRadius(): Unit = {
    print("Enter the radius of the circle: ")
    radius = scala.io.StdIn.readDouble()
  }

  def calculateArea(): Unit = {
    area = math.Pi * radius * radius
  }

  def displayArea(): Unit = {
    printf("The area of the circle with radius %.2f is: %.2f%n", radius, area)
  }
}

// Creating an instance of the Circle class
val circle = new Circle()

// Accepting radius from user
circle.acceptRadius()

// Calculating area
circle.calculateArea()

// Displaying the area
circle.displayArea()
```

OUTPUT :

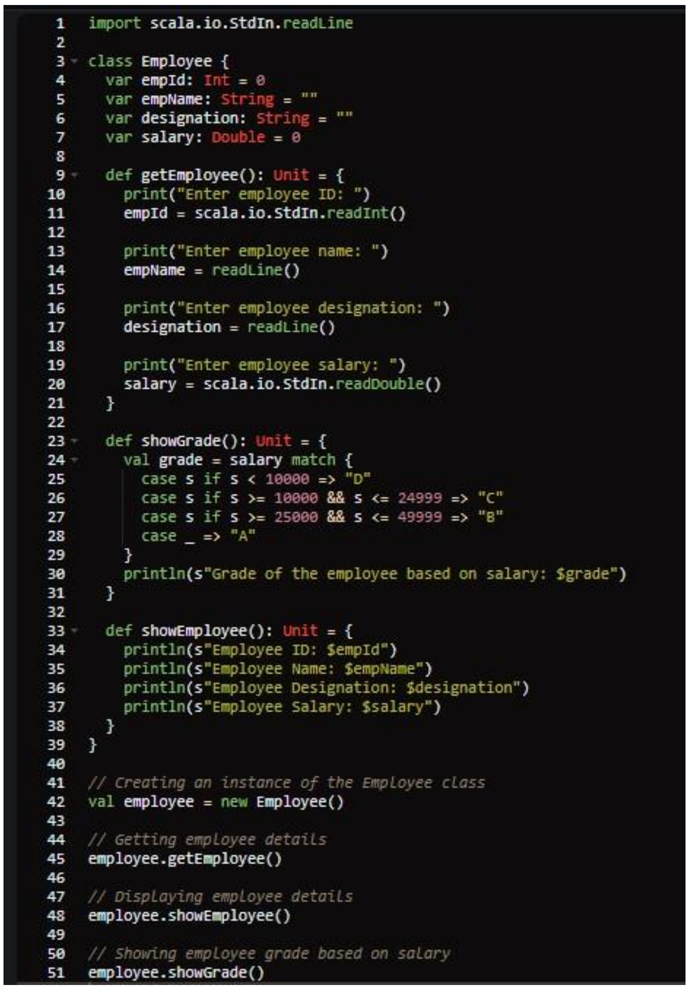


```
Enter the radius of the circle: The area of the circle with radius 20.00 is: 1256.64
```

2. Create a class employee with data member empid, empname, designation and salary. Write a methods get_employee()-to take user input, show_grade –to display grade of the employee based on salary.
3. Show employee () to display employee details.

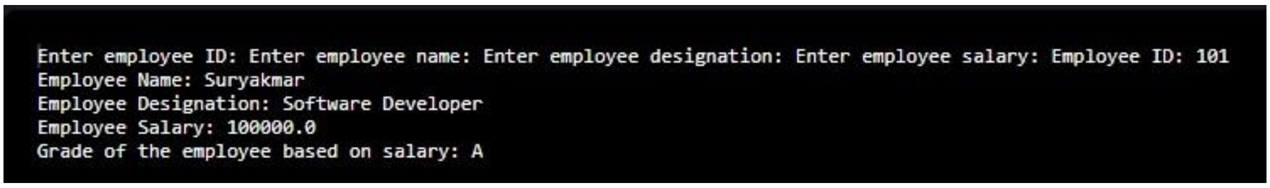
4. Salary Range	5. Grade
6. <10000	7. D
8. 10000-24999	9. C
10. 25000-49999	11. B
12. >50000	13. A

CODE :



