

MIT WORLD PEACE UNIVERSITY

Object Oriented Programming with Java and C++  
Second Year B. Tech, Semester 3

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TO DEMONSTRATE THE USE OF OBJECTS, CLASSES,  
CONSTRUCTORS AND DESTRUCTORS USING C++  
AND JAVA.

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PRACTICAL REPORT

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## 1 Aim and Objectives

To demonstrate the use of objects, classes, constructors and destructors using C++ and JAVA.

1. To study various OOP concepts
2. To acquaint with the use of objects and classes in C++ and Java.
3. To learn implementation of constructor, destructors and dynamic memory allocation

## 2 Problem Statement

Develop an object-oriented program to create a database of employee information system containing the following information: Employee Name, Employee number, qualification, address, contact number, salary details (basic, DA, TA, Net salary), etc. Construct the database with suitable member functions for initializing and destroying the data viz. constructor, default constructor, Copy constructor, destructor. Use dynamic memory allocation concept while creating and destroying the object of a class. Use static data member concept wherever required. Accept and display the information of Employees.

## 3 Theory

### 3.1 Algorithm

An *Algorithm* is a set of statements for solving a problem. They're the building blocks for programming, and they allow things like computers, smartphones, and websites to function and make decisions.

It looks like this, and can be generally implemented in any suitable programming language.

```
1  step 1: Start
2  step 2: Do something
3  step 3: Do something else
4  step 4: Return result
5  step 5: Stop
```

### 3.2 Class

1. In object-oriented programming, a *class* is a blueprint for creating objects (a particular data structure), providing initial values for state (member variables or attributes), and implementations of behavior (member functions or methods).
2. It is a basic concept of Object-Oriented Programming which revolve around the real-life entities.
3. It is like a template for creating objects. You can initialize various variables of varying data types in it.
4. The Syntax for C++ and Java is given below.

```
1 // Syntax in C++
2 class Name_of_Class
3 {
4     private:
5         int a;
6     public:
7         int b;
8     protected:
9         int c;
10        data_type member_function()
11        {
12            return data_type;
13        }
14 }objects;
```

```
1 // Syntax in Java
2 class Name_of_Class
3 {
4     private:
5         int a;
6     public:
7         int b;
8     protected:
9         int c;
10        data_type member_function()
11        {
12            return data_type;
13        }
14 }
```

### 3.3 Objects

1. *Object* is an instance of a *class*. An object in *OOP* is nothing but a self-contained component which consists of methods and properties to make a particular type of data useful.
2. For example color name, table, bag, barking. When you send a message to an object, you are asking the object to invoke or execute one of its methods as defined in the class.
3. From a programming point of view, an object in OOPS can include a data structure, a variable, or a function. It has a memory location allocated. Java Objects are designed as class hierarchies.
4. The syntax for Java and C++ are given below.

```
1 // C++ Syntax
2 class_name obj;
3 Employee CEO;
4 Employee President(Name, Age);
```

```
1 // Java Syntax
2 class_name obj = new class_name;
3 Employee CEO = new Employee();
4 Employee President = new Employee(Name, Age);
```

### 3.4 Default, Parameterized, and Copy Construtor

A constructor is a special member function with exact same name as the class name.

There are **3** Types of Constructors:

1. **Default Constructor:** A constructor with no arguments (or parameters) in the definition is a default constructor. Usually, these constructors use to initialize data members (variables) with real values. If no constructor is explicitly declared, the compiler automatically creates a default constructor with no data member (variables) or initialization.
2. **Parameterized Constructor:** Unlike Default constructor, It contains parameters (or arguments) in the constructor definition and declaration. More than one argument can also pass through a parameterized constructor. Moreover, these types of constructors use for overloading to differentiate between multiple constructors.
3. **Copy Constructor:** A copy constructor is a member function that initializes an object using another object of the same class. It helps to copy data from one object to another.
4. The Syntax for Each of them is same for C++ and Java and is given below.

```
1  class Avenger
2  {
3      static int hero = 0;
4      int age;
5      bool from_earth, is_a_God;
6      string Superpower;
7
8      // default Constructor
9      Avenger()
10     {
11         hero++;
12     }
13
14     // Parameterized Constructor
15     Avenger(bool from_earth, bool is_a_God, int age, String name, string
16     Superpower)
17     {
18         if(!from_earth)
19         {
20             alien_avengers++;
21         }
22     }
23
24     // Copy Constructor
25     Avenger(Avenger &new_Avenger)
26     {
27         this.superpower = new_Avenger.superpower;
28     }
29 }
```

