Object Oriented Programming (OOPS)

Agenda:

1. Data Hiding

2. Abstraction

3. Encapsulation

4. Tightly Encapsulated Class

5. IS-A Relationship(Inheritance)

o Multiple inheritance

o Cyclic inheritance

6. HAS-A Relationship

o Composition

o Aggregation

7. Method Signature

8. Polymorphism

o Overloading

 Automatic promotion in overloading

Overriding

 Rules for overriding

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 Overriding with respect to Var-arg methods

 Overriding with respect to variables

 Differences between overloading and overriding ?

o Method Hiding

9. Block

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. Instance block/Non static block

10. Constructors

o Constructor Vs instance block

o Rules to write constructors

o Default constructor

o Prototype of default constructor

o super() vs this():

o Overloaded constructors

o Recursive functions

12. Coupling

13. Cohesion

 In how many ways get an object in java ?

 Singleton classes

 Factory method

Data Hiding :

 Our internal data should not go out directly that is outside person can't

access

our internal data directly.

 By using private modifier we can implement data hiding.

Example:

```
class Account {
private double balance;
......................;
......................;
}
```

After providing proper username and password only , we can access our

Account

information.

The main advantage of data hiding is security.

Note: recommended modifier for data members is private.

Abstraction :

 Hide internal implementation and just highlight the set of services, is

called

abstraction.

 By using abstract classes and interfaces we can implement abstraction.

Example :

By using ATM GUI screen bank people are highlighting the set of services what they

are offering without highlighting internal implementation.

The main advantages of Abstraction are:

1. We can achieve security as we are not highlighting our internal implementation.(i.e., outside person doesn't aware our internal implementation.)

2. Enhancement will become very easy because without effecting end user we can

able to perform any type of changes in our internal system.

3. It provides more flexibility to the end user to use system very easily.

4. It improves maintainability of the application.

5. It improves modularity of the application.

6. It improves easyness to use our system.

By using interfaces (GUI screens) we can implement abstraction

Encapsulation :

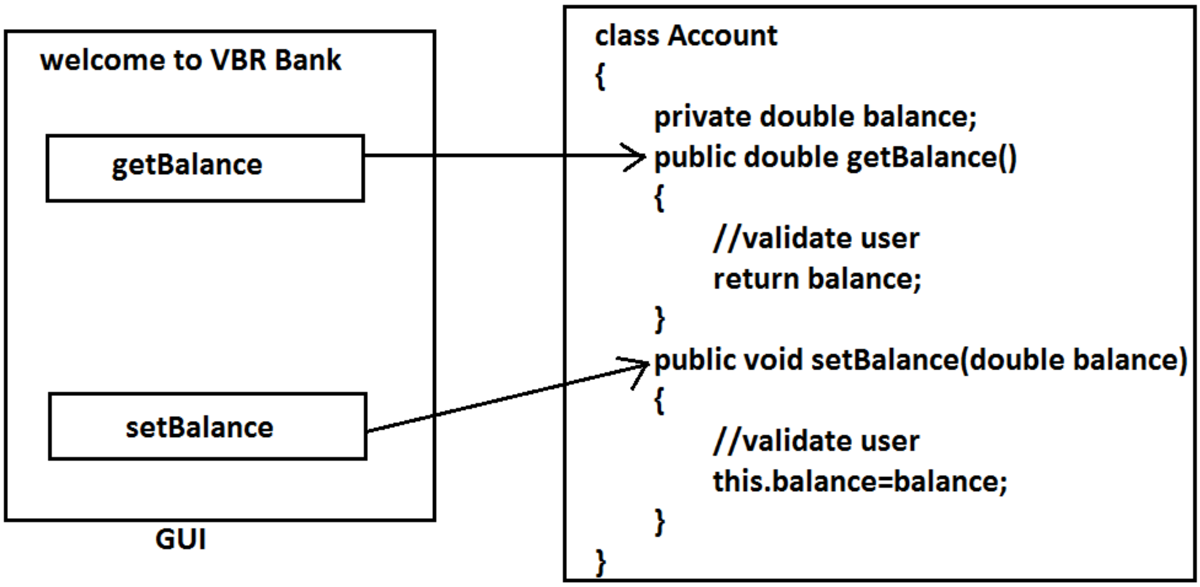
 Binding of data and corresponding methods into a single unit is called Encapsulation .

 If any java class follows data hiding and abstraction such type of class is said to

be encapsulated class.

Encapsulation=Datahiding+Abstraction

Example:



```
class Account
{
        private double balance;
        public double getBalance()
        {
                //validate user
                return balance;
        }
        public void setBalance(double balance)
        {
                //validate user
                this.balance=balance;
        }
}
```

Every data member should be declared as private and for every member

we have to

maintain getter & Setter methods.

The main advantages of encapsulation are :

1. We can achieve security.

2. Enhancement will become very easy.

3. It improves maintainability and modularity of the application.

4. It provides flexibility to the user to use system very easily.

The main disadvantage of encapsulation is it increases length of the code

and slows

down execution.

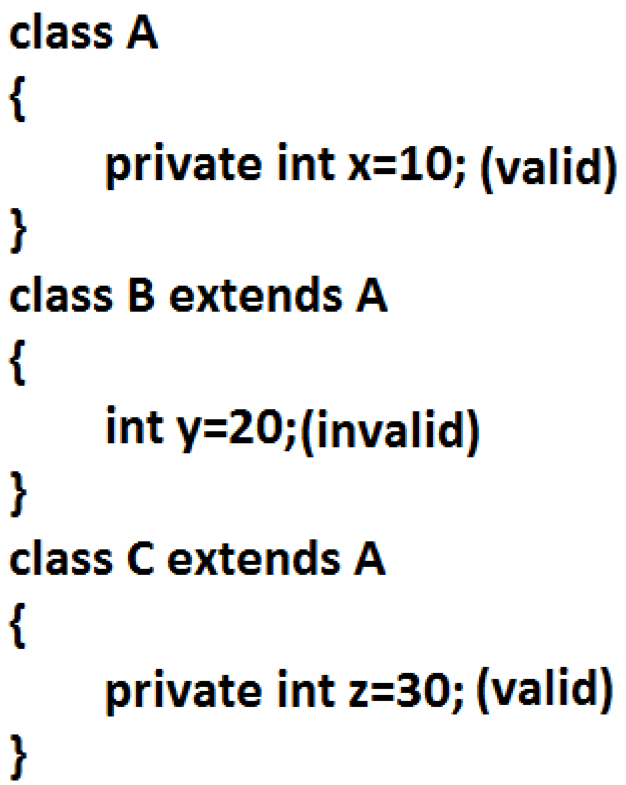
Tightly encapsulated class :

A class is said to be tightly encapsulated if and only if every variable of that class declared as private whether the variable has getter and setter methods are not , and whether these methods declared as public or not, these checkings are not required to perform.

Example:

```
class Account {
private double balance;
public double getBalance() {
return balance;
}
}
```

Which of the following classes are tightly encapsulated?



```
class A
{
        private int x=10; (valid)
}
class B extends A
{
        int y=20;(invalid)
}
class C extends A
{
        private int z=30; (valid)
}
```

Which of the following classes are tightly encapsulated?

```
class A {

int x=10; //not

}

class B extends A {

private int y=20; //not

}

class C extends B {

private int z=30; //not

}
```

Note: if the parent class is not tightly encapsulated then no child class is

tightly

encapsulated.

IS-A Relationship(inheritance) :

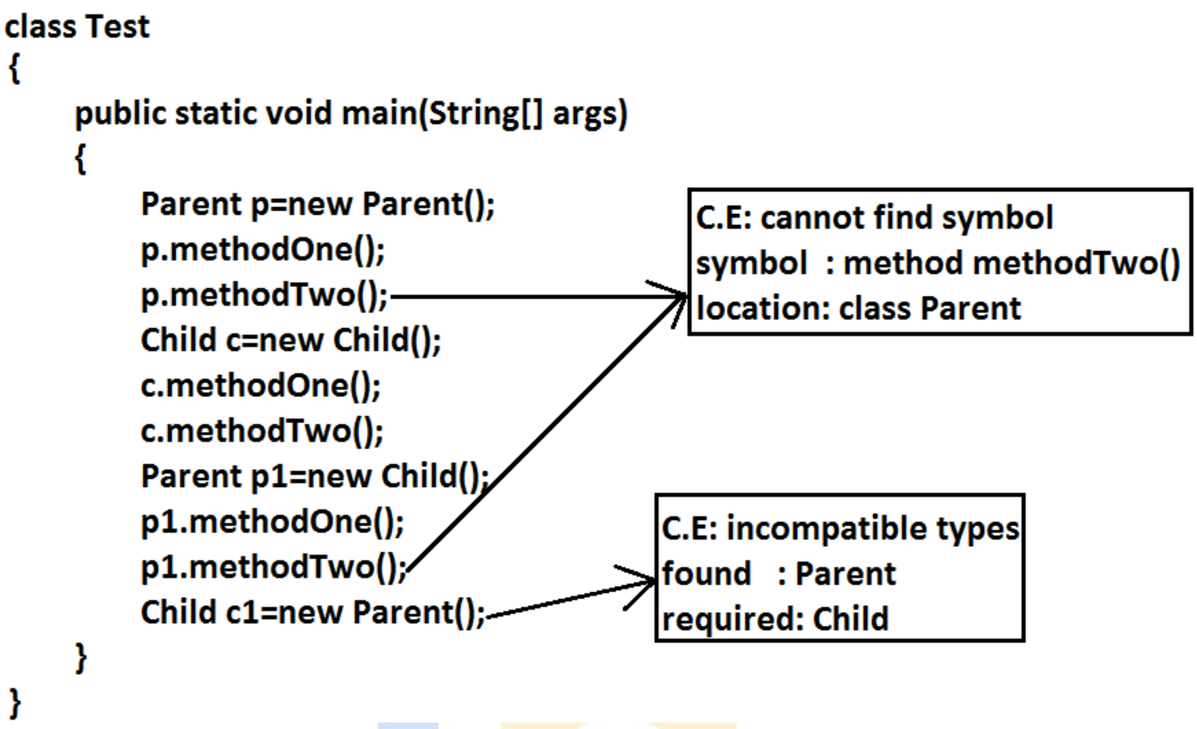
1. Also known as inheritance.

