Class:-
In java class is a blue print or template or logical entity of an object.

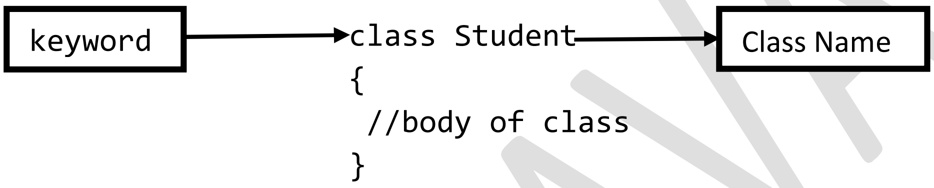
Based on blue print of a class we developed an object.

Class is foundation of any java program.

In java program we write any things inside the class.

Defined class by using **class** keyword

Example:-



```
class Student
{
 //body of class
}
```

java class can contains:-
- **a) Object**
- **b) Variable**
- **c) Method**
- **d) Constructors**
- **e) Blocks(instance block and static block)**
- **f) Interface and Nested class**

Object:-
Object is physical entity which means it is physically exists they have memory.

Object is created based on class properties.

Every object contains three characteristics:-

State:-In java programming state represents by instance variable

Behaviour:- In java programming behaviour represent by method.

Identity:-hashCode is unique identification number for each and every object.

Example:-
```
class Test//class Name
{
int x=10;//state(instance variable)
public static void main(String[]args)
{
Test t=new Test();//object creation
System.out.println(t.x);
}
}
Result:-10
```

We can create an object in following ways:-

1. By using **new** keyword.
2. By using new **newInstance**() .
3. By using clone method
4. By using instance factory method
5. By using pattern factory method
6. By using deserialization..etc

Syntax of Object creation by using new keyword:-
Class_Name reference_variable=new Class_Name();
Example:-
Test t=new Test();
Test.......class-name
t..........reference variable
=..........assignment Operator
new........keyword used for object creation
Test().....constructor call
;..........statement terminate

Java Variable:-

variable is used to store the constant (Literal) values, these values we used in our project requirements.

Variables are also known as fields of a class or properties of a class

All variables must be some types its can be primitive types, array types, class types, interface types etc.
Variable Declaration:- We declare a Variable with three components in this orders.

1. Zero or more Modifier(optional)
2. Variable types(compulsory)
3. Variable names(compulsory)

Example:-

public final int id=101;

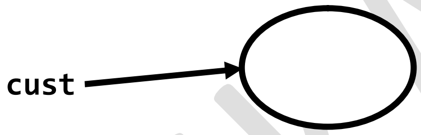
public final :-Modifier
int:- data type
id:-variable name.
101:-literal(or constant value)
;:- statement termination

Types of Variable:-Variable divided into two parts.

Division-1
Based on types of value represented by a variable, all variables are divided into two types.
A. Primitive variable.

Primitive variable:-This type variable we have used to represent primitive data value.
Example:- int x=101;

Reference variable:-This type of variable we have used to represent Object.
Example:-
Customer cust=new Customer();



cust is reference variable which is Pointing to the Customer class object.

Division-2
Based on position of declaration and behaviour, all variables are divided into three parts.

1. **instance variable**
2. **static variable**
3. **local variable**

Instance Variable:-

- If the value of a variable is varied from object to object such types of variables we declared as instance variable.
- For every object a separate copy of instance variable will be created
- We declared instance variable directly inside the class but outside of the any method or constructor or block.

- For the instance variables memory allocated during object creation and memory released when object destroyed. Hence scope of instance variable is exactly same as scope of Object.
- It will be stored in heap memory area.
- We can access instance variable directly in instance area but can't be access in static area directly but by using object reference we can access in Static area.

There are two types of area in java Language:-

A. Instance Area

B. Static Area

Instance Area:-The area which without static keyword such types of area known as instance area.

```
void m1()//instance method
{
//logic here //instance Area
}
```

Static Area:-The area which with static keyword such types of area known as static area.

```
static void m1()//static method
{
//logic here//static Area
}
```

Example:-

```
class Test
{
//instance variable
int a=20;
int b=30;
//static method
public static void main(String[]args)
{
//static area
Test t=new Test();
System.out.println("static area value of a="+t.a);
System.out.println("static area value of a="+t.b);
t.m1();
}
//instance method
void m1()
{
//instance area
System.out.println("instance area value of a="+a);
System.out.println("instance area value of a="+b);
}
}
```

Result:-

```
static area value of a=20
static area value of a=30
instance area value of a=20
instance area value of a=30
```

For instance variable JVM is always providing default value and we have not need to initialize explicitly.

