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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Contents

1 Aim and Objectives

Aim

Implementation of Polymorphism using C++ and Java.

Objectives

1. To understand the use of pure virtual funcitons.
2. To understnad implantation of compile time and run time polymorphism.
3. To learn implementation ofmethod overriding in 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 that can find the area of the following :

- Circle
- Square
- Rectangle

Find the area of these shapes using construtor overloading and method overloading.

2.3 Probelm 3 in Java

Create a Parent Class Hillstations with the methods location() and famousfor(). Create three subclasses by Hill Station names. These subclasses must extend the superclass and override its methods location() and famousfor(). It should refer to the base class object and the base class method overrides the superclass method, and the base class method is invoked at runtime.

3 Theory

3.1 Concept of Compile time Polymorphism

3.2 Concept of Run Time Polymorphism

3.3 Use of Pure Virtual Functions

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 Side of the Square
2. The Radius of the Circle
3. The Length and Breadth of the Rectangle.

6 Output

For C++

1. General Information about Each Employee
2. The Weekly, hourly and commisioned Salary for Respective Employees.

For Java

1. The Area of the Shapes
2. The Location of the Hill Stations
3. The Reason the Hill stations are Famous for.

7 Code

7.1 C++ Implementation

```cpp
// Polymorphism
// Virtual Functionss, overriding functions, and overloading functions.

#include <iostream>
using namespace std;

class Employee
{
public:
    // static int ssn;
    int emp_id = 1000;
    int age = 0;
    double basic_sal = 0, da = 0, ta = 0, gross_sal = 0, net_sal = 0;
    string address_city, position, name;

    virtual void calculate_salary() = 0;

    void display()
    {
        // ssn++;
        // cout << "Employee ssn is:" << ssn << endl;
        cout << "Employee ID is : " << emp_id << endl;
        cout << "Employee Name: " << name << endl;
        cout << "Employee Age: " << age << endl;
        cout << "Employee Address City: " << address_city << endl;
    }

    void accept()
    {
        cout << "Enter the Employee ID: " << endl;
        cin >> emp_id;
        cout << "Enter the Employee Name: " << endl;
        cin >> name;
        cout << "Enter the Employee Age: " << endl;
        cin >> age;
        cout << "Enter the Employee Address City: " << endl;
        cin >> address_city;
    }

    // Destructor
    ~Employee()
    {
        cout << "The Destructor was called" << endl;
    }
};
class SalariedEmployee : public Employee
{
public:
    int weekly_salary;
    int net_sal;
    void accept()
    {
        Employee::accept();
        cout << "Enter the Wage: ";
        cin >> weekly_salary;
    }

    void calculate_salary()
    {
        cout << "Calculating Salary of Salaried Employee" << endl;
        net_sal = weekly_salary * 7;
    }

    void display()
    {
        Employee::display();
        cout << "Weekly Salary is: " << net_sal << endl;
    }
};

class HourlyEmployee : public Employee
{
public:
    int hours, wage;
    int net_sal;

    void accept()
    {
        Employee::accept();
        cout << "Enter the basic salary: " << endl;
        cin >> basic_sal;
        cout << "Enter the Wage: ";
        cin >> wage;
        cout << "Enter the hours worked" << endl;
        cin >> hours;
    }

    void calculate_salary()
    {
        cout << "Calculating Salary of Salaried Employee" << endl;
        if (hours < 40)
        {
            net_sal = basic_sal + hours * wage;
        }
        else
        {
            net_sal = 40 * wage + (hours - 40) * wage * 1.5;
        }
    }

    void display()
    {
        Employee::display();
        cout << "Hourly Employee Salary is: " << net_sal << endl;
    }
};

class CommissionEmployee : public Employee
{
public:
    float gross_sales, commission_rate = 0.05;
    float net_sal;

    void accept()
    {
        Employee::accept();
        cout << "Enter the gross sales: ";
        cin >> gross_sales;
    }

    void calculate_salary()
    {
        cout << "Calculating Salary of Salaried Employee" << endl;
        net_sal = commission_rate * gross_sales;
    }

    void display()
    {
        Employee::display();
        cout << "Commission Employee Salary is: " << net_sal << endl;
    }
};

int main()
{
    cout << "Welcome to Employee Payroll Management System" << endl
         << endl;

    int choice = 1, number = 1;
    Employee *ptr;
    do
    {
        cout << "1. Salaried Employee\n2. Commisisioned Employee\n3. Hourly Employee\n4. Quit\n";
        cout << "\n\nWhose Details do you wanna enter? " << endl;
        cin >> choice;

        if (choice == 1)
        {
            cout << "How many SalariedEmployees are we talking? ";
            cin >> number;
            SalariedEmployee pr[number];
            for (int i = 0; i < number; i++)
            {
                cout << "Enter the Information about the Salaried Employee" << endl;
                pr[i].accept();
            }
            cout << "\nHere is their Information and their Pay Slips" << endl;
            cout << endl
                 << endl;

            cout << "Salaried Employee" << endl;

            for (int i = 0; i < number; i++)
            {
                cout << "Info and Pay Slip of Salaried Employee " << i + 1 << endl;
                ptr = &pr[i];
                ptr->calculate_salary();
                pr[i].display();
                cout << endl;
            }
        }
        else if (choice == 2)
        {
            cout << "How many Commission Employees are we talking? ";
            cin >> number;
            CommissionEmployee tl[number];
            for (int i = 0; i < number; i++)
            {
                cout << "Enter the Information about the Commission Employee " << i + 1 << endl;
                tl[i].accept();
            }
            cout << "Here is their Information and their Pay Slips" << endl;
            cout << endl
                 << endl;
            for (int i = 0; i < number; i++)
            {
                cout << "Info and Pay Slip of Commission Employee " << i + 1 << endl;
                ptr = &tl[i];
                ptr->calculate_salary();
                tl[i].display();
                cout << endl;
            }
            cout << endl
                 << endl;
        }
        else if (choice == 3)
        {
            cout << "How many Hourly Employees are we talking? ";
            cin >> number;
            HourlyEmployee ap[number];
            for (int i = 0; i < number; i++)
            {
                cout << "Enter the Information about the Hourly Employees " << i + 1 << endl;
                ap[i].accept();
            }
            cout << "Here is their Information and their Pay Slips" << endl;
            cout << endl
                 << endl;
            for (int i = 0; i < number; i++)
            {
                cout << "Info and Pay Slip of Hourly Employees" << i + 1 << endl;
                ptr = &ap[i];
                ptr->calculate_salary();
                ap[i].display();
                cout << endl;
            }
            cout << endl
                 << endl;
        }

    } while (choice != 4);

    return 0;
```

```
}
```