2. By using "extends" keywords we can implement IS-A relationship.

3. The main advantage of IS-A relationship is reusability.

Example:

```
class Parent {

public void methodOne(){ }

}

class Child extends Parent {

public void methodTwo() { }
```



```
class Test
{
	public static void main(String[] args)
	{
		Parent p=new Parent();
		p.methodOne();
		p.methodTwo();
		Child c=new Child();
		c.methodOne();
		c.methodTwo();
		Parent p1=new Child();
		p1.methodOne();
		p1.methodTwo();
		Child c1=new Parent();
	}
}
```

```
C.E: cannot find symbol
symbol  : method methodTwo()
location: class Parent
```

```
C.E: incompatible types
found   : Parent
required: Child
```

Conclusion :

1. Whatever the parent has by default available to the child but whatever the child has by default not available to the parent. Hence on the child reference we can call both parent and child class methods. But on the parent reference we can call only methods available in the parent class and we can't call child specific methods.

2. Parent class reference can be used to hold child class object but by using that

reference we can call only methods available in parent class and child

specific

methods we can't call.

3. Child class reference cannot be used to hold parent class object.

Example:

The common methods which are required for housing loan, vehicle loan,

personal loan

and education loan we can define into a separate class in parent class loan.

So that

automatically these methods are available to every child loan class.

Example:

```
class Loan {

//common methods which are required for any type of loan.

}

class HousingLoan extends Loan {

//Housing loan specific methods.

}

class EducationLoan extends Loan {

//Education Loan specific methods.

}
```

 For all java classes the most commonly required functionality is define

inside

object class hence object class acts as a root for all java classes.

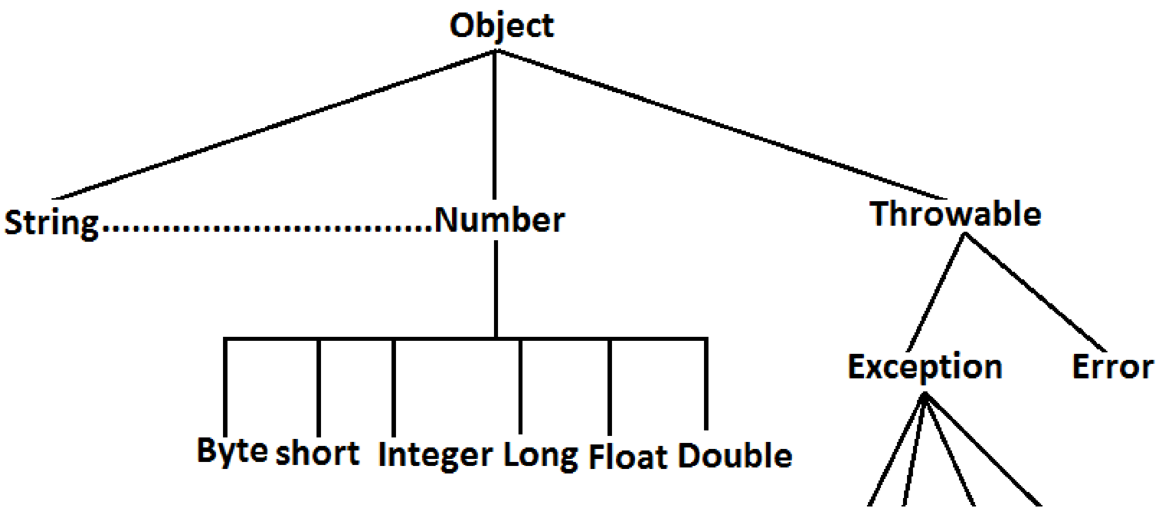
 For all java exceptions and errors the most common required

functionality

defines inside Throwable class hence Throwable class acts as a root for

exception

hierarchy.

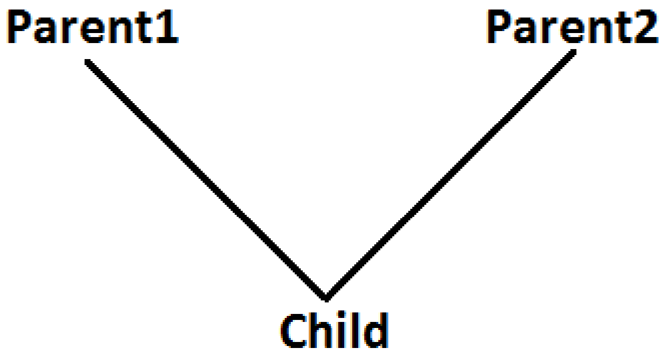


Multiple inheritance :

Having more than one Parent class at the same level is called multiple

inheritance.

Example:

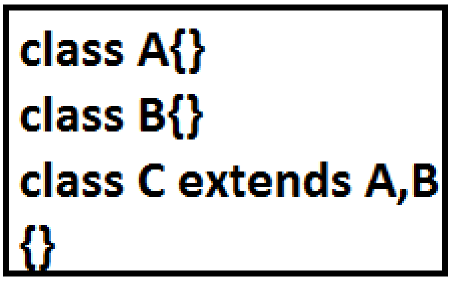


Any class can extends only one class at a time and can't extends more than

one class

simultaneously hence java won't provide support for multiple inheritance.

Example:



```
class A{}
class B{}
class C extends A,B
{}
```

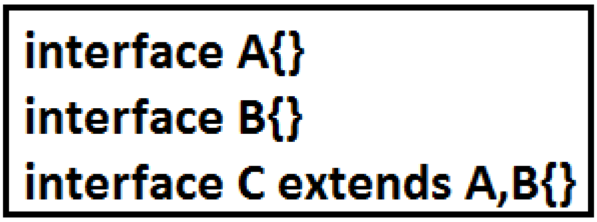
(invalid)

But an interface can extends any no. Of interfaces at a time hence java

provides support

for multiple inheritance through interfaces.

Example:



```
interface A{}
interface B{}
interface C extends A,B{}
```

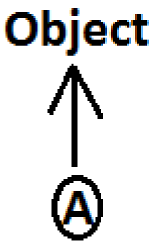
If our class doesn't extends any other class then only our class is the direct

child class of

object.

Example:

```
class A{}
```



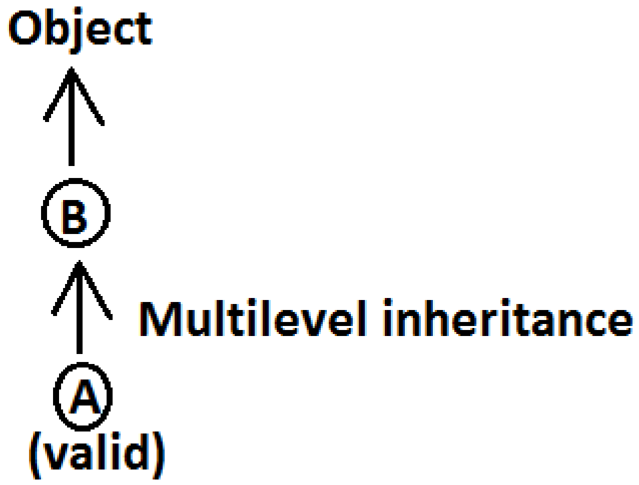
If our class extends any other class then our class is not direct child class of

object, It is

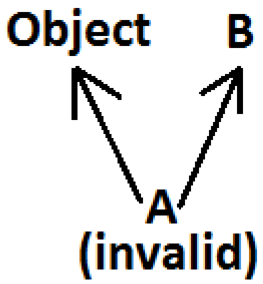
indirect child class of object , which forms multilevel inheritance.

Example 1:

```
class B{}
class  A extends B{}
```



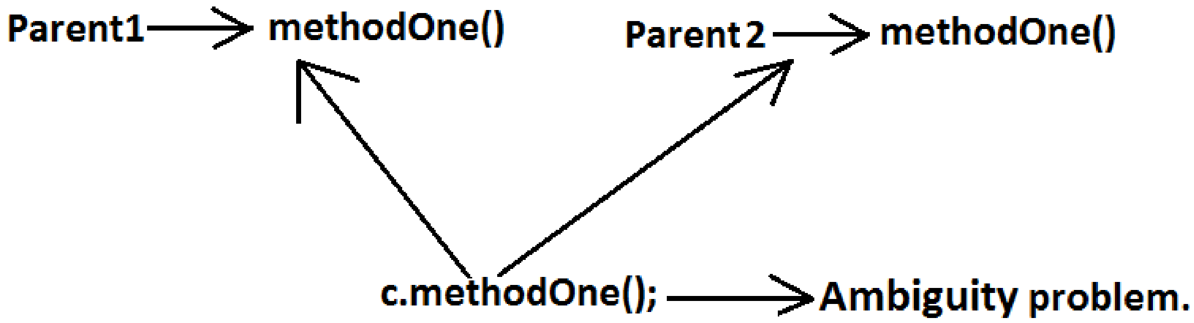
Example 2:



Why java won't provide support for multiple inheritance?

There may be a chance of raising ambiguity problems.

Example:



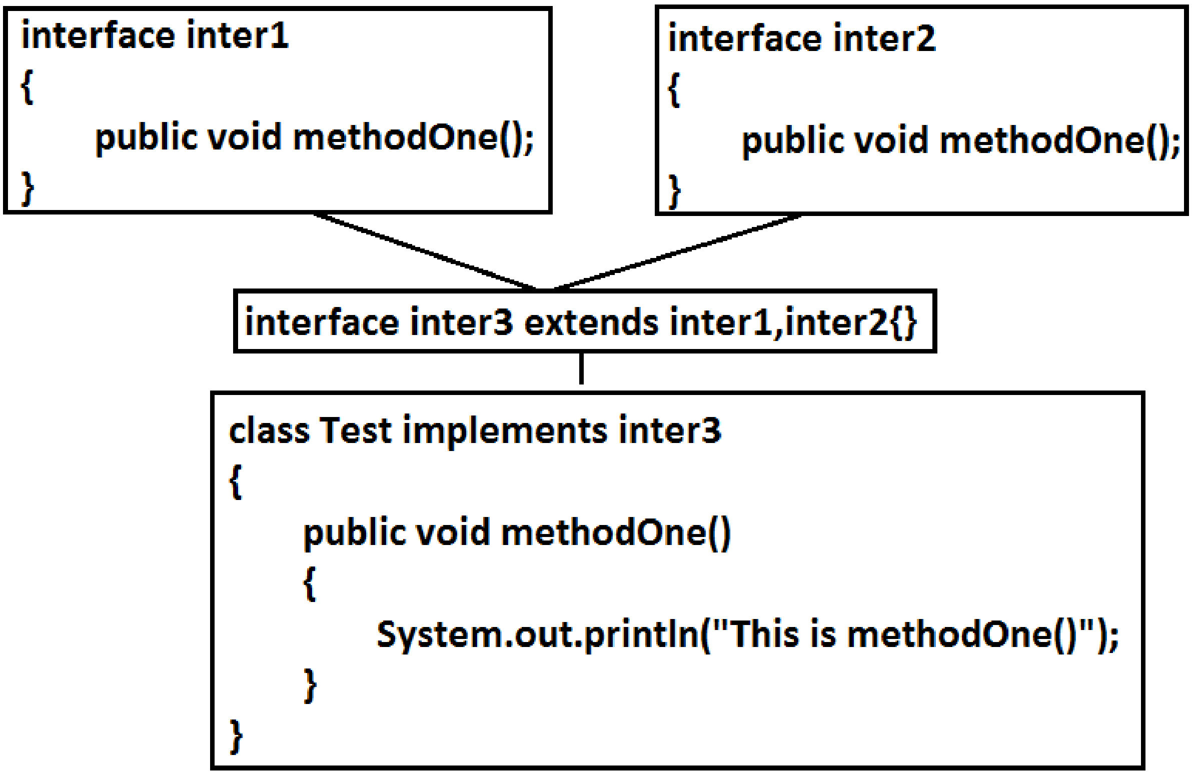
Why ambiguity problem won't be there in interfaces?

