# *Implementing Abstraction*

# Abstract classes

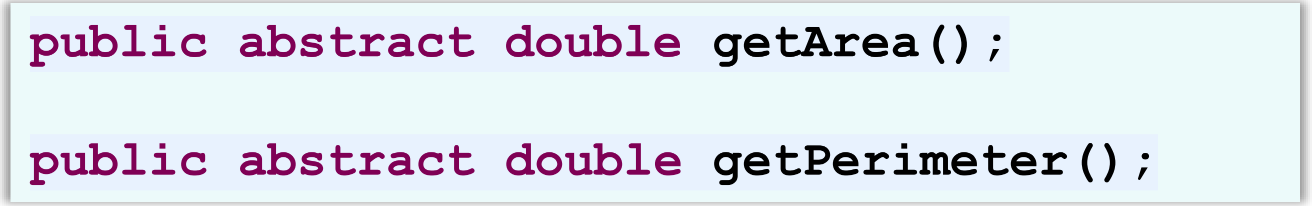
# ABSTRACTION

*“An Abstraction denotes the essential characteristics of an object that distinguishes it from all other kinds of objects and thus provides crisply defined conceptual boundaries, relative to the* perspective of the viewer” – Grady Booch

- ➢ Concept of abstraction is implemented in java by creating abstract classes and interfaces
- ➢ Abstract classes contain the essential attributes and functionality definition’s for classes of similar type
- ➢ Interfaces contain the essential functionality definition’s for classes of various types sharing similar functionalities

# ABSTRACT METHODS

- A class can define a method without the method implementation, such methods have to be marked as abstract
- Abstract methods are defined as shown below



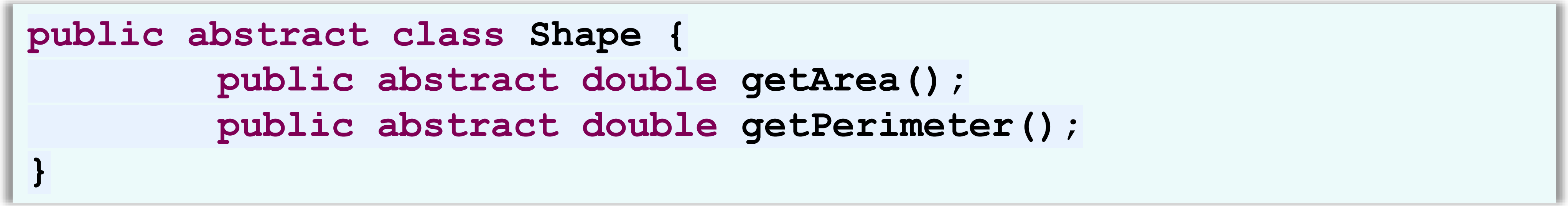
```
public abstract double getArea();

public abstract double getPerimeter();
```

- Why
  - When a class defines abstract methods, It becomes mandatory for its concrete subclasses to implement the functionality
  - Concrete subclass wont get compiled, if all the inherited abstract methods are not implemented
  - Enables a superclass to provide a service definition without specific implementation
  - Enables the methods to be accessed polymorphically

# ABSTRACT CLASS

- Class having even a single abstract method has to be marked abstract as shown below

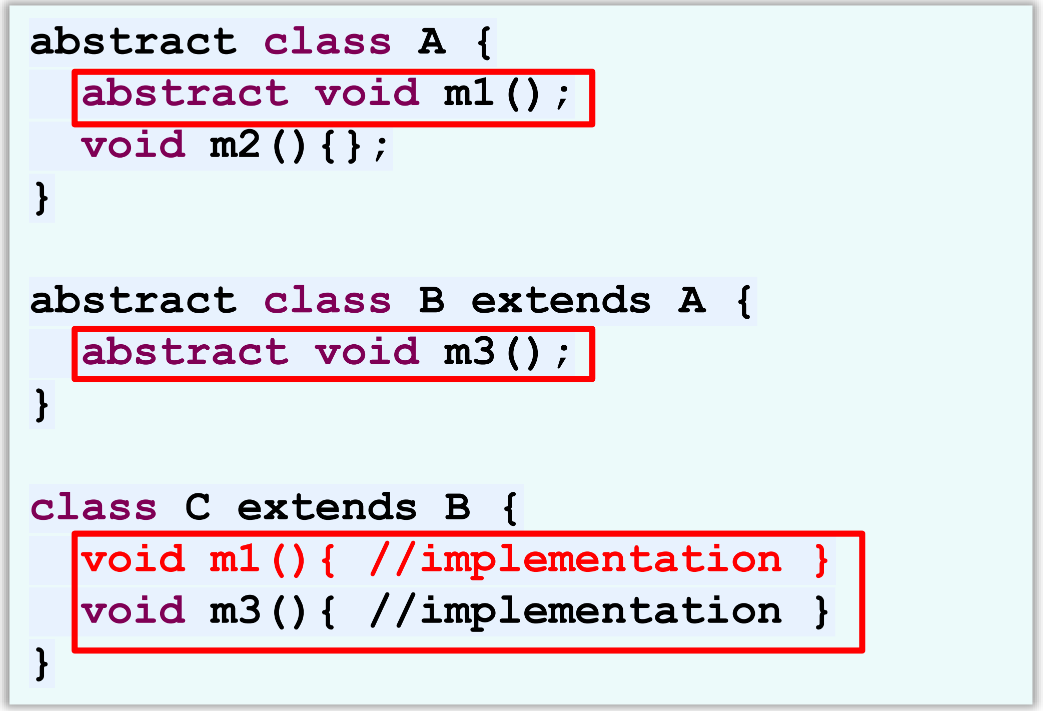


```
public abstract class Shape {
        public abstract double getArea();
        public abstract double getPerimeter();
}
```