```scala
import scala.io.StdIn.readLine

class Employee {
  var empId: Int = 0
  var empName: String = ""
  var designation: String = ""
  var salary: Double = 0

  def getEmployee(): Unit = {
    print("Enter employee ID: ")
    empId = scala.io.StdIn.readInt()

    print("Enter employee name: ")
    empName = readLine()

    print("Enter employee designation: ")
    designation = readLine()

    print("Enter employee salary: ")
    salary = scala.io.StdIn.readDouble()
  }

  def showGrade(): Unit = {
    val grade = salary match {
      case s if s < 10000 => "D"
      case s if s >= 10000 && s <= 24999 => "C"
      case s if s >= 25000 && s <= 49999 => "B"
      case _ => "A"
    }
    println(s"Grade of the employee based on salary: $grade")
  }

  def showEmployee(): Unit = {
    println(s"Employee ID: $empId")
    println(s"Employee Name: $empName")
    println(s"Employee Designation: $designation")
    println(s"Employee Salary: $salary")
  }
}

// Creating an instance of the Employee class
val employee = new Employee()

// Getting employee details
employee.getEmployee()

// Displaying employee details
employee.showEmployee()

// Showing employee grade based on salary
employee.showGrade()
```

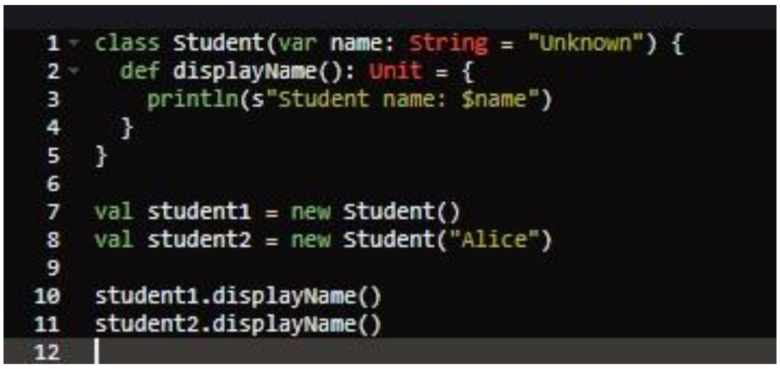
OUTPUT :



```
Enter employee ID: Enter employee name: Enter employee designation: Enter employee salary: Employee ID: 101
Employee Name: Suryakmar
Employee Designation: Software Developer
Employee Salary: 100000.0
Grade of the employee based on salary: A
```

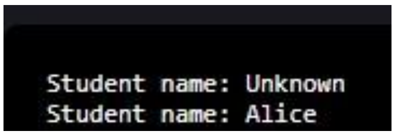
Q4) Write a program to print the names of students by creating a Student class. If no name is passed while creating an object of Student class, then the name should be "Unknown", otherwise the name should be equal to the String value passed while creating object of Student class.

CODE :



```scala
class Student(var name: String = "Unknown") {
  def displayName(): Unit = {
    println(s"Student name: $name")
  }
}

val student1 = new Student()
val student2 = new Student("Alice")

student1.displayName()
student2.displayName()

```

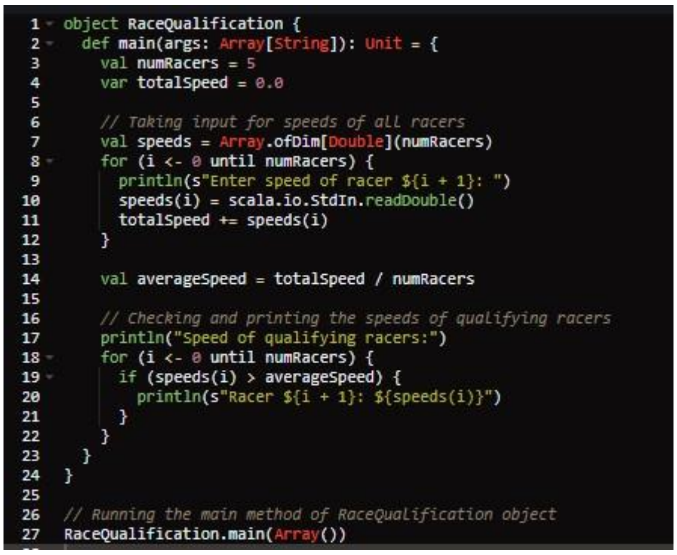
OUTPUT:



```
Student name: Unknown
Student name: Alice
```

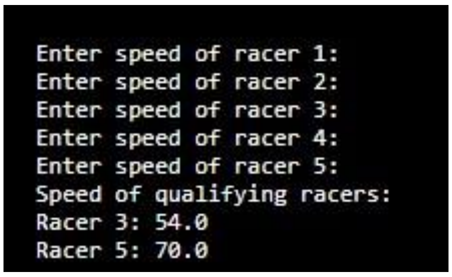
Q5) Five Bikers Compete in a race such that they Drive at Constant speed which may or may not be same as the other. To qualify the race, the speed of as racer must be more than the average speed of all 5 racers. Write Scala program to take as an input the speed of all racer and print back the speed of qualifying racer.

CODE:

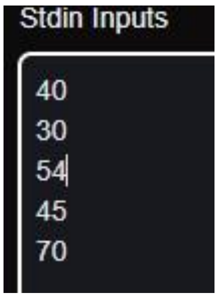


```scala
object RaceQualification {
  def main(args: Array[String]): Unit = {
    val numRacers = 5
    var totalSpeed = 0.0

    // Taking input for speeds of all racers
    val speeds = Array.ofDim[Double](numRacers)
    for (i <- 0 until numRacers) {
      println(s"Enter speed of racer ${i + 1}: ")
      speeds(i) = scala.io.StdIn.readDouble()
      totalSpeed += speeds(i)
    }

    val averageSpeed = totalSpeed / numRacers

    // Checking and printing the speeds of qualifying racers
    println("Speed of qualifying racers:")
    for (i <- 0 until numRacers) {
      if (speeds(i) > averageSpeed) {
        println(s"Racer ${i + 1}: ${speeds(i)}")
      }
    }
  }
}

// Running the main method of RaceQualification object
RaceQualification.main(Array())
```

OUTPUT:



```
Enter speed of racer 1:
Enter speed of racer 2:
Enter speed of racer 3:
Enter speed of racer 4:
Enter speed of racer 5:
Speed of qualifying racers:
Racer 3: 54.0
Racer 5: 70.0
```



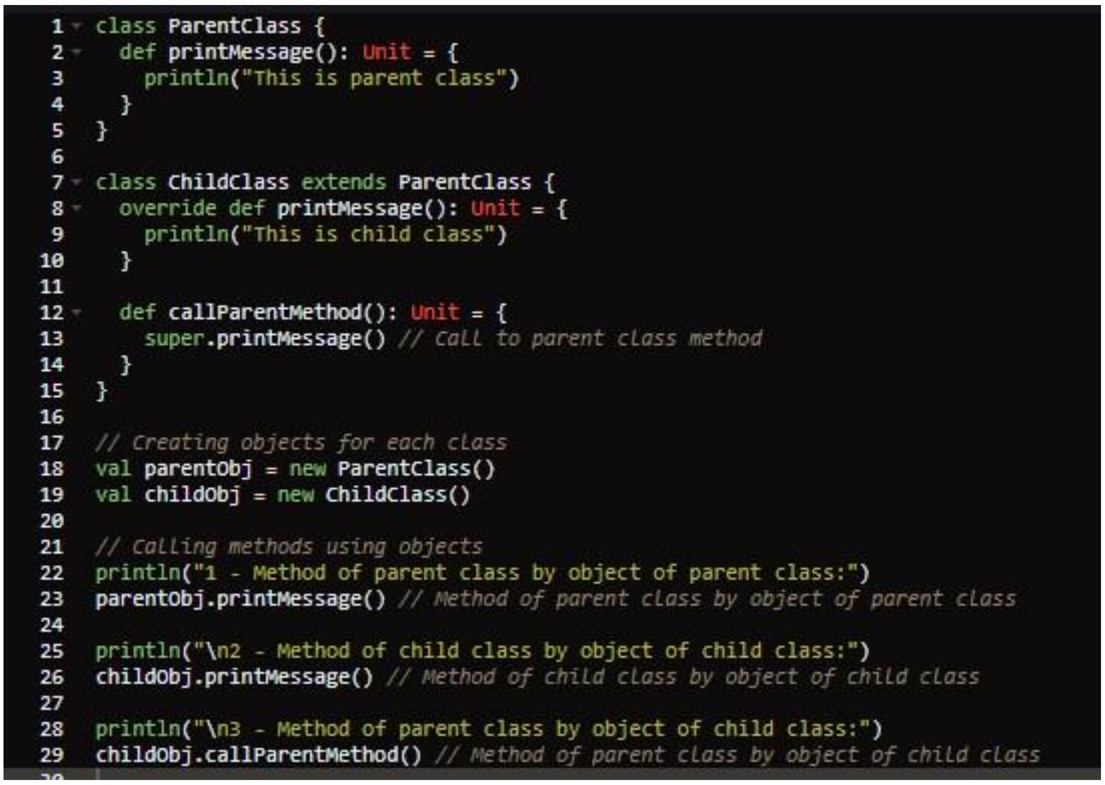
Stdin Inputs