Interfaces having dummy declarations and they won't have

implementations hence no

ambiguity problem.

Example:



```
interface inter1
{
        public void methodOne();
}
```

```
interface inter2
{
        public void methodOne();
}
```

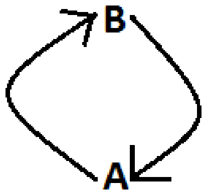
```
interface inter3 extends inter1,inter2{}
```

```
class Test implements inter3
{
        public void methodOne()
        {
                System.out.println("This is methodOne()");
        }
}
```

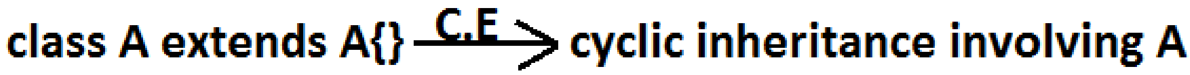
Cyclic inheritance is not allowed in java.

Example 1:

```
class A extends B{} (invalid)
class B extends A{} C.E:cyclic inheritance involving A
```



Example 2:



class A extends A{} $\xrightarrow{C.E}$ cyclic inheritance involving A

HAS-A relationship:

1. HAS-A relationship is also known as composition (or) aggregation.

2. There is no specific keyword to implement HAS-A relationship but

mostly we

can use new operator.

3. The main advantage of HAS-A relationship is reusability.

Example:

```
class Engine

{

//engine specific functionality

}

class Car

{

Engine e=new Engine();

//........................;

//........................;

//........................;

}
```

 class Car HAS-A engine reference.

 The main dis-advantage of HAS-A relationship increases dependency

between

the components and creates maintains problems.

Composition vs Aggregation:

Composition:

Without existing container object if there is no chance of existing contained

objects then

the relationship between container object and contained object is called

composition

which is a strong association.

Example:

University consists of several departments whenever university object

destroys

automatically all the department objects will be destroyed that is without

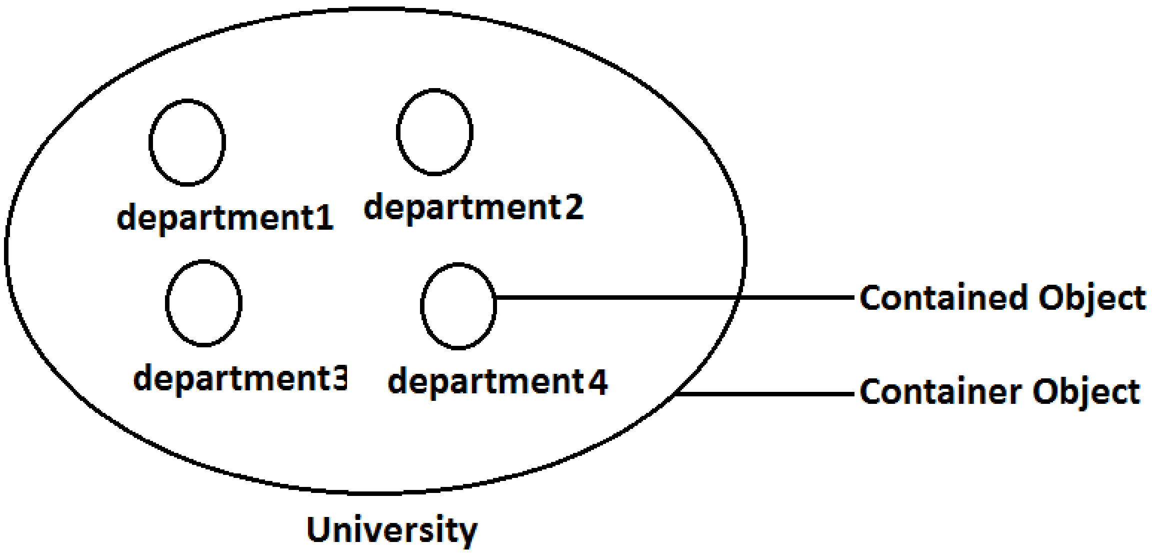
existing

university object there is no chance of existing dependent object hence

these are

strongly associated and this relationship is called composition.

Example:



Aggregation :

Without existing container object if there is a chance of existing contained

objects such

type of relationship is called aggregation. In aggregation objects have weak

association.

Example:

Within a department there may be a chance of several professors will work

whenever

we are closing department still there may be a chance of existing professor

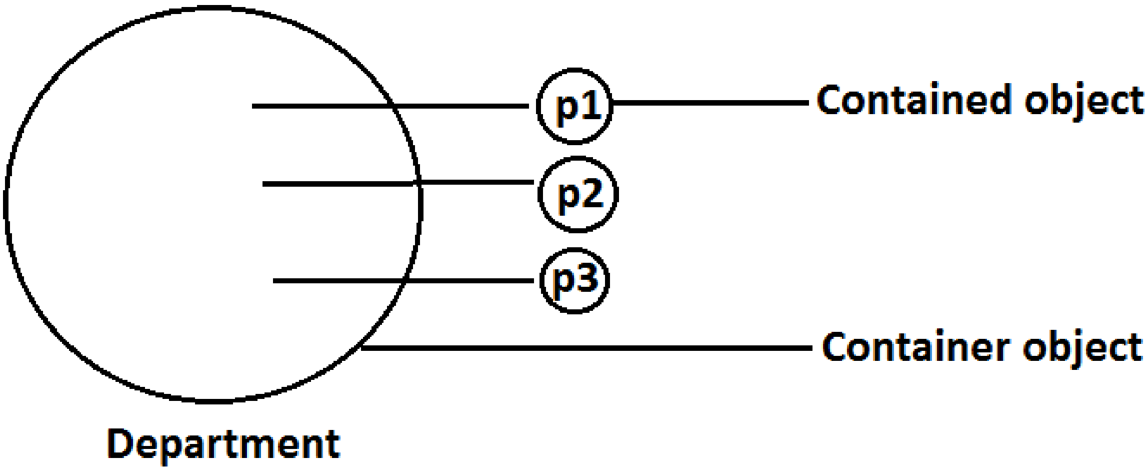
object

without existing department object the relationship between department

and professor

is called aggregation where the objects having weak association.

Example:



Note :

In composition container , contained objects are strongly associated, and

but container

object holds contained objects directly

But in Aggregation container and contained objects are weakly associated

and

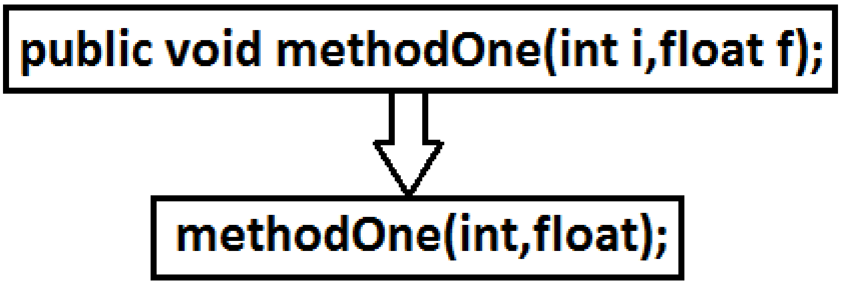
container object just now holds the reference of contained objects.

Method signature:

In java, method signature consists of name of the method followed by

argument types.

Example:



public void methodOne(int i,float f);

methodOne(int,float);

- In java return type is not part of the method signature.

- Compiler will use method signature while resolving method calls.

```
class Test {

public void m1(double d) { }

public void m2(int i) { }

public static void main(String ar[]) {

Test t=new Test();

t.m1(10.5);

t.m2(10);

t.m3(10.5); //CE

}

}
```

```
CE : cannot find symbol

symbol : method m3(double)

location : class Test
```

Within the same class we can't take 2 methods with the same signature

otherwise we

will get compile time error.

Example:

```
public void methodOne() { }

public int methodOne() {

return 10;

}
```

Output:

```
Compile time error

methodOne() is already defined in Test
```

Polymorphism:

Same name with different forms is the concept of polymorphism.

Example 1: We can use same abs() method for int type, long type, float type etc.

Example:

1. abs(int)

2. abs(long)

3. abs(float)

Example 2:

We can use the parent reference to hold any child objects.

We can use the same List reference to hold ArrayList object, LinkedList object, Vector object, or Stack object.

