Object Oriented Programming
CS F213
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Slides Taken from the slides prepared by Dr. Jennifer

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‘Final’ Keyword

Java Final Keyword

- Makes variable a constant
- Prevents Method Overriding
- Prevents Inheritance

Blank or uninitialized final variable

- A final variable that is not initialized at the time of declaration is known as blank final variable.

- It can be used when variable is initialized at the time of object creation and should not be changed after that.
  - Eg. Pan card

- It can be initialized only once (preferably within a constructor).

Final blank variable

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Example 1:

```
class first{

 public static void main(String
     args[]){
    final int i;
    i=10;

       System.out.println("s1: "+i);
       i=20;  // Error

   }
}
```

Example 2:

```
class first{
final int i;
i=10 // Error
first(){
i=10;
}

 public static void main(String
     args[]){

       System.out.println("s1: "+new
    first().i);
   }
}
```

Static Blank Final Variable

- A static final variable that is not initialized at the time of declaration is known as static blank final variable. It can be initialized only in static block.

```
class A{
  static final int data;//static blank final variable
  static{ data=50;}
  public static void main(String args[]){
    System.out.println(A.data);
 }
}
```

Questions?

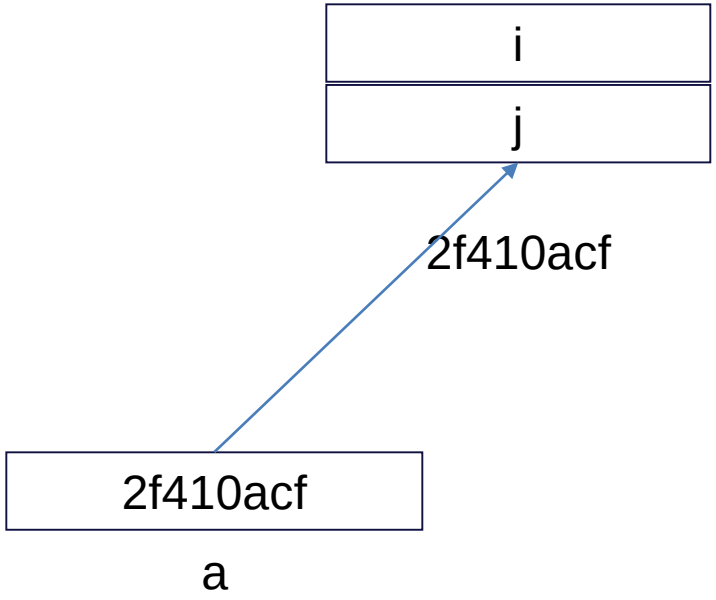
- Is final method inherited?
  - YES. But it cannot be overridden
- Can we declare a constructor final?
  - NO. Constructor is not inherited

Difference between Reference and Object

```
class zero{
int i;
float j;
}

class first{
public static void main(String args[]){

 zero a = new zero();
 System.out.println(a);
 a.i =10;
 a.j=20;
    }
}
```



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Run Time Polymorphism

Dynamic Method Dispatch

- Method overriding is one of the ways in which Java supports Runtime Polymorphism.
- Dynamic method dispatch is the mechanism by which a call to an overridden method is resolved at run time, rather than compile time.
- An overridden method is called through the reference variable of a superclass.
- The determination of the method to be called is based on the object being referred to by the reference variable.
- **Upcasting**: The reference variable of Parent class refers to the object of Child class.

Runtime Polymorphism in Multilevel Hierarchy

```
class zero{
int i=10;
float j=20;
void show() {
System.out.println(i+" "+j);}}

class first extends zero  {
int i=30;
float j=40;
void show() {
System.out.println(i+" "+j);}
}
```

```
class second extends first{
int i=50;
float j=60;
void show() {
System.out.println(i+" "+j);}
 public static void main(String
     args[]){
 zero a ;
 a = new first();
 a.show();
 first s;
s= new second();
s.show();
}
}
```

Output:
30 40.0
50 60.0

Runtime Polymorphism with Data Members

```
class zero{
int i=10;
float j=20;   }
class first extends zero  {
int i=30;
float j=40;    }
class second extends first{
int i=50;
float j=60;
 public static void main(String args[]){
 zero a ;
 a = new first();
 System.out.println(a.i+" "+a.j);
 first s;
 s= new second();
System.out.println(s.i+" "+s.j);   }  }
```

Output:
10 20.0
30 40.0

Static vs. Dynamic Binding (Early vs. Late Binding)

- Static binding happens at compile-time while dynamic binding happens at runtime.
- Binding of private, static and final methods always happen at compile time since these methods cannot be overridden.
- When the method overriding is actually happening and the reference of parent type is assigned to the object of child class type then such binding is resolved during runtime.
- The binding of overloaded methods is static and the binding of overridden methods is dynamic.

