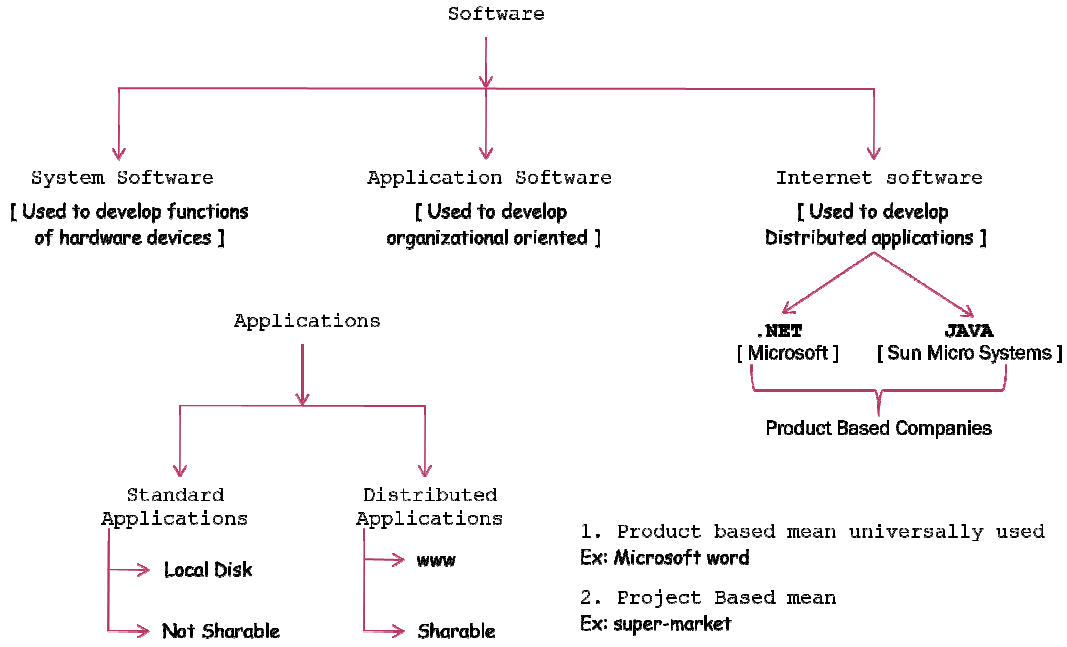
Day - 1:

Software is a development process which converts the imaginaries into reality by writing comes set of programs.



Day - 2:

In IT we develop two types of applications. They are **stand alone applications** and **distributed applications**.

A *stand alone application* is one which runs in the context of local disk. All *stand alone applications* are **not sharable**. *System software* and *application software* comes under *stand alone applications*.

- **System software** is used for developing functionality of hardware devices. Examples are C and ALP (Assembly Language Programming).
- **Application software** is used for developing organizations oriented applications. This is also known as *backend software's*. Examples are dbase, dbase III plus, FoxPro, oracle versions released till now.
- **Internet software** is used for developing *distributed applications*.

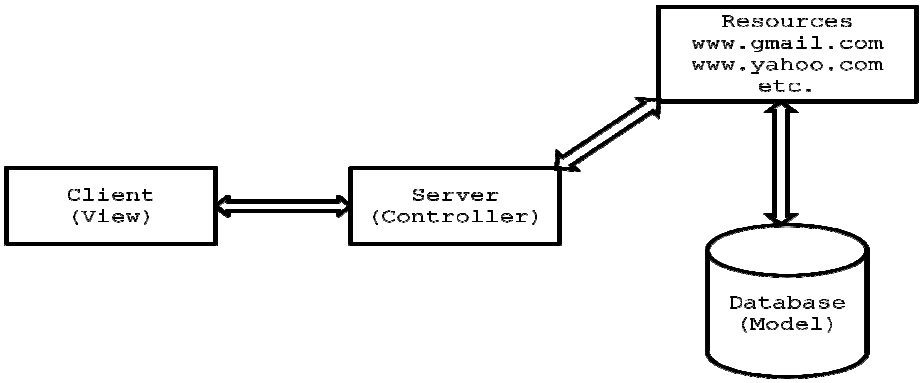
A **distributed application** is one which can be **accessed across the globe**. *Distributed application* is also one which runs in the contest of the **World Wide Web**. To develop *distributed applications* we must use **client-server architecture**.

In *client-server architecture* we must hare at least two programs they are **client program** and **server program**. A *client program* is one which always makes a request to get the service from the server. A *server program* is one which will do three operations **receiving** the request from client, **processing** the client request and **sending** *the response* to the client.

All the above three operations are performed by the server **concurrently**. In order to exchange the data between client and server we must use a protocol called *http* (**hypertext transfer protocol**).

Protocol is a set of values which are defined to exchange the data between client and server either locally or remotely.

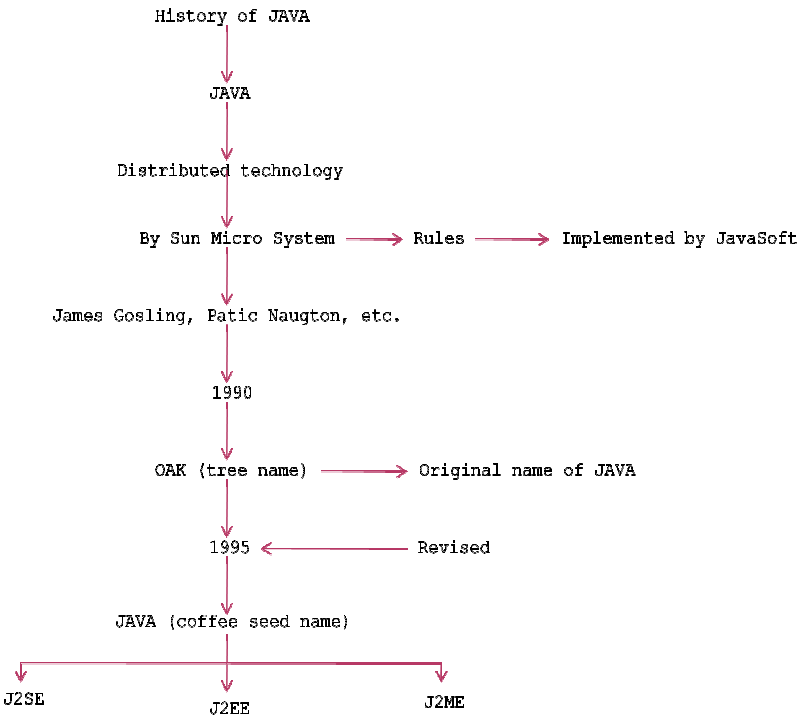
In order to develop *distributed applications*, two software companies came forward whose names are **Microsoft System** and **Sun Micro System**.



Day - 3:

Microsoft System has developed a technology called **DOT NET** and *Sun Micro System* has developed a technology called **JAVA**. Both this technologies are called *distributed technologies*.

The technology DOT NET will run only on that operating system's which are provided by *Microsoft* (as on today). Hence *DOT NET* technology is *platform dependent technology*. Whereas, the technology called *JAVA* will run on all operating system's irrespective of their providers hence *JAVA* is called *platform independent technology*.



The slogan of *JAVA* is "**Write One's Reuse/Run Anywhere** (WORA)".

DOT NET technology is not freely downloadable where as *JAVA* freely downloadable. *DOT NET* supports *Microsoft* developed *design patterns* (general designed patterns are not supported) whereas *JAVA* supports all the *design patterns* which are available in IT.

Design pattern is a predefined and proved rule by third party industry experts to avoid the receiving problems which are occurring in software development.

History of JAVA:

JAVA is a *distributed technology* developed by *James Gosling*, *Patric Naugton*, etc., at *Sun Micro System* has released lot of rules for *JAVA* and those rules are implemented by *JavaSoft Inc, USA* (which is the software division of *Sun Micro System*) in the year 1990. The original name of *JAVA* is **OAK** (which is a tree name). In the year 1995, *OAK* was revised and developed software called *JAVA* (which is a coffee seed name).

JAVA released to the market in three categories **J2SE** (*JAVA* 2 Standard Edition), **J2EE** (*JAVA* 2 Enterprise Edition) and **J2ME** (*JAVA* 2 Micro/Mobile Edition).

i. *J2SE* is basically used for developing *client side applications/programs*.
ii. *J2EE* is used for developing *server side applications/programs*.
iii. *J2ME* is used for developing *server side applications/programs*.

If you exchange the data between *client and server programs* (*J2SE* and *J2EE*), by default *JAVA* is having on internal support with a protocol called *http*. *J2ME* is used for developing *mobile applications* and *lower/system level applications*. To develop *J2ME* applications we must use a protocol called *WAP* (Wireless Applications Protocol).

Day - 4:

FEATURES of java:

1. Simple
2. Platform independent
3. Architectural neutral
4. Portable
5. Multi threading
6. Distributed
7. Networked
8. Robust
9. Dynamic
10. Secured
11. High performance
12. Interpreted
13. Object Oriented Programming Language

1. **Simple:** *JAVA* is simple because of the following factors:
   i. *JAVA* is free from pointers hence we can achieve less development time and less execution time [whenever we write a *JAVA* program we write without pointers and internally it is converted into the equivalent pointer program].
   ii. Rich set of **API** (application protocol interface) is available to develop any complex application.
   iii. The software *JAVA* contains a program called **garbage collector** which is always used to collect unreferenced (unused) memory location for improving performance of a *JAVA* program. [*Garbage collector* is the system *JAVA* program which runs in the background along with regular *JAVA* program to collect unreferenced memory locations by running at periodical interval of times for improving performance of *JAVA* applications.
   iv. *JAVA* contains user friendly syntax's for developing *JAVA* applications.

2. **Platform Independent:**

   A program or technology is said to be *platform independent* if and only if which can run on all available operating systems.

   The languages like C, Cpp are treated as *platform dependent* languages since these languages are taking various amount of memory spaces on various operating systems [the operating system **dos** understands everything in the form of its native format called **Mozart** (MZ) whereas the operating system **Unix** understands everything in its negative format called **embedded linking format** (elf). When we write a C or Cpp program on *dos* operating and if we try to transfer that program to *Unix* operating system, we are unable to execute since the format of these operating systems are different and more over the C, Cpp software does not contain any special programs which converts one format of one operating system to another format of other operating system].

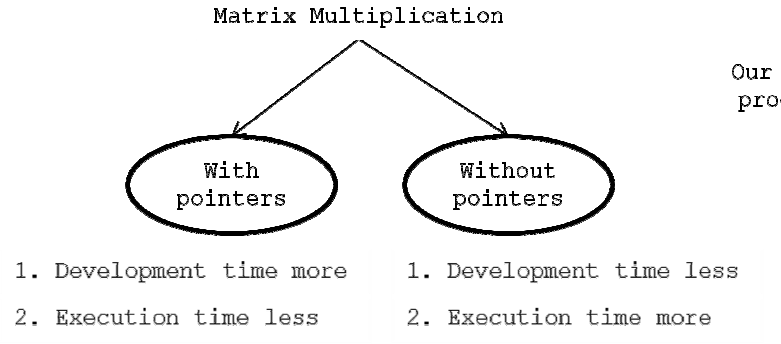
   The language like *JAVA* will have a common data types and the common memory spaces on all operating systems and the *JAVA* software contains the special programs which converts the format of one operating system to another format of other operating system. Hence *JAVA* language is treated as *platform independent* language.

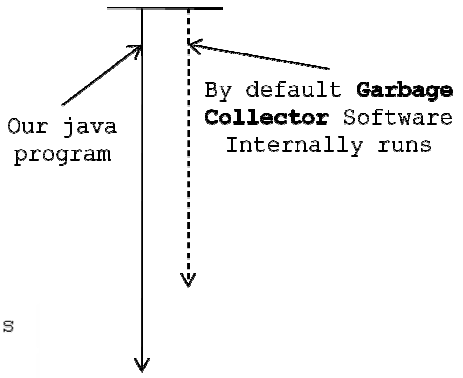
DAY - 5:

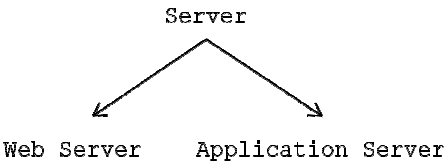
[*JAVA* language is also treated as server independent language since the server side program can run on any of the server which is available in the real world (**web server** or **application server**). *JAVA* can retrieve or store the data in any one of the data base product which is available in rest world irrespective of their vendors (developers) hence *JAVA* language is product independent language.