```
40
30
54
45
70
```

Q6) Create a class with a method that prints "This is parent class" and its subclass with another method that prints "This is child class". Now, create an object for each of the class and call

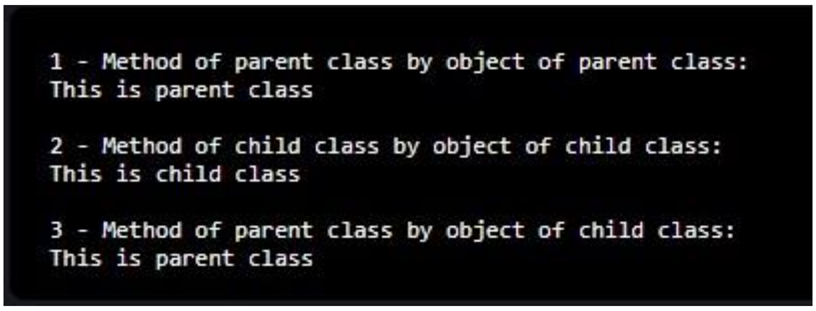
1 - method of parent class by object of parent class
2 - method of child class by object of child class
3 - method of parent class by object of child class

CODE:



```scala
class ParentClass {
  def printMessage(): Unit = {
    println("This is parent class")
  }
}

class ChildClass extends ParentClass {
  override def printMessage(): Unit = {
    println("This is child class")
  }

  def callParentMethod(): Unit = {
    super.printMessage() // Call to parent class method
  }
}

// Creating objects for each class
val parentObj = new ParentClass()
val childObj = new ChildClass()

// Calling methods using objects
println("1 - Method of parent class by object of parent class:")
parentObj.printMessage() // Method of parent class by object of parent class

println("\n2 - Method of child class by object of child class:")
childObj.printMessage() // Method of child class by object of child class

println("\n3 - Method of parent class by object of child class:")
childObj.callParentMethod() // Method of parent class by object of child class
```

OUTPUT:

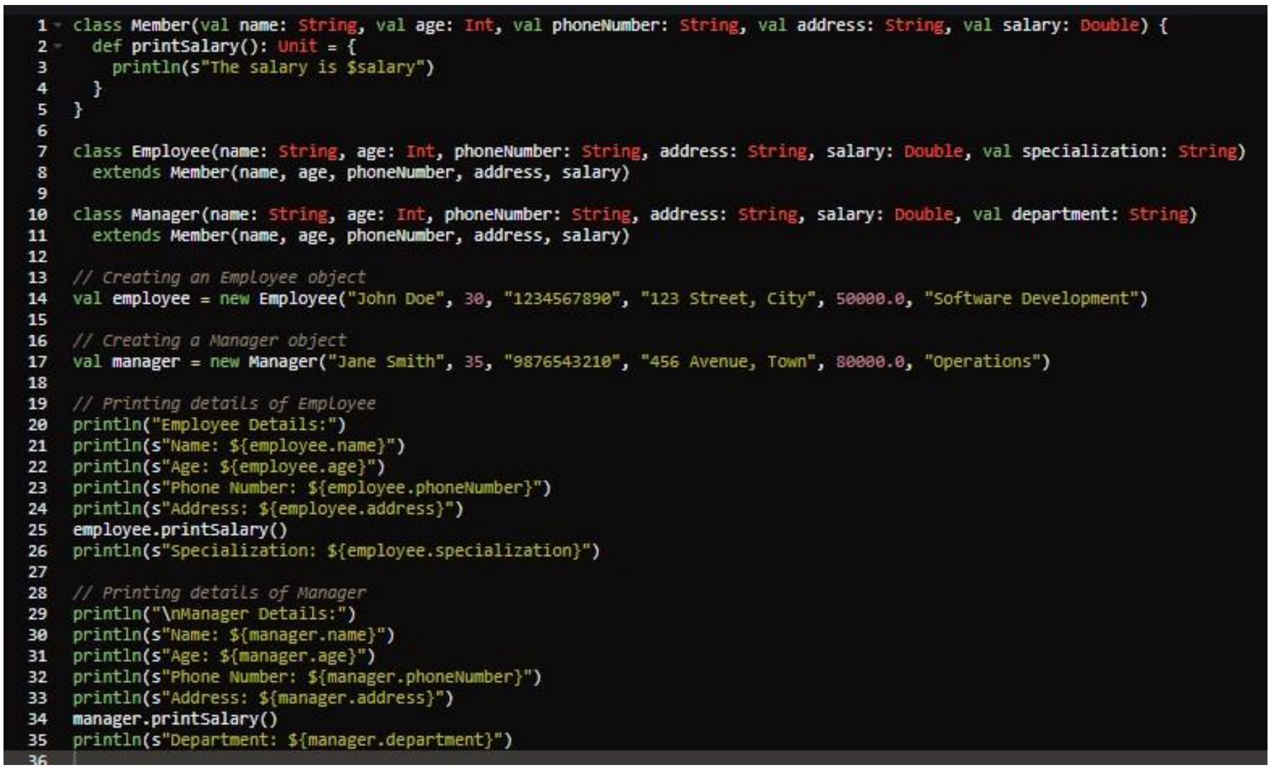