Bank - Example

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```
class TestAccount{
public static void main(String[] args) {

Scanner sr = new Scanner(System.in);

System.out.println("Enter 1 for new customers (< 1 year) and 0 for others");
int yr = sr.nextInt();

BankAccount ba;

if (yr==1)
ba = new BankAccount(111,"Ankit",5000);
else
ba = new CheckingAccount(111,"Ankit",5000);
```

Bank - Example


```
System.out.println("Initial: "+ba.getBalance());

ba.deposit(1000);
ba.withdraw(2000);
ba.deposit(6000);
System.out.println("After three Transactions: " + ba.getBalance());

ba.deductFee();        //ERROR

System.out.println("After fee Deduction: " + ba.getBalance());
sr.close();

}}
```

Solution 1

- Create an empty method in the Bank Account class

```
void deductFee()
{
}
```

- Meaningless, Isn’t it?

Solution 2 – Abstract Class

```
abstract class BankAccount{
private int acc;
private String name;
private float amount;

BankAccount(int acc,String name,float amt)
{
this.acc = acc;
this.name = name;
this.amount = amt;   }

void setAcc(int acc)   {
this.acc = acc;    }

void setName(String name)  {
this.name = name;   }

float getBalance(){
return amount;}

void deposit(float amount)   {
this.amount = this.amount+amount; }

void withdraw(float amount)  {
if (this.amount < amount)
System.out.println("Insufficient
     Funds. Withdrawal Failed");
else
this.amount=this.amount-amount;  }

abstract void deductFee();
}
```

Abstract class

- an instance of an abstract class cannot be created, we can have references of abstract class type
- an abstract class can contain constructors
- we can have an abstract class without any abstract method
- Abstract classes can also have final methods (methods that cannot be overridden)

Example abstract class

```
abstract class Base
{
    final void fun()
{System.out.println("Der
   ived fun() called"); }
}
class Derived extends
   Base { }
```