In order to deal with server side program from the client side, we can use C language client program, Cpp client program, *DOT NET* client program, etc. hence *JAVA* language is a *simple, platform independent, server independent, data base/product independent* and *language independent programming language*].

MVC Architecture:







3. **Architectural Neutral:**

A language or technology is said to be *architectural neutral* which can run on any available processors in the real world. The languages like C, Cpp are treated as *architectural dependent*. The language like *JAVA* can run on any of the processor irrespective of their *architecture* and *vendor*.

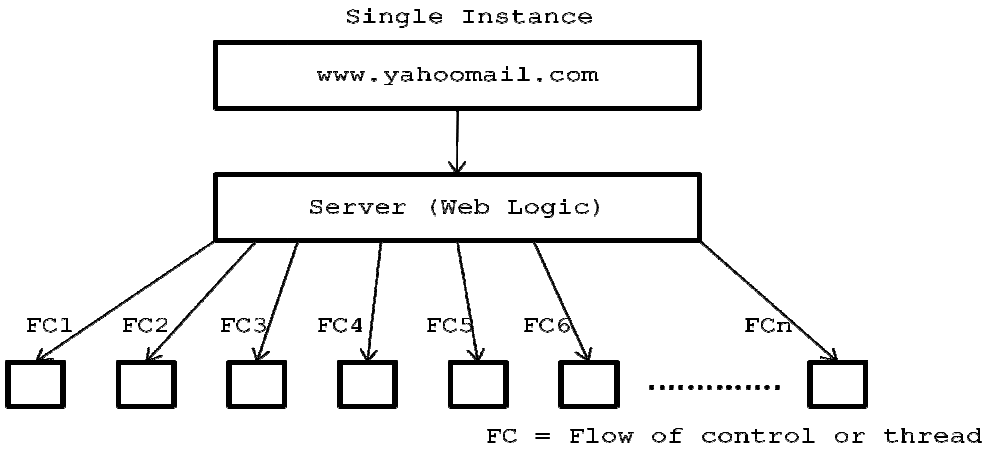
Machine1		Machine2
DOS	≠	UNIX
P3	≠	AMD
JDK	=	JDK

Portability = platform independent + architecture neutral

4. **Portable:**

A portable language is one which can run on all operating systems and on all processors irrespective their *architectures* and *providers*. The languages like C, Cpp are treated as *non-portable* languages whereas the language *JAVA* is called *portable* language.

5. **Multi Threading:**



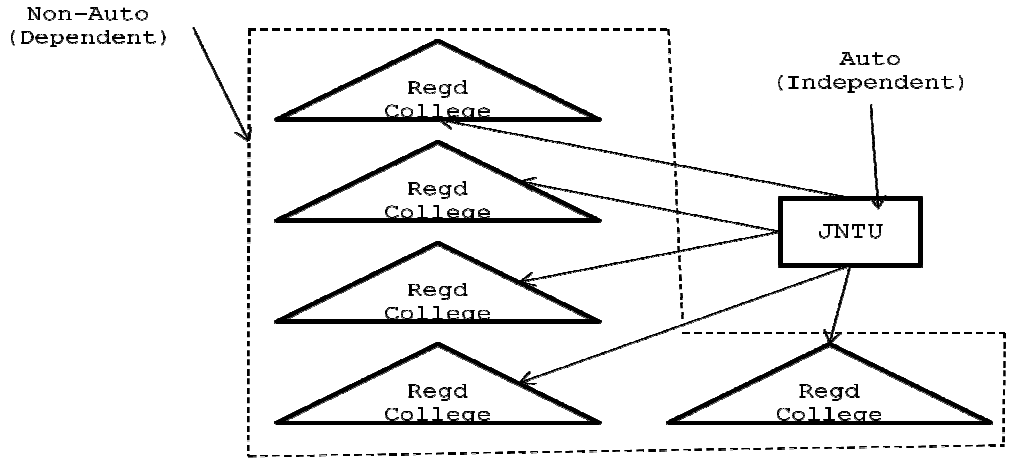
Day - 6:

Definitions:

1. A **flow of control** is known as **thread**.
2. A **multi threaded program** is one in which there exists **multiple flow of controls** i.e., *threads*.
3. A program is said to be **multi threaded program** if and only of there exists n number of sub-programs. For each and every sub-program there exists a separate *flow of control*. All such *flow of controls* are executing concurrently. Such *flow of controls* is known as *threads*. Such type of applications is known as *multi threading applications*.
4. The languages like C, Cpp are treated as *threads* as **single threaded modeling languages** (STML). SMTL are those in which there exists **single flow of control**.
5. The languages like *JAVA* and *DOT NET* are treated as **multi threaded modeling languages** (MTML). MTML are those in which there exist **multiple flows of controls**.
6. Whenever we write a *JAVA* program there exists by default *two threads*. They are **foreground/child thread** and **background/main/parent thread**.
7. A *foreground thread* is one which always executes user defined sub-programs. In a *JAVA* program there is a possibility of existing n number of *foreground threads*.
8. A *background thread* is one which always monitors the status of *foreground thread*. In each and every *JAVA* program there exists only one background thread.
9. Hence *background thread* will be created first and later *foreground thread* will be created.

6. **Distributed:**

A service is a said to be a *distributed* service which runs in *multiple servers* and that service can be accessed by n number of clients across the globe. In order to develop *distributed applications* we must require architecture called *trusted network* architecture. To develop these applications we require a technology called *J2EE*. *Distributed applications* are preferred by large scale organizations.



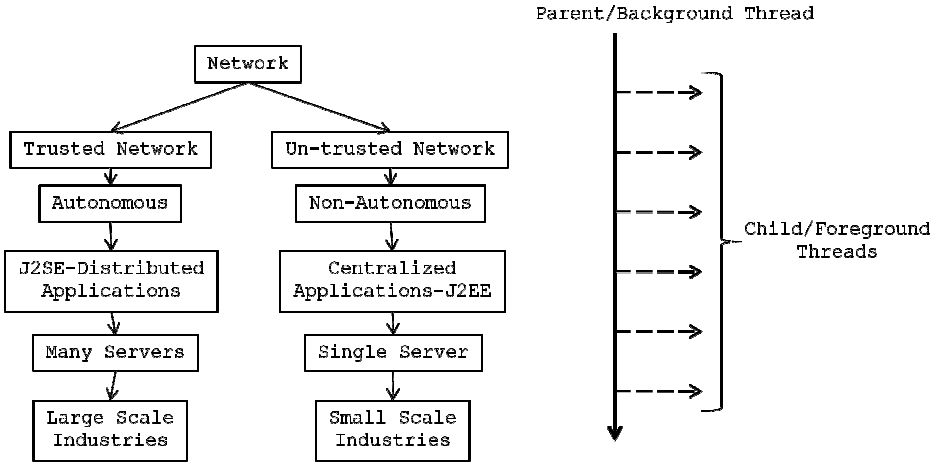
Day -7:

7. **Networked:**

In real world we have two types of networks. They are **un-trusted networks** and **trusted networks**.

Un-trusted networks:

A network is said to be *un-trusted network* in which there exists n number of **inter connected non-autonomous architecture**. *Un-trusted network* is also known as **LAN**. Using this network architecture, we develop *centralized applications*. A *centralized application* is one which runs on **single server** and it can be access in limited graces. In order to develop *centralized applications* we may use a technology called **J2SE** and these kinds of applications are preferred by **small scale organization**.



Trusted network:

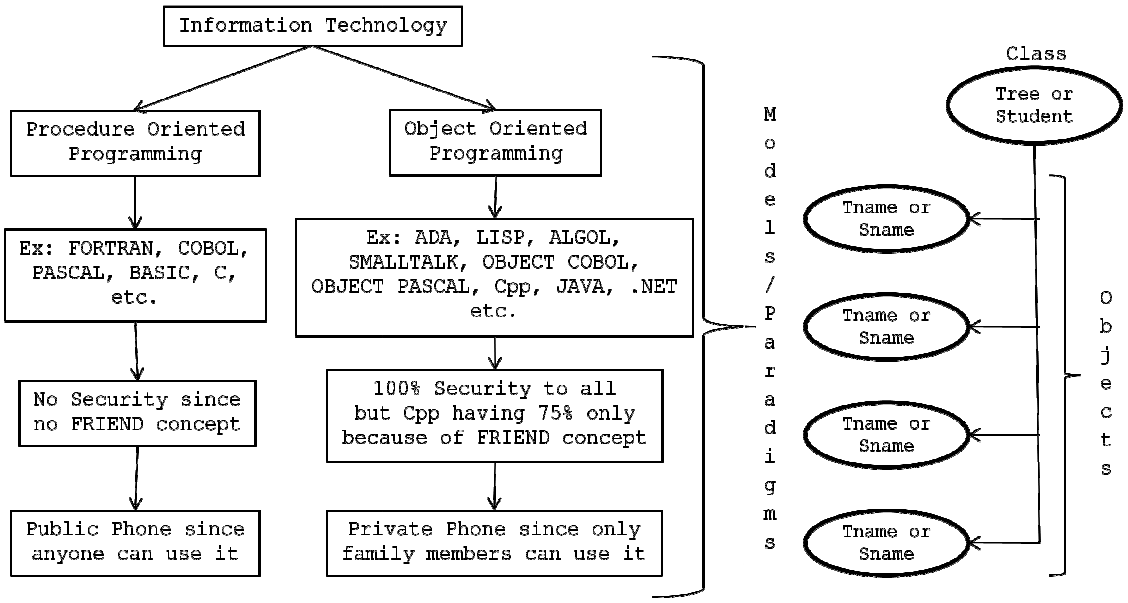
A network is said to be *trusted network* in which there exists n number of **inter connected autonomous architecture**. *Trusted network* is also known as **WAN**. Using this network, we can develop *distributed applications*. A *distributed application* is one which runs on **multiple servers** and it can be access in unlimited graces. In order to develop *distributed applications* we may use

a technology called **J2EE** and these kinds of applications are preferred by **large scale organization**.

Java is OBJECT ORIENTED PROGRAMMING language:

In an IT we have two types of programming models (paradigms) are available. They are **procedure oriented programming language** and **object oriented programming language**.

If we represent the data using *procedural oriented programming languages* then there is no security for the data which we represent. For example when we represent the data of a student in C language using structures concept, the student data can be accessed by all the functions which we write as a part of C program. If one of the functions manipulates or damages the data then we are loosing correction-less (integrity) of the data. Examples of *procedure oriented programming languages* are FORTRON, COBOL, PASCAL, BASIC, C, etc.



When we represent the data in *object oriented programming language* we get the security. Examples of *object oriented programming languages* are LISP, ADA, ALGOL, SMALLTALK, OBJECT COBOL, OBJECT PASCAL, Cpp, JAVA, DOT NET, etc. In order to say any language is an *object oriented programming language* it has to satisfy 8 principles of **OOPs**.

OOPs Principles:

1. Class.
2. Object.
3. Data Abstraction.
4. Data Encapsulation.
5. Inheritance.
6. Polymorphism.
7. Dynamic Binding.
8. Message Passing.

Day - 8:

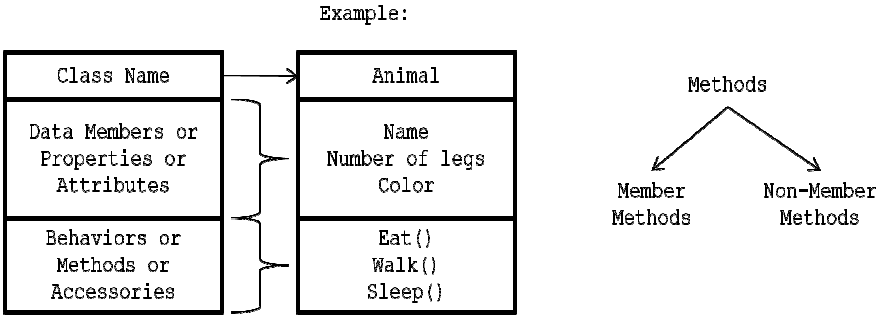
1. **CLASS:** "*A **class** is a way of binding the data and associated methods in a single unit*".

