

MIT WORLD PEACE UNIVERSITY

Object Oriented Programming with Java and C++
Second Year B. Tech, Semester 1

IMPLEMENTATION OF POLYMORPHISM USING C++
AND JAVA

PRACTICAL REPORT

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1 Aim and Objectives

Implementation of Polymorphism using C++ and Java.

2 Problem Statements

2.1 Problem 1 in C++

Write a C++ program with base class Employee and three derived classes namely

- SalariedEmployees
- CommissionEmployees
- HourlyEmployees

Declare calculateSalary() as a pure virtual function in base class and define it in respective derived classes to calculate salary of an employee. The company wants to implement an Object Oriented Application that performs its payroll calculations polymorphically.

2.2 Problem 2 in Java

Define a Class **Shapes** as the Base Class and other :

-

2.3 Problem 3 in Java

Write a java program to create two interfaces Motorbike and Cycle.

- Motorbike interface consists of the attribute speed.
- The method is totalDistance().
- Cycle interface consists of the attributes distance and the method speed().
- These interfaces are implemented by the class TwoWheeler.
- Calculate total distance travelled and Average Speed maintained by Two Wheeler.

3 Theory

3.1 Concept of Inheritance and its types

Inheritance is a process in which one object acquires all the properties and behaviors of its parent object automatically. In such way, you can *reuse, extend, or modify* the attributes and behaviors which are defined in other class.

In C++, the class which inherits the members of another class is called derived class and the class whose members are inherited is called base class. The derived class is the specialized class for the base class. Most ideas of inheritance are directly applicable in Java as well.

3.1.1 Advantages

1. Minimizing duplicate code: Key benefits of Inheritance include minimizing the identical code as it allows sharing of the common code among other subclasses.
2. Flexibility: Inheritance makes the code flexible to change, as you will adjust only in one place, and the rest of the code will work smoothly.
3. Overriding: With the help of Inheritance, you can override the methods of the base class.
4. Data Hiding: The base class in Inheritance decides which data to be kept private, such that the derived class will not be able to alter it.

3.1.2 Types of Inheritance

1. Single inheritance : It is defined as the inheritance in which a derived class is inherited from the only one base class.
2. Multiple inheritance : It is the process of deriving a new class that inherits the attributes from two or more classes.
3. Hierarchical inheritance : When one class inherits another class which is further inherited by another class, it is known as multi level inheritance in C++. Inheritance is transitive so the last derived class acquires all the members of all its base classes.
4. Multilevel inheritance: It is a process of deriving a class from another derived class.
5. Hybrid inheritance : Any legal combination of any of the above inheritance techniques would be known as hybrid inheritance.

Let us Look an Examples of these.

```
1  class A
2  {
3      // Base Class
4  };
5
6  class D
7  {
8      // Base Class 2
9  }
10 class B : public A
11 {
12     // Single Inheritance
13 }
14 class C : public B
15 {
16     // Multi Level Inheritance
17 }
18 class E : public A, public D
19 {
20     // Multiple Inheritance
21 }
22 class F : public E, private D
23 {
24     // hierarchical inheritance
25 }
```

3.1.3 Base class and Derived Class Constructors

Whenever we create an object of a class, the default constructor of that class is invoked automatically to initialize the members of the class.

If we inherit a class from another class and create an object of the derived class, it is clear that the default constructor of the derived class will be invoked but before that the default constructor of all of the base classes will be invoked, i.e the order of invocation is that the base class's default constructor will be invoked first and then the derived class's default constructor will be invoked.

When a class is inherited from other, The data members and member functions of base class comes automatically in derived class based on the access specifier but the definition of these members exists in base class only. So when we create an object of derived class, all of the members of derived class must be initialized but the inherited members in derived class can only be initialized by the base class's constructor as the definition of these members exists in base class only.

This is why the constructor of base class is called first to initialize all the inherited members.