### 3.5 Destuctors

**Destructor** is an instance member function which is invoked automatically whenever an object is going to be destroyed. Meaning, a destructor is the last function that is going to be called before an object is destroyed.

1. Destructor is also a *special member* function like constructor. Destructor destroys the class objects created by constructor.
2. Destructor has the same name as their class name preceded by a tiled ( ) symbol.
3. It is not possible to define more than one destructor.
4. The destructor is only one way to destroy the object create by constructor. Hence destructor can-not be overloaded.
5. Destructor neither requires any argument nor returns any value.
6. It is automatically called when object goes out of scope.
7. Destructor release memory space occupied by the objects created by constructor.
8. In destructor, objects are destroyed in the reverse of an object creation.

In Java, The job of the constructor is done by the compiler, as garbage collection in general is done better by the compiler in java than the programmer. It is for this reason that the finalize() function exists in java but is depricated and its strongly recommended not to use it.

```
1  // C++ Implementation
2  class Avenger()
3  {
4      ~Avenger()
5      {
6          pay_respects();
7      }
8
9      // in java
10     finalize()
11     {
12         System.gc() // call the garbage collector
13     }
14 }
```

### 3.6 Dynamic Allocation and DeAllocation

1. Many times, you are not aware in advance how much memory you will need to store particular information in a defined variable and the size of required memory can be determined at run time.
2. You can allocate memory at run time within the heap for the variable of a given type using a special operator in C++ which returns the address of the space allocated. This operator is called new operator.
3. If you are not in need of dynamically allocated memory anymore, you can use delete operator, which de-allocates memory that was previously allocated by new operator.
4. The Syntax for C++ and Java is given below.

```
1
2 // C++
3 int a = new int;
4 delete a;
5
6 // Java
7 Employee Obj = new Employee()
```

### 4 Algorithm

1. **Start**
2. Create Employee Class
3. Delcare appropriate Data Memembers and define the member funtions
4. Accept multiple employee's Data using an Array of Objects
5. Assign some Basic employees using default, copy and parameterized constructors
6. Show usage of Default Constructor and display the Data
7. Show usage of Parameterized constructor and display that data
8. Show usage of Copy Constructor and display that Data.
9. Distory the objects if possible
10. **End**

### 5 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

### 6 Input

1. Number of Employees for enrollment
2. Employee ID
3. Employee Name
4. Employee Position
5. Employee Address
6. Employee Salary

## 7 Output

**Employee Data** should be displayed by use of member functions.

## 8 Conclusion

Thus, learned to use objects, classes, constructor and destructor and implemented solution of the given problem statement using C++ and Java.