```
class Main {
    public static void
    main(String args[])
    {
        Base b = new
    Derived();
        b.fun();
    }
}
```

Questions

- Is it possible to create abstract and final class in Java?
- Is it possible to have an abstract method in a class?
- Is it possible to have an abstract method in a final class?
- Is it possible to inherit from multiple abstract classes in Java?

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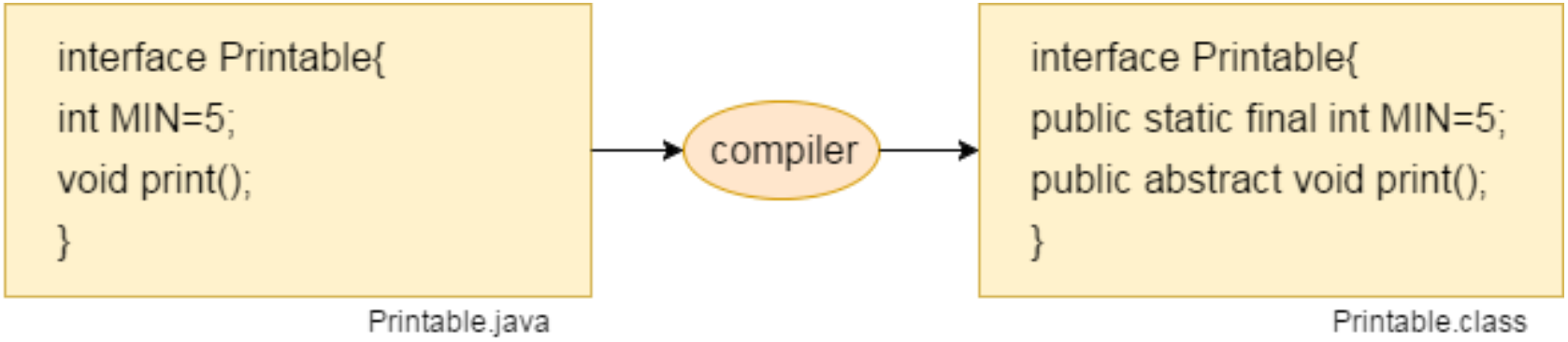
Interfaces

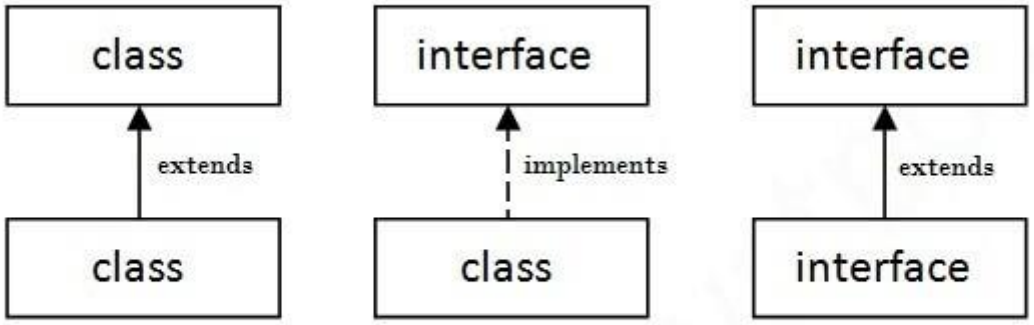
Interface

- Interface is a blueprint of a class containing static constants and abstract methods. It cannot have a method body.

- It is a mechanism to achieve abstraction.



Relationship between Classes and Interfaces



Interfaces - Example

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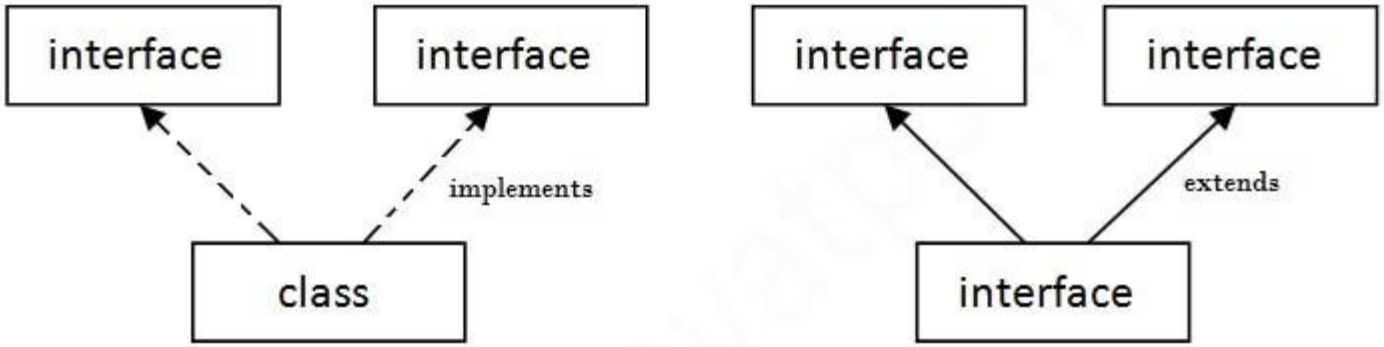
```
Interface Bank {
 void deductFee();
 void withdraw(float amount);
 void deductFee();}

class BankAccount implements Bank{
.
.
public void deductFee();{}
}

class CheckingAccount extends BankAccount implements Bank
{
.
.
.
}
```

Multiple Inheritance in Interface



Multiple Inheritance in Java

Why is Multiple Inheritance not a problem in Interface?


```
interface Printable{
void print();
void show();   }
interface Showable{
void show();
void print();  }

class trial implements
     Printable,Showable {
public void show()  {
System.out.println("Within Show");}

public void print() {
System.out.println("Within Print");}
}
```

```
public class test {
public static void main(String[]
     args) {
trial t = new trial();
t.print();
t.show();
}
}
```

Default Methods in Interface (defender or virtual extension)

- Before Java 8, interfaces could have only abstract methods. Implementation is provided in a separate class

- If a new method is to be added in an interface, implementation code has to be provided in all the classes implementing the interface.

- To overcome this, default methods are introduced which allow the interfaces to have methods with implementation without affecting the classes.

Default Methods

```
interface Printable{
void print();
default void show()
{
System.out.println("Within Show");
}
}

class trial implements Printable {

public void print()
{
System.out.println("Within Print");
}
}
```

```
public class test {
public static void main(String[]
    args) {
trial t = new trial();
t.print();
t.show();
}

}
```

Default Methods & Multiple Inheritance

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```
interface Printable{
void print();
default void show()
{
System.out.println("Within
    Printable Show");
}
}
interface Showable{
default void show()
{
System.out.println("Within
    Showable Show");
}
void print();
}
```

```
class trial implements Printable,Showable{
public void show()  {
Printable.super.show();
Showable.super.show(); }

public void print() {
System.out.println("Within Print"); }}

public class test {
public static void main(String[] args) {
trial t = new trial();
t.print();
t.show();
}
}
```