Let us see an Example

```
1
2 // base class
3 class Parent
4 {
5     public:
6
7     // base class constructor
8     Parent()
9     {
10         cout << "Inside base class" << endl;
11     }
12 };
13
14 // sub class
15 class Child : public Parent
16 {
17     public:
18
19     //sub class constructor
20     Child()
21     {
22         cout << "Inside sub class" << endl;
23     }
24 };
25
26 // main function
27 int main() {
28
29     // creating object of sub class
30     Child obj;
31
32     return 0;
33 }
34
```

Output would be

Inside base class

Inside sub class

4 Platform

Operating System: Arch Linux x86-64

IDEs or Text Editors Used: Visual Studio Code

Compilers : g++ and gcc on linux for C++, and javac, with JDK 18.0.2 for Java

5 Input

For C++

1. Number of Each Type of Employee
2. Name, Age, Address City, and Salary of Each Employee

For Java

1. The Information and Salary about the Full Time Employee
2. The Information and Salary of the Intern Employee
3. Speed, Time and Distance

6 Output

For C++

1. General Information about Each Employee
2. The Gross Salary of Each Employee
3. The Net Salary of Each Employee

For Java

1. The General information about the Full time and the Intern Employee
2. The Hiked salaries of both the Intern Employee, and the Full Time Employee.
3. Speed and Distance.

7 Code

7.1 Java Implementation of Problem 2

```
1 package assignment_2;
2 import java.util.Scanner;
3
4 class Employee
5 {
6     Scanner input = new Scanner(System.in);
7     String name;
8     int emp_id;
9     double salary;
10    int hike = 0;
11
12    final static int full_time_hike_perc = 100;
13    final static int intern_hike_perc = 50;
14
15    void accept()
16    {
17        System.out.println("Enter the Employee Name");
18        name = input.next();
19        System.out.println("Enter The Employee ID");
20        emp_id = input.nextInt();
21        System.out.println("Enter The Employee Salary");
22        salary = input.nextInt();
23    }
24
25    void display_salary()
26    {
27        System.out.println("The Employee Name is: " + name);
28        System.out.println("The Employee ID is: " + emp_id);
29    }
30 }
```

Listing 1: Employee.java

```
1 package assignment_2;
2
3 class InternEmployee extends Employee {
4     double hiked_salary = 0;
5
6     void calculate_salary() {
7         hiked_salary = salary + salary * (full_time_hike_perc / 100);
8     }
9
10    @Override
11    void display_salary() {
12        super.display_salary();
13        System.out.println("The Salary Before the Hike for this Intern Employee is
: " + salary);
14        calculate_salary();
15        System.out.println("The Salary after the Hike for this Intern Employee is
: " + hiked_salary);
16    }
17 }
```

Listing 2: Intern Employee.java

```
1 package assignment_2;
2
3 class FullTimeEmployee extends Employee {
4     double hiked_salary = 0;
5
6     void calculate_salary() {
7         hiked_salary = salary + salary * (full_time_hike_perc / 100);
8     }
9
10    @Override
11    void display_salary() {
12        super.display_salary();
13        System.out.println("The Salary Before the Hike for this Full time Employee
14        is: " + salary);
15        calculate_salary();
16        System.out.println("The Salary after the Hike for this Full time Employee
17        is : " + hiked_salary);
18    }
19 }
```

Listing 3: Full Time Employee.java

```
1 package assignment_2;
2
3 import java.util.Scanner;
4
5 class Main {
6     public static void main(String args[]) {
7         System.out.println("Welcome to Salary Hiking Program");
8         Employee emp = new Employee();
9         FullTimeEmployee full_time_emp = new FullTimeEmployee();
10        System.out.println("Enter the Details about the Full Time Employee: \n");
11        full_time_emp.accept();
12        full_time_emp.display_salary();
13        InternEmployee intern_emp = new InternEmployee();
14        System.out.println("Enter the Details about the Intern Employee: \n");
15        intern_emp.accept();
16        intern_emp.display_salary();
17    }
18 }
```

