Last modification date :- 24th Nov 2015 [new version don't prefer old copy]

Always believe practical knowledge but not theoretical.

Core Java

By

Ratan

Core java syllabus

JAVA introduction:-

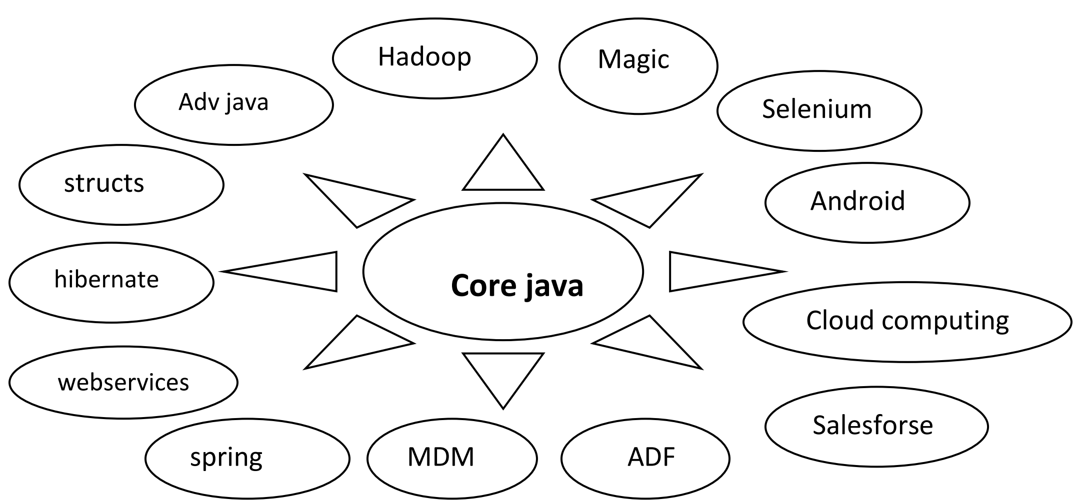
Author	:	***James Gosling***
Vendor	:	***Sun Micro System(**which has since merged into Oracle Corporation**)***
Project name	:	***Green Project***
Type	:	***open source & free software***
Initial Name	:	*OAK language*
Present Name	:	*java*
Extensions	:	*.java & .class & .jar*
Initial version	:	*jdk 1.0 (java development kit)*
Present version	:	***java 8 2014***
Operating System	:	*multi Operating System*
Implementation Lang	:	*c, cpp……*
Symbol	:	*coffee cup with saucer*
Objective	:	*To develop web applications*
SUN	:	***Stanford Universally Network***
Slogan/Motto	:	*WORA(write once run anywhere)*

Importance of core java:-

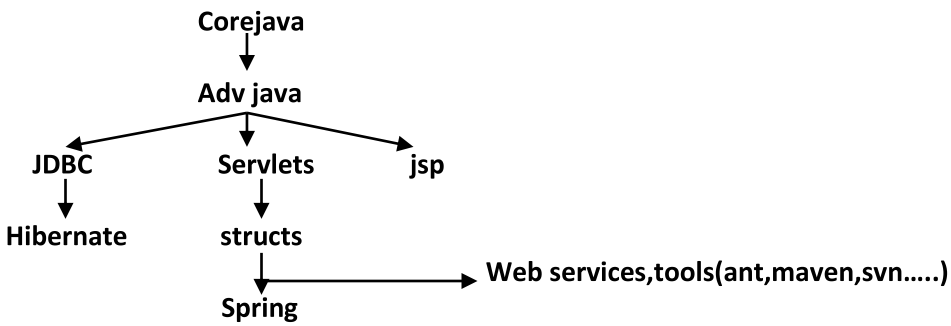
According to the SUN 3 billion devices run on the java language only.

1) Java is used to develop Desktop Applications such as MediaPlayer,Antivirus etc.
2) Java is Used to Develop Web Applications such as sravyajobs.com, irctc.co.in etc.
3) Java is Used to Develop Enterprise Application such as Banking applications.
4) Java is Used to Develop Mobile Applications.
5) Java is Used to Develop Embedded System.
6) Java is Used to Develop SmartCards.
7) Java is Used to Develop Robotics.
8) Java is used to Develop Games ………………………. ***etc.***

Technologies Depends on Core java:-



Learning process of java:-



Parts of the java:-

*As per the **sun micro system** standard the java language is divided into three parts*

1) *J2SE/JSE(java 2 standard edition)*
2) *J2EE/JEE(java 2 enterprise edition)*
3) *J2ME/JME(java 2 micro edition)*

Java keywords:-(50)

Data Types

byte
short
int
long
float
double
char
boolean
(8)

Flow-Control:-

if
else
switch
case
default
break
for
while
do
continue
(10)

method-level:-

void
return
(2)

Object-level:-

new
this
super
instanceof
(4)

source-file:

class
extends
interface
implements
package
import
(6)

Exception *handling:-*

try
catch
finally
throw
throws
(5)

1.5 version:-

enum
assert
(2)

unused:-

goto
const
(2)

Modifiers:-

public
private
protected
abstract
final
static
strictfp
native
transient
volatile
synchronized
(11)

Predefined constants *True, false, null (3)*

Differences between C & CPP & JAVA:-

C-lang

```
 #include<stdio.h>
Void main()
{    Printf("hi ratan");
}
```

Author: **Dennis Ritchie**

Implementation languages:
*COBOL,FORTRAN,*BCPL, B…

In c-lang the predefined support is available in the form of header files.
Ex:- stdio.h , conio.h

The header files contain predefined functions.
Ex:- printf,scanf…..

C-lang ↑ *Header files* ↑ *Functions*

C ↑ *stdio.h* ↑ *printf,scanf..etc*

In above first example we are using ***printf*** *predefined function that is present in stdio.h header file hence must include that header file by using #include statement.*
Ex:#include<stdio.h>

In C lang program execution starts from main method called by ***Operating system.***

To print data use ***printf()***

Cpp-lang

```
#include<iostream.h>
Void main()
{    Cout<<"hello ratan";
}
```

Author : **Bjarne Stroustrup**

implementation languages:
c ,ada,ALGOL68…..

cpp language the predefined is maintained in the form of header files.
Ex:- iostream.h

The header files contains predefined functions.
Ex:- cout,cin….

CPP-lang ↑ *Header files* ↑ *Functions*

CPP ↑ *iostream.h* ↑ *cout,cin..etc*

In above first example we are using ***cout*** *predefined function that is present in stdio.h header file hence must include that header file by using #include statement.*
Ex:#include<stdio.h>

In C lang program execution starts from main method called by ***Operating system.***

To print data use ***cout***

Java –lang

```
Import  java.lang.System;
Import  java.lang.String;
Class Test
{ Public static void main (String [] args)
     {System.out.println ("hi java");
      }
}
```

Author : ***James Gosling***

implementation languages
C,CPP,ObjectiveC…

In java predefined support is available in the form of packages.
Ex: java.lang, java.io,java.awt

The packages contains predefined classes&interfaces and these class & interfaces contains predefined methods.
Ex:- String,System

java-lang ↑ *packages* ↑ ***classes&interface*** ↑ *methods*

java ↑ *java.lang* ↑ *String-class* ↑ *toUpperCase()*

in above exampe we are using two classes(String,System) these classes are present in ***java.lang*** *package must import it by using import keyword.*

a) Import java.lang.*; *all lasses*
b)Import java.lang.System; ***required***
Import java.lang.String; ***classes***
In above two approachaes 2nd good

In java execution starts from main called by JVM
To print data use ***System.out.println()***

Version Name	Code Name	Release Date
JDK 1.0	Oak	23 January 1996
JDK 1.1	(none)	19 February 1997
J2SE 1.2	Playground	4 December 1998
J2SE 1.3	Kestrel	8 May 2000
J2SE 1.4	Merlin	13 February 2002
J2SE 5.0	Tiger	29 September 2004
Java SE 6	Mustang	11 December 2006
Java SE 7	Dolphins	28 July 2011
Java SE 8	(Not available)	18 March 2014

JAVA Features :-(buzz words)

1. *Simple*
2. *Object Oriented*
3. *Platform Independent*
4. *Architectural Neutral*
5. *Portable*
6. *Robust*
7. *Secure*
8. *Dynamic*
9. *Distributed*
10. *Multithread*
11. *Interpretive*
12. *High Performance*

1. *Simple:-*

Java is a simple programming language because,

- ✓ Java technology has eliminated all the difficult and confusion oriented concepts like pointers, multiple inheritance in the java language.
- ✓ Java uses c,cpp syntaxes mainly hence who knows C,CPP for that java is simple language.

2. *Object Oriented:-*

- ➢ Java is object oriented technology because it is representing total data of the class in the form of object.
- ➢ Object oriented programming (OOPs) is a methodology that simplifies software development and maintenance by providing some rules.

  Basic concept of Oops are

  - Object
  - Class
  - Inheritance
  - Polymorphism
  - Encapsulation
  - Abstraction

3. *Platform Independent :-*

When we compile the application by using one operating system (windows) that Compiled file can execute only on the same operating system(windows) this behavior is called platform dependency.

Example :- C,CPP …etc

When we compile the application by using one operating system (windows) that Compiled file can execute in all operating systems(Windows,Linux,Mac…etc) this behavior is called platform independency.

Example :- java,Ruby,Scala,PHP …etc

4. *Architectural Neutral:-*

Java tech applications compiled in one Architecture/hardware (RAM, Hard Disk) and that Compiled program runs on any architecture (hardware) is called Architectural Neutral.

5. *Portable:-*

In Java the applications are compiled and executed in any OS (operating system) and any Architecture (hardware) hence we can say java is a portable language.

6. *Robust:-*

Any technology good at two main areas that technology is robust technology.

a. *Exception Handling*
b. *Memory Allocation*

Java is providing predefined support to handle the exceptions.
Java provides Garbage collector to support memory management.

7. *Secure:-*

- To provide implicit security Java provides one component inside JVM called Security Manager.
- To provide explicit security for the Java applications we are having very good predefined library in the form of ***java.security*** package.

8. *Dynamic:-*

Java is dynamic technology it follows dynamic memory allocation (at runtime the memory is allocated).

9. *Distributed:-*

By using java it is possible to develop distributed applications & to develop distributed applications java uses RMI,EJB…etc

10. <u>Multithreaded: -</u>

- *Thread is a light weight process and a small task in large program.*
- *In java it is possible to create user thread & it possible to execute simultaneously is called multithreading.*
- *The main advantage of multi threading is it shares the same memory & threads are important at multimedia, gaming, web application.*

11. <u>Interpretive:-</u>

JAVA is both interpretive and completive by using Interpreter we are converting source code into byte code and it a interpreter is a part of JVM.

12. <u>High Performance:-</u>

If any technology having features like Robust, Security, Platform Independent, Dynamic and so on then that technology is high performance.

<u>Types of java applications:-</u>

1. ***<u>Standalone applications:</u>***
   - ✓ *It is also known as window based applications or desktop applications.*
   - ✓ *This type of applications must install in every machine like media player, antivirus …etc*
   - ✓ *By using AWT & Swings we are developing these type of applications.*
   - ✓ *This type of application does not required client-server architecture.*
2. ***<u>Web applications:</u>***
   a. *The applications which are executed at server side those applications are called web applications like Gmail, face book ,yahoo…etc .*
   b. *All applications present in internet those are called web-applications.*
   c. *The web applications required client-server architecture.*
      i. *Client : who sends the request.*
      ii. *Server : it contains application & it process the app & it will generate response.*
      iii. *Database : used to store the data.*
   d. *To develop the web applications we are using servlets,structs,spring…etc*
3. ***<u>Enterprise applications:-</u>***
   - *It is a business application & most of the people use the term it I big business application.*
   - *Enterprise applications are used to satisfy the needs of an organization rather than individual users. Such organizations are business, schools, government …etc*
   - *An application designed for corporate use is called enterprise application.*
   - *An application in distributed in nature such as banking applications.*
   - *All j2ee & EJB is used to create enterprise application.*
4. ***<u>Mobile applications:-</u>***

- ✓ *The applications which are design for mobile platform are called mobile applications.*
- ✓ *We are developing mobile applications by sing android,IOS,j2me…etc*
- ✓ *There are three types of mobile applications*
  - *Web-application (gmai l ,online shopping,oracle …etc)*
  - *Native (run on device without internet or browser)ex:phonecall,calculator,alaram,games*
    These are install from application store& to run these apps internet not required.
  - *Hybrid (required internet data to launch) ex:whats up,facebook,LinkedIn…etc*
    These are installed form app store but to run this application internet data required.

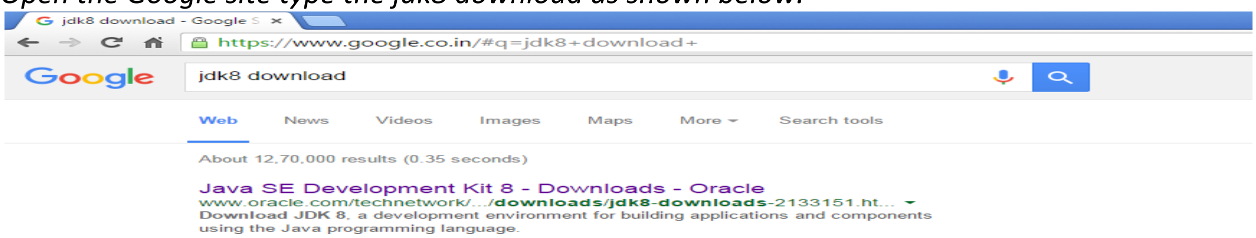
Install the software and set the path :-

1) *Download the software.*
2) *Install the java software in your machine.*
3) *Set the environmental variable.*

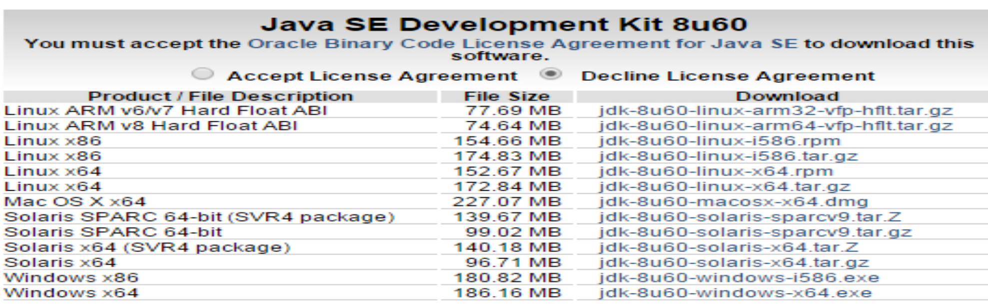
Download the software:-

- ✓ Download the software from internet based on your operating system & processor because the software is different from operating system to operating system & processor to processor.

Open the Google site type the jdk8 download as shown below.



After clicking above link we will get below window then accept license agreement by clinking radio button then choose the software based on your operating system and processor to download.



Java SE Development Kit 8u60

You must accept the Oracle Binary Code License Agreement for Java SE to download this software.

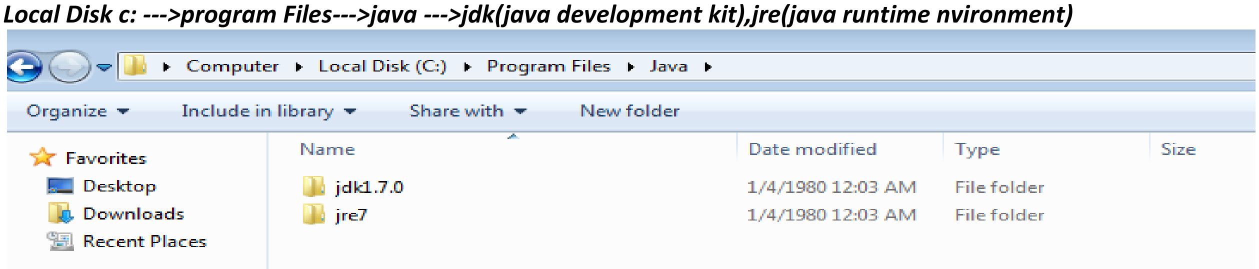
Accept License Agreement   Decline License Agreement

Product / File Description	File Size	Download
Linux ARM v6/v7 Hard Float ABI	77.69 MB	jdk-8u60-linux-arm32-vfp-hflt.tar.gz
Linux ARM v8 Hard Float ABI	74.64 MB	jdk-8u60-linux-arm64-vfp-hflt.tar.gz
Linux x86	154.66 MB	jdk-8u60-linux-i586.rpm
Linux x86	174.83 MB	jdk-8u60-linux-i586.tar.gz
Linux x64	152.67 MB	jdk-8u60-linux-x64.rpm
Linux x64	172.84 MB	jdk-8u60-linux-x64.tar.gz
Mac OS X x64	227.07 MB	jdk-8u60-macosx-x64.dmg
Solaris SPARC 64-bit (SVR4 package)	139.67 MB	jdk-8u60-solaris-sparcv9.tar.Z
Solaris SPARC 64-bit	99.02 MB	jdk-8u60-solaris-sparcv9.tar.gz
Solaris x64 (SVR4 package)	140.18 MB	jdk-8u60-solaris-x64.tar.Z
Solaris x64	96.71 MB	jdk-8u60-solaris-x64.tar.gz
Windows x86	180.82 MB	jdk-8u60-windows-i586.exe
Windows x64	186.16 MB	jdk-8u60-windows-x64.exe

For 32-bit operating system please click on Windows x86
For 64-bit operating system please click on Windowsx64

Install the java software in your machine:-

- ✓ *Install the java software just like media players in your machine.*
- ✓ *After installing the software the installation java folder is available in the fallowing location by default.(but it possible to change the location at the time of installation).*
  Local Disk c: --->program Files--->java --->jdk(java development kit),jre(java runtime nvironment)



After installing To check whether the java is installed in your system or not open the command prompt type javac command.

Process to open command prompt: ***Start --->run---->open:cmd---->ok***

C:\Users\RATAN>javac

```
C:\Users\RATAN>javac
'javac' is not recognized as an internal or external command,
operable program or batch file.
```

Whenever we are getting above information then decide in our system java is installed but the java is not working.

Why java is not working Reason:-

C:\Users\RATAN>javac

Whenever we are typing javac command on the command prompt operating system will pickup javac command search for that command,

a) in the internal operating system calls but javac is not available in the internal system calls list.
b) If it not available in internal system calls list then immediately it won't raise any error, it will search in environmental variables

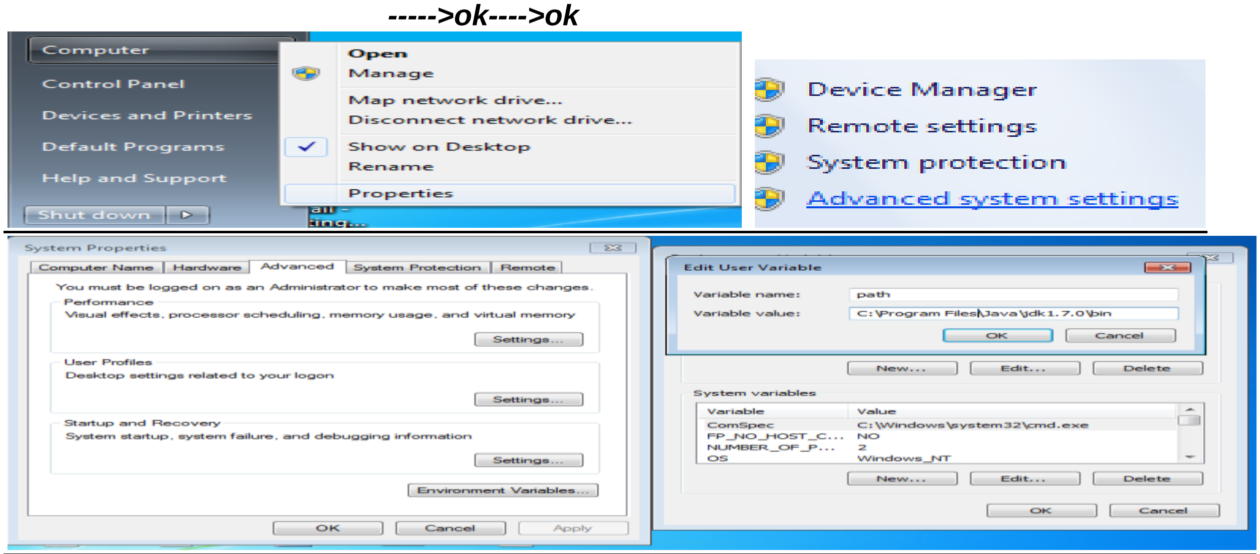
In above two cases if the javac command is not available then operating system will raise error message "javac is not recognized as an internal or external command"

To overcome above problem to make eligible ***javac*** *command operating system set environmental variables.*

The location of javac command is : C:\Program Files\Java\jdk1.7.0\bin

R***ight click on mycomputer --->properties----->Advanced system setting--->Environment Variables --User variables--->new---->***

variable name : path
Variable value : C:\programfiles\java\jdk1.6.0_11\bin;
----->ok---->ok



Now the java is working in your system to check open the ***new*** *command prompt & type javac command then we will get list of commands then decide in your system java is working.*

In your system or your friend system to check java is installed or not open the command prompt & type javac command

*a) If error message displayed java is not working.****('javac' is not recognized as an internal or external command)***
b) If list of commands are displayed then decide java is working properly.

Steps to Design a First Application:-

Step-1:- ***Select an Editor.***
Step-2:- ***Write the application.***
Step-3:- ***save the application.***
Step-4:- ***Compilation Process.***
Step-5:- ***Execution process.***

Step1:- Select an Editor

Editor is a tool or software it will provide very good environment to develop java application.

Ex :- Notepad, Notepad++,edit Plus…..etc

IDE:- (Integrated development Environment)

IDE is providing very good environment to develop the application.

Ex:- Eclipse,MyEclipse,Netbeans,JDeveloper….etc

IDE is a real-time standard but don't use IDE to develop core java applications because 75% work is done by IDE & remaining 25 % work is down by developer.

75% work of IDE is:-

- ✓ Automatic compilation.
- ✓ Automatic package import.
- ✓ It shows all the predefined methods of classes.
- ✓ Automatically generate try catch blocks and throws (Exception handling)
- ✓ It is showing the information about how to fix the bug……………………etc

Note :- Do the practical's of core java only by using Edit Plus software.

Step 2:- Write a program.

- Write the java program based on the java API (Application Programming Interface) rule and regulations .

  Open editplus --->file ---->new ----->click on java (it display sample java application)

- Java is a case Sensitive Language so while writing the program you must take care about the case (Alphabet symbols).

Example application:-

```
import java.lang.System;
import java.lang.String;
class Test          //class declaration
{       //class starts
        public static void main(String[] args)      //program execution starting point
        {       //main starts
                System.out.println("hi Ratan");  //printing statement
        }       //main ends
};      //class ends
class A
{
};
class B
{
};
```

*In above example **String & System c**lasses are present predefined java.lang package hence must import that package by using import statement.*

To import the classes into our application we are having two approaches,

1) Import all class of particular package.
   a. *Import java.lang.*;   //it is importing all classes of java.lang package.*
2) Import required classes
   a. *Import java.lang.System;*
   b. *Import java.lang.String;*

In above two approaches second approach is best approach because we are importing application required classes.

Note: The source file is allows declaring multiple java classes.

<u>Step3:- save the application.</u>

- *After writing the application must save the application by using **(.java)** extension.*
- *While saving the application must fallow two rules*
  - *If the source file contains public class then public class name & Source filename must be same **(publicClassName.java)**. Otherwise compiler generate error message.*
  - *if the source file does not contain public class then save the source file with any name **(anyName.java)** like A.java , Ratan.java, Anu.java …….etc .*

Note: - The source file allowed only one public class, if we are trying to declare multiple public classes then compiler generate error message.

<u>example 1:- invalid</u>

//Ratan.java
```
public  class Test
{    };
class A
{   };
```

<u>example 2:- valid</u>

//Test.java
```
public class Test
{   };
class A
{    };
```

<u>example 3:- invalid</u>

//Test.java
```
public class Test
{   };
public class A
{   };
```

Application location:-

D:	***(any disk)***
|-->rattan	***(any folder)***
|-->Sravya.java	***(your file name)***

Step-4:- Compilation process.

*Compile the java application by using **javac** command.*

Syntax:- *Javac filename*

Javac Test.java

Process of moving application saving location:-

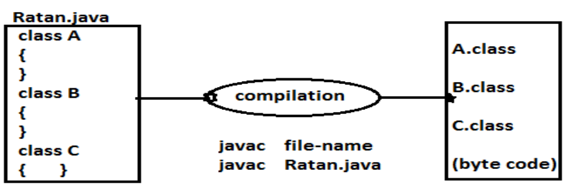
C:\Users\hp> *initial cursor location*
C:\Users\hp>d: *move to local disk D*
D:\>cd ratan *changing directory to ratan*
D:\ratan>javac Sravya.java *compilation process*

Whenever we are performing compilation the compiler will check the syntax errors.

- *If the application contains syntax errors then compiler will generate error message in the form of compilation error.*
- *If the application does not contains syntax errors then compiler will generate .class files.(conversion of **.java** to **.class**)*

Note: - in java .class files generated by compiler at compilation time and .class file generation based on number of classes present in source file.

If the source file contains 100 classes after compilation compiler generates 100 .class files
The compiler generate .class file and .class file contains byte code instructions it is intermediate code.



Process of compiling multiple files:-

D:
|-->ratan
|-->Sravya.java
|-->A.java
|-->B.java
|-->C.java

javac A.java *one file is compiled(A.java)*
javac B.java C.java *two files are compiled*
javac *.java *all files are compiled*

<u>Step-5:- Execution process.</u>

*Run /execute the java application by using **java** command.*

Syntax:- *Java class-name*
Java Test

Whenever you are executing particular class file then JVM perform fallowing actions.

- *JVM wills loads corresponding .class file byte code into memory.*
- *After loading .class file JVM calls main method to start the execution process.*

In above two cases if the class file or main method is not available then at runtime JVM will generate error message.
*If the main method is not available: **"Main method not found in class A, please define the main method".***
*If the .class is not available : **"Could not find main class"**.*

*<u>Executing all generated **.class** files based on example given in second step:-</u>*

Test class ***--->*** *class is loaded & main is present*
A class ***--->*** *class is loaded but main is not present*
B class ***--->*** *class is loaded but main is not present*
XXX class *--->* *XXX class is not present*

D:\ratan>java Test
Hi Ratan
D:\ratan>java A
Error: Main method not found in class A, please define the main method as:
public static void main(String[] args)
D:\ratan>java B
Error: Main method not found in class B, please define the main method as:
public static void main(String[] args)
D:\ratan>java XXX
Error: Could not find or load main class XXX

*Note 1: - compiler is translator it is translating **.java** file to **.class** where as JVM is also a translator it is translating **.class** file to **machine code.***

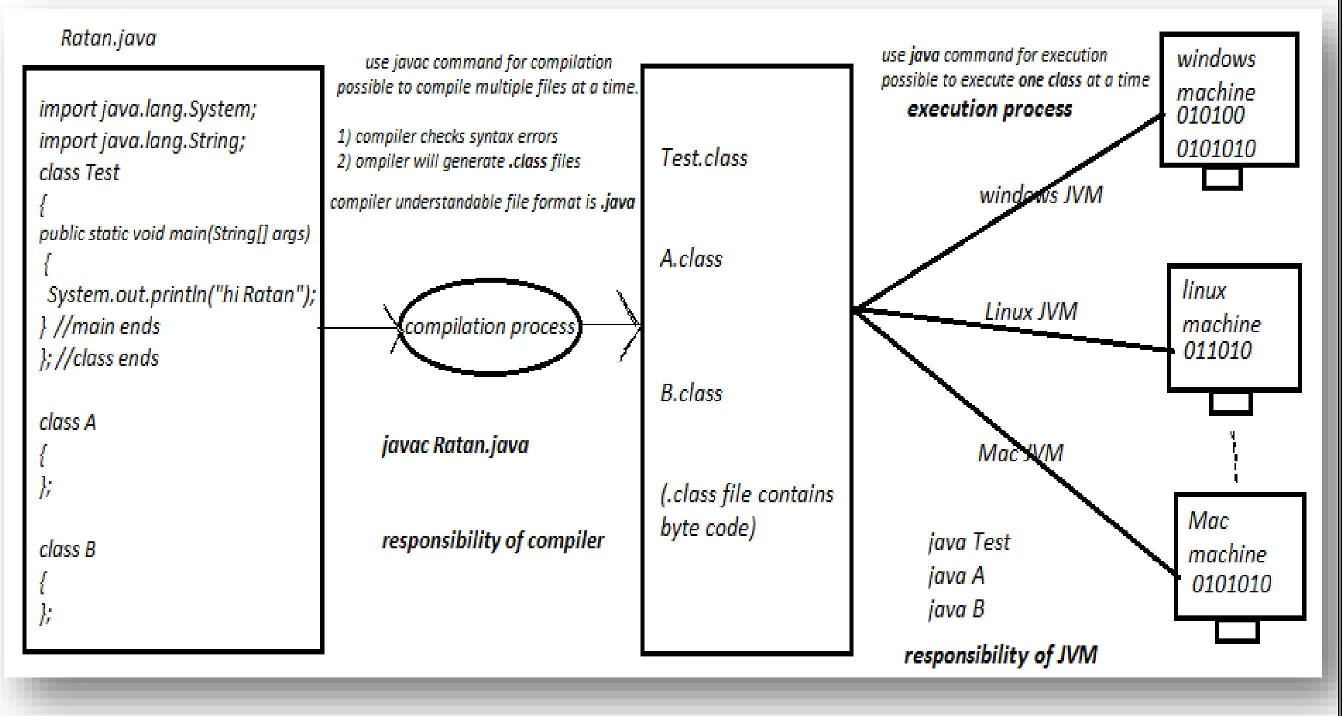
*Note 2:-Compiler understandable file format is **.java** file but JVM understandable file format is **.class** file.*

Note 3:- it is possible to compile multiple files at a time but it is possible to execute only one .class file at a time.

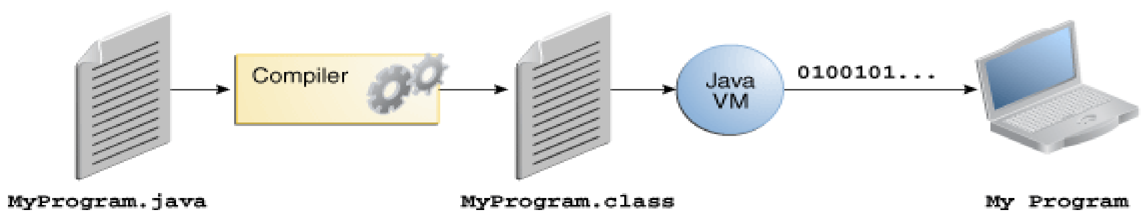
Note 4:- The .java file contains high level language (English) but .class file contains byte code instructions.

Note 5:- The source is allowed to declaring multiple non-public classes but only one public class.

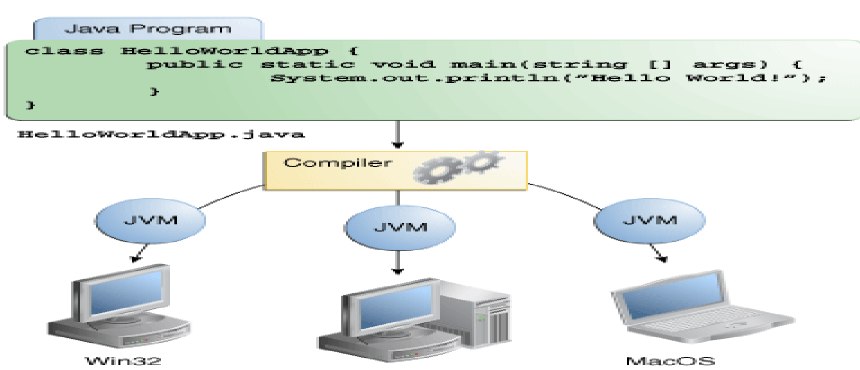
Overview of first application



Environment of the java programming development:-



First program development :-



Note: - java is a platform independent language but JVM is platform dependent.

Example-1:-

- *Java contains 14 predefined packages but the default package in java is **java.lang** package it means if we are importing or not by default this package is imported.*
- *In below example importing classes are optional.*

```
class Test
{	public static void main(String[] args)
	{	System.out.println("hi ratan");
	}
}
```

Example-2:-

*The class contains main method is called **Main class** and java allows to declare multiple main class in a single source file.*

```
class Test1
{	public static void main(String[] args)
	{	System.out.println("Test1 World!");
	}
}
class Test2
{	public static void main(String[] args)
	{	System.out.println("Test2 World!");
	}
}
class Test3
{	public static void main(String[] args)
	{	System.out.println("Test3 World!");
	}
}
```

D:\morn11>java Test1	***D:\morn11>java Test2***	***D:\morn11>java Test3***
Test1 World!	***Test2 World!***	***Test3 World!***

Class Elements:-

- ✓ *Java is a class based language it means everything we are representing based on class.*
- ✓ *The java class contains 5-elements if we know these five elements flow of execution perfectly then java is very simple language otherwise java is very difficult.*

```
Class Test
{
	1. variables		int a = 10;
	2. methods		void add() {business logic }
	3. constructors	Test() {business logic }
	4. instance blocks	{business logic }
	5. static blocks	static {business logic }
}
```

Java coding conventions:-

Classes:-

- ✓ *Class name start with upper case letter and every inner word starts with upper case letter.*
- ✓ *This convention is also known as **camel case** convention.*
- ✓ *The class name should be nouns.*

  Ex:- **S**tring **S**tring**B**uffer **I**nput**S**tream**R**eader ……etc

Interfaces :-

- ❖ *Interface name starts with upper case and every inner word starts with upper case letter.*
- ❖ *This convention is also known as **camel case** convention.*
- ❖ *The class name should be nouns.*

*Ex: **S**erializable **C**loneable **R**andom**A**ccess*

Methods :-

- ✓ *Method name starts with lower case letter and every inner word starts with upper case letter.*
- ✓ *This convention is also known as mixed case convention*
- ✓ *Method name should be verbs.*

  *Ex:- post() char**A**t() to**U**pper**C**ase() compare**T**o**I**gnore**C**ase()*

Variables:-

- ❖ Variable name starts with lower case letter and every inner word starts with upper case letter.
- ❖ This convention is also known as mixed case convention.

Ex :- out in page**C**ontext

Package :-

- ✓ *Package name is always must written in lower case letters.*

  Ex :- java.lang java.util java.io …etc

Constants:-

- ❖ *While declaring constants all the words are uppercase letters .*

  Ex: MAX_PRIORITY MIN_PRIORITY NORM_PRIORITY

NOTE:- The coding standards are mandatory for predefined library & optional for user defined library but as a java developer it is recommended to fallow the coding standards for user defined library also.

Java Tokens:-

- ✓ *Smallest individual part of a java program is called Token.*
- ✓ *It is possible to provide any number of spaces in between two tokens.*

Example:-

```
Class                    Test
          {
     Public              static        void          main
(         String[]                args   )
     {    int            a      =      10            ;
          System  .      out           .             println        (
               "java  tokens");
          }
}
```

***Tokens are**---------→class , test , { , " , […………….etc*

Java Comments:-

- *Comments are used to write the detailed description about application logics to understand the logics easily.*
- *Comments are very important in real time because today we are developing the application but that application maintained by some other person so to understand the logics by everyone writes the comments.*
- *Comments are non executable code these are ignored at compile time.*

There are 3 types of comments.

1) ***Single line Comments:-***

   By using single line comments it is possible to write the description about our programming logics within a single line & these comments are Starts with // (double slash) symbol.

   Syntax:- *//description*

2) ***Multi line Comments:-***

   This comment is used to provide description about our program in more than one line & these commands are start with / & ends with */*

   ```
   Syntax: -    /*----satement-1
                  ----statement-2
                */
   ```

3) ***Documentation Comments:-***

   By using documentation comments it possible to prepare API(Application programming interface) documents.(e will discuss later chapte)

   ```
   Syntax: -        /*
                    *statement-1
                    *statement-2
                    */
   ```

Example:-

```
/*project name:-green project
team size:-     6
team lead:- ratan
*/
class  Test   //class declaration
{        //class starts
         public static void main(String[] args)       // execution  starting point
         {        //main starts
                  System.out.println("ratan");      //printing statement
         }//main ends
};//class ends
```

Separators in java:-

Symbol	***name***	***usage***
( )	*parentheses*	*used to contains list of parameters & contains expression.*
{ }	*braces*	*block of code for class, method, constructors & local scopes.*
[ ]	*brackets*	*used for array declaration.*
;	*semicolon*	*terminates statements.*
,	*comma*	*separate the variables declaration & chain statements in for.*
.	*period*	*used to separate package names from sub packages. And also used for separate a variable,method from a reference type.*

Print() vs Println ():-

Print():- used to print the statement in console and the control is present in the same line.

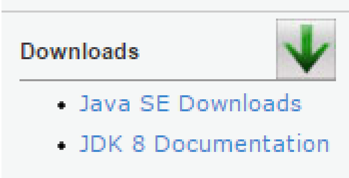
Example:- *System.out.print("Sravyainfotech");*
System.out.print("core java");
Output:-SravyaInfotechcorejava

Println():- used to print the statements in console but the control is there in next line.

Example:- *System.out.println("Sravyainfotech");*
System.out.println("core java");
Output: - ***Sravyainfotech***
Core java

Downloading Api document:-

To download java api document use fallowing link
http://docs.oracle.com/javase/8/docs/



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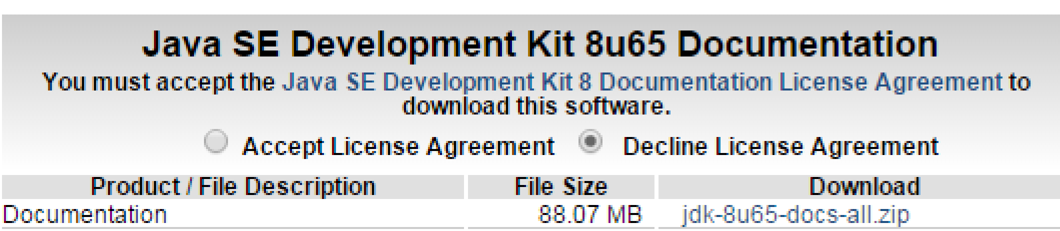

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Java identifiers:-

Every name in java is called identifier such as,

- ✓ *Class-name*
- ✓ *Method-name*
- ✓ *Variable-name*

Rules to declare identifier:

1. *An identifier contains group of Uppercase & lower case characters, numbers ,underscore & dollar sign characters but not start with number.*

int abc=10; ---> valid	int _abc=30; ---> valid	int $abc=40; ---> valid
int a-bc=50; --->not valid	int 2abc=20; ---> Invalid	int not/ok=100 --->invalid

2. *Java identifiers are case sensitive of course java is case sensitive programming language. The below three declarations are different & valid.*

```
class Test
{       int NUMBER=10;
        int number=10;
        int Number=10;
};
```

3. *The identifier should not duplicated & below example is invalid because it contains duplicate variable name.*

```
class Test
{       int a=10;
        int a=20;
};
```

4. *In the java applications it is possible to declare all the predefined class names & interfaces names as a identifier but it is not recommended to use.*

```
class Test
{       public static void main(String[] args)
        {       int String=10;
                float Exception=10.2f;
                System.out.println(String);
                System.out.println(Exception);
        }
};
```

5. *It is not possible to use keywords as a identifiers.*

```
class Test
{       int if=10;
        int try=20;
};
```

6. *There is no length limit for identifiers but is never recommended to take lengthy names because it reduces readability of the code.*

Java primitive Data Types:-

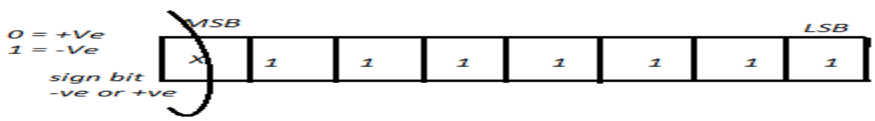
1. Data types are used to represent type of the variable & expressions.
2. Representing how much memory is allocated for variable.
3. Specifies range value of the variable.

There are 8 primitive data types in java

Data Type	***size(in bytes)***	***Range***	***default values***
byte	***1***	***-128 to 127***	***0***
short	***2***	***-32768 to 32767***	***0***
int	***4***	***-2147483648 to 2147483647***	***0***
long	***8***	**–9,223,372,036,854,775,808 to 9 ,223,372,036,854,775,807**	***0***
float	***4***	***-3.4e38 to 3.4e***	***0.0***
double	***8***	***-1.7e308 to 1.7e308***	***0.0***
char	***2***	***0 to 6553***	***single space***
Boolean	***no-size***	***no-range***	***false***

Byte :-

Size	*:*	*1-byte*
MAX_VALUE	*:*	*127*
MIN_VALUE	*:*	*-128*
Range	*:*	*-128 to 127*
Formula	*:*	-2^{n} *to* 2^{n-1} -2^{8} *to* 2^{8-1}



2^6 2^5 2^4 2^3 2^2 2^1 2^0 *64+32+16+8+4+2=128*

Note :-

- *To represent numeric values (10,20,30…etc) use* ***byte,short,int,long.***
- *To represent decimal values(floating point values 10.5,30.6…etc) use* ***float,double.***
- *To represent character use* ***char*** *and take the character within single quotes.*
- *To represent true ,false use* ***Boolean.***

Except Boolean and char remaining all data types consider as a signed data types because we can represent both +ve & -ve values.

Float vs double:-

Float will give 5 to 6 decimal places of accuracy but double gives 14 to 15 places of accuracy.
Float will fallow single precision but double will fallow double precision.

Syntax:- ***data-type name-of-variable = value/literal;***

Ex:- *int a=10;*

Int	------→	Data Type
a	------→	variable name
=	------→	assignment
10	------→	constant value
;	------→	statement terminator

printing variables :-

```
int a=10;
System.out.println(a);          //valid
System.out.println("a");        //invalid
System.out.println('a');        //invalid
```

User provided values are printed

```
int a = 10;
System.out.println(a);//10
boolean b=true;
System.out.println(b);//true
char ch='a';
System.out.println(ch);//a
double d=10.5;
System.out.println(d);//10.5
```

Default values(JVM assigned values)

```
int a;
System.out.println(a);//0
boolean b;
System.out.println(b);//false
char ch;
System.out.println(ch);//single space
double d;
System.out.println(d);//0.0
```

Example :-//Test.java

```
class Test
{       public static void main(String[] args)
        {       float f=10.5;
                System.out.println(f);
                double d=20.5;
                System.out.println(d);
        }
}
```

D:\ratan>javac Test.java
Test.java:3: error: possible loss of precision
float f=10.5;
required: float found: double

*in above example decimal value(10.5) by default double value hence compiler generating error message so to represent float value use **f** constant or perform type casting.*

```
float f =10.5f;         //using f constant (valid)
float f =(float)10.5;   //using type casting (valid)
```

variable declarations:

```
int a=10;               ---->   integer variable
double d=10.5;          ---->   double variable
char ch='a';            ---->   char variable
boolean b=true;         ---->   boolean variable
float f=10.5f;          ---->   float variable
String str="ratan";     ---->   String variable
```

Note:** **String is not a data type & it is a class present in java.lang package to represent group of characters or character array enclosed with in double quotes.

Java Variables:-

- *Variables are used to store the constant values by using these values we are achieving project requirements.*
- *Variables are also known as **fields** of a class or **properties** of a class.*
- *All variables must have a type. You can use primitive types such as int, float, boolean, etc. Or you can use reference types, such as strings, arrays, or objects.*
- *Variable declaration is composed of three components in order,*
  - *Zero or more modifiers.*
  - *The variable type.*
  - *The variable name.*

  Example : public final int x=100;

public int a=10;

public	---->	*modifier (specify permission)*
int	---->	*data type (represent type of the variable)*
a	---->	*variable name*
10	---->	*constant value or literal;*
;	---->	*statement terminator*

There are three types of variables in java

1. ***Local variables.***
2. ***Instance variables.***
3. ***Static variables.***

Local variables:-

- *The variables which are declare inside a **method or constructor or blocks** those variables are called local variables.*

```
class Test
{       public static void main(String[] args)      //execution starts from main method
        {       int a=10;               //local variables
                int b=20;
                System.out.println(a);
                System.out.println(b);
        }
}
```

- *It is possible to access local variables only inside the method or constructor or blocks only, it is not possible to access outside of method or constructor or blocks.*

```
void add()
{       int a=10;       //local variable
        System.out.println(a);   //possible
}
void mul()
{       System.out.println(a);  //not-possible
}
```

- *For the local variables memory allocated when method starts and memory released when method completed.*

Instance variables (non-static variables):-

- ✓ *The variables which are declare inside a class but outside of methods those variables are called instance variables.*
- ✓ *The scope (permission) of instance variable is inside the class having global visibility.*
- ✓ *For the instance variables memory allocated during object creation & memory released when object is destroyed.*
- ✓ *Instance variables are stored in heap memory.*

Areas of java language:-

There are two types areas in java.

1) *Instance Area.*
2) *Static Area.*

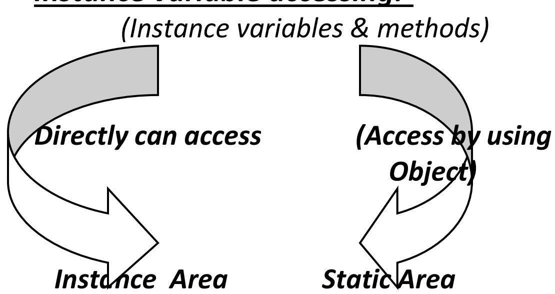
Instance Area:-

```
void m1() //instance method
{       Logics here //instance area
}
```

Static Area:-

```
Static void m1() //static method
{       Logics here //static area
}
```

Instance variable accessing:-



Example:-

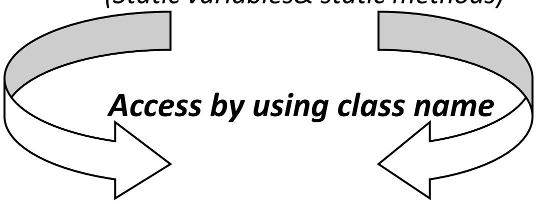
```
class Test
{       //instance variables
        int a=10;
        int b=20;
        //static method
        public static void main(String[] args)
        {       //Static Area
                Test t=new Test();
                System.out.println(t.a);
                System.out.println(t.b);
                t.m1();     //instance method calling
        }
        // instance method
        void m1()     //user defined  method must called by user inside main method
        {       //instance area
                System.out.println(a);
                System.out.println(b);
        }//main ends
};//class ends
```

Static variables (class variables):-

- *The variables which are declared inside the class but outside of the methods with static modifier those variables are called static variables.*
- *Scope of the static variables with in the class global visibility.*
- *Static variables memory allocated during .class file loading and memory released at .class file unloading time.*
- *Static variables are stored in non-heap memory.*

Static variables & methods accessing:-

(Static variables& static methods)



Static area ***instance area***

```
class Test
{       //static variables
        static int a=1000;
        static int b=2000;
        public static void main(String[] args)     //static  method
        {       System.out.println(Test.a);
                System.out.println(Test.b);
                Test t = new Test();
                t.m1();             //instance method calling
        }
        //instance method
        void m1()        //user defined  method called by user inside main method
        {       System.out.println(Test.a);
                System.out.println(Test.b);
        }
};
```

Static variables calling: - We are able to access the static members inside the static area in three ways.

- ✓ *Direct accessing.*
- ✓ *By using class name.*
- ✓ *By using reference variable.*

In above three approaches second approach is best approach .

```
class Test
{       static int x=100;          //static variable
        public static void main(String[] args)
        {       System.out.println(a);              //1-way(directly possible)
                System.out.println(Test.a);         //2-way(By using class name)
                Test t=new Test();
                System.out.println(t.a);            //3-way(By using reference variable)
        }
};
```

Example: - When we create object inside method that object is destroyed when method completed, if any other method required object then create the object inside that method.

```
class Test
{	//instance variable
	int a=10;
	int b=20;
	static void m1()
	{	Test t = new Test();
		System.out.println(t.a);
		System.out.println(t.b);
	}
	static void m2()
	{	Test t = new Test();
		System.out.println(t.a);
		System.out.println(t.b);
	}
	public static void main(String[] args)
	{	Test.m1();	//static method calling
		Test.m2();	//static method calling
	}
};
```

Example:-

```
class Test
{	int a=10;	int b=20;	// instance variables
	static int c=30;  static int d=40;  //static variables
		void m1() //instance method
	{	System.out.println(a);
		System.out.println(b);
		System.out.println(Test.c);
		System.out.println(Test.d);
	}
	static void m2()  //static method
	{	Test t = new Test();
		System.out.println(t.a);
		System.out.println(t.b);
		System.out.println(Test.c);
		System.out.println(Test.d);
	}
	public static void main(String[] args)
	{	Test t = new Test();
		t.m1();  //instance method calling
		Test.m2();	//static method calling
	}
};
```

Variables VS default values:-

Case 1:- for the instance variables JVM will assign default values.

```
class Test
{	int a;
	boolean b;
	public static void main(String[] args)
	{	//access the instance variables  by using object
		Test t=new Test();
		System.out.println(t.a);
		System.out.println(t.b);
	}
};
```

Case 2:- for the static variables JVM will assign default values.

```
class Test
{	static int a;
	 static float b;
	public static void main(String[] args)
	{	//access the static variable  by using class Names
		System.out.println(Test.a);
		System.out.println(Test.b);
	}
};
```

Case 3:-

- *For the instance and static variables JVM will assign default values but for the local variables the JVM won't provide default values.*
- *In java before using local variables must initialize some values to the variables otherwise compiler will raise compilation error "variable a might not have been initialized"*.

```
class Test
{	public static void main(String[] args)
	{	//local variables (access directly)
		int a;
		int b;
		System.out.println(a);
		System.out.println(b);
	}
};
```

```
D:\>javac   Test.java
Test.java:6: variable a might not have been initialized
	 System.out.println(a);
```

Class Vs Object:-

- ***Class is a logical entity it contains logics where as object is physical entity it is representing memory.***
- *Class is blue print it decides object creation without class we are unable to create object.*
- ***Based on single class (blue print) it is possible to create multiple objects but every object occupies memory.***
- *Civil engineer based on blue print of house it is possible to create multiple houses in different places but every house required some area.*
- ***We are declaring the class by using class keyword but we are creating object by using new keyword.***
- *We are able to create object in different ways like*
    - *By using new operator*
    - *By using clone() method*
    - *By using new Instance()*
    - *By using factory method.*
    - *By using deserialization….etc*

But we are able to declare the class by using class keyword.

- ***We will discuss object creation in detailed in constructor concept.***

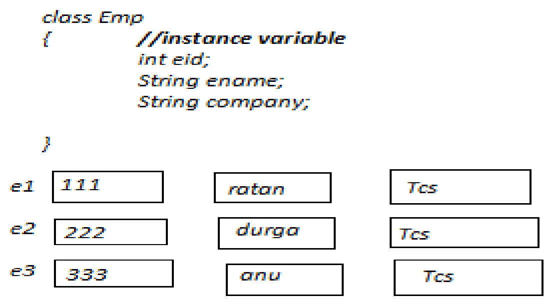
Instance vs. Static variables:-

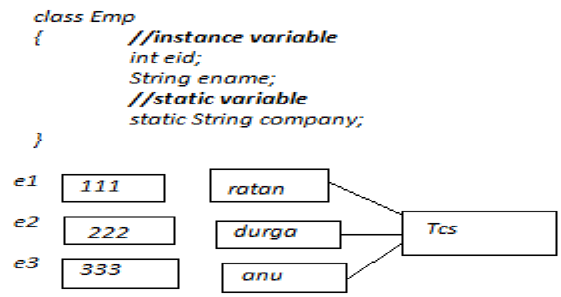
- *For the instance variables the JVM will create separate memory for each and every object it means separate instance variable value for each and every object.*
- *For the static variables irrespective of object creation per class single memory is allocated, here all objects of that class using single copy.*

Example :-

```
class Test
{       int a=10;           //instance variable
        static int b=20;    //static variable
        public static void main(String[] args)
        {       Test t = new Test();
                System.out.println(t.a);  //10
                System.out.println(t.b);  //20
                t.a=111;        t.b=222;
                System.out.println(t.a);  //111
                System.out.println(t.b);  //222
                Test t1 = new Test();     //10 222
                System.out.println(t1.a);       //10
                System.out.println(t1.b);       //222
                t1.b=444;
                Test t2 = new Test();     //10 444
                System.out.println(t2.b);       //444
        }
}
```

Instance variable vs static variable :-





Different ways to initialize the variables :-

```
class Test
{       int s=10;
        int a,b,c;
        int x=10,y,z;
        int i=10,j=20,k;
        int p=10,q=20,r=30;
        public static void main(String[] args)
        {       Test t = new Test();
                System.out.println(t.s);
                System.out.println(t.a+" "+t.b+" "+t.c);
                System.out.println(t.x+" "+t.y+" "+t.z);
                System.out.println(t.i+" "+t.j+" "+t.k);
                System.out.println(t.p+" "+t.q+" "+t.r);
        }
}
```

Summary of variables:-

Characteristic	Local variable	instance variable	static variables
where declared	*inside method or Constructor or block.*	*inside the class outside Of methods*	*inside the class outside of methods .*
Usage	*within the method*	*inside the class.*	*inside the class all*
When memory allocated	*when method starts*	*when object created*	*when .class file loading*
When memory destroyed	*when method ends.*	*When object destroyed*	*when .class unloading.*
Initial values	none, must initialize the value *before first use.*	default values are *Assigned by JVM.*	*default values are Assigned by JVM.*
Relation with Object	*no way related to object.*	*for every object one copy Of instance variable created It means memory.*	*for all objects one copy is created. Single memory.*
Accessing	*directly possible.*	*By using object name.* **Test t = new Test(); System.out.println(t.a);**	*by using class name.* **System.out.println(Test.a);**
Memory	*stored in stack memory.*	*Stored in heap memory*	*non-heap memory.*

Java Methods (behaviors):-

- *Inside the classes directly writing the business logics are not allowed hence inside the class declare the method inside that method writes the logics of the application.*
- *Methods are used to write the business logics of the project.*
- *Coding convention: - method name starts with lower case letter and every inner word starts with uppercase letter(**mixed case**).*

  *Example:- post() , char**A**t() , to**U**pper**C**ase() , compare**T**o**I**gnore**C**ase()……etc*

  There are two types of methods in java,

  1. *Instance method*
  2. *Static method*
- *Inside the class it is possible to declare any number of instance & static methods based on the developer requirement.*
- *It will improve the reusability of the code and we can optimize the code.*

Note: - Whether it is an instance method or static method the methods are used to provide business logics of the project.

Instance method :-

```
void m1()     //instance method
{   //body    //instance area
}
```

Note: - for the instance members memory is allocated during object creation hence access the instance members by using object-name (reference-variable).

Method calling Syntax:-

```
Void m1() { }  //instance method
Objectname.instancemethod( ); //calling  instance method
Test t = new Test();
t.m1( );
```

static method:-

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

*Note: - for the static member's memory allocated during **.class** file loading hence access the static members by using class-name.*

Method calling syntax:-

```
Static void m2()  {  } //static method
Classname.staticmethod( ); //   call static method by using class name
Test.m2( );
```

Every method contains two parts.

1. *Method declaration*
2. *Method implementation (logic)*

```
Example:- void m1()                          ------>  method declaration
          {       Body   (Business logic);   ----->   method implementation
          }
```

Method Syntax:-

[modifiers-list] return-Type Method-name (parameters list) throws Exception

Modifiers-list	------→	*represent access permissions.*	---- →***[optional]***
Return-type	------→	*functionality return value*	---- →***[mandatory]***
Method name	------→	*functionality name*	----- →***[mandatory]***
Parameter-list	------→	*input to functionality*	---- →***[optional]***
Throws Exception	------→	*representing exception handling*	--- →***[optional]***

Example:- ***Public void m1(){*** *logics…**}***
Private int m2(int a,int b) { *logics…**}***

Method Signature:-

Method-name & parameters list is called method signature.

Syntax:- ***Method-name(parameter-list)***

Example:- ***m1(int a)***
m1(int a,int b)

Example-1 :- instance & static methods without arguments.

- ✓ *Instance methods are bounded with objects hence call the instance methods by using object name(reference variable).*
- ✓ *Static methods are bounded with class hence access the static methods by using class-name.*

```
class Test
{       void m1()
        {       System.out.println("m1 instance method");
        }
        static void m2()
        {       System.out.println("m2 static method");
        }
        public static void main(String[] args)
        {       Test t = new Test();
                t.m1();         //calling of instance method by using object-name
                Test.m2();      //calling of static method by using class-name
        }
}
```

Example-2:-instance & static methods with parameters.

- ➢ *If the method is expecting parameters (inputs to functionality) then while calling that method must pass the values to that parameters then only that method will be executed.*
- ➢ *While passing parameters, number of arguments & order of arguments important.*

```
void m1(int a)                  -->t.m1(10);            -->valid
void m2(int a,int b)            -->t.m2(10,'a');        -->invalid
void m3(int a,char ch,float f)  -->t.m3(10,'a',10.6);   -->invalid
void m4(int a,char ch,float f)  -->t.m4(10,'a',10.6f);  -->valid
void m5(int a,char ch,float f)  -->t.m3(10,'c');        -->invalid
```

```
class Test
{       void m1(int a,char ch)    //local variables
        {       System.out.println("m1 instance method");
                System.out.println(a);
                System.out.println(ch);
        }
        static void m2(boolean b,double d)
        {       System.out.println("m2 static method");
                System.out.println(b);
                System.out.println(d);
        }
        public static void main(String[] args)
        {       Test t = new Test();
                t.m1(10,'a');           //calling of instance method by passing inputs
                Test.m2(true,10.5);     //calling of static method by passing inputs
        }
}
```

Example-3 :-

For java methods it is possible to provide Objects as a parameters(in real time project level).

```
class X{}
class Emp{}
class Y{}
class Test
{       void m1(X x ,Emp e)
        {       System.out.println("m1 method");
        }
        static void m2(int a,Y y)
        {       System.out.println("m2 method");
        }
        public static void main(String[] args)
        {       Test t = new Test();
                X x = new X();
                Emp e = new Emp();
                t.m1(x,e);              //calling of instance method by passing objects as an input
                Y y = new Y();
                Test.m2(10,y);          //calling of static method by passing objects as an input
        }
}
```

Main method project code at realtime project level

```
        public static void main(String[] args)
        {       new Test().m1(new X(),new Emp());
                Test.m2(10,new Y());
        }
```

Example-4:-

*For java methods return type is mandatory otherwise the compilation will generate error message **“invalid method declaration; return type required “.***

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

Example -5:-

- *Inside the class it is not possible to declare two methods with same signature , if we are trying to declare two methods with same signature compiler will raise compilation error message **“m1() is already defined in Test ”**(Java class not allowed Duplicate methods)*
- *But It is possible to write two methods with different signature,*

  void m1()

  Void m1(int a) *method signatures are different it is method overloading concept.*

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

Example-6 :-

- *Declaring the class inside another class is called inner classes, java supports inner classes.*
- *Declaring the methods inside other methods is called inner methods but java not supporting inner methods concept if we are trying to declare inner methods compiler generate error message **"illegal start of expression".***

```
class Test
{       void m1()
        {       void m2()  //inner method
                {       System.out.println("m2()  inner  method");
                }
            System.out.println("m1() outer method");
        }
        public static void main(String[] args)
        {       Test t1=new Test();
                t.m1();
        }
};
```

Example 7:-operator overloading

- ✓ *One operator with more than one behavior is called operator over loading.*
- ✓ *Java is not supporting operator overloading concept but only one implicit overloaded operator in java is **+** operator.*
    - *If two operands are integers then **plus (+)** perform addition.*
    - *If at least one operand is String then plus (**+)** perform concatenation.*

```
class Test
{       public static void main(String[] args)
        {       System.out.println(10+20);
                System.out.println("ratan"+"anushka"+2+2+"kids");
                int a=10;
                int b=20;
                int c=30;
                System.out.println(a);
                System.out.println(a+"---");
                System.out.println(a+"---"+b);
                System.out.println(a+"---"+b+"----");
                System.out.println(a+"---"+b+"----"+c);
        }
}
```

***Example-8** :- methods vs. All data- types*

- ✓ *By default the numeric values are integer values but to represent other format like byte, short perform typecasting.*
- ✓ *By default the decimal values are double values but to represent float value perform typecasting or use "**f**" constant. (double d=10.5; float f=20.5f;).*

```
class Test
{       void m1(byte a)         {       System.out.println("Byte value-->"+a);            }
        void m2(short b )       {       System.out.println("short value-->"+b);           }
        void m3(int c)          {       System.out.println("int value-->"+c);             }
        void m4(long d)         {       System.out.println("long value is-->"+d);}
        void m5(float e)        {       System.out.println("float value is-->"+e);}
        void m6(double f)       {       System.out.println("double value is-->"+f);       }
        void m7(char g)         {       System.out.println("character value is-->"+g);    }
        void m8(boolean h)      {       System.out.println("Boolean value is-->"+h);      }
        public static void main(String[] args)
        {       Test t=new Test();
                t.m1((byte)10);         t.m2((short)20);
                t.m3(30);               t.m4(40);
                t.m5(10.6f);            t.m6(20.5);
                t.m7('a');              t.m8(true);
        }
}
```

Example-9:-java method calling

- ➢ *In java one method is calling another method by using method name.*
- ➢ *one java method is able to call more than one method. But once the method is completed the control returns to caller method.*

m1() --->calling ---->m2() ----> calling ---> m3()

m1() <------- after completion-m2() <------after completion m3()

```
class Test
{       void m1()
        {       m2();   //m2() method calling
                System.out.println("m1");
                m2();   //m2() method calling
        }
        void m2()
        {       m3(100);        //m3() method calling
                System.out.println("m2 ");
                m3(200);        //m3() method calling
        }
        void m3(int a)
        {       System.out.println("m3 ");      }
        public static void main(String[] args)
        {       Test t=new Test();
                t.m1();         //m1() method calling
        }       }
```

Example-10 :-

Case 1:- ***This keyword not required***

In below example instance variables and local variables having different names so this keyword not required.

```
class Test
{       //instance variables
        int a=100;
        int b=200;
        void add(int i,int j)
        {       System.out.println(a+b);        //instance  variables addition
                System.out.println(i+j);        //local variables addition
        }
        public static void main(String[] args)
        {       Test t = new Test();
                t.add(10,20);
        }
}
```

Case 2:- ***This keyword required:-***

In below example intstance & local variables having same name, then to represent instance variables use ***this*** *keyword.*

```
class Test
{       //instance variables
        int a=100;
        int b=200;
        void add(int a,int b)
        {       System.out.println(a+b);                //local variables addition
                System.out.println(this.a+this.b);      //instance variables addition
        }
        public static void main(String[] args)
        {       Test t = new Test();
                t.add(10,20);
        }
}
```

Example-11 :-

- *In java **this** keyword is instance variable hence it is not possible to use inside static area. If we are using **this** variable inside static context then compiler will generate error message "**non-static variable** this **cannot be referenced from a static context**".*
- *In the static context it is not possible to use **this & super** keywords.*

```
class Test
{	int a=100;
	static void add(int a)
	{	System.out.println(this.a);
	}
	public static void main(String[] args)
	{	Test t = new Test();
		t.add(10);
	}
}
```

Compilation error:- non-static variable** this **cannot be referenced from a static context.

Example-12 :- ***Conversion of local variables to instace variables to improve the scope of the variable.***

```
class Test
{	//instance variables
	int val1;
	int val2;
	void values(int val1,int val2)//local variables
	{	System.out.println(val1);
		System.out.println(val2);
		//conversion of local to instance (passing local variables values to instance variables)
		this.val1=val1;
		this.val2=val2;
	}
	void add(){	System.out.println(val1+val2);	}
	void mul(){	System.out.println(val1*val2);	}
	public static void main(String[] args)
	{	Test t = new Test();
		t.values(10,20);
		t.add();
		t.mul();
	}
}
```

Example-13 :- methods vs return type.

- ✓ *Every functionality is able to return some functionality return value just like acknowledgement.*
  Ex :- when we applied for driving license then after one month we will receive ID card.

- ✓ *For java methods return type is mandatory & void represent return nothing.*

- ✓ *Methods can have return type primitive such as byte,short,int,long,float….etc OR it can have object return type like Arrays,String,Objects….etc*

- ✓ *If the method is having return type other than void then must return the value by using* ***return*** *keyword otherwise compiler will generate error message "****missing return statement****"*
  Below syntax invalid because method must return int value by using return statement.

```
int m1()
{    System.out.println("Anushka");
}
```

  The below example is valid because it is returning int value by using return statement.

```
int m1()
{    System.out.println("Anushka");
          return 100;
}
```

- ✓ *Inside the method we are able to declare only one return statement that statement must be last statement of the method otherwise compiler will generate error message "****unreachable*** **statement**".
  The below example is invalid because return statement is must be last statement.

```
int m1()
{         return 100;
          System.out.println("Anushka");
 }
```

  The below example valid because return statement is last statement.

```
int m1()
{         System.out.println("Anushka");
          return 100;
 }
```

- ✓ *Every method is able to returns the value but holding (storing) that return value is optional, but it is recommended to hold the return value check the status o the method.*

```
class Test
{       int m1(int a,char ch)
        {       System.out.println("***m1 method***");
                System.out.println(a+"---"+ch);
                return 100;
        }
        boolean m2(String str1,String str2)
        {       System.out.println("****m2 method****");
                System.out.println(str1+"---"+str2);
                return true;
        }
        static String m3(double d,boolean b)
        {       System.out.println("****m3 method****");
                System.out.println(d+"---"+b);
                return "ratan";
        }
        public static void main(String[] args)
        {       Test t=new Test();
                int x = t.m1(10,'a');
                System.out.println("m1() return value-->"+x);

                boolean b = t.m2("ratan","anu");
                System.out.println("m2() return value-->"+b);

                String str = Test.m3(10.5,true);
                System.out.println("m3() return value-->"+str);
        }
}
```

Example 14 :- *It is possible to print return value of the method in two ways,*

1. Hold the value print that value. 2. Directly print call method by using System.out.println()

If the method is having return type is void but if we are trying to call method by using System.out.println() then compiler will generate error message.

```
class Test
{       int m1()
        {       System.out.println("m1 method");
                return 10;          }
        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="+x);           //1-way
                System.out.println("return value="+t.m1());      //2-way
                t.m2();   //valid
                //System.out.println(t.m2()); Compilation error:'void' type not allowed here
        }
}
```

Example 15 :- Java.util.Scanner

- ✓ *Scanner class present in **java.util** package and it is introduced in 1.5 versions & it is used to take dynamic input from the keyboard.*
- ✓ *To communicate with system resources use System class & to take input from keyboard use **in** variable(in=input).*

Scanner s = new Scanner(System.in); //Scanner object creation

to get int value	*---->*	*s.nextInt()*
to get float value	*---->*	*s.nextFloat()*
to get byte value	*---->*	*s.nextbyte()*
to get String value	*---->*	*s.next()*
to get single line	*---->*	*s.nextLine()*
to close the input stream	*---->*	*s.close()*

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	Scanner s=new Scanner(System.in);
		System.out.println("enter emp hobbies");
		String ehobbies = s.nextLine();
		System.out.println("enter emp no");
		int eno=s.nextInt();
		System.out.println("enter emp name");
		String ename=s.next();
		System.out.println("enter emp salary");
		float esal=s.nextFloat();
		System.out.println("*****emp details*****");
		System.out.println("emp no----->"+eno);
		System.out.println("emp name---->"+ename);
		System.out.println("emp sal------>"+esal);
		System.out.println("emp hobbies------>"+ehobbies);
		s.close();		//used to close the stream
	}
}
```

Case:- *The \s represents whitespace.*

```
import java.util.*;
public class Test
{	public static void main(String args[])
	{	 String input = "7 tea 12 coffee";
		Scanner s = new Scanner(input).useDelimiter("\\s");
		System.out.println(s.nextInt());
		System.out.println(s.next());
		System.out.println(s.nextInt());
		System.out.println(s.next());
		s.close();   }}
```

Example 16:- retrun statement vs if-else

```
import java.util.*;
class Test
{       static String status(int age)
        {       if (age>20)
                {       return "eligible for marriage";        }
                else
                {       return "not eligible for marriage";   }
        }
        public static void main(String[] args)
        {       Scanner s = new Scanner(System.in);
                System.out.println("enter your age:");
                int age = s.nextInt();
                String str = Test.status(age);
                System.out.println("your status is="+str);
        }
};
```

Example-17:*<u>- methods vs. return variables</u>*

<u>Returns local variable as a return value</u>

```
class Test
{       int a=10;
        int m1(int a)
        {
        System.out.println("m1() method");
        return a;  //return local variable
        }
        public static void main(String[] args)
        {       Test t = new Test();
                int x = t.m1(100);
                System.out.println(x);
        }
}
D:\>java Test
m1() method
100
```

<u>Returns instance variable as a return value(no local variable)</u>

```
class Test
{       int a=10;
        int m1()
        {
        System.out.println("m1() method");
        return a; //returns instance value
        }
        public static void main(String[] args)
        {       Test t = new Test();
                int x = t.m1();
                System.out.println(x);
        }
}
D:\>java Test
m1() method
10
```

<u>If the application contains both local & instance variables with same name then first priority goes to local variables but to return instance value use this keyword.</u>

```
class Test
{       int a=10;
        int m1(int a)
        {       System.out.println("m1() method");
                return this.a;      //return instance variable as a return value.
        }
        public static void main(String[] args)
        {       Test t = new Test();
                int x = t.m1(100);
                System.out.println("m1() return value is→ "+x);  //printing return value
        }
}
```

Example 18:- ***The java class is able to return user defined class as a return value.***

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

	}
}
```

Note: ***when we print object reference variable it always print hash code of the object (we will discuss later).***

Example 19: **this** *keyword representing current class objects.*

Java method is able to return current class object in two ways.

