Inheritance in java

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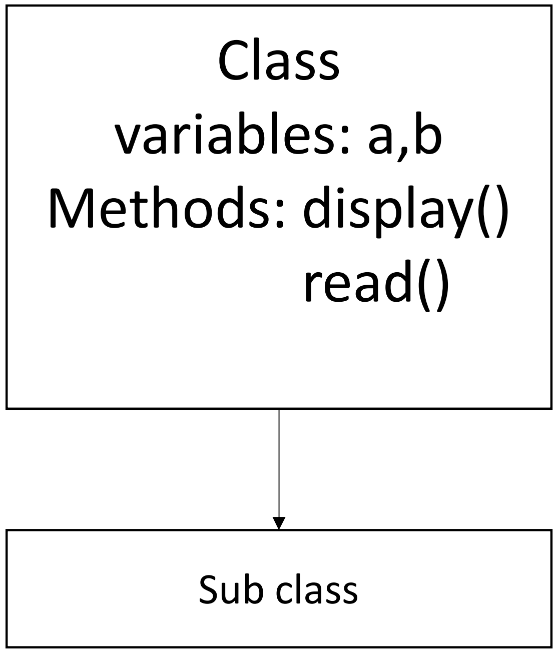
Inheritance

- A process by which one class can acquire properties of another class is called inheritance.
- When a class inherits from another class, it is called as the sub class.
- The class from which subclass derives its properties is called as a super class.
- When a class inherits from another class, the certain members of the parent class or super class become the part of the subclass.

Inheritance



Based on the type of inheritance, these members get inherited
i.e. become a part of the Subclass. The objects of the subclass would then
Not only have subclass members but would also have
the inherited parts of the super class.

Types of inheritance

- Single
- Multilevel
- Hierarchical
- Multiple (Not supported)

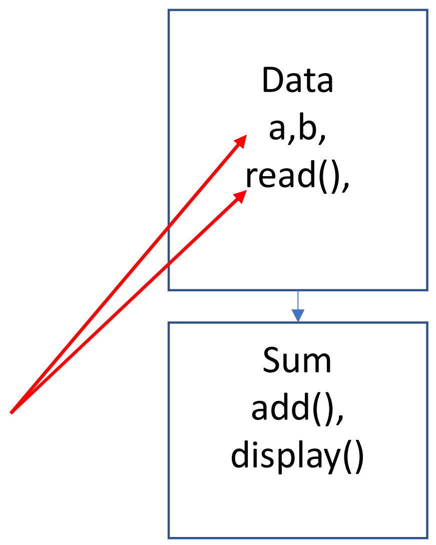
Single inheritance

- Single inheritance is when one subclass inheritance from one super class.
- The example we saw in the previous slide is an example of a single inheritance.
- It is a simplest form of inheritance.

Program to demonstrate single inheritance

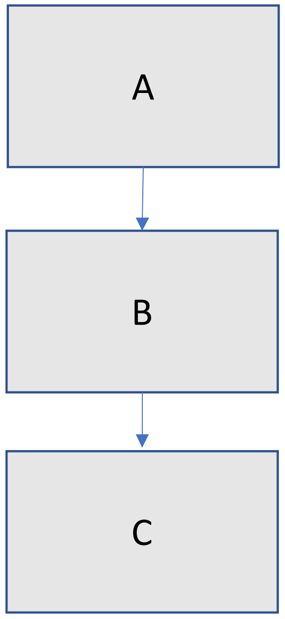
```
import java.io.*;
import java.util.*;

class Data
{
protected int a, b;

public void read(int x, int y)
{
  a=x;
  b=y;
}
}

class Sum extends Data
{
private int sum;
public void add()
{
  sum=a+b;
}
public void display()
{
  System.out.println("Sum="+sum);
}
}
```

```
class singleinheritence{
public static void main (String args[]) {
 int x,y;
 Scanner sc = new Scanner (System.in);
 System.out.println("Enter two numbers");
 x=sc.nextInt();
 y=sc.nextInt();
 Sum s=new Sum();
 s.read(x,y);
 s.add();
 s.display();
}
}
```



Multilevel inheritance

- It is the type of inheritance where a class is inherited by a subclass, then the subclass again gets inherited by a subclass.