Listing 4: Main.java

7.1.1 Java Output for Problem 2

```
1 Welcome to Salary Hiking Program
2 Enter the Details about the Full Time Employee:
3
4 Enter the Employee Name
5 Tony
6 Enter The Employee ID
7 1001
8 Enter The Employee Salary
9 100000
10 The Employee Name is: Tony
11 The Employee ID is: 1001
12 The Salary Before the Hike for this Full time Employee is: 100000.0
13 The Salary after the Hike for this Full time Employee is : 200000.0
14 Enter the Details about the Intern Employee:
```



```
15
16 Enter the Employee Name
17 Steve
18 Enter The Employee ID
19 1002
20 Enter The Employee Salary
21 50000
22 The Employee Name is: Steve
23 The Employee ID is: 1002
24 The Salary Before the Hike for this Intern Employee is: 50000.0
25 The Salary after the Hike for this Intern Employee is : 100000.0
```

Listing 5: Java Output for Problem 2

7.2 Java Implementation of Problem 3 using Interfaces

```
1 package assignment_2b;
2
3 import java.util.Scanner;
4
5 public class TwoWheeler implements Motorcycle, Cycle {
6     public int speed = 0;
7     public int time = 0;
8     public int total_distance = 0;
9
10    @Override
11    public void speed() {
12        System.out.println(total_distance / time);
13    }
14
15    @Override
16    public void totalDistance() {
17        System.out.println(speed * time);
18    }
19 }
```

Listing 6: Two Wheeler.java

```
1 package assignment_2b;
2
3 public interface Motorcycle {
4     public abstract void totalDistance();
5 }
```

Listing 7: Motorcycle.java

```
1 package assignment_2b;
2
3 public interface Cycle {
4     public abstract void speed();
5 }
```

Listing 8: Cycle.java

```
1 package assignment_2b;
2
3 import java.util.Scanner;
4
```

```
5 public class Main {
6
7     public static void main(String args[]) {
8         Scanner input = new Scanner(System.in);
9         TwoWheeler obj = new TwoWheeler();
10
11         System.out.println("Calculating Speed: ");
12         System.out.println("Enter the Distance Travelled by Your 2 Wheeler: ");
13         obj.total_distance = input.nextInt();
14
15         System.out.println("Enter the Time you Travelled on Your 2 Wheeler: ");
16         obj.time = input.nextInt();
17
18         System.out.println("The Speed is: ");
19         obj.speed();
20
21         System.out.println("Calculating Total Distance: ");
22         System.out.println("Enter the Speed of Your 2 Wheeler: ");
23         obj.speed = input.nextInt();
24
25         System.out.println("Enter the Time you Travelled on Your 2 Wheeler: ");
26         obj.time = input.nextInt();
27
28         System.out.println("The Total Distance is: ");
29         obj.totalDistance();
30     }
31 }
```

Listing 9: Main.java

7.2.1 Java Output

```
1 Calculating Speed:
2 Enter the Distance Travelled by Your 2 Wheeler:
3 50
4 Enter the Time you Travelled on Your 2 Wheeler:
5 2
6 The Speed is:
7 25
8 Calculating Total Distance:
9 Enter the Speed of Your 2 Wheeler:
10 25
11 Enter the Time you Travelled on Your 2 Wheeler:
12 2
13 The Total Distance is:
14 50
```