1) Creating object & return reference variable.
2) Return **this** keyword.

In above two approaches 2nd approach is recommended to return the current class object.

```
class Test
{	Test m1()
	{	System.out.println("m1 method");
		Test t = new Test();
		return t;
	}
	Test m2()
	{	System.out.println("m2 method");
		return this;
	}
	public static void main(String[] args)
	{	Test t = new Test();
		Test t1 = t.m1();
		Test t2 = t.m2();
	}
};
```

Example 20:- Template method

- *Let's assume to complete your task you must call four methods then,*
    - *you must remember number of method names.*
    - *Order of calling (which one is first & which one is later).*
- *To overcome above limitation take **x( )** method it is calling four methods internally to complete our task then instead of calling four methods every time call x( ) method that perform our task that x( ) method is called template method.*

```
class Test
{	void customer()		{	System.out.println("custome");	}
	void product()		{	System.out.println("product ");	}
	void selection()	{	System.out.println("selection");	}
	void billing()		{	System.out.println("billing");	}
	void deliveryManager()		//template method
	{	System.out.println("****Template method***");
		//template method is calling four methods in order to complete our task.
		customer();
		product();
		selection();
		billing();
	}
	public static void main(String[] args)
	{	Test t = new Test();	//normal approach
		t.customer();		t.product();
		t.selection();		t.billing();
		//by using template method
		t.deliveryManager();	//this method is calling four methods to complete our task.
	}
};
```

Example 21:- Method recursion *A method is calling itself during execution is called recursion.*

case 1:- (normal output)

```
class RecursiveMethod
{	static void recursive(int a)
	{	System.out.println("number is :- "+a);
		if (a==0)
		{return;
		}
		recursive(--a);	//same method is calling [recursion]
	}
	public static void main(String[] args)
	{	RecursiveMethod.recursive(10);
	}
};
```

case 2:- (StackOverFlowError)

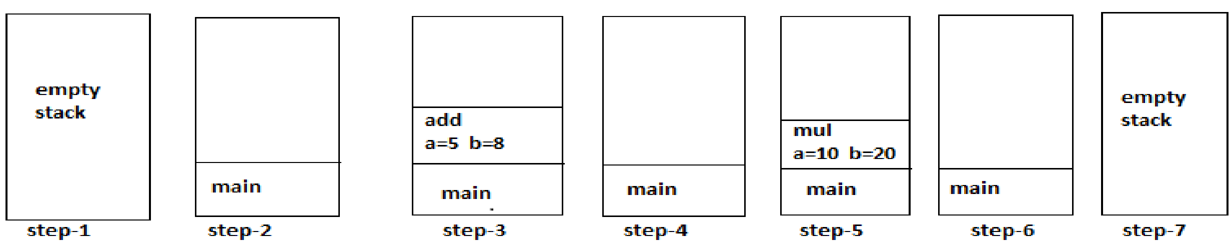
```
class RecursiveMethod
{	static void recursive(int a)
	{	System.out.println("number is :- "+a);
		if (a==0)
		{return;
```

```
                }
                recursive(++a);
        }
        public static void main(String[] args)
        {       RecursiveMethod.recursive(10);
        }
};
```

Example 22 :- Stack Mechanism:-

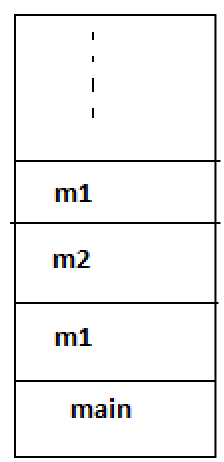
- ✓ In java program execution starts from main method called by JVM & just before calling main method JVM will creates one empty stack memory for that application.
- ✓ When JVM calls particular method then that method entry and local variables of that method stored in stack memory & when the method completed, that particular method entry and local variables are destroyed from stack memory & that memory becomes available to other methods.
- ✓ The jvm will create stack memory just before calling main method & jvm will destroyed stack memory after completion of main method.

```
class Test
{       void add(int a,int b)
        {       System.out.println(a+b);        }
        void mul(int a,int b)
        {       System.out.println(a+b);        }
        public static void main(String[] args)
        {       Test t = new Test();
                t.add(5,8);             t.mul(10,20);
        }
};
```



Example 23 :-when we call methods recursively then we will get StackOverFlowError.

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



CONSTRUCTORS

Class Vs Object:-

- ***Class is a logical entity it contains logics where as object is physical entity it is representing memory.***
- *Class is blue print it decides object creation without class we are unable to create object.*
- ***Based on single class (blue print) it is possible to create multiple objects but every object occupies memory.***
- *Civil engineer based on blue print of house it is possible to create multiple houses in different places but every house required some area.*
- ***We are declaring the class by using class keyword but we are creating object by using new keyword.***
- *We are able to create object in different ways like*
  - *By using new operator*
  - *By using clone() method*
  - *By using new Instance()*
  - *By using instance factory method.*
  - *By using static factory method*
  - *By using pattern factory method*
  - *By using deserialization….etc*

But we are able to declare the class by using class keyword.

Object creation syntax:-

Class-name reference-variable = new class-name ();

Test t = new Test ();

Test ---> *class Name*
t ---> *Reference variables*
= ---> *assignment operator*
new ---> *keyword used to create object*
Test () ---> *constructor*
; ---> *statement terminator*

When we create new instance (Object) of a class using new keyword, a constructor for that class is called.

New :-

- *new keyword is used to create object in java.*
- *When we create object by using new operator after new keyword that part is constructor then constructor execution will be done.*

Rules to declare constructor:-

1) *Constructor name class name must be same.*
2) *It is possible to provide parameters to constructors (just like methods).*
3) *Constructor not allowed explicit return type. (return type declaration not possible even **void**).*

There are two types of constructors,

1) ***Default Constructor (provided by compiler).***
2) ***User defined Constructor (provided by user)*** *or* ***parameterized constructor.***

Default Constructor:-

- ✓ *Inside the class if we are not declaring at least one constructor then compiler generates zero argument constructors with empty implementation at the time of compilation.*
- ✓ *The compiler generated constructor is called **default constructor.***
- ✓ *Inside the class default constructor is invisible mode.*
- ✓ *To check the default constructor provided by compiler open the .class file code by using java decompiler software.*

Application before compilation :-

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

*In above application when we create object by using new keyword "**Test t = new Test ()**" then compiler is searching for **"Test()"** constructor inside the class since not available hence compiler generate default constructor at the time of compilation.*

The default constructor is always 0-argument constructor with empty implementations.

Application after compilation :-

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

In above example at run time JVM will execute compiler provide default constructor during object creation.

User defined constructor:-

The constructors which are declared by user are called user defined constructor.

Example :-

```
class Test
{       //constructor declared by user
        Test()
        {       System.out.println("0-arg constructor");
        }
        Test(int i)
        {       System.out.println("1-arg constructor");
        }
        Test(int a,int b)
        {       System.out.println("2-arg constructor");
        }
        public static void main(String[] args)
        {       Test t1=new Test();
                Test t2=new Test(10);
                Test t3=new Test(100,200);
        }
}
```

Example:-

- *Inside the class if we are declaring at least one constructor (either 0-arg or parameterized) then compiler won't generate default constructor.*
- *Inside the class if we are not declaring at least one constructor (either 0-arg or parameterized) then compiler will generate default constructor.*
- *if we are trying to compile below application the compiler will generate error message "Cannot find symbol " because compiler is unable to generate default constructor.*

```
class Test
{       Test(int i)
        {       System.out.println("1-arg constructor");
        }
        Test(int a,int b)
        {       System.out.println("2-arg constructor");
        }
        public static void main(String[] args)
        {       Test t1=new Test();
                Test t2=new Test(10);
                Test t3=new Test(100,200);
        }
}
E:\>javac Test.java
Test.java:9: cannot find symbol
 Symbol:   constructor Test ()
 Location: class Test
```

Note :- ***default constructor is zero argument constructor but all zero argument constructors are not default constructors.***

Object creation formats:-

2-formats of object creation.

1) *Named object (having reference variable)* ***Test t = new Test();***
2) *Nameless object (without reference variable)* ***new Test();***

```
class Test
{       void m1()
        {       System.out.println("m1 method");
        }
        public static void main(String[] args)
        {       //named object          [having reference variable]
                Test t = new Test();
                t.m1();
                //nameless object       [without reference variable`]
                new Test().m1();
        }
}
```

2- formats of object creation.

1) *Eager object creation.*
2) *Lazy object creation.*

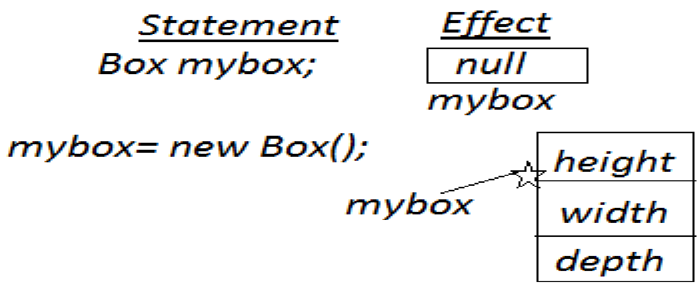
```
class Test
        void m1(){System.out.println("m1 method");}
        public static void main(String[] args)
        {       //Eager object creation approach
                Test t = new Test();
                t.m1();
                //lazy object creation  approach
                Test t1;
                ;;;;;;;;;; //some code here
                t1=new Test();
                t1.m1();
        }
}
```

Example:-

```
class Box
{       double height;
        double width;
        double depth;
};
```

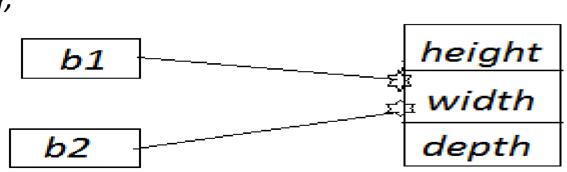
Box mybox; *mybox is the reference to an object of type Box. After executing this line mybox contains the value null.*

mybox = new Box(); *it creates the Box object and assign to mybox reference type.*



Example:-

```
class Box
{       double height=10;
        double width=20;
        double depth=30;
        void volume()
        {       System.out.println(height*width*depth);
        }
};
class Test
{       public static void main(String[] args)
        {       Box b1 = new Box();
                Box b2 = b1;
                b1=null;
                b2.volume();
                //b1.volume();   java.lang.NullPointerException
        }
};
```



In above example both b1 & b2 are pointing to same object. Here b1has been set to null but still b2 is pointing to the original object.

Note: - *When we assign one object reference variable to another object reference variable, you are not creating a copy of the object we are creating copy of the reference.*

Advantages of constructors:-

1) *Constructors are used to write block of java code that code will be executed during object creation.*
2) *Constructors are used to initialize instance variables during object creation.*

Example :- default constructor execution process.

```
class Employee
{	//instance variables
	int eid;
	String ename;
	double esal;
	void display()
	{	//printing instance variables values
		System.out.println("****Employee details****");
		System.out.println("Employee name :-->"+ename);
		System.out.println("Employee eid :-->"+eid);
		System.out.println("Employee sal :-->"+esal);
	}
	public static void main(String[] args)
	{	Employee e1 = new Employee();
		e1.display();
	}
}
```

```
D:\morn11>java Employee
****Employee details****
Employee name :-->null
Employee eid :-->0
Employee sal :-->0.0
```

Problems in above example:-

- ✓ *In above example during object creation time default constructor is executed with empty implementation and initial values of instance variables (default values) printed .*
- ✓ *In above example Emp object is created but default values are printing hence to overcome this limitation use user defined constructor to initialize some values to instance variables.*

Example 2:- user defined o-argument constructor execution process.

```
class Employee
{	//instance variables
	int eid;
	String ename;
	double esal;
	Employee( )   //user defined 0-argument constructor
	{	//assigning values to instance values during object creation
		eid=111;
		ename="ratan";
		esal =60000;
	}
```

```
    void display()
    {   //printing instance variables values
            System.out.println("****Employee details****");
            System.out.println("Employee name :-->"+ename);
            System.out.println("Employee name :-->"+eid);
            System.out.println("Employee name :-->"+esal);
    }
    public static void main(String[] args)
    {       Employee e1 = new Employee();
            e1.display();
    }
}
```

Compilation & execution process:-

```
D:\morn11>javac Employee.java
D:\morn11>java Employee
****Employee details****
Employee name :-->ratan
Employee name :-->111
Employee name :-->60000.0
```

In above example during object creation user provided 0-arg constructor executed used to initialize some values to instance variables.

Problem in above example:-

In above example when we create object it initializing values to instance variables but when we create multiple object for every object same 0-argument constructors is executing it initializing same values for all objects

```
    public static void main(String[] args)
    {       Emp e1 = new Emp();
            e1.display();
            Emp e2 = new Emp();
            e2.display();
    }
    D:\morn11>java Employee
    ****Employee details****
    Employee name :-->ratan
    Employee name :-->111
    Employee name :-->60000.0
    Employee name :-->ratan
    Employee name :-->111
    Employee name :-->60000.0
```

To overcome above limitation use parameterized constructor to initialize different values to different objects

<u>Example 3:- User defined parameterized constructors:-</u>

- Inside the class if the default constructor is executed & object is created but initial values of variables only printed.
- To overcome above limitation inside the class we are declaring user defined 0-argument constructor to assign some values to instance variables but when we create multiple objects for every object same constructor is executing and same values are initializing.
- To overcome above limitation declare the parameterized constructor and pass the different values to different objects.

<u>Example :-</u>

```
class Employee
{       //instance variables
        int eid;
        String ename;
        double esal;
        Employee(int eid,String ename,double esal)      //local variables
        {       //conversion (passing local values to instance values)
                this.eid = eid;
                this.ename = ename;
                this.esal = esal;
        }
        void display()
        {       //printing instance variables values
                System.out.println("****Employee details****");
                System.out.println("Employee name :-->"+ename);
                System.out.println("Employee name :-->"+eid);
                System.out.println("Employee name :-->"+esal);
        }
        public static void main(String[] args)
        {       // during object creation parameterized  constructor executed
                Employee e1 = new Employee(111,"ratan",60000);
                e1.display();
                Employee e2 = new Employee(222,"anu",70000);
                e2.display();
        }
}
E:\>javac Test.java
E:\>java Employee
****Employee details****
Employee name :-->ratan
Employee name :-->111
Employee name :-->60000.0
****Employee details****
Employee name :-->anu
Employee name :-->222
Employee name :-->70000.0
```

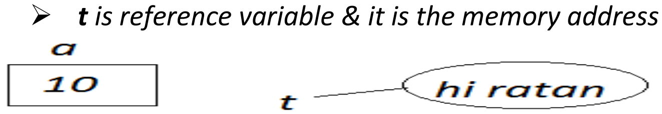
Example :- assign values to instance variables [constructor vs. method]

```
class Student
{       //instance variables
        int sid;
        String sname;
        int smarks;
        //constructor assigning values to instance variables
        Student(int sid,String sname,int smarks)
        {       this.sid=sid;
                this.sname=sname;
                this.smarks=smarks;
        }
        //method assigning values to instance variables
        void assign(int sid,String sname,int smarks)
        {       this.sid=sid;
                this.sname=sname;
                this.smarks=smarks;
        }
        void disp()
        {       System.out.println("****student Details****");
                System.out.println("student name = "+sname);
                System.out.println("student id = "+sid);
                System.out.println("student mrks = "+smarks);
        }
        public static void main(String[] args)
        {       Student s = new Student(111,"ratan",100);
                s.assign(222,"anu",200);
                s.disp();
        }
}
```

```
E:\>java Student
****student Details****
student name = anu
student id = 222
student mrks = 200
```

Example :- primitive variable vs reference variable

- ***a*** *is variable of primitive type such as int,char,double,boolean…etc*
- ***t*** *is reference variable & it is the memory address of object.*




```
class Test
{       public static void main(String[] args)
        {       //a is primitive variable
                int a=10;
                System.out.println(a);
                //t is reference variable
                Test t = new Test ();
                System.out.println(t);
        }
}
```

Constructor calling:-

To call Current class constructor use this keyword

this();	---->	*current class 0-arg constructor calling*
this(10);	---->	*current class 1-arg constructor calling*
this(10 , true);	---->	*current class 2-arg constructor calling*
this(10 , "ratan" , 'a')	---->	*current class 3-arg constructor calling*

Example-1:-

Call the java methods by uisng method name but to call the current class contructor use this keyword.

```
class Test
{       Test( )
        {       this(100);      //current class 1-arg constructor calling
                System.out.println("0-arg constructor  logics");
        }
        Test(int a)
        {       this('g',10);   //current class 2-arg constructor calling
                System.out.println("1-arg constructor logics");
                System.out.println(a);
        }
        Test(char ch,int a)
        {       System.out.println("2-arg constructor logics");
                System.out.println(ch+"----"+a);
        }
        public static void main(String[] args)
        {       new Test( );
        }
}
```

Example 2:-

*Inside the constructor this keyword must be first statement otherwise compiler generate error message "**call to this must be first statement in constructor**".*

No compilation error:-(this keyword first statement)

```
Test()
{       this(10);  //current class 1-argument constructor calling
        System.out.println("0 arg");
}
```

Compilation error:- (this keyword not a first statement)

```
Test()
{       System.out.println("0 arg");
        this(10);  //current class 1-argument constructor calling
}
```

Example-3:-

1. *Constructor calling must be first statement in constructor code it means this keyword must be first statement in constructor.*
2. *In java one constructor is able to call only one constructor at a time but not possible to call more than one constructor.*

Compilation error:-

```
Test()
{       this(100);   //1-arg constructor calling
        this('g',10);  //2-arg constructor calling[compilation error]
        System.out.println("0-arg constructor  logics");
}
```

Object creation parts:- *Every object creation having three parts.*

1) ***Declaration:-***
```
Test t;                    //t is Test type
Student s;                 //s is Student  type
A a;                       //a is A type
```
2) ***Instantiation:-(just object creation)***
```
new Test();            //Test object
new Student();         //student object
new A();               //A object
```
3) ***initialization:-(during object creation perform initialization)***
```
new Test(10,20);               //during object creation 10,20 values initialized
new Student("ratan",111);      //during object creation values are initialized
new A('a',true)                //during object creation values are initialized
```

Example :- By using constructors copy the values of one object to another object.

```
class Student
{       int sid;
        String sname;
        int smarks;
        Student(int sid,String sname,int smarks)
        {       this.sid=sid;      this.sname=sname;      this.smarks=smarks;
        }
        Student(Student s)        //constructor expected Student object
        {       this.sid=s.sid;    this.sname=s.sname;    this.smarks=s.smarks;
        }
        void disp()
        {       System.out.println("****student Details****");
                System.out.println("student name = "+sname);
                System.out.println("student id = "+sid);
                System.out.println("student mrks = "+smarks);
        }
        public static void main(String[] args)
        {       Student s = new Student(111,"ratan",100);
                Student s1 = new Student(s); //constructor is taking Student object
                s.disp();          s1.disp();
        }
}
```

<u>Difference between methods and constructors:-</u>

<u>Property</u>	<u>methods</u>	<u>constructors</u>
1)Purpose	methods are used to write logics but these logics will be executed when we call that method.	Constructor is used write logics of the project but the logics will be executed during Object creation.
2)Variable initialization	It is initializing variable when We call that method.	It is initializing variable during object creation.
3)Return type	Return type not allowed Even void.	It allows all valid return Types(void,int,Boolean…etc)
4)Name	**M**ethod name starts with lower Case & every inner word starts With upper case. Ex: charAt(),toUpperCase()….	Class name and constructor name must be matched.
5)types	a) instance method b)static method	a)default constructor b)user defined constructor
6)inheritance	methods are inherited	constructors are not inherited.
7)how to call	To call the methods use method Name.	to call the constructor use **this** keyword.
8)able to call how many Methods or constructors	one method is able to call multiple methods at a time.	one constructors able to Call only one constructor at a time.
9)this	to call instance method use this Keyword but It is not possible to call static method.	To call constructor use this keyword but inside constructor use only one this statement.
10)Super	used to call super class methods.	Used to call super class constructor
11)Overloading	it is possible to overload methods	it is possible to overload cons.
12)compiler generate Default cons or not	yes	does not apply
13)compiler generate Super keyword.	yes	does not apply.

Constructor chaining :-

- *One constructor is calling same class constructor is called constructor calling.*
- *We are achieving constructor calling by using this keyword.*
- *Inside constructor we are able to declare only one this keyword that must be first statement of the constructor.*

```
class Test
{       Test()
        {       this(10);
                System.out.println("0-arg cons");
        }
        Test(int i)
        {       this(10,20);
                System.out.println("1-arg cons");
        }
        Test(int i,int j)
        {       System.out.println("2-arg cons");
        }
        public static void main(String[] args)
        {       new Test();
        }
}
```

Instance Blocks:-

- *Instance blocks are used to write the logics of projects & these logics are executed during object creation just before constructor execution.*
- *Instance blocks execution depends on object creation it means if we are creating 10 objects 10 times constructors are executed just before constructors instance blocks are executed.*
- *Instance block syntax*

  *{ **//logics here** }*

Example 1:-

```
class Test
{       //instance block
        {       System.out.println("instance block:logics");
        }
        Test()
        {       System.out.println("constructor:logics");
        }
        public static void main(String[] args)
        {       new Test();
        }
}
```

Example 2:-

Inside the class it is possible to declare multiple instance blocks but the execution order is top to bottom.

```
class Test
{	{	System.out.println("instance block-1:logics");
	}
	Test()
	{	System.out.println("0-arg constructor:logics");
	}
	{	System.out.println("instance block-2:logics");
	}
	Test(int a)
	{	System.out.println("1-arg constructor:logics");
	}
	public static void main(String[] args)
	{	new Test();
		new Test();
		new Test(10);
	}
}
```

Example 3:-

- ✓ *Instance block execution depends on object creation but not constructor exaction.*
- ✓ *In below example two constructors are executing but only one object is crating hence only one time instance block is executed.*

```
class Test
{	{	System.out.println("instance block-1:logics");
	}
	Test()
	{	this(10);
		System.out.println("0-arg constructor:logics");	}
	Test(int a)
	{	System.out.println("1-arg constructor:logics");
	}
	public static void main(String[] args)
	{	new Test();
	}
}
E:\>java Test
instance block-1:logics
1-arg constructor:logics
0-arg constructor:logics
```

<u>Example 4:-</u>

Case 1:-

- ✓ *When we declare instance block & instance variable the execution order is top to bottom.*
- ✓ *In below example instance block is declared first so instance block is executed first.*

```
class Test
{	{	System.out.println("instance block");		}	//instance block
	int a=m1();		//instance variables
	int m1()
	{	System.out.println("m1() method called by variable");
		return 100;
	}
	public static void main(String[] args)
	{	new Test();
	}
}
D:\morn11>java Test
instance block
m1() method called by variable
```

case 2;-

- ✓ *When we declare instance block & instance variable the execution order is top to bottom.*
- ✓ *In below example instance variable is declared first so instance block is executed first.*

```
class Test
{	int a=m1();	//instance varaibles
	int m1()
	{	System.out.println("m1() method called by variable");
		return 100;
	}
	{	System.out.println("instance block");
	}
	public static void main(String[] args)
	{	new Test();
	}
}
D:\morn11>java Test
m1() method called by variable
instance block
```

Example-5 :-

- *Instance blocks are used to initialize instance variables during object creation but just before constructor execution.*
- *In java it is possible to initialize the values in different ways*
    - *By using constructors*
    - *By using instance blocks*
    - *By using methods*
    - *By using setter methods……..…etc*

```
class Emp
{	int eid;
	String ename;
	//instance block initializing values
	{	ename="ratan";
		eid=111;
	}
	//constructor initializing values
	Emp()
	{	ename="anu";
		eid=222;
	}
	//method initializing values
	void assign()
	{	ename="aruna";
		eid=333;
	}
	void disp()
	{	System.out.println("****Employee Details****");
		System.out.println("emp id="+eid);
		System.out.println("emp name="+ename);
	}
	public static void main(String[] args)
	{	Emp e = new Emp();
		e.disp();
	}
};
E:\>java Emp
****Employee Details****
emp id=222
emp name=anu
```

static block:-

- *Static blocks are used to write the logics of project that logics are executed during .class file loading time.*
- *In java .class file is loaded only one time hence static blocks are executed once per class.*
- *Static block syntax,*

```
static
{  //logics here
}
```

Note : instance blocks execution depends on object creation but static blocks execution depends on .class file loading.

Example-1 :-

```
class Test
{       static
        {     System.out.println("static block");
        }
        public static void main(String[] args)
        {
        }
}
```

Example-2 :-

Inside the class it is possible to write multiple static blocks but the execution is top to bottom.

```
class Test
{       //static blocks declaration
        static{  System.out.println("static block-1");}
        static{System.out.println("static block-2");}
        //instance blocks declaration
        {       System.out.println("instance block-1");      }
        {       System.out.println("instance block-2");      }
        //constructor declaration
        Test()
        {       System.out.println("0-arg constructor");
        }
        Test(int a)
        {       System.out.println("1-arg constructor");
        }
        public static void main(String[] args)
        {       new Test();
                new Test(10);
        }
}
```

Example-3 :-static block is initializing variable

Static blocks are used to initialize static variables during .class file loading.

```
class Emp
{       static int eid;
        static
        {       eid=111;
        }
        static void assign()
        {       eid=333;
        }
        static void disp()
        {       System.out.println(eid);
        }
        public static void main(String[] args)
        {       Emp e = new Emp();
                e.assign();
                e.disp();
        }
}
```

Example-4 :- To execute static blocks inside the class main() method is mandatory or optional.

```
class Test
{       static
        {    System.out.println("static block");
        }
}
```

- ✓ *When we execute above code up to 1.5 version the code is compiled & executed it will generate output.*

Note : Based on above point up to 1.5 version it is possible to print some statements in output console without using main method inside the class.

- ✓ *When we execute the above code from 1.6 version onwards the code is not compiled it will generate compilation error.*

Note:- based on above point from 1.6 version onwards it is not possible to print some statements in output console without using main method inside the class.

Example-5:-

- ✓ *When we execute the .class file manually then to execute static blocks inside the class main() method mandatory.*
- ✓ *When we load the .class file into memory programmatically then to execute the static blocks main() method is optional.*
- ✓ *In below example both files must present in same folder (same location).*

File 1:- Demo.java

```
class Demo
{       static
        {       System.out.println("Demo class static block");
        }
        void m1()
        {       System.out.println("Demo class m1 method");
        }
};
```

File -2:- Test.java

```
class Test
{       static
        {       System.out.println("Test class static blocks");
        }
        public static void main(String[] args) throws Exception
        {       Class c = Class.forName("Demo");
                Demo d = (Demo)c.newInstance();
                d.m1();
        }
}
E:\>java Test
Test class static blocks
Demo class static block
Demo class m1 method
```

- ❖ *To load the .class file into memory use **forName()** method & it is a static method of **Class** class.*
- ❖ *To check the return type & modifiers & arguments check the predefined support by using **javap** command.*
  E:\>javap java.lang.Class
  public static Class forName(String class-name) throws java.lang.ClassNotFoundException;
- ❖ *forName() method loads .class file into memory and it return type is class pointing to loaded class.*
- ❖ *To created the object for loaded class use newInstance() method & it is a instance method present in **Class** class.*
  public Object newInstance() throws java.lang.InstantiationException, java.lang.IllegalAccessException;

java flow control Statements:-

There are three types of flow control statements in java

a. *Selection Statements*
b. *Iteration statements*
c. *Transfer statements*

1. Selection Statements

a. If b. If-else c. switch

If syntax:-

```
if (condition)
{       true  body;
}
else
{       false body;
}
```

- If is taking condition that condition must be Boolean condition. Otherwise compiler will generate error message.
- The curly brasses are optional but without it are possible to take only one statement except initialization.

Example-1:-

```
class Test
{       public static void main(String[] args)
        {       int a=10,b=20;
                if (a<b)
                {       System.out.println("if body / true body");
                }
                else
                {       System.out.println("else body/false body ");
                }
        }
}
```

Example -2:- For the if the condition it is possible to provide Boolean values.

```
class Test
{       public static void main(String[] args)
        {       if (true)
                {       System.out.println("true body");
                }
                else
                {       System.out.println("false body");
                }
        }
}
```

Example-3:-in c-language 0-false & 1-true but these conventions are not allowed in java.

```
class Test
{	public static void main(String[] args)
	{	if (0)
		{	System.out.println("true body");
		}
		else
		{	System.out.println("false body");
		}
	}
}
```

Example-4:-

```
class Test
{	public static void main(String[] args)
	{	if (true)
			System.out.println("true body");
		else
			System.out.println("false body");
	}
}
```

Switch statement:-

- ✓ Switch statement is used to declare multiple selections.
- ✓ Inside the switch It is possible to declare any number of cases but one default case.
- ✓ Switch is taking the argument, the allowed arguments are
  - ***Byte, Short,Int,Char,enum(1.5 version),String(1.7 version).***
- ✓ Float and double and long is not allowed for a switch argument because these are having more number of possibilities (float and double is having infinity number of possibilities).
- ✓ Based on the provided argument the matched case will be executed if the cases are not matched default will be executed.

Syntax:-

```
switch(argument)
{
   case   label1:     statements;
                      break;
   case   label2 :    statements;
                      break;
        |                  |
        |                  |
   default    :        statements;
                      break;
}
```

Example-1: Normal input and normal output.

```
class Test
{	public static void main(String[] args)
	{	int a=10;
		switch (a)
		{	case 10:System.out.println("anushka");		break;
			case 20:System.out.println("nazriya");		break;
			case 30:System.out.println("samantha");		break;
			default:System.out.println("ubanu");		break;
		}
	}
}
```

Example-2: Inside the switch the case labels must be unique; if we are declaring duplicate case labels the compiler will raise compilation error "duplicate case label".

```
class Test
{	public static void main(String[] args)
	{	int a=10;
		switch (a)
		{	case 10:System.out.println("anushka");		break;
			case 10:System.out.println("nazriya");		break;
			default:System.out.println("ubanu");		break;
		}
	}
}
```

Example-3: Inside the switch for the case labels it is possible to provide expressions (10+10+20 , 10*4 , 10/2).

```
class Test
{	public static void main(String[] args)
	{	int a=100;
		switch (a)
		{	case 10+20+70:System.out.println("anushka");		break;
			case 10+5:System.out.println("nazriya");		break;
			case 30/6:System.out.println("samantha");		break;
			default:System.out.println("ubanu");		break;
		}
	}
}
```

Example-4:- Inside the switch the case label must be constant values. If we are declaring variables as a case labels the compiler will show compilation error "constant expression required".

```
class Test
{	public static void main(String[] args)
	{	int a=10,b=20;
		switch (a)
		{	case a:System.out.println("anushka");		break;
			case b:System.out.println("nazriya");		break;
			default:System.out.println("ubanu");		break;
		}
	}
}
```

Example-5:- inside the switch the default is optional.

```
class Test
{	public static void main(String[] args)
	{	int a=10;
		switch (a)
		{	case 10:System.out.println("10");	break;
		}
	}
};
```

Example 6:- Inside the switch cases are optional part.

```
 class Test
{	public static void main(String[] args)
	{	int a=10;
		switch (a)
		{	default: System.out.println("default");		break;
		}
	}
};
```

Example 7:- inside the switch both cases and default Is optional.

```
public class Test
{    public static void main(String[] args)
     {   int a=10;
        switch(a)
         {
         }
     }
}
```

Example -8:-inside the switch independent statements are not allowed. If we are declaring the statements that statement must be inside the case or default.

```
public class Test
{    public static void main(String[] args)
     {     int x=10;
           switch(x)
           {       System.out.println("Hello World");
           }
     }
}
```

Example-9:- internal conversion of char to integer.   Unicode values   a-97   A-65

```
class Test
{       public static void main(String[] args)
        {       int a=65;
                switch (a)
                {       case 66:System.out.println("10");        break;
                        case 'A':System.out.println("20");       break;
                        case 30:System.out.println("30");        break;
                        default: System.out.println("default");  break;
                }
        }
};
```

Example -10: internal conversion of integer to character.

```
class Test
{       public static void main(String[] args)
        {       char ch='d';
                switch (ch)
                {       case 100:System.out.println("10");       break;
                        case 'A':System.out.println("20");       break;
                        case 30:System.out.println("30");        break;
                        default: System.out.println("default");  break;
                }
        }
};
```

Example -11:-

- ***Inside the switch statement beak is optional.***
- ***If we are not providing break statement then from the matched case onwards up to break statement will be executed, if there is no break statement then end of the switch will be executed. This situation is called as fall though inside the switch case.***

```
class Test
{	public static void main(String[] args)
	{	int a=10;
		switch (a)
		{	case 10:System.out.println("10");
			case 20:System.out.println("20");
			case 40:System.out.println("40");		break;
			default: System.out.println("default");		break;
		}
	}
};
```

Example-12:- ***inside the switch the case label must match with provided argument data type otherwise compiler will raise compilation error "incompatible types".***

```
class Test
{	public static void main(String[] args)
	{	char ch='a';
		switch (ch)
		{	case "aaa"	:System.out.println("samantha");	break;
			case   65	:System.out.println("anu");		break;
			case 'a'	:System.out.println("ubanu");		break;
			default		:System.out.println("default")		break;
		}
	}
}
```

Example-13:- inside the switch we are able to declare the default statement at starting or middle or end of the switch.

```
class Test
{	public static void main(String[] args)
	{	int a=100;
		switch (a)
		{	default: System.out.println("default");
			case 10:System.out.println("10");
			case 20:System.out.println("20");
		}
	}
};
```

Example -14:- The below example compiled and executed only in above 1.7 version because switch is taking String argument from 1.7 version.

```
class Sravya
{     public static void main(String[] args)
     {  String str = "aaa";
        switch (str)
         {       case "aaa"  : System.out.println("Hai");           break;
                 case "bbb"  : System.out.println("Hello");         break;
                 case "ccc"  : System.out.println("how");           break;
                  default    : System.out.println("what");          break;
          }
     }
}
```

Ex-15:-inside switch the case labels must be within the range of provided argument data type otherwise compiler will raise compilation error "possible loss of precision".

```
class Test
{          public static void main(String[] args)
           {          byte b=125;
                      switch (b)
                      {          case 126:System.out.println("20");
                                 case 127:System.out.println("30");
                                 case 128:System.out.println("40");
                                 default:System.out.println("default");
                      }
           }
};
```

Iteration Statements:-

By using iteration statements we are able to execute group of statements repeatedly or more number of times.

1) *For* 2) *while* 3) *do-while*

for syntax:-

```
for (initialization ;condition  ;increment/decrement )
{          Body;
}
```

Flow of execution in for loop:-

```
        1          2  5          4  7
for (initialization ;condition  ;increment/decrement )
{
           Body;  3  6
}
```

With out for loop

```
class Test
{	public static void main(String[] args)
	{	System.out.println("ratan");
		System.out.println("ratan");
		System.out.println("ratan");
		System.out.println("ratan");
		System.out.println("ratan");
	}
};
```

By using for loop

```
class Test
{	public static void main(String[] args)
	{	for (int i=0;i<5;i++)
		{	System.out.println("Ratan");
		}
	}
}
```

Initialization part of for loop:-

Example- 1: Inside the for loop initialization part is optional.

```
class Test
{	public static void main(String[] args)
	{	int i=0;
		for (;i<10;i++)
		{	System.out.println("Rattaiah");
		}
	}
}
```

Example-2:- In the initialization part it is possible to take any number of System.out.println("ratna") statements and each and every statement is separated by comma(,) .

```
class Test
{	public static void main(String[] args)
	{	int i=0;
		for (System.out.println("Aruna"), System.out.println("Ratan");i<10;i++)
		{	System.out.println("Rattaiah");
		}
	}
}
```

Example 3:- compilation error more than one initialization not possible.

```
class Test
{	public static void main(String[] args)
	{	for (int i=0,double j=10.8;i<10;i++)
		{	System.out.println("Rattaiah");
		}
	}
}
```

Ex :-declaring two variables are possible.

```
class Test
{	public static void main(String[] args)
	{	for (int i=0,j=0;i<10;i++)
		{	System.out.println("Rattaiah");
		}
	}
}
```

Conditional part of for loop:-

Example 1:-inside for loop conditional part is optional if we are not providing condition at the time of compilation compiler will provide true value.

```
class Test
{	public static void main(String[] args)
	{	for (int i=0;  ;i++)
		{	System.out.println("Rattaiah");
		}
	}
}
```

Increment/decrement:-

Example-1:- Inside the for loop increment/decrement part is optional.

```
class Test
{	public static void main(String[] args)
	{	for (int i=0; i<10 ; )
		{	System.out.println("Rattaiah");
		}
	}
}
```

Example 2:- Instead of increment/decrement it is possible to take the any number of SOP() statements and each and every statement is separated by comma(,).

```
class Test
{	public static void main(String[] args)
	{	for (int i=0;i<10;System.out.println("aruna"),System.out.println("nagalakshmi"))
		{	System.out.println("Rattaiah");
			i++;
		}
	}
}
```

Example-3 :-

```
class Test
{	static boolean foo(char ch)
	{	System.out.println(ch);
		return true;
	}
	public static void main(String[] args)
	{	int i=0;
		for (foo('A');foo('B')&&(i<2);foo('C'))
		{	i++;
			foo('D');
		}
	}
};
```

Note : ***Inside the for loop each and every part is optional.***
for(;;)------------→represent infinite loop because the condition is always true.

Unreachable statement:-

Ex:- compiler is unable to identify the unreachable statement.

```
class Test
{       public static void main(String[] args)
        {       for (int i=1;i>0;i++)
                {  System.out.println("ratan");
                }
          System.out.println("rest of the code");
        }
}
```

ex:- compiler able to identify the unreachable Statement.

```
class Test
{       public static void main(String[] args)
        {    for (int i=1;true;i++)
                {     System.out.println("ratan");
                }
        System.out.println("rest of the code");
        }
}
```

Note:-

When you provide the condition even thought that condition is represent infinite loop compiler is unable to find unreachable statements,(because that compiler is thinking that condition may fail).

When you provide Boolean value as a condition then compiler is identifying unreachable statement because compiler knows that condition never change.

While loop:-

Syntax:- ***while (condition)*** *//condition must be Boolean & mandatory.*
{ body; }

Example-1 :-

```
class Test
{       public static void main(String[] args)
        {       int i=0;
                while (i<10)
                {       System.out.println("rattaiah");
                        i++;
                }
        }
}
```

Example-2 :- compilation error unreachable statement.

```
class Test
{       public static void main(String[] args)
        {       int i=0;
                while (false)
                {       System.out.println("rattaiah");         //unreachable statement
                        i++;
                }
        }
}
```

Do-While:-

- ✓ *If we want to execute the loop body at least one time them we should go for do-while statement.*
- ✓ *In do-while first body will be executed then only condition will be checked.*
- ✓ In the do-while the while must be ends with semicolon otherwise compilation error.

Syntax:-
```
do
{    //body of loop
} while (condition);
```

Example-1:-
```
class Test
        public static void main(String[] args)
        {       int i=0;
                do
                {       System.out.println("rattaiah");
                        i++;
                }while (i<10);
        }
}
```

Example-2 :- unreachable statement
```
class Test
{       public static void main(String[] args)
        {       int i=0;
                do
                {       System.out.println("rattaiah");
                }while (true);
                System.out.println("Sravyainfotech");     //unreachable statement
        }
}
```

Example-3 :-
```
class Test
{       public static void main(String[] args)
        {       int i=0;
                do
                {       System.out.println("rattaiah");
                }while (false);
                System.out.println("Sravyainfotech");
        }
}
```

Transfer statements:-

By using transfer statements we are able to transfer the flow of execution from one position to another position**.**

- ***Break , Continue , Return, Try***

break:-

Break is used to stop the execution. And is possible to use the break statement only two areas.

a. ***Inside the switch statement.***
b. ***Inside the loops.***

if we are using any other place the compiler will generate compilation error message **" break outside switch or loop".**

Example-1 :- ***break means stop the execution come out of loop.***

```
class Test
{	public static void main(String[] args)
	{	for (int i=0;i<10;i++)
		{	if (i==5)
			break;
			System.out.println(i);
		}
	}
}
```

*Example :- if we are using break outside switch or loops the compiler will raise compilation error **"break outside switch or loop"***

```
class Test
{	public static void main(String[] args)
	{	if (true)
		{	System.out.println("ratan");
			break;
			System.out.println("nandu");
		}
	}
};
```

Example :- Continue: skip the current iteration and it is continue the rest of the iterations normally

```
class Test
{	public static void main(String[] args)
	{	for (int i=0;i<10;i++)
		{	if (i==5)
			continue;
			System.out.println(i);
		}
	}
}
```

Object-Oriented Programming Concepts

- *The first object oriented programming is :* ***Simula, smalltalk***
- *In object oriented programming languages everything represented in the form of object.*
- *Object is real world entity that has state & behavior.*
  Examples:- such as pen,chair,table,house….etc.

Every object contains three characteristics,

1) ***State*** *: well defined condition of an item (instance variable/fields/properties)*
2) ***Behavior*** *: effects on an item (methods/behavior)*
3) ***identity*** *: identification number of an item(hash code)*

Example :-

Object	:	*Car*
State	:	*gear,speed,color…etc*
Behavior	:	*current speed,current gear,Accelarate…etc*
Identity	:	*car number*

Object	:	*house*
State	:	*location*
Behavior	:	*doors open/close.*
Identity	:	*house no*

The main building blocks of oops are,

1. ***Inheritance***
2. ***Polymorphism***
3. ***Abstraction***
4. ***Encapsulation….etc***

Inheritance:-

1. *The process of acquiring properties (variables) & methods (behaviors) from one class to another class is called inheritance.*
2. *We are achieving inheritance concept by using* ***extends*** *keyword. Inheritance is also known as* ***is-a*** *relationship.*
3. *Extends keyword is providing relationship between two classes..*
4. *The main objective of inheritance is code extensibility whenever we are extending the class automatically code is reused.*
5. *In inheritance one class providing properties & another class is acquiring the properties.*
6. *In inheritance parent class is giving properties & Child is acquiring properties from Parent.*

Application code before inheritance

```
class A
{         void m1(){ }
          void m2(){ }
};
class B
{         void m1(){ }
          void m2(){ }
          void m3(){ }
          void m4(){ }
};
class C
{         void m1(){ }
          void m2(){ }
          void m3(){ }
          void m4(){ }
          void m5(){ }
          void m6(){ }
};
```

a. Duplication of code.
b. Code length is increased.

Application code after inheritance

```
class A   //parent class  or super class or base
{         void m1(){ }
          void m2(){ }
};
class B extends A  //child class or sub or derived
{         void m3(){ }
          void m4(){ }
};
class C extends B
{         void m5(){ }
          void m6(){ }
};
```

a. Eliminated duplication.
b. Length of the code is decreased.
c. Reusing properties in child classes.

Note: - To reduce length of the code and redundancy of the code & to improve re-usability of code sun people introduced inheritance concept.

Object creation of parent & child classes:-

In java it is possible to create objects for both parent and child classes,

- ✓ If we are creating object for parent class it is possible to access only parent specific methods.
  A a=new A(); *a.m1(); a.m2();*
- ✓ if we are creating object for child class it is possible to access both parent & child specific methods.
  B b=new B(); *b.m1(); b.m2(); b.m3(); b.m4();*
  C c=new C(); *c.m1(); c.m2(); c.m3(); c.m4(); c.m5(); c.m6();*

Important points:-

```
class A
{         }
class B extends A
{         }
class C extends B
{         }
```

1) *in java if we are extending the class then it will be parent class , if we are not extending the class then **object** class will become parent class.*
2) *In above example A class is direct child class of object & B,C classes are indirect child classes of object.it represent in java every class is child of **object** either directly(A) or indirectly(B,C).*
3) *The root class of all java classes is "**object**" class.*

4) *Every java class contain parent class except **object** class.*
5) *Object class present in **java.lang** package and it contains 11 methods & all java classes able to use these 11 methods because Object class is root class of all java classes.*

To check the predefined support use javap command.

E:\>javap java.lang.Object

public class java.lang.Object

```
{       public final native java/lang/Class<?> getClass();
        public native int hashCode();
        public boolean equals(java.lang.Object);
        protected native java.lang.Object clone() throws ava.lang.CloneNotSupportedException;
        public java.lang.String toString();
        public final native void notify();
        public final native void notifyAll();
        public final native void wait(long) throws java.lang.InterruptedException;
        public final void wait(long, int) throws java.lang.InterruptedException;
        public final void wait() throws java.lang.InterruptedException;
        protected void finalize() throws java.lang.Throwable;
}
```

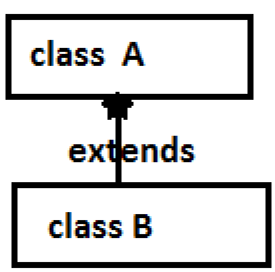
Types of inheritance :-

There are five types of inheritance in java,

1. ***Single inheritance***
2. ***Multilevel inheritance***
3. ***Hierarchical inheritance***
4. ***Multiple inheritance***
5. ***Hybrid Inheritance***

Single inheritance:-

- *One class has only one direct super class is called single inheritance.*
- *In the absence of any other explicit super class, every class is implicitly a subclass of **Object class.***



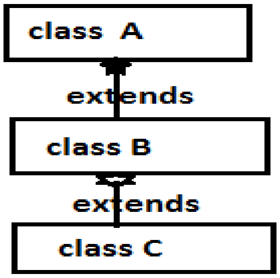
Class B extends A ***===>****class B acquiring properties of A class.*

Example:-

```
class Parent
{       }
class Child extends Parent
{       }
```

Multilevel inheritance:-

One Sub class is extending Parent class then that sub class will become Parent class of next extended class this flow is called multilevel inheritance.



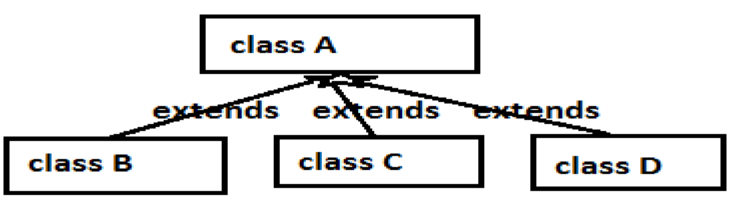
Class B extends A ===> class B acquiring properties of A class
Class C extends B ===> class C acquiring properties of B class
[indirectly class C using properties of A & B classes]

Example:-

```
class A
{       void m1(){System.out.println("m1 method");}
};
class B extends A
{       void m2(){System.out.println("m2 method");}
};
class C extends B
{       void m3(){System.out.println("m3 method");}
        public static void main(String[] args)
        {       A  a = new  A();        a.m1();
                B  b = new  B();        b.m1(); b.m2();;
                C  c = new  C();        c.m1(); c.m2(); c.m3();
        }
}
```

Hierarchical inheritance :-

More than one sub class is extending single Parent is called hierarchical inheritance.



Class B extends A ===> *class B acquiring properties of A class*
Class C extends A ===> *class C acquiring properties of A class*
Class D extends A ===> *class D acquiring properties of A class*

Example:-

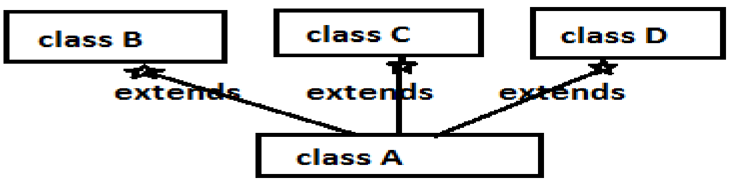
```
class A
{       }
class B extends A
{       }
class C extends A
{       }
```

Multiple inheritance:-

- *One sub class is extending more than one super class is called Multiple inheritance and java not supporting multiple inheritance because it is creating ambiguity problems (confusion state) .*
- *Java not supporting multiple inheritances hence in java one class able to extends only one class at a time but it is not possible to extends more than one class.*

  Class A extends B ===>valid

  Class A extends B ,C ===>invalid

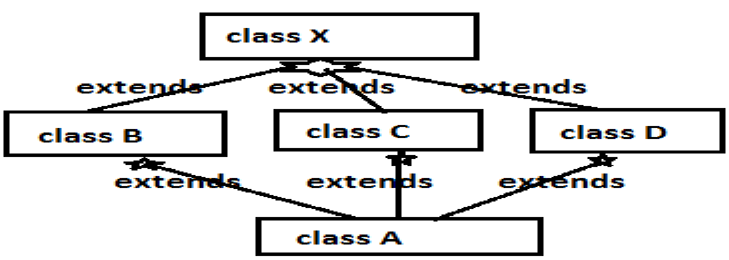


Example:-

```
class Parent1
{	void money()	{System.out.println("parent1  money");}
};
class Parent2
{	void money()	{System.out.println("parent2 money");}
};
class Child extends Parent1,Parent2
{	public static void main(String[] args)
	{	Child c = new Child();
		c.money();	//ambiguity  problems
	}
};
```

Hybrid inheritance:-

- *Hybrid is combination of hierarchical & multiple inheritance .*
- *Java is not supporting hybrid inheritance because multiple inheritance(not supported by java) is included in hybrid inheritance.*



Preventing inheritance:-

- ✓ *You can prevent sub class creation by using final modifier.*
- ✓ *If a parent class declared as final we can't create sub class for that class.*

```
final class Parent
{	}
class Child extends Parent
{	}
```

compilation error:- cannot inherit from final Parent

Instanceof operator:-

- *It is used check the type of the object and it returns Boolean value as a return value.*
  Syntax:- ***reference-variable instanceof class-name;***
- *To use the instanceof operator the class name & reference variable must have some relationship either parent to child or child to parent otherwise compiler will generate error message "**inconvertible types".***
- *If the relationship is child to parent it returns **true** & the relationship is parent to child it return **false**.*

Example :-

```
class Animal{     };
class Dog extends Animal{          };
class  Test
{           public static void main(String[] args)
            {           Test t = new Test();
                        Animal a = new Animal();
                        Dog d = new Dog();
                        Object o = new Object();
                        System.out.println(d instanceof Animal);           //true
                        System.out.println(a instanceof Object);           //true
                        System.out.println(a instanceof Dog);              //false
                        System.out.println(t instanceof Object);           //true
                        System.out.println(o instanceof Animal);           //false
                        //System.out.println(t instanceof Animal);         compilation error:inconvertible types
            }
}
```

Association:-

- *Class A uses class B*
- *When one object wants another object to perform services for it.*
- *Relationship between teacher and student, number of students associated with one teacher or one student can associate with number of teachers. But there is no ownership and both objects have their own life cycles.*

Example-1:-

In below example student uses Teacher class object services.

```
class Teacher
{           void course()
            {           System.out.println("corejava by ratan");
            }
};
class Student
{           public static void main(String[] args)
            {           Teacher t = new Teacher();
                        t.course();
            }
};
```

Aggregation:-

- *Class A has instance of class B is called aggregation.*
- *Class A can exists without presence of class B . a university can exis*ts without chancellor.
- *Take the relationship between teacher and department. A teacher may belongs to multiple departments hence teacher is a part of multiple departments but if we delete department object teacher object will not destroy.*

Example:-

Address.java

```
class Address
{	//instance variables
	int dno;
	String state;
	String country;
	Address(int dno,String state,String country)  //local variables
	{	//conversion process
		this.dno=dno;
		this.state= state;
		this.country = country;
	}
};
```

Heroin.java:

```
class Heroin
{	String hname;
	int hage;
	Address addr;  //reference of address class [dno,state,country]
	Heroin(String hname,int hage,Address addr)
	{	//conversion process
		this.hname = hname;
		this.hage = hage;
		this.addr = addr;
	}
	void display()
	{	System.out.println("*********heroin details******");
		System.out.println("heroin name-->"+hname);
		System.out.println("heroin age-->"+hage);
	System.out.println("heroin address-->"+addr.country+" "+addr.state+" "+addr.hno)
	}
	public static void main(String[] args)
	{	Address a1  = new Address("india","banglore",111);
		Heroin h1 = new Heroin("anushka",30,a1);
		h1.display();
		Address a2  = new Address("US","california",333);
		Heroin h2 = new Heroin("AJ",40,a2);
		h2.display();
```

```
        }
}
```

The above Project level main method code:-

```
public static void main(String[] args)
{               new Heroin("anushka",30,new Address("india","banglore",111)).display();
                new Heroin("AJ",40,new Address("US","california",333)).display();
}
```

Example:-

Test1.java:-

```
class Test1
{       int a;
        int b;
        Test1(int a,int b)
        {       this.a=a;
                this.b=b;
        }
};
```

Test2.java:-

```
class Test2
{       boolean b1;
        boolean b2;
Test2(boolean b1,boolean b2)
        {       this.b1=b1;
                this.b2=b2;
        }
};
```

Test3.java:-

```
class Test3
{       char ch1;
        char ch2;
Test3(char ch1,char ch2)
        {       this.ch1=ch1;
                this.ch2=ch2;
        }
};
```

MainTest.java:-

```
class MainTest
{       //instance variables
        Test1 t1;
        Test2 t2;
        Test3 t3;
        MainTest(Test1 t1 ,Test2 t2,Test3 t3)  //local variables
        {       //conversion of local-instance
                this.t1 = t1;
                this.t2 = t2;
                this.t3 = t3;
        }
        void display()
        {       System.out.println("Test1 object values:-→"+t1.a+"----- "+t1.b);
                System.out.println("Test2 object values:-→"+t2.b1+"----- "+t2.b2);
                System.out.println("Test3 object values:-→"+t3.ch1+"----- "+t3.ch2);
        }
        public static void main(String[] args)
        {       Test1 t = new Test1(10,20);
                Test2 tt = new Test2(true,true);
                Test3 ttt = new Test3('a','b');
                MainTest main = new MainTest(t,tt,ttt);
                main.display();
                // new MainTest(new Test1(10,20),new Test2(true,false),new Test3('a','b'));
        }
};
```

Composition :-

- *Class A owns class B , it is a strong type of aggregation. There is no meaning of child without parent.*
- *Order consists of list of items without order no meaning of items.* ***or*** *bank account consists of transaction history without bank account no meaning of transaction history* ***or w****ithout student class no meaning of marks class.*
- *Let's take Example house contains multiple rooms, if we delete house object no meaning of room object hence the room object cannot exists without house object.*
- *Relationship between question and answer, if there is no meaning of answer without question object hence the answer object cannot exist without question objects.*
- *Relationship between student and marks, there is no meaning of marks object without student object.*

Example :-

Marks.java

```
class Marks
{	int m1,m2,m3;
	Marks(int m1,int m2,int m3)	//local variables
	{	this.m1=m1;		this.m2=m2;		this.m3=m3;
	}
};
```

student.java

```
class Student
{	Marks mk;	//without student class no meaning of marks is called "composition"
	String sname;
	int sid;
	Student(Marks mk,String sname,int sid) //local variables
	{	this.mk = mk;		this.sname = sname;		this.sid = sid;
	}
	void display()
	{	System.out.println("student name:-->"+sname);
		System.out.println("student id:-->"+sid);
		System.out.println("student marks:-->"+mk.m1+"---"+mk.m2+"--"+mk.m3);
	}
	public static void main(String[] args)
	{	Marks m1 = new Marks(10,20,30);
		Student s1 = new Student(m1,"ratan",111);
		s1.display();
		// new Student(new Marks(10,20,30),"ratan",111).display();	project code
		Marks m2 = new Marks(100,200,300);
		Student s2 = new Student(m2,"anu",222);
		s2.display();
		// new Student(new Marks(100,200,300),"anu",222).display(); project code
	}
}
```

Object delegation:-

The process of sending request from one object to another object is called object delegation.

Example :-

```
class RealPerson        //delegate   class
{       void book(){System.out.println("real java book");}
};
class DummyPerson   //delegator class
{       RealPerson r = new RealPerson();
        void book( ) {r.book( ); } //delegation
};
class Student
{       public static void main(String[] args)
        {       //outside world thinking dummy Person doing work but not.
                DummyPerson d = new DummyPerson();
                d.book();
        }
};
```

Super keyword:-

*"**this**" keyword is used to represent current class object& "**super**" keyword is used to represent super class object.*

1. *Super class variables.*
2. *Super class methods.*
3. *Super class constructors.*
4. *Super class instance blocks.*
5. *Super class static blocks.*

super class variables calling:-

```
class Parent
{       int a=10,b=20;
};
class Child extends Parent
{       int a=100;
        int b=200;
        void m1(int a,int b)        //local variables
        {       System.out.println(a+b);                //local variables addition
                System.out.println(this.a+this.b);      //current class variables addition
                System.out.println(super.a+super.b);    //super class variables addition
        }
        public static void main(String[] args)
        {        new Child().m1(1000,2000);
        }
};
```

super class methods calling:-

```
class Parent
{       void m1(){System.out.println("parent m1() method");}
};
class Child extends Parent
{       void m1()       {System.out.println("child class m1() method");}
        void m3()
        {       this.m1();
                super.m1();
        }
        public static void main(String[] args)
        {       new Child().m3();
        }
};
```

*To call the super class methods **super** keyword is mandatory but to represent current class methods **this** keyword is optional.*

super class constructors calling:-

Example-1:-

*To call the current class constructors use **this** keyword but to call super class constructor use **super** keyword.*

```
super()              ---->   super class 0-arg constructor calling
super(10)            ---->   super class 1-arg constructor calling
super(10,20)         ---->   super class 2-arg constructor calling
super(10,'a',true)   ---->   super class 3-arg constructor calling
```

```
class Parent
{       Parent() {System.out.println("parent 0-arg constructor");}
};
class Child extends Parent
{       Child()
        {       this(10);       //current class  1-arg   constructor calling
                System.out.println("Child 0-arg constructor");
        }
        Child(int a)
        {       super();        //super class   0-arg   constructor calling
                System.out.println("child 1-arg constructor--->"+a);
        }
        public static void main(String[] args)
        {       new Child();
        }
};
```

Example-2:-

Inside the constructor super keyword must be first statement otherwise compiler generates error message ***"call to super must be first line in constructor".***

No compilation error:-

```
Child()
{          this(10);             // (this must be first line)
           System.out.println("Child 0-arg constructor");
}
Child(int a)
{          super();              //(super must be first line)
           System.out.println("child 1-arg constructor--->"+a);
}
```

Compilation Error:-

```
Child()
{          System.out.println("Child 0-arg constructor");
           this(10);             //compilation error
}
Child(int a)
{          System.out.println("child 1-arg constructor--->"+a);
           super();              //(compilation Error)
}
```

Example-3:-

Inside the constructor it is possible to use either this keyword or super keyword but,

- ✓ *Two super keywords are not allowed.*
- ✓ *Two this keywords are not allowed.*
- ✓ *Both super & this keyword also not allowed.*

Compilation Error:-

```
Child()
{          this(10);
           super();
           System.out.println("Child 0-arg constructor");
}
Child()
{          super(10);
           super();
           System.out.println("Child 0-arg constructor");
}
Child()
{          this(10);
           this();
           System.out.println("Child 0-arg constructor");
}
```

Example-4:-

In below example parent class default constructor is executed that is provided by compiler.

```
class Parent
{           // default constructor
};
class Child extends Parent
{           Child()
            {           super()
                        System.out.println("Child 0-arg constructor");
            }
            public static void main(String[] args)
            {           new Child();
            }
};
```

D:\>java Child
Child 0-arg constructor

Example-5:-

1. *Inside the constructor weather it is a 0-argument or parameterized if we are not declaring **super or this** keyword then compiler generate super keyword at first line of the constructor.*
2. *The compiler generated super keyword is always 0-arg constructor calling.*

```
class Parent
{           Parent() {     System.out.println("parent 0-arg constructor");     }
};
class Child extends Parent
{           Child()
            {           //super();  generated by compiler at compilation time
                        System.out.println("Child 0-arg constructor");
            }
            public static void main(String[] args)
            {           new Child();
            }
};
```

D:\>java Child
parent 0-arg constructor
Child 0-arg constructor

Example-6:-

In below example child class is calling parent class 0-argument constructor since not there so compiler generate error message.

```
class Parent
{       Parent(int a)   {   System.out.println("parent 1-arg cons-->"+a);   }
};
class Child extends Parent
{       Child()
        {       //super();   generated by compiler
                System.out.println("Child 0-arg constructor");
        }
        public static void main(String[] args)
        {       new Child();
        }
};
```

Example-7:-

In below compiler generate default constructor and inside that default constructor super keyword is generated.

Application code before compilation:- (.java)

```
class Parent
{       Parent() {
        System.out.println("parent 0-arg cons");
        }
};
class Child extends Parent
{       public static void main(String[] args)
        {       new Child();
        }
};
```

Application code after compilation:- (.class)

```
class Parent
{   Parent()
    { System.out.println("parent 0-arg cons");
    }
};
class Child extends Parent
{       /* below code is generated by compiler
        Child()
        {   super();
        } */
        public static void main(String[] args)
        {       new Child();
        }
};
```

Example-8 :-

In below example in Test class 0-argument constructor compiler generate super keyword it execute parent class(Object) default constructor.

```
class Test extends Object
{       Test()
        {       // super();      generated by compiler
                System.out.println("Test class constructor");
        }
        public static void main(String[] args)
        {       new Test();
        }
};
```

Example-9:-

In below example in child class 1-argument & 0 argument constructors compiler generate super keyword hence parent class 0-argument constructor will be executed.

```
class Parent
{	Parent(){System.out.println("parent 0-arg cons");		}
};
class Child extends Parent
{	Child()
	{	 //super();	generated by compiler
		System.out.println("Child 0-arg constructor");
	}
	Child(int a)
	{	 //super();	generated by compiler
		System.out.println("child 1-arg cons");
	}
	public static void main(String[] args)
	{	new Child();
		new Child(10);
	}
};
```

Example-10:-

```
class GrandParent
{	int c;
	GrandParent(int c)
	{	this.c=c;	}
};
class Parent extends GrandParent
{	int b;
	Parent(int b,int c)
	{	super(c);
		this.b=b;	}
};
class Child extends Parent
{	int a;
	Child(int a,int b,int c)
	{	super(b,c);
		this.a=a;	}
	void disp()
	{	System.out.println("child class ="+a);
		System.out.println("parent class ="+b);
		System.out.println("grandparent class ="+c);
	}
	public static void main(String[] args)
	{	new Child(10,20,30).disp();	}
};
```

Super class instance blocks:-

Example-1:-

In parent and child relationship first parent class instance blocks are executed then child class instance blocks are executed.

```
class Parent
{       {System.out.println("parent instance block");}        //instance block
};
class Child extends Parent
{
        {   System.out.println("Child instance block");     }  //instance block
        Child()
        {       System.out.println("chld 0-arg cons");
        }
        public static void main(String[] args)
        {        new Child();
        }
};
```

Example-2:-

```
class Parent
{       {System.out.println("parent instance block");}        //instance block
        Parent(){System.out.println("parent 0-arg cons");}
};
class Child extends Parent
{       {System.out.println("Child instance block");}         //instance block
        Child()
        {       System.out.println("chld 0-arg cons");
        }
        Child(int a)
        {       System.out.println("child 1-arg cons");
        }
        public static void main(String[] args)
        {       new Child();
                new Child(10);
        }
};
```

```
E:\>java Child
parent instance block
parent 0-arg cons
Child instance block
child 0-arg cons
parent instance block
parent 0-arg cons
Child instance block
child 1-arg cons
```

Super class static blocks:-

Example-1:-

In parent and child relationship first parent class static blocks are executed only one time then child class static blocks are executed only one time because static blocks are executed with respect to .class loading.

Instance block execution depends on object creation & static block execution depends on class loading.

```
class Parent
{       static{System.out.println("parent static block");}      //static block
        {System.out.println("parent instance block");}          //instance  block
};
class Child extends Parent
{       static{System.out.println("child static block");}       //static block
        {System.out.println("child instance block");}           //instance block
        public static void main(String[] args)
        {       new Child();
                new Child();
        }
};
E:\>java Child
parent static block
child static block
parent instance block
child instance block
parent instance block
child instance block
```

Example-2:-

```
class Parent
{       Parent(){System.out.println("parent 0-arg cons");}
        {System.out.println("parent class instance block");}
        static{System.out.println("parent class static  block");}
};
class Child extends Parent
{       {System.out.println("child class instance block");}
        Child()
        {       System.out.println("child class 0-arg cons");
        }
        static {System.out.println("child class static block");}
        public static void main(String[] args)
        {       new Child();
        }
};
```

Example-3:-

instance blocks execution depends on number of object creations but not number of constructor executions. If we are creating 10 objects 10 times constructors are executed just before constructor execution 10 times instance blocks are executed.

Static blocks execution depends on .class file loading hence the static blocks are executed only one time for single class.

```
class Parent
{	static {System.out.println("parent static  block");}  //static block
	{System.out.println("parent instance  block");}  //instance block
	Parent(){System.out.println("parent 0-arg cons");}  //constructor
};
class Child extends Parent
{	static {System.out.println("Child static block");} //static block
	{System.out.println("child instance  block");}   //instance block
	Child()
	{	//super(); generated by compiler
		System.out.println("Child 0-arg cons");}
	Child(int a){
		this(10,20);
		System.out.println("Child 1-arg cons");}
	Child(int a,int b)
	{	//super();  generated by compiler
		System.out.println("Child 2-arg cons");
	}
	public static void main(String[] args)
	{	Parent p = new Parent();
		Child c = new Child();
		Child c1 = new Child(100);
	}
};
D:\>java Child
parent static  block
Child static block
parent instance  block
parent 0-arg cons
parent instance  block
parent 0-arg cons
child instance  block
Child 0-arg cons
parent instance  block
parent 0-arg cons
child instance  block
Child 2-arg cons
Child 1-arg cons
```

Example: - object usage in real time projects.

File-1: Gmail.java

```
class Gmail
{	void compose() {	System.out.println("to perform compose operation");	}
	void inbox()	{	System.out.println("to perform inbox operation");	}
	void sentItem() {	System.out.println("to perform sent Item operation");	}
}
```

File-2: UserOperations.java

Problem: *in below example we are creating object locally & in every method we are creating object it increases duplication of the code.*

```
class UserOperations
{	void ratan()
	{	System.out.println("ratan operations:");
		Gmail g = new Gmail();
		g.compose();	}
	void anu()
	{	System.out.println("anu operations:");
		Gmail g = new Gmail();
		g.inbox();	}
	void yadhu()
	{	System.out.println("yadhu operations:");
		Gmail g = new Gmail();
		g.sentItem();	}
}
```

File-2: UserOperations.java

Solution: *in below example we are creating object globally hence every method is able to access this variable.*

```
 class UserOperations
{	Gmail g;
	void ratan()
	{	System.out.println("ratan operations:");
		 g= new Gmail();
		 g.compose();	}
	void anu()
	{	System.out.println("anu operations:");
		g.inbox();	}
	void yadhu()
	{	System.out.println("yadhu operations:");
		g.sentItem();	}
}
```

File 3: Test.java

```
class Test
{	public static void main(String[] args)
	{	UserOperations o = new UserOperations();
		o.ratan();		o.anu();		o.yadhu();
	}
}
```

Polymorphism:-

- *The ability to appear in more forms is called polymorphism.*
- *One thing can exhibits more than one form is called polymorphism.*
- *One functionality with different actions is called polymorphisum.*
- *One person with different debaviours is called polymorphisumk.*
- *Polymorphism is a Greek word poly means many and morphism means forms.*

There are two types of polymorphism in java.

1) *Compile time polymorphism / static binding / early binding*
   Example :- method overloading.
2) *Runtime polymorphism /dynamic binding /late binding.*
   Example :- method overriding.

Compile time polymorphism [Method Overloading]:-

1) If java class allows more than one method with same name but different number of arguments or same number of arguments but different data types those methods are called overloaded methods.
   a. Same method name but different number of arguments.
      void m1(int a){ }
      void m1(int a,int b){ }

   b. Same method name & same number of arguments but different data types.
      void m1(int a){ }
      void m1(char ch){ }
2) To achieve overloading concept one java class sufficient.
3) It is possible to overload any number of methods in single java class.

Example:-

```
class Test
{	//below three methods are overloaded methods.
	void m1(int i)
	{	System.out.println("int-argument method");
	}
	void m1(int i,int j)
	{	System.out.println("int,int argument method=");
	}
	void m1(char ch)
	{	System.out.println("char-argument method");
	}
	public static void main(String[] args)
	{	Test t = new Test();
		t.m1(10);
		t.m1(10,20);
		t.m1('a');
	}
}
```

Example:-

- *In method overloading it is possible to have different data types for overloaded method.*
- *While overloading the methods check the signature(methodname+parameters) of the method but not return type.*

```
class Test
{	//below two methods are overloaded methods
	double m1(int a,int b)
	{	System.out.println("int,int arguments method");
		return 20.5;
	}
	int m1(float f)
	{	System.out.println("float argument method");
		return 100;
	}
	public static void main(String[] args)
	{	Test t=new Test();
		double d = t.m1(10,20);
		System.out.println("return type="+d);
		int x = t.m1(10.5f);
		System.out.println("return type="+x);
	}
}
```

method overloading with type promotion

byte → short ↘
Int → long → float → double
char ↗

Example:-

```
class Test
{	void m1(int a,long b)
	{	System.out.println("int,long arguments method");
	}
	void m1(float f)
	{	System.out.println("float argument");
	}
	public static void main(String[] args)
	{	Test t=new Test();
		t.m1(10,20);
		t.m1((byte)10,(short)20);
		t.m1(10);
		t.m1(10L);
	}
}
E:\>java Test
int,long arguments method
int,long arguments method
float argument
float argument
```

Example:-

```
class Test
{	void sum(int a,int b)
	{	System.out.println("int arguments method");
		System.out.println(a+b);
	}
	void sum(long a,long b)
	{	System.out.println("long arguments method");
		System.out.println(a+b);
	}
	void sum(int a,long b)
	{	System.out.println("int,long arguments method");
		System.out.println(a+b);
	}
	void sum(long a,int b)
	{	System.out.println("long,int arguments method");
		System.out.println(a+b);
	}
	public static void main(String[] args)
	{	Test t=new Test();
		t.sum(1,2);
		t.sum(10L,20L);
		t.sum(100,200L);
		t.sum(1000L,2000);
	}
}
```

Types of overloading:-

There are three types of overloading in java,

a. *Method overloading* } *explicitly by the programmer*
b. *Constructor overloading*
c. *Operator overloading* } *implicitly by the JVM('+' addition& concatenation)*

Constructor Overloading:-

If the class contains more than one constructors with same name but different arguments or same number of arguments with different data types those constructors are called overloaded constructors.

a. *Same constructor name but different number of arguments.*

```
Test(int a){   }		//assume Test is java class
Test(int a,int b){   }
```

b. *Same constructor name & same number of arguments but different data types.*

```
Test(int a){   }
Test(char ch){   }
```

```
class Test
{       //overloaded constructors
        Test()
        {       System.out.println("0-arg constructor");
        }
        Test(int i)
        {       System.out.println("int argument constructor");
        }
        Test(char ch,int i)
        {       System.out.println("char,int argument constructor");
        }
        Test(char ch)
        {       System.out.println("char argument constructor");
        }
        public static void main(String[] args)
        {       new Test();
                new Test(10);
                new Test('a',100);
                new Test('r');
        }
}
```

<u>Operator overloading:-</u>

- ✓ One operator with different behaviors is called Operator overloading .
- ✓ Java is not supporting operator overloading but only one overloaded in java language is ‘+’.
    - If both operands are integer then “**+”** performs addition.
    - If at least one operand is String then “**+**” perform concatenation.