Example:-.

Test.java

```
class Test
{
int a;
double d;
boolean b;
String s;
public static void main(String[]args)
{
Test t=new Test();
System.out.println(t.a);
System.out.println(t.d);
System.out.println(t.b);
System.out.println(t.s);
}
}
```

Result:-

```
0
0.0
false
null
```

It is also known as object level variable attributes

Static variable:-

If value of the variable is not varied from object to object such types of variables declared as static variable.

For every object a single copy of static variable will be created at class level and shared by every object of the class.

Static variable will be declared inside the class but outside of the method or block or constructor with static modifier.

Static variables memory allocated during **.class** file loading and memory released at **.class** file unloading time. So, scope of static variable is exactly same as .class file.

Internal Mechanism of .class file loading and unloading .class file:-
Java Test Enter key pressed

1.start JVM ⇐
2.create and start main Thread
3.locate Test.class
4.load Text.class**// static variable create**
5.execute main() method
6.unload Text.class**// static variable destruction**
7.Terminate main Thread
8.Shut-Down JVM

Static variable are stored in method area(non-heap memory).

We can access static variable either by object reference or by class name but recommended to use to class name. within in the same class it is not required to class name and we can access directly by name.

Exercise:-

```
class Test
{
//static variable
static int x=10;
//static method
public static void main(String[]args)
{
```

```
//static Area
Test t=new Test();
System.out.println(t.x);
System.out.println(Test.x);
System.out.println(x);
//all are valid but Test.x is recommended to call static variable
//because its reflect the properties of static variable.
}
}
```

Result:-

```
10
10
10
```

We can access static variable from both instance and static area directly.

Exercise:-

```
class Test
{
//static variable
static int x=10;
static int y=20;
//static method
public static void main(String[]args)
{
//static area
System.out.println(x);
System.out.println(y);
Test t=new Test();
t.m1();
}
//instance method
void m1()
{
//instance area
System.out.println(x);
System.out.println(y);
}
}
```

Result:-

```
10
```

```
20
10
20
```

For static variable JVM provide default value so we have not need to initialize explicitly.

Exercise:-

```
class Test
{
//static variable
static int a;
static char ch;
static double d;
static boolean b;
public static void main(String[]args)//static method
{
//static area
System.out.println(a);
System.out.println(ch);
System.out.println(d);
System.out.println(b);
}
}
```

Result:-

```
0
0.0
false
```

It is also known as class level variable

Instance Vs. Static variable

Case:-1

In case of instance variable JVM will created separate instance variable values for each and every object.

In case of static variable for every object a single copy of static variable will be created for every object of that class.

Example:-

```
class Test
{
int firstValue=11;
static int secondValue=22;
public static void main(String[]args)
{
Test t1=new Test();
System.out.println(t1.firstValue+".."+t1.secondValue);
Test t2=new Test();
t2.firstValue=111;
t2.secondValue=222;
System.out.println(t2.firstValue+".."+t2.secondValue);
System.out.println(t1.firstValue+".."+t1.secondValue);
}
}
```

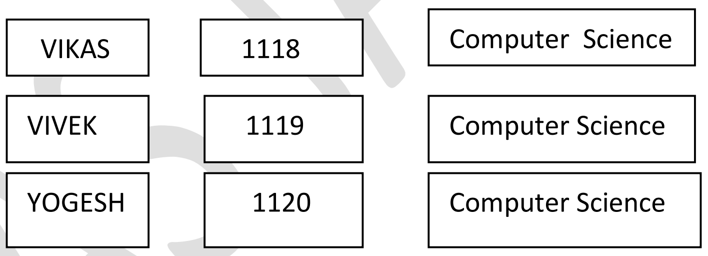
Result:-

```
11..22
111..222
11..222
```