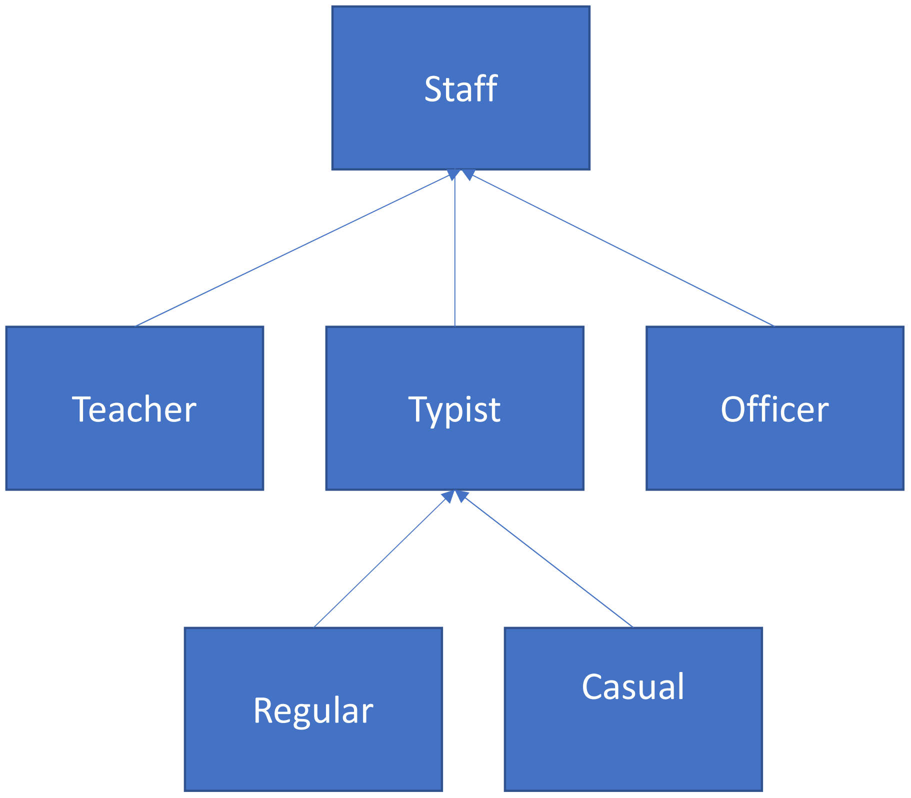


```
import java.util.*;
class Data{
protected float r;
public void read(float x)
{
  r=x;
}
}
class Area extends Data
{


protected float area;
public void calculate()
{
   area=3.14f*r*r;
}
public void display()
{
   System.out.println(“Area=“+area);
}
}
```

```
class Volume extends Area{
private float volume;
public void compute()
{
  volume=area*r*4/3;
}
public void output()
{
   System.out.println(“Volume=“+volume);
}
}
```

```
class Main{
public static void main (String args[]) {
  float x;
  Scanner sc = new Scanner (System.in);
  System.out.println(“Enter the radius:”);
  x=sc.nextFloat();
  Volume a=new Volume();
  a.read(x);
  a.calculate();
  a.display();
  a.compute();
  a.output();
}
}
```

Hierarchical inheritance



Method overriding

- If a class has multiple methods with the same name and different parameter list then it is called method overloading.
- If a base class and derived class have a method with the same name but same parameters, then its called method overriding.
- Example 7.6.1

Method overriding example

Code Example:-

```
import java.util.*;
import java.io.*;
class A{
  int a= 10;
   void read(){
    System.out.println("read base");
   }
}
class B extends A{
  int a =20;
  void read()
   {
    System.out.println("read derived");
   }
}
class test{
  public static void main(String[] args) {
    B b = new B();
    b.read();  // read of derived class overrides the
read of base
  }
}
```

Explanation:-

When the method of a base class
Has same name and same arguments
Of a derived class, the method of
The derived class is always called.
This is called method overriding.

Final keyword

- We can use this “final” keyword with any member of the class or class itself.
- If a field member is declared as final then the variable value cannot be changed i.e it becomes a constant.
- If a method is declared final, it cannot be overridden.
- If a class is declared as final then that class cannot have any subclass.