## 9 Code

### 9.1 Java Implementation

```
1 // Assignment 1 - OOPCJ
2 // Write A Program to show implementation of Constructors in Java
3 // PA34. Krishnaraj Thadesar
4 // SY CSE Semester 3
5 // Date Of Implementation: 19th August
6
7
8 package assignment_1;
9 import java.util.Scanner;
10
11 class Employee {
12
13     // create an object of Scanner
14     Scanner input = new Scanner(System.in);
15
16     int emp_id;
17     int age, basic_sal, da, ta;
18     String address_city, position, name;
19     static int ssn;
20
21     Employee()
22     {
23         System.out.println("Default Constructor was called");
24     }
25
26     // Parameterized Constructor
27     Employee(int e, int a, int b, int d,
28             int t, String add, String pos, String nam)
29     {
30         System.out.println("Parameterized constructor was called");
31         emp_id = e;
32         age = a;
33         basic_sal = b;
34         da = d;
35         ta = t;
36         address_city = add;
37         position = pos;
38         name = nam;
39     }
40
41     // Copy Constructor
42     Employee(Employee E)
```



```
43 {
44     System.out.println("Copy constructor was called");
45     emp_id = E.emp_id;
46     age = E.age;
47     basic_sal = E.basic_sal;
48     da = E.da;
49     ta = E.ta;
50     address_city = E.address_city;
51     position = E.position;
52     name = E.name;
53 }
54
55 double calc_gross_sal()
56 {
57     return basic_sal + da + ta - (0.15 * basic_sal);
58 }
59
60 void display()
61 {
62     ssn = ssn + 1;
63     System.out.println("Employee ssn is: " + ssn);
64     System.out.println("Employee ID is : " + emp_id);
65     System.out.println("Employee Name: " + name);
66     System.out.println("Employee Age: " + age);
67     System.out.println("Employee Position: " + position);
68     System.out.println("Employee basic Salary: " + basic_sal);
69     System.out.println("Employee DA: " + da);
70     System.out.println("Employee TA: " + ta);
71     System.out.println("Employee Gross Salary: " + calc_gross_sal() );
72     System.out.println("Employee Address City: " + address_city);
73     System.out.println("\n");
74 }
75
76 void accept()
77 {
78     System.out.println("Enter the age :");
79     age = input.nextInt();
80     System.out.println("Employee ID is: ");
81     emp_id = input.nextInt();
82     System.out.println("Employee Name: ");
83     name = input.next();
84     System.out.println("Employee Age: ");
85     age = input.nextInt();
86     System.out.println("Employee Position: ");
87     position = input.next();
88     System.out.println("Employee basic Salary: ");
89     basic_sal = input.nextInt();
90     System.out.println("Employee DA: ");
91     da = input.nextInt();
92     System.out.println("Employee TA: ");
93     ta = input.nextInt();
94     System.out.println("Employee Address City: ");
95     address_city = input.next();
96 }
97
98 // @Override
99 // protected void finalize() throws Throwable
100 // {
101 //     try
```

```
102     //     {
103     //         input.close();
104     //     }
105     //     catch(Throwable t)
106     //     {
107     //         throw t;
108     //     }
109     //     finally
110     //     {
111     //         super.finalize();
112     //     }
113     // }
114
115 }
```

Listing 1: Employee.java

```
1 package assignment_1;
2
3 import java.util.Scanner;
4
5 public class Source {
6
7     static Scanner input = new Scanner(System.in);
8
9     public static void main(String[] args) {
10         System.out.println("This is the first Assignment");
11         int count = 0;
12
13         // Default Constructor
14         Employee CEO = new Employee();
15         CEO.emp_id = 1000;
16         CEO.name = "Kom Pany Seeio";
17         CEO.address_city = "Seoul";
18         CEO.age = 45;
19         CEO.basic_sal = 1000000;
20         CEO.da = 1000;
21         CEO.ta = 2000;
22         CEO.position = "CEO";
23
24         // Defining an object using the copy constructor
25         Employee President = new Employee(CEO);
26         President.name = "Precy Dent";
27         President.age = 45;
28         President.address_city = "Delhi";
29         President.basic_sal *= 2;
30         President.position = "President";
31
32         Employee VP = new Employee(1003, 50, 200000, 3000, 1000,
33             "Mumbai", "Vice President", "Visey Presed Ent");
34
35
36         System.out.println("Information about the CEO");
37         CEO.display();
38         System.out.println("Information about the President");
39         President.display();
40         System.out.println("Information about the President");
41         VP.display();
42

```

```
43      System.out.println("Enter the number of employees :");
44      count = input.nextInt();
45      Employee objs[] = new Employee[count];
46
47      for(int i = 0;i < count;i++)
48      {
49          objs[i] = new Employee();
50          objs[i].accept();
51          objs[i].display();
52      }
53      System.gc();
54  }
55 }
```