Listing 10: Java Output for Program 3

7.3 C++ Implementation

```
1 #include <iostream>
2 using namespace std;
3
4 class Employee
5 {
6
7 protected:
```

```
8     static int ssn;
9     int emp_id = 1000;
10    int age = 0;
11    double basic_sal = 0, da = 0, ta = 0, gross_sal = 0, net_sal = 0;
12    string address_city, position, name;
13
14 public:
15     // Default Constructor
16     Employee()
17     {
18         cout << "The Default Constructor was called" << endl;
19     }
20
21     // Parameterized Constructor
22     Employee(int e, int a, string add, string nam)
23     {
24         cout << "Parameterized constructor was called\n";
25         emp_id = e;
26         age = a;
27         address_city = add;
28         name = nam;
29     }
30
31     // Copy Constructor
32     Employee(Employee &E)
33     {
34         cout << "Copy Constructor was called" << endl;
35         emp_id = E.emp_id;
36         age = E.age;
37         address_city = E.address_city;
38         name = E.name;
39     }
40
41     void display()
42     {
43         Employee::ssn++;
44         cout << "Employee ssn is:" << ssn << endl;
45         cout << "Employee ID is : " << emp_id << endl;
46         cout << "Employee Name: " << name << endl;
47         cout << "Employee Age: " << age << endl;
48         cout << "Employee Address City: " << address_city << endl;
49     }
50
51     void accept()
52     {
53         cout << "Enter the Employee ID: " << endl;
54         cin >> emp_id;
55         cout << "Enter the Employee Name: " << endl;
56         cin >> name;
57         cout << "Enter the Employee Age: " << endl;
58         cin >> age;
59         cout << "Enter the Employee Address City: " << endl;
60         cin >> address_city;
61     }
62
63     // Destructor
64     ~Employee()
65     {
66         cout << "The Destructor was called" << endl;
```

```
67     }
68 };
69
70 int Employee::ssn = 1000;
71
72 class Programmer : public Employee
73 {
74
75 protected:
76     double da = 0, hra = 0, pf = 0, scf = 0;
77
78 public:
79     void calc_gross_sal()
80     {
81         da = 0.97 * basic_sal;
82         hra = basic_sal;
83         pf = basic_sal;
84         scf = basic_sal;
85         gross_sal = da + hra + pf + scf + basic_sal;
86     }
87
88     void calc_net_sal()
89     {
90         // Reducing Income Taxes
91         net_sal = gross_sal - (0.15) * gross_sal;
92     }
93
94     void accept()
95     {
96         Employee::accept();
97         cout << "Enter the basic Salary of the Programmer : " << endl;
98         cin >> basic_sal;
99         calc_gross_sal();
100        calc_net_sal();
101    }
102
103    void display()
104    {
105        Employee::display();
106        cout << "The Gross Salary is: " << gross_sal << endl;
107        cout << "The Net Salary is: " << net_sal << endl;
108    }
109 };
110
111 class TeamLeader : public Employee
112 {
113
114 protected:
115     double da = 0, hra = 0, pf = 0, scf = 0;
116
117 public:
118     void calc_gross_sal()
119     {
120         da = 0.97 * basic_sal;
121         hra = basic_sal;
122         pf = basic_sal;
123         scf = basic_sal;
124         gross_sal = da + hra + pf + scf + basic_sal;
125     }
```

```
126
127     void calc_net_sal()
128     {
129         // Reducing Income Taxes
130         net_sal = gross_sal - (0.15) * gross_sal;
131     }
132
133     void accept()
134     {
135         Employee::accept();
136         cout << "Enter the basic Salary of the Team Leader : " << endl;
137         cin >> basic_sal;
138         calc_gross_sal();
139         calc_net_sal();
140     }
141
142     void display()
143     {
144         Employee::display();
145         cout << "The Gross Salary is: " << gross_sal << endl;
146         cout << "The Net Salary is: " << net_sal << endl;
147     }
148 };
149
150 class AssistantProjectManager : public Employee
151 {
152
153     protected:
154         double da = 0, hra = 0, pf = 0, scf = 0;
155
156     public:
157         void calc_gross_sal()
158         {
159             da = 0.97 * basic_sal;
160             hra = basic_sal;
161             pf = basic_sal;
162             scf = basic_sal;
163             gross_sal = da + hra + pf + scf + basic_sal;
164         }
165
166         void calc_net_sal()
167         {
168             // Reducing Income Taxes
169             net_sal = gross_sal - (0.15) * gross_sal;
170         }
171
172         void accept()
173         {
174             Employee::accept();
175             cout << "Enter the basic Salary of the Assistant Project Manager : " <<
endl;
176             cin >> basic_sal;
177             calc_gross_sal();
178             calc_net_sal();
179         }
180
181         void display()
182         {