Let us see an example of a final method

```
import java.util.*;

class Base{
protected float r,vol;
public void read(float x)
{
  r=x;
}
final public void display()
{
  System.out.println("Volume="+vol);
}
}
```

```
class Sphere extends Base
{
public void calculate()
{
  vol=3.14f*r*r*r*4/3;
}
}

class Hemisphere extends Base
{
public void calculate()
{
  vol=3.14f*r*r*r*2/3;
}
}
```

```
class Main{
public static void main (String args[]) {
  float x;
  Scanner sc = new Scanner (System.in);
  System.out.println("Enter the radius:");
  x=sc.nextFloat();
  Sphere s=new Sphere();
  s.read(x);
  s.calculate();
  System.out.println("Sphere:");
  s.display();
  Hemisphere h=new Hemisphere();
  h.read(x);
  h.calculate();
  System.out.println("Hemisphere:");
  h.display();
}
}
```

Notice how the display() method is declared final.

```
import java.util.*;
class Staff
{
        protected String name;
        protected int code;
}
class Teacher extends Staff
{
        private String subject;
        private int experience;
        public void read()
        {
                Scanner sc = new Scanner (System.in);
                System.out.println(“Enter name, code, subject and experience of the teacher:”);
                name=sc.next();
                code=sc.nextInt();
                subject=sc.next();
                experience=sc.nextInt();
        }
        public void display()
        {
                System.out.println(“Teacher Details:\nName:”+name+”\nCode:”+code
                +”\nSubject:”+subject+”\nExperience:”+experience);
        }
}
```

```
class Officer extends Staff
{
		private		String dept;
		private int grade;
		public		void read()
		{
				Scanner sc= new Scanner(System.in);
				System.out.println(“Enter name, code, department and grade of the officer:”);
				name =sc.next();
				code =sc.nextInt();
				dept =sc.next();
				grade =sc.nextInt();
		}
		public void display()
		{
				System.out.println(“Officer Details:\nName:”+name+”\nCode:”+code+
						”\nDepartment:”+dept+”\nGrade:”+grade);
		}
}
class Typist extends Staff
{
		protected int speed,experience;

}
```

```
class Regular extends Typist
{
		private		float salary;
		public void read()
		{
				Scanner sc = new Scanner (System.in);
				System.out.println(“Enter name, code, speed, 
experience and salary of the 						regular typist:”);
				name=sc.next();
				code=sc.nextInt();
				speed=sc.nextInt();
				experience=sc.nextInt();
				salary=sc.nextFloat();
		}
		public void display()
		{
				System.out.println(“Regular Typist 
Details:\nName:”+name+”\nCode:”+code+”\nSpeed:”+speed+”\nExperience:”+e
xperience+”\nSalary:”+salary);
		}
}
```

```
class Casual extends Typist
{
                    private float dailywages;
                    public void read()
                    {
                                        Scanner sc = new Scanner (System.in);
                                        System.out.println(“Enter name, code, speed,
experience and daily wages of                                 the Casual typist:”);
                                        name=sc.next();
                                        code=sc.nextInt();
                                        speed=sc.nextInt();
                                        experience=sc.nextInt();
                                        dailywages=sc.nextFloat();
                    }
                    public void display()
                    {
                                        System.out.println(“Casual Typist
Details:\nName:”+name+”\nCode:”+code+”
                    \nSpeed:”+speed+” \nExperience:”+experience+”\nDaily
Wages:”+dailywages);
                    }
}
```

Abstract class and method

- Abstract class are used to declare common characteristics of subclasses.
- Abstract classes are declared using the keyword “abstract” preceding the class definition. Abstract classes are used to provide a template for subclasses.
- No object can be made of an abstract class. It can be used as a base class for other classes that are derived from the abstract class.
- An abstract class contain fields and methods.
- Refer 7.8.1

```java
public abstract class Payment {

    // Abstract method - must be implemented by subclasses
    public abstract void makePayment(double amount);

    // Concrete method - common for all payment types
    public void printReceipt() {
        System.out.println("Payment successful. Receipt generated.");
    }
}
```

Payment.java

```java
public class CreditCardPayment extends Payment {

    @Override
    public void makePayment(double amount) {
        System.out.println("Paid ₹" + amount + " using Credit Card.");
    }
}
```

CreditCardPayment.java

```java
public class UPIPayment extends Payment {

    @Override
    public void makePayment(double amount) {
        System.out.println("Paid ₹" + amount + " using UPI.");
    }
}
```