<u>Example:-</u>

```
class Test
{       public static void main(String[] args)
        {       int a=10;
                int b=20;
                System.out.println(a+b);          //30     [addition]
                System.out.println(a+"ratan");   //10Ratan [concatenation]
                System.out.println("ratan"+"anu"+2+2+"kids");
                System.out.println(2+2+"kids"+"ratan"+"anu");
        }
}
```

Runtime polymorphism [Method Overriding]:-

- *To achieve method overloading one java class sufficient but to achieve method overriding we required two java classes with parent and child relationship.*
- *The method implementations already present in parent class,*
    a. *If the child class required that implementation then access those implementations.*
    b. *If the child class not required, parent class method implementations then override parent class method in child class to provide child specific implementations.*
- *The sub class overrides super class method to provide sub class method implementations.*
- *In overriding parent class method is called ===> **overridden method***
  *Child class method is called ===> **overriding method***

Example :-

In below example marry method present in parent class with some implementations but child class overriding marry method to provide child specific implementation is called overriding.

```
class Parent
{       void property()
        {       System.out.println("money+land+hhouse");
        }
        void marry()    //overridden method
        {       System.out.println("black girl");
        }
};
class Child extends Parent
{       void marry()    //overriding method
        {       System.out.println("white girl/red girl");
        }
        public static void main(String[] args)
        {       Child c=new Child();
                c.property();
                c.marry();
        }
};
```

E:\>java Child
money+land+hhouse
white girl/red girl

While overriding methods must fallow these rules:-

1) *Overridden method signature & overriding method signatures must be same.*
2) *The return types of overridden method & overriding method must be same (at primitive level).*
3) *While overriding it is possible to change return type by using co-variant return types concept.*
4) *Final methods can't override.*
5) *Static method can't override but method hiding possible.*
6) *Private methods can't override.*
7) *While overriding it is not possible to maintain same level permission or increasing order but not decreasing.*
8) *Overriding with exception handling rules.*

Method overriding rule 1:-

While overriding methods the overridden method signature and overriding method signature must be same.

Method signature nothing but method-name & parameters list.

```
class Parent
{       void marry(){   }       //overridden method
}
class Child extends Parent
{       void marry(){   }       //overriding method
};
```

Method overriding rule-2:-

While overriding method overridden method return type & overriding method return type must be same at primitive level (byte,int,double,boolean…etc) otherwise compiler will generate error message.

```
class Parent
{       void marry(){   }       //overridden method
}
class Child extends Parent
{       int marry(){    }       //overriding method
};
compilation error:-     marry() in Child cannot override marry() in Parent
                        return type int is not compatible with void
```

Method overriding rule-3:-

- ✓ *Before java 1.5 version it is not possible to override the method by changing return type but form java 5 versions it is possible to override the method by changing return type by using co-variant return type's concept.*
- ✓ *While overriding methods it is possible to change the return type of overridden method & overriding methods at class level by using co-variant return type concept but not primitive level.*
- ✓ *The return type of overriding method is must be sub-type of overridden method return type this is called covariant return types.*

Note :while overriding methods it is possible to change return type at class-level but not primitive level.

```
class Animal{   }
class Dog extends Animal{       }
class Parent
{       Animal m1()     //overridden method
        {       System.out.println("parent m1");
                return new Animal();    }
}
class Child extends Parent
{       Dog m1()        //overriding method
        {       System.out.println("child m1");
                return new Dog();       }
        public static void main(String[] args)
        {       Parent p = new Parent();
                Animal a = p.m1();
                Child c = new Child();
                Dog d = c.m1();
        }
};
```

Method overriding rule-4:-

1) *If an overridden method is final it is not possible to override that method in child class.*
2) *Final classes are preventing inheritance concept & final methods are preventing overriding concept.*

Example :-

```
class Parent
{       final void marry(){     }       //overridden method
}
class Child extends Parent
{       void marry(){   }               //overriding method
};
```

Compilation error:- *marry() in Child cannot override marry() in Parent overridden method is final*

Example:-final variables

When we declare variable as a final it is not possible to change the value of final variable. If we are trying to change final variable compiler will generate error message.

Final variables are fixed constants it is not possible to perform modifications.

Case 1:- *in java for the local variables only one modifier is applicable that is **final**.*

```
class Test
{       public static void main(String[] args)
        {       final int a=10;
                a=a+10;         //trying to modify a value it will generate error
                System.out.println(a);
        }
};
```

compilation error:- ***cannot assign a value to final variable a***

case 2:- *if you declare instance or static variable with final we should initialize that variable with some values by using constructors r instance blocks otherwise compiler will generate error message.*

```
class Test
{       final int a;            //instance variable
        final static int b;     //static variable
};
```

The above example will generate error message "variable might not have been initialized"

Example:-

- ✓ *Final class variables are not a final but final class methods are by default final.*
- ✓ *Final class methods are by default final because for the final class not possible to create sub-classes hence it is not possible to override that method.*

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

Type-casting:-

The process of converting data one type to another type is called type casting.

There are two types of type casting

1. Implicit typecasting /widening/up casting
2. Explicit type-casting (narrowing)/do

Type casting chart:-

Up-casting :-

byte → short ↘
Int → long → float → double
char ↗

down-casting:-

byte ← short ↖
Int ← long ← float ← double
char ↙

When we assign higher value to lower data type range then compiler will rise compiler error "possible loss of precision" but whenever we are type casting ***higher data type-lower data type*** *compiler won't generate error message but we will loss the data.*

***Implicit-typecasting:-* (widening) or (up casting)**

1. *When we assign lower data type value to higher data type that typecasting is called up- casting.*
2. *When we perform up casting data no data loss.*
3. *It is also known as up-casting or widening.*
4. *Compiler is responsible to perform implicit typecasting.*

***Explicit type-casting:-* (Narrowing) or (down casting)**

1. *When we assign a higher data type value to lower data type that type-casting is called down casting.*
2. *When we perform down casting data will be loss.*
3. *It is also known as narrowing or down casting.*
4. *User is responsible to perform explicit typecasting.*

Note :- Parent class reference variable is able to hold child class object but Child class reference variable is unable to hold parent class object.

```
class Parent
{           };
class Child extends Parent
{           };
Parent p = new Child();   //valid
Child c = new Parent();   //invalid
```

Example :-type casting

```
 class Parent
{           };
class Child extends Parent
{           };
```

```
class Test
{       public static void main(String[] args)
        {       //implicit typecasting (up casting)
                byte b=120;
                int i=b;   //[automatic conversion of byte-int]
                System.out.println(b);
                char ch='a';
                int a=ch;          //[automatic conversion of char to int]
                System.out.println(a);
                long l1=20;
                float f = l1;      //[automatic conversion of long-float]
                System.out.println(f);
                /*below examples it seems up-casting but compilation error:possible loss of precision
                : conversion not possible
                byte i=100; (1 byte size)
                char ch=i;         (assigned to 2 bytes char)
                System.out.println(ch);
                char ch='a';
                short a=ch;
                System.out.println(a);    compilation error:possible loss of precision
                float f = 10.5f;
                long l = f;
                System.out.println(l);    compilation error:possible loss of precision
                float f=10.5f;
                long l = f;
                System.out.println(l);    compilation error:possible loss of precision (memory
                representation different)              */
                //explicit-typecasting (down-casting)
                // converted-type-name  var-name = (converted-type-name)conversion-var-type;
                int a1=120;
                byte b1 =(byte)a1;
                System.out.println(b1);
                int a2=130;
                byte b2 =(byte)a2;
                System.out.println(b2);
                float ff=10.5f;
                int x = (int)ff;
                System.out.println(x);
                Parent p = new Child();
                //target-type variable-name=(target-type)source-type;
                Child c1 =(Child)p;
                Parent p = new Child();
                Child c1 = (Child)p;
        }
}
```

Example-2:-

- In java parent class reference variable is able to hold Child class object but Child class reference variable unable to hold Parent class object.
  - **Parent p = new Child(); ---->valid**
  - **Child c = new Parent(); ---->invalid**

```
class Parent
{       void m1(){System.out.println("parent m1 method");}      //overridden method
}
class Child extends Parent
{       void m1(){System.out.println("child m1 method");}       //override method
        void m2(){System.out.println("child m2 method");}       //direct method of child class
        public static void main(String[] args)
        {
        //parent class is able to hold child class object
        Parent p1 = new Child();   //creates object of Child class
        p1.m1();          //child m1() will be executed
        //p1.m2(); Compilation  error we are unable to call m2() method
        Child c1 =(Child)p1;   //type casting parent reference variable to child object.
        c1.m1();
        c1.m2();
        }
};
```

- *In above example parent class is able to hold child class object but when you call* ***p.m1();*** *method compiler is checking m1() method in parent class at compilation time. But at runtime child object is created hence Child method will be executed.*
- *Based on above point decide in above method execution decided at runtime hence it is a runtime polymorphism.*
- *When you call* ***p.m2 (); compiler*** *is checking m2 () method in parent class since not there so compiler generate error message. Finally it is not possible to call child class m2 () by using parent reference variable even thought child object is created.*
- *Based on above point we can say by using parent reference it is possible to call only overriding methods (**m1 ()**) of child class but it is not possible to call direct method(**m2()**) of child class.*
- *To overcome above limitation to call child class method perform typecasting.*

Example:- in java it is possible to override methods in child classes but it is not possible to override variables in child classes.

```
class Parent
{       int a=100;
};
class Child extends Parent
{       int a=1000;
        public static void main(String[] args)
        {       Parent p = new Child();
                System.out.println("a vlues is :--->"+p.a); //100
        }
};
```

If a subclass defines a static method with the same signature as a static method in the superclass, then the method in the subclass *hides* the one in the superclass.

```
class Animal
{	void instanceMethod(){System.out.println("instance method in Animal");}
	static void staticMethod(){System.out.println("static method in Animal");}
};
class Dog extends Animal
{	void instanceMethod(){System.out.println("instance method in Dog");}//overriding
	static void staticMethod(){System.out.println("static method in Dog");}//hiding
	public static void main(String[ ] args)
	{	Animal a = new Dog();
		a.instanceMethod();
		a.staticMethod(); // [or] Animal.instanceMethod();
	}
};
```

- The version of the overridden instance method that gets invoked is the one in the subclass.
- The version of the hidden static method that gets invoked depends on whether it is invoked from the superclass or the subclass.

The `Cat` class overrides the instance method in `Animal` and hides the static method in `Animal`. The `main` method in this class creates an instance of `Cat` and invokes`testClassMethod()` on the class and `testInstanceMethod()` on the instance.

Example :- importance of converting parent class reference variable into child class object

```
//let assume predefined class
class ActionForm
{	void xxx(){} //predefined method
	void yyy(){} //predefined method
};
class LoginForm  extends ActionForm  //assume to create LoginForm our class must extends ActonForm
{	void m1(){System.out.println("LoginForm m1 method");}//method of LoginFrom class
	void m2(){System.out.println("LoginForm m2 method");}//method of LoginFrom class

	public static void main(String[] args)
	{	//assume server(Tomcat,glassfish…) is creating object of LoginForm
		ActionForm af = new LoginForm();   //creates object of LoginForm class
		//af.m1();	af.m2();  //by using af it is not possible to call m1() & m2()

		LoginForm lf = (LoginForm)af;//type casting
		lf.m1();
		lf.m2();
	}
};
```

Example :-[overloading vs. overriding]

```
class Parent
{	//overloaded methods
	void m1(int a){System.out.println("parent int m1()-->"+a);}//overridden method
	void m1(char ch){System.out.println("parent char m1()-->"+ch);}//overridden method
};
class Child extends Parent
{	//overloaded methods
	void m1(int a){System.out.println("Child int m1()-->"+a);}//overriding method
	void m1(char ch){System.out.println("child char m1()-->"+ch);}//overriding method
	public static void main(String[] args)
	{
		Parent p = new Parent();//[it creates object of Parent class]
		p.m1(10); p.m1('s'); //10 s [parent class methods executed]
		Child c = new Child();//[it creates object of Child class]
		c.m1(100); c.m1('a'); //[100 a Child class methods executed]
		Parent p1 = new Child();//[it creates object of Child class]
		p1.m1(1000);	p1.m1('z'); //[1000 z child class methods executed]
	}
};
```

Example:- method overriding vs. Hierarchical inheritance

```
class Heroin
{	int rating( ) { return 0 ; }
};
class Anushka extends Heroin
{	int rating(){return 1;}
};
class Nazriya extends Heroin
{	int rating(){return 5;}
};
class Kf extends Heroin
{	int rating(){return 2;}
}
class Test
{	public static void main(String[] args)
	{	/*Heroin h,h1,h2,h3;
		h = new Heroin();
		h1 = new Anushka();
		h2 = new Nazriya();
		h3 = new Kf();*/
		Heroin h = new Heroin();
		Heroin h1 = new Anushka();
		Heroin h2 = new Nazriya();
		Heroin h3 = new Kf();
```

```
            System.out.println("Heroin rating      :--->"+h.rating());
            System.out.println("Anushka rating   :--->"+h1.rating());
            System.out.println("Nazsriya rating :--->"+h2.rating());
            System.out.println("Kf  rating            :--->"+h3.rating());
      }
};
```

In above example when you call rating() method compilation time compiler is checking method in parent class(Heroin) but runtime Child class object are crated hence child class methods are executed.

<u>Example :-</u>

```
class Animal
{void eat(){System.out.println("animal eat");}
};
class Dog extends Animal
{void eat(){System.out.println("Dog eat");}
};
class Cat extends Animal
{     void eat(){System.out.println("cat eat");}
};
class Test
{     public static void main(String[] args)
      {     Animal a1,a2;
            a1=new Dog();        //creates object of Dog class
            a1.eat();            //compiletime:Animal runtime : Dog
            a2=new Cat();        //creates object of Cat class
            a2.eat();            //compiletime:Animal runtime : Cat
      }
};
```

<u>Example-:-method overriding vs. multilevel inheritance.</u>

```
class Person
{     void eat(){System.out.println("4-idly");}
};
class Ratan extends Person
{     void eat(){System.out.println("10-idly");}
};
class RatanKid extends Ratan
{     void eat(){System.out.println("2-idly");}
};
class Test
{     public static void main(String[] args)
      {     Person  p = new Ratan();
            p.eat();             //compiletime: Person  runtime:Ratan
            Ratan r = new RatanKid();
```

```
        r.eat();            //compiletime: Ratan  runtime:RatanKid
        Person p1 = new RatanKid();
        p1.eat();           //compiletime: Person  runtime:RatanKid
    }
};
```

Example :- overriding vs method hiding

- *static method cannot be overridden because static method bounded with class where as instance methods are bounded with object.*
- *In java it is possible to override only instance methods but not static methods.*
- *The below example seems to be overriding but it is method **hiding concept.***

```
class Parent
{   static void m1(){System.out.println("parent m1()");}
};
class Child extends Parent
{   static void m1(){System.out.println("child m1()");}
    public static void main(String[] args)
    {   Parent p = new Child();
        p.m1();  //output : parent m1()
    }
};
```

toString():-

- toString() method present in Object and it is printing String representation of Object.
- toString() method return type is String object it means toString() method is returning String object.
- The toString() method is overridden some classes check the below implementation.
    - In String class toString() is overridden to return content of String object.
    - In StingBuffer class toString() is overridden to returns content of StringBuffer class.
    - In Wrapper classes(Integer,Byte,Character…etc) toString is overridden to returns content of Wrapper classes.

internal implementation:-

```
class Object
{   public String toString()
    {   return getClass().getName() + '@' + Integer.toHexString(hashCode());
    }
};
```

Example:-

Note :- whenever you are printing reference variable internally toString() method is called.

```
    Test t = new Test();   //creates object of Test class reference variable is "t"
    //the below two lines are same.
```

```
        System.out.println(t);
        System.out.println(t.toString());
class Test
{       public static void main(String[] args)
        {       Test t = new Test();
                System.out.println(t);
                System.out.println(t.toString()); //  [Object class toString() executed]
        }
};
```

Example -2:-

toString() method present in Object class but in our Test class we are overriding toString() method hence our class toString() method is executed.

```
class Test
{       //overriding toString() method
        public String toString()
        {       return "ratansoft";
        }
        public static void main(String[] args)
        {       Test t = new Test();
                //below two lines are same
                System.out.println(t);              //Test class toString() executed
                System.out.println(t.toString());  //Test class toString() executed
        }
};
```

Example-3:- very important

```
class Student
{       //instance variables
        String sname;
        int sid;
        Student(String sname,int sid) //local variables
        {       //conversion
                this.sname = sname;
                this.sid = sid;
        }
        public String toString()   //overriding toString() method
        {       return "student name:-->"+sname+"   student id:-->"+sid;
        }
};
class TestDemo
{       public static void main(String[] args)
        {       Student s1 = new Student("ratan",111);
                //below two lines are same
                System.out.println(s1);             //student class toString() executed
                System.out.println(s1.toString()); //student class toString() executed
```

```
        Student s2 = new Student("anu",222);
        //below two lines are same
        System.out.println(s2);           //student class toString() executed
        System.out.println(s2.toString()); //student class toString() executed
    }
};
```

Example :-overriding of toString() method

```
class Test
{       //overriding method
    public String toString()
    {       return "ratnsoft";      }
    public static void main(String[] args)
    {       Test t = new Test();
            System.out.println(t);
            System.out.println(t.toString()); // [here overriding toString() executed it means
            our class toString()  method will be executed]
    }
};
```

In above example overriding toString() method will be executed.

Example :- employee class is not overriding toString()

```
class Employee
{       //instance variables
    String ename;
    int eid ;
      double esal;
    Employee(String ename,int eid,double esal)  //local variables
    {       //conversion of local variables to instance variables
            this.ename = ename;
            this.eid = eid;
            this.esal = esal;
    }
    public static void main(String[] args)
    {       Employee e1 = new Employee("ratan",111,60000);
    //whenever we are printing reference variables internally it calls toString() method
    System.out.println(e1); //e1.toString() [our class toString() executed output printed]
    }
};
```

D:\morn11>java Employee
Employee@530daa

*In above example Employee class is not overriding toString() method so parent class**(Object)** toString() method will be executed it returns hash code of the object.*

<u>Example :- Employee class overriding toString() method</u>

```
class Employee
{         //instance variables
          String ename;
          int eid ;
          double esal;
          Employee(String ename,int eid,double esal)//local variables
          {         //conversion of local variables to instance variables
                    this.ename = ename;
                    this.eid = eid;
                    this.esal = esal;
          }
          public String toString()
          {         return ename+" "+eid+" "+esal;
          }
          public static void main(String[] args)
          {         Employee e1 = new Employee("ratan",111,60000);
                    Employee e2 = new Employee("aruna",222,70000);
                    Employee e3 = new Employee("nandu",222,80000);
          //whenever we are printing reference variables internally it calls toString() method
          System.out.println(e1); //e1.toString() [our class toString() executed output printed]
          System.out.println(e2); //e2.toString() [our class toString() executed output printed]
          System.out.println(e3); //e3.toString() [our class toString() executed output printed]
          }
};
```

In above example when you print reference variables it is executing toString() hence Employee values will be printed.

<u>Final modifier:-</u>

1) Final is the modifier applicable for classes, methods and variables (for all instance, Static and local variables).

<u>Case 1:-</u>

1) if a class is declared as final, then we cannot inherit that class it means we cannot create child class for that final class.
2) Every method present inside a final class is always final but every variable present inside the final class not be final variable.

   <u>Example :-</u>

```
final class Parent   //parent is final class child class creation not possible
{                    };
class Child extends Parent  //compilation error
{                    };
```

<u>Example :-</u>

Note :- Every method present inside a final class is always final but every variable present inside the final class not be final variable.

```
final class Test
{       int a=10;     //not a final variable
        void  m1()    //final method
        {       System.out.println("m1 method is final");
                a=a+100;
                System.out.println(a);   //110
        }
        public static void main(String[] args)
        {       Test t=new Test();
                t.m1();
        }
}
```

Case 2:-

If a method declared as a final we can not override that method in child class.

Example :-

```
class Parent
{       final void marry(){}        //overridden method is final
};
class Child extends Parent
{       void marry(){}              //overriding method
};
```

Compilation Error:- ***marry() in Child cannot override marry() in Parent overridden method is final***

Case 3:-

1) *If a variable declared as a final we can not reassign that variable if we are trying to reassign compiler generate error message.*
2) *For the local variables only one modifier is applicable that is final.*

Example:-

```
class Test
{       public static void main(String[] args)
        {       final int a=100 ; //local variables
                a = a+100;  // [compilation error because trying to reassignment]
                System.out.println(a);
        }
};
```

Compilation Error :- cannot assign a value to final variable a

Example :-

```
class Parent
{       void m1(){}
};
class Child extends Parent
{       int m1(){}
};
D:\morn11>javac Test.java
```

m1() in Child cannot override m1() in Parent
return type int is not compatible with void

case 4:-
for the static variables JVM will provide default values.

```
class Test
{       static int a;
        public static void main(String[] args)
        {       System.out.println("static variable value="+Test.a);
        }
}
```

E:\>java Test
static variable value=0

final variables always needs initialization, if you don’t initialize compiler will generate compilation error.

```
class Test
{       final static int a;
        public static void main(String[] args)
        {       System.out.println("static variable value="+Test.a);
        }
}
```

Compilation error:
variable a might not have been initialized

Advantage of final modifier :-
The main advantage of final modifier is we can achieve security as no one can be allowed to change our implementation.

Disadvantage of final modifier:-
But the main disadvantage of final keyword is we are missing key benefits of Oops like inheritance and polymorphism. Hence is there is no specific requirement never recommended to use final modifier.

Garbage Collector

- Garbage collector is destroying the useless object and it is a part of the JVM.
- To make eligible objects to the garbage collector

Example-1 :-

Whenever we are assigning null constants to our objects then objects are eligible for GC(garbage collector)

```
class Test
{	public static void main(String[] args)
	{	Test t1=new Test();
		Test t2=new Test();
		System.out.println(t1);
		System.out.println(t2);
		;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
		t1=null;		//t1 object is eligible for Garbage collector
		t2=null;		//t2 object is eligible for Garbage Collector
		System.out.println(t1);
		System.out.println(t2);
	}
};
```

Example-2 :-

Whenever we reassign the reference variable the objects are automatically eligible for garbage collector.

```
class Test
{	public static void main(String[] args)
	{	Test t1=new Test();
		Test t2=new Test();
		System.out.println(t1);
		System.out.println(t2);
		t1=t2;			//reassign reference variable then one object is destroyed.
		System.out.println(t1);
		System.out.println(t2);
	}
};
```

Example -3:-

Whenever we are creating objects inside the methods one method is completed the objects are eligible for garbage collector.

```
class Test
{	void m1()
	{	Test t1=new Test();
		Test t2=new Test();
	}
	public static void main(String[] args)
	{	Test t=new Test();
		t.m1();
		System.gc();
	}
```

```
};
class Test
{       //overriding finalize()
        public void finalize()
        {       System.out.println("ratan sir object is destroyed");
                System.out.println(10/0);
        }
        public static void main(String[] args)
        {       Test t1 = new Test();
                Test t2 = new Test();
                ;;;;;;;//usage of objects
                t1=null;        //this object is eligible to Gc
                t2=null;        //this object is eligible to Gc
                System.gc();    //calling GarbageCollector
        }
}
```

```
//import java.lang.System;
import static java.lang.System.*;
class Test extends Object
{       public void finalize()
        {   System.out.println("object destroyed");
        }
        public static void main(String[] args)
        {       Test t1 = new Test();
                Test t2 = new Test();
                t1=null;
                t2=null;
                gc();   //static import
        }
};
```

Ex:- if the garbage collector is calling finalize method at that situation exception is raised such type of exception are ignored.

```
class Test
{       public void finalize()
        {
System.out.println("ratan sir destroyed");
                int a=10/0;
        }
        public static void main(String[] args)
        {       Test t1=new Test();
                Test t2=new Test();
                t1=t2;
                System.gc();
        }
};
```

Ex:- If user is calling finalize() method explicitly at that situation exception is raised.

```
class Test
{       public void finalize()
        {
System.out.println("ratan sir destroyed");
                int a=10/0;
        }
        public static void main(String[] args)
        {       Test t1=new Test();
                Test t2=new Test();
                t1=t2;
                t2.finalize();
        }
};
```

Abstraction:-

There are two types of methods in java

a. **Normal methods**
b. **Abstract methods**

Normal methods:- (component method/concrete method)

Normal method is a method which contains method declaration as well as method implementation.

Example:-

void m1() ***--->method declaration***
{ body; ***--->method implementation***
}

Abstract methods:-

1) The method which is having only method declaration but not method implementations such type of methods are called abstract Methods.
2) In java every abstract method must end with " ; ".

Example : - ***abstract void m1 (); ----→method declaration***

Based on above representation of methods the classes are divided into two types

1) **Normal classes.**
2) **Abstract classes.**

Normal classes:-

Normal class is a ordinary java class it contains only normal methods if we are trying to declare at least one abstract method that class will become abstract class.

Example:-

class Test ***//normal class***
{ void m1() { body ; } ***//normal method***
void m2() { body ; } ***//normal method***
void m3() { body ; } ***//normal method***
};

Abstract class:-

Abstract class is a java class which contains at least one abstract method(wrong definition).

If any abstract method inside the class that class must be abstract.

Example 1:-

class Test ***//abstract class***
{
void m1 ( ) { } ***//normal method***
void m2( ) { } *//****normal method***
void m3(); ***//abstract method***
};

Example-2:-

class Test ***//abstract class***
{
abstract void m1(); ***//abstract method***
abstract void m2(); ***//abstract method***
abstract void m3(); ***//abstract method***
};

Abstract modifier:-

- Abstract modifier is applicable for methods and classes but not for variables.
- To represent particular class is abstract class and particular method is abstract method to the compiler use abstract modifier.
- The abstract class contains declaration of methods it says abstract class partially implement class hence for partially implemented classes object creation is not possible. If we are trying to

create object of abstract class compiler generate error message “class is abstract con not be instantiated”

Example -1:-

- ***Abstract classes are partially implemented classes hence object creation is not possible.***
- ***For the abstract classes object creation not possible, if you are trying to create object compiler will generate error message.***

```
abstract   class   Test                    //abstract class
{          abstract  void m1();            //abstract method
           abstract void m2();             //abstract method
           abstract void m3();             //abstract method
           void m4(){System.out.println("m4 method");}   //normal method
           public static void main(String[] args)
           {          Test t = new Test();
                      t.m4();
           }
};
```

Compilation error:- *Test is abstract; cannot be instantiated*
Test t = new Test();

Example-2 :-

- **Abstract class contains abstract methods for that abstract methods provide the implementation in child classes.**
- **Provide the implementations is nothing but override the methods in child classes.**
- **The abstract class contains declarations but for that declarations implementation is present in child classes.**

```
abstract class Test
{          abstract void m1();
           abstract void m2();
           abstract void m3();
           void m4(){System.out.println("m4 method");}
};
class Test1 extends Test
{          void m1(){System.out.println("m1 method");}
           void m2(){System.out.println("m2 method");}
           void m3(){System.out.println("m3 method");}

           public static void main(String[] args)
           {          Test1 t = new Test1();
                      t.m1();          t.m2();          t.m3();          t.m4();
                      Test t1 = new Test1(); //abstract class reference variable Child class object
                      t1.m1();          //compile : Test   runtime  : Test1
                      t1.m2();          //compile : Test   runtime  : Test1
                      t1.m3() ;         //compile : Test   runtime  : Test1
                      t1.m4() ;         //compile : Test   runtime  : Test1
           }
};
```

Example -3 :-

- **Abstract class contains abstract methods for that abstract methods provide the implementation in child classes.**
- **if the child class is unable to provide the implementation of all parent class abstract methods at that situation declare that class with abstract modifier then take one more child class to complete the implementation of remaining abstract methods.**
- **It is possible to declare multiple child classes but at final complete the implementation of all methods.**

```
abstract class Test
{       abstract void m1();
        abstract void m2();
        abstract void m3();
        void m4(){System.out.println("m4 method");}
};
abstract class Test1 extends Test
{       void m1(){System.out.println("m1 method");}
};
abstract class Test2 extends Test1
{       void m2(){System.out.println("m2 method");}
};
class Test3 extends Test2
{       void m3(){System.out.println("m3 method");}
        public static void main(String[] args)
        {       Test3 t = new Test3();
                t.m1();
                t.m2();
                t.m3();
                t.m4();
        }
};
```

Example :- *inside the abstract class it is possible to declare*

```
abstract class Test
{       public int a=10;
        public final int b=20;
        public static final int c=30;
        void disp1()
        {       System.out.println("a value is="+a);
        }
};
class Test1 extends Test
{       void disp2()
        {       System.out.println("b value is="+b);
                System.out.println("c value is="+c);
        }
        public static void main(String[] args)
        {       Test1 t = new Test1();
```

```
                t.disp1();
                t.disp2();
        }
};
```

Example-5 :-

for the abstract methods it is possible to provide any return type(void, int, char,Boolean…..etc)

```
class Emp{};
abstract class Test1
{       abstract int m1(char ch);
        abstract boolean m2(int a);
        abstract Emp m3();
}
abstract class Test2 extends Test1
{       int m1(char ch)
        {       System.out.println("char value is:-"+ch);
                return 100;
        }
};
class Test3 extends Test2
{       boolean m2(int a)
        {       System.out.println("int value is:-"+a);
                return true;
        }
        Emp m3()
        {       System.out.println("m3 method");
                return new Emp();
        }
        public static void main(String[] args)
        {       Test3 t=new Test3();
                int a=t.m1('a');
                System.out.println("m1() return value is:-"+a);
                boolean b=t.m2(111);
                System.out.println("m2() return value is:-"+b);
                Emp e = t.m3();
                System.out.println("m3() return value is:-"+e);
        }
};
```

Example-6:-

It is possible to override non-abstract as a abstract method in child class.

```
abstract class Test
{   abstract void m1();                              //m1()  abstract method
    void m2(){System.out.println("m2 method");}      //m2() normal method
};
abstract class Test1 extends Test
```

```
{     void m1(){System.out.println("m1 method");}      //m1() normal method
      abstract void m2();                              //m2() abstract method
};
class FinalClass  extends Test1
{     void m2(){System.out.println("FinalClass m2() method");}
      public static void main(String[] args)
      {       FinalClass f = new FinalClass();
              f.m1();
              f.m2();
      }
};
```

Example:-

```
abstract class Test
{       public static void main(String[] args)
        {       System.out.println("this is abstract class main");
        }
};
```

Example-8:-

- *Constructor is used to create object (wrong definition).*
- Constructor is executed during object creation to initialize values to instance variables.
- Constructors are used to write the write the functionality that functionality executed during object creation.
- There are multiple ways to crate object in java but if we are crating object by using "new" then only constructor executed.

Note :- in below example abstract class constructor is executed but object is not created.

```
 abstract class Test
{       Test()
        {       System.out.println("abstrac calss con");
        }
};
class Test1 extends Test
{       Test1()
        {       super();
                System.out.println("normal class con");
        }
        public static void main(String[] args)
        {       new Test1();
        }
};
D:\>java Test1
abstrac calss con
normal class con
```

case 1:- [abstract method to normal method]

```
abstract class Test
{       abstract void m1();
```

```
};
class Test1 extends Test
{	void m1(){System.out.println("m1 method");}
};


case 2:-[normal method to abstract method]
class Test
{	void m1(){System.out.println("m1 method");}
};
abstract class Test1 extends Test
{	abstract void m1();
};
```

***Example-9:-** the abstract class allows zero number of abstract method.*

Definition of abstract class:-

Abstract class may contains abstract methods or may not contains abstract methods but object creation is not possible. The below example contains zero number of abstract methods.

Ex:- HttpServlet (doesn't contains abstract methods still it is abstract object creation not possible)

```
abstract class Test
{	void cm()	{	System.out.println("ratan");	}
	void pm()	{	System.out.println("anushka");	}
	public static void main(String[] args)
	{	Test t = new Test();
		t.cm();   t.pm();
	}
};
Test.java:6: Test is abstract; cannot be instantiated
```

Abstraction definition :-

- The process highlighting the set of services and hiding the internal implementation is called abstraction.
- Bank ATM Screens Hiding the internal implementation and highlighting set of services like , money transfer, mobile registration,…etc).
- Syllabus copy of institute just highlighting the contents of java but implementation there in classed rooms .
- We are achieving abstraction concept by using Abstract classes & Interfaces.

Encapsulation:-

The process of binding the data and code as a single unit is called encapsulation.
We are able to provide more encapsulation by taking the private data(variables) members.
To get and set the values from private members use getters and setters to set the data and to get the data.

Example:-

```
class Encapsulation
{	private int sid;
	private int sname;
	//mutator methods
```

```
        public void setSid(int x)
        {       this.sid=sid;   }
        public void setSname(String sname)
        {       this.sname=sname;   }
        //Accessor methods
        public int getSid()
        {       return sid;     }
        public String getSname()
        {       return  sname;          }
};
```

To access encapsulated use fallowing code:-

```
class Test
{       public static void main(String[] args)
        {       Encapsulation e=new Encapsulation();
                e.setSid(100);
                e.setSname("ratan");
                System.out.println(e.getSid());
                System.out.println(e.getSname());
        }
};
```

Main Method:-

Public static void main(String[] args)

Public ---→ To provide access permission to the jvm declare main with public.
Static ---→ To provide direct access permission to the jvm declare main is static(with out creation of object able to access main method)
Void ---→ don't return any values to the JVM.
String[] args ---→ used to take command line arguments(the arguments passed from command prompt)
String ---→ it is possible to take any type of argument.
[ ] ---→ represent possible to take any number of arguments.

Modifications on main():-

1) Modifiers order is not important it means it is possible to take **public static** or **static public .**
   Example :- ***public static void main(String[] args)***
   static public void main(String[] args)
2) the fallowing declarations are valid
   string[] args String []args String args[]
   Example:- ***static public void main(String[] args)***
   static public void main(String []args)
   static public void main(String args[])
3) instead of args it is possible to take any variable name (a,b,c,… etc)
   Example:- ***static public void main(String... ratan)***
   static public void main(String... a)
   static public void main(String... anushka)
4) for 1.5 version insted of String[] args it is possible to take String… args(only three dots represent variable argument)
   Example:- ***static public void main(String... args)***
5) the applicable modifiers on main method.
   a. public b. static c. final d.strictfp e.synchronized
   in above five modifiers public and static mandatory remaining three modifiers optional.
   Example :- ***public static final strictfp synchronized void main(String... anushka)***

Which of the fallowing declarations are valid:-

1. **public static void main(String... a)** --->valid
2. **final strictfp static void mian(String[] Sravya)** --->invalid
3. **static public void mian(String a[])** --->valid
4. **final strictfp public static main(String[] rattaiah)** --->invalid
5. **final strictfp synchronized public static void main(String... nandu)**--->valid

Strictfp modifier:-

a. Strictfp is a modifier applicable for classes and methods.
b. If a method is declared as strictfp all floating point calculations in that method will follow IEEE754 standard. So that we will get platform independent results.
c. If a class is declared as stictfp then every method in that class will follow IEEE754 standard so we will get platform independent results.

Ex:- strictfp class Test { //methods/// } --->all methods fallows IEEE754
strictfp void m1() { } ---> m1() method fallows IEE754

Native modifier:-

a. Native is the modifier applicable only for methods.
b. Native method is used to represent particular method implementations there in non-java code (other languages like C,CPP) .
c. Native methods are also known as "foreign methods".

Examples:-

```
public final int getPriority();
public final void setName(java.lang.String);
public static native java.lang.Thread currentThread();
public static native void yield();
```

Example:-

```
class Test
{       final strictfp synchronized static public  void main(String...ratan)
        {       System.out.println("hello ratan sir");
        }
};
```

Example:-main method VS inheritance

Case-1

```
class Parent
{       public static void main(String[] args)
        {  System.out.println("parent class");
        }
};
class Child extends Parent
{       public static void main(String[] args)
        {  System.out.println("child class");
        }
};
```

D:\>Java Child
Child class

Case-2

```
class Parent
{       public static void main(String[] args)
        {  System.out.println("parent class");
        }
};
class Child extends Parent
{
};
```

D:\>java Child
Parent class

Example:-main method VS overloading

In java it is possible to overload main method but JVM is always calling String[] main method.

```
class Test
{       public static void main(String[] args)
        {       System.out.println("String[] main method");
                main(100);
        }
        public static void main(int a)
        {       main('r');
                System.out.println("int  main method");
        }
        public static void main(char ch)
        {       System.out.println("char main method");
```

```
        }
}
```

E:\>java Test
String[] main method
char main method
int main method

***note:-** it is not possible to override main method because main is a static method.*

Command Line Arguments:-

- ✓ *The arguments which are passed from command prompt to application at runtime are called command line arguments.*
- ✓ *The command line argument separator is space.*
- ✓ *In single command line argument it is possible to provide space by declaring that command line argument in double quotes.*

Example-1 :-

```
class Test
{       public static void main(String[] ratan)
        {       System.out.println(ratan[0]+"  "+ratan[1]);   //printing command line arguments
                System.out.println(ratan[0]+ratan[1]);
                //conversion of  String-int  String-double
                int a = Integer.parseInt(ratan[0]);
                double d = Double.parseDouble(ratan[1]);
                System.out.println(a+d);
        }
};
```

D:\>java Test 100 200
100 200
100200
300.0

Example-2:-

To provide the command line arguments with spaces then take that command line argument with in double quotes.

```
class Test
{       public static void main(String[] ratan)
        {       //printing command line arguments
                System.out.println(ratan[0]);
                System.out.println(ratan[1]);
        }
};
```

D:\>java Test *corejava ratan*
corejava
ratan
D:\>java Test *core   java ratan*
core
java
D:\>java Test *"core java"   ratan*

core java
ratan

Var-arg method:-(1.5 version)

It allows the methods to take any number of parameters to particular method.

Syntax:- **Void m1(int… a)**{------} **(only 3 dots)**

The above m1() is allows any number of parameters.(0 or 1 or 2 or 3………..n)

Example:-

```
class Test
{	void m1(int... a)
	{	System.out.println("Ratan");
	}
	public static void main(String[] args)
	{	Test t=new Test();
		t.m1();		//int var-arg method executed
		t.m1(10);		//int var-arg method executed
		t.m1(10,20);	//int var-arg method executed
		t.m1(10,20,30);	//int var-arg method executed
	}
}
```

Example:- var-arg VS normal arguments

For java methods it is possible to provide normal arguments along with variable arguments.

```
class Test
{	void m1(char ch,int... a)
	{	System.out.println(ch);
		for (int a1:a)
		{	System.out.println(a1);
		}
	}
	public static void main(String[] args)
	{	Test t=new Test();
		t.m1('a');
		t.m1('b',10);
		t.m1('c',10,20);
		t.m1('d',10,20,30,40);
	}
}
```

Note :- inside the method it is possible to declare only one variable-argument and that must be last argument otherwise the compiler will generate compilation error.

void m1(int... a) ***--->valid***
void m2(int... a,char ch) ***--->invalid***
void m3(int... a,boolean... b) ***--->invalid***
void m4(double d,int... a) ***--->valid***
void m5(char ch ,double d,int... a) ***--->valid***

void m6(char ch ,int... a,boolean... b) ***--->invalid***

Example:- normal-arguments vs variable-argument

If the call contains both var-arg method & normal argument method then it prints normal argument value.

```
class Test
{	void m1(int... a)
	{	System.out.println("variable argument="+a);
	}
	void m1(int a)
	{	System.out.println("normal argument="+a);
	}
	public static void main(String[] args)
	{	Test t=new Test();
		t.m1(10);
	}
}
E:\>java Test
normal argument=10
```

<u>Example :- var-arg method vs overloading</u>

```
class Test
{	void m1(int... a)
	{	for (int a1 : a)
		{	System.out.println(a1);		}
	}
	void m1(String... str)
	{	for (String str1 : str)
		{	System.out.println(str1);			}
	}
	public static void main(String[] args)
	{	Test t=new Test();
		t.m1(10,20,30);		//int var-arg method calling
		t.m1("ratan","Sravya");	//String var-arg calling
		t.m1();//var-arg method vs ambiguity  [compilation error  ambiguous]
	}
}
```

Packages

java-language:-

in java James Gosling is maintained predefined support in the form of packages and these packages contains classes & interfaces, and these classes and interfaces contains predefined methods & variables.

java-language	**james gosling**
↓	↓
packages	**java.lang**
↓	↓
classes & interfaces	**System,String……..**
↓	↓
methods & variables	**length(),charAt(),concat()…**

java source code:-

- java is a open source software we are able to download it free of cost and we are able to see the source code of the java.
- The source code location **C:\Program Files\Java\jdk1.7.0_75\src (zip file)** extract the zip file.
- Java contains 14 predefined packages but the default package in java if ***java.lang.*** package.

Java.lang	**java.beans**	**java.text**	**java.sql**
Java.io	**java.net**	**java.nio**	**java.math**
Java.util	**java.applet**	**java.rmi**	
Java.awt	**java.times**	**java.security**	

Note : The default package in java is java.lang package.

Note : package is nothing but physical folder structure.

Types of packages:-

There are two types of packages in java

1) Predefined packages.
2) User defined packages.

Predefined packages:

The predefined packages are introduced by James Gosling and these packages contains predefined classes & interfaces and these class & interfaces contains predefined variables and methods.

Example:- java.lang, java.io ,java.util…..etc

User defined packages:-

- The packages which are defined by user, and these packages contains user defined classes and interfaces.
- Declare the package by using ***package*** keyword.

syntax : ***package package-name;***

example : ***package com.sravya;***

- Inside the source file it is possible to declare only one package statement and that statement must be first statement of the source file.

Example-1:valid
```
package com.sravya;
import java.io.*;
import java.lang.*;
```

Example-2:Invalid
```
import java.io.*;
package com.sravya;
import java.io.*;
```

Example-3:Invalid
```
import java.io.*;
import java.lang.*;
package com.sravya;
```

Example-4:Invalid
```
package com.sravya;
package com.tcs;
```

some predefined package and it's classes & interfaces:-

Java.lang:-The most commonly required classes and interfaces to write a sample program is encapsulated into a separate package is called java.lang package.

```
java
  |------→lang
           |--→ String(class)
           |--→ StringBuffer(class)
           |--→ Object(class)
           |--→ Runnable(interface)
           |--→ Cloneable(interface)
```

Note:- the default package in the java programming is java.lang package.

Java.io package:-The classes which are used to perform the input output operations that are present in the java.io packages.

```
java
  |------→io
           |--→ FileInputStream(class)
           |--→ FileOutputStream(class)
           |--→FileReader(class)
           |--→ FileWriter(class)
           |--→ Serializable(interface)
```

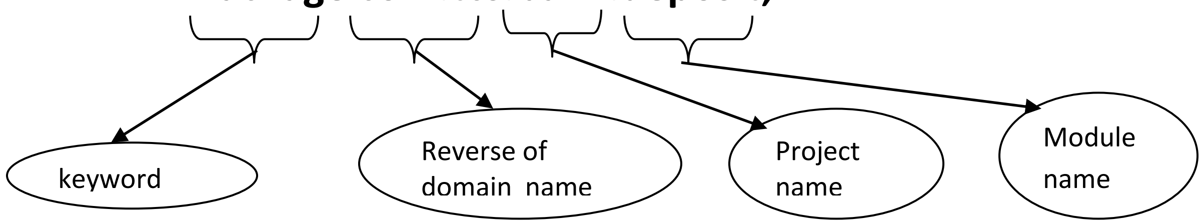
Java.net package:-The classes which are required for connection establishment in the network that classes are present in the java.net package.

```
java
  |------→net
           |--→Socket(class)
           |--→ServerSocket(class)
           |--→URL(class)
           |--→ SocketOption(interface)
```

Package name coding conventions :-(not mandatory but we have to fallow)

1) The package name must reflect with organization domain name***(reverse of domain name).***
   Domain name:- **www.tcs.com**
   Package name:- **Package com.tcs;**
2) Package name must reflect with project name.
   Project name :- **bank**
   package :- **Package com.tcs.bank;**
3) The project name must reflect with project module name.
   Domain name:- **www.tcs.com**
   Project name:- **bank**
   Module name:- **deposit**
   package name:- **Package com.tcs.bank.deposit;**

Package com.tcs.bank.deposit;



Advantages of packages:-

company name : tcs
project name : bank

module-1 *Deposit*

```
com
 |-->tcs
        |-->bank
              |-->deposit
                      |--->.class files
```

module-2 *withdraw*

```
com
 |-->tcs
        |-->bank
              |-->withdraw
                      |--->.class files
```

Module-3 *moneytranfer*

```
com
 |-->tcs
        |-->bank
              |-->moneytranfer
                      |--->.class files
```

module-4 *accountinfo*

```
com
 |-->tcs
        |-->bank
              |-->accountinfo
                      |--->.class files
```

1) ***It improves parallel development of the project.***
2) ***Project maintenance will become easy.***
3) ***It improves sharability of the project.***
4) ***It improves readability.***
5) ***It improves understandability.***

Note :- In real time the project is divided into number of modules that each and every module is nothing but package statement.

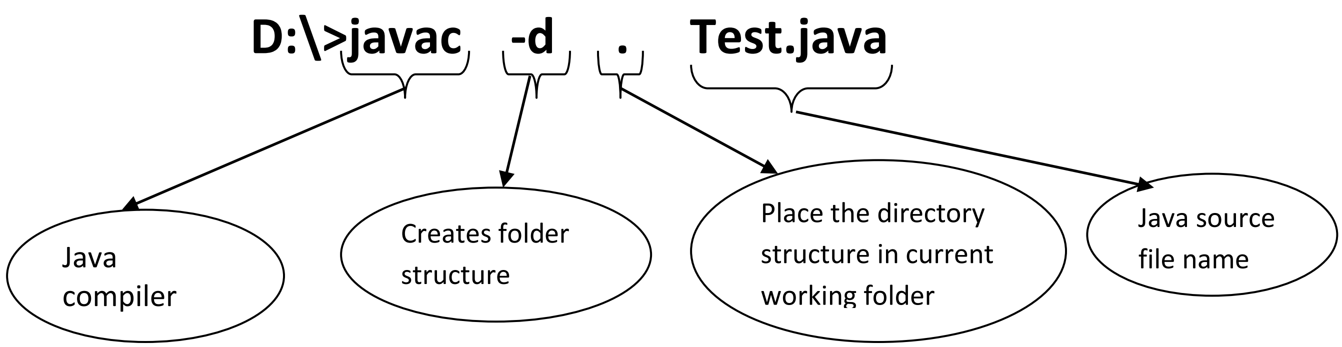
<u>Example-1:-</u>

Step-1: write the application with package statement.

```
package com.sravya.java.corejava;
class Test
{           public static void main(String[] args)
            {           System.out.println("package first example");
            }
}
class A
{  }
class B
{ }
interface It
{ }
```

Step-2: compilation process

If the source file contains the package statement then compile that application by using fallowing command.



Step-3:- folder Structure.

```
com
 |-->sravya
          |-->java
                  |-->corejava
                           |-->Test.class
                           |-->A.class
                           |-->B.class
                           |-->It.class
```

Step-4:-execution process.

Execute the .class file by using fully qualified name(***class name with complete package structure***)

java   com.sravya.java.corejava.Test

*output :   **package first example***

Example-2:-

Error-1 :-

- *If it is a predefined package or user defined package Whenever we are using other package classes then must import that package by using import statement.*
- *If the application required two classes (System,String) then We are able to import the classes in two ways*
    - ***Importing all classes.***

      Import java.lang.;*
    - ***Importing application required classes***

      Import java.lang.System;
      Import java.lang.String;

  In above two approaches second approach is recommended because it is importing application required classes.

Error-2:-

- *Whenever we are using other package classes then that classes must be public otherwise compiler generate error message.*

  Error:class is not public we are unable to access outside package.

Public modifier:-

- ✓ *Public modifier is applicable for variables,methods,classes.*
- ✓ *All packages are able to access public members.*

Default modifier:-

- It is applicable for variables,methods,classes.
- We are able to access default members only within the package and it is not possible to access outside package .
- Default access is also known as package level access.
- The default modifier in java is default.

Error-3:-

- *Whenever we are using other package class member that members also must be public.*

Note : When we declare class as public the corresponding members are not public, if we want access public class members that members also must be public.

File-1: Sravya.java

```
package com.sravya.states.info;
public class Sravya
{	public void ts(){System.out.println("jai telengana");}
	public void ap(){System.out.println("jai andhra");}
	public void others(){System.out.println("jai jai others");}
}
```

File-2: Tcs.java

```
package com.tcs.states.requiredinfo;
import com.sravya.states.info.*;
class  Tcs
{       public static void main(String[] args)
        {       Sravya s = new Sravya();
                s.ts();         s.ap();         s.others();
        }
}
```

E:\>javac -d . Sravya.java **compilation of Sravya**
E:\>javac -d . Tcs.java **compilation of Tcs**
E:\>java com.tcs.states.requiredinfo.Tcs **execution of Tcs**
jai telengana
jai andhra
jai jai others

Private modifier:-

- ✓ *private modifier applicable for methods and variables.*
- ✓ *We are able to access private members only within the class and it is not possible to access even in child classes.*

```
class Parent
{       private int a=10;
};
class Child extends Parent
{       void m1()
        {       System.out.println(a);  //a variables is private Child class unable to access
        }
        public static void main(String[] arghs)
        {       Child c = new Child();
                c.m1();
        }
};
```

error: a has private access in Parent
Note :- the most accessable modifier in java Is public & most restricted modifier in java is private.

Protected modifier:-

- ✓ *Protected modifier is applicable for variables,methods.*
- ✓ *We are able access protected members with in the package and it is possible to access outside packages also but only indirect child classes & it is not possible to call even in indirect child classes.*
- ✓ *But in outside package we can access protected members only by using child reference. If we try to use parent reference we will get compile time error.*

A.java:-

```
package   app1;
public class A
{       protected int fee=1000;
};
```

B.java:-

```
package app2;
import app1.*;
public class B extends A
{	public static void main(String[] args)
	{	B   b = new B( );
		System.out.println(b.fee);
	}
};
```

Summary of variables:-

modifier	Private	no-modifier	protected	public
Same class	yes	yes	yes	yes
Same package sub class	no	yes	yes	yes
Same package non sub class	no	yes	yes	yes
Different package sub class	no	no	yes	yes
Different package non sub class	no	no	no	yes

Example:- method overriding rule-7

- ✓ *In java while overriding it is possible to maintain same level **(default-default)** permission or increasing order **(default-public)** but it is not possible to decrease **(public-default)** the permission.*
- ✓ *In java if we are trying to decrease the permission compiler will generate error message "attempting to assign weaker access privileges"*

Parent-class method	child-class method	
Default	default (same level)	**-->valid**
	protected , public (increasing level)	**--> valid**
	Private (decreasing level)	**--> invalid**
Public	public (same level)	**--> valid**
	Default,private,protected(decreasing)	**-->invalid**
Protected	protected(same level)	**--> valid**
	Public(increasing permission)	**-->valid**
	Default,private (decreasing level)	**-->invalid**

Case 1:- same level [default-default]

```
class Parent
{	void m1(){System.out.println("m1 method");}
};
class Child extends Parent
{	void m1(){System.out.println("m1 method");}
};
```

Case 2:- increasing permission [protected-public]

```
class Parent
{	protected void m1(){System.out.println("m1 method");}
```

```
};
class Child extends Parent
{       public void m1(){System.out.println("m1 method");}
};
```

Case3 :- decreasing permission ***[public-protected]***

```
class Parent
{       public void m1(){System.out.println("m1 method");}
};
class Child extends Parent
{       protected void m1(){System.out.println("m1 method");}
};
```

Example :-

Test.java:-

```
package app1;
public class Test
{       public void m1()   {   System.out.println("app1.Test class m1()");   }
}
```

X.java:-

```
package   app1.corejava;
public class X
{       public void m1()  {   System.out.println("app1.core.X class m1()");  }
}
```

Y.java:-

```
package   app1.corejava.advjava;
public class Y
{       public void m1()   {   System.out.println("app1.corejava.advjava.Y class m1()");   }
}
```

Z.java:-

```
Package   app1.corejava.advjava.structs;
public class Z
{       public void m1()    {   System.out.println("app1.corejava.advjava.structs.Z class m1()");   }
}
```

Ratan.java:-

```
import app1.Test;
import app1.corejava.X;
import app1.corejava.advjava.Y;
import app1.corejava.advjava.structs.Z;
class Ratan
{       public static void main(String[] args)
        {       Test t = new Test();  t.m1();
                X x = new X();  x.m1();
                Y y = new Y();   y.m1();
                Z z = new Z(); z.m1();
        }
};
```

Static import:-

1. *This concept is introduced in 1.5 version.*
2. *if we are using the static import it is possible to call static variables and static methods of a particular class directly to the application without using class name.*
    a. ***import static java.lang.System.*;***

    The above line is used to call all the static members of System class directly into application without using class name.

Ex:-without static mport

```
import java.lang.*;
class Test
{	public static void main(String[] args)
	{
	System.out.println("Hello World!");
	System.out.println("Hello World!");
	System.out.println("Hello World!");
	}
}
```

Ex :- with static import

```
import static java.lang.System.*;
class Test
{	public static void main(String[] args)
	{
	out.println("ratan world");
	out.println("ratan world");
	out.println("ratan world");
	}
};
```

Example:-

```
package com.dss.java.corejava;
public class Sravya
{	public static  int fee=1000;
	public static void course()
	{	System.out.println("core java");
	}
	public static void duration()
	{	System.out.println("1-month");
	}
	public static void trainer()
	{	System.out.println("ratan");
	}
};
```

without static import

```
package com.tcs.course.coursedetails;
import com.dss.java.corejava.*;
class Tcs
{	public static void main(String[] args)
	{	System.out.println(Sravya.fee);
		Sravya.course();
		Sravya.duration();
		Sravya.trainer();
	}
}
```

with static import

```
package com.tcs.course.coursedetails;
import static com.dss.java.corejava.Sravya.*;
class Tcs
{	public static void main(String[] args)
	{	System.out.println(fee);
		course();
		duration();
		trainer();
	}
}
```

Example:-

When you import main package we are able to access only package classes, it is not possible to access sub package classes, if we want sub package classes must import sub packages also.

```
com
 |-->sravya
      |--->A.class
      |--->B.class
      |--->C.class
      |--->ratan
            |--->D.class
```

*In above example when we import **com.sravya.*** it is possible to access only three classes(A,B,C) but it is not possible to access sub package classes **(ratan package D class)** if we want sub package classes must import sub package(**import com.sravya.ratan.***).*

File-1: A.java

```
package jav.corejava;
public class A
{	public void m1()
	{System.out.println("core java World!");
	}
}
```

Package structure:-

```
jav
|-->corejava
     |--->A.class
```

File-2: B.java:

```
package jav.corejava.advjava;
public class  B
{	public void m1()
	{System.out.println("Adv java World!");
	}
}
```

```
jav
|-->corejava
     |--->A.class
     |--->advjava
           |--->B.class
```

File-3: C.java:-

```
package jav.corejava.advjava.structs;
public class  C
{	public void m1()
	{System.out.println("Structs World!");
	}
}
```

```
jav
|-->corejava
     |--->A.class
     |--->advjava
           |--->B.class
           |--->structs
                 |--->C.class
```

File-4:- MainTest.java

Package structure :-

```
import jav.corejava.A;
import jav.corejava.advjava.B;
import jav.corejava.advjava.structs.C;
class MainTest
{	public static void main(String[] args)
	{	new A().m1();
		new B().m1();
		new C().m1();
	}
}
```

Example :-

in java it is not possible to use predefined package names as a user defined packages. If we are trying to use predefined package names as a user defined packages at runtime JVM will generate securityException.

```
package java.lang;
class Test
{	public static void main(String[] args)
	{	System.out.println("Ratan World!");
	}
}
class A
{
};
D:\DP>javac -d . Test.java
D:\DP>java java.lang.Test
Exception in thread "main" java.lang.SecurityException: Prohibited package name: java.lang
```

Applicable modifiers on constructors:-

1) *Public*
2) *Private*
3) *Protected*
4) *default*

Private constructors:-

```
class Parent
{	private Parent(){   }	//private constructor
}
class Child extends Parent
{	Child()
	{super();}	//we are calling parent class private constructor it is not possible
};
D:\>javac Test.java
Test.java:6: Parent() has private access in Parent
```

we are achieving singleton class creation by using private constructors in java:-

- *when we declare constructor with private modifier we can't create object outside of the class.*
- *Singleton class allows to create only one object of particular class and we are achieving singleton class creation by using private constructors.*
- *In some scenarios it is appropriate to have exactly one instance of class like,*
  - *Window manager*
  - *File systems*
  - *Project manager*
  - *Admin*

  These type of objects are called singleton objects.

file-1:-

```
package com.dss.st;
class Test
```

```
{       public static Test t=null;
        private Test(){}
        public static Test getInstance()
        {       if (t==null)
                {       t = new Test();
                }
                return t;
        }
        public void disp()
        {       System.out.println("this is ratan singleton class");
        }
};
```

File-2:-

```
Package com.dss;
Import com.dss.st.Test;
class Test1
{       public static void main(String[] args)
        {       //Test t = new Test(); compilation error  Test() has private access in Test
                Test t1 = Test.getInstance();
                Test t2 = Test.getInstance();
                System.out.println(t1.hashCode());//31168322
                System.out.println(t2.hashCode());//31168322
        }
};
```

Interfaces

1. *Interface is also one of the type of class it contains only abstract methods. And Interfaces not alternative for abstract class it is **extension** for abstract classes.*
2. *The interface allows to declare **only abstract methods** and these methods are by default public & abstract if we are declaring or not.*
3. *The interface is highlighting set of functionalities but implementations are hiding.*
4. *For the interfaces also compiler will generates .class files after compilation.*
5. *Inside the source file it is possible to declare any number of interfaces. And we are declaring the interfaces by using **interface** keyword.*

Syntax:- ***Interface interface-name***

```
interface It1
{       *****
 }
```

- ✓ **if you don't no the anything about implementation just we have the requirement specification then declare that requirements by using interface.**
- ✓ **If u know the implementation but not completely then we should go for abstract classes.**
- ✓ **if you know the implementation completely then we should go for concrete classes.**

Both examples are same

```
Interface it1
{
        Void m1();
        Void m2();
        Void m3();
}
```

```
abstract interface it1
{
public  abstract void m1();
public  abstract void m2();
public  abstract void m3();
}
```

Note: - If we are declaring or not each and every interface method by default public abstract. And the interfaces are by default abstract hence for the interfaces object creation is not possible.

Example-1 :-

- ➢ *Interface constrains abstract methods and by default these methods are "public abstract ".*
- ➢ *Interface contains abstract method for these methods provide the implementation in the implementation classes.*
- ➢ *Implementation class is nothing but the class which implements particular interface.*
- ➢ *While providing implementation of interface methods that implementation methods must be public methods otherwise compiler generate error message "**attempting to assign weaker access privileges".***

```
interface it1
{       Void m1();      //abstract method by default [public abstract]
        Void m2();      //abstract method by default [public abstract]
        Void m3();      //abstract method by default [public abstract]
}
Class Test  implements it1                  //Test is implementation class of It1 interface
 {      Public void m1()                    //implementation method must be public
        {       System.out.println("m1-method implementation ");        }
        Public void m2()
```

```
        {       System.out.println("m2-method implementation");       }
        Public void m3()
        {       System.out.println("m3 –method implementation");      }
        Public static void main(String[] args)
        {       Test t=new Test();
                t.m1();
                t.m2();
                t.m3();
        }
}
```

Example :-

```
interface It1               //abstract
{       void m1();          //public abstract
        void m2();
        void m3();
}
class Test implements It1
{       public void m1(){System.out.println("m1 method");}
        public void m2(){System.out.println("m2 method");}
        public void m3(){System.out.println("m3 method");}

        public static void main(String[] args)
        {       Test t = new Test();
                t.m1();
                t.m2();
                t.m3();

                It1 i = new Test();
                i.m1();  //compile : It1  runtime : Test
                i.m2();  //compile : It1  runtime : Test
                i.m3();  //compile : It1  runtime : Test
        }
};
```

Example-2:-

- *Interface contains abstract method for these methods provide the implementation in the implementation class.*
- *If the implementation class is unable to provide the implementation of all abstract methods then declare implementation class with abstract modifier & complete the remaining abstract method implementation in next created child classes.*
- *If the child class also unable to provide implementation then declare the child class with abstract modifier & take one more child class to complete the implementations.*
- *In java it is possible to take any number of child classes but at final complete the implementation of all abstract methods.*

```
interface It1
{     void m1();          //public abstract
      void m2();
      void m3();
}
abstract class Test implements It1
{     public void m1(){System.out.println("m1 method");}
};
abstract class Test1 extends Test
{     public void m2(){System.out.println("m2 method");}
};
class Test2 extends Test1
{     public void m3(){System.out.println("m3 method");}
      public static void main(String[] args)
      {         Test2 t = new Test2();
                t.m1();
                t.m2();
                t.m3();
      }
};
```

Example:- ***The interface reference variables is able to hold child class objects.***

```
interface It1                    // interface declaration
{         void m1();       //abstract method by default [public abstract]
          void m2();       //abstract method by default [public abstract]
          void m3();       //abstract method by default [public abstract]
}
//Test1 is abstract class contains 2 abstract methods m2() m3()hence object creation not possible
abstract class Test1 implements It1
{         public void m1()
{         System.out.println("m1 method");     }
};
//Test2  is abstract class contains 1 abstract method m3()  hence object creation not possible
abstract class Test2 extends Test1
{         public void m2()
{         System.out.println("m2 method");     }
};
//Test3 is normal class because it contains only normal methods hence object creation possible
class Test3 extends Test2
{         public void m3()
          {         System.out.println("m3 method");     }
          public static void  main(String[] args)
          {         It1 t = new Test3();
                     t.m1();           t.m2();            t.m3();
                    Test1 t1 = new Test3();
                    t1.m1();          t1.m2();           t1.m3();
```

```
            Test2 t2 = new Test3();
            t2.m1();        t2.m2();        t2.m3();
    }
};
```

```
interface It1
{       void m1();
}
interface It2
{       void m2();
}
interface It3 extends It1,It2
{       void m3();
}
class Test implements It1
{       1 method
};
class Test implements It1,It2
{       2 methods
};
class Test implements It1,It2,It3
{       3 methods
};
```

Difference between abstract classes & interfaces:-

Abstract class

1) The purpose of abstract class is to specify default functionality of an object and lest its sub classes explicitly implement that functionality. It stands it is providing

abstraction layer that must be extended and implemented by the corresponding sub classes.

2) An abstract class is a class that declared with **abstract** modifier.

Ex: ***abstract class A***
{ abstract void m1(); }

3) The abstract allows declaring both abstract & concrete methods.

4) Abstract class methods must declare with abstract modifier.

5) If the abstract class contains abstract methods then write the implementations in child classes.

6) In child class the implementation methods need not be public it means while overriding it is possible to declare any valid modifier.

7) The abstract class is able to provide implementations of interface methods.

8) One java class is able to extends only one abstract class at a time.

9) Inside abstract class it is possible to declare main method &constructors.

10) It is not possible to instantiate abstract class.

11) For the abstract classes compiler will generate **.class** files.

12) The variables of abstract class need not be **public static final.**

Interface

1. It is providing complete abstraction layer and it contains only declarations of the project then write the implementations in implementation classes.

2. Declare the interface by using **interface** keyword.
   Ex:- ***interface It1***
   { void m1(); }

3. The interface allows declaring only abstract methods.

4. Interface methods are by default **public abstract.**

5. The interface contains abstract methods writ the implementations in implementation classes.

6. In implementation class the implementation methods must be public.

7. The interface is unable to provide implementation of abstract class methods.

8. One java class is able to implements multiple interfaces at a time.

9. Inside interface it is not possible to declare methods and constructors.

10. It is not possible to instantiate interfaces.

11. For the interfaces compiler will generate .class files.

12. The variables declared in interface by default **public static final.**

Example-1:-

- Inside the interfaces it is possible to declare variables and methods.

- By default interface methods are **public abstract** and by default interface variables are **public static final.**
- The final variables are replaced with their values at compilation time only.

Application before compilations:- (.java file)

```
interface It1              //interface declaration
{       int a=10;          //interface variables
        void m1();         //interface method
}
class Test implements It1
{       public void m1()
        {       System.out.println("m1 method");
                System.out.println(a);
        }
        public static void main(String[] args)
        {       Test t = new Test();
                t.m1();
        }
};
```

Application after compilation:-(.class file)

```
interface It1
{       public abstract void m1();     // compiler generate public abstract
        public static final int a = 10;   //public static final generated by compiler
}
class Test implements It1
{       public void m1()
        {       System.out.println("m1 method");
                System.out.println(10);    //a is final variable hence it replaced at compilation time only
        }
        public static void main(String[] args)
        {       Test t = new Test();
                t.m1();
        }
};
```

Message.java:-

```
package com.sravya.declarations;
public interface Message
{	void morn();
	void even();
	void gn();
}
```

Helper.java-

```
package com.sravya.helper;
import com.sravya.declarations.Message;
public abstract class Helper implements Message
{	public void gn(){System.out.println("good night from helper class");}
}
```

TestClient1.java:-

```
package com.sravya.client;
import com.sravya.declarations.Message;
class TestClient1 implements Message
{	public void morn(){System.out.println("good morning");}
	public void even(){System.out.println("good evening");}
	public void gn(){System.out.println("good 9t");}
	public static void main(String[] args)
	{	TestClient1 t = new TestClient1();
		t.morn();
		t.even();
		t.gn();
	}
}
```

TestClient2.java:-

```
package com.sravya.client;
import com.sravya.helper.Helper;
class TestClient2 extends Helper
{	public void morn(){System.out.println("good morning");}
	public void even(){System.out.println("good evening");}
	public static void main(String[] args)
	{	TestClient2 t = new TestClient2();
		t.morn();
		t.even();
		t.gn();
	}
}
D:\>javac -d . Message.java
D:\>javac -d . Helper.java
D:\>javac -d . TestClient1.java
D:\>javac -d . TestClient2.java
```

```
D:\>java com.sravya.client.TestClient1
good morning
good evening
good 9t

D:\>java com.sravya.client.TestClient2
good morning
good evening
good night from helper class
```

Real time usage of packages:-

Message.java:-

```
package com.dss.declarations;
public interface Message
{       void msg1();
        void msg2();
}
```

BusinessLogic.java:-

```
package com.dss.businesslogics;
import com.dss.declarations.Message;
public class  BusinessLogic implements Message
{       public void msg1(){System.out.println("i like you");}
        public void msg2(){System.out.println("i miss you");}
}
```

TestClient.java:-

```
package com.dss.client;
import com.dss.businesslogics.BusinessLogic;
class  TestClient
{       public static void main(String[] args)
        {       BusinessLogic b = new BusinessLogic();
                b.msg1();
                b.msg2();
                Message b1 = new BusinessLogic();
                b1.msg1();
                b1.msg2();
        }
}
```

Interfaces vs. inheritance :-

Example :-

interface it1 ***//it contains 2 methodsm1() & m2()***
{ public abstract void m1();
public abstract void m2();
}
interface it2 extends it1 ***// it contains 4 methods m1() & m2() & m3() & m4()***
{ public abstract void m3();
public abstract void m4();
}
interface it3 extends it2 ***// it contains 6 methods m1() & m2() & m3() & m4() & m5() & m6***
{ public abstract void m5();
public abstract void m6();
}
interface it4 extends it3 ***// it contains 7 methods m1() & m2() & m3() & m4() & m5() & m6 & m7()***
{ public abstract void m7();
}

Case 1:
class Test implements it1
{ provide the implementation of 2 methods ***m1() & m2()***
};

Case 2:
class Test implements it2
{ provide the implementation of 4 methods ***m1() & m2() & m3() & m4()***
};

Case 3:-
class Test implements it3
{ provide the implementation of 6 methods ***m1() & m2() & m3() & m4() & m5() & m6()***
};

Case 4:-
class Test implements it4
{ provide the implementation of 7 methods ***m1() & m2() & m3() & m4() & m5() & m6() & m7()***
};

Case 6:-
class Test implements it1,it2 ***//one class is able to implements multiple interfaces***
{ provide the implementation of 4 methods ***m1() & m2() & m3() & m4()***
};

Case 7:-
class Test implements it1,it3
{ provide the implementation of 6 methods ***m1() & m2() & m3() & m4() & m5() & m6***
};

Case 8:-
class Test implements it2,it3
{ provide the implementation of 6 methods ***m1() & m2() & m3() & m4() & m5() & m6***
};

Case 9:-
class Test implements it2,it4
{ provide the implementation of 7 methods ***m1() & m2() & m3() & m4() & m5() & m6 & m7()***

};

Case 10:-

class Test implements it1,it2,it3

{ provide the implementation of 6 methods ***m1() & m2() & m3() & m4() & m5() & m6***

};

Case 11:-

class Test implements it1,it2,it3,it4

{ provide the implementation of 7 methods ***m1() & m2() & m3() & m4() & m5() & m6 & m7()***

};

Nested interfaces:-

Example :- declaring interface inside the class is called nested interface.

```
class A
{       interface it1   //nested interface declared in A class
        {       void add();     }
};
class Test  implements  A.it1
{       public void add()
        {       System.out.println("add method");
        }
        public static void main(String[] args)
        {       Test   t=new Test();     t.add();
        }
};
```

Example :- it is possible to declare interfaces inside abstract class also.

```
abstract class A
{       abstract void m1();
        interface it1   //nested interface declared in A class
        {       void m2();      }
};
class Test  implements  A.it1
{       public void m1()
        {       System.out.println("m1 method");
        }
        public void m2()
        {       System.out.println("m2 method");
        }
        public static void main(String[] args)
        {       Test t=new Test();
                t.m1();   t.m2();
        }
};
```

Ex:- declaring interface inside the another interface is called nested interface.

```
interface it2
{       void m1();
        interface it1
        {       void m2();      }
};
class Test2 implements it2.it1
```

```
{       public void m1()
        {       System.out.println("m1 method");        }
        public void m2()
        {       System.out.println("m2 method");        }
        public static void main(String[] args)
        {       Test2 t=new Test2();
                t.m1();  t.m2();
        }
};
```

Marker interface :-

- An interface that has no members (methods and variables) is known as marker interface or tagged interface or ability interface.
- In java whenever our class is implementing marker interface our class is getting some capabilities that are power of marker interface. We will discuss marker interfaces in detail in later classes.