Listing 2: Source.java

### 9.1.1 Java Input

```
1 Enter the number of employees :
2 2
3 Default Constructor was called
4 Enter the age :
5 35
6 Employee ID is:
7 006
8 Employee Name:
9 Peter
10 Employee Age:
11 17
12 Employee Position:
13 Avenger
14 Employee basic Salary:
15 500000
16 Employee DA:
17 3440
18 Employee TA:
19 3550
20 Employee Address City:
21 Brooklyn
22
23
24 Default Constructor was called
25 Enter the age :
26 4
27 Employee ID is:
28 007
29 Employee Name:
30 Thor
31 Employee Age:
32 1500
33 Employee Position:
34 Avenger
35 Employee basic Salary:
36 6000000
37 Employee DA:
38 3000
39 Employee TA:
40 5000
41 Employee Address City:
```

### Listing 3: Python example

#### 9.1.2 Java Output

```
1 This is the first Assignment
2 Default Constructor was called
3 Copy constructor was called
4 Parameterized constructor was called
5 Information about the CEO
6 Employee ssn is: 1
7 Employee ID is : 1000
8 Employee Name: Kom Pany Seeio
9 Employee Age: 45
10 Employee Position: CEO
11 Employee basic Salary: 1000000
12 Employee DA: 1000
13 Employee TA: 2000
14 Employee Gross Salary: 853000.0
15 Employee Address City: Seoul
16
17
18 Information about the President
19 Employee ssn is: 2
20 Employee ID is : 1000
21 Employee Name: Precy Dent
22 Employee Age: 45
23 Employee Position: President
24 Employee basic Salary: 2000000
25 Employee DA: 1000
26 Employee TA: 2000
27 Employee Gross Salary: 1703000.0
28 Employee Address City: Delhi
29
30
31 Information about the President
32 Employee ssn is: 3
33 Employee ID is : 1003
34 Employee Name: Visey Presed Ent
35 Employee Age: 50
36 Employee Position: Vice President
37 Employee basic Salary: 200000
38 Employee DA: 3000
39 Employee TA: 1000
40 Employee Gross Salary: 174000.0
41 Employee Address City: Mumbai
42
43
44 Employee ssn is: 4
45 Employee ID is : 6
46 Employee Name: Peter
47 Employee Age: 17
48 Employee Position: Avenger
49 Employee basic Salary: 500000
50 Employee DA: 3440
51 Employee TA: 3550
52 Employee Gross Salary: 431990.0
```

```
53 Employee Address City: Brooklyn
54
55
56 Employee ssn is: 5
57 Employee ID is : 7
58 Employee Name: Thor
59 Employee Age: 1500
60 Employee Position: Avenger
61 Employee basic Salary: 6000000
62 Employee DA: 3000
63 Employee TA: 5000
64 Employee Gross Salary: 5108000.0
65 Employee Address City: Asgard
```