UPIPayment.java

```
class Main
{
    public static void main(String[] args)
    {
        CreditCardPayment creditcardpayment = new CreditCardPayment();
        creditcardpayment.makePayment(1500);
        creditcardpayment.printReceipt();

        UPIPayment upipayment = new UPIPayment();
        upipayment.makePayment(1000);
        upipayment.printReceipt();
    }
}
```

```
import java.util.List;
import java.util.Arrays;
// import java.util.ArrayList;
class Main
{
    public static void main(String[] args)
    {
        List<Payment> payments = Arrays.asList(
        new CreditCardPayment(),
        new UPIPayment()
        );

        // List<Payment> payments = ArrayList(
        // new CreditCardPayment(),
        // new UPIPayment(),
        // new PayPalPayment()
        // );

        for (Payment p : payments) {
            p.makePayment(1000);
        }
    }
}
```

Constructors in java

- Constructors cannot be inherited.
- However the derived classes can access the base class constructors using the super keyword.
- Let us see an example below

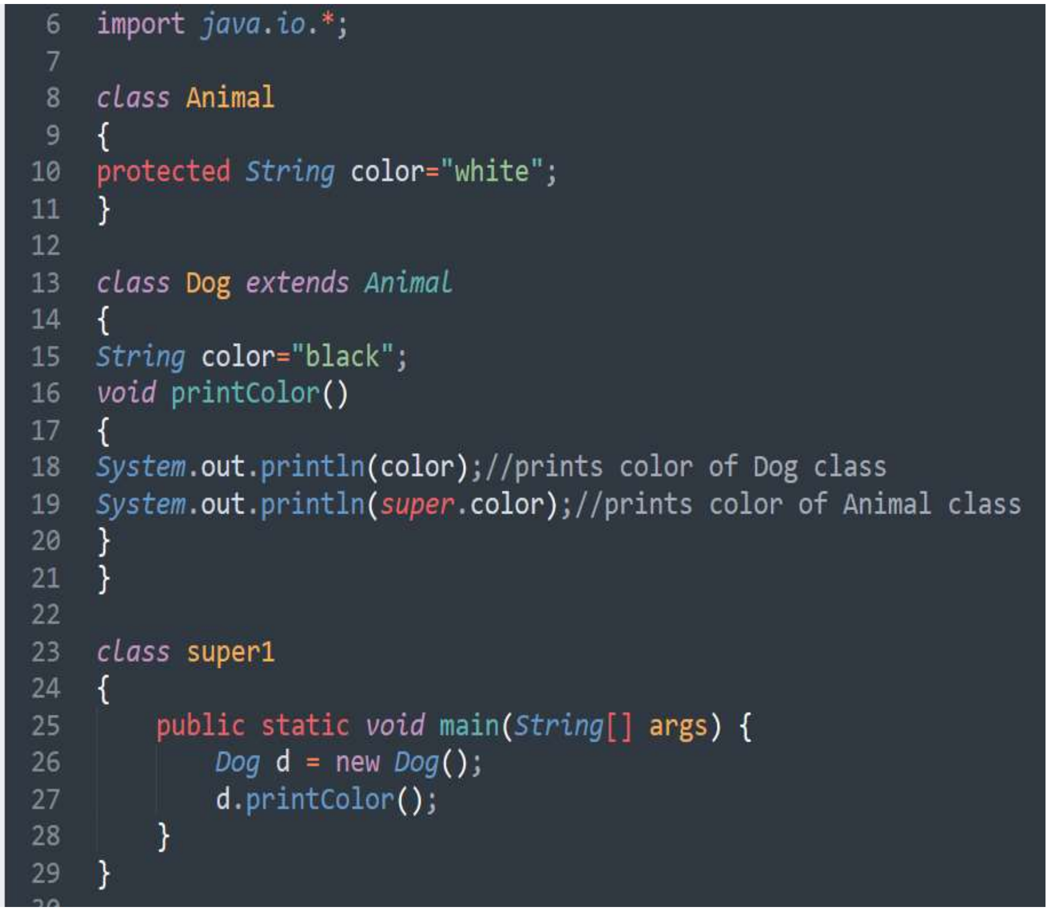
Super keyword

- If you want to access the base class member from the derived class, then we use the super keyword.
- This is especially to access the constructors and method members of the super class.
- Generally it is used for accessing those members of the base class that are not inherited or cannot be inherited.
- We know that the constructors cannot be inherited.
- So if a base class has a constructor and the derived class object needs to call the base constructor, then we can create a derived class constructor and then within it definition we can use the super keyword to call the base class constructor.