```
1 - Method of parent class by object of parent class:
This is parent class

2 - Method of child class by object of child class:
This is child class

3 - Method of parent class by object of child class:
This is parent class
```

Q7) Create a class named 'Member' having the following members:
Data members
1 - Name
2 - Age
3 - Phone number
4 - Address
5 – Salary

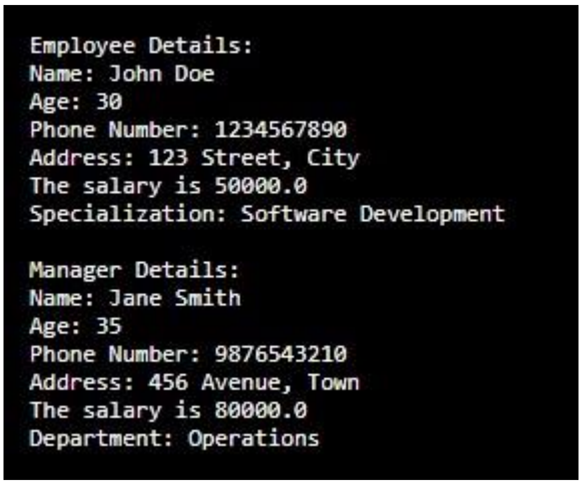
It also has a method named 'printSalary' which prints the salary of the members. Two classes 'Employee' and 'Manager' inherits the 'Member' class. The 'Employee' and 'Manager' classes have data members 'specialization' and 'department' respectively. Now, assign name, age, phone number, address and salary to an employee and a manager by making an object of both of these classes and print the same.

CODE:



```scala
class Member(val name: String, val age: Int, val phoneNumber: String, val address: String, val salary: Double) {
  def printSalary(): Unit = {
    println(s"The salary is $salary")
  }
}

class Employee(name: String, age: Int, phoneNumber: String, address: String, salary: Double, val specialization: String)
  extends Member(name, age, phoneNumber, address, salary)

class Manager(name: String, age: Int, phoneNumber: String, address: String, salary: Double, val department: String)
  extends Member(name, age, phoneNumber, address, salary)

// Creating an Employee object
val employee = new Employee("John Doe", 30, "1234567890", "123 Street, City", 50000.0, "Software Development")

// Creating a Manager object
val manager = new Manager("Jane Smith", 35, "9876543210", "456 Avenue, Town", 80000.0, "Operations")

// Printing details of Employee
println("Employee Details:")
println(s"Name: ${employee.name}")
println(s"Age: ${employee.age}")
println(s"Phone Number: ${employee.phoneNumber}")
println(s"Address: ${employee.address}")
employee.printSalary()
println(s"Specialization: ${employee.specialization}")