Ex:- serializable , Cloneable , RandomAccess…etc

Note: - user defined empty interfaces are not a marker interfaces only, predefined empty interfaces are marker interfaces.

Possibility of extends & implements keywords:-

class extends class
interface extends interface
class implements interface

class A extends B **--->valid**
class A extends B,C **--->Invalid**
class A extends A **--->Invalid**
class A implements It **--->valid**
class A implements It1,It2 **--->valid**
class A extends It **--->Invalid**

interface It1 extends It2 **--->valid**
interface It1 extends It2,It3 **--->valid**
interface It1 extends A **--->invalid**
interface It1 implements It2 **--->invalid**
interface It1 extends It1 **--->invalid**

class A extends B implements It1,It2 **--->valid [extends first]**
class A implements It1,It2 extends B **--->Invalid**

Source file Declaration rules:-

The source file contains the fallowing elements

1) Package declaration---→optional-----→at most one package(0 or 1)--→1st statement
2) Import declaration-----→optional-----→any number of imports--------→2nd statement
3) Class declaration--------→optional-----→any number of classes---------→3rd statement
4) Interface declaration---→optional----→any number of interfaces-----→3rd statement
5) Comments declaration-→optional----→any number of comments----→3rd statement

a. The package must be the first statement of the source file and it is possible to declare at most one package within the source file .
b. The import session must be in between the package and class statement. And it is possible to declare any number of import statements within the source file.
c. The class session is must be after package and import statement and it is possible to declare any number of class within the source file.
    i. It is possible to declare at most one public class.
    ii. It is possible to declare any number of non-public classes.
d. The package and import statements are applicable for all the classes present in the source file.
e. It is possible to declare comments at beginning and ending of any line of declaration it is possible to declare any number of comments within the source file.

Adaptor class:-

It is a intermediate class between the interface and user defined class. And it contains empty implementation of interface methods.

Example:-

```
interface It                // interface
{       void m1():
        void m2();
        ;;;;;;;;
        void m100();
}
class X implements It       //adaptor class
{       public void m1(){}
        public void m2(){}
        ;;;;;;;;
        public void m100{}
};
//user defined class implementing interface
class Test implements It
{       must provide 100 methods impl
};
//user defined class extending Adaptor class(X)
class Test extends X
{ override required methods because already X contins empty implementions
};
```

Adaptor class realtime usage:-

Message.java:- ***interface***

```
package com.dss.declarations;
public interface Message
{       void morn();    // by default public abstarct
        void eve();
        void night();
}
```

HelperAdaptor.java:- ***Adaptor class***

```
package com.dss.helper;
import com.dss.declarations.Message;
public class  HelperAdaptor implements Message
{	public void night(){}
	public void eve(){}
	public void morn(){}
}
```

GoodStudent.java:-

```
package com.dss.bl;
import com.dss.declarations.Message;
public class  GoodStudent implements Message
{	public void morn(){System.out.println("good morning ratan");}
	public void eve(){System.out.println("good evening ratan");}
	public void night(){System.out.println("good nightratan");}
}
```

TestClient.java:-

```
package com.dss.client;
import com.dss.bl.GoodStudent;
import com.dss.bl.Student;
class TestClient
{	public static void main(String[] args)
	{	GoodStudent s = new GoodStudent();
		s.eve();s.morn();s.night();

		Student s1 = new Student();
		s1.morn();
	}
}
```

```
com
 |-->dss
        |--->declarations
        |       |-->Message.class
        |-->helper
        |       |--->HelperAdaptor.class
        |-->bl
        |    |-->GoodStudent.class
        |    |-->Student.class
        |-->client
                |-->TestClient.class
```

Example :-

Demo.java

```
package a;
public interface Demo
{         public void sayHello(String msg);
}
```

ImplClass:-

```
package a;
class Test implements Demo
{         public void sayHello(String msg) //overriding method of Demo interface
          {         System.out.println("hi ratan--->"+msg);
          }
};
public class ImplClass
{         public Test objectcreation()   //it returns Test class Object
          {         Test t = new Test();
                    return t;
          }
}
```

Client.java

```
import a.ImplClass;
import a.Demo;
class Client
{         public static void main(String[] args)
          {         ImplClass i = new ImplClass();
                    Demo d = i.objectcreation();
                     //it returns Object of class Test but we don't  know internally which object is created
                    d.sayHello("hello");
          }
}
```

String manipulations

1) ***Java.lang.String***
2) ***Java.lang.StringBuffer***
3) ***Java.lang.StringBuilder***
4) ***Java.util.StringTokenizer***

Java.lang.String:-

String is used to represent group of characters or character array enclosed with in the double quotes.

```
class Test
{       public static void main(String[] args)
        {       String str="ratan";
                System.out.println(str);

                String str1=new String("ratan");
                System.out.println(str1);

                char[] ch={'r','a','t','a','n'};
                String str3=new String(ch);
                System.out.println(str3);

                char[] ch1={'a','r','a','t','a','n','a'};
                String str4=new String(ch1,1,5);
                System.out.println(str4);

                byte[] b={65,66,67,68,69,70};
                String str5=new String(b);
                System.out.println(str5);

                byte[] b1={65,66,67,68,69,70};
                String str6=new String(b1,2,4);
                System.out.println(str6);
        }
}
```

Case 1:- String vs StringBuffe

*String & StringBuffer both classes are final classes present in **java.lang** package.*

Case 2:-String vs StringBuffer

We are able to create String object in two ways.

1) *Without using new operator* ***String str="ratan";***
2) *By using new operator* ***String str = new String("ratan");***

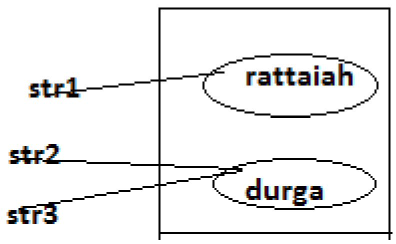
We are able to create StringBuffer object only one approach by using new operator.

StringBuffer sb = new StringBuffer("sravyainfotech");

Creating a string object without using new operator :-

- When we create String object without using new operator the objects are created in SCP (String constant pool) area.

- String str1="rattaiah" ;
  String str2="Sravya";
  String str3="Sravya";



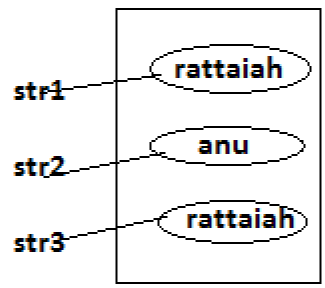
SCP area

- When we create object without using new operator then just before object creation it is always checking previous objects.
  - If the previous object is available with the same content then it won't create new object that reference variable pointing to existing object.
  - If the previous objects are not available then JVM will create new object.
- SCP area does not allow duplicate objects.

Creating a string object by using new operator

- Whenever we are creating String object by using new operator the object created in heap area.

- String str1=new String("rattaiah");
  String str2 = new String("anu");
  String str3 = new String("rattaiah");



Heap area

- When we create object in Heap area instead of checking previous objects it directly creates objects.

- Heap memory allows duplicate objects.

Example:-

```
class Test
{	public static void main(String[] args)
	{	//two approaches to create a String object
		String str1 = "ratan";
		System.out.println(str1);
		String str2 = new String("anu");
		System.out.println(str2);

		//one approach to create StringBuffer Object (by using new operator)
		StringBuffer sb = new StringBuffer("ratansoft");
		System.out.println(sb);
	}
}
```

== *operator :-*

- *It is comparing reference type and it returns Boolean value as a return value.*
- *If two reference variables are pointing to same object then it returns true otherwise false.*

Example:-

```
class Test
{       public static void main(String[] args)
        {       Test t1 = new Test();
                Test t2 = new Test();
                Test t3 = t1;
                System.out.println(t1==t2);     //false
                System.out.println(t1==t3);     //true

                String str1="ratan";
                String str2="ratan";
                System.out.println(str1==str2); //true

                String s1 = new String("anu");
                String s2 = new String("anu");
                System.out.println(s1==s2);     //false

                StringBuffer sb1 = new StringBuffer("sravya");
                StringBuffer sb2 = new StringBuffer("sravya");
                System.out.println(sb1==sb2);   //flase
        }
}
```

Case : ***toString()***

- *toString( ) method present in object class it returns a string representation of object**(class-name@hashcode)**.*
- *String is child class of Object and it is overriding toString() to return content of the String object.*
- *StringBuffer is child class of Object and it is overriding toString() to return content of the StringBuffer object.*

Note :- whenever we are printing any type of reference variable in java internally it is calling toString() method .

```
class Object
{       public java.lang.String toString()
        {       return getClass().getName() + '@' + Integer.toHexString(hashCode());    }
}
class String extends Object
{       //overriding method
        public java.lang.String toString()
        {       return  "content of String";     }
};
class StringBuffer extends Object
{       //overriding method
        public java.lang.String toString()
        {       return "content of String";      }
};
```

Example:-

```
class Test
{       public static void main(String[] args)
        {       //object class toString() executed
                Test t = new Test();
                System.out.println(t);
                System.out.println(t.toString());

                //String  class toString() executed
                String str="ratan";
                System.out.println(str);
                System.out.println(str.toString());

                //StringBuffer class toString() executed
                StringBuffer sb = new StringBuffer("anu");
                System.out.println(sb);
                System.out.println(sb.toString());
        }
};
```

In above example when we call toString() method on Test class reference type then first it will check toString() in Test class since not available it will execute Object class toString().

D:\>java Test

Test@530daa Test@530daa ratan ratan anu anu

Case 3:- immutability vs mutability

*String is **immutability** class it means once we are creating String objects it is not possible to perform modifications on existing object. (String object is fixed object)*

*StringBuffer is a **mutability** class it means once we are creating StringBuffer objects on that existing object it is possible to perform modification.*

Example :-

```
class Test
{       public static void main(String[] args)
        {       //immutability class (modifications on existing content not allowed)
                String str="ratan";
                str.concat("soft");
                System.out.println(str);    //ratan

                //mutability class (modifications on existing content possible)
                StringBuffer sb = new StringBuffer("anu");
                sb.append("soft");
                System.out.println(sb);    //anusoft
        }
}
```

Concat( ) :-

- *Concat() method is combining two String objects and it is returning new String object.*

  public java.lang.String concat(java.lang.String);

Example :-

```
class Test
{       public static void main(String[] args)
        {       String str="ratan";
                String str1 = str.concat("soft");  //concat() method return String object.
                System.out.println(str);
                System.out.println(str1);
        }
}
```

Creation of user defined immutability class:-

- ✓ *Once we create the object, it is not allowing modifications that behavior is called immutability.*
- ✓ *Java contains number of immutable classes like String,wrapper classes(Integer,Long,Float…etc).*
- ✓ *We can achieve immutability nature of the class by using fallowing properties,*

1) ***Declare the fields final & private***

   Once we declare the fields private it is not possible to access outside class & if we declare final modifications are not allowed.

2) ***Declare the class with final***

   Once we declare class with final it is not possible to create child classes it prevents method overriding in sub-classes.

3) ***Set the data by using parameterized constructor***

   Set the data to properties by using constructor but don't use setter methods because setter method meant for data change in object.

File-1:Emp.java

```
class Emp
{	private final String ename;
	Emp(String ename)
	{	this.ename=ename;
	}
	public String getName()
	{	return ename;
	}
};
```

File 2:Test.java

```
class Test
{	public static void main(String[] args)
	{	Emp e = new Emp("ratan");
		System.out.println(e.getName());
	}
}
```

In above example Emp class immutable class because,

a. *Emp class properties are final we are unable to change the value after creating object.*
b. *Emp class if final we are unable create sub-class & it is not possible to override the methods.*
c. *We are using constructor it assign the values only once.*
d. *There is no setter method hence we have no option to change the value of variable.*

Case 4:-

Internal implementation equals() method:-

- equals( ) method present in object used for reference comparison & return Boolean value.
  - If two reference variables are pointing to same object returns true otherwise false.
- String is child class of object and it is overriding equals( ) methods used for content comparison.
  - If two objects content is same then returns true otherwise false.
- StringBuffer class is child class of object and it is not overriding equals() method hence it is using parent class(Object) equals() method used for reference comparison.
  - If two reference variables are pointing to same object returns true otherwise false.

```
class Object
{   public boolean equals(java.lang.Object)
	{	// reference comparison;
	}
};
class String extends Object
{	//String class is overriding equals() method
	 public boolean equals(java.lang.Object);
	{	//content comparison;
	}
};
class StringBuffer extends Object
{	//not overriding hence it is using parent class equals() method
	//reference comparison;
};
```

Example :-

```
class  Test
{          Test(String str)   {     }
           public static void main(String[] args)
           {          Test t1 = new Test("ratan");
                      Test t2 = new Test("ratan");
                      //Object class equals() method executed (reference comparison)
                      System.out.println(t1.equals(t2));

                      String str1 = new String("Sravya");
                      String str2 = new String("Sravya");
                      //String class equals() method executed (content comparison)
                      System.out.println(str1.equals(str2));

                      StringBuffer sb1 = new StringBuffer("anu");
                      StringBuffer sb2 = new StringBuffer("anu");
                      //StringBuffer class equals() executed (reference comparison)
                      System.out.println(sb1.equals(sb2));
           }
}
```

== operator vs equals() :-

- In above example we are completed equals() method.
- == operator used to check reference variables & returns boolean ,if two reference variables are pointing to same object returns true otherwise false.

```
class  Test
{          Test(String str){}
           public static void main(String[] args)
           {          Test t1 = new Test("ratan");
                      Test t2 = new Test("ratan");
                      System.out.println(t1==t2);          //reference comparison     false
                      System.out.println(t1.equals(t2));  //reference comparison     false

                      String str1="anu";
                      String str2="anu";
                      System.out.println(str1==str2);   //reference comparison    true
                      System.out.println(str1.equals(str2));   //content comparison    true

                      String str3 = new String("Sravya");
                      String str4 = new String("Sravya");
                      System.out.println(str3==str4);              //reference comparison   false
                      System.out.println(str3.equals(str4));      //content comparison    true

                      StringBuffer sb1 = new StringBuffer("students");
                      StringBuffer sb2 = new StringBuffer("students");
                      System.out.println(sb1==sb2);                //reference comparison    false
                      System.out.println(sb1.equals(sb2));       //reference comparison    false
           }
}
```

Example :-

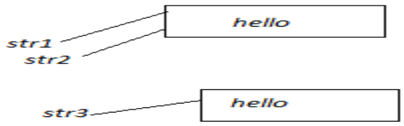
```
class Test
{	Test(String str){}
	public static void main(String[] args)
	{	Test t1 = new Test("ratan");
		Test t2 = new Test("anu");
		Test t3 = t2;
		Test t4 = new Test("ratan");
		System.out.println(t1==t2);//false
		System.out.println(t1==t3);//false
		System.out.println(t3==t2);//true
		System.out.println(t1==t4);//false
		//object class equals() executed reference comparison
		System.out.println(t1.equals(t2));//false
		System.out.println(t3.equals(t2));//true

		String str1 = "ratan";
		String str2="ratan";
		String str3=str2;
		System.out.println(str1==str2);//true
		System.out.println(str3==str2);//true
		System.out.println(str1==str3);//true
		//String class equals() executed content comparison
		System.out.println(str1.equals(str2));//true

		String s1= new String("ratan");
		String s2= new String("ratan");
		String s3=s2;
		System.out.println(s1==s2);//false
		System.out.println(s2==s3);//true
		//String class equals() executed content comparison
		System.out.println(s1.equals(s2));//true

		StringBuffer sb1 = new StringBuffer("anu");
		StringBuffer sb2 = new StringBuffer("anu");
		StringBuffer sb3 = sb1;
		System.out.println(sb1==sb2);//false
		System.out.println(sb1==sb3);//true
		//StringBuffer class equals() executed reference comparison
		System.out.println(sb1.equals(sb3));//true
	}
}
```

Example :- String identity vs String equality




```
class Test
{       public static void main(String[] args)
        {       String str1 = "hello";
                String str2 = "hello";
                String str3= new String("hello");
                //identity checking
                System.out.println(str1==str2);         //true
                System.out.println(str1==str3);         //false
                System.out.println(str1==str3);         //false
                //equality checking
                System.out.println(str1.equals(str2));  //true
                System.out.println(str1.equals(str3));  //true
                System.out.println(str2.equals(str3));  //true
        }
}
```

Java.lang.String class methods:-

1) CompareTo() & compareToIgnoreCase():-

- *By using compareTo() we are comparing two strings character by character, such type of checking is called lexicographically checking or dictionary checking.*
- *compareTo() is return type is integer and it returns three values*
  - *if the two strings are equal then it return* ***zero.***
  - *If the first string first character Unicode value is bigger than second string first character Unicode value then it return* ***+ve*** *value.*
  - *If the first string first character Unicode value is smaller than second string first character Unicode value then it return* ***+ve*** *value.*

compareTo() method comparing two string with case sensitive.

compareToIgnoreCase() method comparing two strings character by character by ignoring case.

```
class Test
{       public static void main(String... ratan)
        {       String str1="ratan";
                String str2="Sravya";
                String str3="ratan";
                System.out.println(str1.compareTo(str2));                   //14
                System.out.println(str1.compareTo(str3));                   //0
                System.out.println(str2.compareTo(str1));                   //-13
                System.out.println(“ratan”.compareTo(“RATAN”));             //+ve
                System.out.println(“ratan”.compareToIgnoreCase(“RATAN”));//0
        }
};
```

Difference between length( ) method and length variable:-

- ***length*** *variable used to find length of the Array.*
- ***length()*** *is method used to find length of the String.*

Example :-

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

String str="rattaiah";
System.out.println(str.length());            //8
```

cahrAt(int) & split() & trim():-

charAt(int):- *By using above method we are able to extract the character from particular index position.*

public char charAt(int);

Split(String):- *By using split() method we are dividing string into number of tokens.*

public java.lang.String[] split(java.lang.String);

trim():- *trim() is used to remove the trail and leading spaces this method always used for memory saver.*

public java.lang.String trim();

```
class Test
{       public static void main(String[] args)
        {       //cahrAt() method
                String str="ratan";
                System.out.println(str.charAt(1));
                //System.out.println(str.charAt(10));    StringIndexOutOfBoundsException
                char ch="ratan".charAt(2);
                System.out.println(ch);
                //split() method
                String s="hi rattaiah how r u";
                String[] str1=s.split(" ");
                for(String str2 : str1)
                {       System.out.println(str2);
                }
                //trim()
                String ss="      ratan    ";
                System.out.println(ss.length());//7
                System.out.println(ss.trim());//ratan
                System.out.println(ss.trim().length());//5
        }
}
```

replace() & toUpperCase() & toLowerCase():-

public java.lang.String replace(Stirng str,String str1):-
public java.lang.String replace(char, char);

replace() method used to replace the String or character.

public java.lang.String toLowerCase();
public java.lang.String toUpperCase();

The above methods are used to convert lower case to upper case & upper case to lower case.

Example:-

```
class Test
```

```
{       public static void main(String[] args)
        {       String str="rattaiah how r u";
                System.out.println(str.replace('a','A'));           //rAttAiAh
                System.out.println(str.replace("how","who"));    //rattaiah how r u

                String str1="Sravya software solutions";
                System.out.println(str1);
                System.out.println(str1.replace("software","hardware"));// Sravya hardware solutions

                String str="ratan HOW R U";
                System.out.println(str.toUpperCase());
                System.out.println(str.toLowerCase());
                System.out.println("RATAN".toLowerCase());
                System.out.println("soft".toUpperCase());
        }
}
```

endsWith() & startsWith() & substring():-

- ***endsWith()*** is used to find out if the string is ending with particular character/string or not.
- ***startsWith()*** used to find out the particular String starting with particular character/string or not.
  public boolean startsWith(java.lang.String);
  public boolean endsWith(java.lang.String);
- *substring() used to find substring in main String.*
  public java.lang.String substring(int); ***int = starting index***
  public java.lang.String substring(int, int); ***int=starting index to int =ending index***
  while printing substring() it includes starting index & it excludes ending index.

Example:-

```
class Test
{       public static void main(String[] args)
        {       String str="rattaiah how r u";
                System.out.println(str.endsWith("u"));          //true
                System.out.println(str.endsWith("how"));        //false
                System.out.println(str.startsWith("d"));        //false
                System.out.println(str.startsWith("r"));        //true
                String s="ratan how r u";
                System.out.println(s.substring(2));             //tan how r u
                System.out.println(s.substring(1,7));           //atan h
                System.out.println("ratansoft".substring(2,5)); //tan
        }
}
```

StringBuffer class methods:-

reverse():-

```
class Test
{       public static void main(String[] args)
        {       StringBuffer sb=new StringBuffer("rattaiah");
                System.out.println(sb);
                System.out.println(sb.delete(1,3));
```

```
        System.out.println(sb);
        System.out.println(sb.deleteCharAt(1));
        System.out.println(sb.reverse());
    }
}
```

Append():-

By using this method we can append the any values at the end of the string

Ex:-

```
class Test
{   public static void main(String[] args)
    {   StringBuffer sb=new StringBuffer("rattaiah");
        String str=" salary ";
        int a=60000;
        sb.append(str);
        sb.append(a);
        System.out.println(sb);
    }
};
```

Insert():-

By using above method we are able to insert the string any location of the existing string.

```
class Test
{   public static void main(String[] args)
    {   StringBuffer sb=new StringBuffer("ratan");
        sb.insert(0,"hi ");
        System.out.println(sb);
    }
}
```

indexOf()   and lastIndexOf():-

Ex:-

```
class Test
{   public static void main(String[] args)
    {   StringBuffer sb=new StringBuffer("hi ratan hi");
        int i;
        i=sb.indexOf("hi");
        System.out.println(i);
        i=sb.lastIndexOf("hi");
        System.out.println(i);
    }
}
```

replace():-

```
class Test
{   public static void main(String[] args)
    {   StringBuffer sb=new StringBuffer("hi ratan hi");
        sb.replace(0,2,"oy");
        System.out.println("after replaceing the string:-"+sb);
    }
}
```

Java.lang.StringBuilder:-

1) Introduced in jdk1.5 version.
2) StringBuilder is identical to StringBuffer except for one important difference.
3) Every method present in the StringBuilder is not Synchronized means that is not thread safe.
4) multiple threads are allow to operate on StringBuilder methods hence the performance of the application is increased.

Cloneable:-

1) The process of creating exactly duplicate object is called cloning.
2) We can create a duplicate object only for the cloneable classes .
3) We can create cloned object by using clone()
4) The main purpose of the cloning is to maintain backup.

```
class Test implements Cloneable
{       int a=10,b=20;
        public static void main(String[] args) throws CloneNotSupportedException
        {       Test t1 = new Test();//creates object of Test class
                Test t2 = (Test)t1.clone();//duplicate object of Test class
                System.out.println(t1.a);
                System.out.println(t1.b);
                t1.b=555;
                t1.a=444;
                System.out.println(t1.a);
                t1.b=333;
                System.out.println(t1.a);
                System.out.println(t1.b);
                //if we want initial values use duplicate object
                System.out.println(t2.a);//10
                System.out.println(t2.b);//20
        }
}
```

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	String str="hi ratan w r u wt bout anushka";
StringTokenizer st = new StringTokenizer(str);//split the string with by default (space symbol)
		while (st.hasMoreElements())
		{
			System.out.println(st.nextElement());
		}

		//used our string to split giver String
		String str1 = "hi,rata,mf,sdfsdf,ara";  StringTokenizer st1 = new
StringTokenizer(str1,",");
		while (st1.hasMoreElements())
		{
			System.out.println(st1.nextElement());
		}


	}
}
```

Wrapper classes

- *Java is an Object oriented programming language so represent everything in the form of the object, but java supports 8 primitive data types these all are not part of object.*
- *To represent 8 primitive data types in the form of object form we required 8 java classes these classes are called wrapper classes.*
- *All wrapper classes present in the **java.lang** package and these all classes are **immutable** classes.*

Wrapper classes hierarchy:-

```
                    Object
        Number      Character      Boolean
Byte  Short  Integer  Long  Float  Double
```

Wrapper classes constructors:-

Integer i = new Integer(10);
Integer i1 = new Integer("100");
Float f1= new Float(10.5);
Float f1= new Float(10.5f);
Float f1= new Float("10.5");
Character ch = new Character('a');

datatypes	***wrapper-class***	**constructors**
byte	*Byte*	*byte,String*
short	*Short*	*short,String*
int	*Integer*	*int,String*
long	*Long*	*long,String*
float	*Float*	*double,float,String*
double	*Double*	*double,String*
char	*Character*	*char*
boolean	*Boolean*	*boolean,String*

Note :- *To create wrapper objects all most all wrapper classes contain two constructors but Float contains three constructors(float,double,String) & char contains one constructor(char).*

toString():-

- *toString() method present in Object class it returns class-name@hashcode.*
- *String,StringBuffer classes are overriding toString() method it returns content of the objects.*
- *All wrapper classes overriding toString() method to return content of the wrapper class objects.*

Example :-

```
class Test
{	public static void main(String[] args)
	{	Integer i1 = new Integer(100);
		System.out.println(i1);
		System.out.println(i1.toString());

		Integer i2 = new Integer("1000");
		System.out.println(i2);
		System.out.println(i2.toString());

		Integer i3 = new Integer("ten");//java.lang.NumberFormatException
		System.out.println(i3);
	}
}
```

*In above example for the integer constructor we are passing **"1000"** value in the form of String it is automatically converted into Integer format.*
*In above example for the integer constructor we are passing **"ten"** in the form of String but this String is unable to convert into integer format it generate exception **java.lang.NumberFormatException.***

Example:- conversion of wrapper to String by using toString() method

```
class Test
{	public static void main(String[] args)
	{	Integer i1 = new Integer(100);
		Integer i2 = new Integer("1000");
		System.out.println(i1+i2);//1100
		//conversion [wrapper object - String]
		String str1 = i1.toString();
		String str2 = i2.toString();
		System.out.println(str1+str2);  //1001000
	}
}
```

Example:-

- *In java we are able to call toString() method only on reference type but not primitive type.*
- *If we are calling toString() method on primitive type then compiler generate error message.*

```
class Test
{	public static void main(String[] args)
	{	Integer i1 = Integer.valueOf(100);
		System.out.println(i1);
		System.out.println(i1.toString());

		int a=100;
		System.out.println(a);
		//System.out.println(a.toString()); error:-int cannot be dereferenced
	}
}
```

valueOf():-

in java we are able to create wrapper object in two ways.

a) By using constructor approach
b) By using valueOf() method

- ✓ valueOf() method is used to create wrapper object just it is alternate to constructor approach and it a static method present in wrapper classes.

Example:-

```
class Test
{       public static void main(String[] args)
        {       //constructor approach to create wrapper object
                Integer i1 = new Integer(100);
                System.out.println(i1);

                Integer i2 = new Integer("100");
                System.out.println(i2);

                //valueOf() method to create Wrapper object
                Integer a1 = Integer.valueOf(10);
                System.out.println(a1);

                Integer a2 = Integer.valueOf("1000");
                System.out.println(a2);
        }
}
```

Example :- conversion of primitive to String.

```
class Test
{       public static void main(String[] args)
        {       int a=100;
                int b=200;
                System.out.println(a+b);

                //primitive to String object
                String str1 = String.valueOf(a);
                String str2 = String.valueOf(b);
                System.out.println(str1+str2);
        }
}
```

XxxValue():- *it is used to convert wrapper object into correspondingprimitive value.*

Example:-

```
class Test
{	public static void main(String[] args)
	{	//valueOf() method to create Wrapper object
		Integer a1 = Integer.valueOf(10);
		System.out.println(a1);

		Integer a2 = Integer.valueOf("1000");
		System.out.println(a2);

		//xxxValue()   [wrapper object into primitive value]
		int x1 = a1.intValue();
		byte x2 = a1.byteValue();
		double x3 = a1.doubleValue();
		System.out.println("int value="+x1);
		System.out.println("byte value="+x2);
		System.out.println("double value="+x3);
	}
}
```

parseXXX():- *it is used to convert String into corresponding primitive value & it is a static method present in wrapper classes.*

Example :-

```
class Test
{	public static void main(String[] args)
	{	String str1="100";
		String str2="100";
		System.out.println(str1+str2);
		//parseXXX()  converion of String to primitive type
		int a1 = Integer.parseInt(str1);
		float a2 = Float.parseFloat(str2);
		System.out.println(a1+a2);
	}
}
```

1) ***primitive ----->Wrapper Object***
   Integer i = Integer.valueOf(100);
2) ***wrapper object ----> primitive***
   byte b = i.byteValue();
3) ***String value ----> primitive***
   String str="100";
   int a = Integer.parseInt(str);
4) ***primitive valu ----> String Object***
   int a=100;
   int b=200;
   String s1 = String.valueOf(a);
   String s2 = String.valueOf(b);

System.out.println(s1+s2);//100200

5) ***String value ---->Wrapper object***
   Integer i = Integer.valueOf("1000");
6) ***wrapper object --->String object***
   ```
   Integer i = new Integer(1000);
   String s = i.toString();
   ```

Autoboxing and Autounboxing:-(introduced in the 1.5 version)

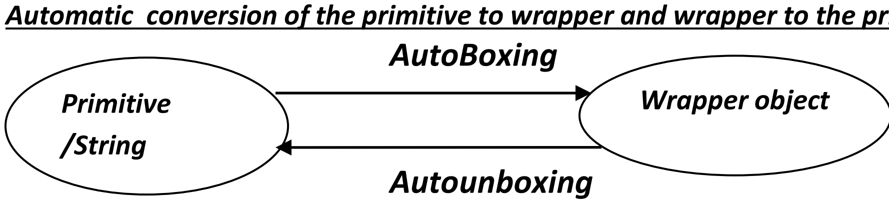
- *Up to 1.4 version to convert primitive/String into Wrapper object we are having two approaches*
  - ***Constructor approach***
  - ***valueOf() method***
- *Automatic conversion of primitive to wrapper object is called autoboxing.*
- *Automatic conversion of wrapper object to primitive is called autounboxing.*

Example:-

```
class Test
{	public static void main(String[] args)
	{	//autoboxing    [primitive - wrapper object]
		Integer i = 100;
		System.out.println(i);
		System.out.println(i.toString());

		//autounboxing [wrapper object - primitive]
		int a = new Integer(100);
		System.out.println(a);
	}
}
```

Automatic conversion of the primitive to wrapper and wrapper to the primitive:-



Example :-

```
class Test
{	public static void main(String[] args)
	{	System.out.println("information about byte data type");
		System.out.println("byte size="+Byte.SIZE);
		System.out.println("byte min value="+Byte.MIN_VALUE);
		System.out.println("byte max value="+Byte.MAX_VALUE);

		System.out.println("information about int data type");
		System.out.println("int size="+Integer.SIZE);
		System.out.println("int min value="+Integer.MIN_VALUE);
		System.out.println("int max value="+Integer.MAX_VALUE);
	}
};
```

Factory method:-

- One java class method returns same class object or different class object is called factory method.
- There are three types of factory methods in java.
  - ***Instance factory method.***
  - ***Static factory method.***
  - ***Pattern factory method.***
- The factory is called by using class name is called static factory method.
- The factory is called by using reference variable is called instance factory method.
- One java class method is returning different class object is called pattern factory method.

Example:-

```
class Test
{	public static void main(String[] args)
	{	//static factory method
		Integer i = Integer.valueOf(100);
		System.out.println(i);

		Runtime r = Runtime.getRuntime();
		System.out.println(r);

		//instance factory method
		String str="ratan";
		String str1 = str.concat("soft");
		System.out.println(str1);

		String s1="sravyainfotech";
		String s2 = s1.substring(0,6);
		System.out.println(s2);

		//pattren factory method
		Integer a1 = Integer.valueOf(100);
		String ss = a1.toString();
		System.out.println(ss);

		StringBuffer sb = new StringBuffer("ratan");
		String sss = sb.toString();
		System.out.println(sss);
	}
}
```

Java .io package

- ✓ This lesson covers java classes used for basic I/O operations. It focuses on I/O streams.
- ✓ The classes covered in I/O stream present in **java.io** package.
- ✓ Most of the classes covered in file I/O are present **java.nio.file** package.

I/O Streams:-

- *Byte Streams handle I/O of raw binary data.*
- *Character Streams handle I/O of character data, automatically handling translation to and from the local character set.*
- *Buffered Streams optimize input and output by reducing the number of calls to the native API.*
- *Scanning and Formatting allows a program to read and write formatted text.*
- *I/O from the Command Line describes the Standard Streams and the Console object.*
- *Data Streams handle binary I/O of primitive data type and String values.*
- *Object Streams handle binary I/O of objects.*

I/O Streams:-

An I/O stream represents input source or an output destination. A stream represent many kind of source and destination like disk files & devices & memory arrays.

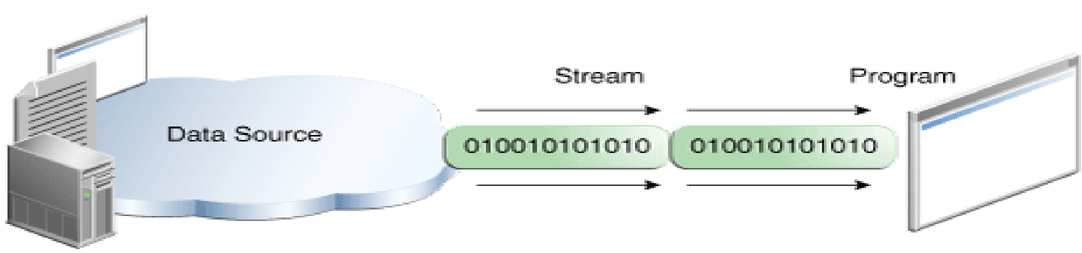
Streams support different kind of data

- *Simple bytes.*
- *Primitive data types*
- *Localized characters*
- *Objects …..etc*

Stream is a communication channel between source and destination & A stream is a sequence of data.

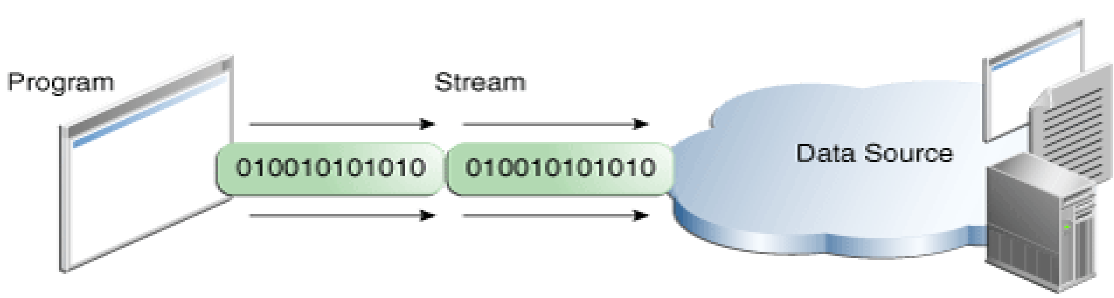
Input stream:-

Program uses Input stream to read the data from a source one item at a time.



Output stream:-

Program uses output stream to write the data to a destination one item at a time.



Byte streams:-

Program uses byte stream to perform input & output of byte data. All byte stream classes developed based on InputStream & OutputStream.

To demonstrate how the byte stream works file I/O provided two main classes

- ✓ *FileInputStream*
  - *It is used to read the data from source one item at a time.*
  - *To read the data from source use read() method of FileInputStream class.*

    public int read() throws java.io.IOException;

    read() method returns first character Unicode value in the form of integer value.

- ✓ *FileOutputStream*
  - *It is used to write the data to destination one item at a time.*
  - *To write the data to destination use write() method of FileOutputStream class.*

    public void write(int unicode) throws java.io.IOException;

    write() method is taking Unicode value of the character as a parameter.

Steps to design application:-

Step1 :- create the channel.
Step 2:- read the data from source file.
Step 3:- store the data in some variable temporarily.
Step 4:- check the stream is ended or data (data flow completed or not).
Step 5:- write the data to destination.
Step 6:- close the streams.

Example :-

```
import java.io.*;
class Test
{	public static void main(String[] args)throws FileNotFoundException,IOException
	{	//Byte oriented channel creation
		FileInputStream fis = new FileInputStream("abc.txt");
		FileOutputStream fos = new FileOutputStream("xyz.txt");
		int c;
		while((c=fis.read())!=-1)
		{	System.out.print((char)c);
			fos.write(c);
		}
		System.out.println("read() & write operatoins are completed");
		//stream closing operations
		fis.close();
		fos.close();
	}
}
```

While working with streams we will get two exceptions mainly FileNotFoundException , IOException & these two exceptions are checked exceptions so must handle these exception by using try-catch blocks or throws keyword.

Character streams:-

Program uses character stream to perform input & output of character data. All character stream classes developed based on Reader & Writer classes.

To demonstrate how the character stream works file I/O provided two main classes

- ✓ *FileReader*
  - *It is used to read the data from source one item at a time.*
  - *To read the data from source use read() method of FileInputStream class.*

    public int read() throws java.io.IOException;

    read() method returns first character Unicode value in the form of integer value.

- ✓ *FileWriter*
  - *It is used to write the data to destination one item at a time.*
  - *To write the data to destination use write() method of FileOutputStream class.*

    public void write(int unicode) throws java.io.IOException;

    write() method is taking Unicode value of the character as a parameter.

Example :-

```
import java.io.FileReader;
import java.io.FileWriter;
import java.io.IOException;
public class Test
{   public static void main(String[] args) throws IOException
        {   FileReader inputStream = null;
       FileWriter outputStream = null;
       try {
          inputStream = new FileReader("abc.txt");
          outputStream = new FileWriter("characteroutput.txt");

          int c;
          while ((c = inputStream.read()) != -1)
            {   outputStream.write(c);
            }
            }
                              finally
                              {         if (inputStream != null)
                                        {           inputStream.close();
                                        }
                                        if (outputStream != null)
                                        {         outputStream.close();
                                        }
                              }
   }
}
```

Note : In CopyCharacters, the int variable holds a character value in its last 16 bits; in CopyBytes, the int variable holds a byte value in its last 8 bits.

Line oriented I/O:-

In above two streams(byte & character) it is possible to read only one item at time it increases number of read & write operations hence the performance is decreased.

To overcome above limitation to improve performance of the application instead of reading the data item by item, read the data line-by-line format to improve the performance.

To perform line oriented operations use two classes.

- ✓ **BufferedReader**
  - *It is used to read the data from source file in line by line format.*
  - *To read the data use readLine() method of BufferedReader class .*

    public java.lang.String readLine() throws java.io.IOException;

    The readLine() method returns first line of the text file in the form of String.
- ✓ **PrintWriter**
  - *It is used to write the data to destination file in line by line format.*
  - *To write the data to file use println() method of PrintWriter class.*

    public void println(java.lang.String);

    The above method used to write the data to destination file.

Example :-

```
import java.io.FileReader;
import java.io.FileWriter;
import java.io.BufferedReader;
import java.io.PrintWriter;
import java.io.IOException;

public class CopyLines {
  public static void main(String[] args) throws IOException {
    BufferedReader inputStream = null;
    PrintWriter outputStream = null;
    try {
      inputStream = new BufferedReader(new FileReader("ratan.txt"));
      outputStream = new PrintWriter(new FileWriter("characteroutput.txt"));
      String l;
      while ((l = inputStream.readLine()) != null) {
        outputStream.println(l);
      }
    }
        finally {
      if (inputStream != null) {
        inputStream.close();
      }
      if (outputStream != null) {
        outputStream.close();
      }
    }
  }
}
```

Buffered Streams:-

- ✓ *In previous examples we are using un-buffered I/O .This means each read and write request is handled directly by the underlying OS.*
- ✓ *In normal streams each request directly triggers disk access it is relatively expensive & performance is degraded.*

To overcome above limitations use buffered streams.

- ➢ *Bufferd input stream read the data from buffered memory and it interacting with hard disk only when buffered memory is empty.*
- ➢ *Buffered output stream write the data to buffer memory.*

There are four buffered stream classes.

Buffered byte streams,

1. *BufferedInputStream*
2. *BufferedOutputStream*

A program can convert an un buffered stream into buffered streams.

```
new BufferedInputStream(new FileInputStream("xanadu.txt"));
new BufferedOutputStream(new FileOutputSream("byteoutput.txt"));
```

Buffered Character streams,

3. *BufferedReader*
4. *BufferedWriter*

A program can convert an un buffered stream into buffered streams.

```
new BufferedReader(new FileReader("ratan.txt"));
new BufferedWriter(new FileWriter("characteroutput.txt"));
```

Example:-

```
import java.io.*;
class Test
{       public static void main(String[] args)
        {       BufferedReader br;
                BufferedWriter bw;
                try{
                br=new BufferedReader(new FileReader("Test1.java"));
                bw=new BufferedWriter(new FileWriter("States.java"));
                String str;
                while ((str=br.readLine())!=null)
                {       bw.write(str);
                }
                br.close();
                bw.close();
                }
                catch(Exception e)
                {       System.out.println("getting Exception");
                }
        }
}
```

Example:-

```
import java.io.*;
class Test
{	public static void main(String[] args)
	{	 BufferedInputStream bis;
		 BufferedOutputStream bos;
		try{
		bis=new BufferedInputStream(new FileInputStream("abc.txt"));
		bos=new BufferedOutputStream(new FileOutputStream("xyz.txt"));
		int str;
		while ((str=bis.read())!=-1)
		{	bos.write(str);
		}
		bis.close();
		bos.close();
		}
		catch(Exception e)
		{	System.out.println(e);
			System.out.println("getting Exception");
		}
	}
}
```

Serialization:-

The process of saving an object to a file (or) the process of sending an object across the network is called serialization.

But strictly speaking the process of converting the object from java supported form to the network supported form of file supported form.

To do the serialization we required fallowing classes

1. FileOutputStream
2. ObjectOutputStream

Deserialization:-

The process of reading the object from file supported form or network supported form to the java supported form is called deserialization.

We can achieve the deserialization by using fallowing classes.

1. FileInputStream
2. ObjectInputStream

```
import java.io.*;
class Emp implements Serializable
{	int eid;
	String ename;
	Emp(int eid,String ename)
	{this.eid=eid;
	 this.ename=ename;
	}
	public static void main(String[] args)throws Exception
```

```
            {
Emp e = new Emp(111,"ratan");

//serialization [write the object to file]
FileOutputStream fos = new FileOutputStream("xxxx.txt");
ObjectOutputStream oos = new ObjectOutputStream(fos);
oos.writeObject(e);
System.out.println("serialization completed");

//deserialization  [read object form text file]
FileInputStream fis = new FileInputStream("xxxx.txt");
ObjectInputStream ois = new ObjectInputStream(fis);
Emp e1 = (Emp)ois.readObject();//returns Object
System.out.println(e1.eid+"----"+e1.ename);
System.out.println("de serialization completed");
            }
}
```

Transient Modifiers

- Transient modifier is the modifier applicable for only variables and we can't apply for methods and classes.
- At the time of serialization, if we don't want to save the values of a particular variable to meet security constraints then we should go for transient modifier.
- At the time of serialization JVM ignores the original value of transient variable and default value will be serialized

```
import java.io.*;
class Emp implements Serializable
{           transient int eid;
            transient String ename;
}
0----null
```

Exception Handling

introduction:-

- *Dictionary meaning of the exception is abnormal termination.*
- ***An exception is an event that occurs during execution of the program, that disturb normal flow of the program instructions.***
- *If the application contains exception then the program terminated abnormally then the rest of the application is not executed.*

To overcome above limitation in order to execute the rest of the application & to get normal termination of the application must handle the exception.

In java we are having two approaches to handle the exceptions.

1) ***By using try-catch block.***
2) ***By using throws keyword.***

Exception Handling:-

- ✓ *The main objective of exception handling is to get normal termination of the application in order to execute rest of the application code.*
- ✓ *Exception handling means just we are providing alternate code to continue the execution of remaining code & to get normal termination of the application.*

Every Exception is a predefined class present in different packages.

java.lang.ArithmeticException
java.io.IOException
java.sql.SQLException
javax.servlet.ServletException ……etc

The exception are occurred due to several reasons

a. *Developer mistakes*
b. *End-user mistakes.*
    i. *While providing inputs to the application.*
    ii. *Whenever user is entered invalid data then Exception is occur.*
    iii. *A file that needs to be opened can't found then Exception is occurred.*
    iv. *Exception is occurred when the network has disconnected at the middle of the communication……..etc*

Types of Exceptions:-

As per the sun micro systems standards The Exceptions are divided into three types

1) ***Checked Exception***
2) ***Unchecked Exception***
3) ***Error***

Checked Exception:-

- ✓ *The Exceptions which are checked by the compiler at the time of compilation is called Checked Exceptions.*

  Examples:- IOException,SQLException,InterruptedException,ClassNotFoundException……..etc
- ✓ *If the application contains checked Exception the compiler is able to check it and it will give intimation to developer regarding Exception in the form of compilation error.*
- ✓ *Handle the checked Exception in two ways*
  - *By using try-catch block.*
  - *By using throws keyword.*

There are two types of predefined methods

- ✓ Exceptional methods

  public static native void sleep(long) ***throws java.lang.InterruptedException***
  public boolean createNewFile() ***throws java.io.IOException***
  public static Class forName(String str) throws ***ClassNotFoundException***
- ✓ Normal methods

  public long length();
  public java.lang.String toString();

In our application whenever we are using exceptional methods the code is not compiled because these methods throws checked exception hence must handle the exception by using try-catch or throws keywords. And no need to remember the methods just use the method compile it then compiler is saying exception information handle it.

Note: - If application contains checked Exception then compile time just compiler is displays exception information for handling ***but the exception raised at runtime*** *if the required resources are not available.*

Checked Exception scenario:-

1) ***java.lang.InterruptedException***

   When we used ***Thread.sleep(2000);*** *your thread is entered into sleeping mode then other threads are able to interrupt the program is terminated abnormally & rest of the application is not executed.*

   To overcome above problem compile time compiler is checking that exception & displaying exception information in the form of compilation error.

   Based on compiler generated error message write the try-catch blocks or throws , if runtime any exception raised the try-catch or throws keyword executed program is terminated normally.
2) ***Java.io.FileNotFoundException***

   If we are trying to read the file from local disk but at runtime if the file is not available program is terminated abnormally rest of the application is not executed.

   To overcome above problem compile time compiler is checking that exception & displaying exception information in the form of compilation error.

   Based on compiler generated error message write the try-catch blocks or throws , if runtime any exception raised the try-catch or throws keyword executed program is terminated normally.
3) ***Java.sql.SQLException***

   If we are trying to connect to data base but at runtime data base is not available program is terminated abnormally rest of the application is not executed.

Note: In above scenarios compile time compiler is display just exception information but exception raised at runtime.

Unchecked Exception:-

- *The exceptions which are not checked by the compiler at the time of compilation are called unchecked Exception.*
  ArithmeticException,ArrayIndexOutOfBoundsException,NumberFormatException….etc
- *If the application contains un-checked Exception code is compiled but at runtime JVM (Default Exception handler) display exception message then program terminated abnormally.*
- *To overcome runtime problem must handle the exception in two ways.*
  - *By using try-catch blocks.*
  - *By using throws keyword.*

Note-1:-

Whether it is a checked Exception or unchecked exception exceptions are raised at runtime but not compile time.

Note 2:-

In java whether it is a checked Exception or unchecked Exception must handle the Exception by using try-catch blocks or throws keyword to get normal termination of application & to execute rest of the application.

Note 3:-

For the checked exception when we write try-catch blocks or throws keyword then only code is compiled but for un-checked exceptions try-catch or throws keyword optional.

Error:-

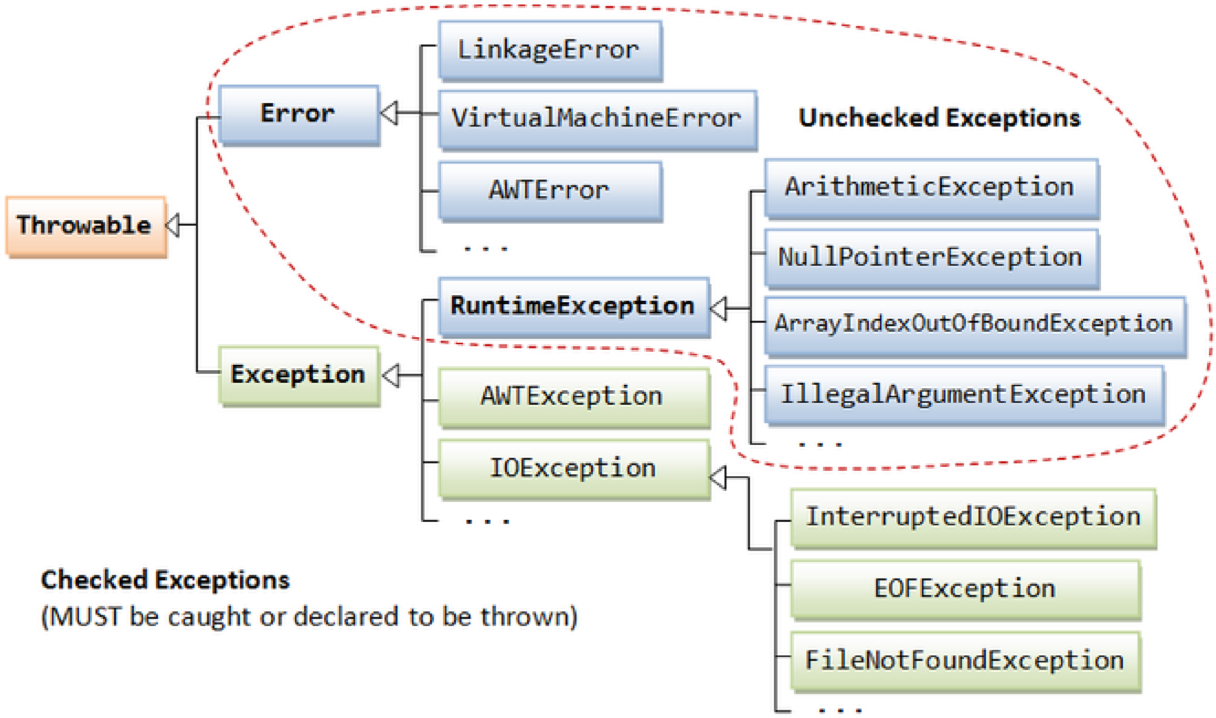
- ✓ *Exceptions are caused to several reasons like developer mistakes, end user input mistakes , network problems.*
  But error is caused due to lack of system resources.
  Heap memory full, Stack memory problem, AWT component problems…..etc
  Example: - StackOverFlowError, OutOfMemoryError, AssertionError…………etc
- ✓ *We are handle the exceptions by using try-catch blocks or throws keyword but it is not possible to handle the errors.*
- ✓ *Error is a un-checked type exception.*

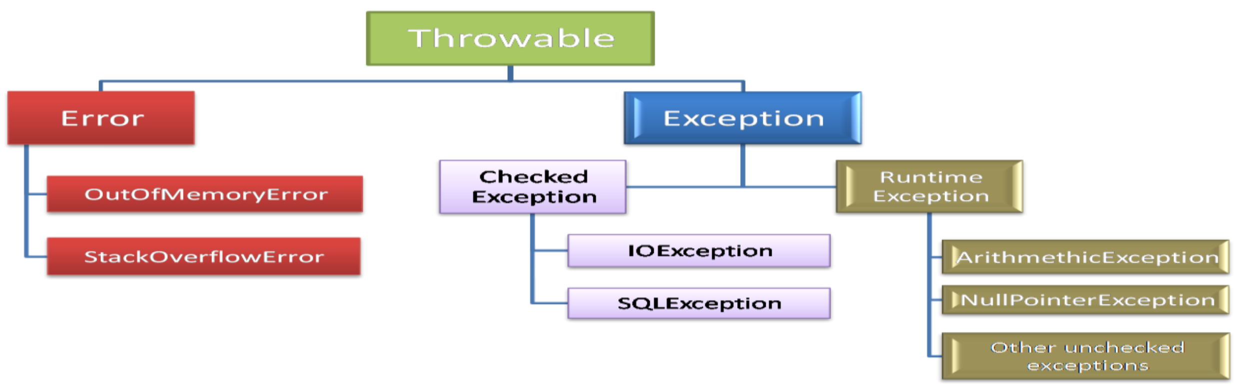
Example:-

```
class Test
{	public static void main(String[] args)
	{	Test[] t = new Test[100000000];
	}
};
```

Exception in thread "main" java.lang.OutOfMemoryError: Java heap space

Exception Handling Tree Structure:-





- ✓ *In above tree Structure RuntimeException its child classes & Error its child classes are Unchecked remaining all exceptions are checked Exceptions.*
- ✓ *The root class of exception handling is **Throwable** class.*
- ✓ *The root class & all its child class are checked then that root class is called **fully checked exception.***
  Example :- IOException,SQLException….etc
- ✓ *The root class contains some class are checked exceptions & some classes are un-checked exception then that root class is called partially checked exception.*
  Example :- Exception , Throwable..etc

Exception handling key words:-

1) *try*
2) *catch*
3) *finally*
4) *throw*
5) *throws*

<u>Exception handling by using Try –catch blocks:-</u>

Syntax:-
```
try
{     exceptional code;
}
catch (ExceptionName  reference_variable)
{    Code to run if an exception is raised (alternate code);
}
```

Example-1 :-

<u>Application without try-catch blocks</u>

```
class Test
{       public static void main(String[] args)
        {       System.out.println("ratan");
                System.out.println(10/0);
                System.out.println("rest of the application");
        }
}
E:\>java Test
ratan
```

Exception in Thread “main” java.lang.ArithmeticException: / by zero

Handled by JVM   type of the Exception   description

In above example exception raised program is terminated abnormally & rest of the application is not executed

<u>Application with try-catch blocks:-</u>

Whenever the exception is raised in the try block JVM won’t terminate the program immediately it will search corresponding catch block.

a. If the catch block is matched then that block will be executed & rest of the application executed & program is terminated normally.

b. If the catch block is not matched program is terminated abnormally.

```
class Test
{       public static void main(String[] args)
        {       System.out.println("ratan");
                try
                {       System.out.println(10/0);
                }
                catch (ArithmeticException ae)
                {       System.out.println(10/2);
                }
                System.out.println("rest of the application");
        }
}
E:\>java Test
ratan
5
rest of the application
```

In above example we are handling exception by using try-catch block hence the program is terminated normally & rest of the application is executed.

Example-2 :-

Whenever the exception is raised in the try block JVM won't terminate the program immediately it will search corresponding catch block.

a. If the catch block is matched then that block will be executed & rest of the application executed & program is terminated normally.
b. If the catch block is not matched program is terminated abnormally.

In below example catch block is not matched hence program is terminated abnormally.

```
class Test
{	public static void main(String[] args)
	{	try
		{	System.out.println("sravya");
			System.out.println(10/0);
		}
		catch(NullPointerException e)
		{	System.out.println(10/2);
		}
		System.out.println("rest of the app");
	}
}
```

```
E:\sravya>java Test
sravya
Exception in thread "main" java.lang.ArithmeticException: / by zero
```

Example 3:- *If there is no exception in try block the corresponding catch blocks are not checked.*

```
class Test
{	public static void main(String[] args)
	{	try
		{	System.out.println("sravya");
			System.out.println("anu");
		}
		catch(NullPointerException e)
		{	System.out.println(10/2);
		}
		System.out.println("rest of the app");
	}
}
```

```
E:\sravya>java Test
sravya
anu
rest of the app
```

Example 4:-

*In Exception handling independent try blocks declaration are not allowed must declare **try-catch** or **try- finally** or **try-catch-finally.***

```
class Test
{	public static void main(String[] args)
	{	try
		{	System.out.println("sravya");
			System.out.println("anu");
		}
		System.out.println("rest of the app");
	}
}
```

E:\sravya>javac Test.java
Test.java:4: 'try' without 'catch' or 'finally'

Example 5:-

- ✓ *In between try-catch blocks it is not possible to declare any statements , if we are declaring statements compiler will generate error message.*
- ✓ *In exception handling must declare try with immediate catch block.*

```
class Test
{	public static void main(String[] args)
	{	try
		{	System.out.println("sravya");
			System.out.println(10/0);
		}
		System.out.println("anu");
		catch(ArithmeticException e)
		{	System.out.println(10/2);
		}
		System.out.println("rest of the app");
	}
}
```

Example 6:-

If the exception raised in try block jvm will search corresponding catch block but if the exception raised other than try-catch blocks it is always abnormal termination.

In below example exception raised in catch block hence program is terminated abnormally.

```
class Test
{	public static void main(String[] args)
	{	try
		{	System.out.println("sravya");
			System.out.println(10/0);
		}
		catch(ArithmeticException e)
		{	System.out.println(10/0);
		}
		System.out.println("rest of the app");
	}
}
```

Example 7:-

- *If the exception raised in try block the remaining code of try block is not executed.*
- *Once the control is out of the try block the control never entered into try block once again.*
- *Don't take normal code inside try block because no guarantee all statements in try-block executed or not.*

```
class Test
{	public static void main(String[] args)
	{	try
		{	System.out.println(10/0);
			System.out.println("sravya");
			System.out.println("ratan");
		}
		catch(ArithmeticException e)
		{	System.out.println(10/2);
		}
		System.out.println("rest of the app");
	}
}
```

E:\sravya>java Test
5
rest of the app

Example 8:-

The way of handling the exception is varied from exception to the exception hence it is recommended to provide try with multiple number of catch blocks.

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	Scanner s=new Scanner(System.in);	//Scanner object used to take dynamic input
		System.out.println("provide the division value");
		int n=s.nextInt();
		try
		{	System.out.println(10/n);
			System.out.println("ratan".charAt(10));
		}
		catch (ArithmeticException ae)
		{	System.out.println("good boys");
		}
		catch (StringIndexOutOfBoundsException  se)
		{	System.out.println("good girls");
		}
		System.out.println("rest of the code");
	}
}
```

Output:- provide the division value: 5
Write the output

Output:- provide the division value: 0
Write the output

Example 9:- *By using **Exception** class catch block it is possible to hold any type of exceptions.*

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	Scanner s=new Scanner(System.in);	//Scanner object used to take dynamic input
		System.out.println("provide the division value");
		int n=s.nextInt();
		try
		{	System.out.println(10/n);
			System.out.println("ratan".charAt(10));
		}
		catch (Exception ae)
		{	System.out.println("good boys");
		}
		System.out.println("rest of the code");
	}
}
```

Output:- provide the division value: 5
Write the output

Output:- provide the division value: 0
Write the output

Example 10:-

*When we declare multiple catch blocks then the catch block order must be **child-parent** but if we are declaring parent to child compiler will generate error message.*

No compilation error

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	Scanner s=new Scanner(System.in);
		System.out.println("provide the division val");
		int n=s.nextInt();
		try
		{	System.out.println(10/n);
			String str=null;
			System.out.println(str.length());
		}
		//catch block order is child to parent
		catch (ArithmeticException ae)
		{	System.out.println("Exception"+ae);
		}
		catch (Exception ne)
		{	System.out.println("Exception"+ne);
		}
		System.out.println("rest of the code");
	}
}
```

Compilation error

```
        //catch block order is parent to child
        catch (Exception ae)
        {       System.out.println("Exception"+ae);
        }
        catch (ArithmeticException ne)
        {       System.out.println("Exception"+ne);
        }
```

Example 11:- *There are three methods to print Exception information*

- *toString()*
- *getMessage()*
- *printStackTrace()*

```
class Test
{       void m1()
        {       m2();
        }
        void m2()
        {       m3();
        }
        void m3()
        {       try{
                System.out.println(10/0);
                }
                catch(ArithmeticException ae)
                {       System.out.println(ae.toString());
                        System.out.println(ae.getMessage());
                        ae.printStackTrace();
                }
        }
        public static void main(String[] args)
        {       Test1 t = new Test1();
                t.m1();
        }
};
D:\DP>java Test
java.lang.ArithmeticException: / by zero        //toString() method output
/ by zero                                       //getMessage() method output
java.lang.ArithmeticException: / by zero        //printStackTrace() method
     at Test1.m3(Test1.java:8)
     at Test1.m2(Test1.java:5)
     at Test1.m1(Test1.java:3)
     at Test1.main(Test1.java:17)
```

Example 12:- *Internally JVM uses printStackTrace() method to print exception information.*

```
class Test
{       void m3()
        {       System.out.println(10/0);
        }
        void m2()
        {       m3();
        }
        void m1()
        {       m2();
        }
        public static void main(String[] args)
        {       new Test().m1();
        }
};
E:\>java Test
Exception in thread "main" java.lang.ArithmeticException: / by zero
      at Test.m3(Test.java:3)
      at Test.m2(Test.java:6)
      at Test.m1(Test.java:9)
      at Test.main(Test.java:12)
```

Example 13:- *It is possible to combine more than one exceptions in single catch block.*

Syntax:- *this is introduced In 1.7 version the code is compiled & executed in above 1.7 version.*

```
catch(ArithmeticException | StringIndexOutOfBoundsException a) .
catch(NumberFormatException | NullPointerException | StringIndexOutOfBoundsException a)
```

```
import java.util.Scanner;
import java.io.*;
public class Test
{   public static void main(String[] args)
  {   Scanner s = new Scanner(System.in);
          System.out.println("enter a number");
          int n = s.nextInt();
                try {
                        System.out.println(10/n);
                        System.out.println("ratan".charAt(13));
                        }
                catch(ArithmeticException | ClassCastException a)
                {       System.out.println("exception info="+a);
                }
        catch(NumberFormatException | NullPointerException | StringIndexOutOfBoundsException a)
                {       System.out.println("exception info="+a);
                }
                System.out.println("Rest of the application");
  }
}
```

Output:- provide the division value: 5
Write the output

Output:- provide the division value: 0
Write the output

Example14:- *multiple exception in single catch for checked Exception.*

```
import java.util.Scanner;
import java.io.*;
public class Test
{   public static void main(String[] args)
  {                         try {
                            FileInputStream f = new FileInputStream("abc.txt");
                            Thread.sleep(2000);
                            }
                catch(FileNotFoundException | InterruptedException a)
                {           System.out.println("exception info="+a);
                }
                System.out.println("Rest of the application");
  }
}
```

<u>Observation :-</u>

```
                 try {      FileInputStream f = new FileInputStream("abc.txt");
                            Thread.sleep(2000);
                            }
                catch(FileNotFoundException | ClassCastException a)
                {           System.out.println("exception info="+a);
                }
                catch(InterruptedException | ClassNotFoundException a)
                {           System.out.println("exception info="+a);
                }
E:\>javac Test.java
error: exception ClassNotFoundException is never thrown in body of corresponding try statement
         catch(InterruptedException | ClassNotFoundException a)
```

Possibilities of try-catch:-

Case-1
```
try
{
}
catch ()
{
}
```

Case-2
```
try
{
}
catch ()
{
}
try
{
}
catch ()
{
}
```

Case-3
```
try
{
}
catch ()
{
}
catch ()
{
}
```

Case-4
```
try
{       try
        {
        }
        catch ()
        {
        }
}
catch ()
{
}
```

Case-5
```
try
{
}
catch ()
{       try
        {
        }
        catch ()
        {
        }
}
```

Case-6
```
try
{       try
        {
        }
        catch ()
        {
        }
}
catch ()
{       try
        {
        }
        catch ()
        {
        }
}
```

Finally block:-

1) *Finally block code is always executed irrespective of try and catch.*
2) *It is used to provide clean-up code*
   - ***a.*** *Database connection closing.* ***Connection.close();***
   - ***b.*** *streams closing.* ***Scanner.close();***
   - ***c.*** *Object destruction .* ***Test t = new Test(); t=null;***
3) *It is not possible to write finally alone.*
   - *a. try-catch-finally ---> valid*
   - *b. try-catch ---> valid*
   - *c. catch-finally ---> invalid*
   - *d. try-catch-catch-finally ---> valid*
   - *e. try-finally ---> valid*
   - *f. catch-catch-finally ---> invalid*
   - *g. Try ---> invalid*
   - *h. Catch ---> invalid*
   - *i. Finally ---> invalid*

Syntax:-

```
try
{    risky code;
}
catch (Exception obj)
{    code to be run if the exception raised (handling code);
}
finally
{      Clean-up code;(database connection closing , streams closing……etc)
}
```

<u>All possibilities of finally block execution :-</u>

<u>Case 1:-</u>

```
try
{          System.out.println("try");
}
catch (ArithmeticException ae)
{          System.out.println("catch");
}
finally
{          System.out.println("finally");
}
```

Output:-
Try
finally

<u>case 2:-</u>

```
try
{          System.out.println(10/0);
}
catch (ArithmeticException ae)
{          System.out.println("catch");
}
finally
{          System.out.println("finally");
}
```

Output:-
catch
finally

<u>case 3:-</u>

```
try
{          System.out.println(10/0);
}
catch (NullPointerException ae)
{          System.out.println("catch");
}
finally
{          System.out.println("finally");
}
```

Output:
finally
Exception in thread "main"
java.lang.ArithmeticException: / by zero
at Test.main(Test.java:4)

<u>case 4:-</u>

```
try
{          System.out.println(10/0);
}
catch (ArithmeticException ae)
{          System.out.println(10/0);
}
finally
{          System.out.println("finally");
}
```

D:\morn11>java Test
finally
Exception in thread "main"
java.lang.ArithmeticException: / by zero
at Test.main(Test.java:7)

case 5:-

```
try
{       System.out.println("try");
}
catch(ArithmeticException ae)
{       System.out.println("catch");
}
finally
{       System.out.println(10/0);
}
System.out.println("rest of the code");
```

D:\>java Test
try
Exception in thread "main"
java.lang.ArithmeticException: / by zero
at Test.main(Test.java:15)

case 6:-it is possible to provide try-finally.