   Any JAVA program if we want to develop then that should be developed with respective *class* only i.e., without *class* there is no JAVA program.

   In *object oriented programming's*, generally we write two types of **methods**. They are **member methods** and **non-member methods**.

   - A *member method* is one which is comes under the scope of the *class*. In JAVA we use only *member methods*.
   - *Non-member methods* are those which are not comes under the scope of the *class*. JAVA does not allow *non-member methods* at all.

Class diagram for defining a *class*:



Syntax for defining a **CLASS:**

```
Class <clsname>
{
      Variable declaration;
      Methods definition;
};
```

Here, *class* is a **keyword** which is used for developing or creating **user defined datatypes**. *Clsname* represents a JAVA valid variable name and it is treated as name of the *class*. *Class* names are used for creating **objects**.

Class contains two parts namely **variable declaration** and **method definitions**. *Variable declaration* represents what type of **data members** which we use as a part of the *class*. *Method definition* represents the type of *methods* which we used as the path of the *class* to perform an operation.

By making use of the variables, which are declared inside the *class*? Every operation in JAVA must be defined with in the *class* only i.e., outside definition is not possible

Example: Define a *class* called a student..?

Answer:

```
Class student
{
      Int stno;
      String stname;
```

```
        Float marks;
        String cname;
        Int getnohoursstudy ()
        {
                ……
                ……
        }
        String getgrade ()
        {
                ……
                ……
        }
} [;]—optional
```

Whenever we define a *class* there is no memory space for *data members* of the *class*. Memory space will be created for the *data members* of the *class* when we create *object*.

NOTE:

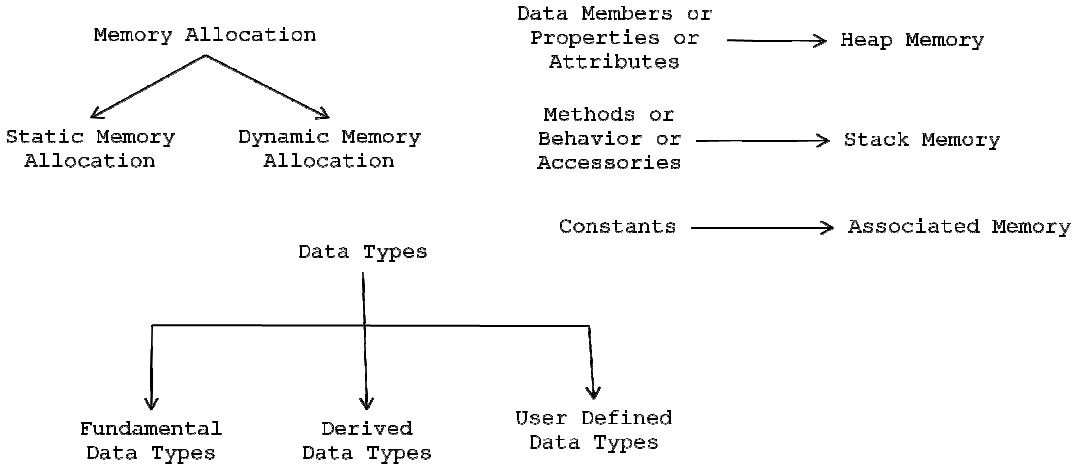
1. In JAVA memory space for the *data members* will be creating on **heap memory** (D**ynamic memory**).
2. Memory space for *methods* will be creating on **stack memory** (that too when we call the *methods*).
3. All **constants** of any JAVA program is available in **associative memory** (retrieving data from *associative memory* is negligible).
4. The *class* definition exists only one time but whose *objects* can exists many number of times i.e., a *class* is acting as a formula form.

Day - 9:

2. **OBJECT:** In order to **store the data** for the *data members* of the *class*, we must create an *object*.
    1. **Instance** (*instance* is a **mechanism of allocating** sufficient amount of **memory space** for *data members* of a *class*) of a *class* is known as an *object*.
    2. **Class variable** is known as an *object*.
    3. **Grouped item** (*grouped item* is a variable which **allows us to store more than one value**) is known as an *object.*
    4. **Value form** of a *class* is known as an *object*.
    5. **Blue print** of a *class* is known as an *object*.
    6. **Logical runtime entity** is known as an *object*.
    7. **Real world entities** are called as *objects*.

NOTE:

- JAVA always follows **dynamic memory allocation** but not **static memory allocation**.
- In order to create a memory space in JAVA we must use an operator called **new**. This *new* operator is known as *dynamic memory allocation operator*.



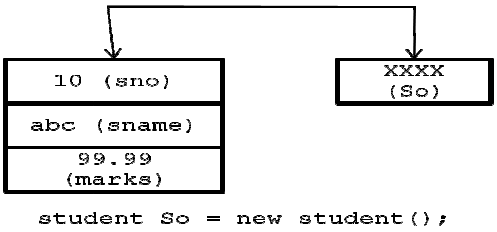
Syntax-**1** for defining an **OBJECT**:

```
<Clsname> objname = new <clsname ()>
```

Clsname represents name of the *class*. *Objname* represents JAVA valid variable name treated as *object*. *New* is called *dynamic memory allocation operator*.

Clsname () represents **constructor**. The *new* operator will perform two standard actions. They are:

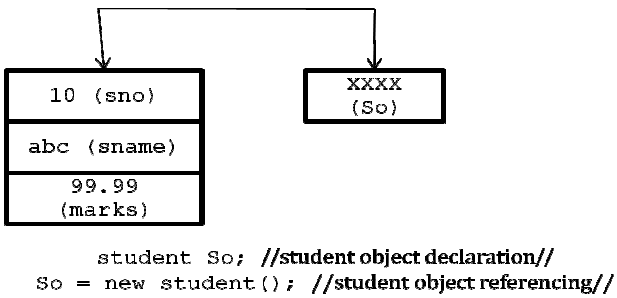
i. It allocates sufficient amount of memory space for the *data members* of the *class*.
ii. It takes an address of the *class* and stored in the left hand side variable of syntax-1.



Syntax-**2** for defining an **OBJECT**:

```
<Clsname> objname; //object declaration//
Objname = new <clsname ()>; //object referencing//
```

When an *object* is **declared** where value is **null**. Since, there is no memory space for *data members* of the *class*. When the *object* is **referenced** the value of the *object* is **not null**. Since, memory space is created for the *data members* of the *class*.



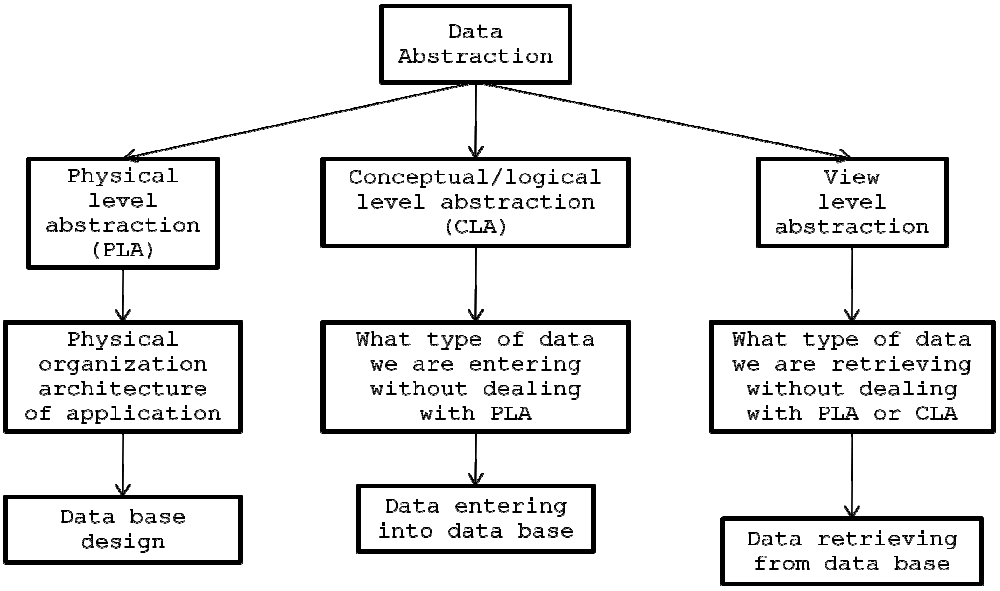
"*The difference between **class** and **object..**?*"

Class	Object
1) A *class* is a way of binding the data and associated methods in a single unit.	1) *Class variable* is known as an *object*.
2) Whenever we start executing a JAVA program, the *class* will be loaded into main memory with the help of **class loader subsystem** (a part of JVM) only once.	2) After loading the *class* into main memory, *objects* can be created in n number.
3) When the *class* id defined there is no memory space for *data members* of a *class*.	3) When an *object* is created we get the memory space for *data members* of the *class*.

3. **Data Abstraction:**

"*Data abstraction is a mechanism of **retrieving** the essential **details without dealing** with **background details***".

Day - 10:



NOTE:

In real world we have three levels of *abstractions*. They are **physical level abstraction, conceptual/logical level abstraction** and **view level abstraction**.

- *Physical level abstraction* is one; it always deals with **physical organization architecture** of the application. For example, in real world an **application designing of any problem** comes under *physical level abstraction*.

Emp table

Empno	Ename	Sal

- *Conceptual/logical level abstraction* is one it always deals with what kind of **data** we are **entering without dealing** with *physical architecture* of the application. For example, **entering** the **data into** the **database, writing the coding and applying testing principle** comes under *conceptual level abstraction*.

Emp table

Empno	Ename	Sal
143	suman	10000
144	kalyan	15000

- *View level abstraction* deals with what kind of **data** we are **retrieving without dealing** with both *conceptual level abstraction* and *physical level abstraction*. For example, **retrieving** the **data from** the **data base** in various combinations. **All internet users** come under *view level abstraction*.

4. **Data Encapsulation:**

"*Data encapsulation is the process of* ***wrapping up on data*** *and* ***associated methods*** *in a* ***single unit***".

- *Data encapsulation* is basically used for **achieving data/information hiding** i.e., security.
- When we want **to send the data** from **client** to the **server** we must always send in the form of **JAVA object** only. Since, by default the JAVA *object* is in **encrypted** form (we should **not send the data** from **client** to the **server** in the form of **fundamental data**).

5. **Inheritance:**

- *Inheritance* is the process of taking the features (*data members* + *methods*) from one *class* to another *class*.
- The *class* which is **giving the features** is known as **base/parent class**.
- The *class* which is **taking the features** is known as **derived/child/sub class**.
- *Instance* is known as **sub classing** or **derivation** or **extendable classes** or **reusability**.

Advantages of INHERITANCE:

I. Application development time is very less.
II. Redundancy (repetition) of the code is reducing. Hence we can get less memory cost and consistent results.
III. Instrument cost towards the project is reduced.
IV. We can achieve the slogan *write one's reuse/run anywhere* (WORA) of JAVA.

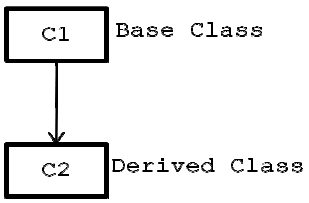
Day - 11:

Types of INHERITANCES (Reusable techniques):

Based on taking the features from **base class** to the **derived class**, in JAVA we have five types of inheritances. They are as follows:

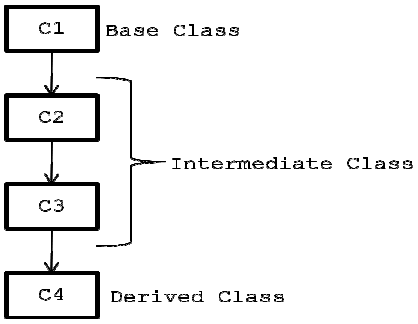
i. **Single Inheritance:**

Single class is one in which there exists **single** *base class* and **single** *derived class*.



ii. **Multi Level Inheritance:**

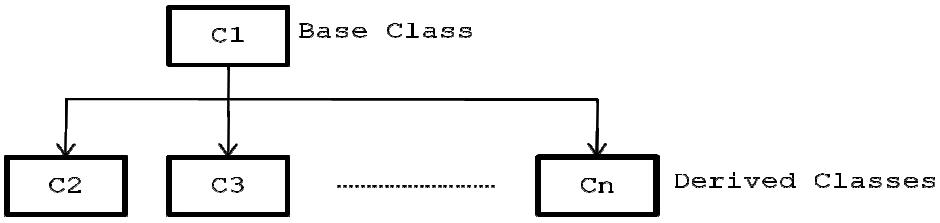
Multi level inheritance is one which there exist **single** *base class*, **single** *derived class* and **n number** of **intermediate** *base classes*.