183             Employee::display();
```

```
184         cout << "The Gross Salary is: " << gross_sal << endl;
185         cout << "The Net Salary is: " << net_sal << endl;
186     }
187 };
188
189 class ProjectManager : public Employee
190 {
191
192 protected:
193     double da = 0, hra = 0, pf = 0, scf = 0;
194
195 public:
196     void calc_gross_sal()
197     {
198         da = 0.97 * basic_sal;
199         hra = basic_sal;
200         pf = basic_sal;
201         scf = basic_sal;
202         gross_sal = da + hra + pf + scf + basic_sal;
203     }
204
205     void calc_net_sal()
206     {
207         // Reducing Income Taxes
208         net_sal = gross_sal - (0.15) * gross_sal;
209     }
210
211     void accept()
212     {
213         Employee::accept();
214         cout << "Enter the basic Salary of the Project Manager : " << endl;
215         cin >> basic_sal;
216         calc_gross_sal();
217         calc_net_sal();
218     }
219
220     void display()
221     {
222         Employee::display();
223         cout << "The Gross Salary is: " << gross_sal << endl;
224         cout << "The Net Salary is: " << net_sal << endl;
225     }
226 };
227
228 int main()
229 {
230     cout << "Welcome to Employee Payroll Management System" << endl
231         << endl;
232
233     int choice = 1, number = 1;
234
235     do
236     {
237         cout << "\n\nWhose Details do you wanna enter? " << endl;
238         cout << "1. Programmer\n2. Team Leader\n3. Assistant Project Manager\n4.
Project Manager\n5. Quit\n";
239         cin >> choice;
240
241         if (choice == 1)
```

```
242     {
243         cout << "How many Programmers are we talking? ";
244         cin >> number;
245         Programmer pr[number];
246         for (int i = 0; i < number; i++)
247         {
248             cout << "Enter the Information about the Programmer" << endl;
249             pr[i].accept();
250         }
251         cout << "\nHere is their Information and their Pay Slips" << endl;
252         cout << endl
253              << endl;
254
255         cout << "Programmer" << endl;
256
257         for (int i = 0; i < number; i++)
258         {
259             cout << "Info and Pay Slip of Programmer " << i + 1 << endl;
260             pr[i].display();
261             cout << endl;
262         }
263     }
264     else if (choice == 2)
265     {
266         cout << "How many Team Leaders are we talking? ";
267         cin >> number;
268         TeamLeader tl[number];
269         for (int i = 0; i < number; i++)
270         {
271             cout << "Enter the Information about the Team Leader " << i + 1 <<
272     endl;
273             tl[i].accept();
274         }
275         cout << "Here is their Information and their Pay Slips" << endl;
276         cout << endl
277              << endl;
278         for (int i = 0; i < number; i++)
279         {
280             cout << "Info and Pay Slip of Team Leader " << i + 1 << endl;
281             tl[i].display();
282             cout << endl;
283         }
284         cout << endl
285              << endl;
286     }
287     else if (choice == 3)
288     {
289         cout << "How many Assistant Project Managers are we talking? ";
290         cin >> number;
291         AssistantProjectManager ap[number];
292         for (int i = 0; i < number; i++)
293         {
294             cout << "Enter the Information about the Assitant Project Manager
295     " << i + 1 << endl;
296             ap[i].accept();
297         }
298         cout << "Here is their Information and their Pay Slips" << endl;
299         cout << endl
300              << endl;
```

```
299         for (int i = 0; i < number; i++)
300         {
301             cout << "Info and Pay Slip of Assitant Project Manager " << i + 1
302             << endl;
303             ap[i].display();
304             cout << endl;
305         }
306         cout << endl
307         << endl;
308     }
309     else if (choice == 4)
310     {
311         cout << "How many Project Managers are we talking? ";
312         cin >> number;
313         ProjectManager pm[number];
314         for (int i = 0; i < number; i++)
315         {
316             cout << "Enter the Information about the Project Manager " << i +
317             1 << endl;
318             pm[i].accept();
319         }
320         cout << "Here is their Information and their Pay Slips" << endl;
321         cout << endl
322         << endl;
323         for (int i = 0; i < number; i++)
324         {
325             cout << "Info and Pay Slip of Project Manager " << i + 1 << endl;
326             pm[i].display();
327             cout << endl;
328         }
329     } while (choice != 5);
330
331     return 0;
332 }
```