```
try
{       System.out.println("try");
}
finally
{       System.out.println("finally");
}
System.out.println("rest of the code");
```

D:\>java Test
try
finally
rest of the code

Example:-in two cases finally block won't be executed

Case 1:- *whenever the control is entered into try block then only finally block will be executed otherwise it is not executed.*

```
class Test
{       public static void main(String[] args)
        {       System.out.println(10/0);
                try{    System.out.println("ratan");
                   }
                finally
                {       System.out.println("finally block");    }
                System.out.println("rest of the code");
        }
};
```

D:\>java Test
Exception in thread "main" java.lang.ArithmeticException: / by zero
at Test.main(Test.java:5)

Case 2:- *In your program when we used System.exit(0) the JVM will be shutdown hence the rest of the code won't be executed .*

```
class Test
{       public static void main(String[] args)
        {       try{    System.out.println("ratan");
                        System.exit(0);
                }
                finally
                {       System.out.println("finally block");    }
                System.out.println("rest of the code");
        }
};
```

D:\>java Test
Ratan

Example :-

```
statement 1
statement 2
try
{       statement 3
        statement 4
        try
        {       statement 5
                statement 6
        }
        catch ()
        {       statement 7
                statement 8
        }
}
catch ()
{       statement 9
        statement 10
        try
        {       statement 11
                statement 12
        }
        catch ()
        {       statement 13
                statement 14
        }
}
Finally{
statement 15
statement 16
}
Statement -17
Statement -18
```

Case1: there is no Exception in the above example.

1, 2, 3, 4, 5, 14, 15 Normal Termination

Case 2:-if the exception is raised in statement 2.

1 , Abnormal Termination

Case 3:- if the exception is raised in the statement 3 the corresponding catch block Is not matched.

1,2,15,16 Abnormal termination

Case 4:- if the exception is raise in the statement-4 the corresponding catch block is matched.

1,2,15,16 Abnormal termination

Case 5:- If the exception is raised in the statement 5 and corresponding catch block is matched.

1,2,3,4,8,9,10,11,14,15 normal termination

Case 6:- If the exception is raised in the statement 6 and corresponding catch block is not matched but outer catch block is matched.

1,2,3,4,8,9,10,11,14,15 normal termination

Case 7:- *If the exception is raised in the statement 5 and the corresponding catch block is matched but while executing catch block exception raised in statement-7, the outer catch block is matched while executing outer catch exception raised in statement-11, the inner catch block is matched but while executing inner catch the exception raised in statement-13.*

1,2,3,4,8,9,12,13,14,15 normal termination.

Case 8:- *If the exception is raised in the statement 6 and the corresponding catch block is matched but while executing catch block exception raised in statement-8, the outer catch block is matched while executing outer catch exception raised in statement-12, the inner catch block is matched but while executing inner catch the exception raised in statement-14.*

1,2,3,4,8,9,12,13,14,15 normal termination.

Case 9:- *If the exception raised in statement 15.*

1,2,3,4,5 abnormal termination.

Case 10:- *if the Exception raised in statement 18.*

Throws keyword:-

There are two approaches two handle the exceptions in java

a. *By using try-catch blocks.*
b. *By using throws keyword.*

Handling exception by using Try-catch	***Handling Exception by using throws keyword***
1. *Try-catch blocks are used to write the exception handling code.*	*Throws keyword is used to delegate the responsibilities of exception handling to caller method.*
2. *By using try-catch blocks it is possible to handle multiple exceptions by using multiple catch blocks.*	*By using throws it is possible to handle multiple exceptions because one method is able to throws multiple exceptions at time.*
3. *We can write the try-catch blocks at method implementation level.*	*We can write the throws keyword at method declaration level.*
4. *We can provide the try-catch blocks at method & constructor & blocks level.*	*We can provide the throws keyword only at method & constructor level but not block level.*

Example 1:-

- ✓ *in below example exception raised in studentDetails() method but it delegating responsibilities of exception handling to hod() method by using throws keyword.*
- ✓ *But hod() method delegating responsibilities of exception handling to principal() method by using throws now principal handing this exception by using try-catch blocks.*

```
class Test
{       void studentDetails() throws InterruptedException
        {       System.out.println("suneel babu is sleeping");
                Thread.sleep(3000);
                System.out.println("do not disturb sir......");
        }
        void hod()throws InterruptedException
        {       studentDetails();
        }
        void principal()
        {       try{
                hod();}
                catch(InterruptedException ie)
                {       ie.printStackTrace();  }
        }
        void officeBoy()
        {       principal();
        }
        public static void main(String[] args)
        {       Test t = new Test();
                t.officeBoy();
        }
}
```

Example 2:-

- *In below example method-by-method using throws keyword to delegate responsibilities of exception handling to caller method.*
- *At final main() method uses throws keyword to delegate the responsibilities of exception handling to JVM.*

```
class Test
{	void studentDetails() throws InterruptedException
	{	System.out.println("suneel babu is sleeping");
		Thread.sleep(3000);
		System.out.println("do not disturb sir......");
	}
	void hod()throws InterruptedException
	{	studentDetails();
	}
	void principal()throws InterruptedException
	{	hod();
	}
	void officeBoy()throws InterruptedException
	{	principal();
	}
	public static void main(String[] args) throws InterruptedException
	{	Test t = new Test();
		t.officeBoy();
	}
}
```

Example 3:-

```
import java.io.*;
class Test
{
	void m2()throws FileNotFoundException,InterruptedException
	{	FileInputStream fis = new FileInputStream("abc.txt");
		Thread.sleep(2000);
		System.out.println("Exceptions are handled");
	}
	void m1()
	{	try{
			m2();}
			catch(FileNotFoundException f) {   f.printStackTrace();  }
			catch(InterruptedException ie)   {   ie.printStackTrace();  }
	}
	public static void main(String[] args) throws InterruptedException
	{	Test t = new Test();
		t.m1();
	}
}
```

Example 4:-

```
import java.io.*;
class Test
{
	void m2()throws Exception			//FileNotFoundException,InterruptedException
	{	FileInputStream fis = new FileInputStream("abc.txt");
		Thread.sleep(2000);
		System.out.println("Exceptions are handled");
	}
	void m1()throws Exception
	{	m2();
	}
	public static void main(String[] args) throws Exception
	{	Test t = new Test();
		t.m1();
	}
}
```

Throw keyword:-

- *All methods use the throw statement to throw an exception. The throw statement requires a single argument a throwable object. Throwable objects are instances of any subclass of the Throwable class.*
- *It is possible to throw user defined exceptions or predefined exceptions by using throw keyword.*
- *Here's an example of a throw statement*
  *throw **someThrowableObject**;*

Note: - throw keyword is used to handover user created exception object to JVM whether it is predefined exception class or user defined exception class.

Example:- throw statement throw an predefined exception.

Step 1:- create the Exception object explicitly by the developer by using new keyword.
new ArithmeticException("ratan not eligible");
Step 2:- handover (throw) user created Exception object to jvm by using throw keyword.
throw new ArithmeticException("ratan not eligible");

```
import java.util.*;
class Test
{	static void validate(int age)
	{	if (age<18)
		{	throw new ArithmeticException("not eligible for vote");
		}
		else
		{	System.out.println("welcome to the voting");
		}
	}
	public static void main(String[] args)
	{	Scanner s=new Scanner(System.in);
		System.out.println("please enter your age ");
		validate(s.nextInt());
		System.out.println("rest of the code");
	}
}
```

```
E:\>java Test
please enter your age
45
Check the output
```

```
E:\>java Test
please enter your age
10
Check the output
```

Example: - throw statement throw a user defined exception.

To achieve this mechanism first we must know how to create user defined exception then we are able to use this throw keyword.

There are two types of exceptions present in the java language

1) *Predefined Exceptions.*
   ArithmeticException,IOException,NullPointerException………….etc
2) *User defined Exceptions.(created by user)*
   InvalidAgeException,MyException…etc

<u>Customization of exception handling :-(creation of predefined exceptions)</u>

There are two types of user defined exceptions

1. *User defined checked exception.*
   a. *Default constructor approach.*
   b. *Parameterized constructor approach.*
2. *User defined un-checked Exception.*
   a. *Default constructor approach.*
   b. *Parameterized constructor approach.*

Note: - while declaring user defined exceptions: the naming conventions are every exception suffix must be the word Exception.

<u>Creation of user defined checked Exception by using default constructor approach:-</u>

Step-1:- create the user defined checked Exception

Normal java class will become Exception class whenever we are extends Exception class.

<u>InvaliedAgeException.java:-</u>

```
package com.tcs.userexceptions;
public class InvalidAgeExcepiton extends Exception
{		//default constructor
};
```

Step-2:- use the user created Exception in our project.

<u>Test.java</u>

```
package com.tcs.project;
import com.tcs.userexceptions.InvalidAgeExcepiton;
import java.util.Scanner;
class Test
{	static void status(int age)throws InvalidAgeExcepiton
	{	if (age>25)
		{System.out.println("eligible for mrg");
		}
		else
		{	throw new InvalidAgeExcepiton();	//default constructor executed
		}
	}
	public static void main(String[] args)throws InvalidAgeExcepiton
	{	Scanner s = new Scanner(System.in);
		System.out.println("enter u r age");//23
		int age = s.nextInt();
		Test.status(age);
	}
}
```

D:\morn11>java com.tcs.project.Test
Enter u r age   & check the output

*Example :-**<u>Creation of user defined checked exception by using parameterized constructor approach.</u>***

step-1:- create the user defined checked exception class.

Normal java class will become checked exception class when we extends Exception class.

<u>InvalidAgeException.java</u>

```
package com.tcs.userexceptions;
public class InvalidAgeExcepiton extends Exception
{       public InvalidAgeExcepiton(String str)
        {       super(str); //super constructor calling in order to print your information
        }
};
```

Step-2:- use user created Exception in our project.

<u>Test.java</u>

```
package com.tcs.project;
import com.tcs.userexceptions.InvalidAgeExcepiton;
import java.util.Scanner;
class Test
{       static void status(int age)throws InvalidAgeExcepiton
        {       if (age>25)
                {       System.out.println("eligible for mrg");
                }
                else
                {       //using user created Exception
                        throw new InvalidAgeExcepiton("not eligible try after some time");
                }
        }
        public static void main(String[] args)throws InvalidAgeExcepiton
        {       Scanner s = new Scanner(System.in);
                System.out.println("enter u r age");
                int age = s.nextInt();
                Test.status(age);
        }
}
```

```
D:\morn11>javac -d . InvalidAgeExcepiton.java
D:\morn11>javac -d . Test.java
D:\morn11>java com.tcs.project.Test
enter u r age
28
eligible for mrg
D:\morn11>java com.tcs.project.Test
enter u r age
20
Exception in thread "main" com.tcs.userexceptions.InvalidAgeExcepiton: not eligible try after some time
    at com.tcs.project.Test.status(Test.java:11)
    at com.tcs.project.Test.main(Test.java:18)
```

*Example:-**creation of user defined un-checked exception by using default constructor approach***

Step-1:- create user defined un-checked exception.

Normal java class will become un-checked exception class when we exetends RuntimeException class.

```
//InvalidAgeException.java
package com.tcs.userexceptions;
public class InvalidAgeExcepiton extends RuntimeException
{           //default constructor
}
```

Step-2:- use user created Exception in your project.

Test.java

```
package com.tcs.project;
import com.tcs.userexceptions.InvalidAgeExcepiton;
import java.util.Scanner;
class Test
{           static void status(int age)
            {           if (age>25)
                        {System.out.println("eligible for mrg");
                        }
                        else
                        {           //using user created Exception
                                    throw new InvalidAgeExcepiton();
                        }
            }
            public static void main(String[] args)
            {           Scanner s = new Scanner(System.in);
                        System.out.println("enter u r age");//23
                        int age = s.nextInt();
                        Test.status(age);
            }
}
```

Example: - creation of user defined un-checked exception by using parameterized constructor approach

Step 1:- create user defined un-checked exception classs.

Normal java class will become un-checked exception class when we exetends RuntimeException class.

```
//InvalidAgeException.java
package com.tcs.userexceptions;
public class InvalidAgeExcepiton extends RuntimeException
{           public InvalidAgeExcepiton(String str)
            {           super(str);
            }
};
```

Step2:- use user created exception object in your project.

Test.java

```
package com.tcs.project;
import com.tcs.userexceptions.InvalidAgeExcepiton;
import java.util.Scanner;
class Test
{	static void status(int age)
	{	if (age>25)
		{	System.out.println("eligible for mrg");
		}
		else
		{	//using user created Exception
			throw new InvalidAgeExcepiton("not eligible for mrg");
		}
	}
	public static void main(String[] args)
	{	Scanner s = new Scanner(System.in);
		System.out.println("enter u r age");
		int age = s.nextInt();
		Test.status(age);
	}
}
```

Different types of exceptions:-

ArrayIndexOutOfBoundsException:-

```
	int[] a={10,20,30};
	System.out.println(a[0]);//10
	System.out.println(a[3]);//ArrayIndexOutOfBoundsException
```

NumberFormatException:-

```
		String str="123";
		int a=Integer.parseInt(str);
		System.out.println(a);//conversion(string - int) is good

		String str1="abc";
		int b=Integer.parseInt(str1);
		System.out.println(b);//NumberFormatException
```

NullPointerException:-

```
		String str="rattaiah";
		System.out.println(str.length());//8

		String str1=null;
		System.out.println(str1.length());//NullPointerException

		Test t = new Test();
		t.m1();  //output printed

		t=null;
		t.m1(); //NullPointerException
```

ArithmeticException:-

```
int b=10/0;
System.out.println(b);//ArithmeticExceptiom
```

IllegalArgumentException:-

```
Thread  priority range is 1-10
1     --->low priority
10  --->high priority
Thread t=new Thread();
t.setPriority(11);//IllegalArgumentException
```

IllegalThreadStateException:-

```
Thread t=new Thread();
t.start();
t.start();//IllegalThreadStateException
```

StringIndexOutOfBoundsException:-

```
String str="rattaiah";
System.out.println(str.charAt(3));//t
System.out.println(str.charAt(13));//StringIndexOutOfBoundsException
```

NegativeArraySizeException:-

```
int[] a1=new int[100];
System.out.println(a1.length);//100

int[] a=new int[-9];
System.out.println(a.length);//NegativeArraySizeException
```

InputMismatchException:-

```
Scanner s=new Scanner(System.in);
System.out.println("enter first number");
int a=s.nextInt();
```

D:\>java Test
enter first number
ratan
Exception in thread "main" java.util.InputMismatchException

Different types of Errors:-

StackOverflowError:-

```
class Test
{       void m1()
        {       m2();
                System.out.println("this is Rattaiah");
        }
        void m2()
        {       m1();
                System.out.println("from Sravyasoft");
        }
        public static void main(String[] args)
        {       Test t=new Test();
                t.m1();
        }
}
```

OutOfMemoryError:-

```
class Test
{	public static void main(String[] args)
	{	int[] a=new int[100000000];	//OutOfMemoryError
	}
}
```

Different types of Exceptions in java:-

Checked Exception	***Description***
ClassNotFoundException	If the loaded class is not available
CloneNotSupportedException	Attempt to clone an object that does not implement the Cloneable interface.
IllegalAccessException	Access to a class is denied.
InstantiationException	Attempt to create an object of an abstract class or interface.
InterruptedException	One thread has been interrupted by another thread.
NoSuchFieldException	A requested field does not exist.
NoSuchMethodException	If the requested method is not available.
UncheckedException	***Description***
ArithmeticException	Arithmetic error, such as divide-by-zero.
ArrayIndexOutOfBoundsException	Array index is out-of-bounds.(out of range)
InputMismatchException	If we are giving input is not matched for storing input.
ClassCastException	If the conversion is Invalid.
IllegalArgumentException	Illegal argument used to invoke a method.
IllegalThreadStateException	Requested operation not compatible with current thread state.
IndexOutOfBoundsException	Some type of index is out-of-bounds.
NegativeArraySizeException	Array created with a negative size.
NullPointerException	Invalid use of a null reference.
NumberFormatException	Invalid conversion of a string to a numeric format.
StringIndexOutOfBoundsException	Attempt to index outside the bounds of a string.

java.lang.NoClassDefFoundError vs java.lang.ClassNotFoundException:-

```
class Test1
{	void m1()
	{	System.out.println("Test1 class m1()");
	}
}
class Test
{	public static void main(String[] args) throws ClassNotFoundException
	{	Test1 t  = new Test1();
		t.m1();
		Class.forName("Emp");
	}
}
```

Observation-1:-

In Test class we are hard coding Test1 object but in target location Test1.class file is not available it will generate ***java.lang.NoClassDefFoundError.***

Observation-2:-

In java to load .class file dynamically at runtime we are using forName() method but if runtime the class is not available it generate ***java.lang.ClassNotFoundException.***

Multi Threading

Information about multithreading:-

1) The earlier days the computer's memory is occupied only one program after completion of one program it is possible to execute another program is called uni programming.
2) Whenever one program execution is completed then only second program execution will be started such type of execution is called co operative execution, this execution we are having lot of disadvantages.
    a. Most of the times memory will be wasted.
    b. CPU utilization will be reduced because only program allow executing at a time.
    c. The program queue is developed on the basis co operative execution

To overcome above problem a new programming style will be introduced is called multiprogramming.

1) Multiprogramming means executing the more than one program at a time.
2) All these programs are controlled by the CPU scheduler.
3) CPU scheduler will allocate a particular time period for each and every program.
4) Executing several programs simultaneously is called multiprogramming.
5) In multiprogramming a program can be entered in different states.
    a. Ready state.
    b. Running state.
    c. Waiting state.
6) Multiprogramming mainly focuses on the number of programs.

Advantages of multiprogramming:-

1. The main advantage of multithreading is to provide simultaneous execution of two or more parts of a application to improve the CPU utilization.
2. CPU utilization will be increased.
3. Execution speed will be increased and response time will be decreased.
4. CPU resources are not wasted.

Thread:-

1) Thread is nothing but separate path of sequential execution.
2) The independent execution technical name is called thread.
3) Whenever different parts of the program executed simultaneously that each and every part is called thread.
4) The thread is light weight process because whenever we are creating thread it is not occupying the separate memory it uses the same memory. Whenever the memory is shared means it is not consuming more memory.
5) Executing more than one thread a time is called multithreading.

Information about main Thread;-

When a java program started one Thread is running immediately that thread is called main thread of your program.

1. It is used to create a new Thread(child Thread).
2. It must be the last thread to finish the execution because it perform various actions.
   It is possible to get the current thread reference by using currentThread() method it is a static public method present in Thread class.

```
class CurrentThreadDemo
{    public static void main(String[] arhgs)
     {         Thread t=Thread.currentThread();
               System.out.println("current Thread--->"+t);
               //change the name of the thread
               t.setName("ratan");
               System.out.println("after name changed---> "+t);
     }
};
```

Single threaded model:-

```
class Test
{                                                              begins
        public static void main(String[] args)
        {
                System.out.println("Hello World!");
                System.out.println("hi rattaiah");             body
                System.out.println("hello Sravyasoft");
        }
}                                                              end
```

In the above program only one thread is available is called main thread to know the name of the thread we have to execute the fallowing code.

The main important application areas of the multithreading are

1. Developing video games
2. Implementing multimedia graphics.
3. Developing animations

A thread can be created in two ways:-

1) By extending Thread class.
2) By implementing **java.lang.Runnable** interface

First approach to create thread extending Thread class:-

Step 1:- **Our normal java class will become Thread class whenever we are extending predefined Thread class.**

```
class MyThread extends Thread
{
};
```

Step 2:- override the run() method to write the business logic of the Thread(run() method present in Thread class).

```
class MyThread extends Thread
{       public void run()
        {       System.out.println("business logic of the thread");
                System.out.println("body of the thread");
        }
}
```

Step 2:-Create userdefined Thread class object.

```
MyThread t=new MyThread();
```

Step 3:-*Start the Thread by using start() method of Thread class.*

```
t.start();
```

Example :-

```
class MyThread extends Thread    //defining a Thread
{       //business logic of user defined  Thread
        public void run()
        {       for (int i=0;i<10;i++)
                {       System.out.println("userdefined Thread");
                }
        }
};
class ThreadDemo
{       public static void main(String[] args)      //main thread started
        {       MyThread t=new MyThread();    //MyThread is created
                t.start();           //MyThread execution started
                //business logic of main Thread
                for (int i=0;i<10;i++)
                {       System.out.println("Main Thread");
                }
        }
};
```

Flow of execution:-

1) Whenever we are calling t.start() method then JVM will search start() method in the MyThread class since not available so JVM will execute parent class**(*Thread)*** start() method.

   Thread class start() method responsibilities

   a. User defined thread is registered into Thread Scheduler then only decide new Thread is created.
   b. The Thread class start() automatically calls run() to execute logics of userdefined Thread.

Thread Scheduler:-

- ✓ Thread scheduler is a part of the JVM. It decides thread execution.
- ✓ Thread scheduler is a mental patient we are unable to predict exact behavior of Thread Scheduler it is JVM vendor dependent.
- ✓ Thread Scheduler mainly uses two algorithms to decide Thread execution.
  1) Preemptive algorithm.
  2) Time slicing algorithm.
- ✓ We can't expect exact behavior of the thread scheduler it is JVM vendor dependent. So we can't say expect output of the multithreaded examples we can say the possible outputs.

Preemptive scheduling:-
In this highest priority task is executed first after this task enters into waiting state or dead state then only another higher priority task come to existence.

Time Slicing Scheduling:-
A task is executed predefined slice of time and then return pool of ready tasks. The scheduler determines which task is executed based on the priority and other factors.

Example :-is it possible to start a thread twice : no

```
class MyThread extends Thread
{       public static void main(String[] args)//main thread started
        {       MyThread t=new MyThread();    //MyThread is created
                t.start();
                t.start();
        }
};
D:\DP>java MyThread
Exception in thread "main" java.lang.IllegalThreadStateException
```

Life cycle stages are:-

1) **New**
2) **Ready**
3) **Running state**
4) **Blocked / waiting / non-running mode**
5) **Dead state**

New :- MyThread t=new MyThread();

Ready :- t.start()

Running state:- If thread scheduler allocates CPU for particular thread. Thread goes to running state The Thread is running state means the run() is executed.

Blocked State:-
If the running thread got interrupted of goes to sleeping state at that moment it goes to the blocked state.

Dead State:-If the business logic of the project is completed means run() over thread goes dead state.

Second approach to create thread implementing Runnable interface:-

Step 1:-our normal java class will become Thread class whenever we are implementing Runnable interface.

class MyClass extends Runnable

```
{
};
```

Step2: override run method to write logic of Thread.

```
class MyClass extends Runnable
{       public void run()
        {       System.out.println("Rattaiah from SravyaInfotech");
                System.out.println("body of the thread");
        }
}
```

Step 3:- **Creating a object.**

MyClass obj=new MyClass();

Step 4:- **Creates a Thread class object.**

After new Thread is created it is not started running until we are calling start() method. So whenever we are calling start method that start() method call run() method then the new Thread execution started.

Thread t=new Thread(obj);
t.start();

creation of Thread implementing Runnable interface :-

```
class MyThread implements Runnable
{       public void run()
        {       //business logic of user defined  Thread
                for (int i=0;i<10;i++)
                {       System.out.println("userdefined Thread");
                }
        }
};
class ThreadDemo
{       public static void main(String[] args)      //main thread started
        {       MyThread r=new MyThread();   //MyThread is created
                Thread t=new Thread(r);
                t.start();           //MyThread execution started
                //business logic of main Thread
                for (int i=0;i<10;i++)
                {       System.out.println("Main Thread");
                }
        }
};
```

First approach:-

important point is that when extending the Thread class, the sub class cannot extend any other base classes because Java allows only single inheritance.

Second approach:-

1) Implementing the Runnable interface does not give developers any control over the thread itself, as it simply defines the unit of work that will be executed in a thread.
2) By implementing the Runnable interface, the class can still extend other base classes if necessary.

Creating two threads by extending Thread class using anonymous inner classes:-

```
class ThreadDemo
{	public static void main(String[] args)
	{	Thread t1 = new Thread()	//anonymous inner class
		{	public void run()
			{System.out.println("user Thread-1");
			}
		};
		Thread t2 = new Thread()	//anonymous inner class
		{	public void run()
			{System.out.println("user thread-2");
			}
		};
		t1.start();
		t2.start();
	}
};
```

Creating two threads by implementing Runnable interface using anonymous inner classes:-

```
class ThreadDemo
{	public static void main(String[] args)
	{
		Runnable r1 = new Runnable()
		{	public void run()
			{System.out.println("user Thread-1");
			}
		};
		Runnable r2 = new Runnable()
		{	public void run()
			{System.out.println("user thread-2");
			}
		};

		Thread t1 = new Thread(r1);
		Thread t2 = new Thread(r2);
		t1.start();
		t2.start();
	}
};
```

Different ways to start the Thread:-

```
class MyThread extends Thread
{	public void run()
	{System.out.println("user thread is running extends Thread");
	}
};
class MyRunnable implements Runnable
```

```
{         public void run()
          {System.out.println("user thread is Running implements Runnable");
          }
};
class ThreadDemo
{         public static void main(String[] args)
          {         //creating Thread class object by passing anonymous classes
                    new Thread(new MyThread()).start();
                    new Thread(new MyRunnable()).start();
          }
};
```

Internal Implementation of multiThreading:-

```
interface Runnable
{         public abstract void run();
}
class Thread implements Runnable
{         public void run()
          {         //empty implementation
          }
};
class MyThread extends Thread
{         public void run()           //overriding run() to write business logic
          {         for (int i=0;i<5 ;i++ )
                    {         System.out.println("user implementation");
                    }
          }
};
```

Difference between t.start() and t.run():-

- In the case of t.start(), Thread class start() is executed a new thread will be created that is responsible for the execution of run() method.
- But in the case of t.run() method, no new thread will be created and the run() is executed like a normal method call by the main thread.

Note :- Here we are not overriding the run() method so thread class run method is executed which is having empty implementation so we are not getting any output.

```
class MyThread extends Thread
{         }
class  ThreadDemo
{         public static void main(String[] args)
          {         MyThread t=new MyThread();
                    t.start();
                    for (int i=0;i<5;i++ )
                    {         System.out.println("main thread");
                    }
```

```
        }
}
```

Note :- If we are overriding start() method then JVM is executes override start() method at this situation we are not giving chance to the thread class start() hence n new thread will be created only one thread is available the name of that thread is main thread.

```
class MyThread extends Thread
{       Public void start()
        {       System.out.println("override start method");
        }
}
class  ThreadDemo
{       public static void main(String[] args)
        {       MyThread t=new MyThread();
                t.start();
                for (int i=0;i<5 ;i++ )
                {       System.out.println("main thread");
                }
        }
}
```

<u>Different Threads are performing different tasks:--</u>

1) Particular task is performed by the number of threads here number of threads(t1,t2,t3) are executing same method (functionality).
2) In the above scenario for each and every thread one stack is created. Each and every method called by particular Thread the every entry stored in the particular thread stack.

```
class MyThread1 extends Thread
{       public void run()
        {       System.out.println("ratan task");
        }
};
class MyThread2 extends Thread
{       public void run()
        {       System.out.println("Sravya task");
        }
};
class MyThread3 extends Thread
{       public void run()
        {       System.out.println("anu task");
        }
};
class ThreadDemo
{       public static void main(String[] args) //1- main Thread
        {       MyThread1 t1 = new MyThread1();
                MyThread2 t2 = new MyThread2();
                MyThread3 t3 = new MyThread3();
                t1.start(); //2
                t2.start(); //3
                t3.start();        //4
```

```
            }
        };
```

Here Four Stacks are created
Main -----------stack1
t1---------------stack2
t2--------------stack3
t3-------------stack4

Multiple threads are performing single task:-

```
class MyThread extends Thread
{       public void run()
        {       System.out.println("Sravyasoft task");
        }
}
class  ThreadDemo
{       public static void main(String[] args)//main Thread is started
        {       MyThread t1=new MyThread();         //new Thread created
                MyThread t2=new MyThread();         //new Thread created
                MyThread t3=new MyThread();         //new Thread created
                t1.start();     //Thread started
                t2.start();     //Thread started
                t3.start();     //Thread started
        }
}
```

Getting and setting names of Thread:-

1) Every Thread in java having name
   a. default name of the main thread is main
   b. default name of user created threads starts from ***Thread-0***.
      t1 --→Thread-0
      t2 --→Thread-1
      t3 --→Thread-2
2) To set the name use setName() & to get the name use getName(),
   Public final String getName()
   Public final void setName(String name)

Example:-

```
class MyThread extends Thread
{       public void run()
        {       System.out.println("thread is running");
        }
}
class ThreadDemo
{       public static void main(String args[])
        {       MyThread t1=new MyThread();
                MyThread t2=new MyThread();
                System.out.println("t1 Thread name="+t1.getName());
                System.out.println("t2 Thread name="+t2.getName());
                System.out.println(Thread.currentThread().getName());
                t1.setName("ratan");
```

```
                System.out.println("after changeing t1 Thread name="+t1.getName());
        }
}
```

Thread Priorities:-

1. Every Thread in java has some property. It may be default priority provided be the JVM or customized priority provided by the programmer.
2. The valid range of thread priorities is 1 – 10. Where one is lowest priority and 10 is highest priority.
3. The default priority of main thread is 5. The priority of child thread is inherited from the parent.
4. Thread defines the following constants to represent some standard priorities.
5. Thread Scheduler will use priorities while allocating processor the thread which is having highest priority will get chance first and the thread which is having low priority.
6. If two threads having the same priority then we can't expect exact execution order it depends upon Thread Scheduler.
7. The thread which is having low priority has to wait until completion of high priority threads.
8. Three constant values for the thread priority.
    a. **MIN_PRIORITY = 1**
    b. **NORM_PRIORITY = 5**
    c. **MAX_PRIORITY = 10**

Thread class defines the following methods to get and set priority of a Thread.

Public final int getPriority()
Public final void setPriority(int priority)

Here 'priority' indicates a number which is in the allowed range of 1 – 10. Otherwise we will get Runtime exception saying "IllegalArgumentException".

Thread priority decide when to switch from one running thread to another this process is called context switching.

```
class MyThread extends Thread
{       public void run()
        {       System.out.println("current Thread name = "+Thread.currentThread().getName());
                System.out.println("current Thread priority = "+Thread.currentThread().getPriority());
        }
};
class ThreadDemo
{       public static void main(String[] args)//main thread started
        {       MyThread t1 = new MyThread();
                MyThread t2 = new MyThread();
                t1.setPriority(Thread.MIN_PRIORITY);
                t2.setPriority(Thread.MAX_PRIORITY);
                t1.start();
                t2.start();
        }
```

};

Java.lang.Thread.yield():-

- Yield() method causes to pause current executing Thread for giving the chance for waiting threads of same priority.
- If there are no waiting threads or all threads are having low priority then the same thread will continue its execution once again.

Syntax:-

Public static native void yield();

Ex:

```
class MyThread extends Thread
{	public void run()
	{
		for(int i=0;i<10;i++)
		{	Thread.yield();
			System.out.println("child thread");
		}
	}
}
class ThreadYieldDemo
{	public static void main(String[] args)
	{	MyThread t1=new MyThread();
		t1.start();
		for(int i=0;i<10;i++)
		{	System.out.println("main thread");
		}
	}
}
```

Java.lang.Thread.join(-,-) method:-

- Join method allows one thread to wait for the completion of another thread.
  - t.join(); ---> here t is a Thread Object whose thread is currently running.
- Join() is used to stop the execution of the thread until completion of some other Thread.
-

if a t1 thread is executed t2.join() at that situation t1 must wait until completion of the t2 thread.

public final void join()throws InterruptedExcetion
Public final void join(long ms)throws InterruptedException
Public final void join(long ms, int ns)throws InterruptedException

Methods of Thread class:-

```
class MyThread extends Thread
{	public void run()
	{	for (int i=0;i<5;i++)
```

```
        {       try{     Thread.sleep(2000);   }
                catch(InterruptedException e)
                {e.printStackTrace();
                }
                System.out.println(i);
        }
    }
};
class ThreadDemo
{       public static void main(String[] args)
    {       MyThread t1=new MyThread();
            MyThread t2=new MyThread();
            MyThread t3=new MyThread();
            t1.start();
            try
            {t1.join();       }
            catch (InterruptedException ie)
            {ie.printStackTrace();
            }
            t2.start();
            t3.start();
    }
};
```

<u>Java.lang.Thread.Interrupted( ):-</u>

- A thread can interrupt another sleeping or waiting thread. But one thread is able to interrupted only another sleeping or waiting thread.
- To interrupt a thread use Thread class interrupt() method.

Public void interrupt()

<u>Effect of interrupt() method call:-</u>

```
    class MyThread  extends Thread
    {       public void run()
            {       try
                    {       for (int i=0;i<10;i++ )
                            {       System.out.println("i am sleeping ");
                                    Thread.sleep(5000);
                            }
                    }
                    catch (InterruptedException ie)
                    {       System.out.println("i got interupted by interrupt() call");
                    }
            }
    };
    class ThreadDemo
    {       public static void main(String[] args)
```

```
                {       MyThread t=new MyThread();
                        t.start();
                        t.interrupt();
                }
        };
```

No effect of interrupt() call:-

```
class MyThread  extends Thread
{       public void run()
        {       for (int i=0;i<10;i++ )
                {       System.out.println("i am sleeping ");
                }
        }
};
class ThreadDemo
{       public static void main(String[] args)
        {       MyThread t=new MyThread();
                t.start();
                t.interrupt();
        }
};
```

NOTE:- ***The interrupt() is effected whenever our thread enters into waiting state or sleeping state and if the our thread doesn't enters into the waiting/sleeping state interrupted call will be wasted.***

Shutdown Hook:-

- Shutdown hook used to perform cleanup activities when JVM shutdown normally or abnormally.
- Clean-up activities like
  - Resource release
  - Database closing
  - Sending alert message
- So if you want to execute some code before JVM shutdown use shutdown hook

The JVM will be shutdown in fallowing cases.

a. When you typed ctrl+C
b. When we used System.exit(int)
c. When the system is shutdown ……etc

To add the shutdown hook to JVM use addShutdownHook(obj) method of Runtime Class.

public void addShutdownHook(java.lang.Thread);

To remove the shutdown hook from JVM use removeShutdownHook(obj) method of Runtime Class.

public boolean removeShutdownHook(java.lang.Thread);

To get the Runtime class object use static factory method getRuntime() & this method present in Runtime class

*Runtime r = Runtime.**getRuntime();***

Factory method:- one java class method is able to return same class object or different class object is called factory method.

Example :-

```
class MyThread extends Thread
{	public void run()
	{System.out.println("shoutdown hook");
	}
};
class ThreadDemo
{	public static void main(String[] args)throws InterruptedException
	{	MyThread t = new MyThread();
		//creating Runtime class Object by using factory method
		Runtime r = Runtime.getRuntime();
		r.addShutdownHook(t); //adding Thread to JVM hook
		for (int i=0;i<10 ;i++)
		{System.out.println("main thread is running");
			Thread.sleep(3000);
		}
	}
};
```

D:\DP>java ThreadDemo
main thread is running
main thread is running
main thread is running
shoutdown hook

while running Main thread press Ctrl+C then hook thread will be executed.

Synchronized :-

- Synchronized modifier is the modifier applicable for methods but not for classes and variables.
- If a method or a block declared as synchronized then at a time only one Thread is allowed to operate on the given object.
- The main advantage of synchronized modifier is we can resolve data inconsistency problems.
- But the main disadvantage of synchronized modifier is it increases the waiting time of the Thread and effects performance of the system .Hence if there is no specific requirement it is never recommended to use.
- The main purpose of this modifier is to reduce the data inconsistence problems.

Non-synchronized methods

```
void m1()
{
}
```

non-synchronized method any number of threads can access

Every thread accessing simultaneously

Thread 1 Thread 2 Thread 3---------Thread N

1) In the above case multiple threads are accessing the same methods hence we are getting data inconsistency problems. These methods are not thread safe methods.
2) But in this case multiple threads are executing so the performance of the application will be increased.

Synchronized methods

synchronized void m2()
{

}
Synchronized method only one thread is allow to access.

Only one thread allowed to access

Thread 1 Thread 2 Thread 3---------Thread N

1) In the above case only one thread is allow to operate on particular method so the data inconsistency problems will be reduced.
2) Only one thread is allowed to access so the performance of the application will be reduced.
3) If we are using above approach there is no multithreading concept.

Hence it is not recommended to use the synchronized modifier in the multithreading programming.

Example :-

```
class Test
{       public static synchronized void x(String msg)       //only one thread  is able to access
        {       try{
                System.out.println(msg);
                Thread.sleep(4000);
                System.out.println(msg);
                Thread.sleep(4000);
                }
                catch(Exception e)
                {e.printStackTrace();}
        }
}
class MyThread1 extends Thread
{       public void run( ) {   Test.x("ratan");  }      };
class MyThread2 extends Thread
{       public void run( ){Test.x("anu");}              };
class MyThread3 extends Thread
{       public void run( ){Test.x("banu");}             };
class TestDemo
{       public static void main(String[] args)  //main thread  -1
        {       MyThread1 t1 = new MyThread1();
                MyThread2 t2 = new MyThread2();
                MyThread3 t3 = new MyThread3();
```

```
                t1.start();     //2-Threads
                t2.start();     //3-Threads
                t3.start();     //4-Threads
        }
}
```

If method is synchronized:
```
D:\DP>java ThreadDemo
anu
anu
banu
banu
ratan
ratan
```

if method is non-synchronized:-
```
D:\DP>java ThreadDemo
banu
ratan
anu
banu
anu
ratan
```

synchronized blocks:-

if the application method contains 100 lines but if we want to synchronized only 10 lines of code use synchronized blocks.

The synchronized block contains less scope compare to method.

If we are writing all the method code inside the synchronized blocks it will work same as the synchronized method.

Syntax:-
```
synchronized(object)
{       //code
}
class Heroin
{       public void message(String msg)
        {       synchronized(this){
                System.out.println("hi "+msg+" "+Thread.currentThread().getName());
                try{Thread.sleep(5000);}
                catch(InterruptedException e){e.printStackTrace();}
                }
                System.out.println("hi Sravyasoft");
        }
};
class MyThread1 extends Thread
{       Heroin h;
        MyThread1(Heroin h)
        {this.h=h;
        }
        public void run()
        {       h.message("Anushka");
        }
};
class MyThread2 extends Thread
{       Heroin h;
        MyThread2(Heroin h)
        {this.h=h;
```

```
	}
	public void run()
	{	h.message("Ratan");
	}
};
class ThreadDemo
{
	public static void main(String[] args)
	{	Heroin h = new Heroin();
		MyThread1 t1 = new MyThread1(h);
		MyThread2 t2 = new MyThread2(h);
		t1.start();
		t2.start();
	}
};
```

Daemon threads:-

The threads wchich are executed at background is called daemon threads.

Ex:- garbage collector,ThreadSchedular.default exceptional handler.

Non-daemon threads:-

The threads which are executed fore ground is called non-daemon threads.

Ex:- normal java application.

- When we create a thread in java that is user defined thread and f it is running JVM will not terminate that process.
- If a thread is marked as a daemon thread JVM does not wait to finish and as soon as all the user defined threads are finished then it terminates the program and all associated daemon threads.
- Set the daemon nature to thread by using setDaemon() method
    - MyThread t = new Mythread();
      t.setDaemon(true);
- To know whether a thread is daemon or not use isDaemon() method
    - Thread.currentThread().isDaemon();

```
class MyThread extends Thread
{	void message(String str)
	{	try	{
				System.out.println("message="+str);
				Thread.sleep(1000);	}
		catch (InterruptedException e)
		{e.printStackTrace();	}
	}
	public void run()
	{	if (Thread.currentThread().isDaemon())
		{	while (true)
			{	message("print hi ratan");
			}
		}
	}
};
class ThreadDemo
{	public static void main(String[] args)
```

```
	{	MyThread t = new MyThread();
		t.setDaemon(true);//setting daemon nature to Thread
		t.start();
		try{Thread.sleep(5000);}
		catch(InterruptedException e)
		{e.printStackTrace();}
		System.out.println("main thread completed");
	}
};
```

Note :- in above example make the setdaemon() is comment mode then the program never terminates even main thread finished it's execution.

```
class MyThread extends Thread
{	int total;
	public void run()
	{	synchronized(this){
		for (int i=0;i<10 ;i++)
		{	total=total+i;
		}
		notify();
	 }
	}
}
class ThreadDemo
{	public static void main(String[] args)
	{	MyThread t = new MyThread();
		t.start();
		synchronized(t)
		{	System.out.println("MyThrad total is waiting for MyThread completion...");
			try{
			t.wait();}
			catch(InterruptedException ie){System.out.println(ie);}
		}
		System.out.println("MyThrad total is ="+t.total);
	}
};
```

Volatile:-

- Volatile modifier is also applicable only for variables but not for methods and classes.
- If the values of a variable keep on changing such type of variables we have to declare with volatile modifier.
- If a variable declared as a volatile then for every Thread a separate local copy will be created.
- Every intermediate modification performed by that Thread will take place in local copy instead of master copy.
- Once the value got finalized just before terminating the Thread the master copy value will be updated with the local stable value. The main advantage of volatile modifier is we can resolve the data inconsistency problem.
- But the main disadvantage is creating and maintaining a separate copy for every Thread
- Increases the complexity of the programming and effects performance of the system.

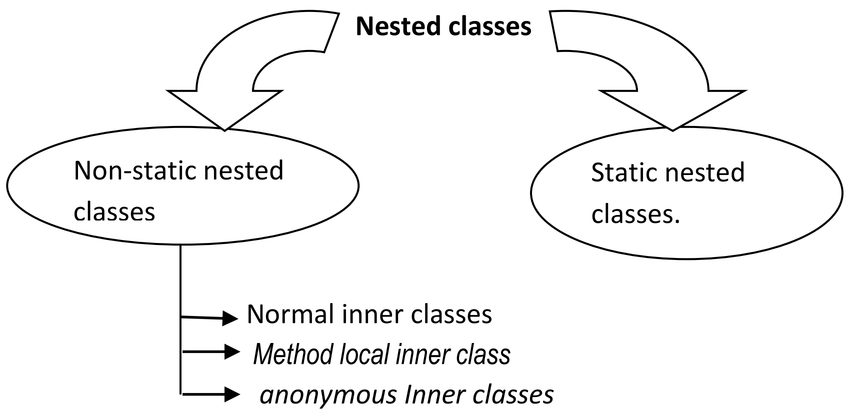
Nested classes

- Declaring the class inside another class is called nested classes. This concept is introduced in the 1.1 version.
- Declaring the methods inside another method is called inner methods java not supporting inner methods concept.

The nested classes are divided into two categories

1. **Static nested classes(nested class declared with static modifier)**
2. **Non static nested classes(these are called inner classes**)
   a. **Normal inner classes**
   b. **Method local inner classes**
   c. **Anonymous inner classes**

Static nested classes:- The nested classes declare as a static modifier is called static nested classes.



syntax of nested classes :-

```
class Outerclasses
{           //static nested class
            static class staticnestedclass
            {           };
            //non-static nested class
            class Innerclass
            {           };
};
```

Uses of nested classes:-

1. **It is the way logically grouping classes that are only used in the one place.**
   If a class is useful to other class only one time then it is logically embedded it into that classes make the two classes together.

A is only one time usage in the B class (without using inner classes)

```
class A
{           };
class B
{           A a=new A();
};
```

by using inner classes

```
class B
{           class A
            {           };
};
```

2. **It increase the encapsulation**

If we are taking two top level classes A and B the B class need the members of A that members even we are declaring private modifier the B class can access the private numbers moreover the B is not visible for outside the world.

3. **It lead the more readability and maintainability of the code**
   Nesting the classes within the top level classes at that situation placing the code is very closer to the top level class.

For the outer classes the compiler will provide the .class and for the inner classes also the compiler will provide the .class file.

The .class file name for the inner classes is **OuterclassName$innerclasssname.class**

Outer class object creation :- Outer o=new Outer();
Inner class object creation :- Outer.Inner i=o.new Inner();
Outer class name :- Outer.class
Inner class name :- Outer$Inner.class

Member inner classes:-

1. If we are declaring any data in outer class then it is automatically available to inner classes.
2. If we are declaring any data in inner class then that data is should not have the scope of the outer class.

Syntax:-

```
class Outer
{    class Inner
     {
     };
};
```

Object creation syntax:-

Syntax 1:-

OuterClassName o=new OuterClassName();
OuterClassName.InnerClassName oi=OuterObjectreference.new InnterClassName();

Syntax 2:-

OuterclassName.InnerClassName oi=new OuterClass().new InnerClass();

Note:- by using outer class name it is possible to call only outer class peroperties and methods and by using inner class object we are able to call only inner classes properties and methods.

Example :-

```
class Outer
{         private int a=100;
          class Inner
          {         void data()
                    {         System.out.println("the value is :"+a);         }
          }
}
class Test
{         public static void main(String[] args)
          {         Outer o=new Outer();
                    Outer.Inner i=o.new Inner();
                    i.data();
          }
};
```

Example :-

```
class Outer
{	int i=100;
	void m1()
	{	//j=j+10;// compilation error
		//System.out.println(j);//compilation error
		System.out.println("m1 method");
	}
	class Inner
	{	int j=200;
		void  m2()
		{	i=i+10;
			System.out.println(i);
		}
	};
};
class Test
{	public static void main(String[] args)
	{	A a=new A();
		System.out.println(a.i);
		a.m1();
		A.B b=a.new B();
		System.out.println(b.j);
		b.m2();
		//b.m1();   compilation error
	}
};
```

Example :-

```
class Outer
{	private int a=10;		private int b=20;
	void m1()
	{	//m2(); not possible
		System.out.println("outer class m1()");
	}
	class Inner
	{	int i=100; int j=200;
		void m2()
		{	System.out.println("inner class m1()");
			System.out.println(a+b);
			System.out.println(i+j);
			m1();
		}
	};
};
class Test
{	public static void main(String... ratan)
	{	Outer o = new Outer();				o.m1();
		Outer.Inner i = o.new Inner();			i.m2();
```

```
        }
};
```

Application required this & super keywords:-

```
class Outer
{       private int a=10;       private int b=20;
        class Inner
        {       int a=100; int b=200;
                void m1(int a,int b)
                {       System.out.println(a+b);//local variables
                        System.out.println(this.a+this.b);//Inner class variables
                        System.out.println(Outer.this.a+Outer.this.b);//outer class variables
                }
        };
};
class Test
{       public static void main(String... ratan)
        {       Outer.Inner i = new Outer().new Inner();
                i.m1(1000,2000);
        }
};

class Outer
{       void m1(){      System.out.println("outer class m1()");   }
        class Inner
        {       void m1()
                {   Outer.this.m1();
                        System.out.println("inner class m1()");
                }
        };
};
class Test
{       public static void main(String... ratan)
        {       Outer.Inner i = new Outer().new Inner();
                i.m1();
        }
};
```

Method local inner classes:-

1. Declaring the class inside the method is called method local inner classes.
2. In the case of the method local inner classes the class has the scope up to the respective method.
3. Method local inner classes do not have the scope of the outside of the respective method.
4. whenever the method is completed
5. we are able to perform any operations of method local inner class only inside the respective method.

Syntax:-

```
class Outer
{       void m1()
        {       class inner
                {               };
        }
};
```

Example:-

```
class Outer
{       private int a=100;
        void m1()
        {       class Inner
                {
                void innerMethod()
                {       System.out.println("inner class method");
                        System.out.println(a);
                }
        };
        Inner i=new Inner();
        i.innerMethod();
        }
};
class Test
{       public static void main(String[] args)
        {       Outer o=new Outer();
                o.m1();
        }
};
class Outer
{       void m1()
        {       class Inner
                {       void m1(){System.out.println("inner class m1()");}
                };
                Inner i =  new Inner();
                i.m1();
        }
        public static void main(String[] args)
        {       Outer o = new Outer();
                o.m1();
        }
};
```

```
class Outer
{       private int a=100;
        void m1()
        {       final int b=200;//local variables must be final variables
                class Inner
                {       void m1()
                        {       System.out.println("inner class m1()");
                                System.out.println(a);
                                System.out.println(b);
                        }
                };
                Inner i =  new Inner();
                i.m1();
        }
        public static void main(String[] args)
        {       Outer o = new Outer();
                o.m1();
        }
};
class Outer
{       int a=10;//instance varaible
        static int b=20; //static variable
        class Inner   //inner class able to access both instance and static variables
        {       void m1()
                {       System.out.println(a);
                        System.out.println(b);
                }
        };
};
class Outer
{       static int a=10;//static variable
        int b=20;               //instance variable
        static class Inner //this inner class able to access only static memebers of outer class
        {               void m1(){
                        System.out.println(a);
                        System.out.println(b);//compilation error
                        }
        };
};
```

Ex 2:-in method local inner classes it is not possible to call the non-final variables inside the inner classes hence we must declare that local variables must be final then only it is possible to access that members.

```
class Outer
{       private int a=100;
        void m1()
        {final int b=1000;
        class Inner
        {       void innerMethod()
                {       System.out.println("inner class method");
```

```
                    System.out.println(a);
                    System.out.println(b);
          }
     };
     Inner i=new Inner();
     i.innerMethod();
     }
};
class Test
{    public static void main(String[] args)
     {    Outer o=new Outer();
          o.m1();
     }
};
```

Static inner classes:-

In general in java classes it is not possible to declare any class as a abstract class but is possible to declare inner class as a static modifier.

Declaring the static class inside the another class is called static inner class.

Static inner classes can access only static variables and static methods it does not access the instace variables and instance methods.

Syntax:-

```
class Outer
{    static class Inner
     {
     };
};
```

```
class Outer
{    static int a=10;
     static int b=20;
     static class Inner
     {    int c=30;
          void  m1()
          {    System.out.println(a);
               System.out.println(b);
               System.out.println(c);
          }
     };
     public static void main(String[] args)
     {    Outer o=new Outer();
          Outer.Inner i=new Outer.Inner();
          i.m1();
     }
};
class Outer
{    static int a=10;//static variable
     static int b=20;//static variable
     static class Inner //this inner class able to access only static memebers of outer class
     {              void m1(){
               System.out.println(a);
```

```
                    System.out.println(b);
                    }
        };
        public static void main(String[] args)
        {       Outer.Inner i = new Outer.Inner();//it creates object of static inner class
                i.m1();
        }
};
class Outer
{       static int a=10;//static variable
        static int b=20;//static variable
        static class Inner //this inner class able to access only static memebers of outer class
        {           void m1(){
                    System.out.println(a);
                    System.out.println(b);
                    }
        };
        public static void main(String[] args)
        {       Outer.Inner i = new Outer.Inner();//it creates object of static inner class
                i.m1();
        }
};
```

Anonymous inner class:-

1. The name less inner class is called anonymous inner class.
2. it can be used to provide the implementation of normal class or abstract class or interface

Anonymous inner classes for abstract classes:-

it is possible to provide abstract method implementations by taking inner classes.

Ex:- we are able to declare anonymousinner class inside the class.

```
abstract class Animal
{       abstract void eat();
};
class Test
{               //anonymous inner class
                Animal a=new Animal()
                {       void eat()      {       System.out.println("animals eating gross");     }
                };
        public static void main(String[] args)
        {       Test t=new Test();
                t.a.eat();
        }
}
```

Functional interface:-

- ✓ *It is introduced in jdk1.8 version & it has exactly one abstract method.*
- ✓ *This interface is also known as single abstract method interface (SAM interface).*
- ✓ *Note that instances of functional interfaces can be created with lambda expressions, method references, or constructor references.*
- ✓ *Java 8 introduced @FunctionalInterface annotation which can be used for compilation errors when the interface you annotated violates the contracts of functional interface.*

Example :
```
@FunctionalInterface
interface Greetings
{	void morning();
}
```
Example : if we declare @functionalInterface annotation but if we are declaring more than one abstract method then compiler will generate error message.
```
@FunctionalInterface
interface Greetings
{		void morning();
		void m1();
}
```
E:\>javac Durga.java
Test.java:1: error: Unexpected @FunctionalInterface annotation @FunctionalInterface
Greetings is not a functional interface
multiple non-overriding abstract methods found in interface Greetings

- ✓ *Functional interface allows only one abstract method it is not allowed second abstract method in functional interface. If we remove @functionalInterface annotation then we are allowed to add second abstract method but it is not a functional interface.*

xample :-
```
interface Executable
{		void execute();
}
class Runner
{		public void run(Executable e)
		{		System.out.println("run method code....");
				e.execute();
		}
};
public class Test
{		public static void main(String[] args)
		{		Runner r = new Runner();
				//anonymous inner class
				r.run(new Executable(){
						public void execute()
						{				System.out.println("execute method block of java code.....");
						}
				});
				//lambda expression
				System.out.println("============");
				r.run(() -> System.out.println("execute method block of code....."));
```

```
        }
};
E:\>java Test
run method code....
execute method block of java code.....
============
run method code....
execute method block of code.....
```

Observation-1:- to write multiple statements(more lines of code).

```
        r.run(() -> {System.out.println("execute method block of code-1.....");
                System.out.println("execute method block of code-2.....");
                });
E:\>java Test
run method code....
execute method block of java code.....
============
run method code....
execute method block of code-1.....
execute method block of code-2.....
```

Example :-

```
interface Executable
{       int execute();
}
class Runner
{       public void run(Executable e)
        {       System.out.println("run method code....");
                int x = e.execute();
                System.out.println("return value="+x);
        }
};
public class Test
{       public static void main(String[] args)
        {       Runner r = new Runner();
                //anonymous inner class
                r.run(new Executable(){
                        public int execute()
                        {       System.out.println("execute method anonymous block of java code.....");
                                return 10;
                        }
                });
                //lambda expression code
                System.out.println("============");
                r.run(() -> {System.out.println("execute method lambda expression code.....");
                                return 20;
                        });
```

```
        }
}
E:\>java Test
run method code....
execute method anonymous block of java code.....
return value=10
=============
run method code....
execute method lambda expression code.....
return value=20
```

Observation:-

If you don't write any code just you want return value use below code

r.run(() -> 20);

```
E:\>java Test
run method code....
execute method anonymous block of java code.....
return value=10
=============
run method code....
return value=20
```

Example :-

```
interface Executable
{       int execute(int a,int b);
}
class Runner
{       public void run(Executable e)
        {       System.out.println("run method code....");
                int x = e.execute(100,200);
                System.out.println("return value="+x);
        }
};
public class Test
{       public static void main(String[] args)
        {       Runner r = new Runner();
                //anonymous inner class code
                r.run(new Executable(){
                        public int execute(int a,int b)
                        {       System.out.println("execute method anonymous block of java code.....");
                                return 10+a;
                        }
                });
                //lambda expression code
                System.out.println("=============");
                r.run((int a,int b) -> 20+a+b);
        }
};
```

```
E:\>java Test
run method code....
execute method anonymous block of java code.....
return value=110
============
run method code....
return value=320
```

Observation :-

```
                    r.run((a,b) -> 20+a);
E:\>java Test
run method code....
execute method anonymous block of java code.....
return value=110
============
run method code....
return value=120
```

Example:- lambda expression ambiguity problems

```
interface Executable
{       int execute(int a);
}
interface StringExecutable
{       int execute(String a);
}
class Runner
{       public void run(Executable e)
        {       System.out.println("run method code....");
                int x = e.execute(10);
                System.out.println("return value="+x);
        }
        public void run(StringExecutable e)
        {       System.out.println("run method code....");
                int x = e.execute("ratan");
                System.out.println("return value="+x);
        }
};
public class Test
{       public static void main(String[] args)
        {       Runner r = new Runner();
                //lambda expression
                System.out.println("============");
                r.run((int a) -> 10);
                r.run((String a) -> 20);
```

```
                    // r.run(a ->100); compilation error: ambiguity problem
        }
};
```

Example :-

```
interface Executable
{       int execute(int a,int b);
}
class Runner
{       public void run(Executable e)
        {       System.out.println("run method code....");
                int x = e.execute(100,200);
                System.out.println("return value="+x);
        }
};
public class Test
{       public static void main(String[] args)
        {       int c=10;
                //c=c+10; must be comments
                Runner r = new Runner();
                //anonymous inner class
                r.run(new Executable(){
                        public int execute(int a,int b)
                        {       System.out.println("execute method anonymous block of java code.....");
                                return a+b+c;
                        }
                });
                //lambda expression
                System.out.println("=============");
                r.run((int a,int b) -> a+b+c);
        }
};
```

```
E:\>java Test
run method code....
execute method anonymous block of java code.....
return value=310
=============
run method code....
return value=310
```

Observation:-

If we remove comments on c=c+10 then we will get fallowing two errors,

```
E:\>javac Test.java
Test.java:20: error: local variables referenced from an inner class must be final or effectively final
                                return a+b+c;
 Test.java:25: error: local variables referenced from a lambda expression must be final or effectively final
            r.run((int a,int b) -> a+b+c);
2 errors
```

Annotations :-(meta data)

- ✓ *Annotations are introduced in 1.5 version it represent metadata of the program.*
- ✓ *Annotations can be used within the packages,classes,methods,constructors…etc*
- ✓ *Annotations are executed by using predefined tool APT(Annotation Processing Tool).*
- ✓ *Annotations are compiled at class file and executed at runtime to perform some logical operations.*
- ✓ *It possible to create the annotations that are not available at runtime.*
- ✓ *And even it is possible to create annotations available in source code and not at compilation time.*

Syntax:-

Annotation can be declared using ‘@’ character as prefix of annotation name.

```
@Annotation
public void annotatedMethod()
{           //logics here
}
```

Annotations has elements in the form of key=value ,the elements are properties of annotation.

```
@Annotataion(name="ratan",age="28")
public void annotatedMethod()
{           //logics here
}
```

If the annotation contains single we can use like this.

```
@Annotataion(“I am hero”)
public void annotatedMethod()
{           //logics here
}
```

It possible to declare multiple annotations at class-level

```
@Annotataion1(name="ratan")
@Annotataion2
public void annotatedMethod()
{           //logics here
}
```

Uses of annotations:-

- ❖ ***Information for the compiler***

  Annotations are used by the compiler to detect suppress warnings or errors based on rules.
  Example :- ***@Override*** *this one makes the compiler to check the method correctly override or not*
  @FunctionalInterface *this one makes the compiler to validate annotated interface is functional interface or not.*
- ❖ ***Documentation***

  Annotations can be used in software applications to ensure the quality of the code like bug finding, report generation…etc
- ❖ ***Code generation***

  Annotations used to generate the code or xml files using meta data information present in the code.
- ❖ ***Runtime processing***

  Annotations that are used in runtime objectives like unit testing, dependency injection…etc

There are three types of annotations

1) *Java built in annotations*
2) *Marker annotations*
3) *Custom annotation*
4) *Meta annotations*

@Override - Checks that the method is an override. Causes a compile error if the method is not found in one of the parent classes or implemented interfaces.

```
@Target(ElementType.METHOD)
@Retention(RetentionPolicy.SOURCE)
public @interface Override {
}
```

@override :-

- ✓ *It instructs the compiler to check parent class method is overriding in child class or not if it is not overriding compiler will generate error message.*
- ✓ *In below example if are not declaring @override annotation a new method of marry(int a) created in child class.*

```
class Parent
{       void marry(String name)
        {   //logics-here  }
};
class Child extends Parent
{       @Override
        void marry(int n)
        { //logics here    }
};
E:\>javac Test.java
error: method does not override or implement a method from a supertype
                @Override
```

@Deprecated - Marks the method as obsolete. Causes a compile warning if the method is used.

This annotation represent the marked element is no longer be used. The compiler generates warning message when we used that marked element.

Example :-

```
@Deprecated
class Test
{       @Deprecated
        void m1()
        {//logics here
        }
}
class Demo
{       public static void main(String[] args)
        {       Test t = new Test();
                t.m1();
        }
```

```
};
E:\>javac Test.java
Note: Test.java uses or overrides a deprecated API.
Note: Recompile with -Xlint:deprecation for details.

E:\>javac -Xlint Test.java
Test.java:10: warning: [deprecation] Test in unnamed package has been deprecated
      Test t = new Test();
Test.java:10: warning: [deprecation] Test in unnamed package has been deprecated
      Test t = new Test();
Test.java:11: warning: [deprecation] m1() in Test has been deprecated
              t.m1();
3 warnings
```

Example -2:-

```
import java.awt.*;
class Student
{       public static void main(String[] args)
        {
                Frame f = new Frame();
                f.show();
        }
};
E:\>javac Test.java
Note: Test.java uses or overrides a deprecated API.
Note: Recompile with -Xlint:deprecation for details.
```

@SuppressWarnings - Instructs the compiler to suppress the compile time warnings specified in the annotation parameters.

```
@Target({TYPE, FIELD, METHOD, PARAMETER, CONSTRUCTOR, LOCAL_VARIABLE})
@Retention(RetentionPolicy.SOURCE)
public @interface SuppressWarnings {
    String[] value();
}
```

Whenever we are using deprecated annotate method then compiler will generate warning messages but to ignore that warning messages use @suppressWarings annotation.

When you compiled below application it won't generate any warnings even it uses @Deprecated annotation.

Example-1 :-

```
class Test
{       @Deprecated
        void m1()
        {//logics here
        }
}
class Demo
{       @SuppressWarnings("deprecation")
        public static void main(String[] args)
        {       new Test().m1();
        }
```

```
};
```

Example-2:-

```
import java.util.*;
class Student
{       @SuppressWarnings("unchecked")
        public static void main(String[] args)
        {       ArrayList al = new ArrayList();
                al.add("ratan");
                al.add("anu");
                al.add("sravya");
                System.out.println(al);
        }
};
```

@SafeVarargs - Suppress warnings for all callers of a method or constructor with a generics varargs parameter, since Java 7.

```
@Documented
@Retention(RetentionPolicy.RUNTIME)
@Target({ElementType.CONSTRUCTOR, ElementType.METHOD})
public @interface SafeVarargs {    }
```

@FunctionalInterface - Specifies that the type declaration is intended to be a functional interface, since Java 8. Annotations applied to other annotations (also known as "Meta Annotations"):

```
@Documented
@Retention(RetentionPolicy.RUNTIME)
@Target(ElementType.TYPE)
public @interface FunctionalInterface {    }
```

Meta annotations:-

- ✓ *it specify information about annotation.*
- ✓ *These annotations are present in **java.lang.annotation** package.*
- ✓ *The meta annotations are*
  - ***@Retention***
  - ***@Target***
  - ***@Documented***
  - ***@Inherited***
  - ***@Repeatable***

***@Retention** annotation specifies how the marked annotation is stored:*

RetentionPolicy.SOURCE

The marked annotation is retained only in the source level and is ignored by the compiler.

RetentionPolicy.CLASS

The marked annotation is retained by the compiler at compile time, but is ignored by the Java Virtual Machine (JVM).

RetentionPolicy.RUNTIME

The marked annotation is retained by the JVM so it can be used by the runtime environment.

@Documented - Marks another annotation for inclusion in the documentation.

Whenever we are using this annotation those elements should be documented by using javadoc tool.

@Target

- *Marks another annotation to restrict what kind of Java elements the annotation may be applied to.*
- *The target annotation specify one of the fallowing element,*

ElementType.ANNOTATION_TYPE	*can be applied to an annotation type.*
ElementType.CONSTRUCTOR	*can be applied to a constructor.*
ElementType.FIELD	*can be applied to a field or property.*
ElementType.LOCAL_VARIABLE	*can be applied to a local variable.*
ElementType.METHOD	*can be applied to a method-level annotation.*
ElementType.PACKAGE	*can be applied to a package declaration.*
ElementType.PARAMETER	*can be applied to the parameters of a method.*
ElementType.TYPE	*can be applied to any element of a class.*

@Inherited –

Marks another annotation to be inherited to subclasses of annotated class (by default annotations are not inherited to subclasses).

Example :-

```
@Target({ElementType.METHOD, ElementType.CONSTRUCTOR})
@Retention(RetentionPolicy.RUNTIME)
@Inherited
@Documented
public @interface MyAnnotation
{    }
```

- *In above example your annotation can be applied only on methods & constructors because you specified this information by using **@Target** annotation.*
- *This annotation is used by JVM at runtime because we specified this information by using @Retention.*
- *Basically parent class annotation is not visible in child classes but it is possible to inherit parent call annotation in child class by using @Inherited annotation.*
- *we can create documentation by using javadoc tool because we declared annotation by using @Documented annotation.*

@Repeatable - Specifies that the annotation can be applied more than once to the same declaration, since Java 8.

<u>Customized Annotations:-</u>

- *Annotations can be created by using @interface fallowed by annotation name.*
  public @interface MyAnnotation
  { }
- *Every annotation is extending java.lang.annotation.Annotation interface hence annotation can't include extend clause.*
  public interface MyAnnotation extends Annotation
  {
  }
-

Example :-
File-1: ProjectInfo.java

```
import java.lang.annotation.*;
@Target({ElementType.TYPE})
@Retention(RetentionPolicy.RUNTIME)
@Inherited
@Documented
public @interface ProjectInfo
{	int pid();
	String pname() default "bank";
	int pteamsize();
	String pstatus();
}
```

File-2:- Emp.java

```
import java.lang.annotation.*;
@ProjectInfo(pid=111,pstatus="not released",pteamsize=5)
class Emp
{	int eid;
	String ename;
	Emp(int eid,String ename)
	{	this.eid=eid;
		this.ename=ename;
	}
	void disp()
	{	System.out.println("***Employee details***");
		System.out.println("emp id="+eid);
		System.out.println("emp name="+ename);
	}
	public static void main(String[] args)
	{	Emp e = new Emp(111,"ratan");
		e.disp();
		Class c = e.getClass();
		Annotation a = c.getAnnotation(ProjectInfo.class);
		ProjectInfo p = (ProjectInfo)a;
		System.out.println("***project details details***");
		System.out.println("project id="+p.pid());
		System.out.println("project name="+p.pname());
		System.out.println("project status="+p.pstatus());
```

```
                System.out.println("project teamsize="+p.pteamsize());
        }
}
```

Observation :-

```
E:\>javadoc Emp.java
Loading source file Emp.java...
Constructing Javadoc information...
Standard Doclet version 1.8.0_65
Building tree for all the packages and classes...
```

Observation :-

```
@Target({ElementType.METHOD})                                    //method level we can use

@ProjectInfo(pid=111,pstatus="not released",pteamsize=5)      //but we are using at class level
public class Emp
{  //logics here   }

E:\>javac Emp.java
Emp.java:2: error: annotation type not applicable to this kind of declaration
@ProjectInfo(pid=111,pstatus="not released",pteamsize=5)
```

Observation :-

```
@Retention(RetentionPolicy.SOURCE)    // ignored at source file level     or
@Retention(RetentionPolicy.CLASS)        //ignored at class level
E:\>java Emp
***Employee details***
emp id=111
emp name=ratan
***project details details***
Exception in thread "main" java.lang.NullPointerException
```

Observation :-

```
@Documented   //if we removed this annotation the documentation is not performed
```

ENUMARATION

1. This concept is introduced in 1.5 version
2. enumeration is used to declare group of named constant s.
3. we are declaring the enum by using enum keyword. For the enums the compiler will generate .classess
4.enum is a keyword and **Enum** is a class and every enum is directl child class of **java.lang.Enum** so it is not possible to inherit the some other class. Hence for the enum inheritance concept is not applicable
5. by default enum constants are **public static final**

```
enum Heroin
{
      Samantha,tara,ubanu ;
}
```

```
enum Week
{
public static final smantha;
public static final  tara;
Public static final  ubanu;
}
```

EX:-calling of enum constants individually

```
enum Heroin
{
          samantha,tara,anu;
}
class Test
{
          public static void main(String... ratan)
          {
          Heroin s=Heroin.samantha;
          System.out.println(s);
          Heroin t=Heroin.tara;
          System.out.println(t);
          Heroin a=Heroin.anu;
          System.out.println(a);
          }
};
```

EX:-
1. printing the enumeration constants by using for-each loop.
2. values() methods are used to print all the enum constants.
3. **ordinal() is used to print the index values of the enum constants.**

```
enum Heroin
{
          samantha,tara,anu;
}
class Test
{
          public static void main(String... ratan)
          {
                    Heroin[] s=Heroin.values();
                    for (Heroin s1:s)
                    {
System.out.println(s1+"----"+s1.ordinal());
                    }
          }
};
```

1. inside the enum it is possible to declare constructors. That constructors will be ececuted for each and every constant. If we are declaring 5 constants then 5 times constructor will be executed.
2. Inside the enum if we are declaring only constants the semicolon is optional.
3. Inside the enum if we are declaring group of constants and constructors at that situation the group of constants must be first line of the enum must ends with semicolon.

Ex :-Semicolan optinal

```
enum Heroin
{       samantha,tara,anu,ubanu
}
class Test
{       public static void main(String... ratan)
        {       Heroin s=Heroin.samantha;
        }
};
```

Ex:- semicolon mandatory

```
enum Heroin
{       samantha,tara,anu,ubanu;
        Heroin()
        {       System.out.println("ratan sir");
        }
}
class Test
{       public static void main(String... ratan)
        {       Heroin s=Heroin.samantha;
        }
};
```

Ex:- constructors with arguments

```
enum Heroin
{       ANUSHKA,UBANU(10),DEEPIKA(10,20);
        Heroin()        {       System.out.println("ratan");    }
        Heroin(int a)   {       System.out.println("raghava");  }
        Heroin(int a,int b)     {       System.out.println("sanki");    }
}
class Test
{       public static void main(String[] arhss)
        {       Heroin[] h =    Heroin.values();
                for (Heroin h1 : h)
                {       System.out.println(h1+"----"+h1.ordinal());
                }
        }
};
```

Ex:-inside the enum it is possible to provide main method.