Case:-2

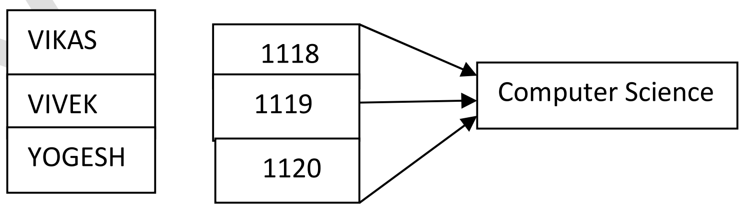
Instance Variable:-

```
class Student
{
String name;
int id;
String branch;
}
```



Static Variable:-

```
class Student
{
String name;
int id;
String branch;
}
```



Local variable:-

Sometime temporary or locally requirement of the variable. such types of variable we declared as local variable.

We declared local variable inside a method or block or constructor.

Example:-

```
class Test
```

```
{
public static void main(String[]args)
{
int a=10;//local variable
int b=20; //local variable
System.out.println(a);
System.out.println(b);
}
}
```

Result:-

```
10
20
```

Local variable will be created while executing the block in which we declare it, once block execution is completes, local variable will be destroyed automatically hence the scope of local variable is the same as block in which we declare it.

It is not possible to access local variable out of the block in which we declare it, otherwise we will get compile time error

Example:-

```
class Test
{
void m1()
{
int x=10;
System.out.println(x);
}
void m2()
{
System.out.println(x);
}
public static void main(String[]args)
{
Test t=new Test();
t.m1();
t.m2();
}
}
```

Result:-

```
Test.java:10: error: cannot find symbol
System.out.println(x);
```

```
symbol:   variable x
location: class Test
```

Local variable will be stored in stack area . hence it is also known as temporary or stack or automatically variables

For local variable JVM won’t provide default value, so we should compulsory to performed initialization explicitly, before using that variable, if we are not used that variable not need to initialize explicitly.

Exercise:-case-1

```
class Test
{
public static void main(String[]args)
{
//Local area of main method
int x;//local variable
System.out.println("Hello");
}
}
```

Result:-Hello

Exercise:-case-2

```
class Test
{
public static void main(String[]args)
{
//Local area of main method
int x;
System.out.println(x);
}
}
```

Result:-

```
Test.java:6: error: variable x might not have been initialized
System.out.println(x);.
```

Note:-Only applicable modifier for local variable is final if we are trying any other then we will get compile Time Error. if we not declared any then it is treated as default but this rule is applicable only for instance and static variable not for local variable.

Example:-

```
class Test
{
public static void main(String[]args)
{
Final int x=10;
private inty=20;
}
}
```

Result:-

```
error: illegal start of expression
private int y=20;
```

METHOD

Method:-

Inside the class we can't write any business logic directly. Inside a class we declare the method and inside that method we write business logic of programming requirement.

If we write any business logic directly inside the class then we will get compile time error.

Example:-

```
class Test
{
int x=10;
int y=20;
System.out.println(x+y);//business logic
}
```

To Solve this problem we write all business logic inside the method

```
class Test
{
int x=10;
int y=20;
public static void main(String[]args)//static method
{
Test t=new Test();
System.out.println(t.x+t.y);//business logic
}
}
```

Every method contain three parts

1)method declaration.
2)method implementation(business logic).
3)method calling.
Example:-

```
class Test
{
public void m1()//method declaration
{
System.out.println("m1()method");//method implementation(business
logic)
}
public static void main(String[]args)
{
Test t=new Test();
t.m1();//method calling
}
}
```

Method Syntax:-
[Modifier-List] Return-Type Method-Name(parameter List)throws Exception

Modifier-List---> Represent access permission------->[optional]

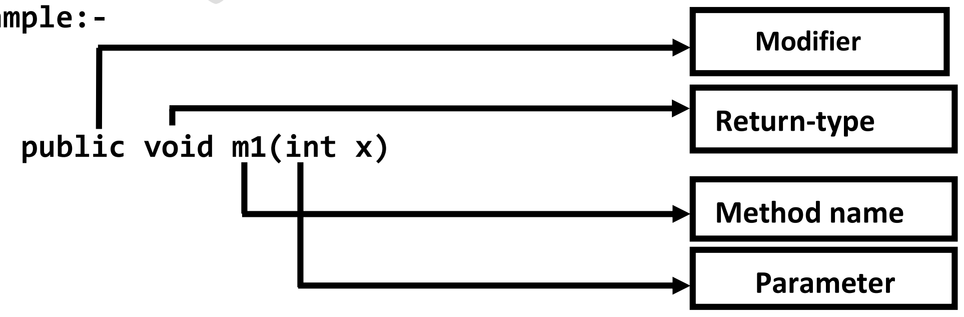
Return-Type--->functionality return value------------>[mandatory]