Example:

1. List l=new ArrayList();

2. List l=new LinkedList();

3. List l=new Vector();

4. List l=new Stack();

Diagram:

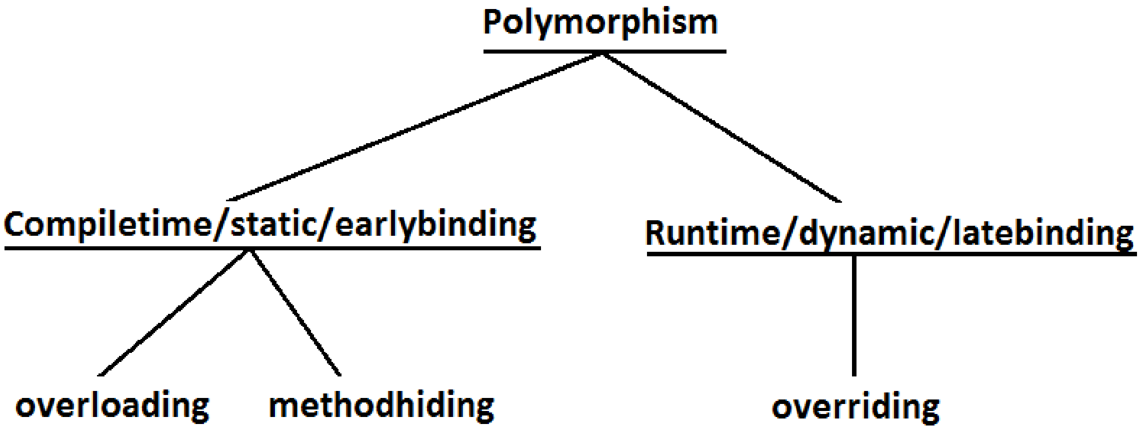
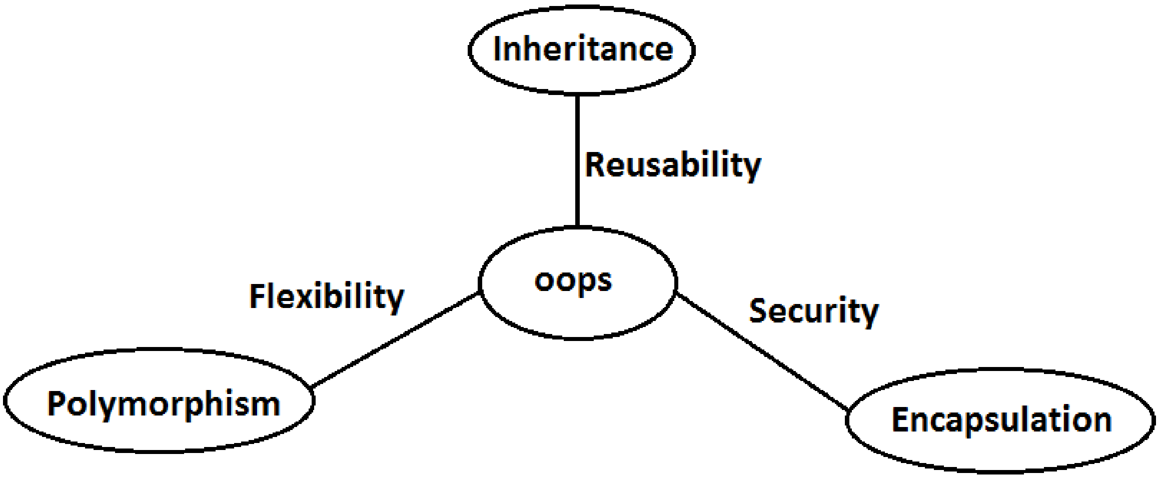


Diagram: 3 Pillars of OOPS



1) Inheritance talks about reusability.

2) Polymorphism talks about flexibility.

3) Encapsulation talks about security.

Beautiful definition of polymorphism:

A boy starts love with the word friendship, but girl ends love with the same

word

friendship, word is the same but with different attitudes. This concept is

nothing but

polymorphism.

Overloading :

1. Two methods are said to be overload if and only if both having the same

name

but different argument types.

2. In 'C' language we can't take 2 methods with the same name and

different types.

If there is a change in argument type compulsory we should go for new

method

name.

Example :

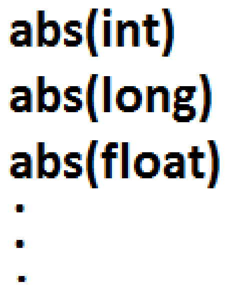
3. Lack of overloading in "C" increases complexity of the programming.

4. But in java we can take multiple methods with the same name and

different

argument types.

Example:



abs(int)
abs(long)
abs(float)
.
.
.

5. Having the same name and different argument types is called method

overloading.

6. All these methods are considered as overloaded methods.

7. Having overloading concept in java reduces complexity of the

programming.

8. Example:

9. class Test {

10. public void methodOne() {

11. System.out.println("no-arg method");

12. }

13. public void methodOne(int i) {

14. System.out.println("int-arg method"); //overloaded methods

```
15. }
16. public void methodOne(double d) {
17. System.out.println("double-arg method");
18. }
19. public static void main(String[] args) {
20. Test t=new Test();
21. t.methodOne();//no-arg method
22. t.methodOne(10);//int-arg method
23. t.methodOne(10.5);//double-arg method
24. }
25. }
```

26. Conclusion : In overloading compiler is responsible to perform method resolution(decision) based on the reference type(but not based on run time object). Hence overloading is also considered as compile time polymorphism(or)

static polymorphism (or)early biding.

Case 1: Automatic promotion in overloading.

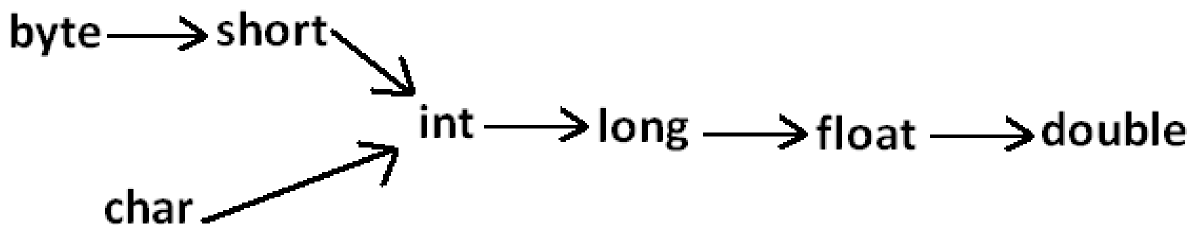
 In overloading if compiler is unable to find the method with exact match we

won't get any compile time error immediately.

 1st compiler promotes the argument to the next level and checks whether the matched method is available or not if it is available then that method will be considered if it is not available then compiler promotes the argument once again to the next level. This process will be continued until all possible promotions still if the matched method is not available then we will get compile time error. This process is called automatic promotion in overloading.

The following are various possible automatic promotions in overloading.

Diagram :



Example:

class Test

{

```
public void methodOne(int i)

{

System.out.println("int-arg method");

}

public void methodOne(float f) //overloaded methods

{

System.out.println("float-arg method");

}

public static void main(String[] args)

{

Test t=new Test();

//t.methodOne('a');//int-arg method

//t.methodOne(10l);//float-arg method

t.methodOne(10.5);//C.E:cannot find symbol

}

}
```

Case 2:

```
class Test

{

public void methodOne(String s)

{
```

```
System.out.println("String version");

}

public void methodOne(Object o) //Both methods are said to

//be

overloaded methods.

System.out.println("Object version");

}

public static void main(String[] args)

{

Test t=new Test();

t.methodOne("arun");//String version

t.methodOne(new Object());//Object version

t.methodOne(null);//String version

}

}
```

Note :

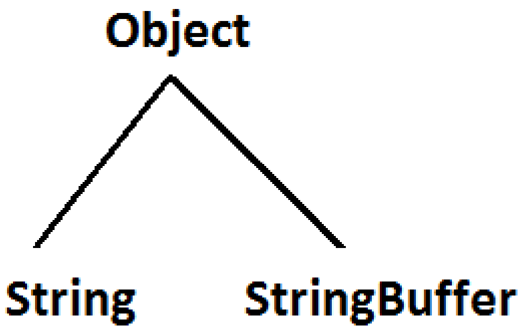
While resolving overloaded methods exact match will always get high priority,

While resolving overloaded methods child class will get the more priority than parent class

Case 3:

```
class Test{
public void methodOne(String s) {
System.out.println("String version");
}
public void methodOne(StringBuffer s) {
System.out.println("StringBuffer version");
}
public static void main(String[] args) {
Test t=new Test();
t.methodOne("arun");//String version
t.methodOne(new StringBuffer("sai"));//StringBuffer version
t.methodOne(null);//CE : reference to m1() is ambiquous
}
}
```

Output:



Case 4:

```
class Test {
public void methodOne(int i,float f) {
System.out.println("int-float method");
}
public void methodOne(float f,int i) {
System.out.println("float-int method");
}
public static void main(String[] args) {
Test t=new Test();
t.methodOne(10,10.5f);//int-float method
t.methodOne(10.5f,10);//float-int method
t.methodOne(10,10); //C.E:
//CE:reference to methodOne is ambiguous,
//both method methodOne(int,float) in Test
//and method methodOne(float,int) in Test match
t.methodOne(10.5f,10.5f);//C.E:
cannot find symbol
symbol : methodOne(float, float)
location : class Test
}
}
```

Case 5 :

```
class Test{
public void methodOne(int i) {
System.out.println("general method");
}
public void methodOne(int...i) {
System.out.println("var-arg method");
}
public static void main(String[] args) {
Test t=new Test();
t.methodOne();//var-arg method
t.methodOne(10,20);//var-arg method
t.methodOne(10);//general method
}
}
```

In general var-arg method will get less priority that is if no other method matched then only var-arg method will get chance for execution it is almost same as default case inside switch.

Case 6:

```
class Animal{ }

class Monkey extends Animal{}

class Test{

public void methodOne(Animal a) {

System.out.println("Animal version");

}

public void methodOne(Monkey m) {

System.out.println("Monkey version");

}

public static void main(String[] args) {

Test t=new Test();

Animal a=new Animal();

t.methodOne(a);//Animal version

Monkey m=new Monkey();

t.methodOne(m);//Monkey version

Animal a1=new Monkey();

t.methodOne(a1);//Animal version

}

}
```

In overloading method resolution is always based on reference type and

runtime object

won't play any role in overloading.

Overriding :

1. Whatever the Parent has by default available to the Child through

inheritance, if

the Child is not satisfied with Parent class method implementation then

Child is

allow to redefine that Parent class method in Child class in its own way this

process is called overriding.

2. The Parent class method which is overridden is called overridden

method.

3. The Child class method which is overriding is called overriding method.

4. Example 1:

5.

6. class Parent {

7. public void property(){

8. System.out.println("cash+land+gold");

9. }

10. public void marry() {

```
System.out.println("subbalakshmi"); //overridden method
}
}
class Child extends Parent{ //overriding
public void marry() {
System.out.println("3sha/4me/9tara/anushka"); //overriding method
}
}
class Test {
public static void main(String[] args) {
Parent p=new Parent();
p.marry();//subbalakshmi(parent method)
Child c=new Child();
c.marry();//Trisha/nayanatara/anushka(child method)
Parent p1=new Child();
p1.marry();//Trisha/nayanatara/anushka(child method)
}
}
```

29. In overriding method resolution is always takes care by JVM based on runtime

object hence overriding is also considered as runtime polymorphism or dynamic

polymorphism or late binding.

30. The process of overriding method resolution is also known as dynamic method

dispatch.

Note: In overriding runtime object will play the role and reference type is dummy.

Rules for overriding :

1. In overriding method names and arguments must be same. That is method

signature must be same.

2. Until 1.4 version the return types must be same but from 1.5 version onwards covariant

return types are allowed.

3. According to this Child class method return type need not be same as Parent

class method return type its Child types also allowed.