Listing 1: Main.Cpp

7.1.1 C++ Input and Output

```
Welcome to Employee Payroll Management System

1. Salaried Employee
2. Commisisioned Employee
3. Hourly Employee
4. Quit


Whose Details do you wanna enter?
1
How many SalariedEmployees are we talking? 1
Enter the Information about the Salaried Employee
Enter the Employee ID:
1001
Enter the Employee Name:
Tony
Enter the Employee Age:
35
Enter the Employee Address City:
NewYork
Enter the Wage: 50000

Here is their Information and their Pay Slips


Salaried Employee
Info and Pay Slip of Salaried Employee 1
Calculating Salary of Salaried Employee
Employee ID is : 1001
Employee Name: Tony
Employee Age: 35
Employee Address City: NewYork
Weekly Salary is: 350000

The Destructor was called
1. Salaried Employee
2. Commisisioned Employee
3. Hourly Employee
4. Quit

Whose Details do you wanna enter?
2
How many Commission Employees are we talking? 1
Enter the Information about the Commission Employee 1
Enter the Employee ID:
1002
Enter the Employee Name:
Steve
Enter the Employee Age:
105
Enter the Employee Address City:
Queens
Enter the gross sales: 500
```

```
Here is their Information and their Pay Slips


Info and Pay Slip of Commission Employee 1
Calculating Salary of Salaried Employee
Employee ID is : 1002
Employee Name: Steve
Employee Age: 105
Employee Address City: Queens
Commission Employee Salary is: 25



The Destructor was called
1. Salaried Employee
2. Commisisioned Employee
3. Hourly Employee
4. Quit


Whose Details do you wanna enter?
3
How many Hourly Employees are we talking? 1
Enter the Information about the Hourly Employees 1
Enter the Employee ID:
1003
Enter the Employee Name:
Bruce
Enter the Employee Age:
50
Enter the Employee Address City:
Space
Enter the basic salary:
600
Enter the Wage: 200
Enter the hours worked
45
Here is their Information and their Pay Slips


Info and Pay Slip of Hourly Employees1
Calculating Salary of Salaried Employee
Employee ID is : 1003
Employee Name: Bruce
Employee Age: 50
Employee Address City: Space
Hourly Employee Salary is: 9500



The Destructor was called
1. Salaried Employee
2. Commisisioned Employee
3. Hourly Employee
4. Quit


Whose Details do you wanna enter?
```

```
4
```

Listing 2: Output for Problem 1

7.2 Java Implementation of Problem 2

```java
package assignment_3;

public class Shapes {

    public double Area;
    public double side;
    public double length;
    public double breadth;
    public int radius;

    Shapes(int radius) {
        Area = 0.0;
        this.radius = radius;
    }

    Shapes(double length, double breadth) {
        Area = 0.0;
        this.length = length;
        this.breadth = breadth;
    }

    Shapes(double side) {
        Area = 0.0;
        this.side = side;
    }

    double Area(int radius) {
        Area = 3.14 * radius * radius;
        return Area;
    }

    double Area(double length, double breadth) {
        Area = length * breadth;
        return Area;
    }

    double Area(double side) {
        Area = side * side;
        return Area;
    }

}
```