- Abstract class
  - Cannot be instantiated (object of abstract class cannot be created)
  - Can have instance and static variables, constructors, non-abstract methods(concrete methods) like any other class
  - Abstract class constructor executes through constructor chaining, when a subclass object is created

# ABSTRACT CLASS AND METHOD RULES

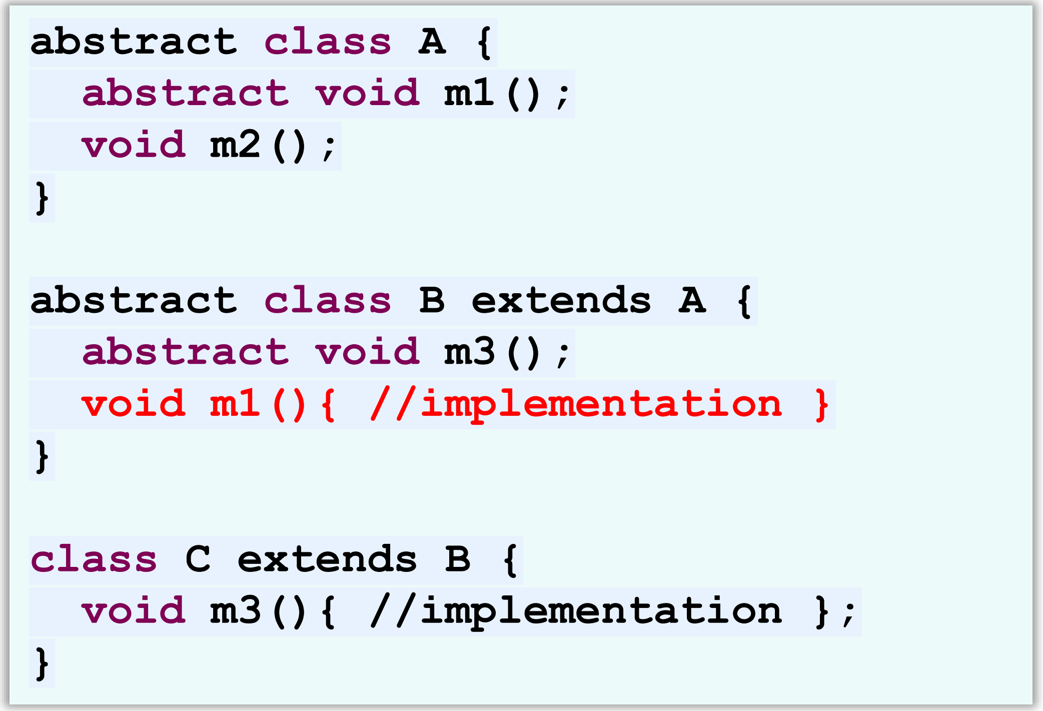
- It is Mandatory for the first concrete subclass to override all unimplemented abstract methods of its abstract Parent Classes



```
abstract class A {
  abstract void m1();
  void m2(){};
}

abstract class B extends A {
  abstract void m3();
}

class C extends B {
  void m1(){ //implementation }
  void m3(){ //implementation }
}
```



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  abstract void m3();
  void m1(){ //implementation }
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class C extends B {
  void m3(){ //implementation };
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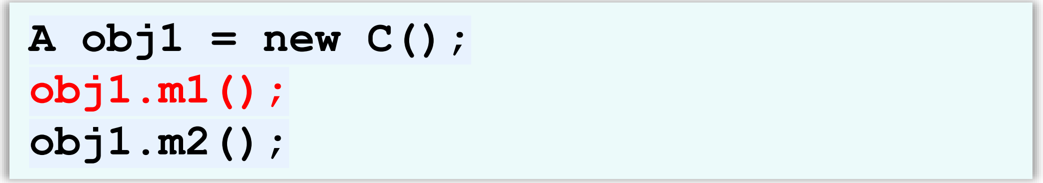
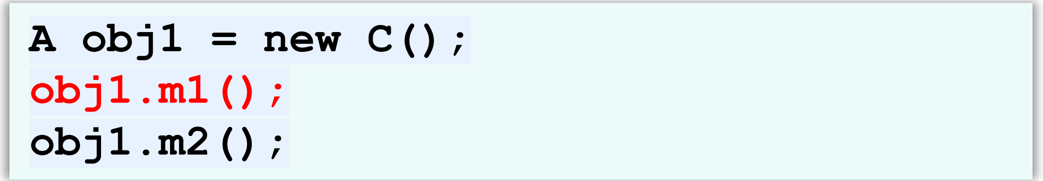
```