Listing 4: Python example

## 9.2 C++ Implementation

```
1 // Assignment 1 - OOPCJ
2 // Write A Program to show implementation of Constructors in C++
3 // PA34. Krishnaraj Thadesar
4 // SY CSE Semester 3
5 // Date Of Implementation: 17th August
6
7 #include <iostream>
8 using namespace std;
9 class Employee
10 {
11 private:
12     static int ssn;
13 protected:
14     int something = 5;
15
16 public:
17     int emp_id = 1000;
18     int age = 0, basic_sal = 0, da = 0, ta = 0;
19     string address_city, position, name;
20
21     // Default Constructor
22     Employee()
23     {
24         ssn += 1;
25         cout << "The Default Constructor was called" << endl;
26     }
27
28     // Parameterized Constructor
29     Employee(int e, int a, int b, int d, int t, string add, string pos, string nam
30 )
31     {
32         cout << "Parameterized constructor was called\n";
33         emp_id = e;
34         age = a;
35         basic_sal = b;
36         da = d;
37         ta = t;
38         address_city = add;
39         position = pos;
40         name = nam;
```

```
40     }
41
42     // Copy Constructor
43     Employee(Employee &E)
44     {
45         cout << "Copy Constructor was called" << endl;
46         emp_id = E.emp_id;
47         age = E.age;
48         basic_sal = E.basic_sal;
49         da = E.da;
50         ta = E.ta;
51         address_city = E.address_city;
52         position = E.position;
53         name = E.name;
54     }
55
56     void display()
57     {
58         cout << "Employee ssn is:" << ssn << endl;
59         cout << "Employee ID is : " << emp_id << endl;
60         cout << "Employee Name: " << name << endl;
61         cout << "Employee Age: " << age << endl;
62         cout << "Employee Position: " << position << endl;
63         cout << "Employee basic Salary: " << basic_sal << endl;
64         cout << "Employee DA: " << da << endl;
65         cout << "Employee TA: " << ta << endl;
66         cout << "Employee Gross Salary: " << calc_gross_sal() << endl;
67         cout << "Employee Address City: " << address_city << endl;
68     }
69
70     void accept()
71     {
72         cout << "Enter the Employee ID: " << endl;
73         cin >> emp_id;
74         cout << "Enter the Employee Name: " << endl;
75         cin >> name;
76         cout << "Enter the Employee Age: " << endl;
77         cin >> age;
78         cout << "Enter the Employee Position: " << endl;
79         cin >> position;
80         cout << "Enter the Employee basic Salary: " << endl;
81         cin >> basic_sal;
82         cout << "Enter the Employee DA: " << endl;
83         cin >> da;
84         cout << "Enter the Employee TA: " << endl;
85         cin >> ta;
86         cout << "Enter the Employee Address City: " << endl;
87         cin >> address_city;
88     }
89
90     float calc_gross_sal()
91     {
92         int gross_sal = da + ta + basic_sal - (.15 * basic_sal);
93         return gross_sal;
94     }
95
96     // Destructor
97     ~Employee()
98     {
```

```
99         cout << "The Destructor was called" << endl;
100     }
101 };
102
103 int Employee::ssn = 1000;
104
105
106 int main()
107 {
108     // Defining an Object using the default Constructor
109     Employee CEO;
110     CEO.emp_id = 1000;
111     CEO.name = "Kom Pany Seeio";
112     CEO.address_city = "Seoul";
113     CEO.age = 45;
114     CEO.basic_sal = 1000000;
115     CEO.da = 1000;
116     CEO.ta = 2000;
117     CEO.position = "CEO";
118
119
120     // Defining an object using the copy constructor
121     Employee President(CEO);
122     President.name = "Precy Dent";
123     President.age = 45;
124     President.address_city = "Delhi";
125     President.basic_sal *= 2;
126     President.position = "President";
127
128     // Defining anothe object using the parameterized constructor
129     Employee VP(1003, 50, 200000, 3000, 1000, "Mumbai", "Vice President", "Visay
Presed Ent");
130
131     // Taking user input for the number of employees
132     int count = 0;
133     cout << "How many values do you wanna input ? ";
134     cin >> count;
135
136     // Dynamically Creating new Objects
137     Employee *Obj = new Employee[count];
138     cout << "Enter the Details" << endl;
139
140     // Accepting Objects from the User.
141     for (int i = 0; i < count; i++)
142     {
143         cout << "Enter information about the Employee Number: " << i + 1 << endl;
144         Obj[i].accept();
145     }
146
147     // Displaying Information about the CEO and the President
148     cout << "Information about the CEO" << endl;
149     CEO.display();
150     cout << "Information about the President" << endl;
151     President.display();
152     cout << "Information about the Vice President" << endl;
153     VP.display();
154
155     // Displaying Information about the other Employees
156     for (int i = 0; i < count; i++)
```

```
157     {
158         cout << "Information about the Employee Number: " << i + 1 << endl;
159         Obj[i].display();
160     }
161
162     delete[] Obj;
163     return 0;
164 }
```