Listing 3: Full Time Employee.java

```java
package assignment_3;

import java.lang.Math;

public class Problem_A {
    public static void main(String[] args) {
        Shapes circle = new Shapes(7);
        Shapes square = new Shapes(1.5);
        Shapes rectangle = new Shapes(1.4, 3.5);
        System.out.println("The Radius of the Circle is: " + circle.radius);
        System.out.println("The Area of the Circle is: " + circle.Area(circle.radius));
        System.out.println("The Side of the Square is: " + square.side);
        System.out.println("The Area of the Square is: " + square.Area(square.side));
        System.out.println("The Length of the Rectangle is: " + rectangle.length);
        System.out.println("The Breadth of the Rectangle is: " + rectangle.breadth);
        System.out.println("The Area of the Rectangle is: "
                + String.format("%.2f", rectangle.Area(rectangle.length, rectangle.breadth)));
    }
}
```

Listing 4: Main.java

7.2.1 Java Output for Problem 2

```
The Radius of the Circle is: 7
The Area of the Circle is: 153.86
The Side of the Square is: 1.5
The Area of the Square is: 2.25
The Length of the Rectangle is: 1.4
The Breadth of the Rectangle is: 3.5
The Area of the Rectangle is: 4.90
```

Listing 5: Output for Problem 2

7.3 Java Implementation of Problem 3 using Interfaces

```java
package assignment_3;

abstract public class HillStation {
    abstract public void location(); // Pure Virtual Function.

    abstract public void famousfor();
}

class Manali extends HillStation {
    @Override
    public void location() {
        System.out.println("Manali in Himachal Pradesh");
    }

    @Override
    public void famousfor() {
        System.out.println(
                "Manali is a high-altitude Himalayan resort town in India's northern Himachal Pradesh state. It has a reputation as a backpacking center. Set on the Beas River, it's a gateway for skiing in the Solang Valley and trekking in Parvati Valley. It's also a jumping-off point for paragliding, rafting and mountaineering in the Pir Panjal mountains, home to 4,000m-high Rohtang Pass.");
    }
}

class Shimla extends HillStation {
    @Override
    public void location() {
        System.out.println("Shimla is in Himachal Pradesh");
    }

    @Override
    public void famousfor() {
        System.out.println(
                "The town is famous for pleasant walking experiences on hillsides surrounded by pine and oak forests. This capital city of Himachal Pradesh is famous for The Mall, ridge, and toy train. With colonial style buildings, the town has relics of ancient past that lend it a distinct look.");
    }
}

class Mahabaleshwar extends HillStation {
    @Override
    public void location() {
        System.out.println("Mahabaleshwar is in Maharashtra");
    }

    @Override
    public void famousfor() {
        System.out.println(
                "Mahabaleshwar is a hill station in India's forested Western Ghats range, south of Mumbai. It features several elevated viewing points, such as Arthur's Seat. West of here is centuries-old Pratapgad Fort, perched atop a mountain spur. East, Lingmala Waterfall tumbles off a sheer cliff. Colorful boats dot Venna Lake, while 5 rivers meet at Panch Ganga Temple to the north.");
    }
}
```

Listing 6: HillStation

```java
package assignment_3;
public class Problem_B {
    public static void main(String[] args) {
        Manali obj = new Manali();
        obj.location();
        obj.famousfor();

        Shimla obj1 = new Shimla();
        obj1.location();
        obj1.famousfor();

        Mahabaleshwar obj2 = new Mahabaleshwar();
        obj2.location();
        obj2.famousfor();
    }
}
```

Listing 7: Main.java

7.3.1 Java Output

```
Manali in Himachal Pradesh
Manali is a high-altitude Himalayan resort town in India's northern Himachal Pradesh state. It has a reputation as a backpacking center. Set on the Beas River, it's a gateway for skiing in the Solang Valley and trekking in Parvati
```

```
    Valley. It's also a jumping-off point for paragliding, rafting and
    mountaineering in the Pir Panjal mountains, home to 4,000m-high Rohtang Pass.
Shimla is in Himachal Pradesh
The town is famous for pleasant walking experiences on hillsides surrounded by
    pine and oak forests. This capital city of Himachal Pradesh is famous for The
    Mall, ridge, and toy train. With colonial style buildings, the town has relics
    of ancient past that lend it a distinct look.
Mahabaleshwar is in Maharashtra
Mahabaleshwar is a hill station in India's forested Western Ghats range, south of
    Mumbai. It features several elevated viewing points, such as Arthur's Seat.
    West of here is centuries-old Pratapgad Fort, perched atop a mountain spur.
    East, Lingmala Waterfall tumbles off a sheer cliff. Colorful boats dot Venna
    Lake, while 5 rivers meet at Panch Ganga Temple to the north.
```

Listing 8: Output for Problem 3

8 Conclusion

Thus, learned to use polymorphism and implemented solution of the given problem statement using C++ and Java.

9 FAQs

1. **Discuss the use of Virtual Functions.**

2. **What is the difference ebtween early binding and late binding.**

3. **Explain the use of abstract keyword in java with examples.**

4. **State Features of abstract base classes.**