4. Example:

5. class Parent {

6. public Object methodOne() {

7. return null;

8. }

9. }

10. class Child extends Parent {

11. public String methodOne() {

12. return null;

13. }

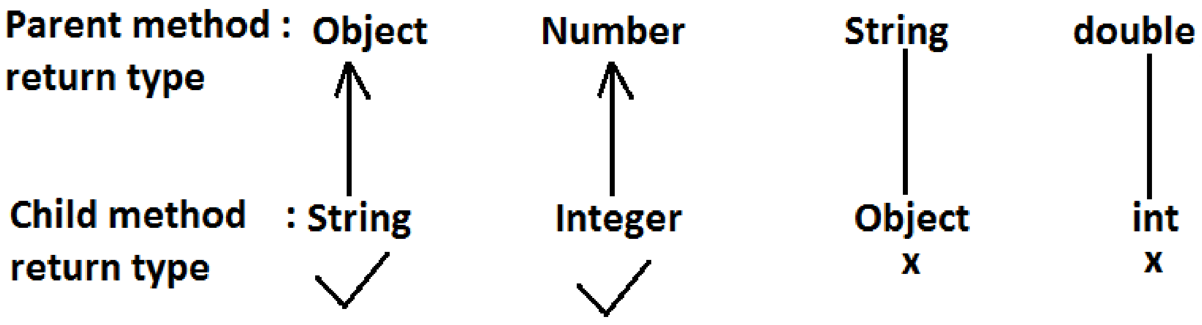
14. }

15.

16. C:> javac -source 1.4 Parent.java //error

It is valid in "1.5" but invalid in "1.4".

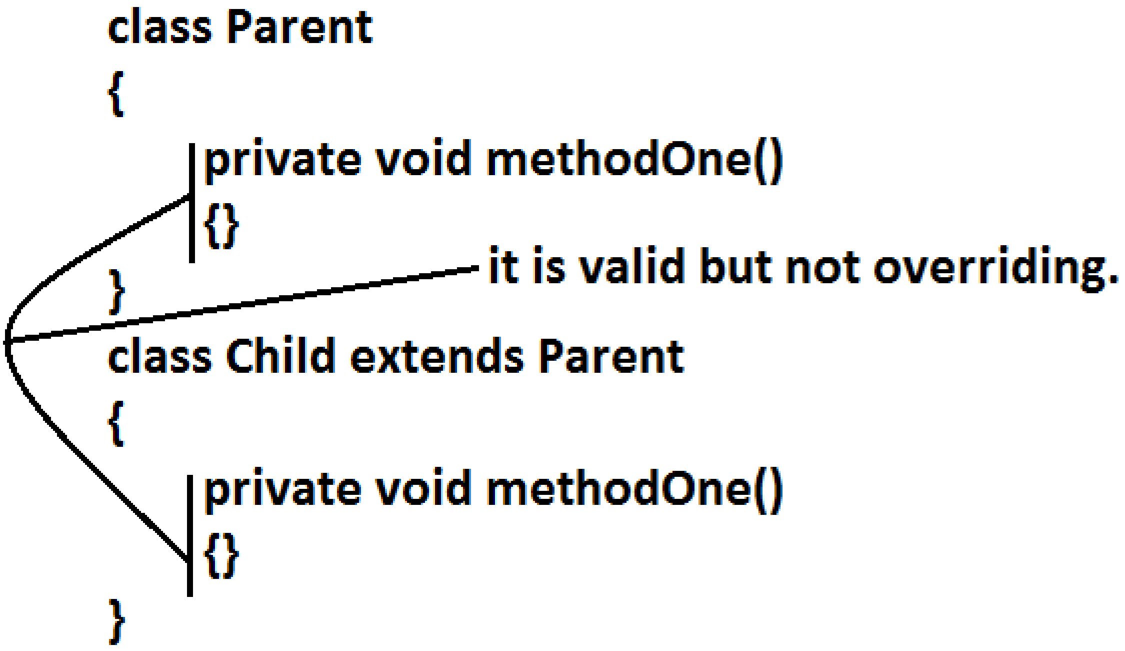
Diagram:



Co-variant return type concept is applicable only for object types but not for primitives.

Private methods are not visible in the Child classes hence overriding concept is not applicable for private methods. Based on own requirement we can declare the same Parent class private method in child class also. It is valid but not overriding.

Example:



```
class Parent
{
    private void methodOne()
    {}
}
class Child extends Parent
{
    private void methodOne()
    {}
}
```

Parent class final methods we can't override in the Child class.

17. Example:

18. class Parent {

19. public final void methodOne() {}

20. }

21. class Child extends Parent{

22. public void methodOne(){}

23. }

24. Output:

25. Compile time error:

26. methodOne() in Child cannot override methodOne()

27. in Parent; overridden method is final

Parent class non final methods we can override as final in child class. We can

override native methods in the child classes.

28. We should override Parent class abstract methods in Child classes to provide

implementation.

29. Example:

30. abstract class Parent {

31. public abstract void methodOne();

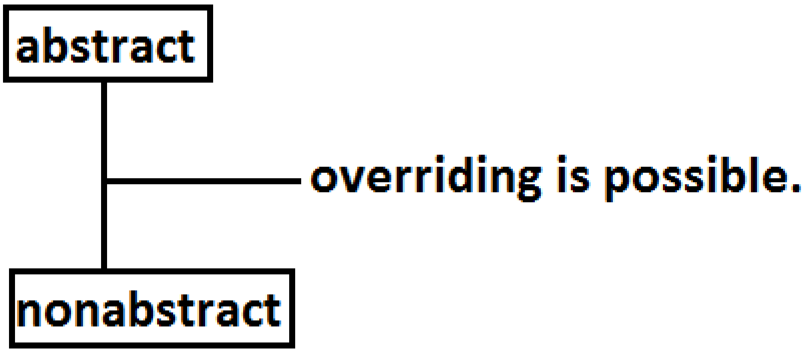
32. }

33. class Child extends Parent {

34. public void methodOne() { }

35. }

Diagram:



36. We can override a non-abstract method as abstract

this approach is helpful to stop availability of Parent method

implementation to

the next level child classes.

37. Example:

38. class Parent {

39. public void methodOne() { }

40. }

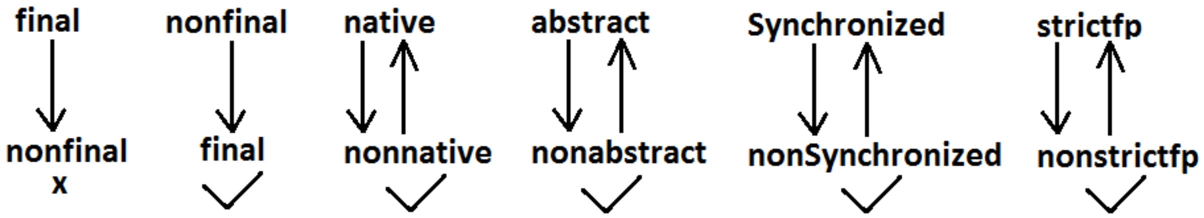
41. abstract class Child extends Parent {

42. public abstract void methodOne();

43. }

Synchronized, strictfp, modifiers won't keep any restrictions on overriding.

Diagram:



44. While overriding we can't reduce the scope of access modifier.

45. Example:

46. class Parent {

47. public void methodOne() { }

48. }

49. class Child extends Parent {

50. protected void methodOne( ) { }

51. }

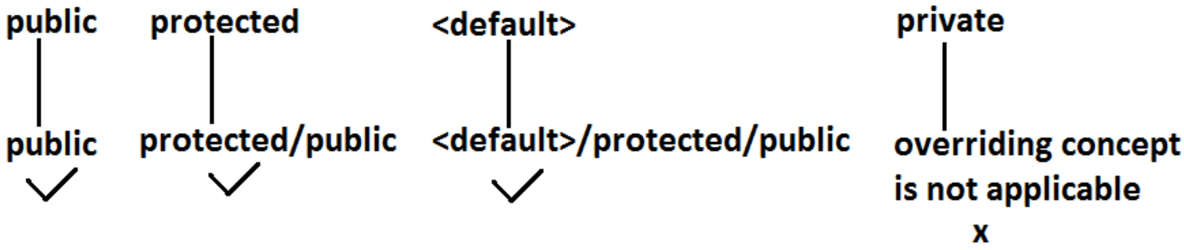
52. Output:

53. Compile time error :

54. methodOne() in Child cannot override methodOne() in Parent;

55. attempting to assign weaker access privileges; was public

Diagram:



private < default < protected < public

Examples :

Overriding with respect to static methods:

Case 1:

We can't override a static method as non static.

Example:

```
class Parent

{

public static void methodOne(){}

//here static methodOne() method is a class level

}

class Child extends Parent

{

public void methodOne(){}

//here methodOne() method is a object level hence

// we can't override methodOne() method

}
```

output :

```
CE: methodOne in Child can't override methodOne() in Parent ;
```

overriden method is static

Case 2:

Similarly we can't override a non static method as static.

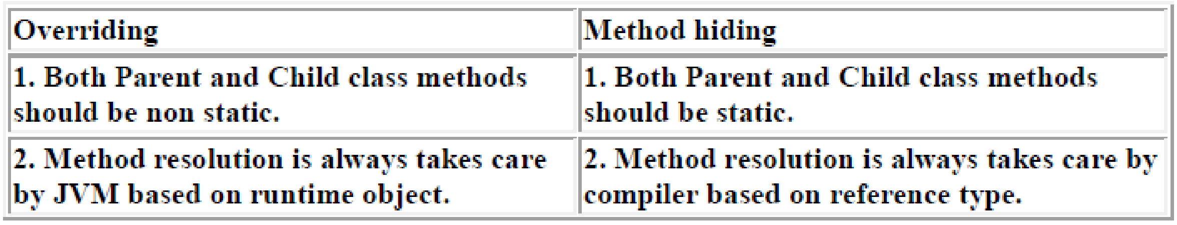
Case 3:

```
class Parent

{

public static void methodOne() {}

}

class Child extends Parent {

public static void methodOne() {}

}
```

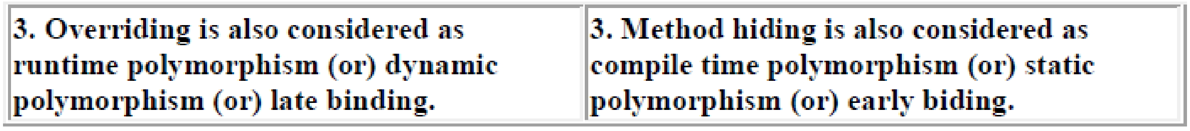
It is valid. It seems to be overriding concept is applicable for static methods but it is not overriding it is method hiding.

METHOD HIDING :

All rules of method hiding are exactly same as overriding except the following differences.