When to use super keyword

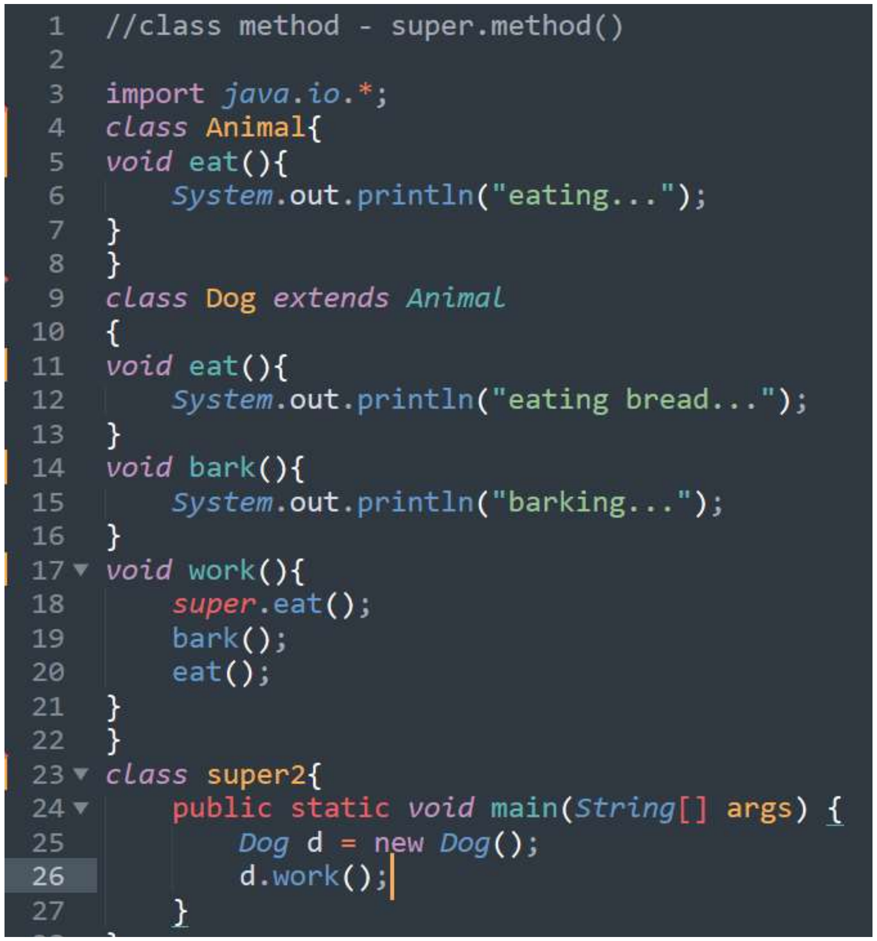
- When an object of a subclass is created, an instance of a [aren’t class is implicitly created that can be referenced using super keyword.
    - A super keyword is used to access the base class variable
    - A super keyword is used to access the base class method
    - A super keyword is used to access the base class constructor