An *intermediate base class* is one, in **one context** it acts as *bass class* and in **another context** it acts as *derived class*.

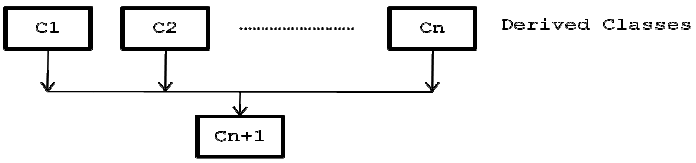
iii. **Hierarchical Inheritance:**

Hierarchical inheritance is one in which there exists **single** *base class* and **n number** of *derived classes*.



iv. **Multiple Inheritances:**

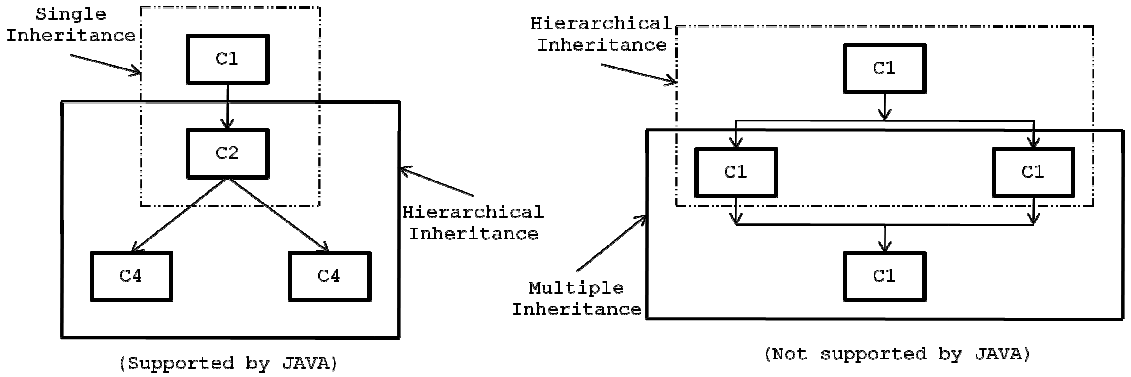
Multiple inheritance is one in which there exists **n number** of *bass classes* and **single** *derived classes*.



Multiple inheritances are **not supported** by JAVA through *classes* but it is **supported** by JAVA through the concept of **interfaces**.

v. **Hybrid Inheritance:**

Hybrid inheritance = **combination** of any available *inheritances* **types**.



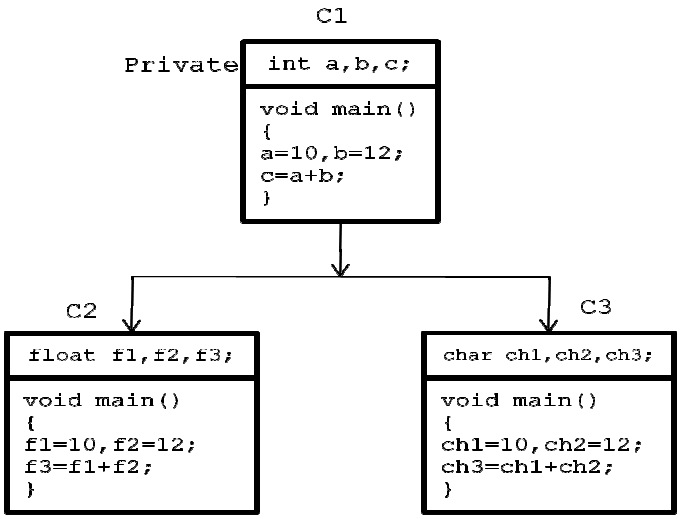
In the *combination*, one of the *combinations* is *multiple inheritances*.

Hybrid inheritance also will **not** be **supported** by JAVA through the concept of *classes* but it is **supported** through the concept of *interfaces*.

6. **<u>Polymorphism</u>:**

Polymorphism is a process of representing "*one form in many forms*".

- In *object oriented programming's*, we have two types of *polymorphism*. They are **compile time polymorphism** and **run time polymorphism**.
- JAVA does **not support** *compile time polymorphism* but JAVA **supports** only *run time polymorphism*.



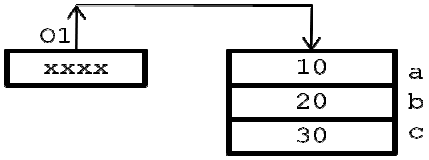
In the above diagram we have a single sum method but it is defined in many forms hence that method is known as **polymorphic method**.

7. **<u>Dynamic Binding</u>:**

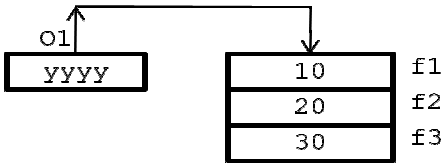
"*Dynamic binding is a mechanism of binding an appropriate version of a derived class which is inherited from base class with base class object*".

- Every real time application will be **developed** with concept of *polymorphism* and **executed** with the concept of *dynamic binding*.
- *Dynamic binding* is basically used to **reduce** the amount of **memory space** for **improving** the **performance** of JAVA applications.

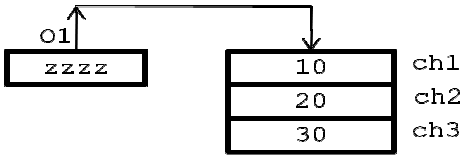
```
1) C1 O1 = new C1();
2) O1.sum();
```




```
3) O1 = new C2();
4) O1.sum();
```




```
5) O1 = new C3();
6) O1.sum();
```



In the line numbers 1, 3 and 5 the *object* oven contains address of c1, c2 and c3 *classes* respectively one at a time. Hence that object is known as **polymorphic object**. In the line numbers 2, 4 and 6 the statement `O1.sum ()` is known as **polymorphic statement**.

NOTE:

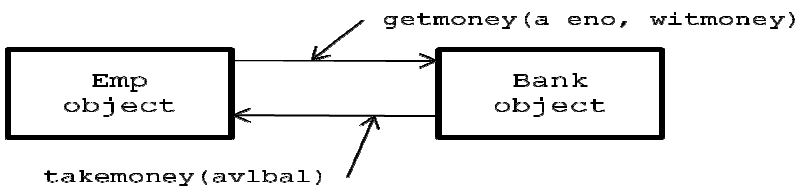
- **Function overriding** = **function heading** is **same** but **function definition** is **different**.
- A function is said to be **overloaded function** if and only if **function name** is **same** but its **signature** (*signature* represents **number of parameters**, **type of parameters** and **order of parameters**) is **different**.

Day - 12:

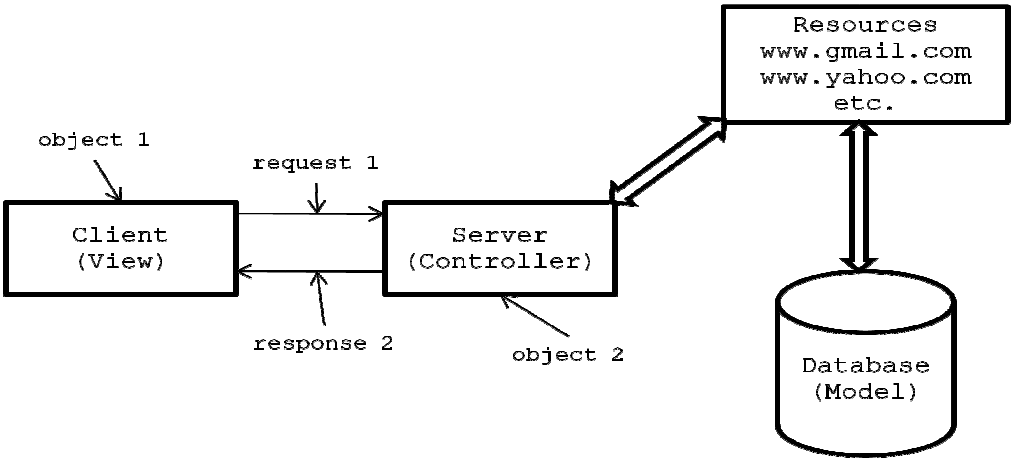
8. **Message Passing:**

Definitions:

i. **Exchanging** the **data between** *multiple objects* is known as **message passing**.



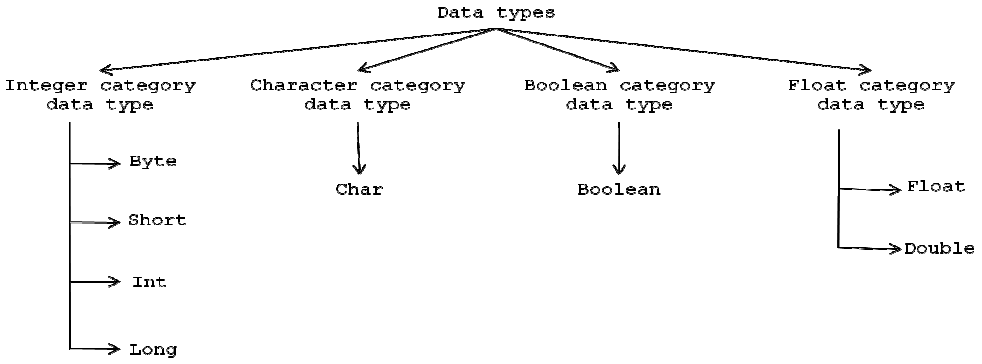
ii. *Message passing* is the process of **exchanging** the **data** between **two remote/local** *objects* for a period of time across the *network* (trusted) for **generating multiple requests** for **obtaining multiple responses** for performing a meaningful operation.



iii. *Message passing* JAVA is achieved through the concept of *methods*.

DATA TYPES in java

"***Data types*** *are used for* ***representing the data in main memory*** *of the computer*".



In JAVA, we have eight *data types* which are organized in four groups. They are **integer category data types**, **float category data types**, **character category data types** and **Boolean category data types**.

1. **Integer category data types:**

These are used to represent *integer data*. This category of *data type* contains four *data types* which are given in the following table:

S. No	Data type	Size (bytes)	Range
1	Byte	1	+127 to -128
2	Short	2	+32767 to -32768
3	Int	4	+2147483647 to -2147483648
4	long	8	$\pm 9.223*10^{18}$

Whatever the *data type* we use that should **not exceed predefined value**.

NOTE: Range of any data type = $(A)^{\text{number of bits occupied by a data type}}$

Where, A = number of bits available in the language which is understand by computer i.e., 2 bits.

For example:

Range of byte $= 2^8$
$= 1$ to 256
$= 0$ to 255
$= 0$ to $(255/2)$
$= (127.5 - 0.5 = +127)\ (127.5 + 0.5 = -128)$

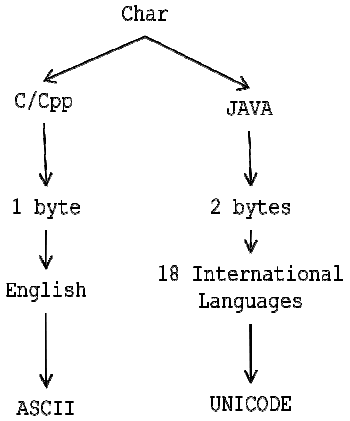
2. **Float category data types:**

Float category data types are **used for representing** the **data** in the **form of scale**, **precision** i.e., these category *data types* are **used for representing float values**. This category contains two *data types*; they are given in the following table:

S. No	Data type	Size (bytes)	Range	Number of decimal places
1	Float	4	+2147483647 to -2147483648	8
2	Double	8	$\pm 9.223*10^{18}$	16

Whenever we take any decimal constant directly in a JAVA program it is by **default** treated as **highest** *data type* in *float category* i.e., double.

3. **Character category data types:**
   - A *character* is an identifier which is **enclosed within single quotes**.
   - In JAVA to represent *character* data, we use a *data type* called **char**. This *data type* takes two bytes since it follows UNICODE *character set*.