Listing 11: Main.Cpp

7.3.1 C++ Input and Output

```
1
2 Welcome to Employee Payroll Management System
3
4 Whose Details do you wanna enter?
5 1. Programmer
6 2. Team Leader
7 3. Assistant Project Manager
8 4. Project Manager
9 5. Quit
10 1
11 How many Programmers are we talking? 1
12 The Default Constructor was called
13 Enter the Information about the Programmer
14 Enter the Employee ID:
15 1001
16 Enter the Employee Name:
17 Tony
18 Enter the Employee Age:
```


OOPJC Assignment 3

```
19 45
20 Enter the Employee Address City:
21 Berlin
22 Enter the basic Salary of the Programmer :
23 450000
24
25 Here is their Information and their Pay Slips
26
27
28 Programmer
29 Info and Pay Slip of Programmer 1
30 Employee ssn is:1001
31 Employee ID is : 1001
32 Employee Name: Tony
33 Employee Age: 45
34 Employee Address City: Berlin
35 The Gross Salary is: 2.2365e+06
36 The Net Salary is: 1.90102e+06
37
38 The Destructor was called
39
40
41 Whose Details do you wanna enter?
42 1. Programmer
43 2. Team Leader
44 3. Assistant Project Manager
45 4. Project Manager
46 5. Quit
47 2
48 How many Team Leaders are we talking? 1
49 The Default Constructor was called
50 Enter the Information about the Team Leader 1
51 Enter the Employee ID:
52 1002
53 Enter the Employee Name:
54 Steve
55 Enter the Employee Age:
56 80
57 Enter the Employee Address City:
58 Queens
59 Enter the basic Salary of the Team Leader :
60 70000
61 Here is their Information and their Pay Slips
62
63
64 Info and Pay Slip of Team Leader 1
65 Employee ssn is:1002
66 Employee ID is : 1002
67 Employee Name: Steve
68 Employee Age: 80
69 Employee Address City: Queens
70 The Gross Salary is: 347900
71 The Net Salary is: 295715
72
73
74
75 The Destructor was called
76
77
```

OOPJC Assignment 3

```
78 Whose Details do you wanna enter?
79 1. Programmer
80 2. Team Leader
81 3. Assistant Project Manager
82 4. Project Manager
83 5. Quit
84 3
85 How many Assistant Project Managers are we talking? 1
86 The Default Constructor was called
87 Enter the Information about the Assitant Project Manager 1
88 Enter the Employee ID:
89 1003
90 Enter the Employee Name:
91 Caulson
92 Enter the Employee Age:
93 60
94 Enter the Employee Address City:
95 Delhi
96 Enter the basic Salary of the Assistant Project Manager :
97 60000
98 Here is their Information and their Pay Slips
99
100
101 Info and Pay Slip of Assitant Project Manager 1
102 Employee ssn is:1003
103 Employee ID is : 1003
104 Employee Name: Caulson
105 Employee Age: 60
106 Employee Address City: Delhi
107 The Gross Salary is: 298200
108 The Net Salary is: 253470
109
110
111
112 The Destructor was called
113
114
115 Whose Details do you wanna enter?
116 1. Programmer
117 2. Team Leader
118 3. Assistant Project Manager
119 4. Project Manager
120 5. Quit
121 4
122 How many Project Managers are we talking? 1
123 The Default Constructor was called
124 Enter the Information about the Project Manager 1
125 Enter the Employee ID:
126 1005
127 Enter the Employee Name:
128 Fury
129 Enter the Employee Age:
130 56
131 Enter the Employee Address City:
132 Pune
133 Enter the basic Salary of the Project Manager :
134 600000
135 Here is their Information and their Pay Slips
136
```

```
137
138 Info and Pay Slip of Project Manager 1
139 Employee ssn is:1004
140 Employee ID is : 1005
141 Employee Name: Fury
142 Employee Age: 56
143 Employee Address City: Pune
144 The Gross Salary is: 2.982e+06
145 The Net Salary is: 2.5347e+06
146
147 The Destructor was called
148
149
150 Whose Details do you wanna enter?
151 1. Programmer
152 2. Team Leader
153 3. Assistant Project Manager
154 4. Project Manager
155 5. Quit
156 5
```

Listing 12: C++ Output

8 Conclusion

Thus, learned to use reusability by applying concept of inheritance, interfaces and implemented solution of the given problem statement using C++ and Java.