Method-Name--->functionality name()---------------->[mandatory]

Parameter-List--->input to functionality------------->[optional]

Throws Exception-->represent Exception Handling-->[optional]

Example:-



Method signature:-In java method name and parameter-list considered as method signature, and inside a class two method with same signature not contain.

Method signature:- method name(parameter-list).

m1(int a)

m1(int a,int b)

Method name are same but method signature are different

There are two types of method in java
1)Instance Method
2)Static method

Instance Method:- Instance Method will be invoked at the time of object creation, If we want to access Instance method inside the instance area by using name of the method directly and inside static area by using object reference . it is also known as non-static method.

```
void m1()//instance method/non-static method
{
 //method Body  //instance area//non static area
}
```

Example:-Access instance method inside the instance area.

```
class Test
{
public void m1()//instance method
{
//instance area
System.out.println("m1()instance method");
}
public void m2()//instance method
{
//instance area
m1();
}
}
```

Example:-Access instance method inside the static area.

```
class Test
{
public void m1()//instance method
{
//instance area
System.out.println("m1()instance method");
}
public void m2()//instance method
{
//instance area
m1();
}
public static void main(String[]args)//static method
{
//static area.
Test t=new Test();
t.m2();
}
}
```

Result:-m1()instance method

Static method:- Static method will be invoked at the time of .class file load .If we want to access static method inside the instance area or static area by using method name directly but this rule is applicable only for within the class but outside of the class we access by using class name.

We can declare static method by using static keyword.

```
static  void m1()//static method
{
//method Body //static area
}
```

Example:-Access static variable within the class.

```
class Test
{
public static void m1()//static method
{
//static area
System.out.println("m1()static method");
}
public void m2()//instance method
{
//instance area
m1();
}
public static void main(String[]args)//static method
{
Test t=new Test();
t.m2();
m1();
}
}
```

Result:-

```
m1()static method
m1()static method
```

Example:-Access static variable outside of the class.

```
class Test1
{
static void m1()
{
System.out.println("m1() static method of Test1 class");
}
}
class Test2
{
public static void main(String[]args)
{
//m1();//12 line
Test1.m1();
}
}
```

Result:-

```
m1() static method of Test1 class
```

Note:-if we are not commenting line 12 then we will get compile time error saying

```
Test.java:12: error: cannot find symbol
m1();
symbol:   method m1()
location: class Test2
```

Case1:-

Instance and static methods without parameter and at the time of method calling we can’t pass any argument

Example:-

```
class Test
{
public void m1()
{
System.out.println("m1()instance method");
}
public static void m2()
{
System.out.println("m2() static method");
}
public static void main(String[]args)
{
Test t=new Test();
t.m1();
Test.m2();
}
}
```

Result:-

```
m1()instance method
m2() static method
```

Case2:-

Instance method and static method with parameter

At the time of method calling, we should compulsory pass the argument then corresponding method will be execute.

While passing parameters, number of argument and order of arguments important.

void m1(int a)...........t.m1(52);............................valid
void m2(int i,char ch,float f)......t.m2(12,’a’,12.32);......invalid
void m3(int i,char ch,float f).........t.m3(10,’v’,12.32f);...valid
void m4(int i char ch,float f).......t.m4(10,’v’);...........invalid

Example:-

```
class Test
{
public void m1(int a,char ch)
{
System.out.println("m1 instance method");
System.out.println(a);
System.out.println(ch);
}
public static void m2(double d,boolean b)
{
System.out.println("m2 static method");
System.out.println(d);
System.out.println(b);
}
public static void main(String[]args)
{
Test t=new Test();
t.m1(10,'v');
Test.m2(15.31,true);
}
}
```

Result:-

```
m1 instance method
10
v
m2 static method
15.31
true
```

Case3:-

While calling method we can pass variable as argument

Example:-

```
class Test
```

```
{
void m1(int a,boolean b,char ch)
{
System.out.println(a);
System.out.println(b);
System.out.println(ch);
}
public static void main(String[]args)
{
int a=10;
boolean b=true;
char ch='v';
Test t=new Test();
t.m1(a,b,ch);
}
}
```

Result:-

```
10
true
v
```

Case4:-

we can provide Object as parameter in the method.