Overriding	Method hiding
1. Both Parent and Child class methods should be non static.	1. Both Parent and Child class methods should be static.
2. Method resolution is always takes care by JVM based on runtime object.	2. Method resolution is always takes care by compiler based on reference type.



3. Overriding is also considered as runtime polymorphism (or) dynamic polymorphism (or) late binding.	3. Method hiding is also considered as compile time polymorphism (or) static polymorphism (or) early biding.

Example:

```
class Parent {

public static void methodOne() {

System.out.println("parent class");

}

}

class Child extends Parent{

public static void methodOne(){

System.out.println("child class");

}

}

class Test{

public static void main(String[] args) {

Parent p=new Parent();

p.methodOne();//parent class

Child c=new Child();
c.methodOne();//child class

Parent p1=new Child();

p1.methodOne();//parent class

}

}
```

Note: If both Parent and Child class methods are non static then it will

become

overriding and method resolution is based on runtime object. In this case

the output is

```
Parent class

Child class

Child class
```

Overriding with respect to Var-arg methods:

A var-arg method should be overridden with var-arg method only. If we are

trying to

override with normal method then it will become overloading but not

overriding.

Example:

```
class Parent {

public void methodOne(int... i){

System.out.println("parent class");
}
}
class Child extends Parent { //overloading but not overriding.
public void methodOne(int i) {
System.out.println("child class");
}
}
class Test {
public static void main(String[] args) {
Parent p=new Parent();
p.methodOne(10);//parent class
Child c=new Child();
c.methodOne(10);//child class
Parent p1=new Child();
p1.methodOne(10);//parent class
}
}
```

In the above program if we replace child class method with var arg then it will become

overriding. In this case the output is

Parent class

Child class

Child class

Overriding with respect to variables:

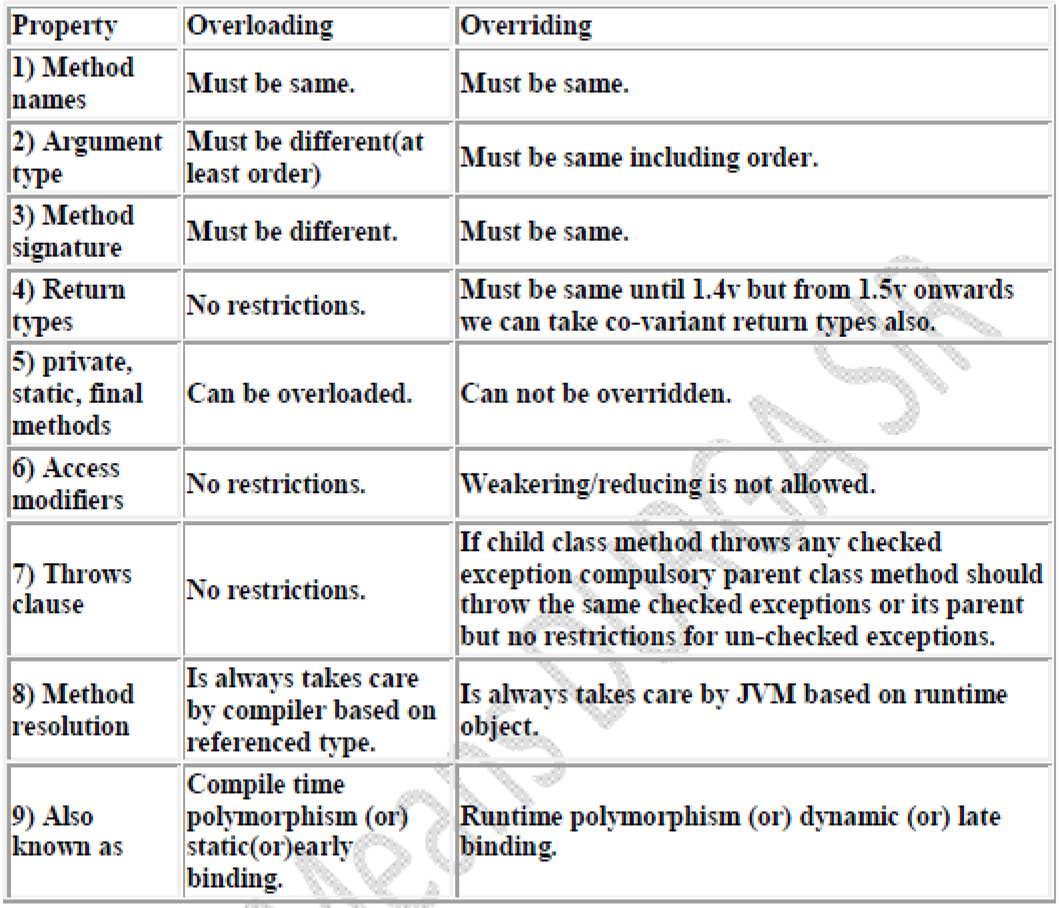
- Overriding concept is not applicable for variables.
- Variable resolution is always takes care by compiler based on reference type.

Example:

```
class Parent
{
int x=888;
}
class Child extends Parent
{
int x=999;
}
class Test
{
public static void main(String[] args)
{
Parent p=new Parent();
System.out.println(p.x);//888
Child c=new Child();
System.out.println(c.x);//999
Parent p1=new Child();
System.out.println(p1.x);//888
}
}
```

Note: In the above program Parent and Child class variables, whether both are static or non static whether one is static and the other one is non static there is no change in the answer.

Differences between overloading and overriding ?



Property	Overloading	Overriding
1) Method names	Must be same.	Must be same.
2) Argument type	Must be different(at least order)	Must be same including order.
3) Method signature	Must be different.	Must be same.
4) Return types	No restrictions.	Must be same until 1.4v but from 1.5v onwards we can take co-variant return types also.
5) private, static, final methods	Can be overloaded.	Can not be overridden.
6) Access modifiers	No restrictions.	Weakering/reducing is not allowed.
7) Throws clause	No restrictions.	If child class method throws any checked exception compulsory parent class method should throw the same checked exceptions or its parent but no restrictions for un-checked exceptions.
8) Method resolution	Is always takes care by compiler based on referenced type.	Is always takes care by JVM based on runtime object.
9) Also known as	Compile time polymorphism (or) static(or)early binding.	Runtime polymorphism (or) dynamic (or) late binding.

Note:

1. In overloading we have to check only method names (must be same) and

arguments (must be different) the remaining things like return type extra

not

required to check.

2. But In overriding we should compulsory check everything like method

names,

arguments, return types, modifiers etc.

Consider the method in parent class

Parent: public void methodOne(int i)throws IOException

In the child class which of the following methods we can take..

1. public void methodOne(int i)//valid(overriding)

2. private void methodOne()throws Exception//valid(overloading)

3. public native void methodOne(int i);//valid(overriding)

4. public static void methodOne(double d)//valid(overloading)

5. public static void methodOne(int i)

Compile time error :

methodOne(int) in Child cannot override methodOne(int) in Parent;

overriding

method is static

6. public static abstract void methodOne(float f)

Compile time error :

1. illegal combination of modifiers: abstract and static

2. Child is not abstract and does not override abstract method

methodOne(float) in Child

IIQ : In how many ways we can create an object ? (or) In

how many ways get an object in java ?

1. By using new Operator :

```
Test t = new Test();
```

3. By using newInstance() :(Reflection Mechanism)

```
Test t=(Test)Class.forName("Test").newInstance();
```

5. By using Clone() :

```
Test t1 = new Test();

Test t2 = (Test)t1.Clone();
```

8. By using Factory methods :

9. Runtime r = Runtime.getRuntime();

10. DateFormat df = DateFormat.getInstance();

11. By using Deserialization :

12. FileInputStream fis = new FileInputStream("abc.ser");

13. ObjectInputStream ois = new ObjectInputStream(fis);

14. Test t = (Test)ois.readObject();

Constructors :

1. Object creation is not enough compulsory we should perform

initialization then

only the object is in a position to provide the response properly.

2. Whenever we are creating an object some piece of the code will be

executed

automatically to perform initialization of an object this piece of the code is

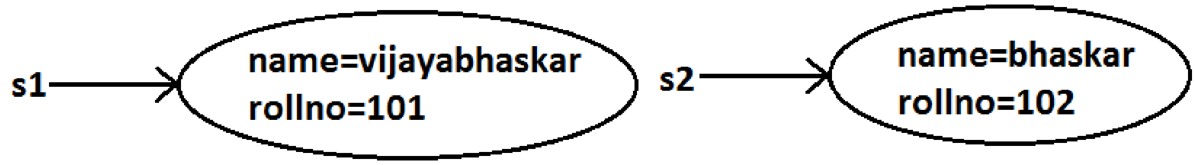
nothing but constructor.

3. Hence the main objective of constructor is to perform initialization of an object.

Example:

```
class Student
{
String name;
int rollno;
Student(String name,int rollno) //Constructor
{
this.name=name;
this.rollno=rollno;
}
public static void main(String[] args)
{
Student s1=new Student("vijayabhaskar",101);
Student s2=new Student("bhaskar",102);
}
}
```

Diagram:



Constructor Vs instance block:

1. Both instance block and constructor will be executed automatically for

every

object creation but instance block 1st followed by constructor.

2. The main objective of constructor is to perform initialization of an object.

3. Other than initialization if we want to perform any activity for every

object

creation we have to define that activity inside instance block.

4. Both concepts having different purposes hence replacing one concept

with

another concept is not possible.

5. Constructor can take arguments but instance block can't take any

arguments

hence we can't replace constructor concept with instance block.

6. Similarly we can't replace instance block purpose with constructor.

Demo program to track no of objects created for a class:

```
class Test

{

static int count=0;
{
count++; //instance block
}
Test()
{}
Test(int i)
{}
public static void main(String[] args)
{
Test t1=new Test();
Test t2=new Test(10);
Test t3=new Test();
System.out.println(count);//3
}
}
```

Rules to write constructors:

1. Name of the constructor and name of the class must be same.

2. Return type concept is not applicable for constructor even void also by mistake if

we are declaring the return type for the constructor we won't get any compile time error and runtime error compiler simply treats it as a method.

3. Example:

4. class Test

5. {

6. void Test() //it is not a constructor and it is a method

7. {}

8. }

9. It is legal (but stupid) to have a method whose name is exactly same as class name.

10. The only applicable modifiers for the constructors are public, default, private, protected.

11. If we are using any other modifier we will get compile time error.

Example:

```
class Test
{
static Test()
{}
}
```

Output:

Modifier static not allowed here

Default constructor:

1. For every class in java including abstract classes also constructor concept

is

applicable.

2. If we are not writing at least one constructor then compiler will generate

default

constructor.