Data type	Size (bytes)	Range
Char	2	+32767 to -32768

   - JAVA is **available in 18 international languages** and it is following UNICODE *character* set.
   - UNICODE *character set* is one which contains all the *characters* which are available in 18 international languages and it **contains 65536 characters**.

Day - 13:

4. **Boolean category data types:**
   - *Boolean category data type* is **used for representing logical values** i.e., **TRUE** or **FALSE** values.
   - To represent *logical values* we use a **keyword** called **Boolean**.
   - This *data type* takes 0 bytes of memory space.

NOTE: All *keywords* in JAVA must be written in **small letters only**.

VARIABLES in java

"*A variable is an identifier whose value will be changed during execution of the program*".

Rules for writing variables:

i. **First letter** must be an **alphabet**.
ii. The **length of the variable** should **not exceed more than 32 characters**.
iii. **No special symbols** are **allowed except underscore**.
iv. **No keywords** should **use** as **variable names**.

Types of variables in JAVA:

- Whenever we develop any JAVA program that will be developed with respect to *class* only.
- In a *class* we can use 'n' number of *data members* and 'n' number of *methods*.
- Generally in JAVA, we can use two types of *data members* or *variables*. They are **instance/non-static variables** and **static variables**.

INSTANCE/NON-STATIC VARIABLES	STATIC VARIABLES
1) An *instance variable* is one whose **memory space is creating each and every time** whenever an **object is created**.	1) *Static variables* are whose **memory space is creating only once** when the **class is loaded** by **class loader subsystem** (a part of JVM) in the **main memory irrespective** of **number of objects**.
2) Programmatically *instance variable* declaration **should not be preceded** by **keyword static**.	2) Programmatically *static variable* declaration **must be preceded by keyword static**.
3) `Data type v1, v2…vn;`	3) `Static data type v1, v2…vn;`
4) *Instance variable* must be **accessed** with respect to *object* name i.e., `objname.varname;`	4) *Static variables* must be **accessed** with respect to *class* name i.e., `classname.varname;`
5) **Value** of *instance variable* is **not sharable**.	5) **Value** of *static variable* is always recommended for **sharable**.
6) *Instance variable* are also known as **object level data members** since they are **dependent on objects**.	6) *Static variable* are also known as **class level data members** since they are **dependent on classes**.

CONSTANTS in java

"*Constant is an identifier whose value cannot be changed during execution of the program*".

- In JAVA to make the identifiers are as *constants*, we use a *keyword* called **final**.
- Final is a *keyword* which is playing an important role in three levels. They are **at variable level**, **at method level** and **at class level**.

i. When we don't want to change the value of the *variable*, then that *variable* must be declared as *final*.

Syntax for **FINAL VARIABLE INITIALIZATION:**

```
Final data type v1=val1, v2=val2 … vn=valn;
```

For example:

```
Final int    a=10;
             a=a+20; //invalid
             a=30; //invalid
```

ii. When the *final variable* is **initialized**, **no** more **modifications or assignments** are **possible**.

Syntax for **FINAL VARIABLE DECLARATION:**

```
Final data type v1, v2……vn;
```

For example:

```
Final int    a;
             a=a+1; //invalid
             a=30+2; //invalid
             a=400; //valid for 1st time
             a=500; //invalid
```

Whenever a final variable is declared first time assignment is possible and no more modification and further assignments are not possible. Hence, final variables cannot be modified.

Day - 14:

PROGRAMMIG BASIC'S

System.out.println ("");

- This statement is **used for displaying** the **data** or **messages** on to the **consol** (monitor).
- Here, **println** is the **predefined instance method** of **print stream class**.
- To call this *method* we require an *object* called *print stream class*.
- The *object* of *print stream class* is called **out** is created as a **static data member** in **system class** (*system* is a **predefined class**).
- Hence to call the *println method* we must use the following statement:

```
System.out.println ("WELCOME TO JAVA");
```

- **Print stream class** is a predefined class which contains nine overloaded instance println methods and nine overloaded instance print methods and whose prototypes are as follows:

```
Public void println (byte);
Public void println (short);
Public void println (int);
Public void println (long);
Public void println (float);
Public void println (double);
Public void println (char);
```

```
Public void println (Boolean);
Public void println (string);

Public void print (byte);
Public void print (short);
Public void print (int);
Public void print (long);
Public void print (float);
Public void print (double);
Public void print (char);
Public void print (Boolean);
Public void print (string);
```

Day - 15:

For example 1:

```
Int a=40000;
System.out.println (a); //40000
System.out.println ("value of a=" + a); //value of a=40000
System.out.println (a + "is the value of a"); //40000 is the value of a
```

For example 2:

```
Int a=10, b=20, c;
C = a + b;
System.out.println (c); //30
System.out.println ("sum=" + c); //sum=30
System.out.println (c + "is the sum"); // 30 is the sum
System.out.println ("sum of" + a + "and" + b + "=" + c); //sum of 10 and 20 is 30
```

For example 3:

```
System.out.println ("WELCOME TO JAVA");
```

STRUCUTURE of a java program

Package details:

```
class <clsname>
{
      Data member's declaration;

      User defined methods;

      Public static void main (string k [])
      {
            Block of statements ();
      }
}
```

- Every program in JAVA must be developed with respect to *class*.
- **Data member's declaration** represents the type of *data members* which we use as a part of the *class*.

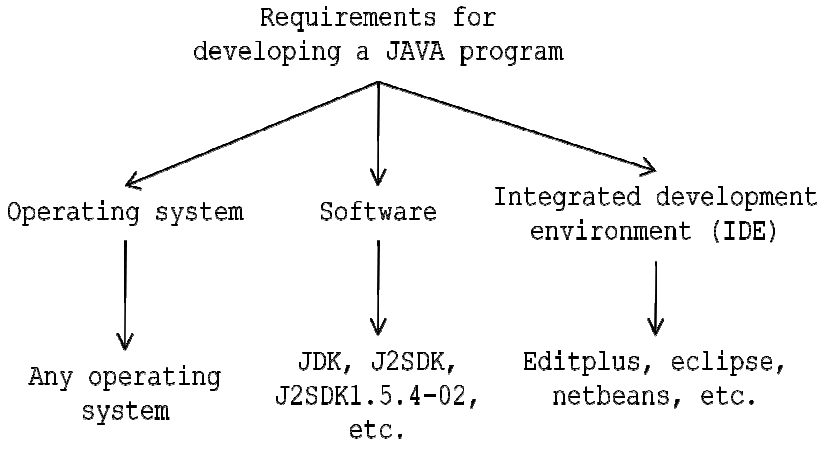
- **User defined methods** represents the type of *methods* which we use as a part of the *class* to perform some meaningful operation by making use of the *data members* of *class*.
- Here **main** represents the name of the *method* where the program execution starts and **void** represents return type of *main method* which indicates *main method* does not return anything.
- Since *main method* is executing only once hence it must be *static method*. Since *main method* can be called/accessed by everybody and hence it belongs to **public method**.
- **Block of statements** represents the valid executable statements of JAVA which will call the *user defined methods*.

Write a JAVA program to display a message "welcome to JAVA"?
Answer:

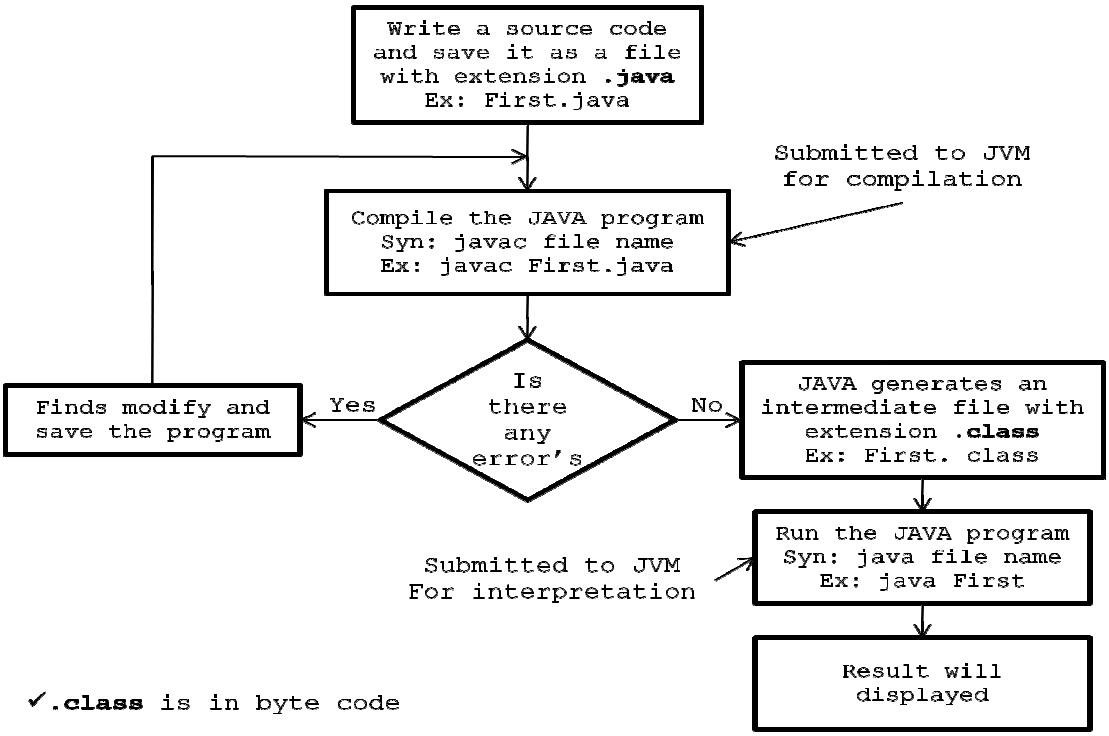
```
class First
{
      Public static void main (string k []);
      {
            System.out.println ("welcome to JAVA");
      }
}
```

NOTE:

- While giving the **file name** to a JAVA program **we must give** the file name **as name of the class** with an **extension** "**.java**" in which ever the *class main method* presents.
- Whenever we give *println* it will **prints in the new line** whereas *print* **prints in the same line**.



Steps for COMPILING and RUNNING the java program



Write a JAVA program which illustrates the concept of *instance methods* and *static methods*?

Answer:

```
class Second
{
      Void disp1 ()
      {
            System.out.println ("disp1-instance");
      }
      Static void disp2 ()
      {
            System.out.println ("disp2-static");
      }
      Public static void main (string k [])
      {
            System.out.println ("main-beginning");
            Second so = new Second ();
            so. disp1 ();
            Second. disp2 ();
            System.out.println ("main-end");
      }
} //second
```

NOTE:

1. **One static method** can **call another static method directly** provide **both the static method belongs to same class**.
2. **One instance method** can **call another instance method directly** provide **both the static instance method belongs to same class**.

Day - 16:

HUNGARIAN NOTATION:

Hungarian Notation is the naming convention followed by *SUN* (**Stanford University Network**) *micro system* to develop their **predefined classes, interfaces, methods** and **data members**.

Hungarian rule for **CLASS** or **INTERFACE:**

If a *class object interface* contains more than one word then we must write **all the first letters must be capital**.

For example:

```
System, NumberFormatException, ArrayIndexOutOfBoundException
```

Hungarian rule for **METHOD:**

If a *method* name contains more than one word then **first word letter is small** and **rest of the words first letters must be capital**.

For example:

```
println (), actionPerformed (), adjustmentValueChanged ()
```

Hungarian rule for **DATA MEMBERS:**

All the *data members* are the *predefined classes* and *interfaces* must be represented used **as capital letters**.

For example:

```
PI, MAX_VALUE, and MIN_VALUE
```

All the *data members* in the *predefined classes* and *interfaces* are belongs to **public static final XXX data members**. XXX represents *data type, variable name* and *variable value*. Every *final data member* must belong to *static data member* **but reverse may or may not be applicable**.

Write a JAVA program to generate the *multiplication table for the given number*?