```
enum Heroin
{       samantha,tara,anu;
        public static void main(String[] args)
        {       System.out.println("enum main method");
        }
}
class Test
{       public static void main(String... ratan)
        { Heroin[] s=Heroin.values();
                for (Heroin s1:s)
                {       System.out.println(s1+"--------"+s1.ordinal());
                }
        }
};
```

Ex:- inside the enums it is possible to declare group of constants and constructors and main method

```
enum Heroin
{
	//group of constants
	ANUSHKA,UBANU,DEEPIKA;
	//contructor
	Heroin()
	{	System.out.println("ratan");
	}
	//enum  main method
	public static void main(String[] args)
	{
		System.out.println("enum m ain method");
	}//end main
}//end enum
class Test
{	public static void main(String[] arhss)
	{	//accessing enum constants
		Heroin[] h =	Heroin.values();
		for (Heroin h1 : h)
		{
			System.out.println(h1+"----"+h1.ordinal());
		}
	}//end main
};//end class
```

Collections framework (java.util)

Pre-requisite topics for Collections framework:-

1) ***Arrays***
2) ***toString() method.***
3) ***type-casting.***
4) ***interfaces.***
5) ***for-each loop.***
6) ***implementation classes.***
7) ***compareTo() method.***
8) ***Wrapper classes.***
9) ***Marker interfaces advantages.***
10) ***Anonymous inner classes.***
11) ***For-each loop***
12) ***Auto-boxing***

Importance of collections:-

- The main objective of collections framework is to represent group of object as a single entity.
- In java Collection framework provide very good architecture to store and manipulate the group of objects.
- Collection API contains group of classes and interfaces that makes it easier to handle group of objects.
- Collections are providing flexibility to store, retrieve, and manipulate data.

The key interfaces of collection framework:-

1. ***Java.util.Collection***
2. ***Java.util.List***
3. ***Java.util.*Set**
4. ***Java.util.*SortedSet**
5. ***Java.util.*NavigablaSet**
6. ***Java.util.*Queue**
7. ***Java.util.*Map**
8. ***Java.util.*SotedMap**
9. ***Java.util.*NavigableMap**
10. ***Map.Entry***
11. ***Java.util.Enumeration***
12. ***Java.util.Iterator***
13. ***Java.util.ListIterator***
14. ***Java.lang.Comparable***
15. ***Java.util.Comparator***

- All collection framework classes and interfaces are present in ***java.util*** package.
- The root interface of Collection framework is **Collection.**
- Collection interface contains 15 methods so all collection implementation classes are able to use these methods because collections is a root interface.

Collection interface methods:-

To check the predefined support use javap command.

>javap java.util.Collection

```
public abstract int size();
public abstract boolean isEmpty();
public abstract boolean contains(java.lang.Object);
public abstract java/util/Iterator<E> iterator();
public abstract java.lang.Object[] toArray();
public abstract <T extends java/lang/Object> T[] toArray(T[]);
public abstract boolean add(E);
public abstract boolean remove(java.lang.Object);
public abstract boolean containsAll(java/util/Collection<?>);
public abstract boolean addAll(java/util/Collection<? extends E>);
public abstract boolean removeAll(java/util/Collection<?>);
public abstract boolean retainAll(java/util/Collection<?>);
public abstract void clear();
public abstract boolean equals(java.lang.Object);
public abstract int hashCode();
```

Iinterface contains abstract method and for that interfaces object creation is not possible hence think about implementation classes of that interfaces.

Collection vs Collections:-

Collection is interface it is used to represent group of objects as a single entity.
Collections is utility class it contains methods to perform operations.

Arrays vs Collections:-

Both Arrays and Collections are used to represent group of objects as a single entity but the differences are as shown below.

Limitations of Arrays

1) *Arrays are used to represent group of objects as a single entity.*
2) *Arrays are used to store homogeneous data(similar data).*
3) *Arrays are capable to store primitive & Object type data*
4) *Arrays are fixed in size, it means once we created array it is not possible to increase & decrease the size based on our requirement.*
5) *With respect to memory arrays are not recommended to use.*
6) *If you know size in advance arrays are recommended to use because it provide good performance.*
7) *Arrays does not contains underlying Data structure hence it is not supporting predefined methods.*
8) *While working with arrays operations(add,remove,update…) are become difficult because it is not supporting methods.*

Advantages of Collections

1) *Collections are used to represent group of objects as a single entity.*
2) *Collections are used to store both heterogeneous data(different type)& homogeneous data.*
3) *Collections are capable to store only object data.*
4) *Collections are growable in nature, it means based on our requirement it is possible to increase & decrease the size.*
5) *With respect to memory collections are recommended to use.*
6) *In performance point of view collections will give low performance compare to arrays.*
7) *Collection classes contains underlying data structure hence it supports predefined methods.*
8) *Here operations are become easy because collections supports predefined methods.*

Characteristics of Collection frame work classes:-

The collections framework contains group of classes but every class is used to represent group of objects as a single entity but characteristics are different.

1) ***The collect ion framework classes introduced Versions***
   Different classes are introduced in different versions.

2) ***Heterogeneous data allowed or not allowed.***
   All most all collection framework classes allowed heterogeneous data except two classes
   i. TreeSet ii. TreeMap

3) ***Null insertion is possible or not possible.***
   Some classes are allowed null insertion but some classes are not allowed.

4) ***Duplicate objects are allowed or not allowed.***
   Inserting same object more than one time is called duplication. Some classes are allowed duplicates but some classes are not allowed duplicates.
   add(e1)
   add(e1)

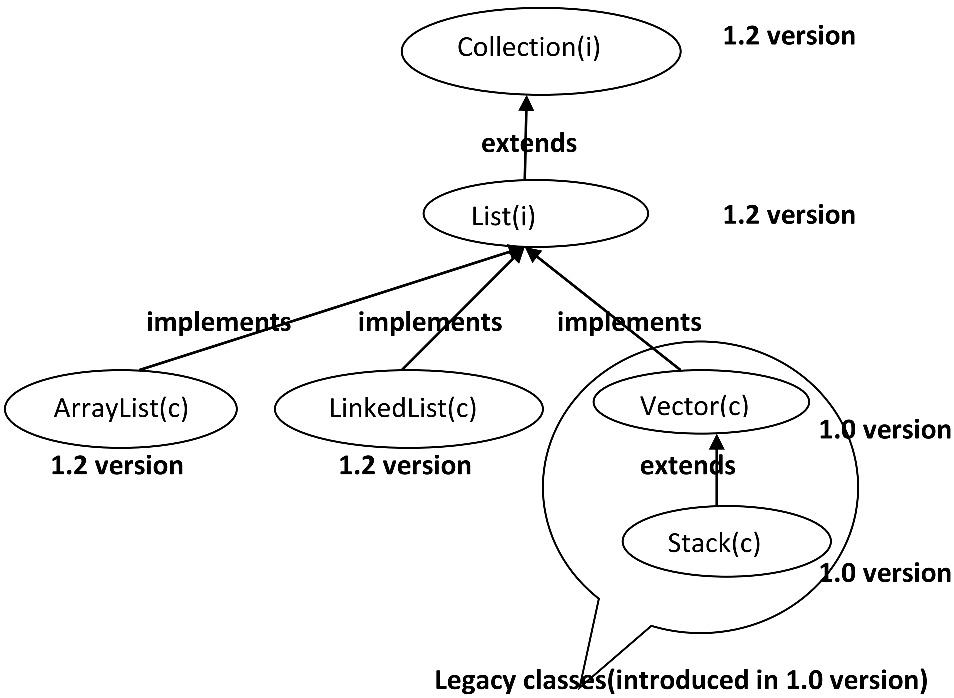
5) ***Insertion order is preserved or not preserved.***
   In which order we are inserting element same order output is printed then say insertion order is preserved otherwise not.
   Input --->e1 e2 e3 output --->e1 e2 e3 insertion order is preserved
   Input --->e1 e2 e3 output --->e2 e1 e3 insertion order is not-preserved

6) ***Collection classes' methods are synchronized or non-synchronized.***
   If the methods are synchronized only one thread is allow to access, these methods are thread safe but performance is reduced.
   If the methods are non-synchronized multiple threads are able to access, these methods are not thread safe but performance is increased.

7) ***Collection classes underlying data structures.***
   Arrays are does not contains underlying data structure hence it is not supporting predefined methods.
   Every collection class contains underlying data structure hence it supports predefined methods.
   Based on underlying data structure the element will be stored.

8) ***Collection classes supported cursors.***
   The collection classes are used to represent group of objects as a single entity & To retrieve the objects from collation class we are using cursors.

List interface:-



I = Interface c=class

Implementation classes of List interface :-

1) *ArrayList*
2) *LinkedList*
3) *Vector*
4) *Stack*

Legacy classes:-

The java classes which are introduced in 1.0 version are called legacy classes and ***java.util*** *package contains 5 legacy classes.*

1) *Dictionary*
2) *HashTable*
3) *Properties*
4) *Stack*
5) *Vector*

Legacy interfaces:-

The java interfaces which are introduced in 1.0 version are called legacy interfaces and ***java.util*** *package contains only one interface is* ***Enumeration****.*

List interface common properties:-

1) *All list class allows heterogeneous data.*
2) *All List interface implementation classes allows null insertion.*
3) *All classes allows duplicate objects.*
4) *All classes preserved insertion order.*

Java.util.ArrayList:-

To check parent class and interface use below command.

D:\ratan>javap java.util.ArrayList

public class java.util.ArrayList<E>

extends *java.util.AbstractList<E>*
implements *java.util.List<E>,*
java.util.RandomAccess,
java.lang.Cloneable,
java.io.Serializable

ArrayList Characteristics:-

1) ArrayList Introduced in 1.2 version.
2) ArrayList stores Heterogeneous objects(different types).
3) In ArrayList it is possible to insert **Null** objects.
4) Duplicate objects are allowed.
5) ArrayList preserved Insertion order it means whatever the order we inserted the data in the same way output will be printed.
6) ArrayList methods are non-synchronized methods.
7) The under laying data structure is growable array.
8) By using cursor we are able to retrieve the data from ArrayList : ***Iterator , ListIterator***

Constructors to create ArrayList:-

Constructor-1:-

ArrayList al = new ArrayList();

The default capacity of the ArrayList is 10 once it reaches its maximum capacity then size is automatically increased by ***New capacity = (old capacity*3)/2+1***

Constructor-2:-

ArrayList al = new ArrayList (int initial-capacity);

It is possible to create ArrayList with initial capacity

Constructor-3:-

ArrayList al = new ArrayList(Collection c);

Adding one collection data into another collection(Vector data intoArrayList) use fallowing constructor.

Example :-

Collections vs Autoboxing

Up to 1.4 version we must create wrapper class object then add that object into ArrayList.

```
import java.util.ArrayList;
class Test
{         public static void main(String[] args)
          {         ArrayList al = new ArrayList();
                    Integer i = new Integer(10);           //creation of Integer Object
                    Character ch = new Character('c');     //creation of Character Object
                    Double d = new Double(10.5);           //creation of Double  Object
                    //adding wrapper objects into ArrayList
                    al.add(i);
                    al.add(ch);
                    al.add(d);
                    System.out.println(al);
```

```
	}
}
```

From 1.5 version onwards add the primitive data into ArrayList that data is automatically converted into wrapper object format is called Autoboxing.

Code before compilation:-

```
import java.util.ArrayList;
class Test
{	public static void main(String[] args)
	{	ArrayList al = new ArrayList();
		al.add(10);   //AutoBoxing
		al.add('a'); //AutoBoxing
		al.add(10.5);//AutoBoxing
		System.out.println(al);
	}
}
```

Code after compilation:-

```
import java.io.PrintStream;
import java.util.ArrayList;
class Test
{  Test()
   {
   }
   public static void main(String args[])
   {  ArrayList arraylist = new ArrayList();
      arraylist.add(Integer.valueOf(10));
      arraylist.add(Character.valueOf('a'));
      arraylist.add(Double.valueOf(10.5));
      System.out.println(arraylist);
   }
}
```

*Example-2:-**ArrayList   vs toString()***

Emp.java:-

```
class Emp
{	int eid;
	String ename;
	Emp(int eid,String ename)
	{	this.eid=eid;
		this.ename=ename;
	}
}
```

Student.java

```
class Student
{	int sid;
	String sname;
	Student(int sid,String sname)
	{	this.sid=sid;
		this.sname = sname;
	}
}
```

Case 1:-

In java when we print reference variable internally it calls toString() method on that object.

```
import java.util.ArrayList;
class Test
{	public static void main(String[] args)
	{	Emp e1 = new Emp(111,"ratan");
		Student s1 = new Student(222,"xxx");
		ArrayList al = new ArrayList();
		al.add(10);			//toString()
		al.add('a');			//toString()
		al.add(e1);			//toString()
		al.add(s1);			//toString()
		System.out.println(al);			//[10, a, Emp@d70d7a, Student@b5f53a]
		System.out.println(al.toString());	//[10, a, Emp@d70d7a, Student@b5f53a]
	}
}
```

Case2:-

```
import java.util.ArrayList;
class Test
{	public static void main(String[] args)
	{	Emp e1 = new Emp(111,"ratan");
		Student s1 = new Student(222,"xxx");
		ArrayList al = new ArrayList();
		al.add(10);
		al.add('a');
		al.add(e1);
		al.add(s1);
		System.out.println(al.toString());	//[10, a, Emp@d70d7a, Student@b5f53a]
		for (Object o : al)
		{	if (o instanceof Integer)
			System.out.println(o.toString());
			if (o instanceof Character)
			System.out.println(o.toString());
			if (o instanceof Emp){
				Emp e = (Emp)o;
				System.out.println(e.eid+"---"+e.ename);
			}
			if (o instanceof Student){
				Student s = (Student)o;
				System.out.println(s.sid+"---"+s.sname);
			}
		}
	}
}
```

Example:- Basic operations of ArrayList

add() *to add the objects into ArrayList & bydefault it add the data at last but it is possible to insert the data at specified index.*

remove() *it removes Objects from ArrayList based on Object & index.*
(for the remove(10) method if we are passing integer value that is always treted as index)

size() *to find the size of ArrayList.*

isEmpty() *to check the objects are available or not.*

Clear() *to remove all objects from ArrayList.*

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	ArrayList al =new ArrayList();
		al.add(10);
		al.add("ratan");
```

```
                al.add("anu");
                al.add('a');
                al.add(10);
                al.add(null);
                System.out.println("ArrayList data="+al);
                System.out.println("ArrayList size-->"+al.size());
                al.add(1,"A1");                    //add the object at first index
                System.out.println("after adding objects ArrayList size-->"+al.size());
                System.out.println("ArrayList Data="+al);
                al.remove(1);             //remove the object index base
                al.remove("A");           //remove the object on object base
                System.out.println("after removeing elemetns arrayList size "+al.size());
                System.out.println("ArrayList data="+al);
                System.out.println(al.isEmpty());
                al.clear();
                System.out.println(al.isEmpty());
        }
}
```

E:\>java Test
ArrayList data=[10, ratan, anu, a, 10, null]
ArrayList size-->6
after adding objects ArrayList size-->7
ArrayList Data=[10, A1, ratan, anu, a, 10, null]
after removeing elemetns arrayList size 6
ArrayList data=[10, ratan, anu, a, 10, null]
false
true

observation:-

in above example when we remove the data by passing numeric value that is by default treated as a index value.

```
ArrayList al = new ArrayList();
al.add(10);
al.add("ratan");
al.add('a');
System.out.println(al);
al.remove(10);   // 10 is taken as index value
```

whenever we are executing above code then JVM treats that 10 is index value but 10th position value is not available hence it is generating exception ***java.lang.IndexOutOfBoundsException: Index: 10, Size: 3***

in above case to remove 10 Integer object then use below code.

```
ArrayList al = new ArrayList();
Integer i = new Integer(10);
al.add(i);
al.remove(i);
System.out.println(al);
```

All collection classes are having 2-formats:-

1) *Normal version (no type safety).*
2) *Generic version. (provide type safety)*

The main purpose of the generics is to provide the type safety to avoid type casting problems.

Arrays [Type safety]:-

Arrays are always type safe it means we can give guarantee for the type of element present in arrays.

For example if we want to store String objects create String[]. By mistake if we are trying to add any other data compiler will generate compilation error.

Example:-

```
String[] str= new String[50];
str[0]="ratan";
str[1]="anu";
str[2]=new Integer(10);
```

```
E:\>javac Test.java
        incompatible types
         str[2]=new Integer(10);
 required: String
 found:    Integer
```

Based on above error we can give guarantee String[] is able to store only String type of objects. Hence with respect to the type arrays are recommended to use because it is type safe.

[Collection]Not type safe:-

Collections are not type safe it means we can't give guarantee for the type of elements present in collection.

If programming requirement is to hold the String type of the objects we are choosing ArrayList , by mistake if we are adding any type of data then compiler is unable to generate compilation error but runtime program is failed.

Example :-

```
ArrayList al = new ArrayList();
al.add("ratan");
al.add("anu");
al.add(new Integer(10)); //allowed
String s1 = (String)al.get(0);
String s2 = (String)al.get(1);
String s3 = (String)al.get(2);//java.lang.ClassCastException
```

Based on above exception we can decide collection is not type safe.

Example :-

```
ArrayList al = new ArrayList();
al.add("ratan");
String str = l.get(0); // java.lang.ClassCastException
String str =(String l.get(0); //type casting is mandatory
```

In above example type-casting is mandatory it is bigger problem in collection.

To overcome above problems use generics,

1) ***To provide type safety.***
2) ***To overcome type casting problems.***

in java it is recommended to use generic version of collections to provide the type safety.

Syntax:-

*ArrayList**<type-name> al = new ArrayList**<type-name>**( );***

The ArrayList is able to store only String data if we are trying to add any other data compiler will generate error message.

Example :-
```
ArrayList<String> al = new ArrayList<String>();
al.add("ratan");
al.add("anu");
al.add(new Integer(10));   //compilation error
```

if we are using generics we will get type safety. At the time retrieval not required to perform type casting.

```
ArrayList<String> al = new ArrayList<String>();
al.add("ratan");
String s1 = al.get(0);
```

Normal version of ArrayList(no type safety)

1) *Normal version is able to hold any type of data(heterogeneous data) hence it is not a type safe.*
```
ArrayList al = new ArrayList();
al.add(10);
al.add('a');
System.out.println(al);
```
2) *At the time of retrieval Always check the type of the object by using **instanceof** operator.*
3) *In normal it is holding different types of data hence while retrieving data must perform **type casting.***
4) *If we are using normal version while compilation compiler generate worning message like **unchecked or unsafe operations.***

Example:- normal version of ArrayList
```
import java.util.*;
class Test
{   public static void main(String[] args)
    {       ArrayList al = new ArrayList();
            al.add(10);
            al.add('a');
            al.add(10.4);
            System.out.println(al);
    }
}
```

Generic version of ArrayList(type safety)

1) Generic version is able to hold specified type of data hence it is a type safe.

ArrayList<tye-name> al = new ArrayList<type-name>( );

```
ArrayList<Integer> al = new ArrayList<Integer>();
    al.add(10);
    al.add(20);
    al.add("ratan");//compilation error
    System.out.println(al);
```

2) Type checking is not required because it contains only one type of data.
3) It is holding specific data hence at the time of retrieval type casting is not required.
4) If we are using generic version compiler won't generate worning messages.

Example :- generic version of ArrayList.
```
import java.util.*;
class Test
{       public static void main(String[] args)
{ArrayList<Integer> al = new ArrayList<Integer>();
```

```
al.add(10);
al.add(20);
al.add(30);
al.add(40);
System.out.println(al);
	}
}
```

Example :- ***retrieving data from generic version of ArrayList.***

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	ArrayList<Emp> al = new ArrayList<Emp>();
		al.add(new Emp(111,"ratan"));
		al.add(new Emp(222,"anu"));
		al.add(new Emp(333,"Sravya"));
		for (Emp e : al)
		{	System.out.println(e.eid+"---"+e.ename);
		}
	}
}
```

Example :-

add(E); ***---->to add the Object.***
remove(java.lang.Object); ***----->to remove the object.***
addAll(); ***------>to add one collection object into another collection.***
contains() ***-----→to check object is available or not.***
containsAll() ***----→to check entire collection data is available or not.***

Example:-

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	Emp e1 = new Emp(111,"ratan");
		Emp e2 = new Emp(222,"Sravya");
		Emp e3 = new Emp(333,"aruna");
		Emp e4 = new Emp(444,"anu");

		ArrayList<Emp> a1 = new ArrayList<Emp>();
		a1.add(e1);
		a1.add(e2);

		ArrayList<Emp> a2 = new ArrayList<Emp>();
		a2.addAll(a1);
		a2.add(e3);
		a2.add(e4);

		System.out.println(a2.contains(e1));
		System.out.println(a2.containsAll(a1));
		a2.remove(e1);
		System.out.println(a2.contains(e1));
		System.out.println(a2.containsAll(a1));
		//printing the data
		for (Emp e:a2)
```

```
                    {       System.out.println(e.eid+"---"+e.ename);
                    }
          }
}
```

```
E:\>java Test
true
true
false
false
222---Sravya
333---aruna
444---anu
```

Example :-

removeAll(Obj):-

*a2.removeAll(a1); // it removes all **a1** data.*

retainAll(Obj):-

*a2.retainAll(a1); // it removes all **a2** data except **a1***

```
import java.util.*;
class Test
{         public static void main(String[] args)
          {         ArrayList<Emp> a1 = new ArrayList<Emp>();
                    a1.add(new Emp(111,"ratan"));
                    a1.add(new Emp(222,"Sravya"));

                    ArrayList<Emp> a2 = new ArrayList<Emp>();
                    a2.addAll(a1);
                    a2.add(new Emp(333,"aruna"));
                    a2.add(new Emp(444,"anu"));

                    a2.removeAll(a1);
                    a2.retainAll(a1);
                    for (Emp e:a2)
                    {         System.out.println(e.eid+"---"+e.ename);
                    }
          }
}
```

Creation of sub ArrayList & swapping data :-

*Create sub ArrayList by using **subList(int,int)** method of ArrayList.*

public java.util.List<E> subList(int, int);

*to swap the data from one index position to another index position then use **swap()** method of Collections class.*

public static void swap(java.util.List<?>, int, int);

```
import java.util.*;
```

```
class Test
{	public static void main(String[] args)
	{	ArrayList<String> a1 = new ArrayList<String>();
		a1.add("ratan");
		a1.add("anu");
		a1.add("Sravya");
		a1.add("yadhu");
		ArrayList<String> a2 = new ArrayList<String>(a1.subList(1,3));
		System.out.println(a2);		//[anu,Sravya]
		ArrayList<String> a3 = new ArrayList<String>(a1.subList(1,a1.size()));
		System.out.println(a3);		//[anu,Sravya,yadhu]

		//java.lang.IndexOutOfBoundsException: toIndex = 7
		//ArrayList<String> a4 = new ArrayList<String>(a1.subList(1,7));
		System.out.println("before swapping="+a1);//[ratan, anu, Sravya, yadhu]
		Collections.swap(a1,1,3);
		System.out.println("after swapping="+a1);// [ratan, yadhu, Sravya, anu]
	}
}
```

<u>ArrayList Capacity:-</u>

```
import java.util.*;
import java.lang.reflect.Field;
class Test
{	public static void main(String[] args)throws Exception
	{	ArrayList<Integer> al  = new ArrayList<Integer>(5);
		for (int i=0;i<10 ;i++)
		{	al.add(i);
			System.out.println("size="+al.size()+" capacity="+getcapacity(al));
		}
	}
	static int getcapacity(ArrayList l)throws Exception
	{	Field f = ArrayList.class.getDeclaredField("elementData");
		f.setAccessible(true);
		return ((Object[])f.get(l)).length;
	}
}
D:\>java Test
size=1 capacity=5
size=2 capacity=5
size=3 capacity=5
size=4 capacity=5
size=5 capacity=5
size=6 capacity=8
size=7 capacity=8
size=8 capacity=8
size=9 capacity=13
```

size=10 capacity=13

Different ways to initialize values to ArrayList:-

Case 1:initializing ArrayList by using asList()

```
import java.util.*;
class ArrayListDemo
{	public static void main(String[] args)
	{	ArrayList<String> al = new ArrayList<String>(
		Arrays.asList("ratan","Sravya","anu"));
		System.out.println(al);
	}
}
```

Case 2:- adding objects into ArrayList by using anonymous inner classes.

```
import java.util.ArrayList;
class ArrayListDemo
{	public static void main(String[] args)
	{	ArrayList<String> al = new ArrayList<String>()
		{	{add("anu");
			 add("ratan");
			}
		};//semicolan is mandatory
		System.out.println(al);
	}
}
```

Case 3:- normal approach to initialize the data

```
import java.util.ArrayList;
class ArrayListDemo
{	public static void main(String[] args)
	{	ArrayList<String> al = new ArrayList<String>();
		al.add("anu");
		al.add("Sravya");
		System.out.println(al);
	}
}
```

Case 4:-

ArrayList<Type> obj = new ArrayList<Type>(Collections.nCopies(count, object));

```
import java.util.*;
class ArrayListDemo
{	public static void main(String[] args)
	{	Emp e1 = new Emp(111,"ratan");
		ArrayList<Emp> al = new ArrayList<Emp>(Collections.nCopies(5,e1));
		for (Emp e:al)
```

```
		{	System.out.println(e.ename+"---"+e.eid);
		}
	}
}
```

Case 5:-adding Objects into ArrayList by using addAll() method of Collections class.

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	ArrayList<String> al = new ArrayList<String>();
		String[] strArray={"ratan","anu","Sravya"};
		Collections.addAll(al,strArray);
		System.out.println(al);
	}
}
```

Q. ***How to get synchronized version of ArrayList?***

Ans:- by default ArrayList methods are synchronized but it is possible to get synchronized version of ArrayList by using fallowing method.

To get synchronized version of List interface use fallowing Collections class static method

public static List synchronizedList(List l)

To get synchronized version of Set interface use fallowing Collections class static method

public static Set synchronizedSet(Set s)

To get synchronized version of Map interface use fallowing Collections class static method

public static Map synchronized Map(Map m)

to get synchronized version of TreeSet use fallowing Collections class static method

Collections.synchronizedSortedSet(SortedSet<T> s)

to get synchronized version of TreeMap use fallowing Collections class static method

Collections.synchronizedSortedMap(SortedMap<K,V> m)

Example:-

```
ArrayList al = new ArrayList();                   //non- synchronized version of ArrayList
List l = Collections.synchronizedList(al);        // synchronized version of ArrayList

HasSet h = new HashSet();                         //non- synchronized version of HashSet
Set h1  = Collections.synchronizedSet(h);         // synchronized version of HashSet

HashMap h = new HashMap();                        //non- synchronized version of HashMap
Map m = Collections.synchronizedMap(h);           // synchronized version of HashMap

TreeSet t = new TreeSet();                                  //non- synchronized version of TreeSet
SortedSet s  = Collections.synchronizedSortedSet(t);        // synchronized version of TreeSet

TreeMap t = new TreeMap();                                  //non- synchronized version of TreeMap
SortedMap  s  = Collections.synchronizedSortedMap(t);       // synchronized version of TreeMap
```

Conversion of Arrays to ArrayList & ArrayList to Arrays:

Example-1:

Conversion of String array to ArrayList (by using asList() method):-

```
import java.util.*;
class ArrayListDemo
{	public static void main(String[] args)
	{	String[] str={"ratan","Sravya","aruna"};
		ArrayList<String> al = new ArrayList<String>(Arrays.asList(str));
		al.add("newperson-1");
		al.add("newperson-2");
		//printing data by using enhanced for loop
		for (String s: al)
		{	System.out.println(s);
		}
	}
}
```

Example-2:-

Conversion of ArrayList to String array by using toArray(T)

public abstract <T extends java/lang/Object> T[] toArray(T[]);

```
import java.util.*;
class ArrayListDemo
{	public static void main(String[] args)
	{	//interface ref-var & implementaiton  class Object
		List<String> al = new ArrayList<String>();
		al.add("anu");
		al.add("Sravya");
		al.add("ratan");
		al.add("natraj");
		String[] a = new String[al.size()];
		al.toArray(a);
		//for-each loop to print the data
		for (String s:a)
		{System.out.println(s);
		}
	}
}
```

Example-3:-

Case-1 :- conversion of ArrayList to Array

public abstract java.lang.Object[] toArray();

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	ArrayList al = new ArrayList();
		al.add(10);
		al.add('c');
		al.add("ratan");
		//converison of ArrayList to array
		Object[] o = al.toArray();
		for (Object oo :o)
		{	System.out.println(oo);
		}
	}
}
```

Case-2 :-

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	ArrayList al = new ArrayList();
		al.add(new Emp(111,"ratan"));
		al.add(new Student(1,"xxx"));
		al.add("ratan");
		//converison of ArrayList to array
		Object[] o = al.toArray();
		for (Object oo :o)
		{	if (oo instanceof Emp)
			{	Emp e = (Emp)oo;
				System.out.println(e.eid+"---"+e.ename);
			}
			if (oo instanceof Student)
			{	Student s = (Student)oo;
				System.out.println(s.sid+"---"+s.sname);
			}
			if (oo instanceof String)
			{	System.out.println(oo.toString());
			}
		}
	}
}
```

<u>Cursors in Collections:</u>

<u>Property</u>	***<u>Enumeration</u>***
1. Purpose	*1) Used to retrieve the data from collection classes.*
2. Legacy or not	*2) Introduced in 1.0 version it is legacy*
3. Applicable for which type of classes	3) It is used to retrieve the data from only legacy classes like vector, Stack…etc
4. Universal cursor or not	4) Not a universal cursor because it is applicable for only legacy classes.
5. How to get the object	5) Get the Enumeration Object by using elements() method. ***Vector v =new Vector();*** ***v.add(10);*** ***v.add(20);*** ***Enumeration e = v.elements();***
6. How many methods	6) It contains two methods hasMoreElements(): to check objects. nextElement() : to retrieve the objects.
7. Operations	7) Only read operations.
8. Cursor moment	8) Only forward direction.
9. Class or interface	9) Interface
10. Versions supports	10) It supports both normal and generic version.

<u>***Iterator***</u>	<u>***ListIterator***</u>
1) *Used to retrieve the objects from collection classes.*	1) *Used to retrieve the data from collection classes.*
2) *Introduced in 1.2 version it is not a legacy*	2) *Introduced in 1.2 version it is not a legacy*
3) It is used to retrieve the data from all collection classes.	3) It is used to retrieve the data from only List type of classes like ArrayList,LinkedList,Vector,Stack.
4) It is a universal cursor because it is applicable for all collection classes.	4) Not a universal cursor because it is applicable for only List interface classes.
5) Get the iterator Object by using iterator() method. ***Vector v =new Vector();*** ***v.add(10);*** ***v.add(20);*** ***Enumeration e = v.iterator();***	5) Get the ListIterator Object by using listIterator() method. ***Vector v =new Vector();*** ***v.add(10);*** ***v.add(20);*** ***Enumeration e = v.listIterator();***
6) It contains two methods hasNext(): to check the objects available or not. Next() : to retrieve the objects.	6) It contains 9 methods
7) read & remove operations are possible.	7) Read, remove, add, and replace operations.
8) Only forward direction.	8) Bidirectional cursor direction.
9) Interface	9) Interface
10) It supports both normal and generic version.	10) It supports both normal and generic version.

<u>***ListIterator methods:-***</u>

public abstract boolean hasNext();
public abstract E next();
public abstract boolean hasPrevious();
public abstract E previous();
public abstract int nextIndex();
public abstract int previousIndex();
public abstract void remove();
public abstract void set(E); ***//replacement***
public abstract void add(E);

Retrieving objects of collections classes:-

We are able to retrieve the objects from collection classes in 3-ways

1) **By using for-each loop.**
2) **By using get() method.**
3) **By using cursors.**

Example application:-

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	ArrayList<String> al =new ArrayList<String>();
		al.add("ratan");
		al.add("anu");
		al.add("sravya");
		//1st appraoch to print Collection data
		for (String  a  :  al )
		{	System.out.println(a);
		}

		//2nd approach to print Collection data
		int size = al.size();
		for (int i=0;i<size;i++)
		{	System.out.println(al.get(i));
		}

		//3rd approach to print Collection data
		//normal version of Iterator(type casting required at the time of retrieving)
		Iterator itr1 = al.iterator();
		while (itr1.hasNext())
		{	String str =(String)itr1.next();
			System.out.println(str);
		}
		//generic  version of Iterator(type casting not required at the time of retrieving)
		Iterator<String> itr2 = al.iterator();
		while (itr2.hasNext())
		{	String str =itr2.next();
			System.out.println(str);
		}
	}
}
```

Example:-

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	ArrayList<String> al =new ArrayList<String>();
		al.add("ratan");
		al.add("anu");
		al.add("sravya");
		ListIterator<String> lstr = al.listIterator();
		lstr.add("suneel");
		while(lstr.hasNext())
		{	if ((lstr.next()).equals("anu"))
			{	lstr.set("Anushka");
			}
		}
		lstr.add("aaa");
		for (String str:al)
		{	System.out.println(str);		}
	}
}
```

E:\>java Test
suneel
ratan
Anushka
sravya
aaa

if we want remove the data:-

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	ArrayList<String> al =new ArrayList<String>();
		al.add("ratan");
		al.add("anu");
		al.add("sravya");
		ListIterator<String> lstr = al.listIterator();
		while(lstr.hasNext())
		{	if ((lstr.next()).equals("ratan"))
			{	lstr.remove();
			}
		}
		for (String str:al)
		{	System.out.println(str);
		}
	}
}
```

E:\>java Test
anu
sravya

Example:-printing data in forward and backward directions.

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	ArrayList<String> al =new ArrayList<String>();
		al.add("ratan");
		al.add("anu");
		al.add("sravya");
		ListIterator<String> lstr = al.listIterator();
		System.out.println("printing data forward direction");
		while(lstr.hasNext())
		{	System.out.println(lstr.next());
		}
		System.out.println("printing data backward direction");
		while(lstr.hasPrevious())
		{	System.out.println(lstr.previous());
		}
	}
}
```

```
E:\>java Test
printing data forward direction
ratan
anu
sravya
printing data backword direction
sravya
anu
ratan
```

<u>Sorting data by using sort() method of Collections class:-</u>

we are able to sort ArrayList data by using sort() method of Collections class and by default it perform ascending order .

public static <T extends java/lang/Comparable<? super T>> void sort(java.util.List<T>);

if we want to person ascending order your class must implements Comparable interface of java.lang package.

*If we want to perform descending order use **Collections.reverseOrder()** method along with **Collection.sort()** method.*

Collections.sort(list , Collections.reverseOrder());

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	ArrayList<String> al = new ArrayList<String>();
		al.add("ratan");
		al.add("anu");
		al.add("Sravya");
		//printing ArrayList data
		System.out.println("ArrayList data before sorting");
		for (String str :al)
		{	System.out.println(str);
		}
		//sorting ArrayList in ascending order
		Collections.sort(al);
		System.out.println("ArrayList data after sorting ascending order");
		for (String str1 :al)
		{	System.out.println(str1);
		}
		//sorting ArrayList in decending order
		Collections.sort(al,Collections.reverseOrder());
		System.out.println("ArrayList data after sorting descending order");
		for (String str2 :al)
		{	System.out.println(str2);
		}

	}
}
```

<u>Example:-</u>

```
import java.util.*;
class Test
{	public static void main(String[] args)
```

```
        {       ArrayList<String> al = new ArrayList<String>();
                al.add("ratan");
                al.add("anu");
                al.add("Sravya");
                Collections.sort(al);
                System.out.println("ArrayList data after sorting");
                for (String str1 :al)
                {       System.out.println(str1);
                }
        }
}
```

- ✓ in above example to perform the sorting of data by using natural sorting order then your objects must be homogeneous and must implements comparable interface.
- ✓ The default natural sorting order internally uses compareTo() method to perform sorting and it compare to objects and it return int value as a return value.

```
"ratan".compareTo("anu")      ==>   +ve    ==>change the order
"ratan".compareTo("ratan")    ==>   0      ==>no change
"anu".compareTo("ratan")      ==>   -ve    ==>no change
```

<u>Example:-</u>

The sorting object(Emp) Not implementing Comparable interface hence it does not perform sorting.

```
import java.util.*;
class Test
{       public static void main(String[] args)
        {       ArrayList al = new ArrayList();
                al.add(new Emp(111,"ratan"));
                Collections.sort(al);
        }
}
```

When we execute the above example JVM will generate Exception,

"java.lang.ClassCastException: Emp cannot be cast to java.lang.Comparable"

<u>Example :-</u>

If the Class contains Heterogeneous data sorting is not possible.

```
import java.util.*;
class Test
{       public static void main(String[] args)
        {       ArrayList al = new ArrayList();
                al.add("ratan");
                al.add(10);
                Collections.sort(al);//java.lang.ClassCastException
                System.out.println(al);
        }
}
```

To overcome above two cases exception use Comparable or Comparator interfaces to perform sorting.

Comparable vs Comparator :-

- ✓ *If we want to perform default natural sorting order then your objects must be homogeneous & comparable.*
- ✓ *Comparable objects are nothing but the objects which are implements comparable interface.*
- ✓ *All wrapper classes & String objects are implementing Comparable interface hence it is possible to perform sorting.*

- ❖ *If we want to sort user defined class like Emp based on eid or ename with default natural sorting order then your class must implements Comparable interface.*
- ❖ *Comparable interface present in java.lang package it contains only one method compareTo(obj) then must override that method to write the sorting logics.*

  public abstract int compareTo(T);
- ❖ If your class is implementing Comparable interface then that objects are sorted automatically by using **Collections.sort().** And the objects are sorted by using compareTo() method of that class.

Normal version of comparable:-

Emp.java:-

```
class Emp implements Comparable
{	int eid;
	String ename;
	Emp(int eid,String ename)
	{	this.eid=eid;
		this.ename=ename;
	}
	public int compareTo(Object o)
	{	Emp e = (Emp)o;
		if (eid == e.eid )
		{	return 0;	}
		else if (eid > e.eid)
		{	return 1;	}
		else
		{	return -1;	}
	}
}
```

Test.java:-

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	ArrayList<Emp> al = new ArrayList<Emp>();
		al.add(new Emp(333,"ratan"));
		al.add(new Emp(222,"anu"));
```

```
                al.add(new Emp(111,"Sravya"));
                Collections.sort(al);
                Iterator itr = al.iterator();
                while (itr.hasNext())
                {       Emp e = (Emp)itr.next();
                        System.out.println(e.eid+"---"+e.ename);
                }
        }
}
```

Generic version of Comparable:-

```
class Emp implements Comparable<Emp>
{       int eid;
        String ename;
        Emp(int eid,String ename)
        {       this.eid=eid;
                this.ename=ename;
        }
        public int compareTo(Emp e)
        {       return  ename.compareTo(e.ename);
        }
}
```

<u>Java.utilComparator :-</u>

- ✓ *For the default sorting order use comparable but for customized sorting order we can use Comparator.*
- ✓ *The class whose objects are stored do not implements this interface some third party class can also implements this interface.*
- ✓ *Comparable present in **java.lang** package but Comparator present in **java.util** package.*
- ✓ *Comparator interface contains two methods,*

```
public interface java.util.Comparator<T> {
  public abstract int compare(T, T);
  public abstract boolean equals(java.lang.Object);
}
```

<u>Normal version of Comparator:-</u>

<u>Emp.java:-</u>

```
class Emp
{       int eid;
        String ename;
        Emp(int eid,String ename)
        {       this.eid=eid;
                this.ename=ename;
        }
}
```

<u>EidComp.java:-</u>

```
import java.util.Comparator;
class EidComp implements Comparator
{	public int compare(Object o1,Object o2)
	{		Emp e1 = (Emp)o1;
			Emp e2 = (Emp)o2;
			if (e1.eid==e2.eid)
			{	return 0;	}
			else if (e1.eid>e2.eid)
			{	return 1;	}
			else
			{	return -1;	}
	}
}
```

EnameComp.java:-

```
import java.util.Comparator;
class EnameComp  implements Comparator
{	public int compare(Object o1,Object o2)
	{	Emp e1 = (Emp)o1;
		Emp e2 = (Emp)o2;
		return (e1.ename).compareTo(e2.ename);
	}
}
```

Test.java:-

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	ArrayList<Emp> al = new ArrayList<Emp>();
		al.add(new Emp(333,"ratan"));
		al.add(new Emp(222,"anu"));
		al.add(new Emp(111,"Sravya"));
		al.add(new Emp(444,"xxx"));

		System.out.println("sorting by eid");
		Collections.sort(al,new EidComp());
		Iterator<Emp> itr = al.iterator();
		while (itr.hasNext())
		{	Emp e = itr.next();
			System.out.println(e.eid+"---"+e.ename);
		}
		System.out.println("sorting by ename");
		Collections.sort(al,new EnameComp());
		Iterator<Emp> itr1 = al.iterator();
		while (itr1.hasNext())
```

```
            {       Emp e = itr1.next();
                    System.out.println(e.eid+"---"+e.ename);
            }
    }
}
D:\vikram>java Test
sorting by eid
111---Sravya
222---anu
333---ratan
444---xxx
sorting by ename
222---anu
111---Sravya
333---ratan
444---xxx
```

<u>The above example code:-(with generic version)</u>

<u>EnameComp.java:-</u>

```
import java.util.Comparator;
class EnameComp  implements Comparator<Emp>
{       public int compare(Emp e1,Emp e2)
        {               return (e1.ename).compareTo(e2.ename);
        }
}
```

<u>EidComp.java:-</u>

```
import java.util.Comparator;
class EidComp implements Comparator<Emp>
{       public int compare(Emp e1,Emp e2)
        {       ***************
                ***************
        }
}
```

Java.lang.Comparable vs java.util.Comparator:-

Property	***Comparable***	***Comparator***
1. Sorting logics	*1) Sorting logics must be in the class whose class objects are sorting.*	*I. Sorting logics in separate class hence we are able to sort the data by using dif attributes.*
2. Sorting method	***2) Int compareTo(Object o1)*** *This method compares this object with o1 object and returns a integer.Its value has following meaning* ***positive –*** *this object is greater than o1* ***zero –*** *this object equals to o1* ***negative –*** *this object is less than o1*	*II. int compare(Object o1,Object o2)* *This method compares o1 and o2 objects. and returns a integer.Its value has following meaning.* ***positive –*** *o1 is greater than o2* ***zero –*** *o1 equals to o2* ***negative –*** *o1 is less than o1*
3. Method calling to perform sorting	***3) Collections.sort(List)*** *Here objects will be sorted on the basis of CompareTo method.*	***III. Collections.sort(List, Comparator)*** *Here objects will be sorted on the basis of Compare method in Comparator*
4. package	*4) Java.lang*	***IV. Java.util***
5. which type of sorting	*5) Default natual sorting order*	***V. For customized sorting order.***

java.util.LinkedList:-

public class java.util.LinkedList ***extends*** *java.util.AbstractSequentialList*
implements *java.util.List<E>,*
java.util.Deque<E>,
java.lang.Cloneable,
java.io.Serializable

1) Introduced in 1.2 version.
2) Heterogeneous objects are allowed.
3) Null insertion is possible.
4) Insertion order is preserved.
5) LinkedList methods are non-synchronized.
6) Duplicate objects are allowed.

7) The under laying data structure is double linkedlist.
8) cursors :- Iterator,ListIterator

constructors:-

LinkedList(); *it builds a empty LinkedList.*

LinkedList(java/util/Collection<? extends E>);

it builds a LinkedList that initialized with the collection data.

<u>Example:- LinkedList basic operations.</u>

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	LinkedList<String> l=new LinkedList<String>();
		l.add("B");
		l.add("C");
		l.add("D");
		l.add("E");
		l.addLast("Z");    //it add object in last position
		l.addFirst("A");   //it add object in first position
		l.add(1,"A1");   //add the Object spcified index
		System.out.println("original content:-"+l);
		l.removeFirst();		//remove first  Object
		l.removeLast();		//remove last t Object
		System.out.println("after deletion first & last:-"+l);
		l.remove("E");		//remove specified Object
		l.remove(2);		//remove the object of specified index
		System.out.println("after deletion :-"+l);//A1 B D
		String val = l.get(0);   //get method used to get the element
		l.set(2,val+"cahged");    //set method used to replacement
		System.out.println("after seting:-"+l);
	}
};
```

D:\>java Test
original content:-[A, A1, B, C, D, E, Z]
after deletion first & last:-[A1, B, C, D, E]
after deletion :-[A1, B, D]
after seting:-[A1, B, A1cahged]

<u>Example:-Adding one collection data into another Collection.</u>

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	ArrayList<String> al = new ArrayList<String>();
		al.add("ratan");
		al.add("balu");

		LinkedList<String> linked = new LinkedList<String>(al);
		linked.add("anu");
		linked.add("simran");
```

```
            System.out.println(linked);
      }
}
```

E:\>java Test
[ratan, balu, anu, simran]

Example :- LinkedList cloneing process:-

```
import java.util.*;
class Test
{     public static void main(String[] args)
      {
       LinkedList<String> arrl = new LinkedList<String>();
       arrl.add("First");
      arrl.add("Second");
      arrl.add("Third");
      arrl.add("Random");
      System.out.println("Actual LinkedList:"+arrl);
      LinkedLis  copy = (LinkedLis) arrl.clone();
      System.out.println("Cloned LinkedList:"+copy);
   }
}
```

E:\>java Test
Actual LinkedList:[First, Second, Third, Random]
Cloned LinkedList:[First, Second, Third, Random]

Vector:- (legacy class introduced in 1.0 version)

```
public class java.util.Vector extends java.util.AbstractList
                              implements   java.util.List<E>,
                                           java.util.RandomAccess,
                                           java.lang.Cloneable,
                                           java.io.Serializable
```

1) Introduced in 1.0 version it is a legacy class.
2) Heterogeneous objects are allowed.
3) Duplicate objects are allowed.
4) Null insertion is possible.
5) Insertion order is preserved.
6) The under laying data structure is growable array.
7) Vector methods are synchronized.
8) Applicable cursors are Iterator,Enumeration,ListIterator.

Vector constructors:-

Vector();
Vector(int initialCapacity);
Vector(int intialCapacity, int increment);
Vector(java/util/Collection<? extends E>);

Constructor 1:-

The default initial capacity of the Vector is 10 once it reaches its maximum capacity it means when we trying to insert 11 element that capacity will become double[20].

```
Vector v = new Vector();
System.out.println(v.capacity());       //10
v.add("ratan");
System.out.println(v.capacity());       //10
System.out.println(v.size());           //1
```

Constructor 2:-

It is possible to create vector with specified capacity by using fallowing constructor. in this case once vector reaches its maximum capacity then size is double based on provided initial capacity.

```
Vector v = new Vector(int initial-capacity);
Vector<String> vv = new Vector<String>(3);
    System.out.println(vv.capacity());   //3
    vv.add("aaa");
    vv.add("bbb");
    vv.add("ccc");
    vv.add("ddd");
    System.out.println(vv.capacity());   //6
    System.out.println(vv.size());       //4
```

Constructor 3:-

It is possible to create vector with initial capacity and providing increment capacity by using fallowing constructor.

```
Vector v = new Vector(int initial-capacity, int increment-capacity);
    Vector<String> v = new Vector<String>(2,5);
    System.out.println(v.capacity());    //2
    v.add("ratan");
    v.add("aruna");
    v.add("Sravya");
    System.out.println(v.capacity());    //7
    System.out.println(v.size());        //3
```

Constructor 4:-

Vector(java/util/Collection<? extends E>);

It creates the Vector that contains another Collection data.

Example:-

```
import java.util.*;
class Test
{       public static void main(String[] args)
        {       ArrayList<String> al = new ArrayList<String>();
                al.add("no1");
                al.add("no2");

                Vector<String> v = new Vector<String>(al);
```

```
        v.add("ratan");
        v.add("aruna");
        System.out.println(v);

        ArrayList<String> a2 = new ArrayList<String>(v);
        a2.add("xxx");
        a2.add("yyy");
        System.out.println(a2);
    }
}
E:\>java Test
[no1, no2, ratan, aruna]
 [no1, no2, ratan, aruna, xxx, yyy]
```

Example:-

In below example Vector class removeElement() method removes the data always based on object but not index.

```
Vector v=new Vector();
v.addElement("ratan");
v.removeElement("ratan");
System.out.println(v); //[ ] empty output
```

```
Vector v=new Vector();
v.addElement("ratan");
v.removeElement(0);
System.out.println(v); //[ratan]
```

The List interface remove() method removes the data based on index and object.

```
Vector v=new Vector();
v.addElement("ratan");
v.remove(0);
System.out.println(v); //[ ] empty output
```

```
import java.util.*;
class  Test
{       public static void main(String[] args)
        {
        Vector<Integer> v=new Vector<Integer>();  //generic version of vector
        for (int i=0;i<5 ;i++ )
        {       v.addElement(i);
        }
        v.addElement(6);
        v.removeElement(1);      //it removes element object  based
        Enumeration<Integer> e = v.elements();
        while (e.hasMoreElements())
        {       Integer i = e.nextElement();
                System.out.println(i);
        }
        v.clear();          //it removes all objects of vector
        System.out.println(v);
        }
}
```

E:\>java Test
01246[]

Copying data from Vector to ArrayList:-

*To copy data from one class to another class use **copy()** method of Collections class.*

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	ArrayList<String> al = new ArrayList<String>();
		al.add("10");
		al.add("20");
		al.add("30");
		Vector<String>  v = new Vector<String>();
		v.add("ten");
		v.add("twenty");
		//copy data from vector to ArrayList
		Collections.copy(al,v);
		System.out.println(al);
	}
}
```

```
D:\vikram>java Test
[ten, twenty, 30]
```

Passing data {ArrayList to Vector} & Vector to ArrayList:-

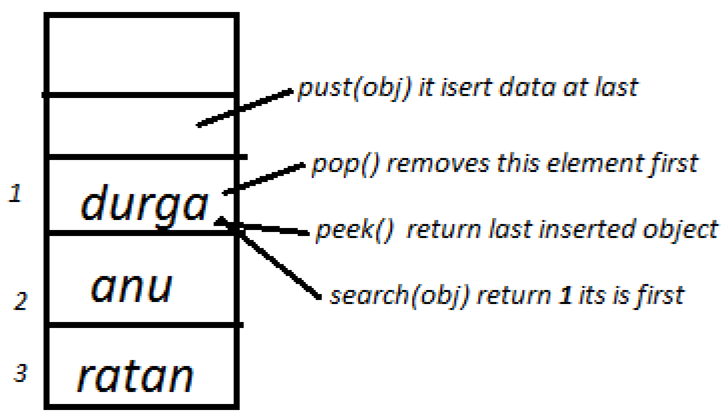
```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	ArrayList<String> a1 = new ArrayList<String>();
		a1.add("ratan");
		a1.add("anu");
		a1.add("Sravya");
		a1.add("yadhu");
		//ArrayList - Vector
		Vector<String> v = new Vector<String>(a1);
		v.add("xxx");
		v.add("yyy");
		System.out.println(v);		//[ratan, anu, Sravya, yadhu, xxx, yyy]
		//Vector-ArrayList
		ArrayList<String> a2 = new ArrayList<String>(v);
		a2.add("suneel");
		System.out.println(a2);		//[ratan, anu, Sravya, yadhu, xxx, yyy, suneel]
	}
}
```

Stack:- (legacy class introduced in 1.0 version)

1) It is a child class of vector.
2) Introduce in 1.0 version it is a legacy class.
3) It is designed for LIFO(last in fist order).

Example:-

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	Stack<String> s = new Stack<String>();
		s.push("ratan");		//insert the data top of the stack
		s.push("anu");		//insert the data top of the stack
		s.push("Sravya");
		System.out.println(s);
		System.out.println(s.search("Sravya"));	//1   last added object will become first
		System.out.println(s.size());
		System.out.println(s.peek());	//to return last element of the Stack
		s.pop();			//remove the data top of the stack
		System.out.println(s);
		System.out.println(s.isEmpty());
		s.clear();
		System.out.println(s.isEmpty());
	}
}
```



Example :-

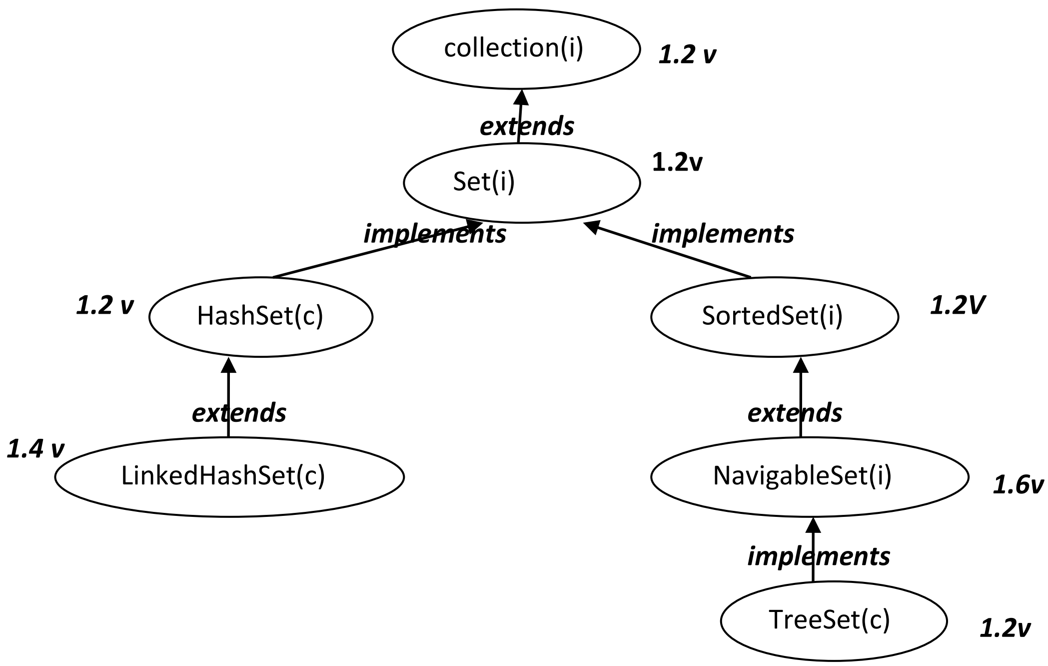
```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	String reverse="";
		Scanner s = new Scanner(System.in);
		System.out.println("enter input string to check palendrome or not");
		String str = s.nextLine();
		Stack stack = new Stack();
		for (int i=0;i<str.length();i++)
		{	stack.push(str.charAt(i));
```

```
            }
            while (!stack.isEmpty())
            {       reverse=reverse+stack.pop();
            }
            if (str.equals(reverse))
            {       System.out.println("the input String palindrome");
            }
            else
            {       System.out.println("the input String not- palindrome");
            }
      }
}
```

EmpBean.java:-

```
public class EmpBean implements Comparable<EmpBean>
{     private int eid;
      private String ename;
      public void setEid(int eid)
      {     this.eid=eid;
      }
      public void setEname(String ename)
      {     this.ename=ename;
      }
      public int getEid()
      {return eid;
      }
      public String getEname()
      {return ename;
      }
      public int compareTo(EmpBean o)
      {     if (eid==o.eid)
            {return 0;
            }
            if (eid>o.eid)
            {return 1;
            }
            else{return -1;}
      }
};
```

Set interface:-



Java.util.HashSet:-

public class java.util.HashSet ***extends*** *java.util.AbstractSet*
implements *java.util.Set<E>,*
java.lang.Cloneable,
java.io.Serializable

Note:- in entire Collections <E> specifies the type of the Object the Collection implementation classes will hold.

constructors:-
HashSet(); *it creates default HashSet.*
HashSet(java/util/Collection<? extends E>);
It initialize the HashSet by passing another collection data.
HashSet(int capacity);
It create the HashSet by specified capacity. And the default capacity of HashSet is 16.
HashSet(int capacity,float fillRatio);
It initialize both capacity and fillratio(also called as load factor) and fillration must be 0.0 to 1.0 after filling this ratio a new HashSet object is created.
The default fill ratio is 0.75.

Note :- *The Set interface and HashSet,LinkedHashSet class does not contains new methods it uses super class methods if you want check the predefined support by using* ***javap*** *command.*
Javap java.util.Set
Javap java.util.HashSet

1) *Introduced in 1.2 version.*

2) *Heterogeneous objects are allowed.*
3) *Duplicate objects are not allowed if we are trying to insert duplicate values then we won't get any compilation & Execution errors simply add method returns false .*
4) *Null insertion is possible but if we are inserting more than one null it return only one null value (because duplicates are not allowed).*
5) *The under laying data structure is HashTable.*
6) *Insertion order is not preserved it is based on the hash code of the object (hashing mechanism).*
7) *Methods are non-synchronized.*
8) *It supports only Iterator cursor to retrieve the data.*

Example:-HashSet data duplication.

```
import java.util.*;
class  Test
{	public static void main(String[] args)
	{	HashSet<String> h = new HashSet<String>();
		h.add("C");
		h.add("D");
		System.out.println(h.add("D"));
		System.out.println(h.add("D"));
		System.out.println(h);
	}
}
E:\>java Test
false
false
[D, C]
```

Example:- HashSet with cursor.

```
import java.util.*;
class  Test
{	public static void main(String[] args)
	{	HashSet<String> h = new HashSet<String>();
		h.add("A");
		h.add("B");
		h.add("C");
		h.add("D");
		h.add("D");
		//creation of Iterator Object
		Iterator<String> itr = h.iterator();
		while (itr.hasNext())
		{	String str  = itr.next();
			System.out.println(str);
		}
	}
}
```

Example:-Adding one collection data into another.

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	HashSet<String> h1 = new HashSet<String>();
		h1.add("ratan");
		h1.add("anu");
		h1.add("Sravya");
		HashSet<String> h2 = new HashSet<String>(h1);
		h2.add("no1");
		h2.add("no2");
		System.out.println(h2);
	}
}
E:\>java Test
[Sravya, ratan, anu, no2, no1]
```

Java.util.LinkedHashSet:-

```
public class java.util.LinkedHashSet	extends	java.util.HashSet
					implements	java.util.Set<E>,
							java.lang.Cloneable,
							java.io.Serializable
```

1. Introduced in 1.4 version and It is a child class of HashSet.
2. Heterogeneous objects are allowed.
3. Duplicate objects are not allowed if we are trying to insert duplicate values then we won't get any compilation & Execution errors simply add method return false.
4. Insertion order is preserved.
5. Null insertion is possible only once(because duplication is not possible).
6. The under laying data structure is LinkedList & hashTable.
7. Methods are non-synchronized.
8. It supports only Iterator cursor o retrieve the data.

Conastructors:-

```
LinkedHashSet();
LinkedHashSet(java/util/Collection<? extends E>);
LinkedHashSet(int capacity);
LinkedHashSet(int capacity,float fillRatio);
```

Example:-

```
import java.util.*;
class  Test
{	public static void main(String[] args)
	{	Set<String> h = new LinkedHashSet<String>();
		h.add("A");
		h.add("B");
		h.add("C");
		h.add("D");
		h.add("D");
		Iterator<String> itr = h.iterator();
```

```
            while (itr.hasNext())
            {String str  = itr.next();
             System.out.print(str);
            }
      }
}
E:\>java Test
ABCD
```

Java.util.TreeSet:-

public class java.util.TreeSet ***extends*** *java.util.AbstractSet<E>*
implements *java.util.NavigableSet<E>, java.lang.Cloneable, java.io.Serializable*

<E> *specifies the type of the Object the set will be hold.*

Constructors:-

TreeSet();

It will create empty TreeSet that will be sorted in ascending order according to natural order of its elements.

TreeSet(java/util/Collection<? extends E>);

It creates the TreeSet with some collection data.

TreeSet(java/util/Comparator<? super E>);

It will create empty TreeSet with comparator specified sorting order (customization or sorting).

TreeSet(java/util/SortedSet<E>);

It builds the TreeSet that contains the elements of SortedSet.

1. *TreeSet introduced in 1.2 version.*
2. *Heterogeneous data is not allowed.*
3. *Insertion order is not preserved but it sorts the elements in some sorting order.*
4. *Duplicate objects are not allowed.*
5. *Null insertion is possible only once.*
6. *TreeSet Methods are non-synchronized.*
7. *The underlying data Structure is Balanced Tree.*
8. *It supports Iterator cursor to retrieve the data.*

Case -1:

```
TreeSet<String> t=new TreeSet<String>();
t.add("ratan");
t.add("anu");
t.add("sravya");
System.out.println(t);     //[anu, ratan, sravya]
```

- *When we insert the data in TreeSet, by default it prints the data in sorting order(ascending or alphabetical order) because it is implementing SortedSet interface.*

- *To perform the sorting internally it uses compareTo() method and it compare the two objects it returns int value as a return value.*
  “ratan”.compareTo(“anu”) ==> +ve ==>change the order
  “ratan”.compareTo(“ratan”) ==> 0 ==>no change
  “anu”.compareTo(“ratan”) ==> -ve ==>no change

Case 2:-

```
TreeSet t=new TreeSet();
t.add("ratan");
t.add("anu");
t.add(10);        // java.lang.ClassCastException
System.out.println(t);
```

- ✓ *TreeSet allows homogeneous data, if we are trying to insert heterogeneous data while performing sorting by using compareTo() JVM will generate **java.lang.ClassCastException (**because it is not possible to compare integer data with String) **.***

Case 3:-

```
TreeSet t=new TreeSet();
t.add("ratan");
t.add(null); //java.lang.NullPointerException
System.out.println(t);
```

- *If the TreeSet contains data if we are trying to insert null value at the time of comparison JVM will generate **//java.lang.NullPointerException.***
- *In java any object with comparison of null it will generate **java.lang.NullPointerException.***

Case 4:-`

```
TreeSet t=new TreeSet();
t.add(null);
System.out.println(t);//[null]
```

- ✓ *In empty TreeSet it is possible to insert null value because it is not performing any comparisons.*

Example:-TreeSet default sorting order.

```
import java.util.*;
class Test
{       public static void main(String[] args)
        {       TreeSet<String> t = new TreeSet<String>();
                t.add("ratan");
                t.add("anu");
                t.add("sravya");
                System.out.println(t);

                TreeSet<Integer> t1 = new TreeSet<Integer>();
                t1.add(10);
                t1.add(12);
                t1.add(8);
                System.out.println(t1);
        }
}
E:\>java Test
[anu, ratan, sravya]
```

[8, 10, 12]

Example:-TreeSet customized Sorting Order.

```
import java.util.*;
class Fruit
{	public static void main(String[] args)
	{	TreeSet<String> t = new TreeSet<String>(new MyComp());
		t.add("orange");
		t.add("banana");
		t.add("apple");
		System.out.println(t);
	}
}
class MyComp implements Comparator<String>
{	public int compare(String s1,String s2)
	{	return s1.compareTo(s2);//[apple, bananna, orange]
		//return -s1.compareTo(s2);//[orange, bananna, apple]
	}
};
```

Example:-Different possibilities of sorting order.

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	TreeSet<Integer> t=new TreeSet<Integer>(new MyComp());   // line-1
		t.add(50);
		t.add(20);
		t.add(40);
		t.add(10);
		t.add(30);
		System.out.println(t);
	}
}
import java.util.*;
class MyComp implements Comparator
{	public int compare(Object o1,Object o2)
	{	Integer i1 = (Integer)o1;
		Integer i2 = (Integer)o2;
		//check all possibilities by placing comments
		//return i1.compareTo(i2);
		//return -i1.compareTo(i2);
		//return i2.compareTo(i1);
		//return -i2.compareTo(i1);
		//return -1;
		//return +1;
		//return 0;
	}
}
```

Observation-1:

in above example at line number-1 if we are not passing comparator object then JVM will call compareTo() method as part of default sorting order .
Based on above line the default sorting will done by using ***compareTo()*** *method.*

Observation-2:-

In above example at line number 1 if we are passing comparator object then JVM will call compare() method to perform sorting instead of compareTo() method.

Example :-write a program to insert String data into TreeSet to perform sorting in reverse of alphabetical order.

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	TreeSet<String> t = new TreeSet<String>(new MyComp());
		t.add("ratan");
		t.add("anu");
		t.add("aravya");
		t.add("aruna");
		System.out.println(t);
	}
}
class MyComp implements Comparator<String>
{	public int compare(String s1,String s2)
	{	return s2.compareTo(s1);
		//return -s1.compareTo(s2);
	}
};
```

Example :-write a program to insert StringBuffer data into TreeSet to perform sorting in alphabetical order.

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	TreeSet<StringBuffer> t = new TreeSet<StringBuffer>(new MyComp());
		t.add(new StringBuffer("ccc"));
		t.add(new StringBuffer("aaa"));
		t.add(new StringBuffer("ddd"));
		t.add(new StringBuffer("bbb"));
		System.out.println(t);
	}
}
class MyComp implements Comparator<StringBuffer>
{	public int compare(StringBuffer sb1,StringBuffer sb2)
	{	String s1 = sb1.toString();
		String s2 = sb2.toString();
		//return s2.compareTo(s1);
		return -s1.compareTo(s2);
	}
```

};

Example :- write a program to insert String & StringBuffer object into TreeSet, where sorting is increasing length order. If two objects are having same length then use alphabetical order.

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	TreeSet t = new TreeSet(new MyComp());
		t.add("ratan");
		t.add(new StringBuffer("sravya"));
		t.add("anu");
		t.add(new StringBuffer("suneelbabu"));
		t.add("sri");
		System.out.println(t);
	}
}
class MyComp implements Comparator
{	public int compare(Object o1,Object o2)
	{	String s1 = o1.toString();
		String s2 = o2.toString();
		int l1=s1.length();
		int l2=s2.length();
		if (l1<l2)
		{	return -1;
		}
		else if (l1>l2)
		{	return 1;
		}
		else
		{	return s1.compareTo(s2);
		}
	}
};
```

<u>Example:- passing sortedset object to TreeSet constructor.</u>

```
import java.util.*;
class Sravya
{	public static void main(String[] args)
	{	TreeSet<Integer> t=new TreeSet<Integer>();
		t.add(20);
		t.add(40);
		t.add(10);
		t.add(30);
		System.out.println(t);    //10 20 30 40
		SortedSet s = t.headSet(30);
		TreeSet tt = new TreeSet(s);
		System.out.println(tt);   //10 20
	}
}
```

Example :-Elimination duplicate objects by using set interface.

```
import java.util.*;
class Test
{       public static void main(String[] args)
        {       String[] str={"ratan","anu","sravya","anu"};
                List<String> l = Arrays.asList(str);

                TreeSet<String> t = new TreeSet<String>(l);
                System.out.println(t);
        }
}
```

E:\>java Test
[anu, ratan, sravya]

Example :-basic operations on TreeSet.

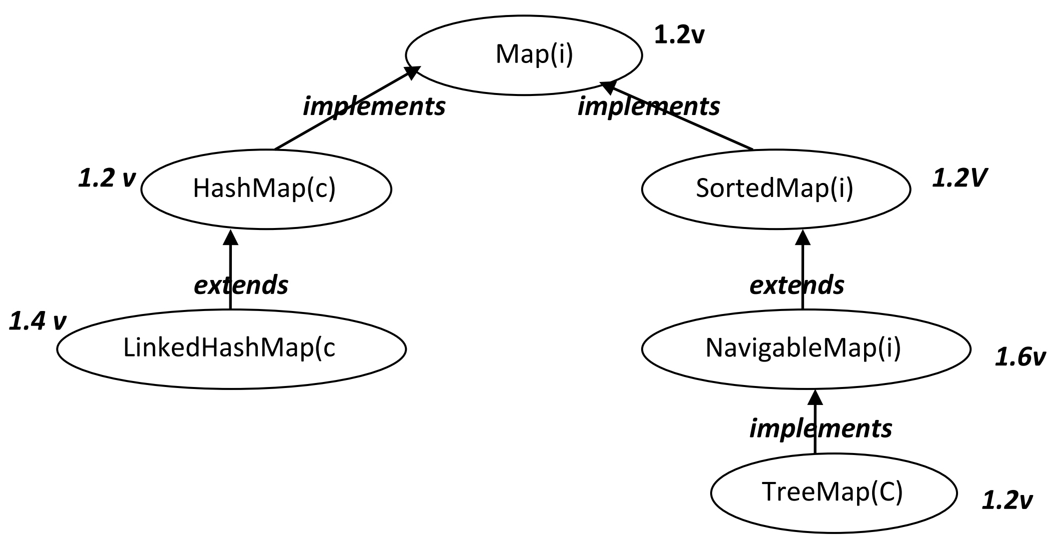
public E first();	it print first element
public E last();	it print last element
public E lower(E);	it print lower object of specified object
public E higher(E);	it print higher object of specified object
public java/util/SortedSet<E> subSet(E, E);	it print subset
public java/util/SortedSet<E> headSet(E);	it print specified object above objects
public java/util/SortedSet<E> tailSet(E);	it print specified objects below values
public E pollFirst();	it print and remove first
public E pollLast();	it print and remove last.