Example:-

```
class Dog
{}
class Cat
{}
class Rat
{}
class Test
{
public void m1(Dog d,Cat c)
{
System.out.println("m1()instance method");
}
static void m2(int a,Rat r)
{
System.out.println("m2() static method");
}
public static void main(String[]args)
{
Dog d=new Dog();
Cat c=new Cat();
Rat r=new Rat();
Test t=new Test();
new Test().m1(new Dog(),new Cat());
t.m1(d,c);
t.m2(10,r);
Test.m2(10,new Rat());
}
}
```

Result:-

```
m1()instance method
m1()instance method
m2() static method
m2() static method
```

Case5:-

Inside a class we can't declare two methods with same signature otherwise we will get compile time error.

Example:-

```
class Test
{
void m1(int a)
{
System.out.println("m1 instance method");
}
static void m1(int b)
{
System.out.println("m1 static method");
}
public static void main(String[]args)
{
Test t=new Test();
t.m1(10);
}
}
```

Result:-

```
Test.java:7: error: method m1(int) is already defined in class Test
static void m1(int b)
```

Case6:-

Declaring a method inside another method is not possible in java method inner concept is not applicable.

Example:-

```
class Test
{
public void m1()
{
void m2()
{
System.out.println("m2()inner method");
}
}
public static void main(String[]args)
{
Test t=new Test();
t.m1();
}
}
```

Result:-

```
Test.java:5: error: illegal start of expressionvoid m2()
Test.java:5: error: ';'
Expected void m2()
```

Case7:-

Type-casting at method argument level

Example:-

```
class Test
{
public void m1(int x)
{
System.out.println("int value="+x);
}
public void m1(byte b)
{
System.out.println("byte value="+b);
}
public void m1(short s)
{
System.out.println("short value="+s);
}
public void m1(char ch)
{
System.out.println("char value="+ch);
}
public void m1(long l)
{
System.out.println("long value="+l);
}
public void m1(float f)
{
System.out.println("float value="+f);
}
public void m1(double d)
{
System.out.println("double value="+d);
}
public static void main(String[]args)
{
Test t=new Test();
t.m1(10);
t.m1((byte)20);
t.m1((short)30);
t.m1(40l);
t.m1('V');
t.m1(50.50f);
t.m1(60.60);
}
}
```

Result:-

```
int value=10
byte value=20
short value=30
long value=40
char value=V
float value=50.5
double value=60.6
```

Case8:-

A method can call any number of method but once method execution is completed the control returns to the caller method.

Example:-

```
class Test
```

```
{
public void m1()
{
m2();
System.out.println("m1()mehtod");
m2();
}
public void m2()
{
m3(100);
System.out.println("m2()method");
m3(100);
}
public void m3(int x)
{
System.out.println("m3()method");
}
public static void main(String[]args)
{
Test t=new Test();
t.m1();
}
}
```

Result:-

```
m3()method
m2()method
m3()method
m1()mehtod
m3()method
m2()method
m3()method
```

Method Vs Return type

In java method return type is compulsory and void represent nothing return .if we declare a method without return type then we will get compile time error.

Example:-

```
class Test
{
public m1()
{
System.out.println("m1()method not contain return type");
}
public static void main(String[]args)
{
Test t=new Test();
t.m1();
}
}
```

Result:-

```
Test.java:3: error: invalid method declaration; return type required
public m1()
```

Method return type can be any type like

-primitive types
-Array types
-class types
-Interface types
-Enum types

If the method return type other than void then must return the value by using return keyword otherwise we will get compile time error

Case1:- A method declare with float return type.

Example:-

```
class Test
{
float m1()
{
System.out.println("vikas");
return 11;
}
public static void main(String[]args)
{
Test t=new Test();
t.m1();
}
}
```

Result:-vikas

Case2:- A method declare without return type.