```
A obj1 = new C();
obj1.m1();
obj1.m2();
```



```
A obj1 = new C();
obj1.m1();
obj1.m2();
```

# ABSTRACT CLASS AND METHOD RULES

- Abstract class cannot be marked final
  - Why
    - Reason for creating abstract class is that, it should be inherited

- Abstract methods cannot be made private or final
  - Why
    - Private methods are not inherited and final methods cannot be overridden
    - Violates the reason for existence of abstract methods

- It is legally allowed for an abstract class not to have any abstract method

# *Interfaces*

# INTERFACES OVERVIEW AND ADVANTAGES

- Interface defines similarities that classes of various types share, but do not necessarily constitute a class relationship
- Interface is a contract for what a class can do, without providing the specifics of implementation
- Interface are just like classes but contain only abstract methods and constants

- Advantages
  - Provides polymorphic benefits of multiple inheritance
  - Can be implemented by any class, from any inheritance tree which share common functionality
  - Used to expose services to external application without providing specifics of implementation
  - Helps in implementing loose coupling

# DEFINING INTERFACES

```
public interface Rewardable{
    int calculateRewardPoints(double amount);
}
```

- Interface can contain
  - Method prototypes
    - only method definition and not implementation
    - methods are implicitly public and abstract
    - methods must not be static/final
  - Variables
    - Are implicitly public, static, and final
    - Must be initialized

- Interface cannot be instantiated

```
Rewardable r1;              //Can
be created
r1 = new Rewardable();   //
Compile Error
```

# IMPLEMENTING INTERFACES

- A class can implement an interface using the implements keyword
- It should be used only after the extends keyword (if there is one)
- A class can implement more than one interface

```
public interface Rewardable{
      int calculateRewardPoints(double amount);
}

public class SBAccount implements Rewardable{
public int calculateRewardPoints(double amount){
      //implementation
    }
}
```

```
Rewardable r1 = new SBAccount();
r1.calculateRewardPoints(500);
```

# IMPLEMENTING INTERFACES

- A class must implement all the methods declared in the interface
- The implemented method can be marked as final

```
interface I1{
  void m1();
  void m2();
}

interface I2{
  void m3();
}

class C1 implements I1,I2{
  public void m1(){ //implementation}
  public void m2(){ //implementation}
  public final void m3(){ //implementation}
}
```

```
I1 obj1 = new C1();
obj1.m1();
obj1.m2();
```

Using a reference of interface only methods defined in the interface can be accessed

```
C1 obj2 = new C1();
obj2.m1();
obj2.m2();
obj2.m3();
```

# ABSTRACT CLASS IMPLEMENTING INTERFACES

- An abstract class implementing an interface may choose not to provide the implementation of interface methods

```
interface I1{
    void m1();
    void m2();
}

abstract class C1 implements I1{
    abstract void m3();
    public void m2(){ //implementation}
}

class C2 extends C1{
    public void m1(){ //implementation}
    public void m3(){ //implementation}
}
```

```
I1 obj1 = new C2();
obj1.m1();
obj1.m2();

C1 obj2 = new C2();
obj2.m1();
obj2.m2();
obj2.m3();
```

# INSTANCEOF

- ➢ An object of a class that implements an interface is also considered as an object of that interface

```
public interface Rewardable{...}

public interface Taxable{...}

public class SBAccount implements Rewardable, Taxable{...}
```

```
SBAccount sb1 = new SBAccount();

 System.out.println(sb1 instanceof SBAccount);          //TRUE
 System.out.println(sb1 instanceof Rewardable);  //TRUE
 System.out.println(sb1 instanceof Taxable);   //TRUE
```

# EXTENDING INTERFACES

- An interface can extend one or more interfaces
- Similar to inheritance in classes
- An interface cannot implement another interface

```
interface I1{
  void m1();
}

interface I2 extends I1{
  void m2();
}

class C1 implements I2{
  public void m1(){ //implementation}
  public void m2(){ //implementation}
}
```

# INTERFACE VS ABSTRACT CLASS

**Interface**

- A class can implement multiple interfaces
- Methods must be public and abstract
- Variables
  - must be public, static and final
  - Must be initialized
- Constructors
  - Cannot have Constructors

**Abstract Class**

- A class can extend only one abstract Class
- Methods have no Restrictions
- Variables
  - No Restrictions
- Constructors
  - Constructors are invoked by subclasses through constructor chaining