Answer:

```
class Mul //Business Logic Class (BLC)
{
	int n;
	void set (int x)
	{
		n=x;
	}
	void table ()
	{
		for (int i=1; i<=10; i++)
		{
			int res=n*i;
			System.out.println (n + "*" + i + "=" + result);
		}
	}
};
class MulDemo //Execution Logic Class (ELC)
{
```

```
        Public static class main (string k [])
        {
                Mul mo = new Mul ();
                mo.set (4);
                mo.table ();
        }
};
```

NOTE:

- The *data members* of a *class* can be used in all the functions of the *class*.
- The *variable* which we use as a part of function heading is known as **formal parameters** and they can be used within the function only.
- The *variables* which we use as a part of function definition/body then those *variables* known as *local variables* and they can be used within its **scope** i.e., function definition.
- The *variables* which we use within the function call then those *variables* are known as **actual parameters**.

For example:

```
int n=4;
mo.set (n);
```

Where 'n' is the actual parameter.

Day - 17:

The following table gives the details about those *classes* and *methods* used for **converting storing data** to **fundamental data**:

DATA TYPES	WRAPPER CLASS	CONVERTION METHOD FROM STRING DATA TO FUNDAMENTAL DATA TYPE
1. byte	1. Byte	1. `public static byte parseByte (string)`
2. short	2. Short	2. `public static short parseShort (string)`
3. int	3. Integer	3. `public static int parseInt (string)`
4. long	4. Long	4. `public static long parseLong (string)`
5. float	5. Float	5. `public static float parseFloat (string)`
6. double	6. Double	6. `public static double parseDouble (string)`
7. char	7. Char	7. `public static char parseChar (string)`
8. boolean	8. Boolean	8. `public static boolean parseBoolean (string)`

Whenever we develop a JAVA program it is recommended to write 'n' number of **business logic classes** and **single execution logic class**. A *business logic class* is one which contains 'n' number of **user defined methods** in which we write **business logic**. *Business logic* is one which is provided by JAVA programmer according **business rules** (requirements) started by customer. Whatever **data** we represent in **JAVA runtime environment** it is by **default treated as objects** of **string data**. As a programmer when we start any JAVA program an *object* of *string class* is created depends on number of values we pass.

Wrapper classes are basically used for converting the string data into fundamental data type. Each and every *wrapper class* contains the following generalized **parse methods**.

```
public static Xxx parseXxx (String);
```

here, Xxx represents **fundamental data type**.

Length is an **implicit attribute** created by JVM to determine number of elements or size of the array.

For example:

```
int a [] = {10, 20, 30, 40};
System.out.println (a. length); //4
String s1 [] = {10, 20, 30};
System.out.println (s1.length); //3

class Data
{
	public static void main (String s [])
	{
		int noa=s.length;
		System.out.println ("NUMBER OF VALUES ="+noa);
		System.out.println (s [0] +s [1]);
		int x=Integer.parseInt (s [0]); //8
		int y=Integer.parseInt (s [1]); //9
		int z=x+y;
		System.out.println ("SUM ="+z);
	}
};
```

8 and 9 lines used for *converting string* into *int data type*.

Write a JAVA program for printing the data which we pass from **command prompt**?

Answer:

```
class Print
{
	public static void main (String k [])
	{
		System.out.println ("NUMBER OF VALUES ="+k.length);
		for (int i=0; i<k.length; i++)
		{
			System.out.println (k[i] +" ");
		}
	}
};
```

Write a JAVA program which computes sum of two numbers by accepting the data from command prompt (DOS)?

Answer:

```
class Sum
{
	int a, b, c; //a,b,c are data members
	void assign (int x, int y) //x,y are formal parameters
	{
		a=x;
		b=y;
```

```
	}
	void add () //add () is business logic method
	{
		c=a+b;
	}
	void disp () //disp () is business logic method
	{
		System.out.println ("SUM OF "+a+" AND "+b+" = "+c);
	}
};
class SumDemo
{
	public static void main (String k [])
	{
		int x=Integer.parseInt (k [0]);
		int y=Integer.parseInt (k [1]);
		Sum so=new Sum ();
		so. assign(x, y);
		so. add ();
		so.disp ();
	}
};
```

NOTE: The data which we pass through *command prompt* is called **command line arguments**.

Write a JAVA program to check weather the given number is prime or not?

Answer:

```
class Prime
{
	int n;
	void set (int x)
	{
		n=x;
	}
	String decide ()
	{
		int i;
		for (i=2; i<n; i++)
		{
			if (n%i==0)
			{
				break;
			}
		}
	if (i==n)
	{
		return "PRIME";
	}
	else
	{
		return "NOT"+"PRIME";
	}
	}
};
class PrimeDemo
```

```
{
	public static void main (String k [])
	{
		int n=Integer.parseInt (k [0]);
		Prime po=new Prime ();
		po.set (n);
		String so=po.decide ();
		System.out.println (so);
	}
};
```

Write a JAVA program which converts an ordinary number into roman number?

Answer:

```
class Roman
{
	int n;
	void set (int x)
	{
		n=x;
	}
	void convert ()
	{
		if (n<=0)
		{
			System.out.print ("NO ROMAN FOR THE GIVEN NUMBER");
		}
		else
		{
			while (n>=1000)
			{
				System.out.print ("M");
				n=n-1000;
			}
			if (n>=900)
			{
				System.out.print ("CM");
				n=n-900;
			}
			if (n>=500)
			{
				System.out.print ("D");
				n=n-500;
			}
			if (n>=400)
			{
				System.out.print ("CD");
				n=n-400;
			}
			while (n>=100)
			{
				System.out.print ("C");
				n=n-100;
			}
			if (n>=90)
			{
```

```
                        System.out.print ("XC");
                        n=n-90;
                }
                if (n>=50)
                {
                        System.out.print ("L");
                        n=n-50;
                }
                if (n>=40)
                {
                        System.out.print ("XL");
                        n=n-40;
                }
                while (n>=10)
                {
                        System.out.print ("X");
                        n=n-10;
                }
                if (n>=9)
                {
                        System.out.print ("IX");
                        n=n-9;
                }
                if (n>=5)
                {
                        System.out.print ("V");
                        n=n-5;
                }
                if (n>=4)
                {
                        System.out.print ("IV");
                        n=n-4;
                }
                while (n>=1)
                {
                        System.out.print ("I");
                        n=n-1;
                }
                System.out.println ();
        }
    }
};
class RomanDemo
{
    public static void main (String k [])
    {
        int n=Integer.parseInt (k [0]);
        Roman r=new Roman ();
        r.set (n);
        r.convert ();
    }
};
```

Day - 18:

CONSTRUCTORS in java

A **constructor** is a **special member method** which will be called by the JVM **implicitly** (automatically) for placing **user/programmer defined values instead of placing default values**. *Constructors* are meant for **initializing the object**.

ADVANTAGES of constructors**:**

1. A *constructor eliminates* **placing** the **default values**.
2. A *constructor* **eliminates calling** the **normal method implicitly**.

RULES/PROPERTIES/CHARACTERISTICS of a constructor**:**

1. **Constructor name** must be **similar** to **name of the class**.
2. *Constructor* **should not return any value even void also** (**if we write the return type** for the *constructor* then that *constructor* will be **treated as ordinary method**).
3. *Constructors* **should not be static** since *constructors* will be called **each and every time whenever an object is creating**.
4. *Constructor* **should not be private provided** an *object* of **one** *class* is **created** in **another** *class* (*constructor* can be *private* **provided an object of one class created in the same class**).
5. *Constructors* will not be **inherited** at all.
6. *Constructors* are called *automatically* whenever an *object* is creating.

TYPES of constructors**:**

Based on creating *objects* in JAVA we have two types of *constructors*. They are **default/parameter less/no argument constructor** and **parameterized constructor**.

- A *default constructor* is one which **will not take any parameters**.

Syntax**:**

```
class <clsname>
{
	clsname () //default constructor
	{
		Block of statements;
		……;
		……;
	}
	……;
	……;
};
```

For example:

```
class Test
{
	int a, b;
	Test ()
	{
		System.out.println ("I AM FROM DEFAULT CONSTRUCTOR...");
		a=10;
		b=20;
```

```
                System.out.println ("VALUE OF a = "+a);
                System.out.println ("VALUE OF b = "+b);
        }
};
class TestDemo
{
        public static void main (String [] args)
        {
                Test t1=new Test ();
        }
};
```

RULE-1:

Whenever we create an *object* **only** with *default constructor*, defining the *default constructor* **is optional**. **If** we are **not defining default constructor of a class**, then JVM will **call automatically system defined default constructor** (SDDC). **If** we **define**, JVM will **call user/programmer defined default constructor** (UDDC).

Day - 19:

- A *parameterized constructor* is one which takes some parameters.

Syntax:

```
class <clsname>
{
        ……;
        ……;
        <clsname> (list of parameters) //parameterized constructor
        {
                Block of statements (s);
        }
        ……;
        ……;
}
```

For example:

```
class Test
{
        int a, b;
        Test (int n1, int n2)
        {
                System.out.println ("I AM FROM PARAMETER CONSTRUCTOR...");
                a=n1;
                b=n2;
                System.out.println ("VALUE OF a = "+a);
                System.out.println ("VALUE OF b = "+b);
        }
};
class TestDemo1
{
        public static void main (String k [])
        {
```

```
                Test t1=new Test (10, 20);
        }
};
```

RULE-2:

Whenever we create an *object* using *parameterized constructor*, it is **mandatory** for the JAVA programmer to define *parameterized constructor* **otherwise we will get compile time error**.

- **Overloaded constructor** is one in which **constructor name** is **similar but its signature is different**. *Signature* represents **number of parameters, type of parameters and order of parameters**. Here, at least **one thing must be differentiated**.

For example:

```
Test t1=new Test (10, 20);
Test t2=new Test (10, 20, 30);
Test t3=new Test (10.5, 20.5);
Test t4=new Test (10, 20.5);
Test t5=new Test (10.5, 20);
```

RULE-3:

Whenever we **define/create** the *objects* with respect to **both** *parameterized constructor* and *default constructor*, it is **mandatory** for the JAVA programmer **to define both** the *constructors*.

NOTE:

When we define a *class*, that *class* can contain two categories of *constructors* they are **single default constructor** and **'n' number of parameterized constructors** (*overloaded constructors*).

Write a JAVA program which illustrates the concept of *default constructor*, *parameterized constructor* and *overloaded constructor*?

Answer:

```
class Test
{
        int a, b;
        Test ()
        {
                System.out.println ("I AM FROM DEFAULT CONSTRUCTOR...");
                a=1;
                b=2;
                System.out.println ("VALUE OF a ="+a);
                System.out.println ("VALUE OF b ="+b);
        }
        Test (int x, int y)
        {
                System.out.println ("I AM FROM DOUBLE PARAMETERIZED CONSTRUCTOR...");
                a=x;
                b=y;
                System.out.println ("VALUE OF a ="+a);
                System.out.println ("VALUE OF b ="+b);
        }
        Test (int x)
```

```
	{
		System.out.println ("I AM FROM SINGLE PARAMETERIZED CONSTRUCTOR…");
		a=x;
		b=x;
		System.out.println ("VALUE OF a ="+a);
		System.out.println ("VALUE OF b ="+b);
	}
	Test (Test T)
	{
		System.out.println ("I AM FROM OBJECT PARAMETERIZED CONSTRUCTOR…");
		a=T.a;
		b=T.b;
		System.out.println ("VALUE OF a ="+a);
		System.out.println ("VALUE OF b ="+b);
	}
};
class TestDemo2
{
	public static void main (String k [])
	{
		Test t1=new Test ();
		Test t2=new Test (10, 20);
		Test t3=new Test (1000);
		Test t4=new Test (t1);
	}
};
```

NOTE: By **default** the **parameter passing mechanism** is **call by reference**.

'this ': 'this' is an internal or implicit object created by JAVA for two purposes. They are

i. 'this' *object* is internally pointing to current class object.
i. Whenever the formal parameters and data members of the class are similar, to differentiate the data members of the class from formal parameters, the data members of class must be proceeded by 'this'.

Day - 20:

this (): *this ()* is used for **calling current class default constructor** from **current class parameterized constructors**.

this (…): *this (…)* is used for **calling current class parameterized constructor** from **other category constructors** of the **same class**.