3. If we are writing at least one constructor then compiler won't generate

any

D efault constructor. Hence every class contains either compiler generated

constructor (or) programmer written constructor but not both

simultaneously.

Prototype of default constructor:

1. It is always no argument constructor.

2. The access modifier of the default constructor is same as class modifier.

(This

rule is applicable only for public and default).

3. Default constructor contains only one line. super(); it is a no argument

call to

super class constructor.

Programmers code	Compiler generated code

class Test { }	class Test {
	Test()
	{
	super();
	}
	}

public class Test { }	public class Test {
	public Test()
	{
	super();
	}
	}

class Test
{
void Test(){}
}
	class Test
	{
	Test()
	{
	super();
	}
	void Test()
	{}

	}

class Test
{
Test(int i)
{}
}
	class Test
	{
	Test(int i)
	{
	super();
	}
	}

class Test
{
Test()
{
super();
}
}
	class Test
	{
	Test()
	{
	super();
	}
	}

class Test
{
Test(int i)
{
	class Test
	{
	Test(int i)
	{

this();
}
Test()
{}
}
	this();
	}
	Test()
	{
	super();
	}
	}

super() vs this():

The 1st line inside every constructor should be either super() or this() if we are not writing anything compiler will always generate super().

Case 1: We have to take super() (or) this() only in the 1st line of

constructor. If we are

taking anywhere else we will get compile time error.

Example:

```
class Test
{
Test()
{
System.out.println("constructor");
super();
}
}
```

Output:

Compile time error.

Call to super must be first statement in constructor

Case 2: We can use either super() (or) this() but not both simultaneously.

Example:

```
class Test
{
Test()
{
```

```
super();

this();

}

}
```

Output:

Compile time error.

Call to this must be first statement in constructor

Case 3: We can use super() (or) this() only inside constructor. If we are using anywhere else we will get compile time error.

Example:

```
class Test

{

public void methodOne()

{

super();

}

}
```

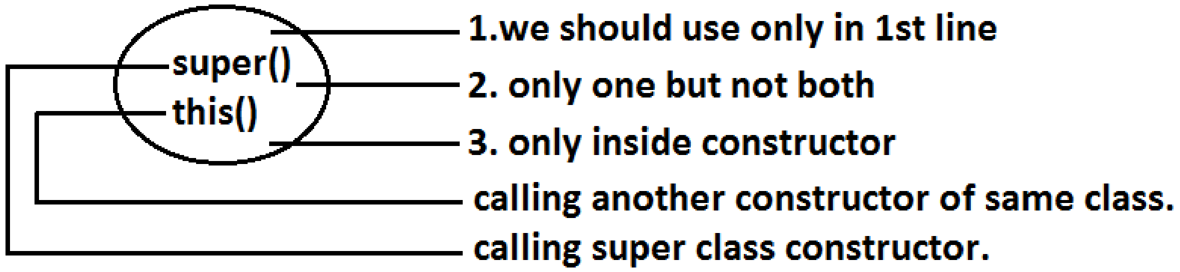
Output:

Compile time error.

Call to super must be first statement in constructor

That is we can call a constructor directly from another constructor only.

Diagram:


super()
this()
1.we should use only in 1st line
2. only one but not both
3. only inside constructor
calling another constructor of same class.
calling super class constructor.

Example:

Super()	

Example:

class Test

{

public static void main(String[] args)

{

System.out.println(super.hashCode());

```
}
}
```

Output:

Compile time error.

Non-static variable super cannot be referenced from a static context.

Overloaded constructors :

A class can contain more than one constructor and all these constructors having the same name but different arguments and hence these constructors are considered as overloaded constructors.

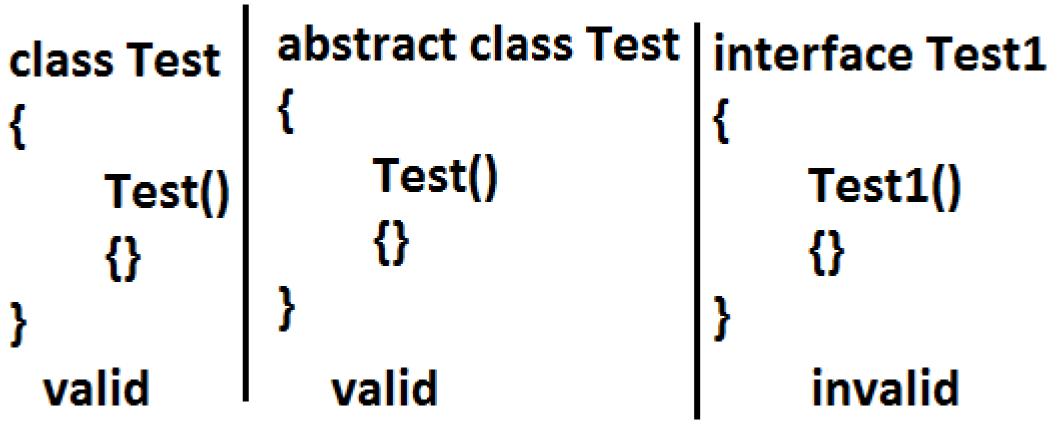
Example:

```
class Test {
Test(double d){
System.out.println("double-argument constructor");
}
Test(int i) {
this(10.5);
System.out.println("int-argument constructor");
}
Test() {
```

```
this(10);

System.out.println("no-argument constructor");

}

public static void main(String[] args) {

Test t1=new Test(); //no-argument constructor/int-argument

//constructor/double-argument constructor

Test t2=new Test(10);

//int-argument constructor/double-argument constructor

Test t3=new Test(10.5);//double-argument constructor

}

}
```

- Parent class constructor by default won't available to the Child. Hence Inheritance concept is not applicable for constructors and hence overriding concept also not applicable to the constructors. But constructors can be overloaded.
- We can take constructor in any java class including abstract class also but we can't take constructor inside interface.

Example:



```
class Test
{
	Test()
	{}
}
  valid
```

```
abstract class Test
{
	Test()
	{}
}
  valid
```

```
interface Test1
{
	Test1()
	{}
}
  invalid
```

We can't create object for abstract class but abstract class can contain

constructor what

is the need ?

Abstract class constructor will be executed for every child class object

creation to

perform initialization of child class object only.

Which of the following statement is true ?

1. Whenever we are creating child class object then automatically parent

class

object will be created.(false)

2. Whenever we are creating child class object then parent class

constructor will be

executed.(true)

Example:

abstract class Parent

{

```
}
Parent()
{
System.out.println(this.hashCode());
//11394033//here this means child class object
}
}
class Child extends Parent
{
Child()
{
System.out.println(this.hashCode());//11394033
}
}
class Test
{
public static void main(String[] args)
{
Child c=new Child();
System.out.println(c.hashCode());//11394033
}
}
```

Case 1: recursive method call is always runtime exception where as

recursive

constructor invocation is a compile time error.

Note:

Recursive functions:

A function is called using two methods (types).

1. Nested call

2. Recursive call

Nested call:

 Calling a function inside another function is called nested call.

 In nested call there is a calling function which calls another

function(called

function).

Example:

```
public static void methodOne()

{

methodTwo();

}

public static void methodTwo()

{

methodOne();
```

}

Recursive call:

 Calling a function within same function is called recursive call.

 In recursive call called and calling function is same.

Example:

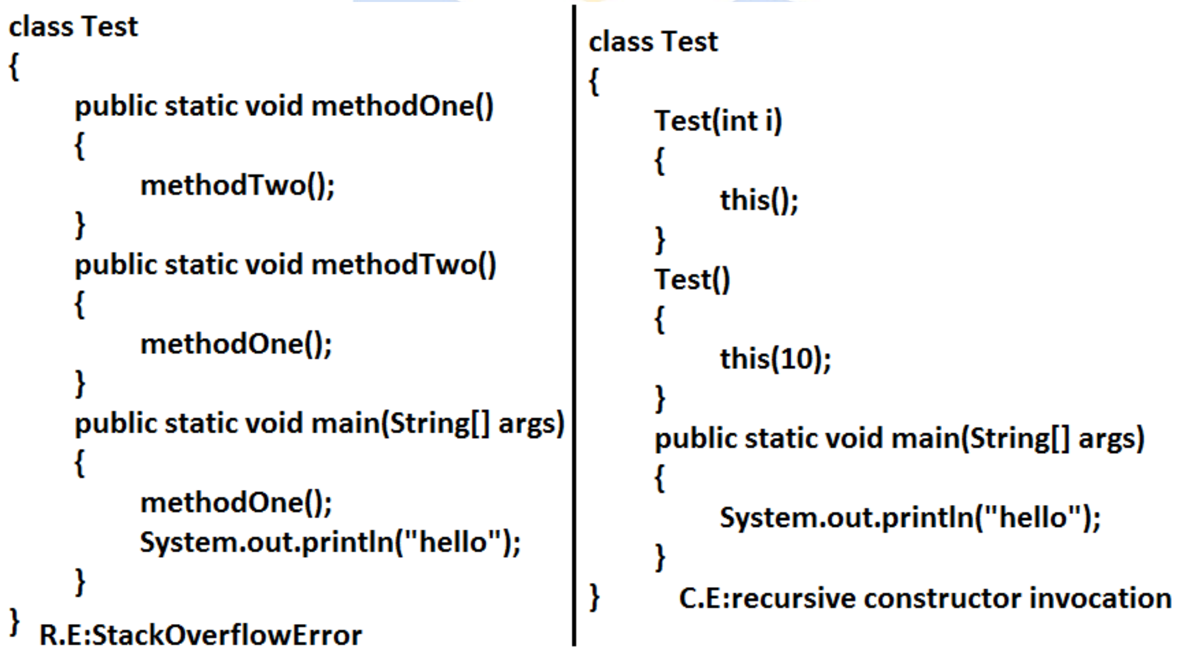
public void methodOne()

{

methodOne();

}

Example:



```
class Test
{
        public static void methodOne()
        {
                methodTwo();
        }
        public static void methodTwo()
        {
                methodOne();
        }
        public static void main(String[] args)
        {
                methodOne();
                System.out.println("hello");
        }
}  R.E:StackOverflowError
```

```
class Test
{
        Test(int i)
        {
                this();
        }
        Test()
        {
                this(10);
        }
        public static void main(String[] args)
        {
                System.out.println("hello");
        }
}     C.E:recursive constructor invocation
```

Note: Compiler is responsible for the following checkings.

1. Compiler will check whether the programmer wrote any constructor or

not. If

he didn't write at least one constructor then compiler will generate default constructor.