Listing 5: Main.Cpp

### 9.2.1 C++ Input

```
1 The Default Constructor was called
2 Copy Constructor was called
3 Parameterized constructor was called
4 How many values do you wanna input ? 2
5 The Default Constructor was called
6 The Default Constructor was called
7
8 Enter the Details
9
10 Enter information about the Employee Number: 1
11 Enter the Employee ID:
12 005
13 Enter the Employee Name:
14 Tony
15 Enter the Employee Age:
16 40
17 Enter the Employee Position:
18 Philanthropist
19 Enter the Employee basic Salary:
20 5000000
21 Enter the Employee DA:
22 3000
23 Enter the Employee TA:
24 3000
25 Enter the Employee Address City:
26 NewYork
27
28 Enter information about the Employee Number: 2
29 Enter the Employee ID:
30 006
31 Enter the Employee Name:
32 Steve
33 Enter the Employee Age:
34 105
35 Enter the Employee Position:
36 Captain
37 Enter the Employee basic Salary:
38 600000
39 Enter the Employee DA:
40 2999
41 Enter the Employee TA:
42 2000
43 Enter the Employee Address City:
44 Brooklyn
```

Listing 6: C++ Input



### 9.2.2 C++ Output

```
1 Information about the CEO
2 Employee ssn is:1003
3 Employee ID is : 1000
4 Employee Name: Kom Pany Seeio
5 Employee Age: 45
6 Employee Position: CEO
7 Employee basic Salary: 1000000
8 Employee DA: 1000
9 Employee TA: 2000
10 Employee Gross Salary: 853000
11 Employee Address City: Seoul
12
13 Information about the President
14 Employee ssn is:1003
15 Employee ID is : 1000
16 Employee Name: Precy Dent
17 Employee Age: 45
18 Employee Position: President
19 Employee basic Salary: 2000000
20 Employee DA: 1000
21 Employee TA: 2000
22 Employee Gross Salary: 1.703e+06
23 Employee Address City: Delhi
24
25 Information about the Vice President
26 Employee ssn is:1003
27 Employee ID is : 1003
28 Employee Name: Visey Presed Ent
29 Employee Age: 50
30 Employee Position: Vice President
31 Employee basic Salary: 200000
32 Employee DA: 3000
33 Employee TA: 1000
34 Employee Gross Salary: 174000
35 Employee Address City: Mumbai
36
37 Information about the Employee Number: 1
38 Employee ssn is:1003
39 Employee ID is : 5
40 Employee Name: Tony
41 Employee Age: 40
42 Employee Position: Philanthropist
43 Employee basic Salary: 5000000
44 Employee DA: 3000
45 Employee TA: 3000
46 Employee Gross Salary: 4.256e+06
47 Employee Address City: NewYork
48
49 Information about the Employee Number: 2
50 Employee ssn is:1003
51 Employee ID is : 6
52 Employee Name: Steve
53 Employee Age: 105
54 Employee Position: Captain
55 Employee basic Salary: 600000
56 Employee DA: 2999
57 Employee TA: 2000
```

```
58 Employee Gross Salary: 514999
59 Employee Address City: Brooklyn
60
61 The Destructor was called
62 The Destructor was called
63 The Destructor was called
64 The Destructor was called
65 The Destructor was called
```

Listing 7: C++ Output

### 10 FAQs

#### 1. What are classes?

In object-oriented programming, a **class** is a blueprint for creating objects (a particular data structure), providing initial values for state (member variables or attributes), and implementations of behavior (member functions or methods).

It is a basic concept of Object-Oriented Programming which revolve around the real-life entities.

```
class <class_name>{  
    field;  
    method;  
}
```

#### 2. Explain : Array of Objects:

An array of objects is like any other array in C++ and Java. An Array usually is just a collection of variables that have the same data type, and are placed in contiguous memory locations. An Array of Objects is similar in that instead of variables there are objects which are placed contiguously in memory.