// Printing details of Manager
println("\nManager Details:")
println(s"Name: ${manager.name}")
println(s"Age: ${manager.age}")
println(s"Phone Number: ${manager.phoneNumber}")
println(s"Address: ${manager.address}")
manager.printSalary()
println(s"Department: ${manager.department}")
```

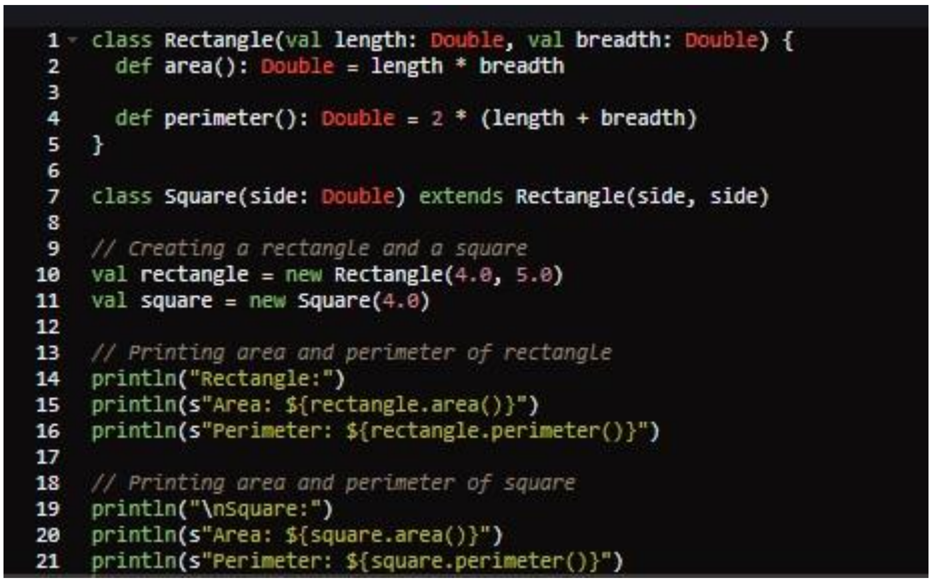
OUTPUT:



```
Employee Details:
Name: John Doe
Age: 30
Phone Number: 1234567890
Address: 123 Street, City
The salary is 50000.0
Specialization: Software Development

Manager Details:
Name: Jane Smith
Age: 35
Phone Number: 9876543210
Address: 456 Avenue, Town
The salary is 80000.0
Department: Operations
```

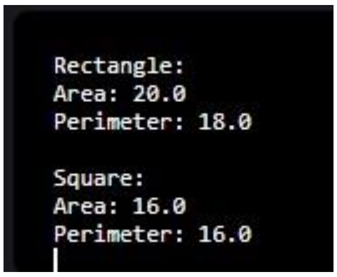
Q8) Create a class named 'Rectangle' with two data members 'length' and 'breadth' and two methods to print the area and perimeter of the rectangle respectively. Its constructor having parameters for length and breadth is used to initialize length and breadth of the rectangle. Let class 'Square' inherit the 'Rectangle' class with its constructor having a parameter for its side (suppose s) calling the constructor of its parent class as 'super(s,s)'. Print the area and perimeter of a rectangle and a square.

CODE:



```scala
class Rectangle(val length: Double, val breadth: Double) {
  def area(): Double = length * breadth

  def perimeter(): Double = 2 * (length + breadth)
}

class Square(side: Double) extends Rectangle(side, side)

// Creating a rectangle and a square
val rectangle = new Rectangle(4.0, 5.0)
val square = new Square(4.0)

// Printing area and perimeter of rectangle
println("Rectangle:")
println(s"Area: ${rectangle.area()}")
println(s"Perimeter: ${rectangle.perimeter()}")

// Printing area and perimeter of square
println("\nSquare:")
println(s"Area: ${square.area()}")
println(s"Perimeter: ${square.perimeter()}")
```

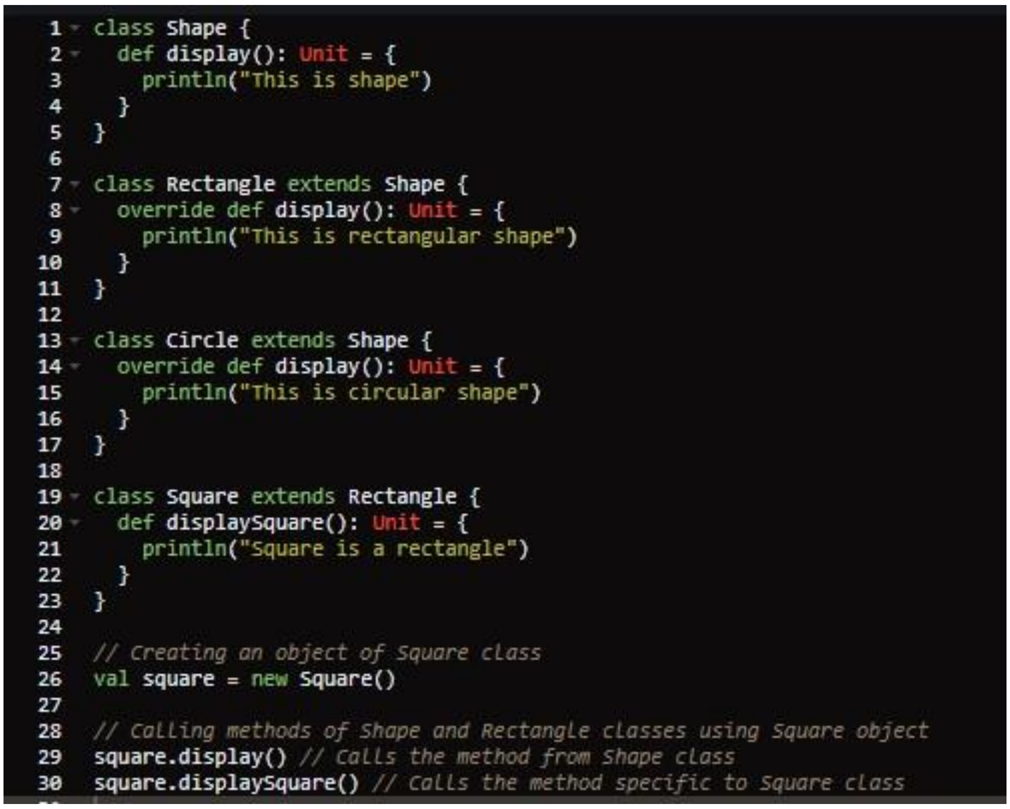
OUTPUT:



```
Rectangle:
Area: 20.0
Perimeter: 18.0

Square:
Area: 16.0
Perimeter: 16.0
```

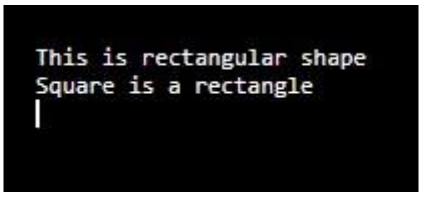
Q9) Create a class named 'Shape' with a method to print "This is This is shape". Then create two other classes named 'Rectangle', 'Circle' inheriting the Shape class, both having a method to print "This is rectangular shape" and "This is circular shape" respectively. Create a subclass 'Square' of 'Rectangle' having a method to print "Square is a rectangle". Now call the method of 'Shape' and 'Rectangle' class by the object of 'Square' class.

CODE :



```scala
class Shape {
  def display(): Unit = {
    println("This is shape")
  }
}

class Rectangle extends Shape {
  override def display(): Unit = {
    println("This is rectangular shape")
  }
}

class Circle extends Shape {
  override def display(): Unit = {
    println("This is circular shape")
  }
}

class Square extends Rectangle {
  def displaySquare(): Unit = {
    println("Square is a rectangle")
  }
}

// Creating an object of Square class
val square = new Square()

// Calling methods of Shape and Rectangle classes using Square object
square.display() // Calls the method from Shape class
square.displaySquare() // Calls the method specific to Square class
```

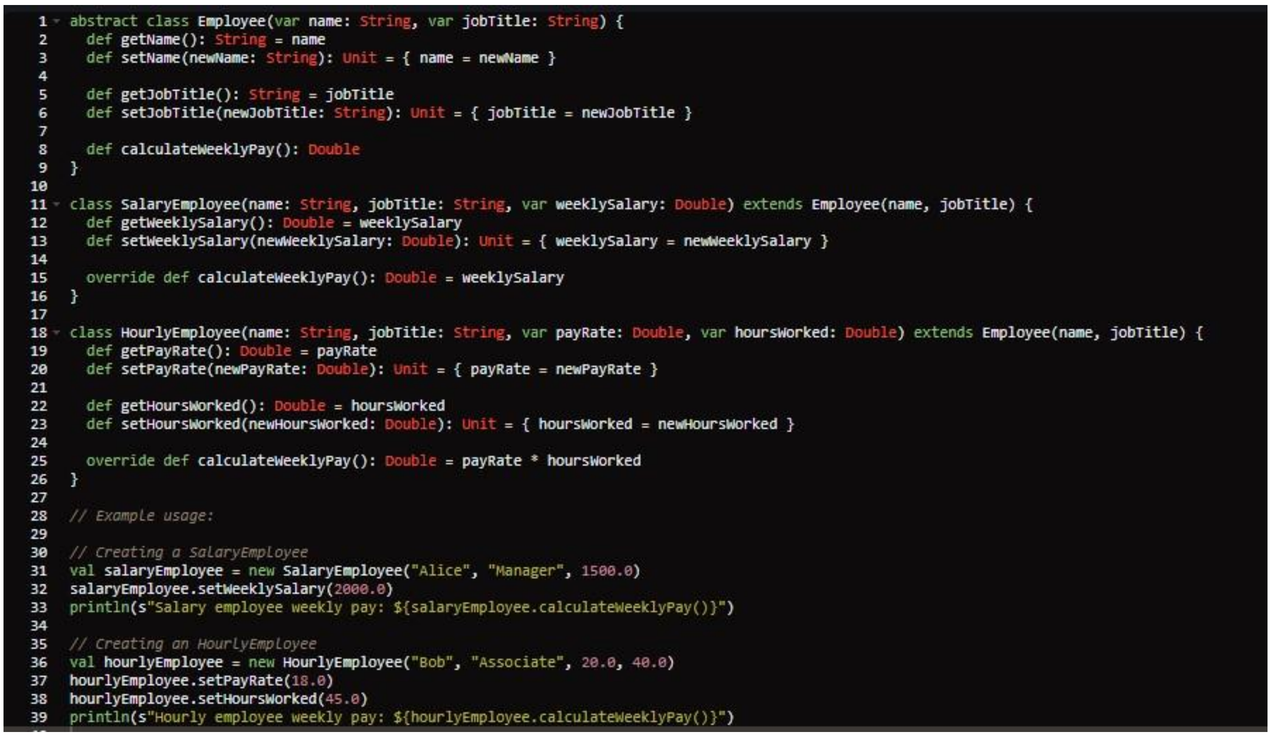
OUTPUT:



```
This is rectangular shape
Square is a rectangle
```

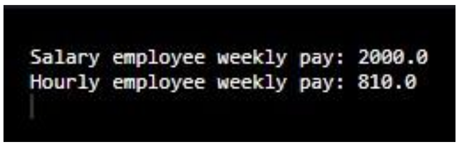
Q10) Design a class hierarchy rooted in the class Employee that includes subclasses for HourlyEmployee and SalaryEmployee. The attributes shared in common by these classes include the name, and job title of the employee, plus the accessor and mutator methods needed by those attributes. The salaried employees need an attribute for weekly salary, and the corresponding methods for accessing and changing this variable. The hourly employees should have a pay rate and an hours worked variable. There should be an abstract method called calculateWeeklyPay (), defined abstractly in the superclass and implemented in the subclasses. The salaried worker's pay is just the weekly salary. Pay for an hourly employee is simply hours worked times pay rate.

CODE :



```scala
abstract class Employee(var name: String, var jobTitle: String) {
  def getName(): String = name
  def setName(newName: String): Unit = { name = newName }

  def getJobTitle(): String = jobTitle
  def setJobTitle(newJobTitle: String): Unit = { jobTitle = newJobTitle }

  def calculateWeeklyPay(): Double
}

class SalaryEmployee(name: String, jobTitle: String, var weeklySalary: Double) extends Employee(name, jobTitle) {
  def getWeeklySalary(): Double = weeklySalary
  def setWeeklySalary(newWeeklySalary: Double): Unit = { weeklySalary = newWeeklySalary }

  override def calculateWeeklyPay(): Double = weeklySalary
}

class HourlyEmployee(name: String, jobTitle: String, var payRate: Double, var hoursWorked: Double) extends Employee(name, jobTitle) {
  def getPayRate(): Double = payRate
  def setPayRate(newPayRate: Double): Unit = { payRate = newPayRate }

  def getHoursWorked(): Double = hoursWorked
  def setHoursWorked(newHoursWorked: Double): Unit = { hoursWorked = newHoursWorked }

  override def calculateWeeklyPay(): Double = payRate * hoursWorked
}

// Example usage:

// Creating a SalaryEmployee
val salaryEmployee = new SalaryEmployee("Alice", "Manager", 1500.0)
salaryEmployee.setWeeklySalary(2000.0)
println(s"Salary employee weekly pay: ${salaryEmployee.calculateWeeklyPay()}")

// Creating an HourlyEmployee
val hourlyEmployee = new HourlyEmployee("Bob", "Associate", 20.0, 40.0)
hourlyEmployee.setPayRate(18.0)
hourlyEmployee.setHoursWorked(45.0)
println(s"Hourly employee weekly pay: ${hourlyEmployee.calculateWeeklyPay()}")
```

OUTPUT:



```
Salary employee weekly pay: 2000.0
Hourly employee weekly pay: 810.0
```