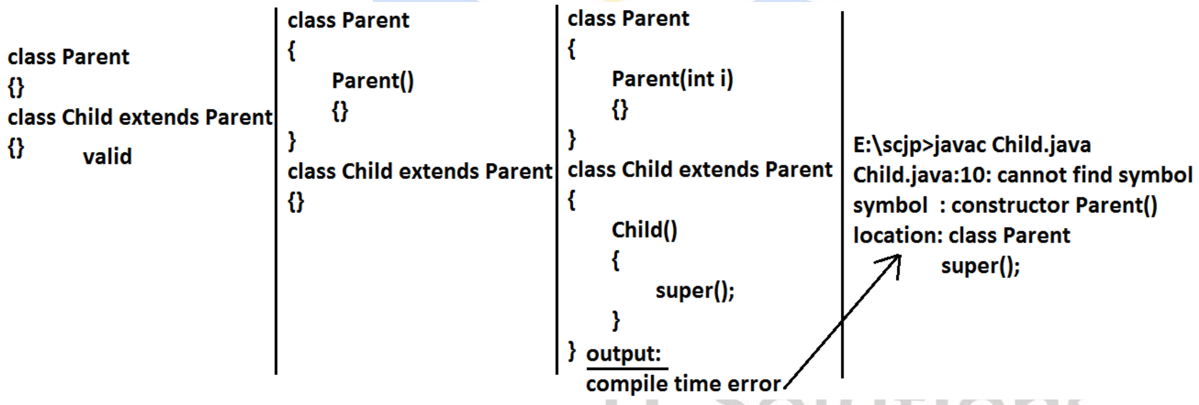
2. If the programmer wrote any constructor then compiler will check whether he

wrote super() or this() in the 1st line or not. If his not writing any of these compiler will always write (generate) super().

3. Compiler will check is there any chance of recursive constructor invocation. If

there is a possibility then compiler will raise compile time error.

Case 2:



```
class Parent
{}
class Child extends Parent
{}        valid
```

```
class Parent
{
      Parent()
      {}
}
class Child extends Parent
{}
```

```
class Parent
{
      Parent(int i)
      {}
}
class Child extends Parent
{
      Child()
      {
            super();
      }
} output:
  compile time error
```

```
E:\scjp>javac Child.java
Child.java:10: cannot find symbol
symbol  : constructor Parent()
location: class Parent
            super();
```

 If the Parent class contains any argument constructors while writing Child

classes we should takes special care with respect to constructors.

 Whenever we are writing any argument constructor it is highly recommended to

write no argument constructor also.

Singleton classes :

For any java class if we are allow to create only one object such type of

class is said to be

singleton class.

Example:

1) Runtime class

2) ActionServlet

3) ServiceLocator

4) BusinessDelegate

Runtime r1=Runtime.getRuntime();

//getRuntime() method is a factory method

Runtime r2=Runtime.getRuntime();

Runtime r3=Runtime.getRuntime();

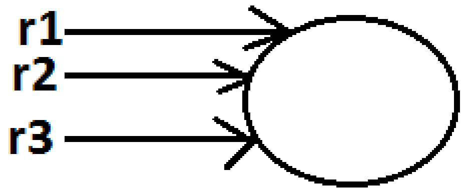
....

....

System.out.println(r1==r2);//true

System.out.println(r1==r3);//true

Diagram:



Advantage of Singleton class :

If the requirement is same then instead of creating a separate object for
every person
we will create only one object and we can share that object for every
required person we
can achieve this by using singleton classes. That is the main advantages of
singleton
classes are Performance will be improved and memory utilization will be
improved.

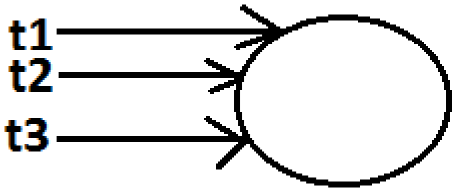
Creation of our own singleton classes:

We can create our own singleton classes for this we have to use private
constructor,
static variable and factory method.

Example:

```
class Test
{
private static Test t=null;
private Test()
{}
public static Test getTest()
//getTest() method is a factory method

{

if(t==null)

{

t=new Test();

}

return t;

}

}

class Client

{

public static void main(String[] args)

{

System.out.println(Test.getTest().hashCode());//1671711

System.out.println(Test.getTest().hashCode());//1671711

System.out.println(Test.getTest().hashCode());//1671711

System.out.println(Test.getTest().hashCode());//1671711

}

}
```

Diagram:



IIQ : We are not allowed to create child class but class is not final , How it is

Possible ?

By declaring every constructor has private.

```
class Parent {
private Parent() {
}
```

We can't create child class for this class

Note : When ever we are creating child class object automatically parent

class

constructor will be executed but parent object won't be created.

```
class Parent {
Parent() {
System.out.println(this.hashCode()); //123
}
}
class Child extends Parent {
Child() {
System.out.println(this.hashCode());//123
```

```
}
}
class Test {
public static void main(String ar[]) {
Child c=new Child();
System.out.println(c.hashCode());//123
```

Which of the following is true ?

1. The name of the constructor and name of the class need not be same.(false)

2. We can declare return type for the constructor but it should be void. (false)

3. We can use any modifier for the constructor. (false)

4. Compiler will always generate default constructor. (false)

5. The modifier of the default constructor is always default. (false)

6. The 1st line inside every constructor should be super always. (false)

7. The 1st line inside every constructor should be either super or this and if we are

not writing anything compiler will always place this().(false)

8. Overloading concept is not applicable for constructor. (false)

9. Inheritance and overriding concepts are applicable for constructors. (false)

10. Concrete class can contain constructor but abstract class cannot. (false)

11. Interface can contain constructor. (false)

12. Recursive constructor call is always runtime exception. (false)

13. If Parent class constructor throws some un-checked exception

compulsory Child

class constructor should throw the same un-checked exception or it's

Parent.

(false)

14. Without using private constructor we can create singleton class. (false)

15. None of the above.(true)

Factory method:

By using class name if we are calling a method and that method returns the

same class

object such type of method is called factory method.

Example:

Runtime r=Runtime.getRuntime();//getRuntime is a factory method.

DateFormat df=DateFormat.getInstance();

If object creation required under some constraints then we can implement

by using

factory method.

Note : When ever we are loading child class autimatically the parent class

will be loaded

but when ever we are loading parent class the child class don't be loaded

automatically.

Static block:

 Static blocks will be executed at the time of class loading hence if we

want to

perform any activity at the time of class loading we have to define that

activity

inside static block.

 With in a class we can take any no. Of static blocks and all these static

blocks will

be executed from top to bottom.

Example:

The native libraries should be loaded at the time of class loading hence we

have to

define that activity inside static block.

Ex 1 : Every JDBC driver class internally contains a static block to register the driver

with DriverManager hence programmer is not responsible to define this explicitly.

Example:

```
class Driver
{
static
{
//Register this driver with DriverManager
}
}
```

IIQ : Without using main() method is it possible to print some statements to the

console?

Ans : Yes, by using static block.

Example:

```
class Google
{
```

```
static

{

System.out.println("hello i can print");

System.exit(0);

}

}
```

Output:

```
Hello i can print
```

IIQ : Without using main() method and static block is it possible to print some statements to the console ?

Example 1:

```
class Test

{

static int i=methodOne();

public static int methodOne()

{

System.out.println("hello i can print");

System.exit(0);

return 10;

}
}
```

Output:

```
Hello i can print
```

Example 2:

```
class Test

{

static Test t=new Test();

Test()

{

System.out.println("hello i can print");

System.exit(0);

}

}
```

Output:

```
Hello i can print
```

Example 3:

```
class Test

{

static Test t=new Test();

{

System.out.println("hello i can print");
System.exit(0);
}
}
```

Output:

```
Hello i can print
```

IIQ : Without using System.out.println() statement is it possible to print some statement to the console ?

Example:

```
class Test
{
public static void main(String[] args)
{
System.err.println("hello");
}
}
```

Note : Without using main() method we can able to print some statement to the console , but this rule is applicable untill 1.6 version from 1.7 version onwards to run java program main() method is mandatory.

```
class Test {

static {

System.out.println("ststic block");

System.exit(0);

}

}
```

It is valid in 1.6 version but invalid or won't run in 1.7 version

Coupling :

The degree of dependency between the components is called coupling.

Example:

```
class A
```

```
{
static int i=B.j;
}
class B extends A
{
static int j=C.methodOne();
}
class C extends B
{
public static int methodOne()
{
return D.k;
}
}
class D extends C
{
static int k=10;
public static void main(String[] args)
{
D d=new D();
}
```

}

The above components are said to be tightly coupled to each other because

the

dependency between the components is more.

Tightly coupling is not a good programming practice because it has several

serious

disadvantages.

1. Without effecting remaining components we can't modify any

component hence

enhancement(development) will become difficult.

2. It reduces maintainability of the application.

3. It doesn't promote reusability of the code.

It is always recommended to maintain loosely coupling between the

components.

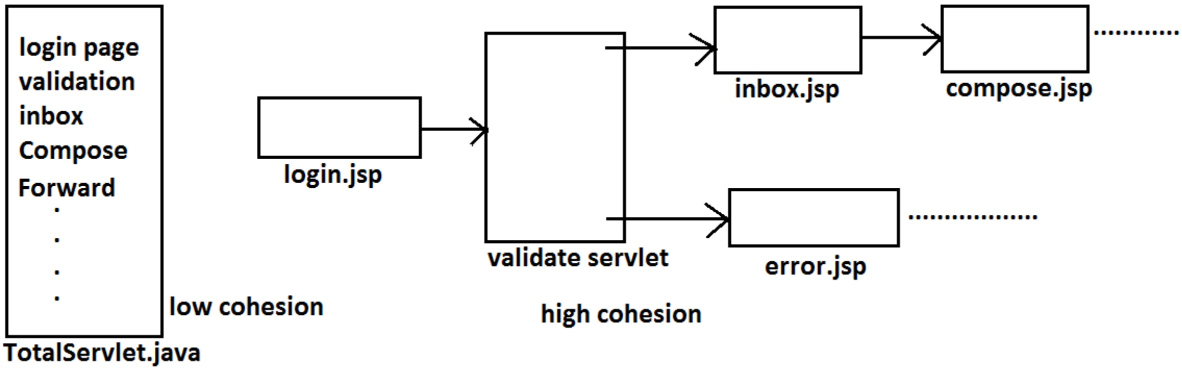
Cohesion:

For every component we have to maintain a clear well defined functionality

such type of

component is said to be follow high cohesion.

Diagram:



High cohesion is always good programming practice because it has several advantages.

1. Without effecting remaining components we can modify any component hence

enhancement will become very easy.

2. It improves maintainability of the application.

3. It promotes reusability of the application.(where ever validation is required we

can reuse the same validate servlet without rewriting)

Note: It is highly recommended to follow loosely coupling and high cohesion.