9 FAQs

1. Discuss ambiguity arises in multipath inheritance and how it is to be avoided in C++?

In *multiple* inheritances, when one class is derived from two or more base classes then there may be a possibility that the base classes have functions with the same name, and the derived class may not have functions with that name as those of its base classes.

If the derived class object needs to access one of the similarly named member functions of the base classes then it results in ambiguity because the compiler gets confused about which base's class member function should be called.

To solve this ambiguity scope resolution operator is used denoted by ' :: '

The Syntax to use it is:

```
1      ObjectName.ClassName::FunctionName();
2
```

An Example:

```
1  // C++ program to resolve inheritance
2  // ambiguity
3
4  #include<iostream>
5  using namespace std;
6
7  // Base class A
8
9  class A {
10     public:
11
12     void func() {
13         cout << " I am in class A" << endl;
14     }
15 };
16
17 // Base class B
18
19 class B {
20     public:
21
22     void func() {
23         cout << " I am in class B" << endl;
24     }
25 };
26
27 // Derived class C
28 class C: public A, public B {
29
30
31 };
```

```
32
33 // Driver Code
34
35 int main() {
36
37     // Created an object of class C
38     C obj;
39
40     // Calling function func() in class A
41     obj.A::func();
42
43     // Calling function func() in class B
44     obj.B::func();
45
46     return 0;
47 }
48
49
```

2. What's the difference between public, private, and protected?

public, *private*, and *protected* are known as access modifiers. Like their name suggests, they modify the access given to objects and subclasses.

- (a) If you do class child : **private** parent; then every private data member becomes inaccessible, coz anyway that's what should happen, then the protected data members become private, and public data members also become private.
- (b) If you do class child : **protected** parent; then it's the same thing, except you still can't access private variables, but protected and public data members become protected.
- (c) Same with class child : **public** parent; everything remains unchanged. The objects will behave in accordance with the usual laws of objects.

3. Why can't derived class access private things from base class?:

The **private** access modifier, when used in any class, by its definition restricts sub classes and its objects to access variables declared in its scope. As a result, derived classes can not access the private variables defined in the base class.

```
1     class A
2     {
3         private:
4             int a;
5     };
6     class B: public A
7     {
8
9     }obj;
10    int main()
11    {
12        A.a // not accessible
13    }
14
```

4. Explain use of 'super' keyword with suitable example

The *super* keyword in Java refers to the parent class's variables and functions. Whenever you create the instance of subclass, an instance of parent class is created implicitly which is referred by super reference variable.

- *super* can be used to refer immediate parent class instance variable.
- *super* can be used to invoke immediate parent class method.
- *super()* can be used to invoke immediate parent class constructor.

5. Why to use concept of interface in Java

An **Interface** in Java programming language is defined as an abstract type used to specify the behavior of a class. An interface in Java is a blueprint of a class. A Java interface contains static constants and abstract methods.

The interface in Java is a mechanism to achieve abstraction. There can be only abstract methods in the Java interface, not the method body. It is used to achieve abstraction and multiple inheritance in Java. In other words, you can say that interfaces can have abstract methods and variables. It cannot have a method body. Java Interface also represents the IS-A relationship.

Like a class, an interface can have methods and variables, but the methods declared in an interface are by default abstract (only method signature, no body).

- **Provides Communication** - One of the uses of the interface is to provide communication. Through interface you can specify how you want the methods and fields of a particular type.
- **Multiple Inheritance** - Java doesn't support multiple inheritance, using interfaces you can achieve multiple inheritance.
- **Abstraction**- Abstraction is a process of hiding the implementation details from the user, only the functionality will be provided to the user. In other words, the user will have the information on what the object does instead of how it does it.
Since all the methods of the interface are abstract and user doesn't know how a method is written except the method signature/prototype. Using interfaces, you can achieve (complete) abstraction.
- **Loose Coupling** : Coupling refers to the dependency of one object type on another, if two objects are completely independent of each other and the changes done in one doesn't affect the other both are said to be loosely coupled. You can achieve loose coupling in Java using interfaces