Syntax:

```
Employee obj[5];
```

#### 3. Explain when to use different types of constructors? There are 3 Types of constructors:

- (a) **Default Constructor:** This type is called when the Object is just created in its most simple declaration. It does not take any parameters, or arguments. So if you have a simple class, that does not have many user dependent variables and fields, that does a rather general task, then it is better to use default constructors, where you do not have to assign any user variables to class variables, and have to just call some basic instantiating functions depending on class requirements and functions.
- (b) **Parameterized Constructor:** Say there are variables that the user has entered that need to be assigned to the class object, or there are certain properties of each object different from other objects of the same class, like in enemies in a game, or employees in a Company, each object can be initialized with a set of variables. In this situation it is better to just use a parameterized constructor.
- (c) **Copy Constructor:** If you have many constructors that are often similar in definition and declaration, but have very few dissimilar properties, it is better to use copy constructors. For example Trees in a RPG game, where each tree has the same basic structure, but you might have small variation in just the height or the position of the tree.

#### 4. Explain use of static member functions.

**Static member functions** in java are those that can be accessed by other classes without declaring an Object of that class. This is often why the main function needs to be public and static. Every other member function needs to be accessed by an object of that class, as opposed to static ones.

In terms of memory, the *static* keyword in C++ is used when you have a variable that needs to be accessed by several objects of the same class, and this variable doesn't need to be different for each object. An Example would be the Security number of an Employee, which just needs to be incremented as an object is created. It is accessed by each object, and therefore it makes sense for it to be declared in a way where it does not get copied for each object, thereby saving space.

### 5. How java program is executed?

Java, being a *platform-independent programming language*, doesn't work on the one-step compilation. Instead, it involves a two-step execution, first through an OS-independent compiler; and second, in a virtual machine (JVM) which is custom-built for every operating system. First, the source '.java' file is passed through the compiler, which then encodes the source code into a machine-independent encoding, known as Bytecode. The content of each class contained in the source file is stored in a separate '.class' file.

The class files generated by the compiler are independent of the machine or the OS, which allows them to be run on any system. To run, the main class file (the class that contains the method main) is passed to the JVM and then goes through three main stages before the final machine code is executed.

### 6. What is the use of JVM?

**Java Virtual Machine**, or JVM, loads, verifies and executes Java bytecode. It is known as the interpreter or the core of Java programming language because it executes Java programming.

**JVM** is specifically responsible for converting bytecode to machine-specific code and is necessary in both JDK and JRE. It is also platform-dependent and performs many functions, including memory management and security. In addition, JVM can run programs written in other programming languages that have been translated to Java bytecode.

### 7. What are the different control statements used in C++ and Java?

There are several Control statements in Java and C++

- (a) Loops like for, while and do while
- (b) Logical Control statements like if, else if, else, switch statements
- (c) Ternary Operator as another form of logical operation
- (d) Branching Statements include Keywords like break and continue.

Examples:

```
1 // Loops
2 for(int i = 0; i < 5; i++)
3 {
4     cout<<"This is a basic for loop, and exists in both cpp and java.";
5 }
6 do
7 {
8     cout<<"This is a do while loop";
```

```
9      }while(condition);
10     while(true)
11     {
12         cout<<"This is a while loop";
13     }
14
15     // Logical Statements
16     if(condition)
17     {
18         cout<<"Condition true";
19     }
20     else cout << "Condition false";
21
22     condition = condition ? true : false;
23
24     // Branching statements:
25     switch(condition)
26     {
27         case 1: cout<<"Case 1 is being executed";
28                 break;
29         case 2: cout<<"Case 2 is being executed";
30                 break;
31         default: cout<<"Default case";
32                 break;
33     }
34
```

**8. Write couple of examples/applications suitable to use OOP concepts specially use of classes, objects and constructors.**

- (a) **Game Development:** Enemies, walls, obstacles, trees, NPCs, are often structured as classes. This is because they have a set template that each member follows, and there are often many of them in a game. This makes OOP the perfect choice.
- (b) **Machine Learning:** Machine learning often requires extensive and complex algorithms that need to be written and applied on a set of data. If such algorithms are put together as classes, then their objects can be fed that data and that algorithm can be run on it efficiently and easily, as opposed to writing it every time for each data set.
- (c) **Software Development:** GUI components like buttons, sliders, panels, frames, bars, etc often have a singular functionality associated with them. As there are many such components in a GUI, it makes sense to make them into classes, and spawn their objects in various meaningful positions in the UI.