1. Super to access base class variable



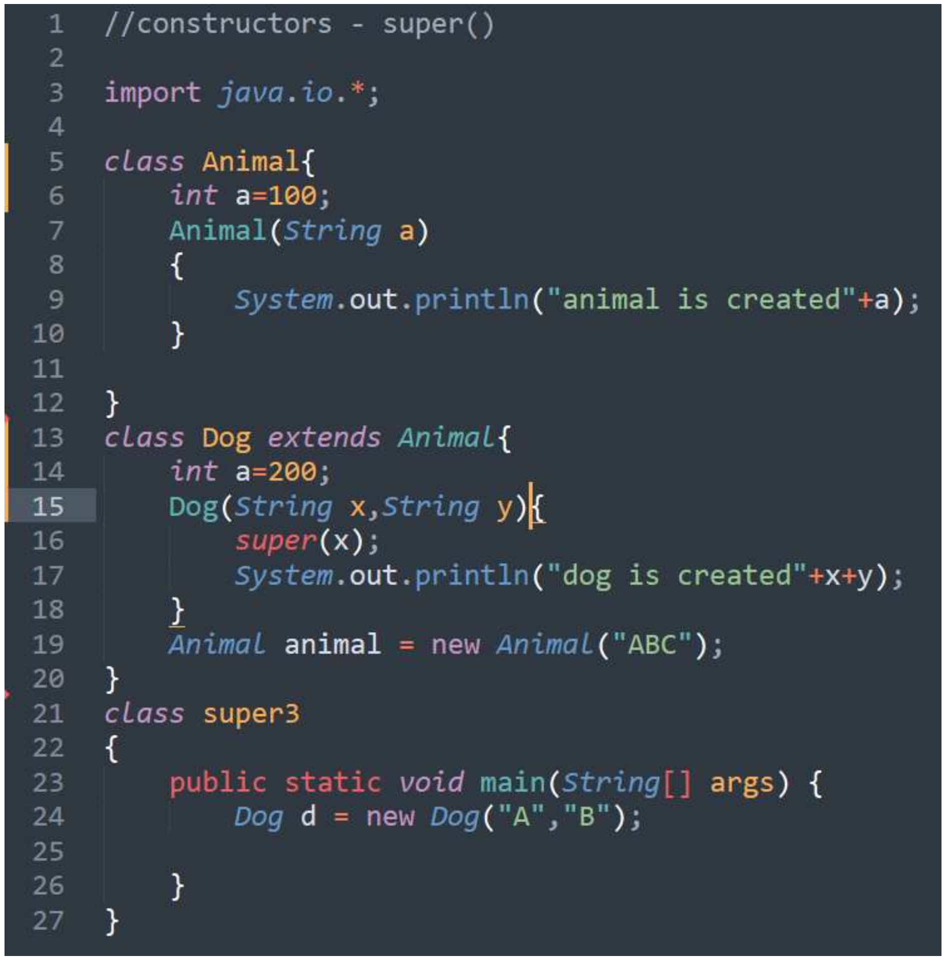
```
import java.io.*;

class Animal
{
protected String color="white";
}

class Dog extends Animal
{
String color="black";
void printColor()
{
System.out.println(color);//prints color of Dog class
System.out.println(super.color);//prints color of Animal class
}
}

class super1
{
    public static void main(String[] args) {
        Dog d = new Dog();
        d.printColor();
    }
}
```

2. Super to access class method()



```java
//class method - super.method()

import java.io.*;
class Animal{
void eat(){
    System.out.println("eating...");
}
}
class Dog extends Animal
{
void eat(){
    System.out.println("eating bread...");
}
void bark(){
    System.out.println("barking...");
}
void work(){
    super.eat();
    bark();
    eat();
}
}
class super2{
    public static void main(String[] args) {
        Dog d = new Dog();
        d.work();
    }
```

3. Super to access base class constructor



```java
//constructors - super()

import java.io.*;

class Animal{
	int a=100;
	Animal(String a)
	{
		System.out.println("animal is created"+a);
	}

}
class Dog extends Animal{
	int a=200;
	Dog(String x,String y){
		super(x);
		System.out.println("dog is created"+x+y);
	}
	Animal animal = new Animal("ABC");
}
class super3
{
	public static void main(String[] args) {
		Dog d = new Dog("A","B");

	}
}
```

Explanation

- An object c is created of the child class. The constructor as we know is automatically called.
- In the child class, we have the constructor called child which can call the constructor of the parent class using super().
- When super keyword is written, without specifying the method name, the constructor of the base class is called.
- The display() method is then called for the child class. Again using the keyword “super”, the display() method of the parent class is called.
- This is how we can prevent method overriding.

Interface

- Java doesn’t support multiple inheritance.
- This problem is solved in java using Interface.
- Some features of interface:
    - One interface can extend as many interfaces as required.
    - A java class can implement as many interfaces as required.
    - A class that implements an interface has to either define all methods of that interface or declare abstract methods whose definitions may be defined in the subclass.

Extending the interface

- Interface can be used for defineing a general template and then classes can implement the interface and hence inherit the properties of the “interface”.
- Interface just specify the method declaration and can also contain fields.
- Methods of the interface must be public or abstract.

Variables in the interface

- The fields are implicitly public static final.
- The definition of the interface begins with the keyword interface.
- No object can be made of an interface i.e. it cannot be instantiated.
- Refer program 7.9.1