For example:

```
class Test
{
	int a, b;
	Test ()
	{
2-→		this (10); //calling current class single parameterized constructor
```

```
            System.out.println ("I AM FROM DEFAULT CONSTRUCTOR...");
            a=1;
            b=2;
            System.out.println ("VALUE OF a = "+a);
            System.out.println ("VALUE OF b = "+b);
      }
      Test (int x)       ---2
      {
3-→         this (100, 200); //calling current class double parameterized constructor
            System.out.println ("I AM FROM SINGLE PARAMETERIZED CONSTRUCTOR...");
            a=b=x;
            System.out.println ("VALUE OF a = "+a);
            System.out.println ("VALUE OF b = "+b);
      }
      Test (int a, int b)      ---3
      {
            System.out.println ("I AM FROM DEFAULT CONSTRUCTOR...");
            this.a=a;
            this.b=b;
            System.out.println ("VALUE OF a = "+this.a);
            System.out.println ("VALUE OF b = "+this.b);
            System.out.println ("VALUE OF a = "+a);
            System.out.println ("VALUE OF b = "+b);
      }
};
class TestDemo3
{
      public static void main (String k [])
      {
1-→         Test t1=new Test ();
      }
};
```

Rule for '**this**'**:**

Whenever we use either *this ()* or *this (…)* in the *current class constructors*, that statements **must be used as first statement only**.

The **order of the output** containing *this ()* or *this (...)* will be in the **reverse order of the input** which we gave as inputs.

For more clarity refer the above program.

For example we need output as follows:

```
I AM FROM DEFAULT CONSTRUCTOR…        ---1
VALUE OF a = 1
VALUE OF b = 2
I AM FROM SINGLE PARAMETERIZED CONSTRUCTOR… ---2
VALUE OF a = 100
VALUE OF b = 200
I AM FROM DOUBLE PARAMETERIZED CONSTRUCTOR… ---3
VALUE OF a = 10
VALUE OF b = 10
```

We must write in the following order as input:

```
Test (10);         ---3
Test (100, 200);   ---2
```

```
Test ();            ---1
```

NOTE:

Whenever we refer the *data members* which are **similar** to *formal parameters*, the JVM gives **first preference** to *formal parameters* whereas whenever we write a keyword *this* **before the variable name** of a *class* then the JVM *refers to data members* of the *class*.

this methods are used for *calling current class constructors*.

NOTE:

- If any *method* called by an *object* then that *object* is known as **source object**.
- If we pass an *object* as a parameter to the method then that *object* is known as **target object**.

For example:

SOURCE OBJECT. METHOD NAME (TARGET OBJECT);

```
t1. display (t2); // written in main
```

In the definition of **display method** t1 *data members* are referred by **this. Data member names** (this. a & this. b) whereas t2 *object data members* are referred by formal object name. Data member names (T. a & T. b).

```
void display (Test T) //T is formal object member
{
      System.out.println ("VALUE OF a BELONGS TO DATA MEMBER ="+this.a);
      System.out.println ("VALUE OF b BELONGS TO DATA MEMBER ="+this.a);
      System.out.println ("VALUE OF a BELONGS TO FORMAL OBJECT MEMBER ="+T.a);
      System.out.println ("VALUE OF b BELONGS TO FORMAL OBJECT MEMBER ="+T.a);

}
```

Day - 21:

Write a JAVA program which computes sum of two objects by accepting the data from command prompt?

Answer:

```
class Test
{
      int a,b;
      Test ()
      {
            a=b=0;
      }
      Test (int a, int b)
      {
            this.a=a;
            this.b=b;
      }
      Test sum (Test T)
      {
```

```
            Test T11=new Test ();
            T11.a=this.a+T.a;
            T11.b=this.b+T.b;
            return (T11);
      }
      void display ()
      {
            System.out.println ("VALUE OF a = "+a);
            System.out.println ("VALUE OF b = "+b);
      }
};
class SumDemo1
{
      public static void main (String k[])
      {
            int n1=Integer.parseInt (k[0]);
            int n2=Integer.parseInt (k[1]);
            int n3=Integer.parseInt (k[2]);
            int n4=Integer.parseInt (k[3]);
            Test t1=new Test (n1,n2);
            Test t2=new Test (n3,n4);
            Test t3=new Test ();
      //    t3=t1+t2; invalid statement
            t3=t1.sum (t2);
            System.out.println ("t1 VALUES ARE AS FOLLOWS...");
            t1.display ();
            System.out.println ("t2 VALUES ARE AS FOLLOWS...");
            t2.display ();
            System.out.println ("t3 VALUES ARE AS FOLLOWS...");
            t3.display ();
      }
};
```

TYPES of RELATIONSHIPS in java

Based on **reusing** the *data members* from **one** *class* to **another** *class* in JAVA we have **three types** of **relationships**. They are **is-a relationship, has-a relationship** and **uses-a relationship**.

- *Is-a relationship* is one in which *data members* of **one class** is **obtained** into **another class** through the concept of **inheritance**.
- *Has-a relationship* is one in which an *object* of **one class** is **created** as a *data member* in **another class**.
- *Uses-a relationship* is one in which a *method* of **one class** is **using** an *object* of **another class**.

Inheritance is the technique which **allows us to inherit** the *data members* and *methods* from **base class** to **derived class**.

- *Base class* is one which **always gives its features** to *derived classes*.
- *Derived class* is one which **always takes features** from *base class*.

A **Derived class** is one which contains some of **features** of its own **plus** some of the *data members* from *base class*.

Syntax for **INHERITING** the features from *base class* to *derived class*:

```
class <clsname-2> extends <clsname-1>
{
      Variable declaration;
      Method definition;
};
```

Here, `clsname-1` and `clsname-2` represents *derived class* and *base class* respectively.

Extends is a **keyword** which is **used for inheriting** the *data members* and *methods* from *base class* to the *derived class* and it **also improves functionality** of *derived class*.

NOTE:

- *Final classes* **cannot** be *inherited*.
- If the *base class* contains *private data members* then that type of *data members* **will not be inherited into** *derived class*.

Whenever we develop any inheritance application, it is always recommended to create an object of bottom most derived class. Since, bottom most derived class contains all the features from its super classes.

Day - 22:

- **One** *class* can *extend* only **one** *class* at a time. Since, JAVA does not support *multiple inheritance*.

Whenever we **inherit** the *base class members* into *derived class*, when we **creates** an *object* of *derived class*, JVM always **creates the memory space** for *base class members* **first and later memory space will be created** for *derived class members*.

For example:

```
class c1;
{
      int a;
      void f1()
      {
            …….;
      }
};
class c2 extends c1
{
      int b;
      void f2()
      {
            …….;
      }
};
```

NOTE:

- Whatever the *data members* are coming from *base class* to the *derived class*, the *base class members* are **logically declared** in *derived class*, the *base class methods* are **logically defined** in *derived class*.
- **Private** *data members* and **private** *methods* of the *base class* will **not be** *inherited* at all.

Write a JAVA program computes sum of two numbers using inheritance?

Answer:

```
class Bc
{
	int a;
};
class Dc extends Bc
{
	int b;
	void set (int x, int y)
	{
		a=x;
		b=y;
	}
	void sum ()
	{
		System.out.println ("SUM = "+(a+b));
	}
};
class InDemo
{
	public static void main (String k [])
	{
		int n1=Integer.parseInt (k [0]);
		int n2=Integer.parseInt (k [1]);
		Dc do1=new Dc ();
		do1.set (n1, n2);
		do1.sum ();
	}
};
```

For every *class* in JAVA we have a **super class** called **object class**. The purpose of *object class* is that it provides *garbage collector* **for collecting unreferenced memory locations** from the *derived classes*.

'Super' keyword:

Super keyword is **used for differentiating** the *base class features* with *derived class features*. *Super keyword* is placing an important role in three places. They are **at variable level, at method level** and **at constructor level**.

- *Super at variable level*

  Whenever we **inherit** the *base class members* into *derived class*, there is a **possibility** that *base class members* are **similar** to *derived class members*.

  In order **to distinguish** the *base class members* with *derived class members* in the *derived class*, the *base class members* **will be preceded by a keyword super**.

Syntax for **super** at **VARIABLE LEVEL**:

```
super. base class member name
```

For example:

```
class Bc
{
	int a;
};
class Dc extends Bc
{
	int a;
	void set (int x, int y)
	{
		super.a=x;
		a=y; //by default 'a' is preceded with 'this.' since 'this.' represents current class
	}
	void sum ()
	{
		System.out.println ("SUM = "+(super.a+a));
	}
};
class InDemo1
{
	public static void main (String k [])
	{
		int n1=Integer.parseInt (k[0]);
		int n2=Integer.parseInt (k[1]);
		Dc do1=new Dc ();
		do1.set (n1, n2);
		do1.sum ();
	}
};
```

- *Super at method level*

  Whenever we **inherit** the *base class methods* into the *derived class*, there is a **possibility** that *base class methods* are **similar** to *derived methods*.

  To differentiate the *base class methods* with *derived class methods* in the *derived class*, the *base class methods* **must be preceded by a keyword super**.

  Syntax for **super at method level**: `super. base class method name`

For example:

```
class Bc
{
	void display ()
	{
		System.out.println ("BASE CLASS - DISPLAY...");
	}
};
class Dc extends Bc
{
	void display ()
	{
```

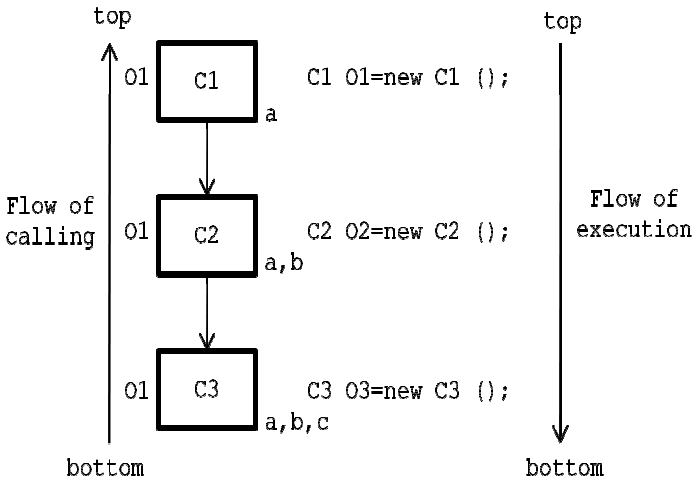
```
            super.display (); //refers to base class display method
            System.out.println ("DERIVED CLASS - DISPLAY...");
      }
};
class InDemo2
{
      public static void main (String k [])
      {
            Dc do1=new Dc ();
            do1.display ();
      }
};
```

Day - 23:

- *Super at constructor level*

Whenever we develop any inheritance application, we use to create always object of bottom most derived class. When we create an object of bottom most derived class, it in turns calls its immediate super class default constructor and it in turns calls its top most super class default constructor. Therefore, in JAVA environment, constructors will be called always from bottom to top and the execution starts from top to bottom.

Consider the following multi level inheritance:

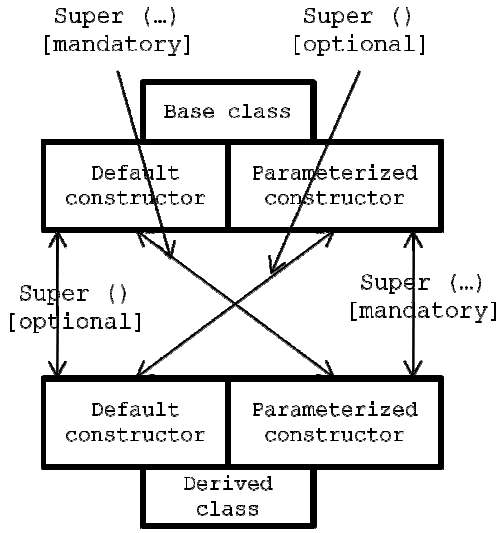


Super () is used for calling super class default constructor from default constructor or from parameterized constructor of derived class. It is optional.

Super (…) is used for calling super class parameterized constructor either from default constructor or from parameterized constructor of derived class. It is always mandatory.

RULES:

Whenever we use either super () or super (…) in derived class constructors they must be used as first statement.



1. Whenever we want to call default constructor of base class from default constructor of derived class using super () in default constructor of derived class is optional.