```
import java.util.*;
class Test
{       public static void main(String[] args)
        {       TreeSet<Integer> t=new TreeSet<Integer>();
                t.add(50);
                t.add(20);
                t.add(40);
                t.add(10);
                t.add(30);
                System.out.println(t);//10 20 30 40 50
                System.out.println(t.headSet(30));//[10,20]
                System.out.println(t.tailSet(30));//[30,40,50]
                System.out.println(t.subSet(20,50));//[20,30,40]
                System.out.println("last element="+t.last());//50
                System.out.println("first element="+t.first());//10
                System.out.println("lower element="+t.lower(50));//40
                System.out.println("higher element="+t.higher(20));//30
                System.out.println("print & remove first element="+t.pollFirst());//10
                System.out.println("print & remove last  element="+t.pollLast());//50
                System.out.println("final elements="+t);//20 30 40
                System.out.println("TreeSet size="+t.size());//3
                System.out.println(t.remove(30));
                System.out.println("TreeSet size="+t.size());//2
```

```
            System.out.println("final elements="+t);//20 40
      }
}
```

E:\>java Test
[10, 20, 30, 40, 50]
[10, 20]
[30, 40, 50]
[20, 30, 40]
last element=50
first element=10
lower element=40
higher element=30
print & remove first element=10
print & remove last element=50
final elements=[20, 30, 40]
TreeSet size=3
TreeSet size=true
TreeSet size=2
final elements=[20, 40]

<u>Map interface:-</u>



<u>Java.util.HashMap:-</u>

public class java.util.HashMap ***extends*** *java.util.AbstractMap*
implements *java.util.Map*
java.lang.Cloneable,
java.io.Serializable

1) *introduced in 1.2 version.*
2) *Heterogeneous data allowed.*
3) *Underlying data Structure is HashTable.*

4) *Duplicate keys are not allowed but values can be duplicated.*
5) *Insertion order is not preserved it is based on hashcode.*
6) *Null is allowed for key(only once)and allows for values any number of times.*
7) *Every method is non-synchronized so multiple Threads are operate at a time hence permanence is high.*

Constructors:-

HashMap(); *it creates default HashMap.*

HashMap(java/util/Map<? extends K, ? extends V> var);

it creates the HashMap by initializing the values specified in var.

HashMap(int capacity);

*It creates the hashmap with specified capacity but the default capacity is **16.***

HashMap(int capacity, float fillRatio);

It creates the hashMap with specified capacity & fillRatio.(default capacity is 16 & default fill ratio 0.75)

Entry:-

- ✓ *The each and every key value pair is called **Entry.***
- ✓ *The Map contains group of entries.*
- ✓ *Entry is sub interface of Map interface hence get the entry interface by using Map interface.*

```
interface Map
{       interface Entry
        {       public abstract Object getKey();
                public abstract Object getValue();
                public abstract Object setValue();
        }
}
```

- ✓ *To get all the keys use keyset() method.*
  public java/util/Set<K> keySet();
- ✓ *To get all the values use values() method.*
  public java/util/Collection<V> values();
- ✓ *To get all the entries use entrySet() method.*
  public java/util/Set<java/util/Map$Entry<K, V>> entrySet();

Example :-

```
import java.util.*;
class Test
{       public static void main(String[] args)
        {       HashMap h = new HashMap();
                h.put(111,"ratan");
                h.put(222,"anu");
                h.put(333,"banu");
                //keySet() to get all keys.
                Set s1=h.keySet();
                System.out.println("all keys:--->"+s1);
                //values() to get all the values.
                Collection c = h.values();
                System.out.println("all values--->"+c);
```

```
                //entrySet() to get all the entries.
                Set ss = h.entrySet();
                System.out.println("all entries--->"+ss);
                Iterator itr = ss.iterator();
                while (itr.hasNext())
                {       Map.Entry  m= (Map.Entry)itr.next();
                        System.out.println(m.getKey()+"----"+m.getValue());
                }
        }
};
E:\>java Test
all keys:--->[222, 111, 333]
all values--->[anu, ratan, banu]
all entries--->[222=anu, 111=ratan, 333=banu]
222----anu
111----ratan
333----banu
```

Java.util.LinkedHashMap:-

public class java.util.LinkedHashMap ***extends*** *java.util.HashMap*
implements *java.util.Map*

1) *interdicted in 1.4 version*
2) *Heterogeneous data allowed.*
3) *Underlying data Structure is HashTable & linkedlist.*
4) *Duplicate keys are not allowed but values can be duplicated.*
5) *Insertion order is preserved.*
6) *Null is allowed for key(only once)and allows for values any number of times.*
7) *Every method is non-synchronized so multiple Threads are operate at a time hence permanence is high.*

Constructors:-

LinkedHashMap(); *it creates default HashMap.*

LinkedHashMap(java/util/Map<? extends K, ? extends V> var);
it creates the HashMap by initializing the values specified in var.

LinkedHashMap(int capacity);
It creates the hashmap with specified capacity but the default capacity is ***16.***

LinkedHashMap(int capacity, float fillRatio);
It creates the hashMap with specified capacity & fillRatio.(default capacity is 16 & default fill ratio 0.75)

Emp.java:

```
class Emp
{       int eid;
        String ename;
        Emp(int eid,String ename)
        {this.eid=eid;
         this.ename=ename;
        }
}
```

```
//Student.java
class Student
{       //instance variables
        int sid;
        String sname;
        Student(int sid,String sname)//local variables
        { this.sname=sname; this.sid=sid;
```

```
        }                                               }
```

Test.java:-

```
import java.util.*;
class  Test
{       public static void main(String[] args)
        {       LinkedHashMap<Emp,Student> h = new LinkedHashMap<Emp,Student>();
                h.put(new Emp(111,"ratan"), new Student(1,"budha"));
                h.put(new Emp(222,"anu"), new Student(2,"ashok"));
                Set s = h.entrySet();
                Iterator itr = s.iterator();
                while (itr.hasNext())
                {       Map.Entry m = (Map.Entry)itr.next();
                        Emp e = (Emp)m.getKey();
                        System.out.println(e.ename+"--"+e.eid);
                        Student ss = (Student)m.getValue();
                        System.out.println(ss.sname+"--"+ss.sid);
                }
        }
}
```

Example:-

```
import java.util.*;
class  Test
{       public static void main(String[] args)
        {
                Map<Integer,String> h1 = new LinkedHashMap<Integer,String>();
                h1.put(111,"ratan");
                h1.put(222,"sravya");

                Map<Integer,String> h2 = new LinkedHashMap<Integer,String>(h1);
                h2.put(333,"anu");

                for (Map.Entry m : h2.entrySet())
                {               System.out.println(m.getKey()+"---"+m.getValue());
                }
        }
}
```

Java.util.HashTable:-

public class java.util.Hashtable ***extends*** *java.util.Dictionary*
implements *java.util.Map,java.lang.Cloneable, java.io.Serializable*

1. *Introduced in the 1.0 version it's a legacy class.*
2. *Heterogeneous data allowed for both key & value.*
3. *Duplicate keys are not allowed but values can be duplicated.*
4. *Every method is synchronized hence only one thread is allowed to access it is a Thread safe but performance is decreased.*
5. *Null is not allowed for both key & Value , if we are trying to insert null values we will get NullPointerException.*
6. *HashTable was made generic by JDK5.*
7. *The underlaying datastructure is hashtable.*

Constructors:-

HashTable(); *it creates default HashMap.*

HashTable (java/util/Map<? extends K, ? extends V> var);
it creates the HashMap by initializing the values specified in var.

HashTable (int capacity);
It creates the hashmap with specified capacity but the default capacity is ***11.***

HashTable (int capacity, float fillRatio);
It creates the hashMap with specified capacity & fillRatio.(default capacity is 11 & default fill ratio 0.75)

Ex:-
```
import java.util.Hashtable;
import java.util.Collection;
import java.util.Set;
class Test
{       public static void main(String[] args)
        {       Hashtable<String,String> h = new Hashtable<String,String>();
                //adding data in HashTable
                h.put("1","one");
                h.put("2","two");
                h.put("3","three");
                System.out.println(h);
                System.out.println(h.get("1"));  //one
                System.out.println(h.isEmpty());
                h.remove("3");
                System.out.println(h.containsKey("1"));
                System.out.println(h.containsKey("3"));
                System.out.println(h.containsValue("one"));
                System.out.println(h.size());
                //to get all values objects
                Collection<String> c = h.values();
                for (String i : c)
                {       System.out.println(i);
                }
```

```
        //to get all key objects
        Set<String> s = h.keySet();
        for (String ss : s)
        {       System.out.println(ss);
        }
    }
}
```

Java.util.TreeMap:-

public class java.util.TreeMap ***extends*** *java.util.AbstractMap*
implements *java.util.NavigableMap,java.lang.Cloneable, java.io.Serializable*

1) This class is introduced in 1.2 version.
2) It allows homogeneous data if we are trying to insert heterogeneous data at runtime while perform sorting JVM will generate ClassCastException.
3) Duplicate keys are not allowed but values can be duplicated.
4) Insertion order is not preserved it is based on some sorting order of keys.
5) The underlying data structure is red-black trees.
6) For empty treeset it is possible to insert null key once, but if the treeset contains data if we are inserting null keys at runtime we will get NullPointerException but for the values any number of null values insertion possible.

Constructors:-

TreeMap();
it will create empty treemap that will be sorted by using natural order of its keys.

TreeMap(java/util/Comparator<? super K>);
It create treemap that will be sorted by using customized sorting oder.

TreeMap(java/util/Map<? extends K, ? extends V>);
It create the treemap with specified data.

TreeMap(java/util/SortedMap<K, ? extends V>);
It creates the treemap by initializing sortedmap data.

Observations of TreeMap:

Case1:-
```
TreeMap h = new TreeMap();
h.put(444,"ratan");
h.put(222,"anu");
h.put(111,"aaa");
System.out.println(h);//{111=aaa, 222=anu, 444=ratan}
```
In treemap when we insert the data that will be printed in sorting order based on key.

Case 2:-
```
TreeMap h = new TreeMap();
h.put(444,"ratan");
h.put("ratan","aaa"); //java.lang.ClassCastException
System.out.println(h);
```
Treemap allows homogeneous data, if we are inserting heterogeneous data while performing sorting it will generate **java.lang.ClassCastException.**

Case 3:-
```
TreeMap h = new TreeMap();
h.put(444,"ratan");
h.put(null,"aaa"); //java.lang.NullPointerException
System.out.println(h);
```

If the treemap contains data then we are adding null value hence while performing sorting it will generate ***java.lang.NullPointerException(any object with comparisionof null it will generate NullPointerException)***

Case 4:-
```
TreeMap h = new TreeMap();
h.put(null,"aaa");
System.out.println(h);//{null=aaa}
```
In empty treemap it is possible to insert null value.

Example:-
```
import java.util.TreeMap;
import java.util.Set;
import java.util.Collection;
import java.util.Map.Entry;
class Test
{	public static void main(String[] args)
	{	TreeMap<String,String> tmain = new TreeMap<String,String>();
		tmain.put("ratan","no1");
		tmain.put("anu","no2");

		TreeMap<String,String> tsub = new TreeMap<String,String>();
		tsub.putAll(tmain);
		tsub.put("x","no3");
		tsub.put("y","no4");
		System.out.println(tsub);

		if (tmain.containsKey("ratan"))
		{System.out.println("ratan is great");
		}
		if (tsub.containsValue("no1"))
		{System.out.println("no1 ratan only");
		}
		//printing all the keys
		Set<String> s = tsub.keySet();
		for (String ss : s)
		{	System.out.println(ss);
		}
		//printing all the values
		Collection<String> s1 = tsub.values();
		for (String ss1 : s1)
		{	System.out.println(ss1);
		}
		Set<Entry<String,String>> s2 = tsub.entrySet();
		for (Entry<String,String> ss2 : s2)
		{	System.out.println(ss2);
		}
		tsub.clear();
		System.out.println(tsub);
	}
}
```

Example:-

```
import java.util.*;
class MyComp implements Comparator
{	public int compare(Object o1,Object o2)
	{	String s1 = (String)o1;
		String s2 = (String)o2;
		return s2.compareTo(s1);
	}
}
import java.util.*;
class Test
{	public static void main(String[] args)
	{	TreeMap h = new TreeMap(new MyComp());
		h.put("ratan",111);
		h.put("anu",222);
		h.put("zzzz",333);
		System.out.println(h);//{zzzz=333, ratan=111, anu=222}
	}
}
```

Example:-

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	TreeMap h = new TreeMap();
		h.put(111,"ratan");
		h.put(222,"anu");
		h.put(333,"aaa");
		h.put(444,"aaa");
		System.out.println(h);

		Map m = h.subMap(222,444);
		System.out.println(m);

		System.out.println(h.firstEntry());
		System.out.println(h.lastEntry());
		System.out.println(h.firstKey());
		System.out.println(h.lastKey());
		System.out.println(h.lowerKey(222));
		System.out.println(h.higherKey(222));

		SortedMap s1 = h.headMap(333);
		TreeMap t1 = new TreeMap(s1);
		System.out.println(t1);

		SortedMap s2 = h.tailMap(333);
		TreeMap t2 = new TreeMap(s2);
```

```
                System.out.println(t2);
        }
}
```

Example :-

Ceiling()

it return current provided value or greater value but if treemap does not contains same or grater value then it returns null .

floor():-

it returns current value or less value but if treemap does not contains same value or less then it return null.

pollFirstEntry:- *it removes first entry & it prints that entry.*

pollLastEntry():- *it removes last entry and it prints that entry.*

```
import java.util.*;
class Test
{       public static void main(String[] args)
        {       TreeMap h = new TreeMap();
                h.put(111,"ratan");
                h.put(222,"anu");
                h.put(444,"aaa");
                System.out.println(h);

                System.out.println(h.ceilingKey(222));
                System.out.println(h.ceilingEntry(333));
                System.out.println(h.floorKey(222));
                System.out.println(h.floorEntry(333));
                System.out.println(h.ceilingKey(666));

                Map.Entry m1 = h.pollFirstEntry();
                System.out.println(m1.getKey()+"---"+m1.getValue());
                Map.Entry m2 = h.pollLastEntry();
                System.out.println(m2.getKey()+"---"+m2.getValue());

                System.out.println(h);
        }
}
```

Java.util.IdentityHashMap:-

public class java.util.IdentityHashMap ***extends*** *java.util.AbstractMap*
implements *java.util.Map,java.io.Serializable, java.lang.Cloneable*

It is same as hashmap except one difference,

In case of Hashmap JVM will use equals( ) method to identify duplicate keys.(it performs content comparison)

In case of identityhashmap JVM will use ***==*** *operator to identify the duplicate keys.(it perform reference comparison)*

Example:-

```
import java.util.*;
class  Test
{           public static void main(String[] args)
            {           //equals() method to identify duplicate keys.
                        HashMap<Integer,String> h = new HashMap<Integer,String>();
                        h.put(new Integer(10),"ratan");
                        h.put(new Integer(10),"anu");
                        System.out.println(h);

                        //== operator to identify duplicate keys.
                        IdentityHashMap<Integer,String> h1 = new IdentityHashMap<Integer,String>();
                        h1.put(new Integer(10),"ratan");
                        h1.put(new Integer(10),"anu");
                        System.out.println(h1);
            }
}
E:\>java Test
{10=anu}
{10=anu, 10=ratan}
```

Java.util.WeakHashMap:-

public class java.util.WeakHashMap ***extends*** *java.util.AbstractMap*
implements *java.util.Map*

WeakHashMap is same as HashMap except fallowing difference,

If an object is associated with hashmap that object is not destroyed even though it does not contains any reference type.
But in case of weakhashmap if the object does not contains reference type that object iseligible for garbage collector even though it associated with weakhashmap.

HashMap

```
import java.util.*;
class A
{           public String toString()
            {           return "A";
            }
            public void finalize()
            {System.out.println("object destroyed");
            }
};
class Test
{           public static void main(String[] args)
            {           HashMap h = new HashMap();
                        A  a= new A();
                        h.put(a,"ratan");
                        System.out.println(h);
                        a=null;
                        System.gc();
                        System.out.println(h);
            }
}
E:\>java Test
{A=ratan}
{A=ratan}
```

WeakHashMap

```
import java.util.*;
class A
{           public String toString()
            {           return "A";
            }
            public void finalize()
            {System.out.println("object destroyed");
            }
};
class Test
```

```
{        public static void main(String[] args)                    System.out.println(h);
{WeakHashMap h = new WeakHashMap();                           }
                A  a= new A();                          }
                h.put(a,"ratan");                       E:\>java Test
                System.out.println(h);                  {A=ratan}
                a=null;                                 {}
                System.gc();                            object destroyed
```

Java.util.Properties:-

- ✓ *In standalone applications(JDBC) or web-applications(web sites) the data is frequently changing like,*
    - a. *Database username*
    - b. *Database password*
    - c. *url*
    - d. *driver …etc*
- ✓ *in above scenario for every change must perform modifications in all .java files but it is complex.to overcome this problem use properties file.*
- ✓ *Properties file is a normal text file with .properties extension & it contains key=value formatted data but both key and value is string format.*
- ✓ *Once we done modifications on .properties file that modifications are reflected all the .java files.*

Abc.properties :-

```
username = system
password = manager
driver = oracle.jdbc.driver.OracleDriver
trainer = Ratan
```

Test.java:-

```
import java.util.*;
import java.io.*;
class  Test
{        public static void main(String[] args) throws FileNotFoundException,IOException
         {        //locate properties file
                  FileInputStream fis=new FileInputStream("abc.properties");
                  //load the properties file by using load() method of Properties class
                  Properties p = new Properties();
                  p.load(fis);
                  //get the data from properties class by using getProperty()
                  String username = p.getProperty("username");
                  String driver = p.getProperty("driver");
                  String password = p.getProperty("password");
                  String trainer = p.getProperty("trainer");
                  //use the properties file data
                  System.out.println("DataBase username="+username);
                  System.out.println("DataBase password ="+password);
```

```
                System.out.println("driver ="+driver);
                System.out.println("trainer="+trainer);
        }
}
```

Collections:-

```
import java.util.*;
class Test
{       public static void main(String[] args)
        {       ArrayList<String> al = new ArrayList<String>();
                al.add("ratan");
                al.add("anu");
                al.add("Sravya");
                //to perform sorting use sort method of collections class
                Collections.sort(al);
                Iterator itr =al.iterator();
                while (itr.hasNext())
                {System.out.println(itr.next());
                }
        }
}
```

Comparable interface :-

- *Comparable interface used to perform sorting of user defined class objects.*
- *Comparable present in java.lang package and it contains only method*
  public abstract int compareTo(Object obj-name);
- *By using comparable We are able sort the object by suing single data member like **sid,sname**.*
- *String & all Wrapper classes are implement Comparable interface hence if we are storing these Objects these are comparable.*

If first object sid value is greater than existing object then it returns positive//no change in data
If the object sid values is less than existing object then it returns negative.//change location
If any negative or both are equals then it returns zero. //no change in data

Student.java

```
class Student implements Comparable
{       int sid;
        String sname;
        Student(int sid,String sname)//local var
        { this.sname=sname; this.sid=sid;
        }
        public int compareTo(Object obj)
        {       Student s = (Student)obj;
                if (sid>s.sid)
                {return 1;
                }
```

```
			if (sid<s.sid)
			{return -1;
			}
			If(sid==0){
			return 0;}
		}
}
```

Test.java:-

```
import java.util.*;
class Test
{
		public static void main(String[] args)
		{
			ArrayList<Student> al = new ArrayList<Student>();
			al.add(new Student(11,"ratan"));
			al.add(new Student(2,"Sravya"));
			al.add(new Student(333,"anu"));
			Collections.sort(al);
			Iterator<Student> itr =al.iterator();
			while (itr.hasNext())
			{		Student s = itr.next();
					System.out.println(s.sid+"----"+s.sname);
			}
		}
}
import java.util.*;
class Comp  implements Comparator
{
		public int compare(Object o1,Object o2)
		{
			EmpBean e1 = (EmpBean)o1;
			EmpBean e2 = (EmpBean)o2;
			if (e1.eid==e2.eid)
			{return 0;
			}
			if (e1.eid>e1.eid)
			{return 1;
			}
			else{return -1;}
		}
}
import java.util.*;
class Test
{		public static void main(String[] args)
```

```
	{
		TreeSet<EmpBean> s = new TreeSet<EmpBean>(new Comp());
		EmpBean e1 = new EmpBean();
		e1.setEid(111);
		e1.setEname("ratan");
		EmpBean e2 = new EmpBean();
		e2.setEid(22);
		e2.setEname("anu");

		s.add(e1);
		s.add(e2);

		for (EmpBean e:s)
		{System.out.println(e.eid+"---"+e.ename);
		}

	}
}
public class EmpBean implements Comparable<EmpBean>
{	int eid;
	String ename;
	public void setEid(int eid)
	{	this.eid=eid;
	}
	public void setEname(String ename)
	{	this.ename=ename;
	}
	public int getEid()
	{return eid;
	}
	public String getEname()
	{return ename;
	}
	public int compareTo(EmpBean o)
	{
		if (eid==o.eid)
		{return 0;
		}
		if (eid>o.eid)
		{return 1;
		}
		else{return -1;}
	}
};
```

networking

Introduction to networking:-

1) The process of connecting the resources (computers) together to share the data is called networking.
2) Java.net is package it contains number of classes by using that classes we are able to connection between the devices (computers) to share the information.

3) Java.net package provide support for the TCP (Transmission Control Protocol),UDP(user data gram protocol) protocols.

4) In the network we are having to components
   a. Sender
   b. Receiver

   Sender/source: - the person who is sending the data is called sender.
   Receiver/destination:- the person who is receiving the data is called receiver.
   In the network one system can acts as a sender as well as receiver.

5) In the networking terminology everyone says client and server.
   I. Client
   II. Server

   Client:- the person who is sending the request and taking the response is called client.
   Server:- the person who is taking the request and sending the response is called server.

Categories of network:-

We are having two types of networks
1) Per-to-peer network.
2) Client-server network.

Client-server:-

In the client server architecture always client system behaves as a client and server system behaves as a server.

Peer-to-peer:-

In the peer to peer client system sometimes behaves as a server, server system sometimes behaves like a client the roles are not fixed.

Types of networks:-

Intranet:-

It is also known as a private network. To share the information in limited area range(within the organization) then we should go for intranet.

Internet:-

It is also known as public networks. Where the data maintained in a centralized server hence we are having more sharability. And we can access the data from anywhere else.

Extranet:-

This is extension to the private network means other than the organization , authorized persons able to access.

The frequently used terms in the networking:-

1) IP Address
2) URL(Uniform Resource Locator)

3) Protocol
4) Port Number
5) MAC address.
6) Connection oriented and connection less protocol
7) Socket.

Protocol:-

Protocol is a set of rules fallowed by the every computer present in the network this is useful to send the data physically from one place to another place in the network.

- TCP(Transmission Control Protocol)(connection oriented protocol)
- UDP (User Data Gram Protocol)(connection less protocol)
- Telnet
- SMTP(Simple Mail Transfer Protocol)
- IP (Internet Protocol)

IP Address:-

1) IP Address is a unique identification number given to the computer to indentify it uniquely in the network.
2) The IP Address is uniquely assigned to the computer it is not duplicated.
3) The IP Address range is 0-255 if we are giving the other than this range that is not allowed.
4) We can identify the particular computer in the network with the help of IP Address.
5) The IP Address contains four digit number
   a. 125.0.4.255 ----> Valid
   b. 124.654.5.6 ----> Invalid
   c. 1.2.3.4.5.6 ----> Invalid
6) Each and every website contains its own IP Address we can access the sites through the names otherwise IP Address.
   Site Name :- www.google.com
   IP Address :- 74.125.224.72

Example:-

```
import java.net.*;
import java.io.*;
class Test
{	public static void main(String[] args) throws Exception
	{	BufferedReader br=new BufferedReader(new InputStreamReader(System.in));
		System.out.println("please enter site name");
		String sitename=br.readLine();
		InetAddress in=InetAddress.getByName(sitename);
		System.out.println("the ip address is:"+in);
	}
}
```

java Test
www.google.com
The IP Address is:www.google.com/74.125.236.176
java Test
www.yahoo.com
The IP Address is: www.yahoo.com/ 106.10.139.246
Java Test
Please press enter key then we will get IP Address of the system.

The IP Address is : local host/we are getting IP Address of the system

Note:- If the internet is not available we are getting java.net.UnKnownHostException.

URL(Uniform Resource Locator):-

1) URL is a class present in the java.net package.
2) By using the URL we are accessing some information present in the world wide web.
3) Example of URL is:-

    http://www.Sravyasoft.com:10/Corejava_rattaiah.asp

    Protocol path port path

    The URL contains information like
    a. Protocol to use **http://**
    b. Server name/IP address **www.Sravyasoft.com**
    c. Port number of the particular application and it is optional(:10)
    d. File name or directory name **Corejava_rattaiah.asp**
4) To crate the object for URL we have to use the fallowing syntax
    a. URL obj=new URL(String protocol, String host, int port, String path);
    b. URL obj=new URL(String protocol, String host, String path);

Example:-

```
import java.net.*;
class Test
{	public static void main(String[] args) throws Exception
	{	URL url=new URL("http://www.Sravyasoft.com:10/index.html");
		System.out.println("protocal is:"+url.getProtocol());
		System.out.println("host name is:"+url.getHost());
		System.out.println("port number is:"+url.getPort());
		System.out.println("path is:"+url.getPath());
		System.out.println(url);
	}
}
```

Communication using networking :-

In the networking it is possible to do two types of communications.

1) Connection oriented(TCP/IP communication)
2) Connection less(UDP Communication)

Connection Oriented:-

a) In this type of communication we are using combination of two protocols TCP,IP.
b) In this type of communication the main purpose of the TCP is transferred in the form of packets between the source and destination. And the main purpose of the IP is finding address of a particular system.

   To achieve the fallowing communication the java peoples are provided the fallowing classes.
   a. Socket
   b. ServerSocket

Layers of the TCP/IP connection.

Application Layer

TCP

IP
↕
Data Link Layer
↕
Physical Layer

Application Layer:- Takes the data from the application and sends it to the TCP layer.

TCP Protocol:-

it will take the data which is coming from Application Layer and divides in to small units called Packets. Then transfer those packets to the next layer called IP. The packet contains group of bytes of data.

IP:- It will take the packets which is coming from TCP and prepare envelop called 'frames' hence the frame contains the group of packets. Then it will identify the particular target machine on the basis of the IP address and sent that frames to the physical layer.

Physical Layer:-Based on the physical medium it will transfer the data to the target machine.

Connection Less :- (UDP)

1) UDP is a protocol by using this protocol we are able to send data without using Physical Connection.
2) This is a light weight protocol because no need of the connection between the client and server .
3) This is very fast communication compare to the TCP/IP communication.
4) This protocol not sending the data inn proper order there may be chance of missing the data.
5) This communication used to send the Audio and Video data if some bits are lost but we are able to see the video and images we are getting any problems.

To achieve the UDP communication the java peoples are provided the fallowing classes.

1. DataGrampacket.
2. DataGramSocket.

Socket:-

1) Socket is used to create the connection between the client and server.
2) Socket is nothing but a combination of IP Address and port number.
3) The socket is created at client side.
4) Socket is class present in the java.net package
5) It is acting as a communicator between the client and server.
6) Whenever if we want to send the data first we have to create a socket that is acts as a medium.

Create the socket

1) Socket s=new Socket(int IPAddress, int portNumber);
   a. Socket s=new Socket("125.125.0.5",123);

      Server IP Address. Server port number.
2) Socket s=new Socket(String HostName, int PortNumber);
   a. Socket s=new Socket(Sravyasoft,123);

Client.java:-

```
import java.net.*;
import java.io.*;
class Client
{	public static void main(String[] args)throws Exception
```

```
	{	Socket s=new Socket("localhost",5555);
		String str="ratan from client";
		OutputStream os=s.getOutputStream();
		PrintStream ps=new PrintStream(os);
		ps.println(str);

		InputStream is=s.getInputStream();
		BufferedReader br=new BufferedReader(new InputStreamReader(is));
		String str1=br.readLine();
		System.out.println(str1);
	}
}
```

<u>Server.java:-</u>

```
import java.io.*;
import java.net.*;
class Server
{	public static void main(String[] args) throws Exception
	{	//to read the data from  client
		ServerSocket ss=new ServerSocket(5555);
		Socket s=ss.accept();

		System.out.println("connection is created ");
		InputStream is=s.getInputStream();

		BufferedReader br=new BufferedReader(new InputStreamReader(is));
		String data=br.readLine();
		System.out.println(data);

		//write the data to the client
		data=data+"this is from server";
		OutputStream os=s.getOutputStream();
		PrintStream ps=new PrintStream(os);
		ps.println(data);
	}
}
```

Java.awt package

- Abstract Window Tool kit is an **API** it supports graphical user interface programming.
- By using java.awt package we are able to develop the components like
    - TextFiled , Label, Button ,Checkbox ,RadioButton…..etc
- AWT components are platform dependent it displays the application according to the view of operating system.
- By using java.awt package we are able to prepare static components to provide the dynamic nature to the component use **java.awt.event** package.**(it is a sub package of java.awt).**
-

1. This application not providing very good look and feel hence the normal users facing problem with these types of applications.
2. By using AWT we are preparing application these applications are called console based or CUI application.

Note

Java.awt package is used to prepare static components.
Java.awt.event package is used to provide the life to the static components.

GUI(graphical user interface):-

1. It is a mediator between end user and the program.
2. AWT is a package it will provide very good predefined support to design GUI applications.

component :-

- ✓ The root class of java.awt package is Component class.
- ✓ Component is an object which is displayed pictorially on the screen.
  Ex:- Button,Label,TextField......etc

Container:-

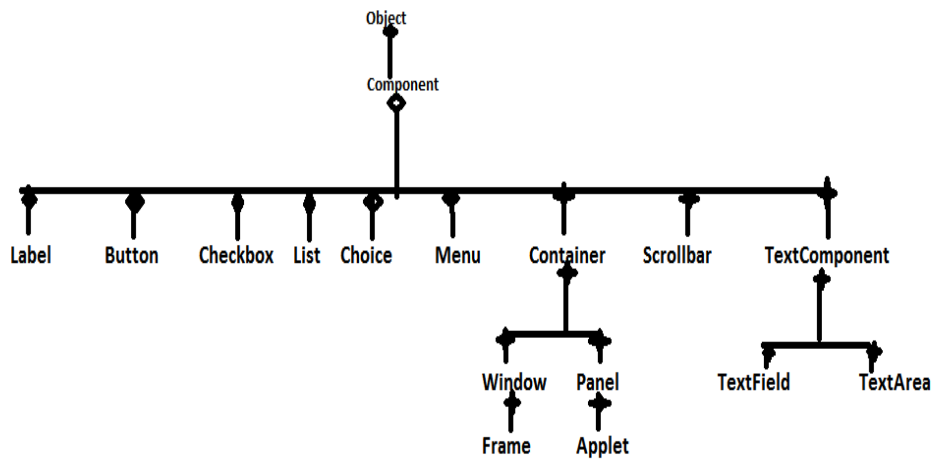
- it is a component in awt that contains another components like Button,TextField…etc
- Container is a sub class of Component class.
- The classes that extends container classes those classes are containers such as Frame, Dialog and Panel.

Event:-

The event nothing but a action generated on the component or the change is made on the state of the object.
Ex:-
Button clicked, Checkboxchecked, Itemselected in the list, Scrollbar scrolled horizontal/vertically.

Classes of AWT:-

The classes present in the AWT package.



Java.awt.Frame:-

Frame is a Basic component in AWT, it contains other components like Button, TextField...etc. There are two approaches to create a frame

1) ***By extending Frame class.***
2) ***By creating Object of Frame class.***

Constructors:-

Frame f=new Frame();
Frame f=new Frame("MyFrame");

Characteristics of the Frame:-

- ✓ When we create a Frame class object the Frame will be created automatically with invisible mode so to provide visible nature to the frame use setVisible() method of Frame class.
  public void setVisible(boolean b)
  where b==true visible mode b==false means invisible mode.
- ✓ When we created a Frame the initial size of the Frame is 0 pixel heights & 0 pixel width so it is not visible to use. To provide particular size to the Frame we have to use setSize() method.
  public void setSize(int width,int height)
- ✓ To provide title to the Frame use. ***public void setTitle(String Title)***
- ✓ When we create a Frame, the default background color of the Frame is white. If you want to provide particular color to the Frame we have to use the following method.
  public void setBackground(color c)

Example-1 :- creation of Frame By creating Object of Frame class.

```
import java.awt.*;
class Demo
{	public static void main(String[] args)
	{	Frame f=new Frame();		//frame creation
		f.setVisible(true);		//now frame is visible by default not visible
		f.setSize(400,400);		//set the size of the frame
		f.setBackground(Color.red);	//set the background
		f.setTitle("myframe");		//set the title of the frame
	}
};
```

CRATION OF FRAME BY TAKING USER DEFINED CLASS*

```
import java.awt.*;
class MyFrame extends Frame
{	MyFrame()
	{	setVisible(true);
		setSize(500,500);
		setTitle("myframe");
		setBackground(Color.red);
	}
}
class Demo
{	public static void main(String[] args)
	{	MyFrame f=new MyFrame();
	}
};
```

To display text on the screen:-

1. If you want to display some textual message or some graphical shapes on the Frame then we have to override paint(), which is present in the Frame class.
   public void paint(Graphics g)

2. To set a particular font to the text,we have to use Font class present in java.awt package
   Font f=new Font(String type,int style,int size);
   Ex: Font f= new Font("arial",Font.Bold,30);

Ex :-
```
import java.awt.*;
class Test extends Frame
{
	public static void main(String[] args)
	{
		Test t=new Test();
		t.setVisible(true);
		t.setSize(500,500);
		t.setTitle("myframe");
		t.setBackground(Color.red);
	}
	public void paint(Graphics g)
	{
		Font f=new Font("arial",Font.ITALIC,25);
		g.setFont(f);
		g.drawString("hi ratan how r u",100,100);
	}
}
```

Note:-

1. When we create a MyFrame class constructor,jvm executes MyFrame class construcor just before this JVM has to execute Frame class zero argument constructor.
2. In Frame class zero argument constructor repaint() method will be executed, it will access predefined Frame class paint() method. But as per the requirement overriding paint() method will be executed.
3. Therefore the paint() will be executed automatically at the time of Frame creation.

Preparation of the components:-

Label: -

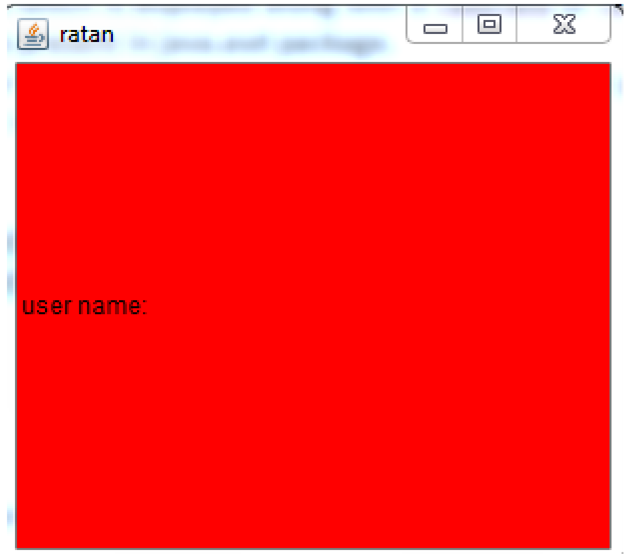
1) Label is a constant text which is displayed along with a TextField or TextArea.
2) Label is a class which is present in java.awt package.
3) To display the label we have to add that label into the frame for that purpose we have to use add() method present in the Frame class.

Constructor:-

Label l=new Label();
Label l=new Label("user name");

Ex :-
```
import java.awt.*;
```
```
class Test
{
```

```
        public static void main(String[] args)
        {
                Frame f=new Frame();
                f.setVisible(true);
                f.setTitle("ratan");
                f.setBackground(Color.red);
                f.setSize(400,500);
        Label l=new Label("user name:");
                f.add(l);
        }
}
```



TextField:-

- TextField is an editable area and it is possible to provide single line of text.
- Enter Button doesn't work on TextField.
    - To set Text to the textarea we have to use ***t.setText("Sravya");***
    - To get the text form the TextArea we have to use ***String s=t.getText();***
    - To append text into the TextArea ***t.appendText("ratan");***

Constructor:-

```
TextFiled tx=new TextFiled();
TextField tx=new TextField("ratan");
```

Ex :-

```
import java.awt.*;
class Test
{       public static void main(String[] args)
        {       Frame f=new Frame();
                f.setVisible(true);
                f.setTitle("ratan");
                f.setBackground(Color.red);
                f.setSize(400,500);
//TextField tx=new TextField(); empty TextField
TextField tx=new TextField("ratan");
//TextField with data
                f.add(tx);
        }
}
```

TextArea:- *TextArea is a Editable Area & enter button will work on TextArea.*

TextArea t=new TextArea();

TextArea t=new TextArea(int rows,int columns);

- ✓ To set Text to the textarea we have to use ***ta.setText("Sravya");***
- ✓ To get the text form the TextArea we have to use ***String s=ta.getText();***
- ✓ To append the text into the TextArea *use* **ta.appendText("ratan");**

```
import java.awt.*;
class Test
{	public static void main(String[] args)
	{	Frame f=new Frame();
		f.setVisible(true);
		f.setTitle("ratan");
		f.setBackground(Color.red);
		f.setSize(400,500);
		f.setLayout(new FlowLayout());
		Label l=new Label("user name:");
		TextArea tx=new TextArea(4,10);//4 character height 10 character width
		tx.appendText("ratan");
		tx.setText("aruna");
		System.out.println(tx.getText());
		f.add(l);
		f.add(tx);
		}
}
```

Choice:- *List is allows to select multiple items but choice is allow to select single Item.*

Choice ch=new Choice();

Methods :-

1. To add items to the choice use add() method.
2. To remove item from the choice based on String use remove()method. ***choice.remove("HYD");***
3. To remove the item based on the index position use ***choice.remove(2);***
4. To remove the all elements ***ch.removeAll();***
5. To inset the data into the choice based on the particular position. ***choice.insert(2,"ratan");***
6. To get selected item from the choice use ***String s=ch.getSelectedItem();***
7. To get the selected item index number use ***int a=ch.getSelectedIndex();***

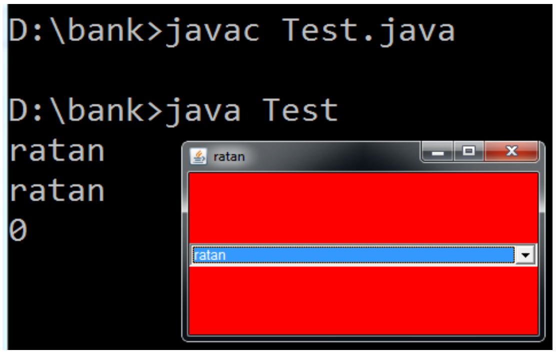
ex:-

```
import java.awt.*;
class Test
{	public static void main(String[] args)
	{	Frame f=new Frame();
		f.setVisible(true);
```

```
                        f.setTitle("ratan");
                        f.setBackground(Color.red);
                        f.setSize(400,500);
                        Choice ch=new Choice();
                        ch.add("c");
                        ch.add("cpp");
                        ch.add("java");
                        ch.add(".net");
                        ch.remove(".net");
                        ch.remove(0);
                        ch.insert("ratan",0);
                        f.add(ch);
System.out.println(ch.getItem(0));
System.out.println(ch.getSelectedItem());
System.out.println(ch.getSelectedIndex());
                        //ch.removeAll();



            }
}
```



List: List is providing list of options to select. Based on your requirement we can select any number of elements. To add the List to the frame we have to use add() method.

CONSTRUCTOR:-

List l=new List(); It will creates the list by default size is four elements.
List l=new List(3); It will display the three items size and it is allow selecting the only single item.
List l=new List(5,true); It will display the five items and it is allow selecting the multiple items.

Methods:-

- ✓ To add the elements to the List use ***list.add("c");***
- ✓ To add the elements to the List at specified index ***list.add("ratan",0);***
- ✓ To remove element from the List use ***list.remove("c");***
- ✓ To get selected item from the List use ***String x=l.get SelectedItem();***
- ✓ To get selected items from the List we have to use ***String[] x=s.getSelectedItems()***

```
import java.awt.*;
class Test
{           public static void main(String[] args)
            {           Frame f=new Frame();
                        f.setVisible(true);
                        f.setTitle("ratan");
                        f.setBackground(Color.red);
                        f.setSize(400,500);
                        f.setLayout(new FlowLayout());
                        List l=new List(4,true);
                        l.add("c");         l.add("cpp");        l.add("java");       l.add(".net");
                        l.add("ratan");     l.add("arun",0);     l.remove(0);         f.add(l);
                        System.out.println(l.getSelectedItem());
                        }
```

}

Checkbox: - The user can select more than one checkbox at a time.

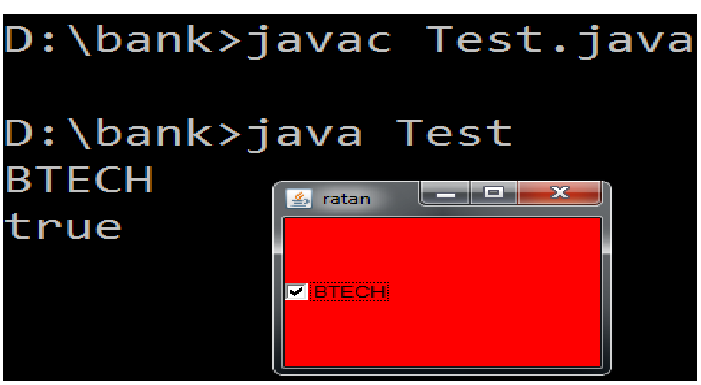
1) Checkbox cb1=new CheckBox();
2) Checkbox cb2=new CheckBox("MCA");
3) Checkbox cb3=new CheckBox("BSC",true);

Methods:-

1. To set a label to the CheckBox explicitly use ***cb.setLabel("BSC");***
2. To get the label of the checkbox use ***String str=cb.getLabel();***
3. To get state of the CheckBox use ***Boolean b=ch.getState();***

Ex:-

```
import java.awt.*;
class Test
{         public static void main(String[] args)
          {         Frame f=new Frame();
                    f.setVisible(true);
                    f.setTitle("ratan");
                    f.setBackground(Color.red);
                    f.setSize(400,500);
                    Checkbox cb1=new Checkbox("BTECH",true);
                    f.add(cb1);
                    System.out.println(cb1.getLabel());
                    System.out.println(cb1.getState());
                    }
}
```



RADIO BUTTON:

- ✓ AWT does not provide any predefined support to create RadioButtons.
- ✓ It is possible to select Only item from group of items and we are able to create RadioButton by using two classes.
  - o CheckBoxgroup
  - o CheckBox

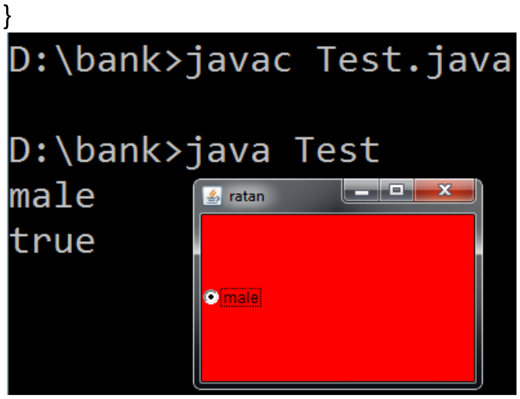
step 1:- Create CheckBox group object. ***CheckBoxGroup cg=new CheckBoxGroup();***
step 2:- pass Checkboxgroup object to the Checkbox class argument.
CheckBox cb1=new CheckBox("male",cg,false);
CheckBox cb2=new CheckBox("female",cg,false);

Methods:-

1) To get the status of the RadioButton use ***String str=Cb.getState();***
2) To get Label of the RadioButton use ***String str=getLabel().***

Ex:-

```
import java.awt.*;
class Test
{       public static void main(String[] args)
        {       Frame f=new Frame();
                f.setVisible(true);
                f.setTitle("ratan");
                f.setBackground(Color.red);
                f.setSize(400,500);
                CheckboxGroup cg=new CheckboxGroup();
                Checkbox cb1=new Checkbox("male",cg,true);
                f.add(cb1);
                System.out.println(cb1.getLabel());
                System.out.println(cb1.getState());
                }
}
```



Layout Managers:-

```
import java.awt.*;
class Test
{       public static void main(String[] args)
        {       Frame f=new Frame();
                f.setVisible(true);
                f.setTitle("ratan");
```

```
                f.setBackground(Color.red);
                f.setSize(400,500);
                Label l1=new Label("user name:");
                TextField tx1=new TextField();
                Label l2=new Label("password:");
                TextField tx2=new TextField();
                Button b=new Button("login");
                f.add(l1);          f.add(tx1);          f.add(l2);
                f.add(tx1);         f.add(b);
        }
}
```

Event delegation model:-

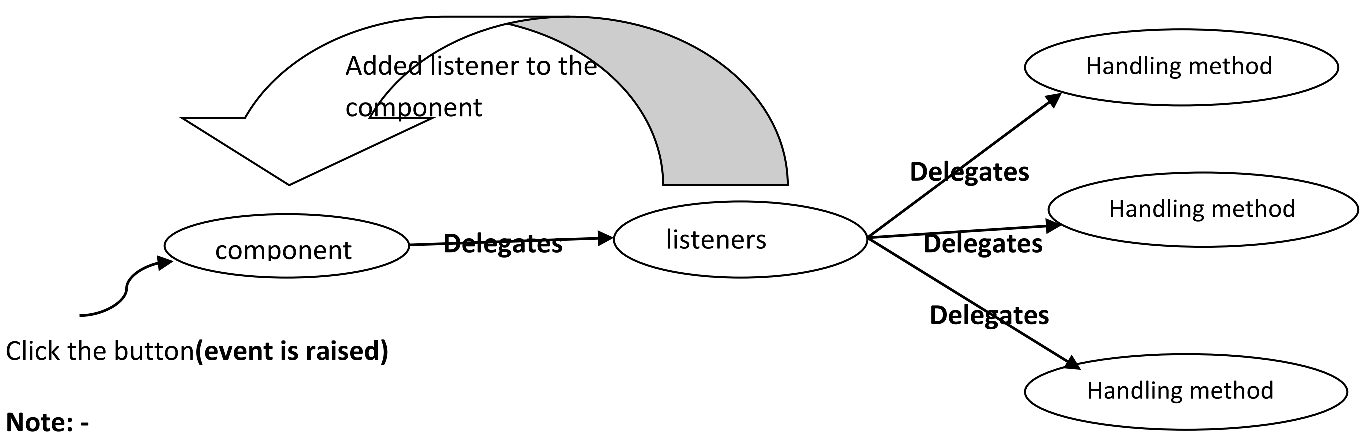
1. When we create a component the components visible on the screen but it is not possible to perform any action for example button.
2. Whenever we create a Frame it can be minimized and maximized and resized but it is not possible to close the Frame even if we click on Frame close Button.
3. The Frame is a static component so it is not possible to perform actions on the Frame.
4. To make static component into dynamic component we have to add some actions to the Frame.
5. To attach actions to the Frame component we need event delegation model.

Whenever we click on button no action will be performed clicking like this is called event.

Event: - Event is nothing but a particular action generated on the particular component.

1. When an event generates on the component the component is unable to respond because component can't listen the event.
2. To make the component listen the event we have to add listeners to the component.
3. Wherever we are adding listeners to the component the component is able to respond based on the generated event.
4. A listener is a interface which contain abstract methods and it is present in java.awt.event package
5. The listeners are different from component to component.

A component delegate event to the listener and listener is designates the event to appropriate method by executing that method only the event is handled. This is called Event Delegation Model.



Note: -

To attach a particular listener to the Frame we have to use following method

Public void AddxxxListener(xxxListener e)

Where xxx may be ActionListener,windowListener
The Appropriate Listener for the Frame is "windowListener"

ScrollBar:-

1. By using ScrollBar we can move the Frame up and down.
   ScrollBar s=new ScrollBar(int type)

Type of scrollbar

1. VERTICAL ScrollBar
2. HORIZONTAL ScrollBar

To create a HORIZONTAL ScrollBar**:-**

ScrollBar sb=new ScrollBar(ScrollBar.HORIZONTAL);
To get the current position of the scrollbar we have to use the following method.
public int getValue()

To create a VERTICAL ScrollBar**:-**

ScrollBar sb=new ScrollBar(ScrollBar.VERTICAL);

Appropriate Listeners for Components:-

GUI Component	Event Name	Listner Name	Lisener Methods
1.Frame	Window Event	Window Listener	1.Public Void WindowOpened(WindowEvent e) 2.Public Void WindowActivated(WindowEvent e) 3.Public Void WindowDeactivated(WindowEvent e) 4.Public Void WindowClosing(WindowEvent e) 5.Public Void WindowClosed(WindowEvent e) 6.Public Void WindowIconfield(WindowEvent e) 7.Public Void WindowDeiconified(WindowEvent e)
2.Textfield	ActionEvent	ActionListener	1.Public Void Actionperformed(ActionEvent ae)
3.TextArea	ActionEvent	ActionListener	1.Public Void Actionperformed(ActionEvent ae)
4.Menu	ActionEvent	ActionListener	1.Public Void Actionperformed(ActionEvent ae)
5.Button	ActionEvent	ActionListener	1.Public Void Actionperformed(ActionEvent ae)
6.Checkbox	ItemEvent	ItemListener	1.Public Void ItemStatechanged(ItemEvent e)
7.Radio	ItemEvent	ItemListener	1.Public Void ItemStatechanged(ItemEvent e)
8.List	ItemEvent	ItemListener	1.Public Void ItemStatechanged(ItemEvent e)
9.Choice	ItemEvent	ItemListener	1.Public Void ItemStatechanged(ItemEvent e)
10.Scrollbar	AdjustmentEvent	AdjustmentListener	1.Public Void AdjustementValueChanged (AdjustementEvent e)
11.Mouse	MouseEvent	MouseListener	1.Public Void MouseEntered(MouseEvent e) 2.Public Void MouseExited(MouseEvent e) 3.Public Void MousePressed(MouseEvent e) 4.Public Void MouseReleased(MouseEvent e) 5.Public Void MouseClicked(MouseEvent e)

12.Keyboard	KeyEvent	KeyListener	1.Public Void KeyTyped(KeyEvent e) 2.Public Void KeyPressed(KeyEvent e) 3.Public Void KeyReleased(KeyEvent e)

PROVIDING CLOSING OPTION TO THE FRAME*

```
import java.awt.*;
import java.awt.event.*;
class MyFrame extends Frame
{	MyFrame()
	{	this.setSize(400,500);
		this.setVisible(true);
		this.setTitle("myframe");
		this.addWindowListener(new myclassimpl());
	}
}
class myclassimpl implements WindowListener
{	public void windowActivated(WindowEvent e)
	{	System.out.println("window activated");
	}
	public void windowDeactivated(WindowEvent e)
	{	System.out.println("window deactivated");
	}
	public void windowIconified(WindowEvent e)
	{	System.out.println("window iconified");
	}
	public void windowDeiconified(WindowEvent e)
	{	System.out.println("window deiconified");
	}
	public void windowClosed(WindowEvent e)
	{	System.out.println("window closed");
	}
	public void windowClosing(WindowEvent e)
	{	System.exit(0);
	}
	public void windowOpened(WindowEvent e)
	{	System.out.println("window Opened");
	}
};
class Demo
{	public static void main(String[] args)
	{	MyFrame f=new MyFrame();
```

```
	}
};
```

PROVIDING CLOSEING OPTION TO THE FRAME*

```
import java.awt.*;
import java.awt.event.*;
class MyFrame extends Frame
{	MyFrame()
	{	this.setVisible(true);
		this.setSize(500,500);
		this.setBackground(Color.red);
		this.setTitle("rattaiah");
		this.addWindowListener(new Listenerimpl());
	}
};
class Listenerimpl extends WindowAdapter
{	public void windowClosing(WindowEvent we)
	{	System.exit(0);
	}
};
class Demo
{	public static void main(String[] args)
	{	MyFrame f=new MyFrame();
	}
};
```

Note ;- by using WindowAdaptor class we can close the frame. Internally WindowAdaptor class implements WindowListener interface. Hence WindowAdaptor class contains empty implementation of abstract methods.

PROVIDING CLOSEING OPTION THE FRAME***

```
import java.awt.*;
import java.awt.event.*;
class MyFrame extends Frame
{	MyFrame()
	{	this.setVisible(true);
		this.setSize(500,500);
		this.setBackground(Color.red);
		this.setTitle("rattaiah");
		this.addWindowListener(new WindowAdapter()
		{
```

```
            public void windowClosing(WindowEvent we)
            {           System.exit(0);
            }           });
            }
}
class FrameEx
{           public static void main(String[] args)
            {                       MyFrame f=new MyFrame();
            }
};
***WRITE SOME TEXT INTO THE FRAME********
import java.awt.*;
class MyFrame extends Frame
{           MyFrame()
            {           this.setVisible(true);
                        this.setSize(500,500);
                        this.setBackground(Color.red);
                        this.setTitle("rattaiah");
            }
            public void paint(Graphics g)
            {           Font f=new Font("arial",Font.BOLD,20);
                        g.setFont(f);
                        this.setForeground(Color.green);
                        g.drawString("HI BTECH ",100,100);
                        g.drawString("good boys &",200,200);
                        g.drawString("good girls",300,300);
            }
}
class FrameEx
{           public static void main(String[] args)
            {           MyFrame f=new MyFrame();
            }
};
********LAYOUT MACHANISUMS    FLOWLAYOUT**********
import java.awt.*;
import java.awt.event.*;
class MyFrame extends Frame
{           Label l1,l2;
            TextField tx1,tx2;
            Button b;
            MyFrame()
            {           this.setVisible(true);
                        this.setSize(340,500);
                        this.setBackground(Color.green);
                        this.setTitle("rattaiah");
                        l1=new Label("user name:");                 l2=new Label("password:");
                        tx1=new TextField(25);             tx2=new TextField(25);
                        b=new Button("login");
```

```
            tx2.setEchoChar('*');
            this.setLayout(new FlowLayout());
            this.add(l1);     this.add(tx1);    this.add(l2);     this.add(tx2);          this.add(b);
            }
}
class Demo
{       public static void main(String[] args)
        {       MyFrame f=new MyFrame();
        }
};
```

*****BORDERLAYOUT**********

```
import java.awt.*;
class MyFrame extends Frame
{       Button b1,b2,b3,b4,b5;
        MyFrame()
        {       this.setBackground(Color.green);
                this.setSize(400,400);
                this.setVisible(true);
                this.setLayout(new BorderLayout());
                 b1=new Button("Boys");
                 b2=new Button("Girls");
                 b3=new Button("management");
                 b4=new Button("Teaching Staff");
                 b5=new Button("non-teaching staff");
                this.add("North",b1);          this.add("Center",b2);
                this.add("South",b3);          this.add("East",b4);
                this.add("West",b5);
        }
}
class Demo
{       public static void main(String[] args)
        {       MyFrame f=new MyFrame();
        }
};
```

********CardLayout*************

```
import java.awt.*;
class MyFrame extends Frame
{       MyFrame()
        {       this.setSize(400,400);
                this.setVisible(true);
                this.setLayout(new CardLayout());
                Button b1=new Button("button1");
                Button b2=new Button("button2");
                Button b3=new Button("button3");
                Button b4=new Button("button4");
                Button b5=new Button("button5");
                this.add("First Card",b1);              this.add("Second Card",b2);
                this.add("Thrid Card",b3);              this.add("Fourth Card",b4);
```

```
		this.add("Fifth Card",b5);
	}
}
class Demo
{	public static void main(String[] args)
	{		MyFrame f=new MyFrame();
	}
};
```

********GRIDLAYOUT**********

```
import java.awt.*;
class MyFrame extends Frame
{	MyFrame()
	{	this.setVisible(true);
		this.setSize(500,500);
		this.setTitle("rattaiah");
		this.setBackground(Color.red);
		this.setLayout(new GridLayout(4,4));
		for (int i=0;i<10 ;i++ )
		{	Button b=new Button(""+i);
			this.add(b);
		}
	}
};
class Demo
{	public static void main(String[] args)
	{	MyFrame f=new MyFrame();
	}
};
```

*********ACTIONLISTENER**********

```
import java.awt.*;
import java.awt.event.*;
class myframe extends Frame implements ActionListener
{	TextField tx1,tx2,tx3;
		Label l1,l2,l3;
		Button b1,b2;
		int result;
	myframe()
	{	this.setSize(250,400);
		this.setVisible(true);
		this.setLayout(new FlowLayout());
		 l1=new Label("first value");
		 l2=new Label("second value");
		 l3=new Label("result");

		 tx1=new TextField(25);
		tx2=new TextField(25);
```

```
                tx3=new TextField(25);

                b1=new Button("add");
                b2=new Button("mul");

                b1.addActionListener(this);
                b2.addActionListener(this);
                this.add(l1);           this.add(tx1);          this.add(l2);
                this.add(tx2);          this.add(l3);           this.add(tx3);
                this.add(b1);           this.add(b2);
        }
        public void actionPerformed(ActionEvent e)
        {       try{
                int fval=Integer.parseInt(tx1.getText());
                int sval=Integer.parseInt(tx2.getText());
                String label=e.getActionCommand();
                if (label.equals("add"))
                {       result=fval+sval;
                }
                if (label.equals("mul"))
                {       result=fval*sval;
                }
                tx3.setText(""+result);
                }
        catch(Exception ee)
                {
                ee.printStackTrace();
                }
        }
};
class Demo
{       public static void main(String[] args)
        {       myframe f=new myframe();
        }
};
```

***** LOGIN STATUS*********

```
import java.awt.*;
import java.awt.event.*;
class MyFrame extends Frame implements ActionListener
{       Label l1,l2;
        TextField tx1,tx2;
        Button b;
        String status="";
        MyFrame()
        {       setVisible(true);
                setSize(400,400);
```

```
                setTitle("girls");
                setBackground(Color.red);
                l1=new Label("user name:");
                l2=new Label("password:");
                tx1=new TextField(25);
                tx2=new TextField(25);

                b=new Button("login");
                b.addActionListener(this);
                tx2.setEchoChar('*');

                this.setLayout(new FlowLayout());

                this.add(l1);
                this.add(tx1);
                this.add(l2);
                this.add(tx2);
                this.add(b);
        }
        public void actionPerformed(ActionEvent ae)
        {       String  uname=tx1.getText();
                String upwd=tx2.getText();
                if (uname.equals("Sravya")&&upwd.equals("dss"))
                {       status="login success";         }
                else
                {       status="login failure";         }
        repaint();
        }
        public void paint(Graphics g)
                {
                Font f=new Font("arial",Font.BOLD,30);
                g.setFont(f);
                this.setForeground(Color.green);
                g.drawString("Status:----"+status,50,300);

                }
}
class Demo
{       public static void main(String[] args)
        {       MyFrame f=new MyFrame();
        }
};
```

******MENUITEMS************

```
import java.awt.*;
import java.awt.event.*;
class MyFrame extends Frame implements ActionListener
{
```

```
        String label="";
        MenuBar mb;
        Menu m1,m2,m3;
        MenuItem mi1,mi2,mi3;
        MyFrame()
        {       this.setSize(300,300);
                this.setVisible(true);
                this.setTitle("myFrame");
                this.setBackground(Color.green);

                 mb=new MenuBar();
                 this.setMenuBar(mb);

                 m1=new Menu("new");
                 m2=new Menu("option");
                 m3=new Menu("edit");
                mb.add(m1);
                mb.add(m2);
                mb.add(m3);

                mi1=new MenuItem("open");
                mi2=new MenuItem("save");
                mi3=new MenuItem("saveas");

                mi1.addActionListener(this);
                mi2.addActionListener(this);
                mi3.addActionListener(this);

                m1.add(mi1);
                m1.add(mi2);
                m1.add(mi3);
        }
        public void actionPerformed(ActionEvent ae)
        {
                label=ae.getActionCommand();
                repaint();
        }


        public void paint(Graphics g)
        {
                Font f=new Font("arial",Font.BOLD,25);
                g.setFont(f);
                g.drawString("Selected item....."+label,50,200);
        }
}
class Demo
{
```

```
        public static void main(String[] args)
        {
                MyFrame f=new MyFrame();
        }
};
```

*****MOUSELISTENER INTERFACE**********

```
import java.awt.*;
import java.awt.event.*;
class myframe extends Frame implements MouseListener
{       String[] msg=new String[5];
        myframe()
        {       this.setSize(500,500);
                this.setVisible(true);
                this.addMouseListener(this);
        }
        public void mouseClicked(MouseEvent e)
        {       msg[0]="mouse clicked......("+e.getX()+","+e.getY()+")";
                repaint();
        }
        public void mousePressed(MouseEvent e)
        {       msg[1]="mouse pressed......("+e.getX()+","+e.getY()+")";
                repaint();
        }
        public void mouseReleased(MouseEvent e)
        {       msg[2]="mouse released......("+e.getX()+","+e.getY()+")";
                repaint();
        }
        public void mouseEntered(MouseEvent e)
        {       msg[3]="mouse entered......("+e.getX()+","+e.getY()+")";
                repaint();
        }
        public void mouseExited(MouseEvent e)
        {       msg[4]="mouse exited......("+e.getX()+","+e.getY()+")";
                repaint();
        }
        public void paint(Graphics g)
        {       int X=50;
                int Y=100;
                for(int i=0;i<msg.length;i++)
                {       if (msg[i]!=null)
                        {       g.drawString(msg[i],X,Y);
                                Y=Y+50;
                        }
                }
        }
```

```
};
class Demo
{           public static void main(String[] args)
            {           myframe f=new myframe();
            }
};
```

```
*******ITEMLISTENER INTERFACE**********
import java.awt.*;
import java.awt.event.*;
class myframe extends Frame implements ItemListener
{           String qual="",gen="";
            Label l1,l2;
            CheckboxGroup cg;
            Checkbox c1,c2,c3,c4,c5;
            Font f;
            myframe()
            {           this.setSize(300,400);
                        this.setVisible(true);
                        this.setLayout(new FlowLayout());

                         l1=new Label("Qualification:  ");
                         l2=new Label("Gender:  ");

                         c1=new Checkbox("BSC");
                         c2=new Checkbox("BTECH");
                         c3=new Checkbox("MCA");

                         cg=new CheckboxGroup();
                         c4=new Checkbox("Male",cg,false);
                         c5=new Checkbox("Female",cg,true);

                        c1.addItemListener(this);
                        c2.addItemListener(this);
                        c3.addItemListener(this);
                        c4.addItemListener(this);
                        c5.addItemListener(this);

                        this.add(l1);               this.add(c1);               this.add(c2);
                        this.add(c3);               this.add(l2);               this.add(c4);
                        this.add(c5);
            }
                        public void itemStateChanged(ItemEvent ie)
                        {           if(c1.getState()==true)
                                    {           qual=qual+c1.getLabel()+",";
```

```
                    }
                    if(c2.getState()==true)
                    {       qual=qual+c2.getLabel()+",";
                    }
                    if(c3.getState()==true)
                    {       qual=qual+c3.getLabel()+",";
                    }
                    if(c4.getState()==true)
                    {       gen=c4.getLabel();
                    }
                    if(c5.getState()==true)
                    {       gen=c5.getLabel();
                    }
                    repaint();
            }
            public void paint(Graphics g)
            {       Font f=new Font("arial",Font.BOLD,20);
                    g.setFont(f);
                    this.setForeground(Color.green);
                    g.drawString("qualification------>"+qual,50,100);
                    g.drawString("gender-------------->"+gen,50,150);
                    qual="";
                    gen="";
            }
}

class rc
{       public static void main(String[] args)
        {       myframe f=new myframe();
        }
};
```

*********KEYLISTENER INTERFACE***********

```
import java.awt.*;
import java.awt.event.*;
class myframe extends Frame
{       myframe()
        {       this.setSize(400,400);
                this.setVisible(true);
                this.setBackground(Color.green);
                this.addKeyListener(new keyboardimpl());
        }
};
class keyboardimpl implements KeyListener
{       public void keyTyped(KeyEvent e)
        {       System.out.println("key typed "+e.getKeyChar());
        }
        public void keyPressed(KeyEvent e)
        {       System.out.println("key pressed "+e.getKeyChar());
```

```
        }
        public void keyReleased(KeyEvent e)
        {       System.out.println("key released "+e.getKeyChar());
        }
}
class Demo
{       public static void main(String[] args)
        {       myframe f=new myframe();
        }
};
***********CHECK LIST AND CHOICE************
import java.awt.*;
import java.awt.event.*;
class myframe extends Frame implements ItemListener
{       Label l1,l2;
        List l;
        Choice ch;
        String[] tech;
        String city="";
        myframe()
        {       this.setSize(300,400);
                this.setVisible(true);
                this.setLayout(new FlowLayout());

                l1=new Label("Technologies:  ");
                l2=new Label("City:  ");

                l=new List(3,true);
                l.add("c");             l.add("c++");           l.add("java");
                l.addItemListener(this);

                ch=new Choice();
                ch.add("hyd");          ch.add("chenni");               ch.add("Banglore");
                ch.addItemListener(this);

                this.add(l1);           this.add(l);            this.add(l2);           this.add(ch);
        }
        public void itemStateChanged(ItemEvent ie)
        {       tech=l.getSelectedItems();
                city=ch.getSelectedItem();
                repaint();
        }
        public void paint(Graphics g)
        {       Font f=new Font("arial",Font.BOLD,20);
                g.setFont(f);
                String utech="";
                for(int i=0;i<tech.length ;i++ )
                {       utech=utech+tech[i]+"   ";              }
```

```
                    g.drawString("tech:-------"+utech,50,200);
                    g.drawString("city---------"+city,50,300);
                    utech="";
          }
}
class Demo
{         public static void main(String[] args)
          {                   myframe f=new myframe();
          }
};
*********AdjustmentListener**********
import java.awt.*;
import java.awt.event.*;
class myframe extends Frame implements AdjustmentListener
{         Scrollbar sb;
          int position;
          myframe()
          {         this.setSize(400,400);
                    this.setVisible(true);
                    this.setLayout(new BorderLayout());

                    sb=new Scrollbar(Scrollbar.VERTICAL);
                    this.add("East",sb);

                    sb.addAdjustmentListener(this);
          }
          public void adjustmentValueChanged(AdjustmentEvent e)
          {         position=sb.getValue();
          }
          public void paint(Graphics g)
          {         g.drawString("position:"+position,100,200);
                    repaint();
          }
}
class scrollbarex
{         public static void main(String[] args)
          {         myframe f=new myframe();
          }
};
```

SWINGS

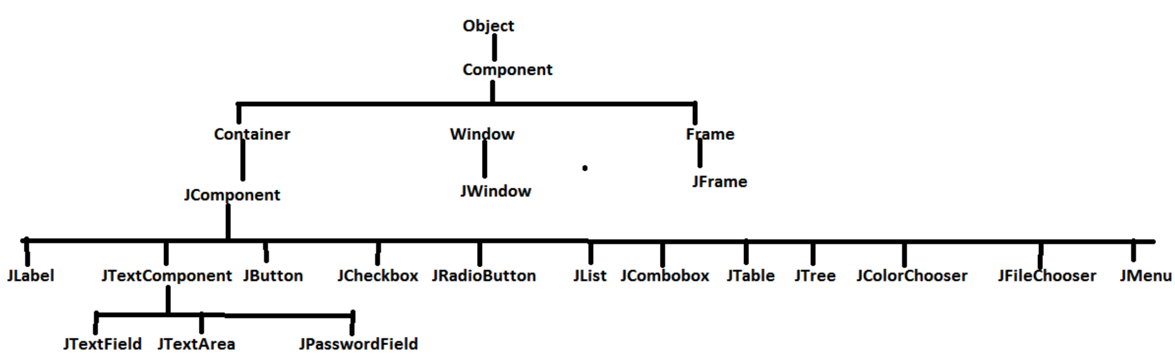
1. *Sun Micro Systems introduced AWT to prepare GUI applications but awt components not satisfy the client requirement.*
2. *An alternative to AWT Netscape Communication has provided set of GUI components in the form of IFC(Internet Foundation Class) but IFC also provide less performance and it is not satisfy the client requirement.*
3. *In the above context[sun+Netscape] combine and introduced common product to design GUI applications.*

Differences between awt and Swings:

- ✓ AWT components are heavyweight component but swing components are light weight component.
- ✓ AWT components consume more number of system resources Swings consume less number of system resources.
- ✓ AWT components are platform dependent but Swings are platform independent.
- ✓ AWT is provided less number of components where as swings provides more number of components.
- ✓ AWT doesn't provide Tooltip Test support but swing components have provided Tooltip test support.

  in awt for only window closing : windowListener windowAdaptor
  In case of swing use small piece of code.
  f.setDefaultCloseOption(JFrame.EXIT-ON-CLOSE);
- ✓ AWT will not follow MVC but swing follows MVC Model View Controller It is a design pattern to provide clear separation b/w controller part,model part,view part.
  - Controller is a normal java class it will provide controlling.
  - View part provides presentation.
  - Model part provides required logic.
- ✓ In case of AWT we will add the GUI components in the Frame directly but Swing we will add all GUI components to panes to accommodate GUI components.

Classes of swing:-



Example :-

```
import java.awt.*;
import javax.swing.*;
class MyFrame extends JFrame
{       JLabel l1,l2,l3,l4,l5,l6,l7;
        JTextField tf;
        JPasswordField pf;
        JCheckBox cb1,cb2,cb3;
        JRadioButton rb1,rb2;
        JList l;
        JComboBox cb;
        JTextArea ta;
        JButton b;
        Container c;
        MyFrame()   //constructor
                {
                this.setVisible(true);
                this.setSize(150,500);
                this.setTitle("SWING GUI COMPONENTS EXAMPLE");
                this.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);
                c=this.getContentPane();
                c.setLayout(new FlowLayout());
                c.setBackground(Color.green);
                l1=new JLabel("User Name");
                l2= new JLabel("password");
                l3= new JLabel("Qualification");
                l4= new JLabel("User Gender");
                l5= new JLabel("Technologies");
                l6= new JLabel("UserAddress");
                l7= new JLabel("comments");
                tf=new JTextField(15);
                tf.setToolTipText("TextField");
                pf=new JPasswordField(15);
                pf.setToolTipText("PasswordField");
                cb1=new JCheckBox("BSC",false);
                cb2=new JCheckBox("MCA",false);
                cb3=new JCheckBox("PHD",false);
                rb1=new JRadioButton("Male",false);
                rb2=new JRadioButton("Female",false);
                ButtonGroup bg=new ButtonGroup();
                bg.add(rb1);            bg.add(rb2);
                String[] listitems={"cpp","c","java"};
                l=new JList(listitems);
                String[] cbitems={"hyd","pune","bangalore"};
                cb=new JComboBox(cbitems);
                ta=new JTextArea(5,20);
                b=new JButton("submit");
                c.add(l1);              c.add(tf);              c.add(l2);              c.add(pf);
```

```
		c.add(l3);		c.add(cb1);		c.add(cb2);		c.add(cb3);
		c.add(l4);		c.add(rb1);		c.add(rb2);		c.add(l5);
		c.add(l);		c.add(l6);		c.add(cb);		c.add(l7);
		c.add(ta);		c.add(b);
		}
}
class SwingDemo
{	public static void main(String[] args)
	{	MyFrame f=new MyFrame();
	}
};
```

********JCOLORCHOOSER***********

```
import java.awt.*;
import java.awt.event.*;
import javax.swing.*;
import javax.swing.event.*;
class MyFrame extends JFrame implements ChangeListener
{	JColorChooser cc;
	Container c;
	MyFrame()
	{	this.setVisible(true);
		this.setSize(500,500);
		this.setTitle("SWING GUI COMPONENTS EXAMPLE");
		this.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);
		c=getContentPane();
		cc=new JColorChooser();
		cc.getSelectionModel().addChangeListener(this);
		c.add(cc);
	}
	public void stateChanged(ChangeEvent c)
	{	Color color=cc.getColor();
		JFrame f=new JFrame();
		f.setSize(400,400);
		f.setVisible(true);
		f.getContentPane().setBackground(color);
	}
}
class Demo
{	public static void main(String[] args)
	{			MyFrame f=new MyFrame();
	}
};
```

********JFILECHOOSER********************

```
import java.io.*;
import java.awt.*;
import java.awt.event.*;
import javax.swing.*;
import javax.swing.event.*;
```

```
class MyFrame extends JFrame implements ActionListener
{       JFileChooser fc;
        Container c;
        JLabel l;
        JTextField tf;
        JButton b;
        MyFrame()
        {       this.setVisible(true);
                this.setSize(500,500);
                this.setTitle("SWING GUI COMPONENTS EXAMPLE");
                this.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);
                c=getContentPane();
                 l=new JLabel("Select File:");
                 tf=new  JTextField(25);
                 b=new JButton("BROWSE");
                this.setLayout(new FlowLayout());
                b.addActionListener(this);
                c.add(l);               c.add(tf);              c.add(b);
                }
        public void actionPerformed(ActionEvent ae)
        {               class FileChooserDemo extends JFrame implements ActionListener
                        {       FileChooserDemo()
                                {       Container c=getContentPane();
                                        this.setVisible(true);
                                        this.setSize(500,500);
                                        fc=new JFileChooser();
                                        fc.addActionListener(this);
                                        fc.setLayout(new FlowLayout());
                                        c.add(fc);
                                }
                                public void actionPerformed(ActionEvent ae)
                                {       File f=fc.getSelectedFile();
                                        String path=f.getAbsolutePath();
                                        tf.setText(path);
                                        this.setVisible(false);
                                }
                        }
                        new FileChooserDemo();
        }
}
class Demo
{       public static void main(String[] args)
        {       MyFrame f=new MyFrame();
        }
};
```

```
********JTABLE******************
import javax.swing.*;
import java.awt.*;
import javax.swing.table.*;
class Demo1
{	public static void main(String[] args)
	{JFrame f=new JFrame();
	f.setVisible(true);
	f.setSize(300,300);
	Container c=f.getContentPane();
	String[] header={"ENO","ENAME","ESAL"};
	Object[][] body={{"111","aaa",5000},{"222","bbb",6000},{"333","ccc",7000},{"444","ddd",8000}};
	JTable t=new JTable(body,header);
	JTableHeader th=t.getTableHeader();
	c.setLayout(new BorderLayout());
	c.add("North",th);
	c.add("Center",t);
	}
}
```

```
*****************APPLET****************
import java.awt.*;
import java.applet.*;
public class Demo2 extends Applet
{
	public void paint(Graphics g)
	{
		Font f=new Font("arial",Font.BOLD,20);
		g.setFont(f);

		g.drawString("Sravya Software Solutions",100,200);
	}
};
```

<u>Configuration of Applet:-</u>

```
<html>
<applet code="Demo2.class" width="500"  height="500">
</applet>
</html>
```

```
*******INIT()   START() STOP()  DESTROY()*************
import java.awt.*;
import java.applet.*;
```

```
public class Demo3 extends Applet
{	String msg="";
	public void paint(Graphics g)
	{	Font f=new Font("arial",Font.BOLD,20);
		g.setFont(f);
		g.drawString("Sravya Software Solutions   "+msg,100,200);
	}
	public void init()
	{	msg=msg+"initialization"+"  ";
	}
	public void start()
	{	msg=msg+"starting"+"  ";
	}
	public void stop()
	{	msg=msg+"stoping";
	}
	public void destroyed()
	{	msg=msg+"destroyed";
	}
};
<html>
<applet code="Demo3.class" width="500" height="500">
</applet>
</html>
```

INTERNATIONALIZATION (i18N)

I18N enables the application to support in different languages.