Example:-

```
class Test
```

```
{
float m1()
{
System.out.println("vikas");
}
public static void main(String[]args)
{
Test t=new Test();
t.m1();
}
}
```

Result:- Test.java:6: error: missing return statement

Inside a method we can declare only one return statement and that statement should be last statement otherwise we will get compile time error.

Case1:-Return statement is not last statement

Example:-

```
class Test
{
public int m1()
{
return 10;
System.out.println("m1()method");
}
public static void main(String[]args)
{
Test t=new Test();
t.m1();
}
}
```

Result:-

```
Test.java:6: error: unreachable statement
System.out.println("m1()method");
```

Case2:-Return statement is last the statement of the method.

```
class Test
{
public int m1()
{
System.out.println("m1()method");
return 10;
}
public static void main(String[]args)
{
Test t=new Test();
t.m1();
}
}
```

Result:- m1()method

Every method is able to return the value but holding that return value is optional ,but it is recommended to hold the return value check the status of the method.

Example:-

```
class Test
{
public boolean m1(int x,char ch)
{
System.out.println("m2() method");
System.out.println(x+".."+ch);
return true;
}
public static void main(String[]args)
{
Test t=new Test();
boolean b=t.m1(10,'v');
System.out.println("m1()method return values="+b);
}
}
```

Result:-

```
m2() method
10..v
m1()method return values=true
```

Print the return type values of the method by two ways.

1) Hold the value and then print that value

2) Directly print call method by using System.out.println() ,this approach is only applicable if method return type must be not void otherwise we will get compile time error.

Example:-

```
class Test
{
int m1()
{
System.out.println("m1()method");
return 7;
}
void m2()
{
System.out.println("m2()method");
}
public static void main(String[]args)
{
Test t=new Test();
int x=t.m1();
System.out.println("return value of m1()method is="+x);
System.out.println("return value of m1()method is="+t.m1());
t.m2();
//System.out.println(t.m2());//line:-19
}
}
```

Result:-

```
m1()method
return value of m1()method is=7
m1()method
return value of m1()method is=7
m2()method
```

Note:-If we remove comment form line 19 then we will get compile time error Saying:-

Test.java:19: error: 'void' type not allowed here
System.out.println(t.m2());

```
class Test
{
void m1(int age)
{
if(age>=18)
{
System.out.println("you are eligible for voting");
}
else
{
System.out.println("you are not eligible for gc");
}
}
public static void main(String[]args)
{
Test t=new Test();
t.m1(18);
}
}
```

Result:-

```
you are eligible for voting
```

A java class is able to return user defined class as a return type.

Example:-

```
class X
{}
class Emp
{}
class Test
{
public X m1()
{
System.out.println("m1()method");
X x=new X();
return x;
}
public Emp m2()
{
System.out.println("m2()method");
Emp e=new Emp();
return e;
}
public static String m3()
{
System.out.println("m3()method");
return "vikas";
}
public static void main(String[]args)
{
Test t=new Test();
X x1=t.m1();
System.out.println(x1);
Emp e=t.m2();
System.out.println(e);
String s=Test.m3();
System.out.println(s);
}
}
```

Result:-

```
m1()method
X@15db9742
m2()method
Emp@6d06d69c
m3()method
vikas
```

Template Method:-
In general, after complete the task we required to perform all the method calling, so at the time of method calling we should remember two things.

1. Number of method and name of method.
2. Order of method(which one is first and which one is later).

Overcome this problem we used Template Method, Template Method is normal method inside this we perform calling all method and based on our requirement we calling only Template Method instead all method one by one.

Example:-

```
//Template method
class Test
{
void customer()
{
System.out.println("customer");
}
void  product()
{
System.out.println("product");
}
void selection()
{
System.out.println("selection");
}
void billing()
{
System.out.println("billing");
}
void deliveryManager()
{
customer();
product();
selection();
billing();
}
public static void main(String[]args)
{
Test t=new Test();
t.deliveryManager();
}
}
Result:-
customer
product
selection
billing
```

Method recursion :-A method calling itself during execution is called recursion.

Example:-

```
class Test
{
public void m1()
{
System.out.println("m1() method");
m1();
}
public static void main(String[]args)
{
Test t=new Test();
t.m1();
}
}
```