For example:

```
class Bc
{
	Bc ()
	{
		System.out.println ("I AM FROM BASE CLASS...");
	}
};
class Ibc extends Bc
{
	Ibc ()
	{
		System.out.println ("I AM FROM INTERMEDIATE BASE CLASS...");
	}
};
class Dc extends Ibc
{
	Dc ()
	{
		super (); //optional
		System.out.println ("I AM FROM DERIVED CLASS...");
	}
};
class InDemo3
{
	public static void main (String k [])
	{
		Dc o1=new Dc ();
	}
};
```

2. Whenever we want to call the super class parameterized class from parameterized class of the derived class using super (…) in parameterized class of derived class is mandatory.

For example:

```
class C1
{
	int a;
	C1 (int a)
	{
		System.out.println ("PARAMETERIZED CONSTRUCTOR - C1");
		this.a=a;
		System.out.println ("VALUE OF a = "+a);
	}
};
class C2 extends C1
{
	int b;
	C2 (int a, int b)
	{
		super (a);
		System.out.println ("PARAMETERIZED CONSTRUCTOR - C2");
		this.b=b;
		System.out.println ("VALUE OF b = "+b);
	}
};
class InDemo4
{
	public static void main (String k [])
	{
		C2 o2=new C2 (10, 20);
	}
};
```

3. Whenever we want to call default constructor of base class from parameterized class of derived class using super () in parameterized class of derived class is optional.

For example:

```
class C1
{
	int a;
	C1 ()
	{
		System.out.println ("PARAMETERIZED CONSTRUCTOR - C1");
		this.a=a;
		System.out.println ("VALUE OF a = "+a);
	}
};
class C2 extends C1
{
	int b;
	C2 (int b)
	{
		super (); //optional
		System.out.println ("PARAMETERIZED CONSTRUCTOR - C2");
		this.b=b;
		System.out.println ("VALUE OF b = "+b);
	}
};
```

```
class InDemo5
{
	public static void main (String k [])
	{
		C2 o2=new C2 (20);
	}
};
```

4. Whenever we want to call parameterized class of base class from default constructor of derived class using super (…) in default constructor of derived class is mandatory.

For example:

```
class C1
{
	int a;
	C1 (int a)
	{
		System.out.println ("PARAMETERIZED CONSTRUCTOR – C1");
		this.a=a;
		System.out.println ("VALUE OF a = "+a);
	}
};
class C2 extends C1
{
	int b;
	C2 ()
	{
		super (10);
		System.out.println ("DEFAULT CONSTRUCTOR – C2");
		this.b=20;
		System.out.println ("VALUE OF b = "+b);
	}
};
class InDemo6
{
	public static void main (String k [])
	{
		C2 o2=new C2 ();
	}
};
```

Day - 24:

Best example for the above given rules:

```
class Bc
{
	Bc ()
	{
		System.out.println ("BASE CLASS – DEFAULT CONSTRUCTOR");
	}
	Bc (int x)
	{
		this ();
```

```
                System.out.println ("BASE CLASS – PARAMETERIZED CONSTRUCTOR");
        }
};
class Ibc extends Bc
{
        Ibc ()
        {
                super (100);
                System.out.println ("INTERMEDIATE BASE CLASS - DEFAULT CONSTRUCTOR");
        }
        Ibc (int x)
        {
                this ();
                System.out.println ("INTERMEDIATE BASE CLASS - PARAMETERIZED CONSTRUCTOR");
        }
};
class Dc extends Ibc
{
        Dc ()
        {
                this (10);
                System.out.println ("DERIVED CLASS – DEFAULT CONSTRUCTOR");
        }
        Dc (int x)
        {
                super (10);
                System.out.println ("DERIVED CLASS – PARAMETERIZED CONSTRUCTOR");
        }
};
class StDemo
{
        public static void main (String k [])
        {
                Dc do1=new Dc ();
        }
};
```

ABSTRACT CLASSES:

In JAVA we have two types of *classes*. They are **concrete classes** and **abstract classes**.

- A *concrete class* is one which **contains fully defined methods**. *Defined methods* are also known as **implemented or concrete methods**. With respect to *concrete class*, we **can create an object of that class directly**.

For example:

```
class C1
{
        int a,b;
        void f1 ()
        {
                ……;
                ……;
        }
        void f2 ()
        {
```

```
            …….;
            …….;
      }
};
```

To call the above method:

```
C1 O1=new C1 ();
O1.f1 ();
O1.f2 ();
```

- An *abstract class* is one which **contains some defined methods and some undefined methods**. *Undefined methods* are also known as **unimplemented or abstract methods**. *Abstract method* is one which **does not contain any definition**. **To make the method as abstract** we have to use a keyword called **abstract before the function declaration**.

  Syntax for **ABSTRACT CLASS:**

  ```
  abstract return_type method_name (method parameters if any);
  ```

For example:

```
Abstract void sum ();
```

The abstract methods make us to understand what a method can do but it does not give how the method can be implemented. Every abstract method belongs to a class under class is known as abstract class, to make the class as abstract we use a keyword called abstract before the class specification.

Syntax for **ABSTRACT CLASS:**

```
abstract class <clsname>
{
      Abstract return_type method_name (method parameters if any);
};
```

For example:

```
abstract class Op
{
      abstract void sum ();
};
```

Day - 25:

With respect to *abstract class* we **cannot create an object direct** but we **can create indirectly**. **An object abstract class is equal to an object of that class which extends that abstract class.**

For example:

```
class CC extends AC
{
      …….;
```

```
      ……….;
};
AC Ao=new AC (); //invalid
AC Ao=new CC ();
or
AC Ao;
Ao=new CC ();
```

Write a JAVA program for computing sum of two integers and floats using abstract classes?

Answer:

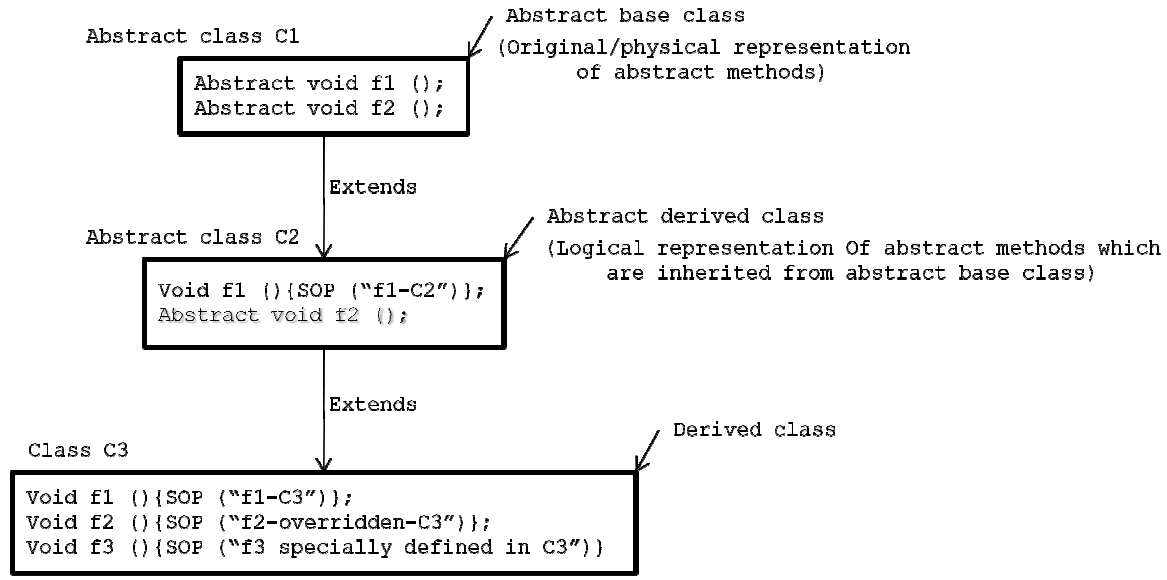
```
abstract class Op
{
      abstract void sum ();
};
class isum extends Op
{
      void sum ()
      {
            int a,b,c;
            a=10;
            b=20;
            c=a+b;
            System.out.println ("INT VALUE = "+c);
      }
};
class fsum extends Op
{
      void sum ()
      {
            float f1,f2,f3;
            f1=10.26f;
            f2=20.32f;
            f3=f1+f2;
            System.out.println ("FLOAT VALUE = "+f3);
      }
};
class AbDemo
{
      public static void main (String k [])
      {
//          Op o1=new Op (); invalid
            Op o2;
            o2=new isum ();
            o2.sum ();
            o2=new fsum ();
            o2.sum ();
      }
};
```

Abstract classes should **not be final**, **since**, they are **always reusable**. *Abstract classes* are basically used **to implement polymorphism**; we **use the concept of dynamic binding**. Hence, *abstract classes*, *polymorphism* and *dynamic binding* will **improve the performance** of JAVA J2EE applications **by reducing amount of memory space**.

Whenever we **inherit** 'n' number of *abstract methods* **from** *abstract base class* to *derived class*, if the **derived class defines all 'n' number of abstract methods** then the *derived class* is **concrete class**. If the *derived class* is **not defining at least one abstract method out of 'n' abstract methods** then the *derived class* is known as **abstract derived class** and **to make that class abstract**, we use a **keyword** called **abstract**.

An *abstract base class* is one **which contains physical representation of abstract methods**. An *abstract derived class* is one **which contains logical declaration of abstract methods which are inherited from abstract base class**.

Day - 26:



Implement the above diagram by using abstract class's polymorphism and dynamic binding.

Answer:

```
abstract class C1
{
	abstract void f1 ();
	abstract void f2 ();
};
abstract class C2 extends C1
{
	void f1 ()
	{
		System.out.println ("f1-C2-original");
	}
};
class C3 extends C2
{
	void f1 ()
	{
		super.f1 ();
		System.out.println ("f1-C3-OVERRIDDEN");
	}
	void f2 ()
```

```
	{
		System.out.println ("f2-C3");
	}
	void f3 ()
	{
		System.out.println ("f3-C3-SPECIALLY DEFINED");
	}
};
class AbDemo1
{
	public static void main (String k [])
	{
		C3 o3=new C3 ();
		o3.f1 ();
		o3.f2 ();
		o3.f3 ();
//		C2 o2=new C2 (); invalid
		C2 o2=new C3 ();
		o2.f1 ();
		o2.f2 ();
//		o2.f3 (); invalid
		C1 o1=new C3 (); // or o2
		o1.f1 ();
		o1.f2 ();
//		o1.f3 ();
	}
};
```

Output:

With respect to *Concrete Class*:

```
C3 o3=new C3 ();
o3.f1 (); // f1 - overridden - C3
o3.f2 (); // f2 - C3
o3.f3 (); // f3 - defined in - C3
```

With respect to *Abstract Derived Class*:

```
C2 o2=new C2 (); // invalid
C2 o2=new C3 ();
o2.f1 (); // f1 - overridden - C3
o2.f2 (); // f2 - C3
o2.f3 (); // invalid
```

With respect to *Abstract Base Class*:

```
C1 o1;
o1=o2; // it mean., new C3 ()
o1.f1 (); // f1 - overridden - C3
o1.f2 (); // f2 - C3
o1.f3 (); // invalid
```

An *object* of either *concrete base class* or *abstract base class* **contains the details about** those *methods* **which are available in** that *class* **only** but this *object* (*concrete base class* or *abstract base class*) **does not contains details of** those *methods* **which are specially defined in derived class's**.

Application:

Write a JAVA program to display the fonts of the system?

Answer:

```
import java.awt.GraphicsEnvironment;
class Fonts
{
	public static void main (String k [])
	{
		GraphicsEnvironment
		ge=GraphicsEnvironment.getLocalGraphicsEnvironment ();
		String s []=ge.getAvailableFontFamilyNames ();
		System.out.println ("NUMBER OF FONTS = "+s.length);
		for (int i=0; i<s.length; i++)
		{
			System.out.println (s [i]);
		}
	}
};
```

A **factory method** is one whose **return type is similar to name of the class** where it presents.

For example:

```
getLocalGraphicsEnvironment ();
```

RULES for **factory method:**

1. The *return type* of the *factory method* **must be similar to name of the class** where it presents.
2. Every *factory method* **must be static** (so that we can call with respect to name of the *class*).
3. Every *factory method* **must be public**.

Factory methods are **used for creating an object without using new operator**. Every **predefined abstract class contains at least one factory method for creating an object of abstract class**.

Whenever we define a *concrete class*, that *concrete class* **also can be made it as abstract** and it is **always further reusable or extendable** by further *classes*.

When we **define only** *concrete class* **we may extend or we may not extend** by *derived classes*.