- *Internationalization is also called as i18n because in between I & n 18 words are present.*
- *By using Locale class and ResourceBundle class we are enable I18n on the application.*
- *Local is nothing but language + country.*
- *For making your application to support I18n we need to prepare local specific properties file it means for English one properties file & hindi one properties file …etc.*
- *The property file format is key = value*
- *The properties file name fallowed pattern bundlenamewith language code and country code.*
    - *ApplicationMessages_en_US.properties*.
- *In single web application contains different properties file all the properties files key must be same and values are changed local to Locale.*

Java.util.Locale:-

- *Locale Object is decide properties file based on argument you passed and then it display locale specific details based on Properties file entry.*

Locale l = new Locale(args[0],args[1]);
Locale l = new Locale(en,US);

D:\5batch>javap java.util.Locale

```
Compiled from "Locale.java"
public final class java.util.Locale extends java.lang.Object i
  public static final java.util.Locale ENGLISH;
  public static final java.util.Locale FRENCH;
  public static final java.util.Locale GERMAN;
  public static final java.util.Locale ITALIAN;
  public static final java.util.Locale JAPANESE;
  public static final java.util.Locale KOREAN;
  public static final java.util.Locale CHINESE;
  public static final java.util.Locale SIMPLIFIED_CHINESE;
  public static final java.util.Locale TRADITIONAL_CHINESE;
  public static final java.util.Locale FRANCE;
  public static final java.util.Locale GERMANY;
  public static final java.util.Locale ITALY;
  public static final java.util.Locale JAPAN;
  public static final java.util.Locale KOREA;
  public static final java.util.Locale CHINA;
  public static final java.util.Locale PRC;
  public static final java.util.Locale TAIWAN;
  public static final java.util.Locale UK;
  public static final java.util.Locale US;
  public static final java.util.Locale CANADA;
```

public static final java.util.Locale CANADA_FRENCH;

Sample Language Codes

Language Code	Description
de	German
en	English
fr	French
ru	Russian
ja	Japanese
jv	Javanese
ko	Korean
zh	Chinese

To get particular language and country code use fallowing example:-

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	Locale l = Locale.FRANCE;
		System.out.println(l.getLanguage());
		System.out.println(l.getCountry());
	}
}
```

D:\5batch>java Test
fr
FR

Java.util.ResourceBundle:-

Creates ResourceBundle object by passing Local object then by using ResourceBoundle we are able to get data form properties file that is decide by Locale.

- *It is possible to create ResourceBundle Object without specifying Locale it will take default properties file with default language.*
  ResourceBundle bundle1 = ResourceBundle.getBundle("Application");
- *It is possible to create ResourceBundle Object by specifying default Locale object.*
  ResourceBundle bundle2 = ResourceBundle.getBundle("Application",Locale.FRANCE);
- *It is possible to create ResourceBundle object by creating new user Locale Object*
  ResourceBundle bundle3 = ResourceBundle.getBundle("Application",new Locale("ratan","RATAN"));

Application 1:-

Steps to design application:-

Step-1:- prepare properties files to support different languages and countries.

Application.properties	*default properties file(base properties file)*
Application_fr_FR.properties	*French properties file*
Allication_ratan_RATAN.properties	*Ratan country properties file*

Step 2:- create locale object it identified particular language and country and it decides execution of properties file.

Locale l = new Locale("en","US");

The above statement specify language is English and country united states

Locale l = new Locale("fr","CA");
Locale x = new Locale("fr","FR");

The above two locales specifies France language in Canada & France

Instead of hard coding language name and country name get the values from command prompt at runtime.

```
Public static void main(String[ ] args)
{       Locale l = new Locale(args[0],args[1]);
}
D:\5batch>java Test fr FR
```

Step 3:-create ResourceBundle by passing Locale object.

//if no local is Matched this property file is executed [default property file]

ResourceBundle bundle1 = ResourceBundle.getBundle("Application");

//it create ResourceBundle with local that is already defined [France properties file]

ResourceBundle bundle2 = ResourceBundle.getBundle("Application",Locale.FRANCE);

Step 4:- fetch the text form ResourceBundle

```
String msg = Bundle.getString("wish");
System.out.println(msg);
```

Application.properties:-

```
countryname = USA
lang = eng
```

Application_fr_FR.properties:-

```
countryname = canada
lang = france
```

Allication_ratan_RATAN.properties:-

```
countryname=Ratan
lang= ratan
```

Test.java:-

```
import java.util.*;
class Test
{       public static void main(String[] args)
        {
//if no local is Matched this property file is executed
ResourceBundle bundle1 = ResourceBundle.getBundle("Application");
//it create ResourceBundle with local that is already defined
Locale l1 = Locale.FRANCE;
ResourceBundle bundle2 = ResourceBundle.getBundle("Application",l1);
//it creates ResourceBundle with new user created Locale
Locale l2 = new    Locale("ratan","RATAN")
ResourceBundle bundle3 = ResourceBundle.getBundle("Application",l2);
System.out.println(bundle1.getString("countryname")+"--"+bundle1.getString("lang"));
System.out.println(bundle2.getString("countryname")+"--"+bundle2.getString("lang"));
System.out.println(bundle3.getString("countryname")+"--"+bundle3.getString("lang"));
        }
}
```

Output:-

```
D:\5batch>java Test
USA--eng
Canada--france
Ratan--Ratan
```

APPLICATION 2:-

```
import java.util.*;
class Test
{       public static void main(String[] args)
        {       //creates local object with the help of arguments
                Locale l = new Locale(args[0],args[1]);
        //it creates resource bundle with local passed from as command line arguments
                ResourceBundle bundle = ResourceBundle.getBundle("Application",l);
                System.out.println(bundle.getString("countryname"));
                System.out.println(bundle.getString("lang"));
        }
}
D:\5batch>java Test x y
USA
eng
D:\5batch>java Test fr FR
canada
france
D:\5batch>java Test ratan RATAN
Ratan
ratan
```

Application before internationalization:-

```
import java.util.*;
class Test
{
	public static void main(String[] args)
	{	System.out.println("hello");
		System.out.println("i like you");
		System.out.println("i hate you");
	}
}
```

We are decide to print this messages in different languages like Germany, French…..etc then we must translate the code in different languages by moving the message out of source code to text file it looks the program need to be internationalized(supporting different languages).

Application.properties:-

```
wish = hello
lovely = i love you
angry = i hate you
```

Application_fr_FR.properties:-

```
wish = hlloe
lovely = i evol you
angry = i etah you
```

Application_hi_IN.properties:-

```
wish=\u0c39\u0c46\u0c32\u0c4d\u0c32\u0c4a
lovely=\u0c07 \u0c32\u0c4a\u0c35\u0c46 \u0c2f\u0c4a\u0c09
angry=\u0c07 \u0c39\u0c24\u0c46 \u0c09
```

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	Locale l = new Locale(args[0],args[1]);
		ResourceBundle rb = ResourceBundle.getBundle("Application",l);
		System.out.println(rb.getString("wish"));
		System.out.println(rb.getString("lovely"));
		System.out.println(rb.getString("angry"));
	}
}
```

```
D:\5batch>java Test x y
hello
i love you
i hate you
```

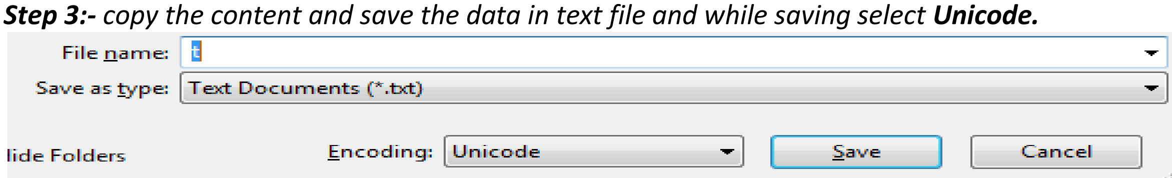
```
D:\5batch>java Test fr FR
hlloe
i evol you
i etah you
D:\5batch>java Test hi IN
??????
? ???? ???
? ??? ?
```

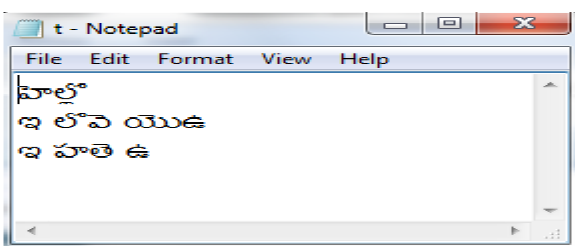
<u>Conversion of any language to Unicode values:-</u>

Step 1:- download Unicode editor from internet ***www.higopi.com***

Step 2:- unzip the file and click on index.html page select language and type the words.

Step 3:- *copy the content and save the data in text file and while saving select* ***Unicode.***





Step 4:- convert the above language to Unicode character format.

Syntax:- native2ascii -encoding encoding-name source-file destination-file

D:\>native2ascii -encoding unicode t.txt output.txt

t1 - Notepad

File Edit Format View Help

```
\u0c39\u0c46\u0c32\u0c4d\u0c32\u0c4a
\u0c07 \u0c32\u0c4a\u0c35\u0c46 \u0c2f\u0c4a\u0c09
\u0c07 \u0c39\u0c24\u0c46 \u0c09
```

Application :-

Application.properties:-

```
wish = hello
lovely = i love you
angry = i hate you
```

Application_fr_FR.properties:-

```
wish = hlloe
lovely = i evol you
angry = i etah you
```

Application_tl_IN.properties:-

```
wish=\u0c39\u0c46\u0c32\u0c4d\u0c32\u0c4a
lovely=\u0c07 \u0c32\u0c4a\u0c35\u0c46 \u0c2f\u0c4a\u0c09
angry=\u0c07 \u0c39\u0c24\u0c46 \u0c09
```

Test.java:-

```
import java.util.*;
import java.awt.*;
class Test
{	public static void main(String[] args)
	{	Locale l = new Locale(args[0],args[1]);
		ResourceBundle b = ResourceBundle.getBundle("Application",l);
		Frame f = new Frame();		//to create frame
		f.setVisible(true);		//to provide visibility to frame
		f.setSize(300,75);	//to align the frame set bounds
		f.setLayout(new FlowLayout());	//to set the frame proper format
		//creation of buttons with labels
		Button b1 = new Button(b.getString("wish"));
		Button b2 = new Button(b.getString("lovely"));
		Button b3 = new Button(b.getString("angry"));
		//adding buttons into frame
		f.add(b1);
		f.add(b2);
		f.add(b3);
	}
}
```

Test.java:- example

```
import java.util.*;
public class Test {
    static public void main(String[] args) {
        String language;
        String country;
        Locale currentLocale;
        ResourceBundle messages;
        if (args.length != 2)
        {       language = new String("en");
                country = new String("US");
        }
              else
              {   language = new String(args[0]);
            country = new String(args[1]);
        }
currentLocale = new Locale(language, country);
        messages = ResourceBundle.getBundle("Application", currentLocale);
        System.out.println(messages.getString("wish"));
        System.out.println(messages.getString("lovely"));
        System.out.println(messages.getString("angry"));
```

```
   }
}
D:\5batch>java Test
hello
i love you
i hate you
D:\5batch>java Test x y
hello
i love you
i hate you
D:\5batch>java Test tl IN
??????
? ???? ???
? ??? ?
D:\5batch>java Test fr FR
hlloe
i evol you
i etah you
```

Example :- display Date in different Locale.

DateFormat.DEFAULT,
DateFormat.SHORT,
DateFormat.MEDIUM,
DateFormat.LONG,
DateFormat.FULL

Sample Date Formats

Style	U.S. Locale	French Locale
DEFAULT	Jun 30, 2009	30 juin 2009
SHORT	6/30/09	30/06/09
MEDIUM	Jun 30, 2009	30 juin 2009
LONG	June 30, 2009	30 juin 2009
FULL	Tuesday, June 30, 2009	mardi 30 juin 2009

Test.java:-

```
import java.util.*;
import java.text.DateFormat;
class Test
{           public static void main(String[] args)
            {
Date d = new Date();
//default locale en US
DateFormat df1 = DateFormat.getDateInstance(DateFormat.DEFAULT,Locale.getDefault());
System.out.println(df1.format(d));
//date of fresh
```

```
DateFormat df2 =DateFormat.getDateInstance(DateFormat.MEDIUM,Locale.FRENCH);
System.out.println(df2.format(d));
//date of Italy
DateFormat df3 =DateFormat.getDateInstance(DateFormat.SHORT,Locale.ITALY);
System.out.println(df3.format(d));
        }
};
```

D:\5batch>java Test
Nov 21, 2014
21 nov. 2014
21/11/14

Example on time format:-

Sample Time Formats

Style	U.S. Locale	German Locale
DEFAULT	7:03:47 AM	7:03:47
SHORT	7:03 AM	07:03
MEDIUM	7:03:47 AM	07:03:07
LONG	7:03:47 AM PDT	07:03:45 PDT
FULL	7:03:47 AM PDT	7.03 Uhr PDT

```
import java.util.*;
import java.text.*;
class Test
{       public static void main(String[] args)
        {Date d = new Date();
DateFormat df1 = DateFormat.getTimeInstance(DateFormat.DEFAULT,Locale.getDefault());
System.out.println(df1.format(d));
DateFormat df2 = DateFormat.getTimeInstance(DateFormat.MEDIUM,Locale.FRENCH);
System.out.println(df2.format(d));
DateFormat df3 = DateFormat.getTimeInstance(DateFormat.SHORT,Locale.ITALY);
System.out.println(df3.format(d));
        }
};
```

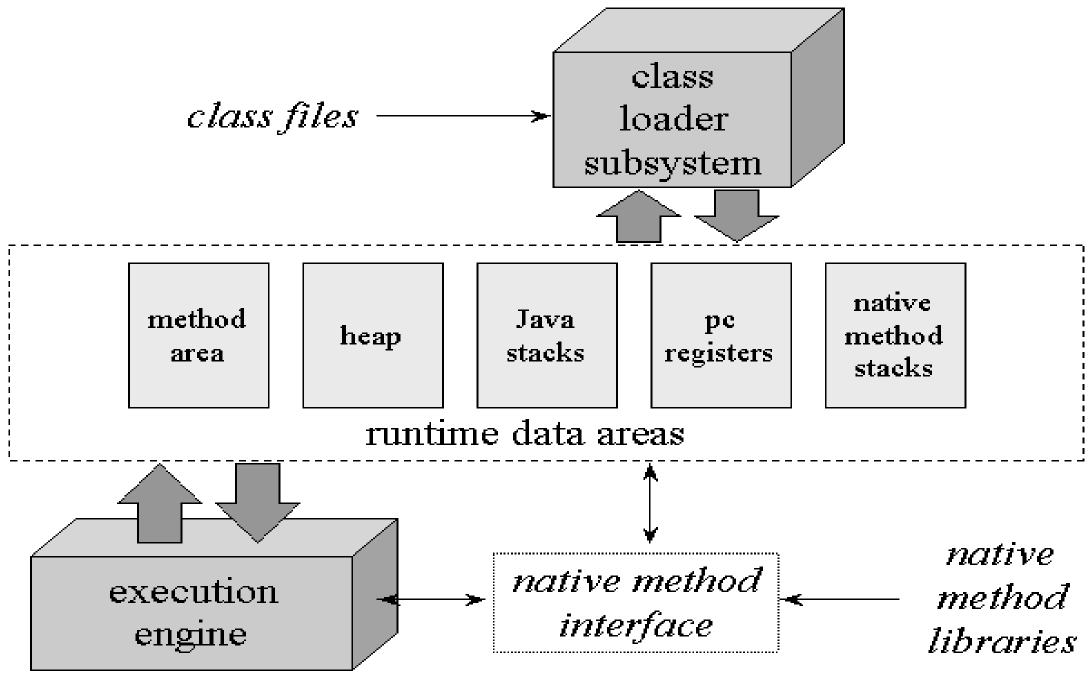
Example on both data and Time format:-

Sample Date and Time Formats

Style	U.S. Locale	French Locale
DEFAULT	Jun 30, 2009 7:03:47 AM	30 juin 2009 07:03:47
SHORT	6/30/09 7:03 AM	30/06/09 07:03
MEDIUM	Jun 30, 2009 7:03:47 AM	30 juin 2009 07:03:47
LONG	June 30, 2009 7:03:47 AM PDT	30 juin 2009 07:03:47 PDT
FULL	Tuesday, June 30, 2009 7:03:47 AM PDT	mardi 30 juin 2009 07 h 03 PDT

```
import java.util.*;
import java.text.*;
class Test
{	public static void main(String[] args)
	{	Date d = new Date();
DateFormat df1 =  DateFormat.getDateTimeInstance(DateFormat.FULL,DateFormat.FULL,Locale.getDefault());
System.out.println(df1.format(d));
DateFormat df2 =  DateFormat.getDateTimeInstance(DateFormat.FULL,DateFormat.FULL,Locale.FRENCH);
System.out.println(df2.format(d));
	}
};
```

JVM Architecture:-



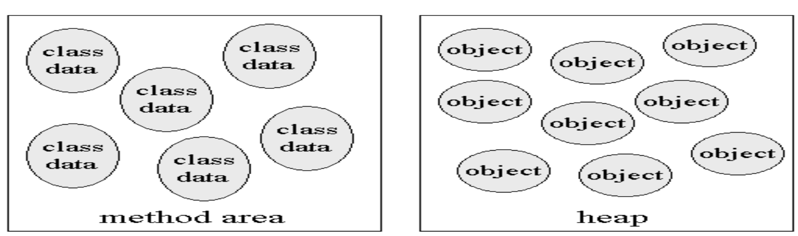
Class loader subsystem:-

1. It is used to load the classes and interfaces.
2. It verifies the byte code instructions.
3. It allots the memory required for the program.

Runtime data area:-this is the memory resource used by the JVM and it is 5 types

Method Area:-It is used to store the class data and method data.

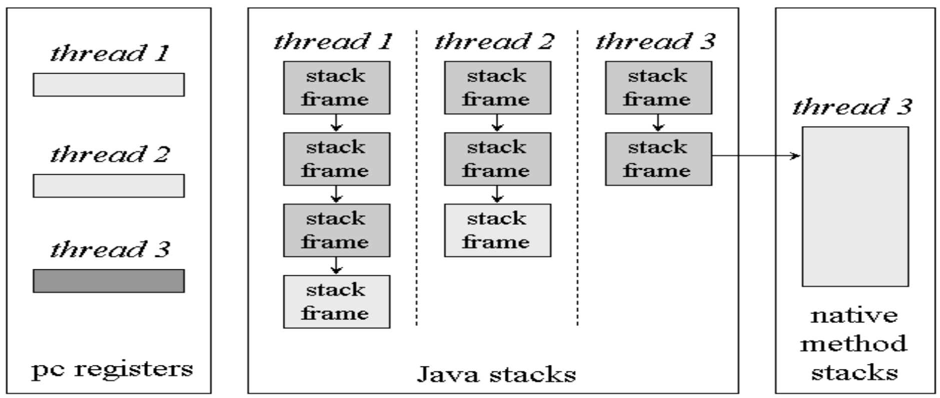
Heap area:-It is used to store the Objects.



Runtime data areas shared among all threads.

Java stacks:-

- *Whenever new thread is created for each and every new thread the JVM will creates PC(program coubter) register and stack.*
- *If a thread executing java method the value of pc register indicates the next instruction to execute.*
- *Stack will stores method invocations of every thread. The java method invocation includes local variables and return values and intermediate calculations.*
- *The each and every method entery will be stored in stack. And the stack contains grounp of enteries and each and every entry stored in one stack frame hence stack is group of stack frames.*
- *Whenever the method complets the entry is automatically deleted from the stach so whatever the functionalities declared in method it is applicable only for respective methods.*
  Java native method stack is used to store the native methods invocations.



Runtime data areas exclusive to each thread.

Native method interface:-

Native method interface is a program that connects native methods libraries (C header files) with JVM for executing native methods.

Native method library: It contains native libraries information.

Execution engine:-

It is used to execute the instructions are available in the methods of loaded classes. It contains JIT(just in time compiler) and interpreter used to convert byte code instructions into machine understandable code.

Modifiers summary:-

- ***In java no concept like "access specifiers and access modifiers" and only one concept is there modifiers concept.***
- ***How many Modifiersin java means don't say 3 or 4 or 5 ,in java 11 modifiers are there.***
- ***The default modifier in java is "default".***

Proof 1:-

```
private class Test
{	public static void main(String[] args)
	{
	}
}
```

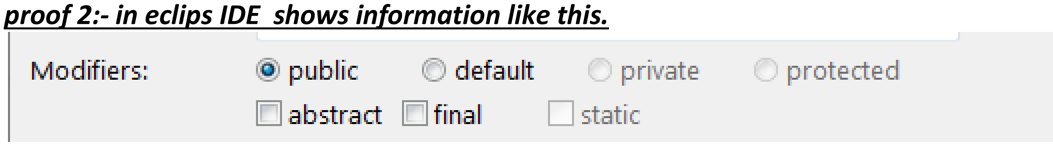
Compilation Error:-

D:\morn11>javac Test.java

Test.java:1: modifier private not allowed here

private class Test

proof 2:- in eclips IDE shows information like this.



modifier	***classes***	***methods***	***variables***
public	*yes*	*yes*	*yes*
private	*no*	*yes*	*yes*
default	*yes*	*yes*	*yes*
protected	*no*	*yes*	*yes*
final	*yes*	*yes*	*yes*
abstract	*yes*	*yes*	*no*
strictfp	*yes*	*yes*	*no*
transient	*no*	*no*	*yes*
native	*no*	*yes*	*no*
static	*no*	*yes*	*yes*
synchronized	*no*	*yes*	*no*
volatile	*no*	*no*	*yes*

Java is not a object oriented programming language:-

java supporting primitive data types there are not a objects. To represent these primitives in the form of objects java having concept like Wrapper classes.

```
int a=10;
boolean b=true;
```

Without creation of object we are able to achieve application requirement by using static methods.

```
class Test
{	static void m1()
	{	System.out.println("hi ratan");
	}
```

```
        public static void main(String[] args)
        {       Test.m1();
        }
}
```

java is not supporting oops concepts like multiple inheritance & hybrid inheritance.

Class A extends B,C===➔error

Different approaches to create objects in java:-

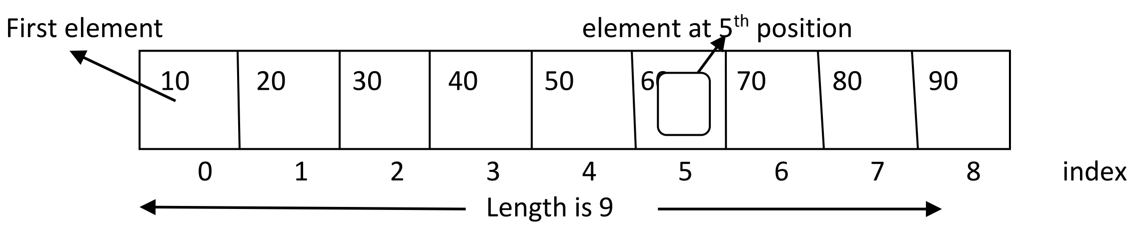
1. *By using new operator.*
2. *by using clone() method.*
3. *without using new operator by using* ***String str=”ratan”; [by using String content].***
4. *at the time of deserialization we are getting the data from file we are stored in object form.*
5. *By using factory method*
    a. *Instance factory method*
    b. *Static factory method*
6. *By using newInstance method. (used by servers)……etc*

Arrays

- *Arrays are used to represent group of elements as a single entity but these elements are homogeneous & fixed size.*
- *The size of Array is fixed it means once we created Array it is not possible to increase and decrease the size.*
- ***Array in java is index based first element of the array stored at 0 index.***

Advantages of array:-

- ✓ Instead of declaring individual variables we can declare group of elements by using array it reduces length of the code.
- ✓ We can store the group of objects easily & we are able to retrieve the data easily.
- ✓ We can access the random elements present in the any location based on index.
- ✓ Array is able to hold reference variables of other types.



Different ways to declare a Array:-

int[] values;
int []values;
int values[];

declaration & instantiation & initialization :-

```
Approach 1:-  int  a[]={10,20,30,40};       //declaring, instantiation, intialization
Approach 2:-  int[] a=new int[100];   //declaring, instantiation
              a[0]=10;                //initialization
              a[1]=20;
              ;;;;;;;;;;;;;;;;;;;;;
              a[99]=40;
```

```
// declares an array of integers
   int[] anArray;
 // allocates memory for 10 integers
     anArray = new int[10];
  // initialize first element
     anArray[0] = 10;
   // initialize second element
    anArray[1] = 20;
  // and so forth
     anArray[2] = 30;      anArray[3] = 40;      anArray[4] = 50;      anArray[5] = 60;
     anArray[6] = 70;      anArray[7] = 80;      anArray[8] = 90;      anArray[9] = 100;
```

Example :- taking array elements from dynamic input by using scanner class.

```
import java.util.*;
class Test
{	public static void main(String[] args)
	{	int[] a=new int[5];
		Scanner s=new Scanner(System.in);
		System.out.println("enter values");
		for (int i=0;i<a.length;i++)
		{	System.out.println("enter "+i+" value");
			a[i]=s.nextInt();
		}
		for (int a1:a)
		{	System.out.println(a1);
		}
	}
}
```

Example :- find the sum of the array elements.

```
class Test
{	public static void main(String[] args)
	{	int[] a={10,20,30,40};
		int sum=0;
		for (int a1:a)
		{	sum=sum+a1;
		}
		System.out.println("Array Element sum is="+sum);
	}
}
```

<u>Method parameter is array & method return type is array:-</u>

```
class Test
{	static void m1(int[] a)	//method parameter is array
	{	for (int a1:a)
		{	System.out.println(a1);
		}
	}
	static int[] m2()	//method return type is array
	{	System.out.println("m1 method");
		return new int[]{100,200,300};
	}
	public static void main(String[] args)
	{	Test.m1(new int[]{10,20,30,40});
		int[] x  = Test.m2();
		for (int x1:x)
		{	System.out.println(x1);
		}
	}
}
```

Example:- adding the objects into Array and printing the objects.

```
class Test
{	public static void main(String[] args)
	{	int[] a = new int[5];
		a[0]=111;
		for (int a1:a)
		{	System.out.println(a1);
		}
		Emp e1 = new Emp(111,"ratan");
		Emp e2 = new Emp(222,"anu");
		Emp e3 = new Emp(333,"sravya");
		Emp[] e = new Emp[5];
		e[0]=e1;
		e[1]=e2;
		e[2]=e3;
		for (Emp ee:e)
		{	System.out.println(ee);		}
	}
}
```

Output:-

```
E:\>java Test
111	0	0	0	0
Emp@530daa   Emp@a62fc3   Emp@89ae9e   null   null
```

Example:- printing array elements with elements and default values.

```
class Test
{	public static void main(String[] args)
	{	Emp[] e = new Emp[5];
		e[0]=new Emp(111,"ratan");
		e[1]=new Emp(222,"anu");
		e[2]=new Emp(333,"sravya");
		for (Object ee:e)
		{	if (ee instanceof Emp)
			{	Emp eee = (Emp)ee;
				System.out.println(eee.eid+"----"+eee.ename);
			}
			if (ee==null)
			{	System.out.println(ee);
			}
		}
	}
}
```

Output:-

```
E:\>java Test
111----ratan
222----anu
333----sravya
null
null
```

Finding minimum & maximum element of the array:-

```
class Test
{       public static void main(String[] args)
        {       int[] a = new int[]{10,20,5,70,4};
                for (int a1:a)
                {       System.out.println(a1);
                }
                //minimum element of the Array
                int min=a[0];
                for (int i=1;i<a.length;i++)
                {       if (min>a[i])
                        {       min=a[i];
                        }
                }
                System.out.println("minimum value is ="+min);
                //maximum element of the Array
                int max=a[0];
                for (int i=1;i<a.length;i++)
                {       if (max<a[i])
                        {       max=a[i];
                        }
                }
                System.out.println("maximum value is ="+max);
        }
}
```

Example :- copy the data from one array to another array

```
class Test
{       public static void main(String[] args)
        {       int[] copyfrom={10,20,30,40,50,60,70,80};
                int[] copyto = new int[7];
                System.arraycopy(copyfrom,1,copyto,0,7);
                for (int cc:copyto)
                {       System.out.println(cc);
                }
        }
}
```

Example :- copy the data from one array to another array

```
class Test
{       public static void main(String[] args)
        {       int[] copyfrom={10,20,30,40,50,60,70,80};
                int[] newarray=java.util.Arrays.copyOfRange(copyfrom,1,4);
                for (int aa:newarray)
                {       System.out.println(aa);  //20 30 40
                }
        }
}
```

Example:- finding null index values.

```
class Test
{	public static void main(String[] args)
	{	String[] str= new String[5];
		str[0]="ratan";
		str[1]="anu";
		str[2]=null;
		str[3]="sravya";
		str[4]=null;
		for (int i=0;i<str.length;i++)
		{	if ( str[i]==null)
			{	System.out.println(i);
			}
		}
	}
}
```

Root structure:-

```
java.lang.Object
   |
   |--java.lang.reflect.Array
```

Array is a final class can't be extended.

To get the class name of the array:-

```
class Test
{	public static void main(String[] args)
	{	int[] a={10,20,30};
		System.out.println(a.getClass().getName());
	}
}
```

Example:-process of adding different types Objects in Object array

Test.java:-

```
class Test
{	public static void main(String[] args)
	{	Object[] a= new Object[6];
		a[0]=new Emp(111,"ratan");
		a[1]=new Integer(10);
		a[2]=new Student(1,"anu");
		for (Object a1:a)
		{	if (a1 instanceof Emp)
			{	Emp e1 = (Emp)a1;
				System.out.println(e1.eid+"---"+e1.ename);
			}
			if (a1 instanceof Student)
			{	Student s1 = (Student)a1;
				System.out.println(s1.sid+"---"+s1.sname);
			}
			if (a1 instanceof Integer)
			{	System.out.println(a1);
			}
			if (a1==null)
			{	System.out.println(a1);
			}
		}
	}
}
```

Emp.java:

```
class Emp
{	int eid;
	String ename;
	Emp(int eid,String ename)
	{	//conversion of local to instance
		this.eid=eid;
		this.ename=ename;
	}
}
```

Student.java:-

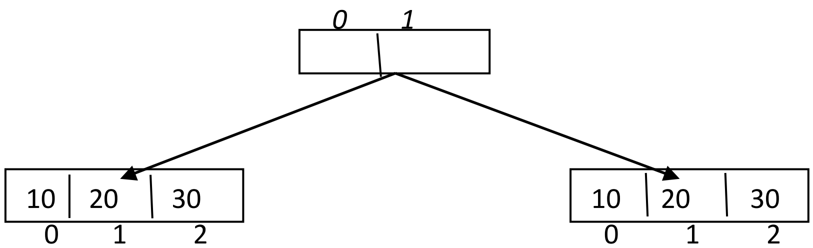
```
class Student
{	int sid;
	String sname;
	Student(int sid,String sname)
	{	//conversion of local to instance
			this.sid=sid;
			this.sname=sname;
	}
}
```

declaration of multi dimensional array:-

```
int[][]    a;
int        [][]a;
int        a[][];
int        []a[];
```

Example :-

```
class Test
{       public static void main(String[] args)
        {       int[][] a={{10,20,30},{40,50,60}};
                System.out.println(a[0][0]);//10
                System.out.println(a[1][0]);//40
                System.out.println(a[1][1]);//50
        }
}
```



a[0][0]------→10 a[0][1]------→20 a[0][2]-----→30 a[1][0]-----→40
a[1][1]-----→50 a[1][2]-----→60

Example:-

```
class Test
{       public static void main(String[] args)
        {       String[][] str={{"A.","B.","C."},{"ratan","ratan","ratan"}};
                System.out.println(str[0][0]+str[1][0]);
                System.out.println(str[0][1]+str[1][1]);
                System.out.println(str[0][2]+str[1][2]);
        }
}
```

Example :- febonacci series

```
import java.util.Scanner;
class Test
{       public static void main(String[] args)
        {       System.out.println("enter start series of febonacci");
                int x = new Scanner(System.in).nextInt();
                int[] feb = new int[x];
                feb[0]=0;
                feb[1]=1;
                for (int i=2;i<x;i++)
                {       feb[i]=feb[i-1]+feb[i-2];
                }
                //print the data
                for (int feb1 : feb)
                {       System.out.print(" "+feb1);
                }
```

```
        }
}
```

Example :- febonacci series

```
import java.util.Scanner;
class Test
{       public static void main(String[] args)
        {       System.out.println("enter the no required for febonacci");
                int a = new Scanner(System.in).nextInt();

                System.out.println("enter first no of  febonacci");
                int x = new Scanner(System.in).nextInt();
                System.out.println("enter second no of febonacci");
                int y = new Scanner(System.in).nextInt();

                int[] feb = new int[a];
                feb[0]=x;
                feb[1]=y;
                for (int i=2;i<a;i++)
                {       feb[i]=feb[i-1]+feb[i-2];
                }
                //print the data
                for (int feb1 : feb)
                {       System.out.print(" "+feb1);
                }
        }
}
```

Pre-increment & post increment :-

Pre-increment :- it increases the value by 1 then it will execute statement.

Post-increment :-it executes the statement then it will increase value by 1.

```
class Test
{       public static void main(String[] args)
        {       //post increment
                int a=10;
                System.out.println(a);          //10
                System.out.println(a++);        //10
                System.out.println(a);          //11
                //pre increment
                int b=20;
                System.out.println(b);          //20
                System.out.println(++b);        //21
                System.out.println(b);          //21
                System.out.println(a++ + ++a + a++ + ++a);
                                                  //11   13   13   15
        }
}
```

Pre-decrement & postdencrement :-

Pre-decrement :- it decreases the value by 1 then it will execute statement.

Post-decrement :-it executes the statement then it will increase value by 1.

```
class Test
{	public static void main(String[] args)
	{	//post decrement
		int a=10;
		System.out.println(a);		//10
		System.out.println(a--);	//10
		System.out.println(a);		//9
		//post decrement
		int b=20;
		System.out.println(b);		//20
		System.out.println(--b);	//19
		System.out.println(b);		//19
		System.out.println(a-- + --a + a-- + --a);
						//9	7		7	5
	}
}
```

Java Class declaration interview questions

1) What is present version of java and initial version of java?
2) How many modifiers in java and how many keywords in java?
3) What is initial name of java and present name of java?
4) What do you en by open source software & java is open source software or not?
5) What are dependent languages and technologies on java?
6) What do you mean by licensed version and what are the licensed softwares?
7) Can we have multiple public classes in single source file?
8) What do you mean by platform dependent & platform independent ? java is which type?
9) What do you mean by main class & it is possible to declare multiple main classes in single source file or not?
10) What do you mean by token and literal?
11) What do you mean by identifier?
12) Can we create multiple objects for single class?
13) Is it possible to declare multiple public classes in single source file?
14) What is the difference between editor and IDE(integrated development environment)
15) Write the examples of editor and IDE?
16) Define a class & object?
17) What are the coding conventions of classes and interfaces?
18) What are the coding conventions of methods and variables?
19) Is java object oriented programming language?
20) In java program starts form which method and who is calling that method?
21) What are the commands required for compilation and execution?
22) Is it possible to compile how many files at a time & is it possible to execute how many classes at a time?
23) The compiler understandable file format & JVM understandable file format?
24) What is the difference between JRE and JDK?
25) What is the difference between path and class path?
26) What is the purpose of environmental variables setup?
27) What are operations done at compilation time and execution time?
28) What is the purpose of JVM?
29) JVM platform dependent or independent?
30) Is it possible to provide multiple spaces in between two tokens?
31) Class contains how many elements what are those?
32) Who is generating .class file and .class files generation is based on?
33) What is .class file contains & .java contains?
34) What is the purpose of data types and how many data types are present in java?
35) Who is assigning default values to variables?
36) What is the default value of int, char, Boolean, double?
37) Is null is a keyword or not?
38) What is the default values for objects
39) Can I have multiple main methods in single class?
40) What is the default package in java?
41) Can I import same class twice yes-→what happened no -→why ?
42) Is empty java source file is valid or not?
43) What is the purpose of variables in java?
44) How many types of variables in java and what are those variables?
45) What is the life time of static variables and where these variables are stored?

46) What is the life time of instance variables and where these variables are stored?
47) What is the life time of local variables and where these variables are stored?
48) For the static members when memory is allocated?
49) Where we declared local variables & instance variables & static variables
50) For the instance members when memory is allocated?
51) For the local variables when memory is allocated?
52) What is the difference between instance variables and static variables?
53) Can we declare instance variables inside the instance methods & static variables inside the static method?
54) If the local variables of methods and class instance variables having same names at that situation how we are represent local variables and how are representing instance variable?
55) What is the purpose of method & how many types of methods in java?
56) What do you mean by method signature?
57) What do you mean by method declaration & implementation?
58) What is the purpose of template method?
59) Can we have inner methods in java?
60) One method is able to call how many methods at time?
61) For java methods return type is mandatory or optional?
62) Who will create and destroy stack memory in java?
63) When we will get stackoverFlowError?
64) Is it possible to declare return statement any statement of the method or any specific rule is there?
65) When we will get "variable might not have been initialized" error message?
66) What are the different ways to create a object?
67) By using which keyword we are creating object in java?
68) Object creation syntax contains how many parts?
69) How many types of constructors in java?
70) What are the advantages of constructors in java?
71) How one constructor is calling another constructor? One constructor is able to call how many constructors at time?
72) What do you mean by instantiation?
73) What is the difference between named Object & nameless object?
74) What do you mean by eager object creation & lazy object creation?
75) What is the difference between object instantiation and object initialization?
76) What is the purpose of this keyword?
77) Is it possible to use this keyword inside static area?
78) What is the need of converting local variables to instance variables?
79) Is it possible to convert instance variables to local variables yes→how no-→why?
80) When we will get compilation error like "call to this must be first statement in constructor"?
81) When we will get compilation error line "cannot find symbol"?
82) What do u mean by operator overloading, is it java supporting operator overloading concept?
83) What is the purpose of scanner class and it is present in which package and introduced in which version?
84) What are the applicable modifiers for constructors?
85) Who is generating default constructor and at what time?
86) What is object and what is relationship between class and Object?
87) Is it possible to execute default constructor and user defined constructor time?
88) What is the purpose of instance block & what is the syntax?

89) What is the difference between instance block & constructor?
90) What do you mean by object delegation?
91) What is the purpose of instance blocks when it will execute?
92) Inside class it is possible to declare how many instance blocks & constructors ?
93) What is the purpose of static block & what is the execution process?
94) For a class I am creating ten objects so how many times instance blocks are executed & how many times static blocks are executed?
95) How to load the .class file into memory programmatically?
96) How to create the object of loaded class in java?
97) To execute the static block inside the class main method mandatory or optional?
98) Is it possible to print some statements in output console without using main method or not?
99) What is execution flow of method VS constructor Vs instance blocks Vs static blocks?
100) When instance blocks and static blocks are executed?

Flow control statement

1) *How many flow control statements in java?*
2) *What is the purpose of conditional statements?*
3) *What is the purpose of looping statements?*
4) *What are the allowed arguments of switch?*
5) *When we will get compilation error like "possible loss of precision"?*
6) *Inside the switch case vs. default vs. Break is optional or mandatory?*
7) *Switch is allowed String argument or not?*
8) *Inside the switch how many cases are possible and how many default declarations are possible?*
9) *What is difference between if & if-else & switch?*
10) *What is the default condition of for loop?*
11) *Inside for initialization & condition & increment/decrement parts optional or mandatory?*
12) *When we will get compilation error like "incompatible types"?*
13) *We are able to use break statements how many places and what are the places?*
14) *What is the difference between break& continue?*
15) *What do you mean by transfer statements and what are transfer statements present in java?*
16) *for (; ;) representing?*
17) *When we will get compilation error like "unreachable statement "?*
18) *Is it possible to declare while without condition yes -→what is default condition no→what is error?*
19) *What is the difference between while and do-while?*
20) *While declaring if , if-else , switch curly braces are optional or mandatory?*

Oops

1) What are the main building blocks of oops?
2) What do you mean by inheritance?

3) How to achieve inheritance concept and inheritance is also known as?
4) How many types of inheritance in java and how many types of inheritance not supported by java?
5) How to prevent inheritance concept?
6) If we are extending the class then your class will become parent class but if we are not extending what is the parent class?
7) One class able to extends how many classes at a time?
8) What is the purpose of extends keyword?
9) What do you mean by cyclic inheritance java supporting or not?
10) What is the difference between child class and parent class?
11) Which approach is recommended to create object either parent class object or child class object?
12) Except one class all class contains parent class in java what is that except class?
13) What is the purpose of instanceof keyword in java?
14) What is the root class for all java classes?
15) How to call super class constructors?
16) Is it possible to use both super and this keyword inside the method?
17) Is it possible to use both super and this keyword inside the constructor?
18) Inside the constructor if we are not providing this() and super() keyword the compiler generated which type of super keyword?
19) What is the execution process of constructors if two classes are there in inheritance relationship?
20) What is the execution process of instance blocks if two classes are there in inheritance relationship?
21) What is the execution process of static blocks if two classes are there in inheritance relationship?
22) What is the purpose of instanceof operator in java & what is the return-type?
23) If we are using instanceof both reference-variable & class-name must have some relationship otherwise compiler generated error message is what?
24) If the child class and parent class contains same variable name that situation how to call parent class variable in child class?
25) What do you mean by aggregation and what is the difference between aggregation and inheritance?
26) What do you mean by aggregation and composition and Association?
27) Aggregation is also known as?
28) How many objects are created ?
    a. MyClassHero c1,c2;
       C1 = New MyClassHero();
29) What do you mean by polymorphism?
30) How many types of polymorphism in java?
31) What do you mean by method overloading and method overriding?
32) How many types of overloading in java?
33) Java supports operator overloading or not?
34) Is it possible to overload the constructors are not?
35) What do you mean by constructor overloading?
36) What are the implicit overloaded operators in java explain it?
37) What do you mean by overriding? What are rules must fallow while performing method overriding?

38) What do you mean by overridden method & overriding method?
39) To achieve overriding how many java classes are required?
40) Is it possible to override variable in java?
41) When we will get compilation error like "overridden method is final"?
42) What is the purpose of final modifier java?
43) Is it possible to override static methods yes-→how no-→why?
44) Parent class reference variable is able to hold child class object or not?
45) What do you mean by dynamic method dispatch?
46) The applicable modifiers only on local variables?
47) What do you mean by type casting & how many types?
48) Is it all methods present in final class is always final and all variables present final class is always final or not ?
49) If Parent class is holding child class object then by using that we are able to call only overridden methods of child class but how to call direct methods of child class?
50) Object class present in which package & it contains how many methods?
51) When we will get compilation error like "con not inherit from final parent"?
52) What do you mean by co-variant return types?
53) What do you mean by method signature?
54) What do u mean by method hiding and how to prevent method hiding concept?
55) What do you mean by abstraction?
56) How many types of classes in java generally?
57) Normal class is also known as ?
58) What is the difference between normal method and abstract method?
59) What is the difference between normal class and abstract class?
60) Is it possible to create a object for abstract class?
61) What do you mean by abstract variable?
62) Is it possible to override non-abstract method as a abstract method?
63) Is it possible to declare main method inside the abstract class or not?
64) What is the purpose of abstract modifier in java?
65) How to prevent object creation in java?
66) What is the definition of abstract class?
67) In java is it abstract class reference variable is able to hold child class object or not?
68) What do you mean by encapsulation & what is the examples encapsulation?
69) What do you mean by tightly encapsulated class?
70) What do you mean accessor method and mutator method ?
71) How many ways area there to set some values to class properties (variables)?
72) What do you mean by javaBean class?
73) The javabean class is also known as?
74) In java program execution starts from which method & who is calling that method?
75) Can we inherit main method in child class?
76) The applicable modifiers on main method?
77) While declaring main method public static modifiers order mandatory or optional?
78) What is the argument of main method?
79) What is the return type of main method?
80) What are the mandatory modifiers for main method and optional modifiers of main method?
81) Why main method is public & static?

82) What do you by command line arguments & command line arguments are stored in which format(type)?
83) Is it possible to pass command line arguments with space symbol no→ why yes→how ?
84) What is the purpose of strictfp modifier?
85) What is the purpose of native modifier?
86) What do you mean by native method and it also known as?
87) Is it possible to overload the main method or not yes=how no=why?
88) Is it possible to override the main method or not yes=how no=why?
89) What is the purpose of variable argument method & what is the syntax?
90) If the application contains both normal argument & variable argument then which one executed first?
91) The java method allows both variable argument & normal argument in single method?
92) Is it possible to overload the variable argument methods are not?
93) What is the difference between method overloading & variable argument method.
94) What are the modification are allowed on main method?
95)

Packages

1. What do you mean by package and what it contains?
2. How many pre-defined packages in java?
3. What is the default package in java?
4. Is it possible to declare package statement any statement of the source file?
5. What is the difference between user's defined package and predefined package?
6. What are coding conventions must fallow while declaring user defined package names?
7. Is it possible to declare multiple packages in single source file?
8. What do you mean by import?
9. What is the location of predefined packages in our system?
10. How many types of imports present in java explain it?
11. How to import individual class and all classes of packages and which one is recommended?
12. What do you mean by static import?
13. What is the difference between normal and static import?
14. I am importing two packages, both packages contains one class with same name at that situation how to create object of two package classes?
15. If we are importing root package at that situation is it possible to use sub package classes in our applications?
16. What is difference between main package and sub package?
17. If source file contains package statement then by using which command we are compiling that source file?
18. What do you mean by fully qualified name of class?
19. What is the default modifier in java?
20. What is the public access and default access?
21. The public class members(variables,methods,constructors) are by default public or not?
22. What is private access and protected access?

23. What is most restricted modifier in java?
24. What is most accessible modifier in java?
25. Is it possible to declare pre-defined package names as a user defined package names or not?
26. What are the applicable modifiers for constructors?
27. Is it possible to override private methods or not yes=how no=why?
28. When we will get compilation error like "attempting to assign weaker access privileges" how to rectify?

Exception handling

1. What do you mean by Exception?
2. How many types of exceptions in java?
3. What is the difference between Exception and error?
4. What is the difference between checked Exception and un-checked Exception?
5. Checked exceptions are caused by?
6. Unchecked exceptions are caused by?
7. Errors are caused by?
8. Is it possible to handle Errors in java?
9. What the difference is between partially checked and fully checked Exception?
10. What do you mean by exception handling?
11. How many ways are there to handle the exception?
12. What is the root class of Exception handling?
13. Can you please write some of checked and un-checked exceptions in java?
14. What are the keywords present in Exception handling?
15. What is the purpose of try block?
16. In java is it possible to write try with out catch or not?
17. What is the purpose catch block?
18. What is the difference between try-catch?
19. Is it possible to write normal code in between try-catch blocks?
20. What are the methods used to print exception messages?
21. What is the purpose of printStackTrace( ) method?
22. What is the difference between printStackTrace( ) & getMessage()?
23. What is the purpose of finally block?
24. If the exception raised in catch block what happened?
25. Independent try blocks are allowed or not allowed?
26. Once the control is out of try , is it remaining statements of try block is executed?
27. Try-catch , try-catch-catch , catch-catch , catch-try how many combinations are valid?
28. Try-catch-finally , try-finally ,catch-finally , catch-catch-finally how many combinations are valid?
29. Is possible to write code in between try-catch-finally blocks?
30. Is it possible to write independent catch blocks?
31. Is it possible to write independent finally block?
32. What is the difference between try-catch –finally?
33. What is the execution flow of try-catch?

34. If the exception raised in finally block what happened?
35. What are the situations finally block is executed?
36. What are the situations finally block is not executed?
37. What is the purpose of throws keyword?
38. What is the difference between try-catch blocks and throws keyword?
39. What do you mean by default exception handler and what is the purpose of default exception handler?
40. How to delegate responsibility of exception handling calling method to caller method?
41. What is the purpose of throw keyword?
42. If we are writing the code after throw keyword usage then what happened?
43. What is the difference between throw and throws keyword?
44. How to create user defined checked exceptions?
45. How to create user defined un-checked exceptions?
46. Where we placed clean-up code like resource release, database closeting inside the try or catch or finally and why ?
47. Write the code of ArithmeticException?
48. Write the code of NullPointerException?
49. Write the code of ArrayIndexOutOfBoundsException & StringIndexOutOfBoundsException?
50. Write the code of IllegalThreadStateException?
51. When we will get InputMisMatchException?
52. When we will get IllegalArgumantException?
53. When we will get ClassCastException?
54. When we will get OutOfMemoryError?
55. What is the difference between ClassNotFoundException & NoClassDefFoundError?
56. When we will get compilation error like "unreportedException must be catch"?
57. When we will get compilation error like "Exception XXXException has already been caught"?
58. When we will get compilation error like "try without catch or finally"?
59. How many approaches are there to create user defined unchecked exceptions and un-checked exceptions?
60. What do you mean by exception re-throwing?
61. How to create object of user defined exceptions?
62. How to handover user created exception objects to JVM?
63. What is the difference user defined checked and unchecked Exceptions?
64. Is it possible to handle different exceptions by using single catch block yes-->how no→why?

Interfaces

a. What do you mean by interface how to declare interfaces in java?
b. Interfaces allows normal methods or abstract methods or both?
c. For the interfaces compiler generates .class files or not?
d. Interface is also known as?
e. What is the abstract method?

f. By default modifiers of interface methods?
g. What is the purpose of implements keyword?
h. Is it possible to declare variables in interface ?
i. Can abstract class have constructor ? can interface have constructor?
j. What must a class do to implement interface?
k. What do you by implementation class?
l. Is it possible to create object of interfaces?
m. What do you mean by abstract class?
n. When we will get compilation error like “attempting to assign weaker access privileges”?
o. What is the difference between abstract class and interface?
p. What do you mean by helper class?
q. Which of the fallowing declarations are valid & invalid?
    - ***a. class A implements it1***
    - ***b. class A implements it1,it2,it3***
    - ***c. interface it1 extends it2***
    - ***d. interface it1 extends it2,it3***
    - ***e. interface it1 extends A***
    - ***f. interface it1 implements A***

r. what is the difference between classes and interfaces?
s. The interface reference variable is able to hold implementation class objects or not?
    - a. Interface-name reference-variable = new implementation class object(); valid or invalid

t. What is the real-time usage of interfaces?
u. what is the limitation of interfaces how to overcome that limitation?
v. What do you mean by adaptor class?
w. What is the difference between adaptor class interfaces?
x. Is it possible to create user defined adaptor classes?
y. Tell me some of the adaptor classes?
z. What do you mean by marker interface and it is also known as?
aa. Define marker interfaces?
bb. What are the advantages of marker interfaces?
cc. Is it possible to create user defined marker interfaces or not?
dd. Is it possible to declare nested interfaces or not?

Different types of methods in java (must know information about all methods)

1) Instance method
2) Static method
3) Normal method
4) Abstract method

5) Accessor methods
6) Mutator methods
7) Inline methods
8) Call back methods
9) Synchronized methods
10) Non-synchronized methods
11) Overriding method
12) Overridden method
13) Factory method
14) Template method
15) Default method
16) Public method
17) Private method
18) Protected method
19) Final method
20) Strictfp method
21) Native method

Different types of classes in java (must know information about all classes)

1) Normal class /concrete class /component class
2) Abstract class
3) Tightly encapsulated class
4) Public class
5) Default class
6) Adaptor class
7) Final class
8) Strictfp class
9) JavaBean class /DTO(Data Transfer Object) /VO (value Object)/BO(Business Object)
10) Singleton class
11) Child class
12) Parent class
13) Implementation class

Different types of variables in java (must know information about all varaibles)

1) Local variables
2) Instance variables
3) Static variables

4) Final variables
5) Private variables
6) Protected variables
7) Volatile variables
8) Transient variables
9) Public variables

String manipulation

1) *How many ways to create a String object & StringBuffer object?*
2) *What is the difference between*
   a. *String str="ratan";*
   b. *String str = new String("ratan");*
3) *equals() method present in which class?*
4) *What is purpose of String class equals() method.*
5) *What is the difference between equals() and == operator?*
6) *What is the difference between by immutability & immutability?*
7) *Can you please tell me some of the immutable classes and mutable classes?*
8) *String & StringBuffer & StringBuilder & StringTokenizer presented package names?*
9) *What is the purpose of String class equals() & StringBuffer class equals()?*
10) *What is the purpose of StringTokenizer nd this class functionality replaced method name?*
11) *How to reverse String class content?*
12) *What is the purpose of trim?*
13) *Is it possible to create StringBuffer object by passing String object as a argument?*
14) *What is the difference between concat() method & append()?*
15) *What is the purpose of concat() and toString()?*
16) *What is the difference between StringBuffer and StringBuilder?*
17) *What is the difference between String and StringBuffer?*
18) *What is the difference between compareTo() vs eqauls()?*
19) *What is the purpose of contains() method?*
20) *What is the difference between length vs length()?*
21) *What is the default capacity of StringBuffer?*
22) *What do you mean by factory method?*
23) *Concat() method is a factory method or not?*
24) *What is the difference between heap memory and String constant pool memory?*
25) *String is a final class or not?*
26) *StringBuilder and StringTokenizer introduced in which versions?*
27) *What do you mean by legacy class & can you please give me one example of legacy class?*
28) *How to apply StringBuffer class methods on String class Object content?*
29) *When we use String & StringBuffer & String*
30) *What do you mean by cloneaing and use of cloning?*
31) *Who many types of cloneaing in java?*
32) *What do you mean by cloneable interface present in which package and what is the purpose?*
33) *What do you mean by marker interface and Cloneable is a marker interface or not?*
34) *How to create duplicate object in java(by using which method)?*

Wrapper classes

1. *What is the purpose of wrapper classes?*

2. *How many Wrapper classes present in java what are those?*
3. *How many ways are there to create wrapper objects?*
4. *When we will get NumberFormatException?*
5. *How many constructors are there to create Character Wrapper class Object ?*
6. *How many constructors are there to create Integer Wrapper class?*
7. *How many constructors are there to create Float Wrapper class?*
8. *What do you mean by factory method?*
9. *What is the purpose of valueOf() method is it factory method or not?*
10. *How to convert wrapper objects into corresponding primitive values?*
11. *What is the implementation of toString() in all wrapper classes?*
12. *How to convert String into corresponding primitive?*
13. *What do you mean by Autoboxing and Autounboxng & introduced in which version?*
14. *Purpose of parseXXX() & xxxValue() method?*
15. *Which Wrapper classes are direct child class of Object class?*
16. *which Wrapper classes are direct child class of Number class?*
17. *How to convert primitive to String?*
18. *When we will get compilation error like "int cannot be dereferenced"?*
19. *Wrapper classes are immutable classes or mutable classes?*
20. *Perform fallowing conversions int--->String String--->int Integer--->int int--->Integer ?*

Collections

1) *What is the main objective of collections?*
2) *What are the advantages of collections over arrays?*
3) *Collection frame work classes are present in which package?*
4) *What is the root interface of collections?*
5) *List out implementation classes of List interface?*
6) *List out implementation classes of set interface?*
7) *List out implementation classes of map interface?*
8) *What is the difference between heterogeneous and homogeneous data?*
9) *What do you mean by legacy class can you please tell me some of the legacy classes present in collection framework?*
10) *What are the characteristics of collection classe?*
11) *What is the purpose of generic version of collection classes?*
12) *What is the difference between general version of ArrayList and generic version of ArrayList?*
13) *What is purpose of generic version of ArrayList & arrays?*
14) *How to get Array by using ArrayList?*
15) *What is the difference betweenArrayList and LinkedList?*
16) *How to decide when to use ArrayList and when to use LinkedList?*
17) *What is the difference between ArrayList & vector?*
18) *How can ArrayList be synchronized without using vector?*
19) *Arrays are already used to hold homogeneous data but what is the purpose of generic version of Collection classes?*
20) *What is the purpose of RandomAccess interface and it is marker interface or not?*
21) *What do you mean by cursor and how many cursors present in java?*
22) *How many ways are there to retrieve objects from collections classes what are those?*
23) *What is the purpose of Enumeration cursor and how to get that cursor object?*
24) *By using how many cursors we are able to retrieve the objects both forward backward direction and what are the cursors?*

25) What is the purpose of Iterator and how to get Iterator Object?
26) What is the purpose of ListIterator and how to get that object?
27) What is the difference between Enumeration vs Iterator Vs ListIterator?
28) We are able to retrieve objects from collection classes by using cursors and for-each loop what is the difference?
29) All collection classes are commonly implemented some interfaces what are those interfaces?
30) What is the difference between HashSet & linkedHashSet?
31) all most all collection classes are allowed heterogeneous data but some collection classes are not allowed can you please list out the classes?
32) What is the purpose of TreeSet class?
33) What is the difference between Set & List interface?
34) What is the purpose of Map interface?
35) What do you mean by entry.
36) What is the difference between HashMap & LinkedHashMap?
37) What is the difference between comparable vs Comparator interface?
38) What is the difference between TreeSet andTtreeMap?
39) What is the difference between HashTable and Properties file key=value pairs?
40) What do you mean by properties file and what are the advantages of properties file?
41) Properties class present in which package?
42) What is the difference between collection & collections?

Garbage Collector

1. *What is the functionality of Garbage collector?*
2. *How many ways are there to make eligible our objects to Garbage collector?*
3. *How to call Garbage collector explicitly?*
4. *What is the purpose of gc( ) method?*
5. *What is the purpose of finalize() method?*
6. *If the exception raised in finalize block what happened* ***error or output?***
7. *What is the purpose of RunTime class?*
8. *How to create object of RunTime class?*
9. *What is singleton class?*
10. *What is the algorithm fallowed by GC?*
11. *What is the difference between final , finally , finalize()?*
12. *When GarbageCollector calls finalize()?*
13. *Finalize method present in which class?*
14. *Which part of the memory involved in garbage collector Heap or Stack?*
15. *Who creates stack memory and who destroy that memory?*
16. *What do you mean by demon thread? Is Garbage collector is DemonThread?*
17. *How many times Garbage collector does call finalize() method for object?*
18. *What are the different ways to call Garbage collector ?*
19. *How to enable/disable call of finalize()?*
20. *Is it possible to call finalize() method explicitly by the programmer?*

Enumeration

1) What is the purpose Enumeration?

2) *How to declare enum?*
3) *enum constants are by default?*
4) *One enum is able extends other enum or not?*
5) *For the enum compiler generate .class files or not?*
6) *What is the difference enum & Enum?*
7) *Is it possible to declare main method & constructor inside the enum or not?*
8) *Is it possible to provide parameterized constructor inside the enum?*
9) *What is the difference between enum and class?*
10) *What is the purpose of values() methods?*
11) *What is the purpose of ordinal() method?*
12) *Is it possible to crate object for enum?*
13) *For enum inheritance concept is applicable or not?*
14) *Is it possible to create object of enum?*
15) *When enum constants are loaded?*
16) *Enums are able to implement interfaces or not?*
17) *Enum introduced in which version?*
18) *What is the difference between* ***enum & Enumeration & Enum?***
19) *Is it possible to override toString() method inside enum?*
20) *Can you use enum constants switch case in java?*

<u>Nested classes</u>

1) *What are the advantages of inner classes?*
2) *How many types of nested class?*
3) *How many types of inner classes?*
4) *What do you by static inner classes?*
5) *The inner class is able to access outer class private properties or not?*
6) *The outer class is able to access inner classes properties& methods or not?*
7) *How to create object inner class and outer class?*
    a. *Class Outer*
       { class Inner{ }
       }
8) *For the inner classes compiler generates .class files or not? If generates write the name of above inner class .class file name ?*
9) *The outer class object is able to call inner class properties & methods or not?*
10) *The inner class object is able to call outer class properties and methods or not?*
11) *What is the difference between normal inner classes and static inner classes?*
12) *What do you mean by anonymous inner classes?*
13) *What do you mean by method local inner classes?*
14) *Is it possible to create inner class object without outer class object?*
15) *Java supports inner method concept or not ?*
16) *Is it possible to declare main method inside inner classes?*
17) *Is it possible to declare constructors inside inner classes?*
18) *If outer class variables and inner class variables are having same name then hoe to represent outer class variables and how to represent inner class variables?*
19) *Is it possible to declare same method in both inner class and outer class?*
20) *Is it possible to declare main method inside outer classes?*

<u>File IO</u>

1. *What is the purpose of java.io package?*
2. *What do you mean by stream?*
3. *What do you mean by channel and how many types of channels present in java?*
4. *What is the difference between normal stream & buffered Streams?*
5. *What is the difference between FileInputStream & BufferedReader?*
6. *What is the difference between FileOutputStream & printwriter?*
7. *Println() method present in which class?*
8. *Out is which type of variable(instance /static) present in which class?*
9. *To create byte oriented channel we required two class what are those classes?*
10. *To create character oriented channel we required two class what are those classes?*
11. *What is the difference between byte oriented channel and character oriented channel?*
12. *What is the difference between read() & readLine() method?*
13. *What is the difference between normal Streams & bufferd streams?*
14. *Wat is the purpose of write() & println() ?*
15. *Example classes normal Streams & bufferd streams?*
16. *What do you mean by serialization?*
17. *What is the purpose of Serializable interface& it is marker interface or not ?*
18. *How to prevent serialization concept?*
19. *What do you mean deserialization?*
20. *To perform deserialization we required two classes what are those classes?*
21. *To perform serialization we required two classes what are those classes?*
22. *What is the purpose of transient modifier?*
23. *What are advantage of serialization?*
24. *Serializable interface present in which package?*
25. *When we will get IOException how many ways are there to handle the exceptions?*
26.
27. *IOException is checked Exception or unchecked Exception?*

Multhreading

1. *What do you mean by Thread?*
2. *What do you mean by single threaded model?*
3. *What is the difference single threaded model and multithreaded model?*
4. *What do you mean by main thread and what is the importance?*
5. *What is the difference between process and thread?*
6. *How many ways are there to create thread which one prefer?*
7. *Thread class& Runnable interface present in which package?*
8. *Runnable interface is marker interface or not?*
9. *What is the difference between t.start() & t.run() methods where t is object of Thread class?*
10. *How to start the thread?*
11. *What are the life cycle methods of thread?*
12. *Run() method present in class/interface ?Is it possible to override run() method or not?*
13. *Is it possible to override start method or not?*
14. *What is the purpose of thread scheduler?*
15. *Thread Scheduler fallows which algorithm?*
16. *What is purpose of thread priority?*
17. *What is purpose of sleep() & isAlive() & isDemon() & join() & getId() & activeCount() methods?*
18. *Jvm creates stack memory one per Thread or all threads only one stack?*

19. *What is the thread priority range & how to set priority and how to get priority?*
20. *What is the default name of user defined thread and main thread? And how to set the name and how to get the name?*
21. *What is the default priority of main thread?*
22. *Which approach is best approach to create a thread?*
23. *What is the difference between synchronized method and non-synchronized method?*
24. *What is the purpose of synchronized modifier?*
25. *What is the difference between synchronized method and non synchronized method?*
26. *What do you mean by demon thread tell me some examples?*
27. *what is the purpose of volatile modifier?*
28. *What is the difference between synchronized method and synchronized block?*
29. *Wait() notify() notifyAll() methods are present in which class?*
30. *When we will get Exception like "IllegalThreadStateException" ?*
31. *When we will get Exception like "IlleglArgumentException" ?*
32. *If two threads are having same priority then who decides thread execution?*
33. *How two threads are communicate each other?*
34. *What is race condition?*
35. *How to check whether the thread is demon or not? Main thread is demon or not?*
36. *How a thread can interrupt another thread?*
37. *Explain about wait() motify() notifyAll()?*
38. *Once we create thread what is the default priority?*
39. *What is the max priority & min priority & norm priority?*
40. *What is the difference between preemptive scheduling vs time slicing?*

Internationalization

1) *What is the main importance of I18n?*
2) *What is the purpose of locale class?*
3) *What is the format of the properties file?*
4) *Local class present in which package?*
5) *What do you mean by properties file and what it contains?*
6) *What is the purpose of ResourceBundle class and how to create object?*
7) *How to convert different languages characters into Unicode characters?*
8) *What is the command used to convert different language characters into Unicode characters?*
9) *Who decides properties file executions?*
10) *What is the method used to get values from properties file?*
11) *By using which classes we are achieving i18n?*
12) *What is the default Locale and how to get it?*
13) *Is it possible to create your own locale?*
14) *What is purpose of DateFormat class and it is preset in which package?*
15) *What are the DataFormat Constantans' to print Date & time?*
16) *How to print date in different Locales?*
17) *How to print time in different locales?*
18) *How to print both date & time by using single method?*
19) *What do you mean by factory method? getBundle() is factory method or not?*
20) *How to get particular locale language & country?*

COREJAVA SCHEDULE

1. First application	1-days	1. Introduction
2. Variables	2-days	2. java Class
3. Methods	2-days	3. OOPS
4. Constructors	2-days	4. Packages
5. Instance, static blocks	1-day	5. nested classes
6. Flow control statements	1-day	6. Exception Handling
7. Inheritance	3-days	7. Multi Threading
8. polymorphism,	3-days	8. Java.io package
9. packages	2-days	9.Enumeration
10. Abstraction	2-days	10. Assertions
11. Encapsulation	1-day	11. Collections
12. Garbage collector	1-day	12. Arrays
13. Exception Handling	3-days	13. Generics
14. Java.IO package	1-day	14. Internationalization (I18N)
15. String manipulations	2-days	15. AWT
16. Wrapper classes	1-day	16.Swings
17. Multithreading	3-days	17. Networking
18. Enumeration, assertions	1-day	18.String manipulations
19. Nested classes	1-day	19. Wrapper classes
20. I18n(internationalization)	1-day	20. Interfaces
21. Collections,Arrays,generics	4-days	21. Garbage collector
22. Applet,AWT,swings	2-days	22.JDBC basics

Number of days : 42 days ***Number of topics : - 22***

Note 1: - Every topic Real Time project implementation examples will be provided.

Note 2:- we will discuss 1000+ interview questions in class room.

Note 3:- complete material will be provided.

Note 4:- within one week we are able to write examples in classroom .

Thank you ***by Mr. Ratan.***

1st class	*Demo- importance of java.*
2nd class	*Demo-differences between c& cpp& java.*
3rd class	*installation process*
4th class	*first application*
5th class	*first application & data-types*
6th class	*variables*
7th class	*variables & method introduction.*
8th class	*methods examples.*
9th class	*constructors*
10th class	*instance blocks& static blocks*
11th class	*inheritance*
12th class	*inheritance-Aggregation keyword*
13th class	*super keyword*
14th class	*polymorphism-overloading*
15th class	*polymorphism-overriding*
16th class	*polymorphism-overriding rules*
17th class	*packages*
19th class	*abstraction-abstract classes*
20th class	*abstraction-interfaces*
21th class	*encapsulation*
22th class	*main method*
23th class	*flow control statements*
24st class	*nested classes*
25th class	*exception handling try-catch*
26th class	*exception handling finally-throws*
27th class	*exception handling throw & customization*
28th class	*String manipulations*
29th class	*wrapper classes*
30th class	*java.io*
31st class	
32nd class	

Example 1:-

```
class Test
{	2-instance variables
	static void m1()
	{	print 2-variables
	}
	static void m2()
	{	print 2-vriables
	}
	public static void main(String[] args)
	{	call m1();
		call m2();
	}
};
```

Example 2:

```
class Test
{	2-instance variables
	2-static variables
	void m1()
	{	print 4-variables
	}
	static void m2()
	{	print 4-vriables
	}
	public static void main(String[] args)
	{	call m1();
		call m2();
	}
};
```

Example 3:-

```
class Test
{	2-instance variables
	2-static variables
	                        arguments               return-type
	1-instance method(X x,Emp e)                    Test
	1-static method(any 2-args)                     float
	1-instance method(Product p,int a)              String
	1-static method(any 1-args)                     char

	public static void main(String[] args)
	{	print the 4-variables
		call the four methods
	}
};
```

Example :-

```
class Test
{	2-instance variables
	2-static variables
				arguments		return-type
	1-instance method(Y y,int a)		Emp
	1-static method(any 3-args)		int
	1-instance method(Student s,int a)	double
	1-static method(any 1-args)		Y
	1-constructor(1-arg)
	1-constructor(2-arg)
	1-instance block (1-sop statement)
	1-instance block (1-sop statement)
	1-static block (1-sop statement)
	1-static block (1-sop statement)
	public static void main(String[] args)
	{	create the objects
		print the 4-variables
		call the four methods
	}
};
```

Example:-

```
class Emp
{	void details()
	{	take the details from keyboard by uisng scanner class.
		eid		ename		esal
	}
	void display()
	{	print the emp details.
	}
	void status()
	{	if (esal>3000)
		{	good employee;
		}
		else
		{	very good employee;
		}
	}
	public static void main(String[] args)
	{	call details method
		call display method
		call status method
	}
};
```